COLORADO
Oil & Gas Conservation Commission
Department of Natural Resources

Casing and Cement Standards for Geologic Isolation
Piceance Basin Bradenhead Monitoring Area and Nearby Fields
April 18, 2016



Drill rig in foreground with Grand Hogback in background near Silt, Colorado (photo taken by Dennis Ahlstrand, COGCC)

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1.00 Introduction

This report summarizes current and past Colorado Oil and Gas Conservation Commission (COGCC) requirements in the Piceance Basin Bradenhead Monitoring Area (BMA) and nearby areas to the north and east; it outlines planned changes to requirements for cement isolation during primary cementing of casing strings, during remediation when bradenhead pressure or flow thresholds have been exceeded, and during plugging of wells. This report generally discusses new requirements as they apply to all fields referenced in this report. Requirements for each field are defined more specifically on Field Scout Cards and Isolation Wellbore Diagrams, included as Appendix A. Appendix A also includes field type logs, annotated by COGCC Staff, to create a consistent standard in and around the BMA for geologic isolation.

Operator-reported formation tops for shallow Tertiary and Upper Cretaceous formations have historically been variable, particularly for the following intervals:

Wasatch G Sand

When reported, operators typically report the top of an upper interval or a lower interval of the Wasatch G Sand, whichever interval is more prominent on geophysical logs, but the intervals are not reported individually. Operators generally do not report Wasatch G Sand top(s) in the southeastern portion of the basin, east of Rulison Field and east of Buzzard Creek Field, in areas where the Wasatch G Sand is not productive. The Wasatch G Sand has thicker sandstone intervals and is more prominent on gamma ray and electrical logs where it is productive west of the BMA.

Appendix A Field Scout Cards and annotated type logs show COGCC Staff picks for the top(s) Wasatch G Sand in all fields, except Divide Creek Field and Wolf Creek Storage field, where the underlying Mesaverde Group outcrops at or near surface.

Fort Union Formation

As is the case with the Wasatch G Sand in the BMA, operators generally do not report the Fort Union Formation top in BMA fields, primarily because the stratigraphically-equivalent interval is not pronounced on geophysical logs in these fields. The Fort Union Formation has similar characteristics on logs to underlying portions of the Wasatch Formation in the BMA (designated the “Middle” Wasatch in this report). The Fort Union

Formation was used by COGCC staff for correlation relative to the overlying Wasatch G Sand and the Middle Wasatch in this report.

Mesaverde Group

Operator-reported formation tops for the Cretaceous Ohio Creek Formation, the "Upper" Mesaverde (commonly described by some operators as the interval immediately below the Ohio Creek Formation), and the Williams Fork Formation have historically varied significantly from operator to operator and field to field. In many cases, these formation names have been used interchangeably for the same geologic markers that are apparent on geophysical logs shown in Appendix A. Further, some operators have designated sandstones at the bottom of the Tertiary Wasatch Formation (the "Lower" Wasatch described in this report) to be the top of Ohio Creek, Mesaverde, or Williams Fork.

This report does not focus on the productive intervals of the Williams Fork Formation (including the Cameo Coals), the Iles Formation, or underlying productive formations, except as noted in Section 7.00. However, those formations are also shown in Appendix A whenever formation tops were apparent to COGCC Staff on logs or otherwise reported in COGCC's well files.

The intent of this report is to define a consistent standard from field to field in the BMA for geologic isolation across and above Mesaverde Group formations and the lower portion of the Wasatch Formation. Isolation of the Wasatch G Sand is also required by rule where it is the shallowest known producing horizon, and therefore, Wasatch G Sand intervals are also identified in Appendix A.

COGCC Staff attempted to develop a consensus of operator-reported formation tops to define the standards presented in Appendix A. Inherently, this approach may result in dissenting opinions from some industry geologists on the specific geologic markers used to select formation tops. COGCC Staff welcomes comments on formation tops presented in this report if factual inaccuracies or inconsistency in selection of geologic markers on logs are apparent. However, field-specific isolation of the sandstone intervals discussed in this report and identified in Appendix A will be COGCC's underlying goal.

2.00 Summary of Key Findings

1. The BMA is located in the southeastern portion of the Piceance Basin;
2. Casing and cementing requirements have periodically become more stringent, beginning with policies that applied to Garfield County as a whole in 1997;
3. Field orders applicable to casing, cementing, and bradenhead monitoring in the BMA date back to 2004; the most significant changes to casing and cement practices and bradenhead monitoring commenced in 2004;
4. COGCC Staff is engaged in an on-going study to review isolation needs for all gas fields within the BMA and nearby fields; based on our geologic isolation review presented in this report, COGCC Staff has concluded that there is merit for increasing cement requirements in the BMA and nearby fields to cover the Lower Wasatch, as defined by COGCC in this report, and other critical intervals of the Wasatch Formation in a few smaller areas to isolate shallow Wasatch G Sand production and other Underground Injection Control (UIC) disposal intervals;
5. For various reasons described in this report and previous reports on file with COGCC, full cementing of the Wasatch Formation is not planned;
6. Mitigation and remediation strategies are discussed, following COGCC's standard practices, with a plan to implement more stringent strategies, where necessary, for geologic isolation in existing wells;
7. Enforcement will be pursued to establish formal corrective action requirements and deadlines for wells where additional mitigation or remediation is determined to be necessary by COGCC Staff; and,
8. New reference materials have been created to assist COGCC Staff and operators with decisions on zonal isolation requirements.

3.00 Applicable Rules, COGCC Field Orders and Policies

Notice to Operators Drilling Williams Fork Formation Wells in Garfield County, Surface Casing Depth and Modification of Leakoff Test Requirements, dated May 3, 2001, revised June 23, 2006 (Garfield County NTO)

- The Garfield County NTO has specific requirements for the "Rulison Overpressured Area" that are not discussed herein. The Rulison Overpressured Area is west of the area discussed in this report. The Garfield County NTO is referenced because it includes minimum surface casing requirements that apply county-wide, including fields within the BMA.
- A September 22, 1998 policy preceded the Garfield County NTO with similar surface casing setting depth requirements that are now required in the Garfield County NTO. The old policy also applied to the Rulison Overpressured Area, and more generally Garfield County, with many prior revisions published in 1997 and 1998. These older policies have been superseded by the Garfield County NTO and are not discussed in this report.

Notice to Operators Drilling Mesaverde Group or Deeper Wells in the Mamm Creek Field Area in Garfield County, Well Cementing Procedure and Reporting Requirements, dated July 23, 2004, Revised February 9, 2007 (Cementing NTO)

COGCC Order Nos. 1V-276,191-12, and 191-23 (Field Orders), approved on August 16, 2004, July 11, 2005, and April 4, 2006 respectively:

- Order 1V-276 established a drilling moratorium area within 2 miles of a gas seep in West Divide Creek
- Order 191-12 allowed limited drilling within the moratorium area
- Order 191-23 eliminated the drilling moratorium and required compliance with the Cementing NTO

COGCC Order Nos. 1-107, 139-56, 191-22, and 369-2 (Field Orders) approved on September 20, 2004

- Defined requirements for the Bradenhead Monitoring Area

Notice to Operators Drilling Wells in the Buzzard, Mamm Creek, and Rulison Fields, Garfield County and Mesa County, Procedures and Submittal Requirements for Compliance with COGCC Order Nos. 1-107, 139-56, 191-22, and 369-2, dated July 8, 2010 (Bradenhead NTO)

- Clarified implementation and reporting requirements for the associated Field Orders
- Commission Order 369-2 and the Bradenhead NTO title refer to the “Buzzard” Field, but the Buzzard Field is located west of the Bradenhead NTO area. The Bradenhead NTO actually encompasses the Buzzard Creek Field. Cause Number 369 is correct, as it applies to the Buzzard Creek Field

Field Orders and NTOs referenced above are available on COGCC’s website.

4.00 Location

The areas discussed in this report are shown on Figure 1. The Cementing NTO applies to Townships 6 through 8 South, Ranges 91 through 93 West, and Township 9 South, Range 91 West, 6th P.M., and includes the following fields:

- Alkali Creek (northern portion)
- Divide Creek
- Kokopelli
- Mamm Creek (excluding the Peach Valley area north of I-70)
- Rulison (eastern portion)

The Bradenhead NTO governs the BMA (red outline shown on Figure 1), defined as Townships 6 through 9 South, Ranges 91 through 93 West, 6th P.M., and includes the following fields:

- Alkali Creek
- Brush Creek (eastern portion)
- Buzzard Creek
- Divide Creek
- Kokopelli
- Mamm Creek (excluding Peach Valley area north of I-70)
- Rulison (eastern portion)
- Sheep Creek
- Vega

Two additional fields located east of the BMA are also referenced in this report:

- Baldy Creek
- Wolf Creek (gas storage)

5.00 Current Casing and Cement Requirements

Surface Casing

There are no planned changes to existing surface casing requirements:

- Operators must set 10% of total vertical depth (TVD) county-wide (Garfield County NTO)
- Operators are encouraged to set 1,100 feet (ft) minimum county-wide (Garfield County NTO)
- Operators must set 10% of TVD (Cementing NTO area)
- Operators must set 15% of TVD or 500 ft below the depth of any water well within a one (1) mile radius, whichever is greater, in the East Mamm Creek Area (EMCA), which is a smaller area located within the Cementing NTO area, as shown on Figure 1 Operators must set surface casing a minimum of 50 ft below the Molina Member of the Wasatch Formation in the EMCA (Permit Conditions applied effective September 19, 2011)
- Surface casing must be fully cemented (required by COGCC statewide rules)

Intermediate Casing

There are no planned changes to existing intermediate casing requirements, except as noted below (strike through and underlined text):

- Not required, except for the current Cementing NTO requirement in the EMCA to add intermediate casing, only if a formation integrity test fails after drilling out of surface casing:
    - Intermediate casing shall be set at a depth at least fifty (50) feet below the top of the Mesaverde Formation [the Upper Mesaverde, as described in this report]. The intermediate casing shall be cemented to a height of at least five hundred (500) feet above the ~~depth of the intermediate casing shoe~~ top of the Lower Wasatch [as defined in this report] if no kicks have been encountered in the Wasatch Formation. If kicks have been encountered in the Wasatch Formation the top of cement shall be adjusted to ~~comply with Rule 317.i. and to cover~~ provide coverage to five hundred (500) feet above ~~all gas bearing intervals~~ the shallowest gas signature in the Wasatch Formation.
        - Gas kicks are not common in the Wasatch Formation.
        - As discussed below in Section 6.00, the top of "Lower Wasatch" is defined on new type logs annotated by COGCC for each field in the BMA, and log tops were selected by COGCC. Lower Wasatch is not a recognized geologic formation or member in the literature.
        - Current permit conditions related to production casing in the EMCA define "shallowest gas signature" as 2,500 gas units on a mud log.
        - During studies performed in 2011, COGCC evaluated the need for intermediate casing in the EMCA. The evaluation, including potential advantages and disadvantages of intermediate casing, is summarized in the *EMC Study Response Memo* (Response Memo), dated September 19, 2011, Subject Line: COGCC Response to the conclusions and recommendations in the June 20, 2011 *East Mamm Creek Project Drilling and Cementing Study*, prepared by Crescent Consulting, LLC et al. (Crescent Study).
    - The Crescent Study and Response Memo are both available on COGCC's website.
- Intermediate casing is often proposed by operators for horizontal wells, which are not currently common in the BMA. Mancos/Niobrara horizontal wells have additional drilling and well control concerns unrelated to geologic isolation concerns discussed in this report, often necessitating the use of intermediate casing in those wells.

Production Casing

Production casing in the BMA is run from surface to total depth for wells completed in the Mesaverde Group. Production casing cement coverage requirements have changed from time to time in the BMA:

- The statewide requirement of 200 ft above shallowest known producing horizon was used historically, prior to promulgation of the first Cementing NTO in 2004:
    - Except for areas where Wasatch G sand gas is produced in the Rulison Field, the Mesaverde Group Top of Gas (TOG) is the shallowest producing horizon. Gas is held in place by high water saturation in the Upper Williams Fork. The Piceance is a basin-centered play without a traditional cap rock that would be common in conventional plays. However, gas migration from the Mesaverde Group may be limited to an extent by tight permeability of Williams Fork Formation sandstones and apparently continuous shale(s) proximate to the Ohio Creek Formation, which is evident on geophysical logs in the BMA (mentioned in an Encana statement in Section 7.24).
- Cement coverage requirements increased to 500 ft above TOG, effective with the first Cementing NTO on July 23, 2004.
- Prior to publication of this report, production casing cement was required by permit conditions to a minimum of 200 ft above all Mesaverde Group (and Ohio Creek Formation, if present) oil, gas, and water-bearing sandstone and coalbed formations in the Piceance Basin:
    - Permit conditions were initially applied to permits in fall 2011, and the requirement was gradually phased in through 2013.
    - Permit conditions were initially limited to the U.S. Department of the Interior, Bureau of Land Management's (BLM's) Colorado River Valley District area for consistency with BLM requirements (includes most of the BMA, except for fields in the southwest portion: Brush Creek, Buzzard Creek, Sheep Creek, and Vega).
    - The area of application was expanded to the entire Piceance Basin in 2014.
- Beginning in 2015, COGCC requires an isolation demonstration or remediation if permit-specified cement coverage requirements are not met. This is in addition to Requests to Complete required for the Cementing NTO area, and it applies to the entire Piceance Basin. Operators must provide multiple lines of evidence to show that adequate isolation was achieved if remediation is not proposed. Approval is subject to the judgment of the COGCC Area Engineer, and it requires operator evaluations regarding more than one (but not necessarily all) of the following:
    - Cement Job Summary: Provide a cement job summary and operator's estimated top of lead cement and top of tail cement based on calculation
    - Operations Summary (Daily Drilling Records): Provide a summary of water flows, lost circulation, gas kicks, and any other drilling anomalies while drilling the uncemented interval
    - Bradenhead Pressure and Flow Summary: Provide a history of pressures and flows from the bradenhead annulus.

- Cement Bond Log: Use to identify cement quality. Discuss bond quality, top of tail, top of lead, stage tool depth (if used), any apparent channeling, and effective isolation.
- Induction Log: Use to identify sandstones and coalbeds that are not covered by cement.
- Neutron-Density Log: Use to identify coalbeds and gas-bearing zones that are not covered by cement.
- Reservoir Saturation or equivalent cased-hole log(s): Use to identify sandstones, coalbeds and gas-bearing zones that are not covered by cement.
- Colorado Division of Water Resources Water Well Data: Show that groundwater resources are adequately protected by surface casing and intermediate or production casing cement.
- Offset well production data summary: Show that economic oil and gas zones in the subject well and surrounding wells are isolated with cement.
- Bradenhead, intermediate annulus (if present), and production gas analytical data: Identify the source of the annular gas flow.
- Bradenhead and intermediate annulus (if present) water analytical data: Identify characteristics of any water being discharged from the bradenhead or intermediate (if any) annulus.

6.00 Isolation Requirement Changes for New Wells

Full Cement Coverage – Divide Creek Field

With the publication of this report, COGCC is increasing cement requirements for full production casing (or intermediate casing, if intermediate casing is used) cement coverage in an area encompassing the Mesaverde outcrop in the Divide Creek Field, in addition to an approximate one-mile buffer around the outcrop, shown as Area 1 on Figure 2.

Cement Top Required 500 Feet Above Lower Wasatch

COGCC is increasing cement coverage requirements to include production casing (or intermediate casing, if intermediate casing is used) cement isolation to 500 ft above the Lower Wasatch, which generally consists of a few hundred feet of sandstones interlayered with shale that immediately overly the Ohio Creek Formation and exhibit characteristics similar to the Ohio Creek Formation on open-hole resistivity logs or equivalent cased-hole logs (e.g., Reservoir Saturation Tool). The top of “Lower Wasatch” is defined on new type logs annotated by COGCC for each field in the BMA (see Appendix A). Lower Wasatch is not a recognized geologic formation or member in the literature.

The isolation requirement will be applied to most of the BMA, except the southwest portion, shown as Area 2 on Figure 2. This requirement will account for geologic structural complexities in the following areas (field specific geologic structure is discussed briefly on the Field Scout Cards in Appendix A):

- Alkali Creek
  - Northern portion of the field in T8S, R92W
- Baldy Creek
  - Critical area based on bradenhead water flows observed to the north in Kokopelli Field; Baldy Creek Field is outside of the BMA, and therefore, current bradenhead data is not available
- Divide Creek
  - Small part of the field in Area 2, outside of the Mesaverde Outcrop Area 1 buffer
- Kokopelli
  - Entire field
- Mamm Creek
  - Most of the field, excluding the extreme southwest portion of the field outside of Area 2 (west of the Middleton Creek Unit UIC disposal area)
- Rulison
  - Northeastern and eastern portion of the field
- Wolf Creek Gas Storage
  - Entire field, based on log characteristics for wells in the field and observed water flows to the north in Kokopelli Field and to the west in Divide Creek Field; Wolf Creek Field is outside of the BMA, and therefore, current bradenhead data is not available

Cement Top Required 200 Feet Above Lower Wasatch

The new isolation requirement in the southwestern portion of the BMA, not specifically described above, will be 200 ft above the Lower Wasatch top. This standard will also apply to portions of Brush Creek Field, Rulison Field, and Vega Field to the north, south, and west of the BMA.

Additional Cement Required Above Critical Wasatch Zones

In addition to the requirements shown above, isolation in certain fields will include cement coverage across the Molina and Atwell Gulch member the Wasatch (Middleton Creek Unit UIC disposal area) and cement coverage across the Wasatch G Sand within one mile of productive Wasatch G Sand wells (current or past production).

Acceptable Molina and Atwell Gulch is considered to be casing setting depth up to 200 ft above the Molina top, as shown on annotated type logs in Appendix A. Refer to Area 3 on Figure 3, which includes an approximate one-mile buffer around the injection area:

- Mamm Creek
  - Middleton Creek Unit UIC disposal area (Molina and Atwell Gulch injection zones)
  - New wells only; the ¼-mile Federal requirement would still be used for required remediation of existing offset wells prior to injection; consideration would be given for expanding the remedial requirement to ½-mile around each proposed UIC well if volume increase requests are expected

Acceptable Wasatch G Sand coverage is considered to be 200 ft below the Fort Union top to 200 ft above the Upper interval of the Wasatch G Sand, as shown on annotated type logs in Appendix A; stage cement is acceptable. Refer to Area 4, shown on Figure 3:

- Brush Creek
  - Wasatch G production in one well, currently plugged and abandoned
- Buzzard Creek
  - Wasatch G production in one well, currently shut-in
- Rulison
  - Wasatch G production in two wells within the BMA; Wasatch G production is more prevalent to the west of the BMA, and Wasatch G Sand coverage is required within one mile of productive Wasatch G wells in portions of the Rulison Field west of the BMA that are not otherwise identified on Figure 3

7.00 Fluid Isolation Concerns

The following subsections primarily discuss gas and water in the Wasatch Formation, but isolation of Mesaverde Group production gas is also addressed. The United States Geological Survey generally characterizes the Wasatch Formation in the BMA as “variegated claystone, siltstone, sandstone, and conglomerate; carbonaceous shale and lignite near base” (Miscellaneous Investigation Series Map I-999, available in the Geologic Map Legend information on COGCC’s online Geographic Information System [GIS]). Wasatch sandstones are commonly described as lenticular and discontinuous within the claystone and siltstone matrix.

7.10 Mesaverde Formation Gas Isolation and Wasatch Formation Stray Gas

Full Wasatch Formation cement isolation has not been a COGCC requirement, nor is it a current requirement for gas wells in the Southeastern Piceance Basin. Wellbore gas trapping and migration continue to be potential concerns when production or intermediate casing is cemented into surface casing. This concept is discussed in COGCC Staff's September 19, 2011 presentation to the Commission and the Crescent Study (both documents are available on COGCC's website).

The Commission approved Field Orders for the BMA in 2004, with a required bradenhead mitigation/remediation threshold of 150 pounds per square inch gauge (psig). The threshold was established to prevent the potential for formation breakdown at the surface casing shoe as a result of high bradenhead pressures. Calculation of the threshold was based on the following assumptions:

- "Typical" surface casing setting depths in the BMA at the time was 600 ft
- A surface pressure gradient of 0.50 psig/ft would result in likely breakdown of the formation (adding a water-filled annulus gradient would result in a total gradient at the surface casing shoe of 0.50 psi/ft + 0.43 psi/ft = 0.93 psi/ft)
- A safety factor of 2 was applied to the surface pressure gradient: 0.50 psi/ft / 2 = 0.25 psi/ft, which results in the 150 psig threshold using the "typical" surface casing depth of 600 ft => 0.25 psi/ft * 600 ft = 150 psig
- Post-2004 surface casing setting depths are generally deeper than 600 ft in the BMA because of the Cementing NTO 10% of TVD requirement (15% of TVD in EMCA), making the 150 psig threshold more conservative (less likely for formation breakdown) in wells with surface casing set deeper than 600 ft

COGCC acknowledges the presence of low pressure sandstones in the Wasatch Formation. Low pressure zones may be partially or fully filled with drilling mud and lost circulation material near the wellbore as losses are experienced during drilling, (see operator statements in Subsection 7.24). Cement losses into these zones are often evident on cement bond logs (CBLs) in the BMA and generally throughout the Piceance Basin as sandy intervals with poor bond. This is the reason why large intervals of cement (compared to statewide standards) are required above productive zones and other critical zones. Furthermore, the lenticular sandstones are discontinuous and of limited extent with intervening claystone and siltstone surrounding the sandstone lenses. Operators commonly use lightweight lead cement to limit cement losses into the sandstones. Lightweight cement does not show up on CBLs as well as heavier tail cement, which is normally used across productive gas zones the underlying Mesaverde Group. Based on COGCC Staff experience reviewing CBLs and temperature logs in the BMA, top of lead cement may appear at an approximate 30% Bond Index.

Because of low pressure zones in the Wasatch Formation, it is commonly difficult to achieve desired cement tops and a high Bond Index over large intervals, and therefore, increased cement coverage also increases the likelihood that the entire casing and cement system will result in an adequate seal. This concept was evident in 2012 when Encana

evaluated gas analytical data from three wells of concern with bradenhead pressures that exceeded the Commission Order mitigation/remediation threshold of 150 psig:

- Boulton 33-15 (045-07135)
  - Top of good bond below Mesaverde top but above top Williams Fork perforation
- Buerger 15-1D (A15) (045-09150)
  - Cemented to surface with top of good bond below Mesaverde top but above top Williams Fork perforation
- Galloway 2-5A (C2) (045-09171)
  - Top of good bond below Mesaverde top but above top Williams Fork perforation

Only one of the three wells, Boulton 33-15, satisfied a U.S. Environmental Protection Agency (EPA) published recommendation for Continuous Interval with a Bond Index greater than or equal to 80% for "zone isolation" (EPA Region VIII Ground Water Section Guidance No. 34 suggests 15 ft for 4.5 inch casing and 33 ft for 7 inch casing). However, adequate seals above Williams Fork gas were still present in all three wells, based on evaluation of gas sample analytical results. The following statement was provided by Encana's consultant, Universal Geoscience Consulting, Inc., (UGCI) regarding these wells:

> "UGCI generated a geochemical report addressing the source of gas in bradenheads in an area coincident with the plunging nose of the Divide Creek anticline. Mud gas, produced gas, bradenhead gas, and Wasatch completion gas samples were compared in that report. The report concluded that the composition of produced gas samples was unique, whereas the composition of bradenhead gases was different and derived from small sand lenses within the Wasatch Formation. Key diagnostic gas composition parameters useful for differentiating Wasatch Formation gas from Williams Fork Formation gas are as follows: the relative concentration of [carbon dioxide {CO_2}], wetness (percent C_2+ fraction of all hydrocarbons), the ratio of ethane/methane and ethane/propane, and the difference in stable isotope ratios of carbon in methane minus that in ethane and carbon in ethane minus that in propane. Parameters related to the butane and pentane fractions of gas samples are not sufficiently different to be diagnostic."

As discussed in Section 6.00, COGCC is requiring additional cement to cover the Lower Wasatch in new wells, with the primary intent of isolating potential water flows, but the increased cement coverage will also serve to further prevent gas migration from the Mesaverde Group to the Wasatch Formation via uncemented wellbore annuli. As discussed in COGCC Staff's September 19, 2011 presentation to the Commission and the Crescent Study, COGCC Staff believes that the monitoring and mitigation program is effective, when implemented properly. Based on review of annual bradenhead pressure data, COGCC Staff recognizes that pressures have exceeded the 150 psig mitigation/remediation threshold in some wells. A forward plan to address that concern is presented in Section 8.00.

The presence of stray gas in naturally occurring, non-productive, sandstones is apparent throughout the Wasatch Formation on geophysical logs within the BMA and to a larger extent, the Piceance Basin. In most cases, stray gas results in negligible flow, but may build pressure over time. Stray gas has been observed during logging since the early development of the basin and has prompted bradenhead monitoring, mitigation, and remediation measures established by Field Orders and the Bradenhead NTO, as discussed in Section 3.00 and elsewhere in this report.

7.20 Wasatch Formation Water Isolation

COGCC has not considered the Wasatch Formation to be an aquifer requiring full cement coverage in the past, except for the shallow, weathered portion where water wells are screened. The following describes COGCC's current and historic rationale for excluding the Wasatch Formation as an interval requiring cement coverage behind production casing (or intermediate casing, if present). An exception related to the Lower Wasatch is discussed in Section 6.00 with COGCC's forward plan to isolate the lower portion of the Wasatch Formation. This section of the report is primarily related to the Middle Wasatch between shallow water resources that are covered by surface casing ("Upper" Wasatch) and the top of the Lower Wasatch. As discussed in this report, the Middle Wasatch includes portions of the Shire Member, the Molina Member, the Wasatch G Sand, and the Atwell Gulch Member.

COGCC Staff reviewed references presented in the following subsections to evaluate geologic and hydrogeologic characteristics of the Wasatch Formation, Ohio Creek Formation, and Upper Mesaverde. Except for the Wasatch G Sand, these intervals are above productive gas zones.

7.21 EPA Definition of Underground Source of Drinking Water

Underground Source of Drinking Water (USDW) – An aquifer or portion of an aquifer that supplies any public water system or that contains a sufficient quantity of ground water to supply a public water system, and currently supplies drinking water for human consumption, or that contains fewer than 10,000 mg/l total dissolved solids and is not an exempted aquifer (http://water.epa.gov/type/groundwater/uic/glossary.cfm#t).

An underline was added to EPA's definition above to emphasize the term "aquifer" and sufficient quantity of groundwater.

COGCC contends that sandstones in the Middle Wasatch are not consistent with the term "aquifer" in the definition of a USDW based on exhibits and discussions provided in the following subsections. COGCC acknowledges that aquifer exemptions have been approved for the Molina and Atwell Gulch members of the Wasatch Formation in the Middleton Creek Unit UIC disposal area and a Lower Wasatch UIC well in the Vega Field, which also injects into the Ohio Creek Formation and Upper Mesaverde. Aquifer exemptions are required administratively by COGCC Rule 324B, regardless of groundwater quantity if a water sample is submitted with a UIC disposal

application and the sample has a total dissolved solids (TDS) concentration of less than 10,000 milligrams per liter (mg/l). This was the case in Middleton Creek Unit UIC disposal area. Encana collected water samples from the Wasatch Formation with great difficulty, as described below in Subsection 7.24, supporting COGCC's contention that the Middle Wasatch does not contain a sufficient quantity of ground water to supply a public water system. Other operators in the area have expressed similar concerns to COGCC Staff in the past when attempting to collect Wasatch water samples for UIC permit applications.

7.22 Colorado Geological Survey Publication

Colorado Geological Survey (CGS) considers the Wasatch Formation to be a Confining Unit in the Piceance Basin:

Era	System	Series	Stratigraphic Unit	Unit Thickness (feet)	Physical Description	Hydro-geologic Unit	Saturated Thickness (feet)	Hydrologic Characteristics
Cenozoic	Tertiary	Eocene	Uinta Formation	0–1,400	Silty sandstone, siltstone and marlstone	Upper Piceance Basin aquifer		Conductivity range <0.2 to >1.6 ft/day; yield 1 to 900 gpm; transmissivity 610–770 ft²/day
			Green River Formation	As much as 5,000	*Parachute Creek Member* kergenous, dolomitic marlstone and shale 500–1,800 ft *Anvil Points Member* shale, fine-grained sandstone and marlstone 0–1,870 ft *Garden Gulch Member* claystone, siltstone, clay-rich oil shale and marlstone 0–900 ft *Douglas Creek Member* siltstone, shale and channel sandstone 0–900 ft	Mahogany confining unit Lower Piceance Basin aquifer Confining unit		Conductivity range <0.1 to >1.2 ft/day; yield 1 to 1,000 gpm; transmissivity 260–380 ft²/d
			Wasatch Formation	About 5,000	Shale and lenticular sandstone			
		Paleocene	Fort Union Formation	Very thin	Coarse-grained sandstone	Fort Union aquifer		
Mesozoic	Cretaceous	Upper Cretaceous	Mesaverde Group	Averages 3,000 may be >7,000	*Fox-Hills Sandstone, Lewis Shale, Williams Fork Formation, Iles Formation*; sandstone interbedded shale and coal	Mesaverde aquifer	<500–2,000	
			Mancos Shale	More than 7,000	Mainly shale but Frontier Sandstone may be local aquifer	Mancos confining unit		

(CGS Ground Water Atlas of Colorado, Special Publication 53, 2003)

The Tertiary Fort Union Formation, as shown in the stratigraphic column above, is prominent in the northwestern part of the Piceance Basin, including parts of Parachute Field and Grand Valley Field, located west of the fields described in this report. Portions of the Wasatch Formation appear to be present below the Fort Union Formation in the

BMA, parts of Parachute Field and Grand Valley Field. Geologic markers consistent with operator-reported Fort Union tops in the Parachute and Grand Valley fields were used by COGCC Staff to correlate Fort Union tops presented on annotated type logs in Appendix A. However, as indicated in Section 1.0 of this report, the Fort Union is not prominent on logs for fields in the BMA. Rather, the stratigraphically-equivalent Fort Union interval has log characteristics similar to underlying portions of the Middle Wasatch, and therefore, the Fort Union is considered a confining unit for fields in the BMA, consistent with the Middle Wasatch, rather than an aquifer. COGCC Staff believes that the graphic presented above is more characteristic of portions of the Piceance Basin to the northwest, as it relates to the Fort Union Formation.

7.23 Digital Formation Studies

COGCC retained a petrophysical consultant, Digital Formation, to evaluate open hole logs in the Mamm Creek Field and Rulison Field in attempt to determine the presence, mobility, and salinity of water in the Wasatch, Ohio Creek, and Upper Mesaverde formations. COGCC selected wells that had both resistivity and neutron-density logs for the Mamm Creek Field Study for comparison of two analysis methods. Eight wells per field were evaluated using comparisons between Spontaneous Potential (SP) analysis and traditional Archie analysis (resistivity-porosity method).

Overall report results were similar in both fields, but COGCC Staff considered the results conflicting and inconclusive because of a lack of clean, thick sands in the Wasatch Formation. In many cases, there was little correlation between the salinities from Archie analysis and from the SP log. Digital Formation expressed higher confidence in the ~~SP~~ Archie results [*correction on 5/31/2016, DDA*], but EPA guidance indicates that these methods may be unreliable when the results do not agree:

> "If both logging methods [SP and Resistivity-Porosity] are used to calculate TDS concentrations for a single well with no water analysis available, and both estimates are close, a conservative approach would be to choose the lower TDS concentration [this was not the case with Digital Formation's calculations; variance between the two methods was generally high in the Wasatch Formation]. If the difference becomes large, differing by a factor greater than 2, and a review of the input data reveals no obvious errors, accurate TDS concentrations can not be determined from geophysical logs." (Survey of Methods to Determine Total Dissolved Solids Concentrations, EPA, September, 1988)

This contention regarding accuracy of TDS calculations using log data is supported by statements provided by operators that log analysis techniques are unreliable for determination of water salinity in the Piceance Basin because of bed thickness, shale content, and gas saturation (see Statement 1 by Williams in Section 7.24 below).

A complication of the petrophysical analysis resulted in a determination that Wasatch sands with the potential for fresh water either have poor rock quality (high shale content, consistent with immobile, or “bound” water) or they have mobile water, which are essentially contradictory statements for the Wasatch Formation. Based on multiple operator statements provided below in Subsection 7.24, COGCC Staff believes that the former is true (mobility of water in the Wasatch Formation is low because of low water saturation and high shale content in Wasatch sandstones).

To the contrary, COGCC Staff believes that fresh water (less than 10,000 mg/l TDS) in the Mesaverde Group, including the Ohio Creek Formation, may be associated with mobile water, and Digital Formation indicated that fresh water is likely in the Upper Mesaverde, supporting COGCC’s existing requirement to cement above the Ohio Creek Formation.

7.24 Operator Observations

COGCC has required demonstrations from certain operators regarding the presence and mobility of groundwater in the Wasatch Formation. The following summarizes operator statements received by COGCC for various fields within and proximate to the BMA:

1) Williams, Grand Valley, Parachute and Rulison Fields (2010)

“There are very few sands in the Wasatch that are conducive to SP, Formation Factor or RWA [apparent formation water resistivity] analyses to determine accurate salinities. These sands are thin, shaly sands and many have indications of gas saturation even at shallow depths.

The Wasatch sands currently at shallow depths in this area were buried to significantly deeper depths in the past. The porosity and permeabilities of these units are very tight and thus transmissivity is very low. Exhumation and removal of several thousand feet of rock has not altered these properties. The presence of gas demonstrates that they follow the unconventional basin-centered gas trapping mechanism and therefore no hydraulic connection to the [Colorado] [R]iver. Water was most likely trapped and altered during burial and diagenesis and has not been flushed with less saline waters today.

[State Engineer’s Office (SEO)] approved the alternate rules for a nontributary determination of the Wasatch Fm in the Piceance Basin. This Williams led effort used a very conservative Glover-Balmer approach that determined a nontributary distance of 8,865 ft from outcrop. It is very unlikely that the shallow Wasatch sands are in contact with tributary streams and thus flushing of saline waters is unlikely.

Encana has a Wasatch well (Federal 29-6W) in [Section] 26 nearby that has a nice gas show at 1132' and a top perforation at 1752 ft. This suggests that significant quantities of gas have migrated into these shallow sands and we could expect some amount of gas saturation to occur at even shallow depths thus making a salinity determination from logs very difficult.

In the [p]ast Williams has underbalanced air drilled 144 Wasatch wells in [the] Piceance Valley area. Review of well files indicated no water was encountered during [the] drilling process. Cuttings removal supports the observation of no free water hence drilling was dry all the way from surface casing shoe to [total depth (TD)]."

Regarding a study performed by Williams in cooperation with BLM in 2009: "This study looked for SP reversals to look for water fresher than Rmf [drilling mud filtrate resistivity]. Of 174 wells with shallow SP digits, none show a convincing reversal and most Wasatch sandstones were too thin to get a good [static spontaneous potential (SSP)] for analysis. This study looked for water fresher than Rmf, not fresher than 5,000 ppm [parts per million, equivalent to mg/l for the purposes of this report] [sodium chloride (NaCl)]. Many of our mud filtrates are ~ 2,500 ppm NaCl."

2) Encana, Mamm Creek Field (Atwell Gulch and Molina members, UIC proposal)

"Intervals of fine-grained silty-sand are laterally discontinuous and deposited in an extremely very fine grained mudstone dominated environment throughout the entire vertical section from the surface to the base of the injection zone [base of the injection zone is in the Wasatch Formation above, but near the top of the Ohio Creek Formation]. The porosity curve data show 12-16% porosity in the thicker silt-sand intervals in the injection zone from the top of the Molina down through the Atwell Gulch section [members of the Wasatch Formation]. Further, the invasion profile seen in the resistivity curve data suggest that the high porosity silt-sand intervals are permeable enough to exhibit little to no separation in both low and high resistivity intervals. We interpret the low resistivity zones as fully invaded with drilling mud and the high resistivity zones as being fully invaded with drilling mud but with the possibility of some non-commercial gas saturation. This is supported by [neutron-density porosity (Nphi-Dphi) log curve] approach but no cross-over which we see in many productive and non-productive sand lenses throughout the basin."

Encana stated that the Uintah section (Tertiary formation above the Wasatch Formation) and the Shire Gulch section (member of the Wasatch Formation above the Molina Member) drills with a rate of penetration (ROP) of approximately 50 ft/hr. Encana further stated that both intervals have been described in the literature as 60-80% mudstone dominated with lenticular, highly

discontinuous sands. Encana stated that there were no losses of drilling fluid in this interval and characterizes the interval as an "aquitard."

Encana stated that the first loss zones are in the Molina Member, below the Shire Member, with an average ROP decrease to 46 ft/hr. Encana stated that the lithology is still described as mudstone with lenticular sands that have increased sand content.

"The Mesaverde (Upper Williams Fork) is capable of gas production however it is at lower gas saturations and thus may have a mobile component of water as well." COGCC Staff contends that this supports Digital Formation's log analysis of the Mesaverde interval. "A transition zone below the base of the Wasatch encounters an unconformable surface near the top of the Mesaverde identified in the literature as the Ohio Creek member…A stratigraphic consistent shale zone is encountered locally near the top of this transition zone…Below this shale zone we begin to see an increase in thicker sand bodies with blocky log character…Rates of penetration plunge to a range of 26-30'/hr. due to the increase in siliceous sand in the rock. These characteristics are common from the top of the Mesaverde to the top of the Rollins member of the Iles [F]ormation."

"…Past history of sampling [in the proposed Molina and Atwell Gulch members of the Wasatch Formation] would indicate this [water] sampling will be difficult and possibly yield limited water for sampling…the sample taken for the representative reservoir water [in offset, existing UIC wells completed in the Molina and Atwell Gulch members of the Wasatch Formation] was obtained with great difficulty, due to the formation being under vacuum." This statement supports COGCC Staff's contention that water mobility is limited in the Wasatch Formation. "The water that was eventually sampled, took many days to swab in with very little volume to show for the efforts…" Encana swabbed four days to recover 22 bbls (barrels), equivalent to approximately 0.16 gpm (gallons per minute), which COGCC Staff contends is not adequate to serve a public water supply. "…average swabbing in a [gas] producing zone would yield 80-120 [barrels of water per day (bwpd). This constitutes the key information supporting the fact that the pore pressure in this zone is less than hydrostatic…[fluid loss] rates [to the formation while drilling, range] from 20-30 [barrels per hour (bbl/hr)]…the porosity and resistivity curve data indicate the high porosity intervals [in the Molina and Atwell Gulch intervals] are permeable and further evidenced by the drilling losses encountered throughout this section. The under pressured formation accepts large volumes at reasonable injection pressures…"

3) Williams, Kokopelli Field (2011)

Regarding a shallow Wasatch sand at a depth of 1412' in the Jolley 8-315D well (045-16034): "Negative SP deflection: Rw [water resistivity] < Rmf; Borehole in good condition in sands; Questionable resistivity but formation water salinity is probably greater than 9,000 ppm."

4) Williams, northern portion of Parachute Field and northwestern portion of Rulison Field

In 2011, COGCC questioned Williams regarding a large number of wells that had deep-set surface casing through the Wasatch G (those wells targeted deeper Mesaverde objectives). Williams explained that their predecessor (Barrett Resources) secured an agreement with COGCC and BLM in the late 1990's to set deep surface casing across the Wasatch G, with the intention of using that interval for UIC disposal at some point in the future. Williams stated that past gas production had depleted the Wasatch G interval, making it attractive for possible UIC disposal using shallow Wasatch wells. Williams provided technical details on Wasatch Formation geology in 2011, as summarized below. COGCC expressed concern with this future plan for UIC disposal in 2011, because the Wasatch G is less than 2,000 feet deep in the area, which is a current COGCC depth threshold for additional scrutiny regarding of UIC applications.

"Original reservoir pressures for the Wasatch G sand were at or below a water gradient (0.433 [pounds per square inch per vertical foot of depth {psi/ft}]). Air drilling was successfully employed to drill these wells primarily due to the lack of water influx during drilling and the lower pressures required underbalanced techniques. The completion process employed foam fracturing techniques (Nitrogen or [carbon dioxide {CO_2}] energized fluids) in order to recover fracturing fluids that would not have flowed back due to the low reservoir pressure."

5) WPX, Rulison Field

Regarding the Mead RWF 332-23 well (045-20052): "…a constant fluid level is present in the production casing annulus, which is an indication of no fluid cross-zone flow. The first echometer [fluid level device measurement] was taken on March 23, 2015 and showed a fluid level of approximately 1,085 ft above the surface casing shoe. The second reading was taken on March 30, 2015 and it showed a fluid level of 1,088 ft above the surface casing shoe. These echometers usually have a variance of a couple hundred feet, so for all intents and purposes the data suggests the fluid level is not changing over time. The lack of bradenhead pressure suggests that gas is not moving behind pipe. Also, we believe the system permeability is around 10^-3 [millidarcies (md)] in the Ohio Creek Formation." Similar arguments have been submitted for other WPX wells in the Grand Valley and Parachute fields.

6) WPX, Grand Valley and Rulison Fields

"The SSP is the ideal electrochemical potential of the formation in a clean, thick, water-bearing, permeable sand…However, this method is not valid in the Piceance due to the presence of clays, thin beds and hydrocarbons. An SP reversal can indicate if the formation water is fresher than the drilling mud…334 wells in the Piceance Valley with shallow SP logs were evaluated…No definitive SP reversals were observed.

The Rwa curve can be displayed on a log [Pickett] plot and should equal Rw in clean, 100% wet sands. Unfortunately, clays and traces of hydrocarbons even at shallow depths make this method unreliable in the Piceance. COGCC Staff believes that this was also a problem that Digital Formation encountered during their log review. "In…the Rulison Field, a Pickett plot from surface down to the top of the Mesaverde deviates from the theoretical plot due to the presence of clay and trace amounts of hydrocarbons."

7) Caerus, Grand Valley Field

"The open logs run in the Nolte 14B (045-22311) and 14C (045-22300) show inconsistent gas saturations, indicative of residual [stray] gas, above top of gas. These gas saturations are likely to be trapped by high water saturations within the same sandstone reservoir and probably don't produce." Caerus further stated that water saturations are high but less than 100%, except for one to four thin zones (< 5') in these wells, where water saturation appears to reach 100%; Wasatch is approximately 4000 ft thick in this area.

"The Wasatch G sandstone appears gas saturated. No Rw data makes it difficult to calculate a saturation, however, the resistivity values and signature are consistent with hydrocarbons and would be very difficult to explain with water."

8) Ursa, Grand Valley Field

"Water saturation above the TOG is relatively low with only 3 sand intervals exceeding >70% [water saturation (Sw)]…I would not expect these zones to have moveable water given a normal hydrostatic pressure gradient (.433 psi/ft) above TOG and the elevated clay content in the Wasatch Formation. In comparison to the Rollins [Member of the Iles] Formation…a known moveable water zone, these zones have a lower Sw and pressure gradient. In the three intervals with Sw > 70%, resistivity curves shows very low permeability as they do not have [a] mud invasion profile. These sands also do not contain fresh water based on their low resistivity. Fresh water zones would have an elevated deep resistivity (RT90). Only one zone above TOG has elevated resistivity, the Ohio Creek interval."

8.00 Cement Remediation Strategies Prior to and During Stimulation Activities

When a TOC initially does not meet standards prior to stimulation, operators and COGCC Staff have agreed that remediation should proceed alternately with hydraulic fracture ("frac") stages from bottom up. If remediation is performed first, then remedial squeeze holes would introduce a weakness in the casing that may fail when subjected to stimulation pressures. Also, desired stimulation rates generally cannot be achieved when a smaller diameter frac string is used rather than stimulating down the larger diameter production casing. This point was addressed in the Crescent Study and Response Memo. The Cementing NTO requires bradenhead pressure monitoring prior to stimulation, with reporting required on Requests to Complete. Effective beginning in 2009, COGCC Rule 341 requires bradenhead pressure monitoring during stimulation.

9.00 Mitigation and Remediation Strategies after Stimulation

To date, venting has been used more often than remediation to mitigate bradenhead pressures. Water flows have generally been directed to tanks in most cases as an initial step with the intention of blowing down transient pressure. The Bradenhead NTO allows bradenhead valves to be shut in or allowed to vent, at the operator's discretion with prior approval, when pressure does not exceed the BMA Commission Order screening threshold of 150 psig. The Bradenhead NTO states that mitigation (i.e., venting) or remediation is required with prior approval for pressures at or above 150 psig.

Operator application of mitigation and remediation strategies has not always been consistent, and therefore, COGCC Staff is in the process of re-evaluating remediation needs on a well-by-well basis with the following priority: 1) significant water flows are repeatedly observed during annual blowdown events; and, 2) significant gas flows are observed during annual blowdown events with 7-day shut-in pressures above 150 psig or continuous gas flows at the end of the blowdown tests.

COGCC Staff first reviews bradenhead pressure and fluid flow history to flag wells that meet the Field Order mitigation/remediation thresholds as described above. Detailed well file and geophysical log reviews are then performed. Examples for three wells in the Mamm Creek Field are attached as Appendix B.

Remediation is generally not planned for wells in which cement cannot be circulated above the existing TOC (e.g., already cemented into the surface casing). Remediation is generally not planned for wells with no apparent bradenhead pressure buildup or no significant fluid flow.

10.00 Mitigation and Remediation Enforcement

When COGCC Staff advises remediation based on the results of detailed well file and log reviews, COGCC Staff will issue Warning Letters to include the following corrective action requirements:

- Submit a cement remediation procedure on a Sundry Notice. The goal of remediation will be to reduce bradenhead pressure to less than 150 psig and eliminate water flows or significant gas flows in the bradenhead annulus. Preference will be given to procedures that include cement squeeze(s) working from the existing production or intermediate casing top of cement up to the top of Wasatch Formation gas shows on logs. Cement coverage of the Mesaverde Group (including the Ohio Creek Formation) and the Lower Wasatch will be required if not already present. Completion the remediation work will be required within 12 months of Sundry Notice approval.
- Collect new water samples from the bradenhead annulus and the intermediate annulus (if any) to determine the source of the water flow.
- Collect new gas sample from the bradenhead annulus, the intermediate annulus (if any), and the production casing to determine the source of the gas flow.

11.00 New COGCC Reference Materials

Field Scout Cards, Isolation Wellbore Diagrams, and Annotated Type Logs for fields in the BMA and nearby fields are available in Appendix A. These documents are intended to be a reference for COGCC Staff and operators for consistency of casing, cementing, and plugging requirements. Field Scout Cards include the following data:

- Location
- Surface Geology
- Geologic Structure
- Stratigraphy (formation tops correlate to measured depths on annotated logs)
- Map with stratigraphy cross section lines
- Water Resource Isolation Concerns
- Productive Zone Isolation Concerns
- UIC Water Data
- Commission Order Summary (Significant Engineering and Spacing Issues)
- Historic Well Construction
- New Well Construction Standards
- Plugging Objectives
- Notes (includes references to special permit conditions in designated areas, well control events, and hydrogen sulfide detections)

Isolation Wellbore Diagrams illustrate past, current, and new isolation requirements for new wells, wells to be remediated (same as new well requirements) and wells to be plugged. Isolation requirements shown on the wellbore diagrams correspond to the isolation requirements stated on the Field Scout Cards.

Annotated Type Logs include COGCC Staff picks or operator picks for key Tertiary and Cretaceous formation tops as they relate to water resource and productive zone correlation. The logs specify whether picks for formation tops were made by COGCC Staff or the operator. As discussed further in Section 1.00, operator-reported formation tops for certain fields have been variable, particularly for the Wasatch G Sand, the Ohio Creek Formation, the Upper Mesaverde, and the Williams Fork Formation. The objective of this study was to present a general consensus of formation top picks and required isolation intervals, defined on the Annotated Type Logs. The logs are indexed to the stratigraphy cross sections on the Field Scout Cards. A summary figure showing all cross sections for the Field Scout Cards in Appendix A is provided as Figure 4.

LIST OF ACRONYMS

bbls	Barrels (equivalent to 42 gallons)
bbl/hr	Barrels of Water per Hour
BLM	U.S. Department of the Interior, Bureau of Land Management
BMA	Bradenhead Monitoring Area
bwpd	Barrels of Water per Day
CBL	Cement Bond Log
CGS	Colorado Geological Survey
CO_2	Carbon Dioxide
COGCC	Colorado Oil and Gas Conservation Commission
EMCA (or EMC)	East Mamm Creek Area
EPA	U.S. Environmental Protection Agency
ft	Feet
GIS	Geographic Information System
gpm	Gallons per Minute
md	Millidarcies
mg/l	Milligrams per Liter
NaCl	Sodium Chloride
Nphi-Dphi	Neutron-Density Porosity
NTO	Notice to Operators
ppm	Parts per Million
psig	Pounds per Square Inch Gauge
psi/ft	Pounds per Inch per Vertical Foot of Depth (pressure gradient)
Rmf	Drilling Mud Filtrate Resistivity
ROP	Rate of Penetration
Rw	Water Resistivity
RWA (or Rwa)	Apparent formation Water Resistivity
SEO	Colorado Department of Natural Resources, Division of Water Resources, State Engineer's Office
SSP	Static Spontaneous Potential
SP	Spontaneous Potential
Sw	Water Saturation
TDS	Total Dissolved Solids
TOC	Top of Cement
TOG	Top of Gas
TVD	Total Vertical Depth
UGCI	Universal Geoscience Consulting, Inc.
UIC	Underground Injection Control
USDW	Underground Source of Drinking Water

FIGURES

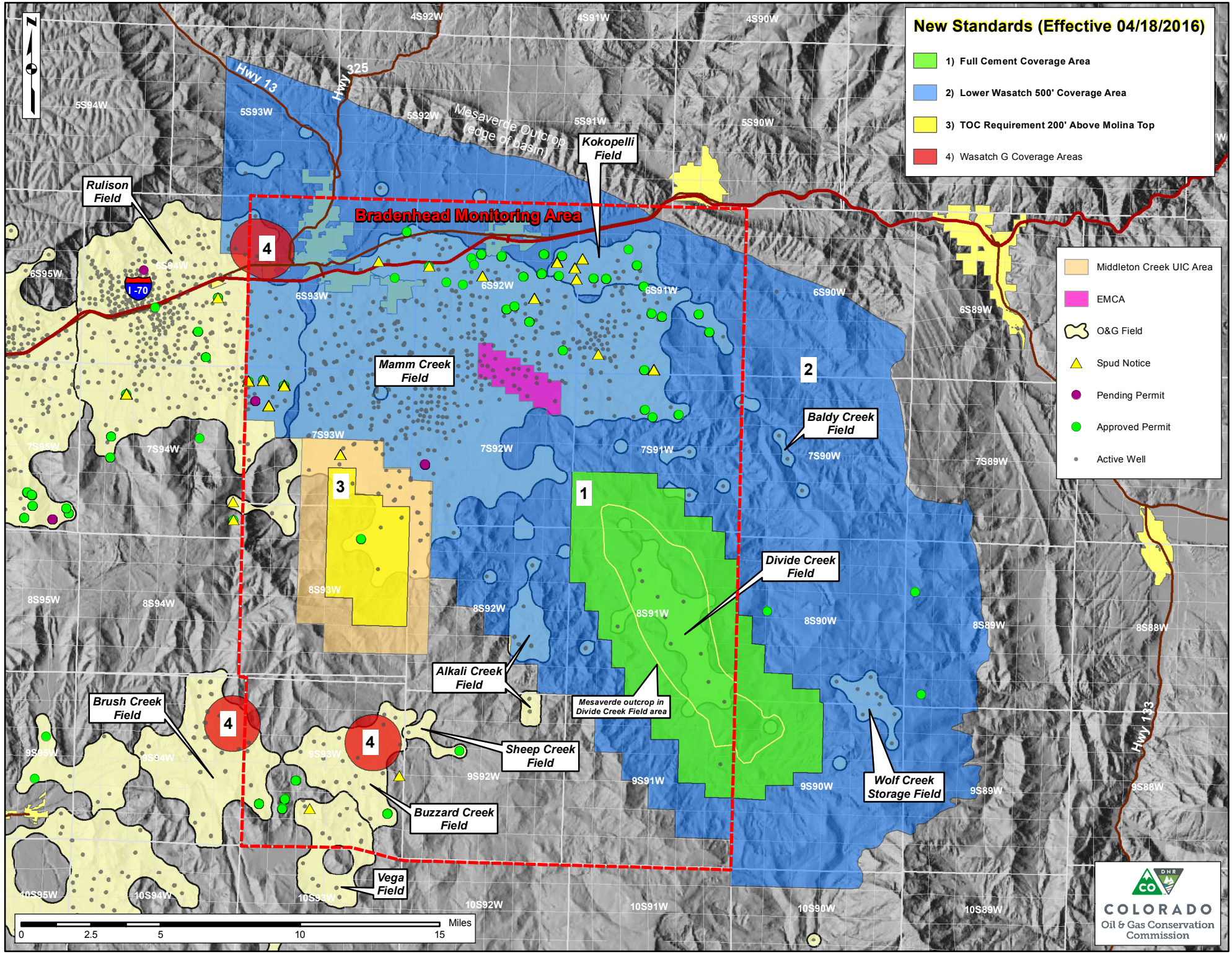

New Standards (Effective 04/18/2016)
1) Full Cement Coverage Area
2) Lower Wasatch 500' Coverage Area
3) TOC Requirement 200' Above Molina Top
4) Wasatch G Coverage Areas
Middleton Creek UIC Area
EMCA
O&G Field
Spud Notice
Pending Permit
Approved Permit
Active Well
Bradenhead Monitoring Area
Rulison Field
Kokopelli Field
Mamm Creek Field
Baldy Creek Field
Divide Creek Field
Alkali Creek Field
Mesaverde outcrop in Divide Creek Field area
Brush Creek Field
Sheep Creek Field
Buzzard Creek Field
Wolf Creek Storage Field
Vega Field
Mesaverde Outcrop (edge of basin)
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Hwy 325
Hwy 133
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COLORADO
Oil & Gas Conservation Commission

Figure 1

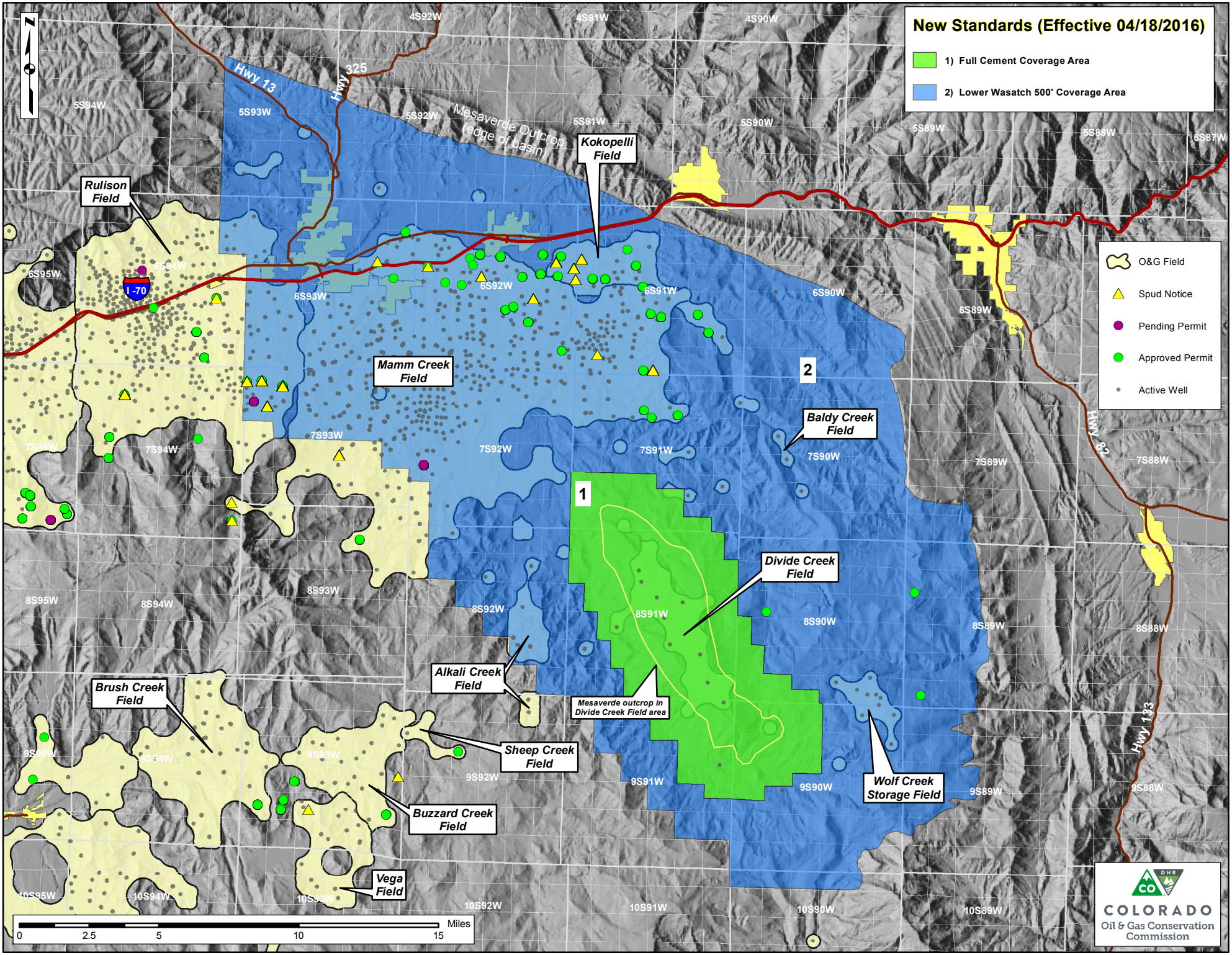

New Standards (Effective 04/18/2016)
1) Full Cement Coverage Area
2) Lower Wasatch 500' Coverage Area
O&G Field
Spud Notice
Pending Permit
Approved Permit
Active Well
Hwy 13
Hwy 325
Hwy 82
Hwy 133
I -70
Mesaverde Outcrop (edge of basin)
Rulison Field
Kokopelli Field
Mamm Creek Field
Baldy Creek Field
Divide Creek Field
Alkali Creek Field
Brush Creek Field
Sheep Creek Field
Buzzard Creek Field
Vega Field
Wolf Creek Storage Field
Mesaverde outcrop in Divide Creek Field area
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4S91W
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5S94W
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5S92W
5S91W
5S90W
5S89W
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COLORADO
Oil & Gas Conservation Commission

Figure 2

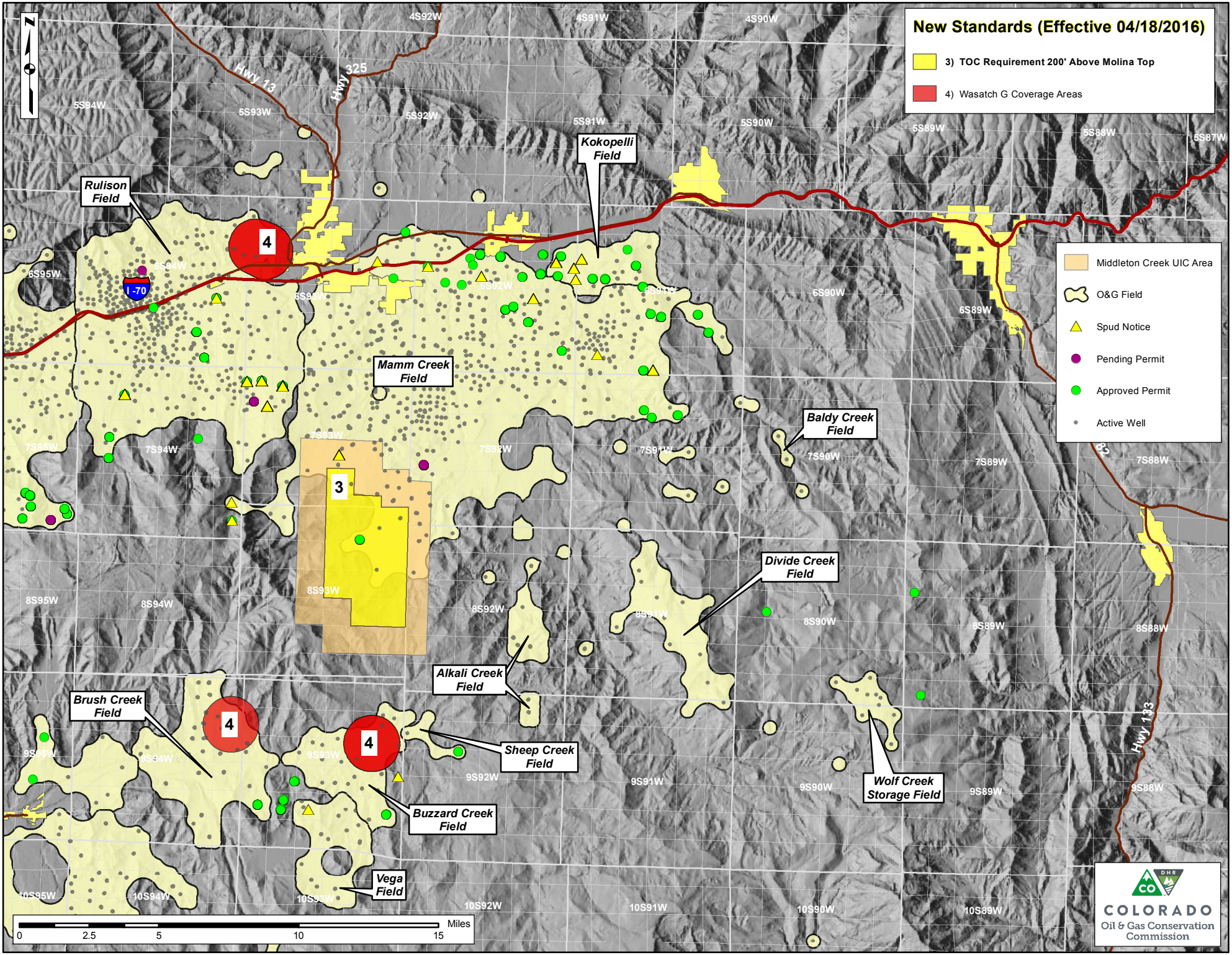

New Standards (Effective 04/18/2016)
3) TOC Requirement 200' Above Molina Top
4) Wasatch G Coverage Areas
Middleton Creek UIC Area
O&G Field
Spud Notice
Pending Permit
Approved Permit
Active Well
Rulison Field
Kokopelli Field
Mamm Creek Field
Baldy Creek Field
Divide Creek Field
Alkali Creek Field
Brush Creek Field
Sheep Creek Field
Buzzard Creek Field
Wolf Creek Storage Field
Vega Field
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COLORADO
Oil & Gas Conservation Commission

Figure 3

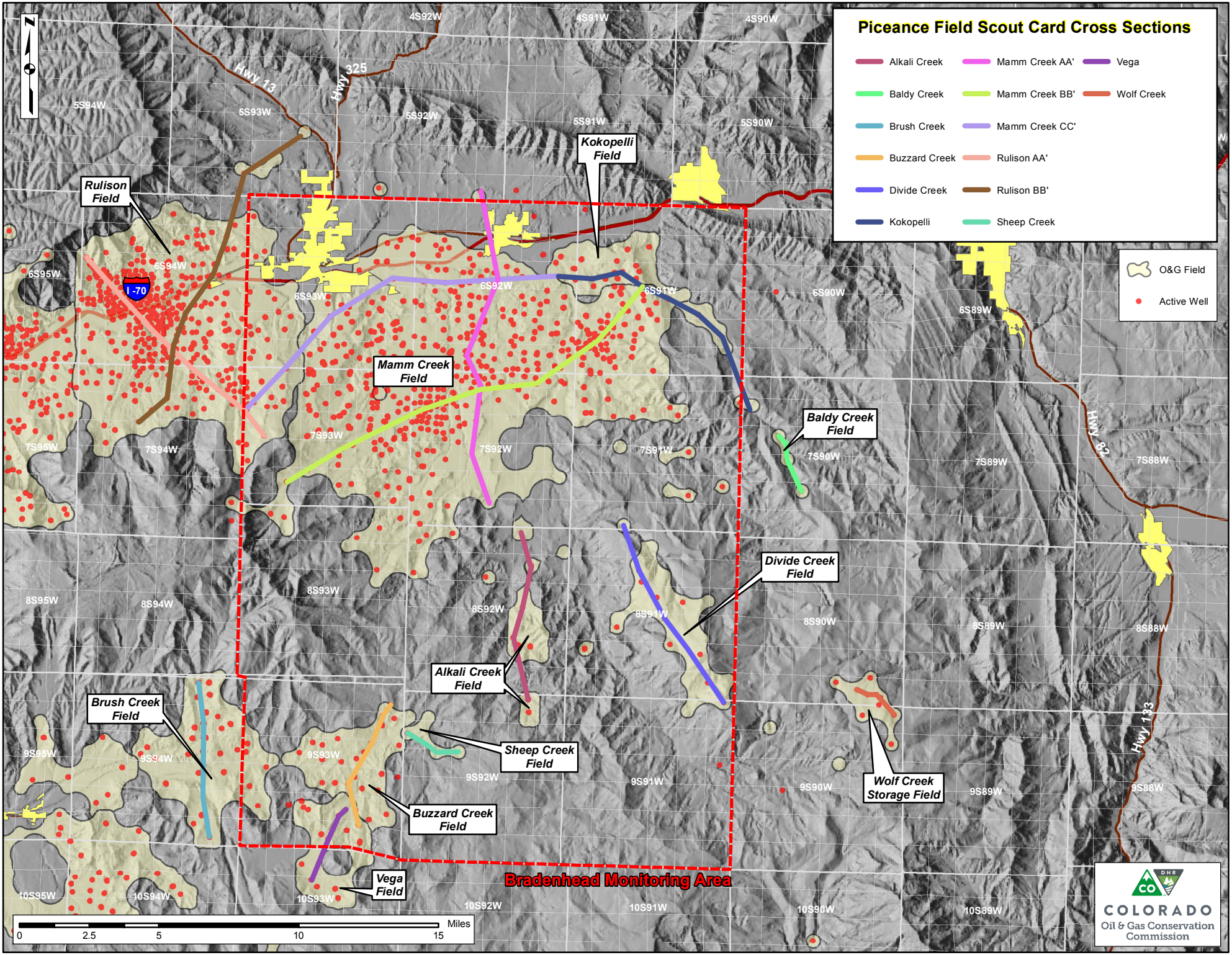

Piceance Field Scout Card Cross Sections
Alkali Creek
Baldy Creek
Brush Creek
Buzzard Creek
Divide Creek
Kokopelli
Mamm Creek AA'
Mamm Creek BB'
Mamm Creek CC'
Rulison AA'
Rulison BB'
Sheep Creek
Vega
Wolf Creek
O&G Field
Active Well
Rulison Field
Kokopelli Field
Mamm Creek Field
Baldy Creek Field
Divide Creek Field
Alkali Creek Field
Brush Creek Field
Sheep Creek Field
Buzzard Creek Field
Vega Field
Wolf Creek Storage Field
Bradenhead Monitoring Area
Hwy 13
Hwy 325
Hwy 82
Hwy 133
I -70
4S92W
4S91W
4S90W
5S94W
5S93W
5S92W
5S91W
5S90W
6S95W
6S94W
6S93W
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Miles
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COLORADO
Oil & Gas Conservation Commission

Figure 4

APPENDIX A

Field Scout Cards

Isolation Wellbore Diagrams

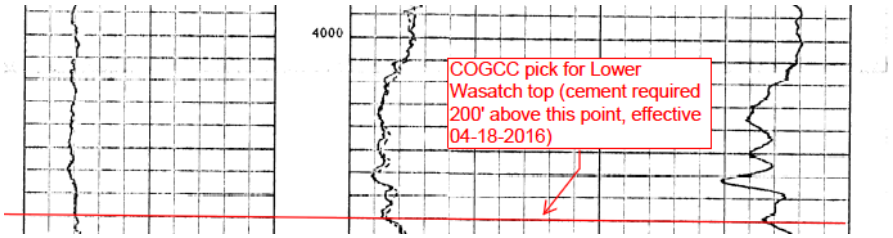
Annotated Type Logs

Casing and Cement Standards for Geologic Isolation
Piceance Basin Bradenhead Monitoring Area and Nearby Fields

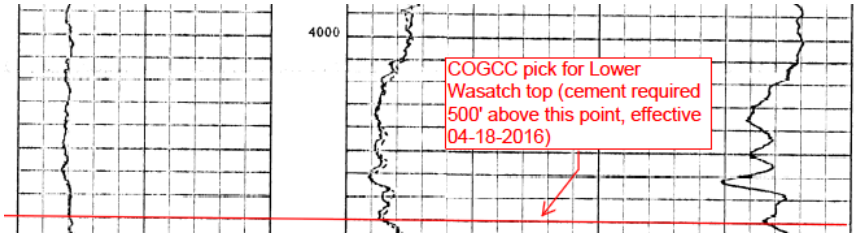
April 19, 2016 CORRECTIONS PRIOR TO PUBLICATION
APPENDIX A

The following changes do not affect the report text, conclusions, or field-specific Field Scout Cards or Isolation Wellbore Diagrams.

PDF PAGE 65 (NOW PAGE 72), BALDY CREEK TYPE LOG

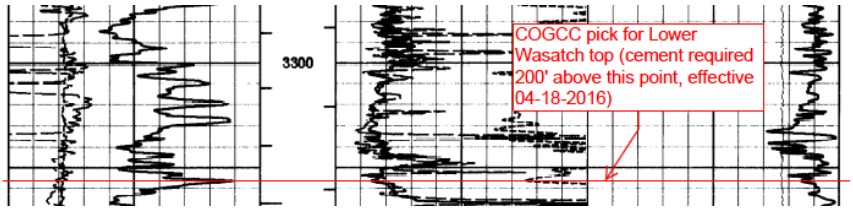


CHANGED TO:

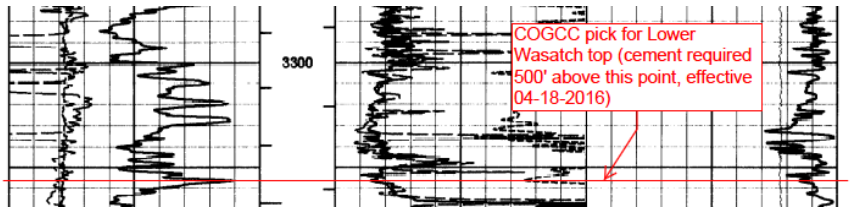


April 19, 2016 CORRECTIONS PRIOR TO PUBLICATION
APPENDIX A

PDF PAGE 153 (NOW PAGE 160), KOKOPELLI TYPE LOG

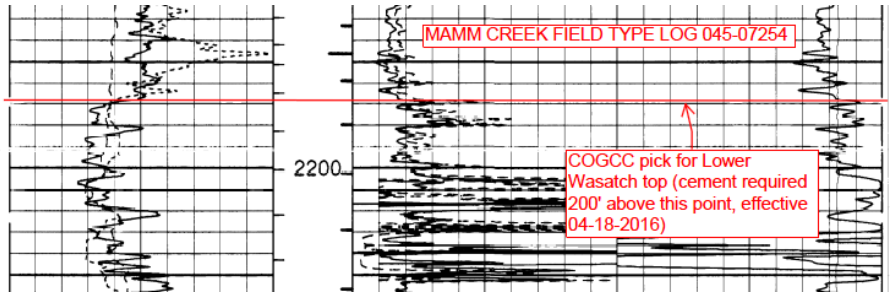


CHANGED TO:

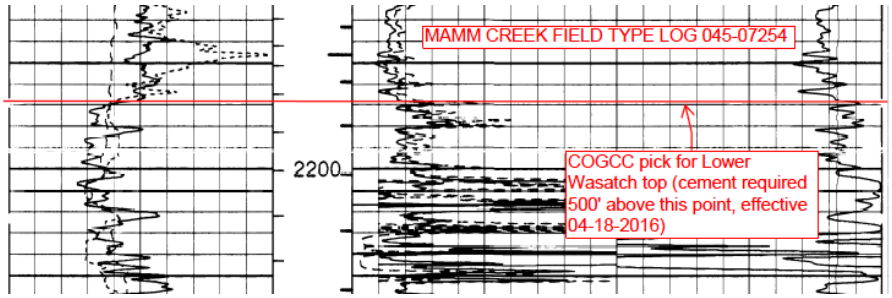


April 19, 2016 CORRECTIONS PRIOR TO PUBLICATION
APPENDIX A

PDF PAGE 179 (NOW PAGE 186), MAMM CREEK TYPE LOG

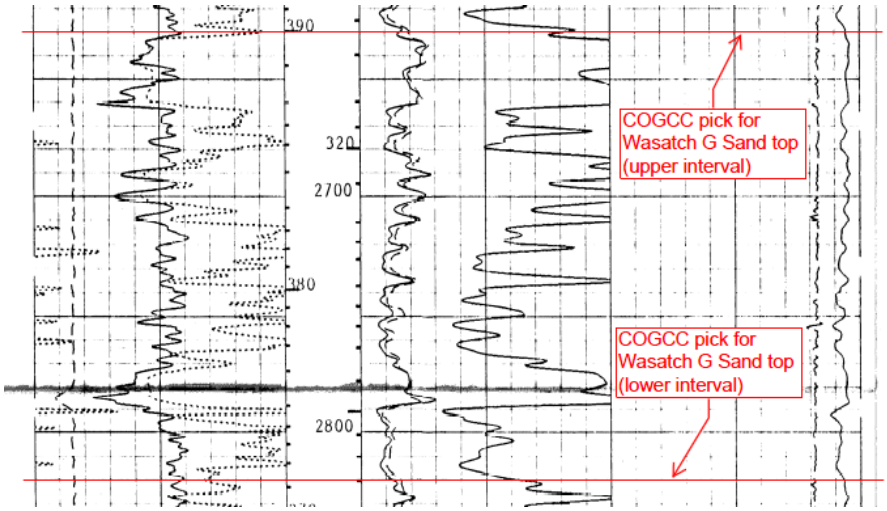


CHANGED TO:

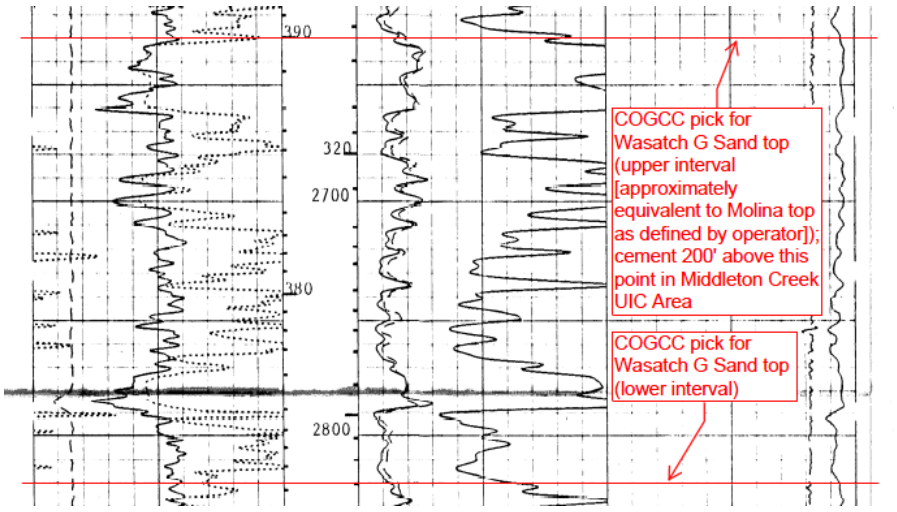


April 19, 2016 CORRECTIONS PRIOR TO PUBLICATION
APPENDIX A

PDF PAGE 193 (NOW PAGE 200), MAMM CREEK TYPE LOG

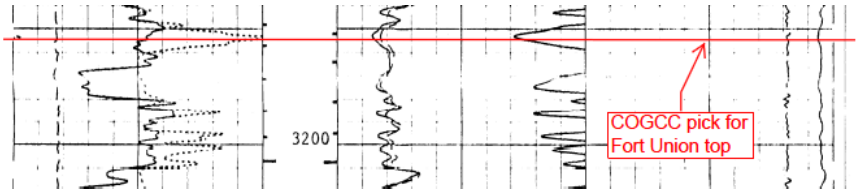


CHANGED TO:

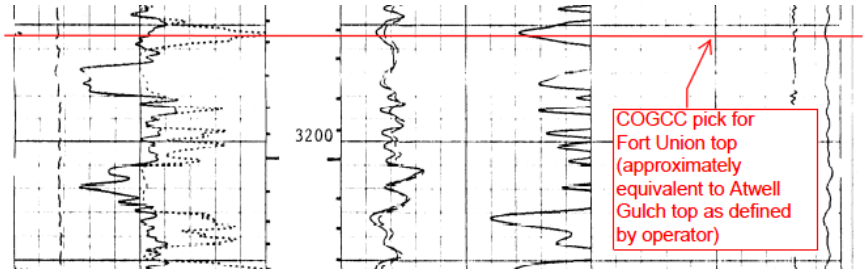


April 19, 2016 CORRECTIONS PRIOR TO PUBLICATION
APPENDIX A

PDF PAGE 194 (NOW PAGE 201), MAMM CREEK TYPE LOG

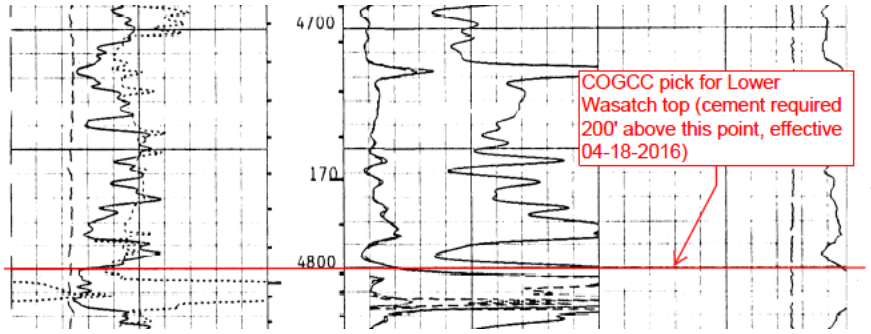


CHANGED TO:

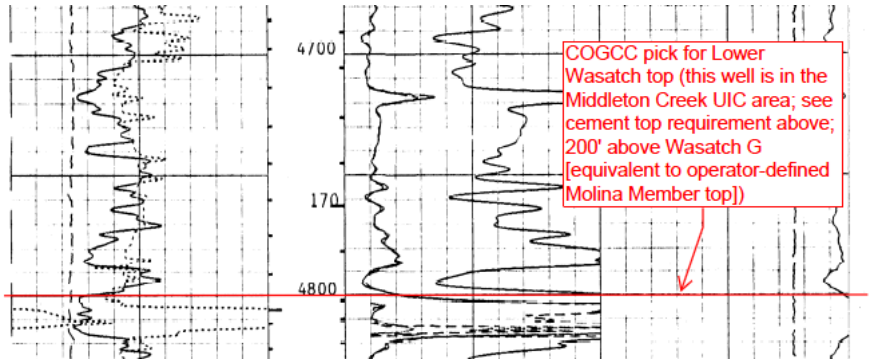


April 19, 2016 CORRECTIONS PRIOR TO PUBLICATION
APPENDIX A

PDF PAGE 197 (NOW PAGE 204), MAMM CREEK TYPE LOG
(ALSO SHOWN ON SLIDE 22 OF PRESENTATION TO THE COMMISSION)



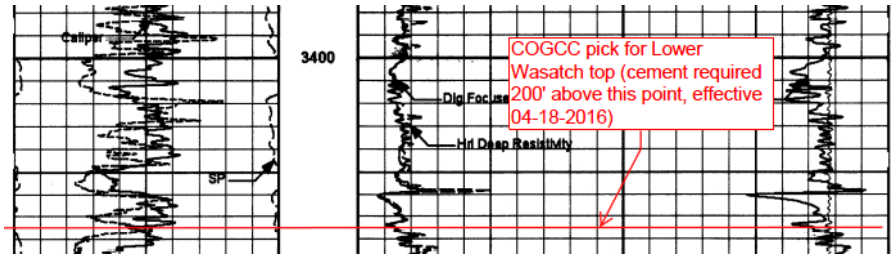
CHANGED TO:



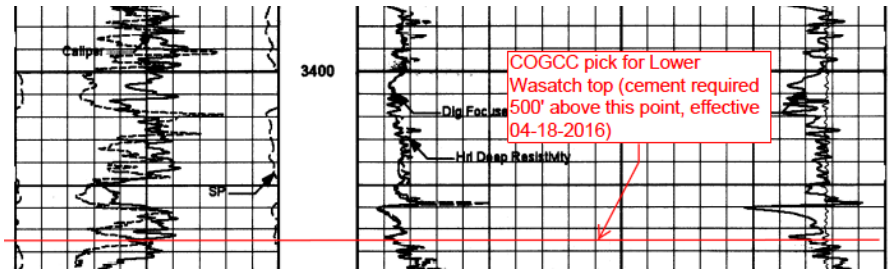
Casing and Cement Standards for Geologic Isolation
Piceance Basin Bradenhead Monitoring Area and Nearby Fields

April 19, 2016 CORRECTIONS PRIOR TO PUBLICATION
APPENDIX A

PDF PAGE 213 (NOW PAGE 220), MAMM CREEK TYPE LOG



CHANGED TO:



COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056075

FIELD NAME	**ALKALI CREEK**
FIELD NUMBER	**1950**

LOCATION

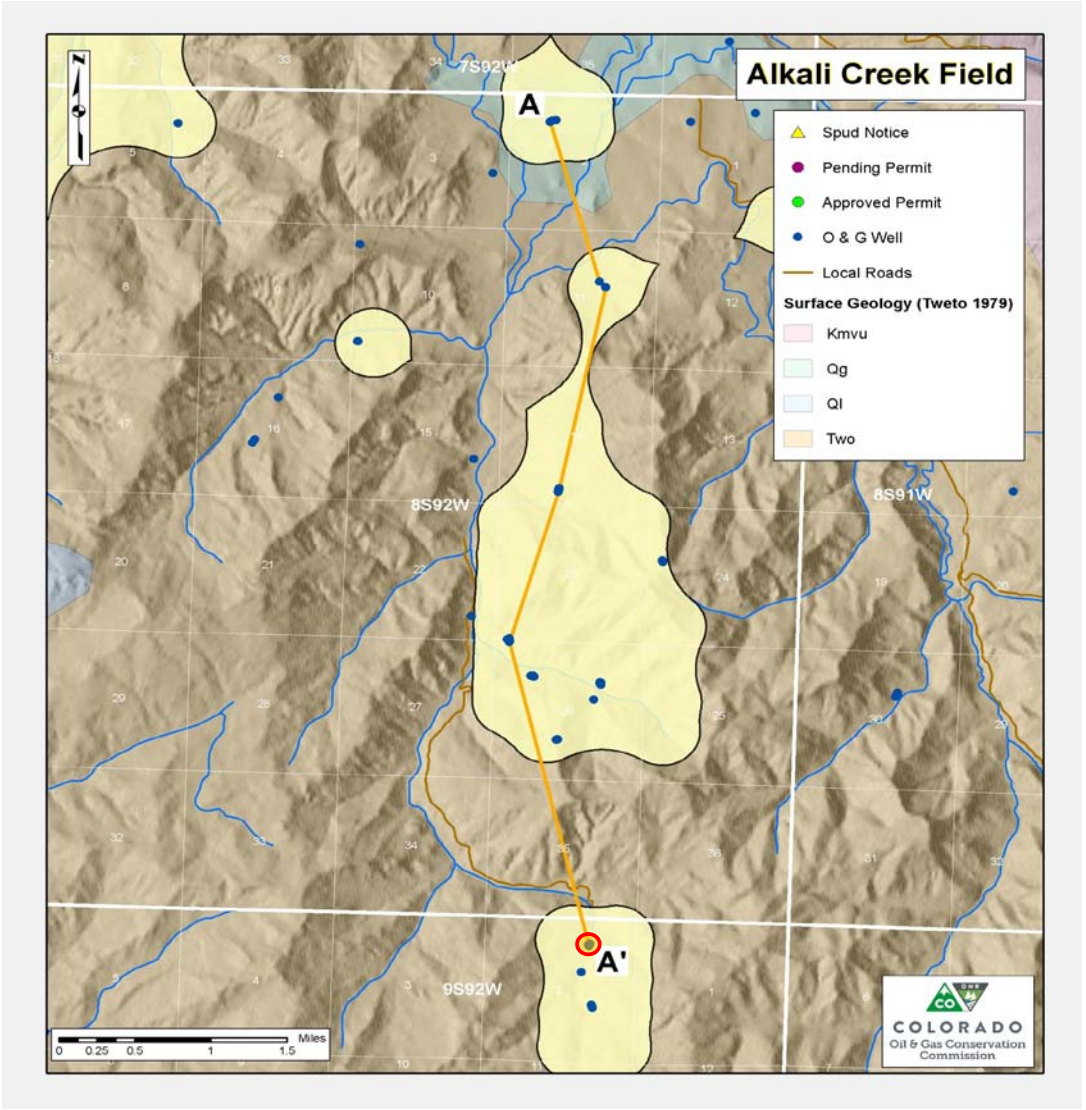
Basin	Piceance
Township(s)	7S to 9S
Range(s)	92W

SURFACE GEOLOGY

Surface Geology consists of alluvium at the north end of the field, underlain by the Wasatch Formation. The Wasatch Formation outcrops at surface throughout most of the field.

GEOLOGIC STRUCTURE

A northwest-southeast trending, northeasterly-sloping monocline is present on COGCC's 250K GIS Geology layer. The monocline extends to the southeast, generally following West Divide Creek, beginning near the northern end of this field. The northern three wells on the following stratigrapic cross section are on the down-slope portion of the monocline, and the southern three wells are on the up-slope portion of the monocline. The monocline may explain differences in ground surface elevation. However, shallower depths to formation tops in the northern portion of the field likely results from the more prominent structure of the Divide Creek Anticline to the east of this field.



Type Log Well

COGCC OIL AND GAS FIELD SCOUT CARD
ALKALI CREEK #1950

				A - North					A' - South
STRATIGRAPHY			**API Number =>**	**045-09008**	**045-06840**	**045-09359**	**077-09262**	**077-09656**	**077-05111**
			Surface Elevation =>	**6,606**	**6,766**	**6,789**	**7,315**	**7,304**	**7,717**
All depths are measured depths			**Well Type =>**	**Drifted**	**Vertical**	**Directional**	**Directional**	**Directional**	**Vertical**
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water	0					
	Wasatch	Upper	Shallow Water		0	0	0	0	0
	Wasatch	G-Sand*	None					1,574/1,676*	1,777/1,954*
	Wasatch	Fort Union*	None					2,058*	2,280*
	Wasatch	Middle	None						
	Wasatch	Lower*	Water	1,313*	Log N/A**	1,740*	3,100*	3,254*	3,434*
Mesaverde	Williams Fork	Ohio Creek	Water	1,674*	2,152	2,112*	3,730*	3,794*	3,960*
Mesaverde	Williams Fork	U. Mesaverde	Water	1,868*	2,250	2,367*	4,055	4,000*	4,290*
Mesaverde	Williams Fork	Top of Gas	Gas	2,287		2,773	5,635	5,599	
Mesaverde	Williams Fork	Cameo	Gas	4,584	4,992		6,705	6,646	6,607*
Mesaverde	Iles	Rollins	Gas	5,554	5,682		7,485	7,400	7,450*
Mesaverde	Iles	Cozzette	Gas						8,010
Mesaverde	Iles	Corcoran	Gas						8,208
	Mancos		Possible Gas						
	Niobrara		Possible Gas						

Annotated Type Log for 077-05111: COGCC Document Number 2056076

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

*** No log available to verify depth to top of L. Wasatch or reported opertor tops for underlying formation top picks*

WATER RESOURCE ISOLATION

Alluvium, Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde
The deepest water well within the vicinity of the field is 355' (likely Wasatch)

PRODUCING ZONE ISOLATION

Primary Objectives: Mesaverde Group (Williams Fork, Cameo, Rollins, Cozzette, and Corcoran)

UNDERGROUND INJECTION CONTROL

None in this field.

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

1-107 (9/20/2004)	Establishes a Bradenhead Monitoring Area, including the Alkali Creek Field.

COGCC OIL AND GAS FIELD SCOUT CARD
ALKALI CREEK #1950

HISTORIC WELL CONSTRUCTION

Except for older wells that may have shallow surface casing (e.g., 300' to 400'), surface casing setting depths generally range from 900' to 1,900'. Production casing generally terminates in the Iles Formation. Production casing cement may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 4/18/2016)

Minimum surface casing of 5% TVD required for well control in Mesa County (10% TVD recommended) and to cover water resources in the upper interval of the Wasatch Formation. Check offset logs for shallow Wasatch groundwater, which should be covered by typical setting depths of 900' or more. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. New Standards require cementing intermediate (if used) or production casing at least 200' above Lower Wasatch sands in Township 9S-92W or at least 500' above Lower Wasatch sands in Townships 7S-92W and 8S-92W, as shown on the annotated type log for this field.

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug above Ohio Creek and across Lower Wasatch (squeeze to 200'/500' above Lower Wasatch if no annular cement coverage); stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000-foot intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug. Larger surface casing shoe plugs should be considered for wells with less than 900' of surface casing.

NOTES

Portions of this field are located within the Mamm Creek Field Cementing Notice to Operators Area. Special requirements and Form 2 Conditions of Approval apply.

This field is located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.

ISOLATION REQUIREMENTS FOR TYPICAL WELLS

Date 04/18/2016 **COGCC Document No.** 2056111

FIELD NAME **ALKALI CREEK**
FIELD NUMBER **1950**

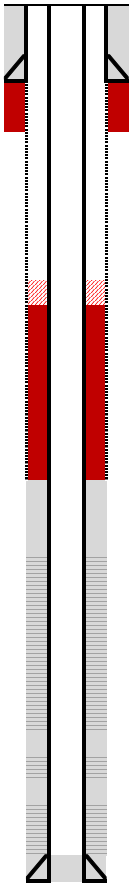
LOCATION
Basin Piceance
Township(s) 7S to 9S
Range(s) 92W

Notes:

Depths to formation tops differ significantly with changes of ground surface elevation and geologic structure across the field. Refer to the Stratigraphy chart on the Field Scout Card. These wellbore diagrams reflect average depths.

Cement isolation requirements of 200' above L. Wasatch are for Township 9S-92W, and cement isolation requirements of 500' above L. Wasatch are for 7S-92W and 8S-92W.

Depth	Formation/Member
0	Alluvium/ U. Wasatch
1,000	
	Wasatch G
2,000	
3,000	
	L. Wasatch
	Ohio Creek
4,000	U. Mesaverde
5,000	
	Top of Gas
6,000	
	Cameo
7,000	
	Rollins
8,000	Cozzette Corcoran

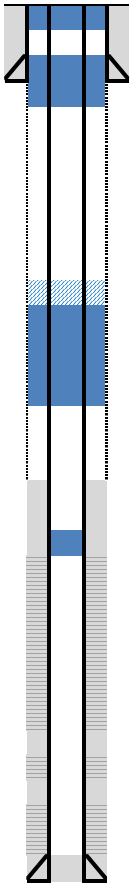


New Surface Casing Standard
Minimum 10% TVD or cover all apparent water resources in the U. Wasatch, whichever is more stringent.

New Cement Standard
Cement must provide coverage across Ohio Creek and Lower Wasatch (200'/500' above Lower Wasatch), in addition to productive interval coverage.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of U. Mesaverde, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	Alluvium/ U. Wasatch
1,000	
	Wasatch G
2,000	
3,000	
	L. Wasatch
	Ohio Creek
4,000	U. Mesaverde
5,000	
	Top of Gas
6,000	
	Cameo
7,000	
	Rollins
8,000	Cozzette Corcoran



Plug Placement

Surface plug

Surface casing shoe plug
Set deeper shoe plug if casing depth < 900 ft

Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 feet); not shown on this figure

Squeeze plug across Ohio Creek and L. Wasatch (top of plug 200'/500' above L. Wasatch)

Plug in casing above Mesaverde Group Completions

ALKALI CREEK FIELD TYPE LOG 077-05111
COGCC Document Number 2056076
04-18-2016

SCHLUMBERGER

INDUCTION-ELECTRICAL LOG

SCHLUMBERGER WELL SURVEYING CORPORATION
Houston, Texas

COUNTY MESA, COLORADO
LOCATION 1043' FNL - 1600' FEL NW NE
WELL EAST BUZZARD CREEK # 31-2
COMPANY PACIFIC NAT. GAS

COMPANY PACIFIC NATURAL GAS EXPLORATION
WELL EAST BUZZARD CREEK # 31-2
FIELD WILDCAT
COUNTY MESA STATE COLORADO
LOCATION 1043' FNL - 1600' FEL NW NE
Sec. 2 Twp. 9S Rge. 92W

Other Services: SL-C, GR-N

Elev.: K.B. 7729
D.F. -
G.L. 7717

Permanent Datum: G.L. Elev. 7717
Log Measured From K.B. 12 Ft. Above Perm. Datum
Drilling Measured From K.B.

Date	8-13-63		
Run No.	ONE	TWO	
Depth—Driller	5700	8450	
Depth—Logger	5701	8446	
Btm. Log Interval	5700	8445	
Top Log Interval	266	5700	
Casing—Driller	10 3/4 @ 265	7 5/8 @ 5700	@
Casing—Logger	266	5700	
Bit Size	9 7/8"	6 3/4"	
Type Fluid in Hole	GEL-CHEMICAL	CONTROL-X MUD	
Dens. / Visc.	9.5 / 65	9.3 / 120	
pH / Fluid Loss	8.5 / 8.2 ml	9.0 / 5.6 ml	ml
Source of Sample	PITS	CIRC.	
R_m @ Meas. Temp.	5.0 @ 70°F	2.5 @ 75°F	@ °F
R_{mf} @ Meas. Temp.	4.8 @ 70°F	1.9 @ 75°F	@ °F
R_{mc} @ Meas. Temp.	2.4 @ 124°F	2.2 @ 75°F	@ °F
Source: R_{mf} / R_{mc}	FP / C	PRESS / PRESS	
R_m @ BHT	2.8 @ 124°F	1.0 @ 200°F	@ °F
Time Since Circ.	3 HOURS	4 HOURS	
Max. Rec. Temp.	124 °F	200 °F	°F
Equip. / Location	2598 / GJ	2598 / GJ	/
Recorded By	MONTGOMERY	WARNER	
Witnessed By	CLUTTER	CLUTTER	

OIL & GAS CONSERVATION COMMISSION
OCT 28 1964
DENVER, COLORADO

FOLD HERE

REMARKS RUN # 2 S.P. TRACED FROM DOWN RUN 8212' TO T.D.

Changes in Mud Type or Additional Samples

Date / Sample No.			
Depth—Driller			
Type Fluid in Hole			
Dens. / Visc.			
pH / Fluid Loss	ml		
Source of Sample	RUN # 1	RUN # 2	
R_m @ Meas. Temp.	@ °F	@ °F	
R_{mf} @ Meas. Temp.	@ °F	@ °F	
R_{mc} @ Meas. Temp.	@ °F	@ °F	
Source: R_{mf} / R_{mc}			
R_m @ BHT	@ °F	1.0 @ 200°F	
R_{mf} @ BHT	2.7 @ 124°F	0.7 @ 200°F	
R_{mc} @ BHT	@ °F	0.8 @ 200°F	

Scale Changes

Type Log	Depth	Scale Up Hole	Scale Down Hole
RUN # 1		NONE	
RUN # 2		NONE	

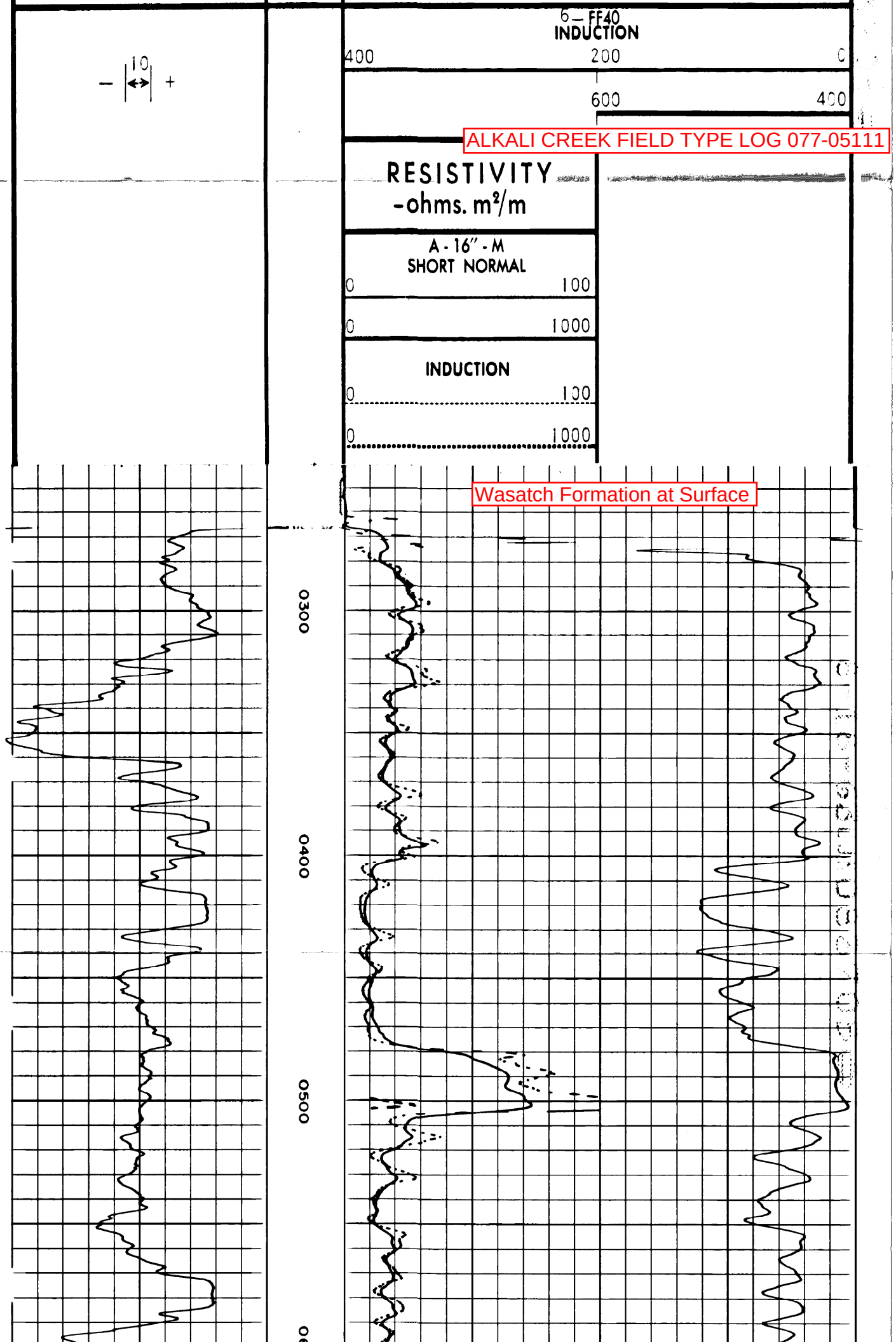
Equipment Data

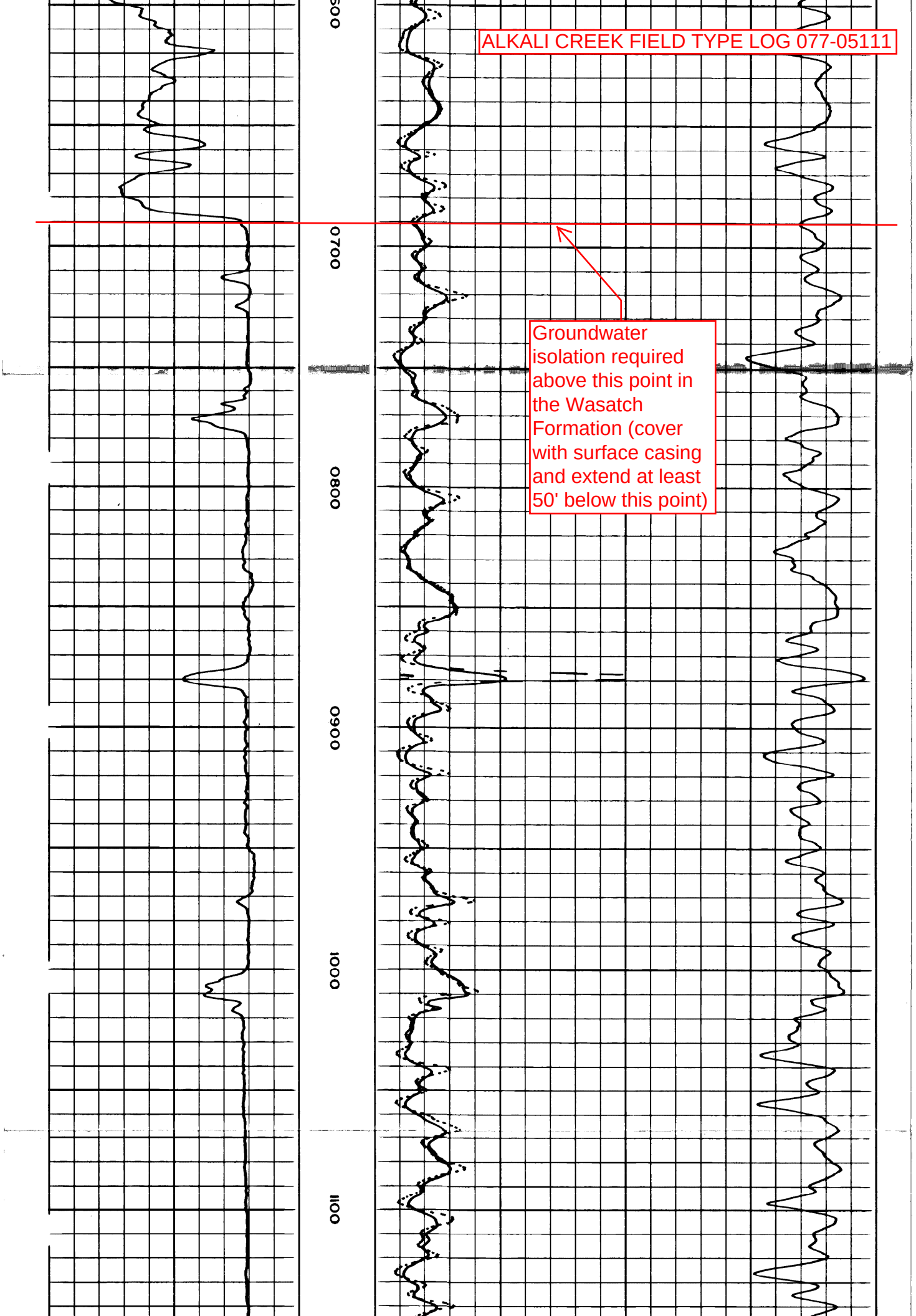
Run No.	Tool Type	Tool Position	Other
ONE	6FF40	CENTERED	
TWO	6FF40	CENTERED	

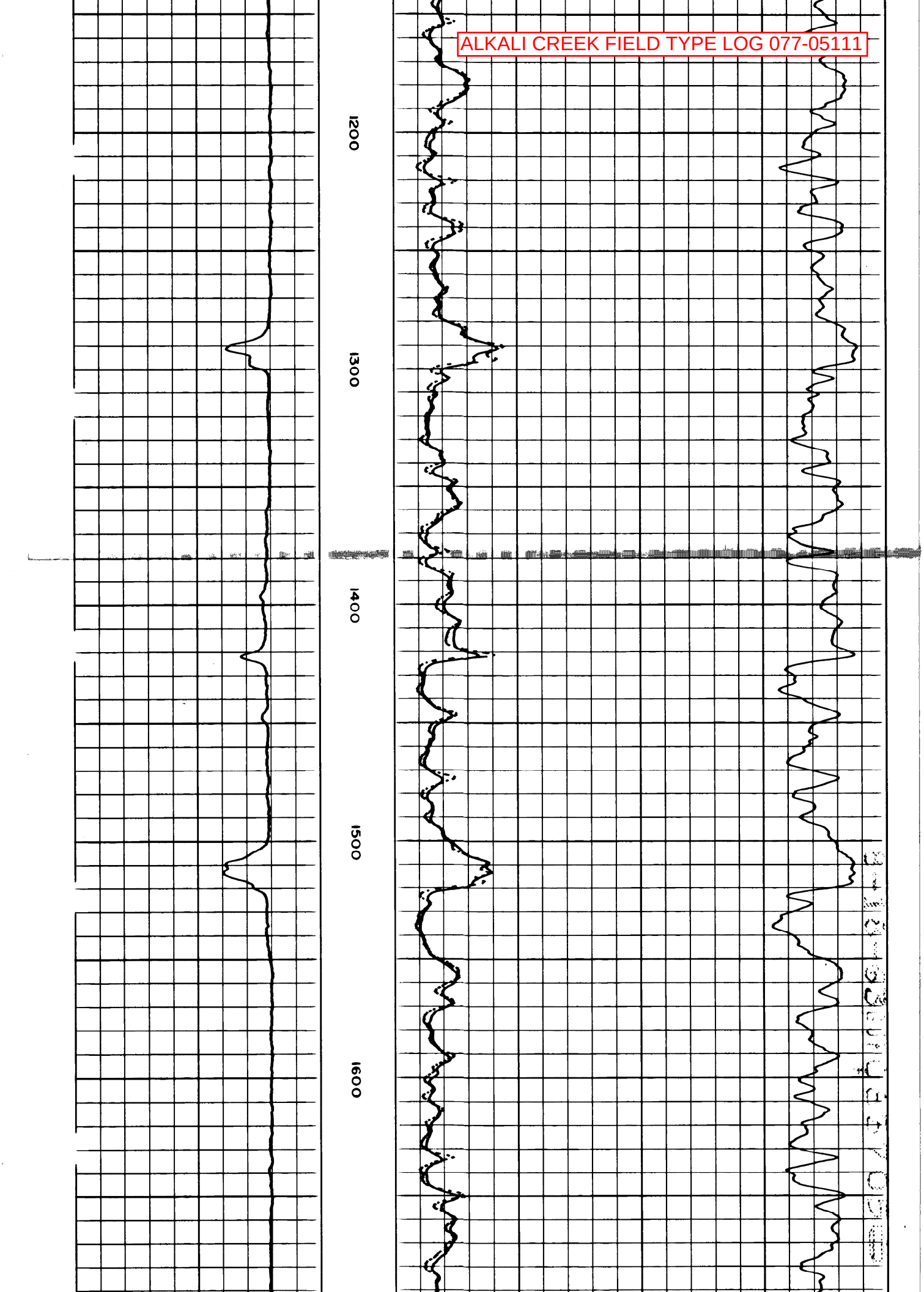
C.D.: USED S.O.: = 1 1/2" RUN # 1 & 2 RUN # 2 WHIPSTOCK @ 6020

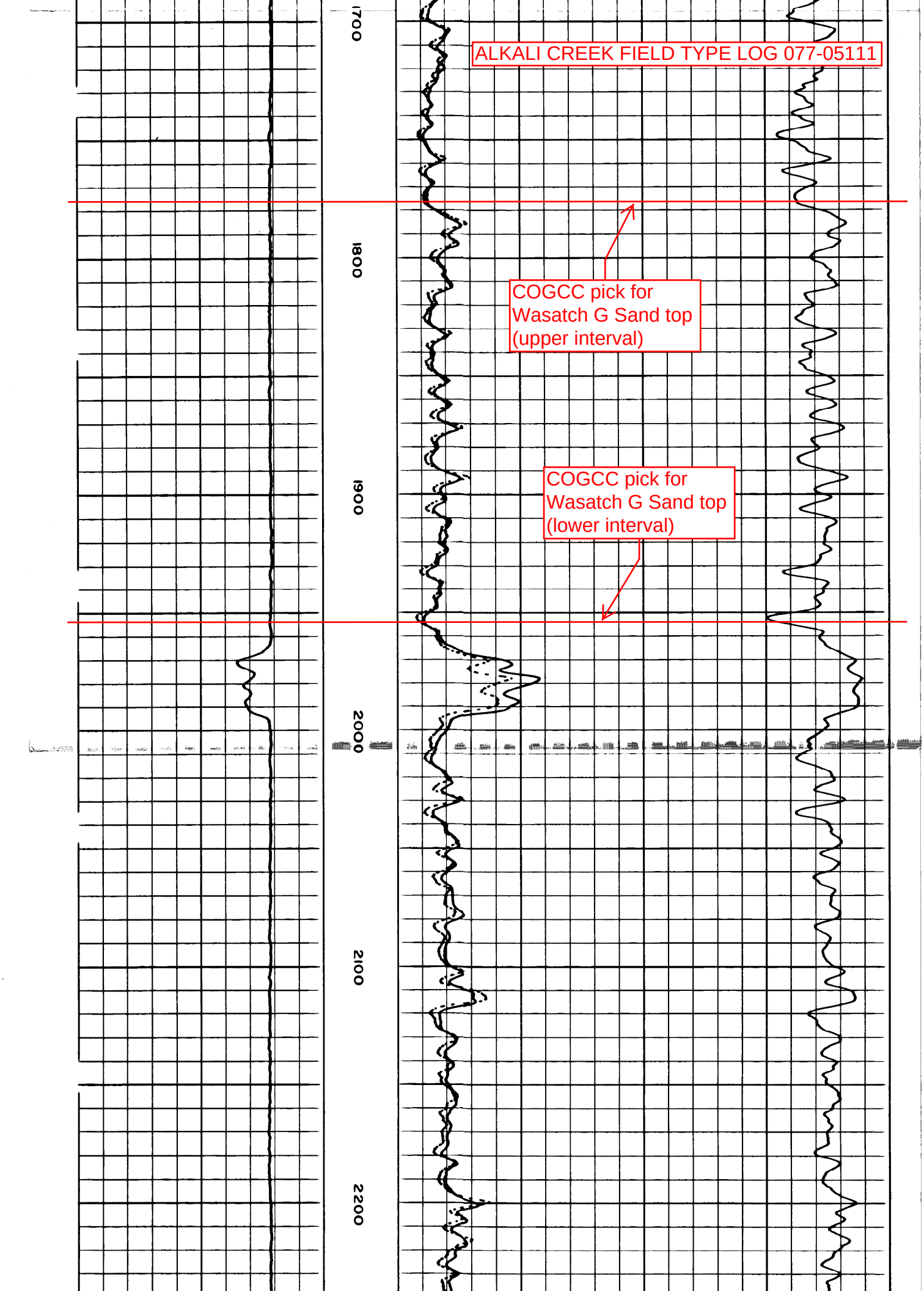
Equip. Used: CART. No. RUN # 1&2 534 D
PANEL No. 124 E
SONDE No. 216 K
SBR 4

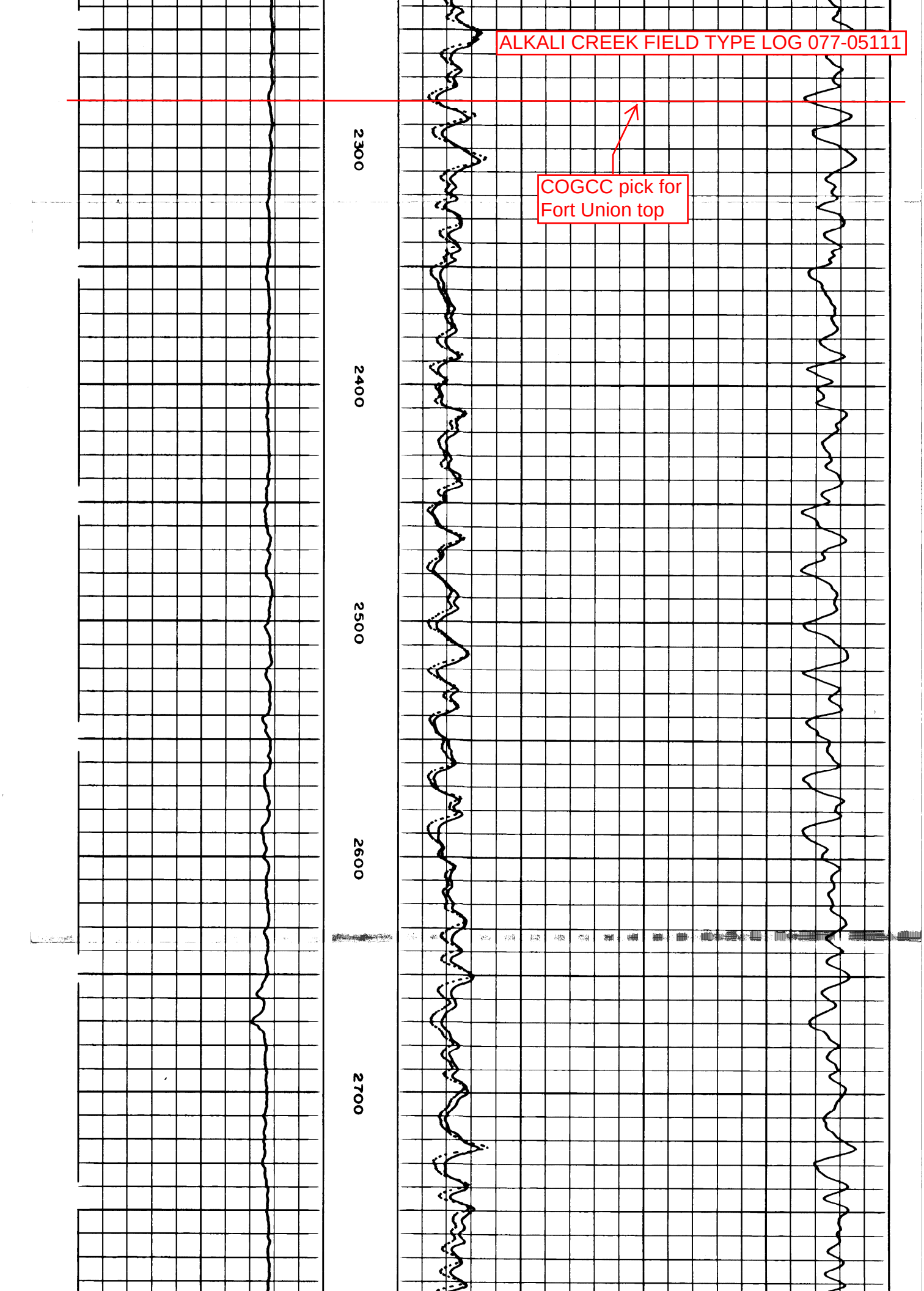
SPONTANEOUS-POTENTIAL millivolts	DEPTHS	CONDUCTIVITY millimhos/m = 1000 / ohms. m²/m

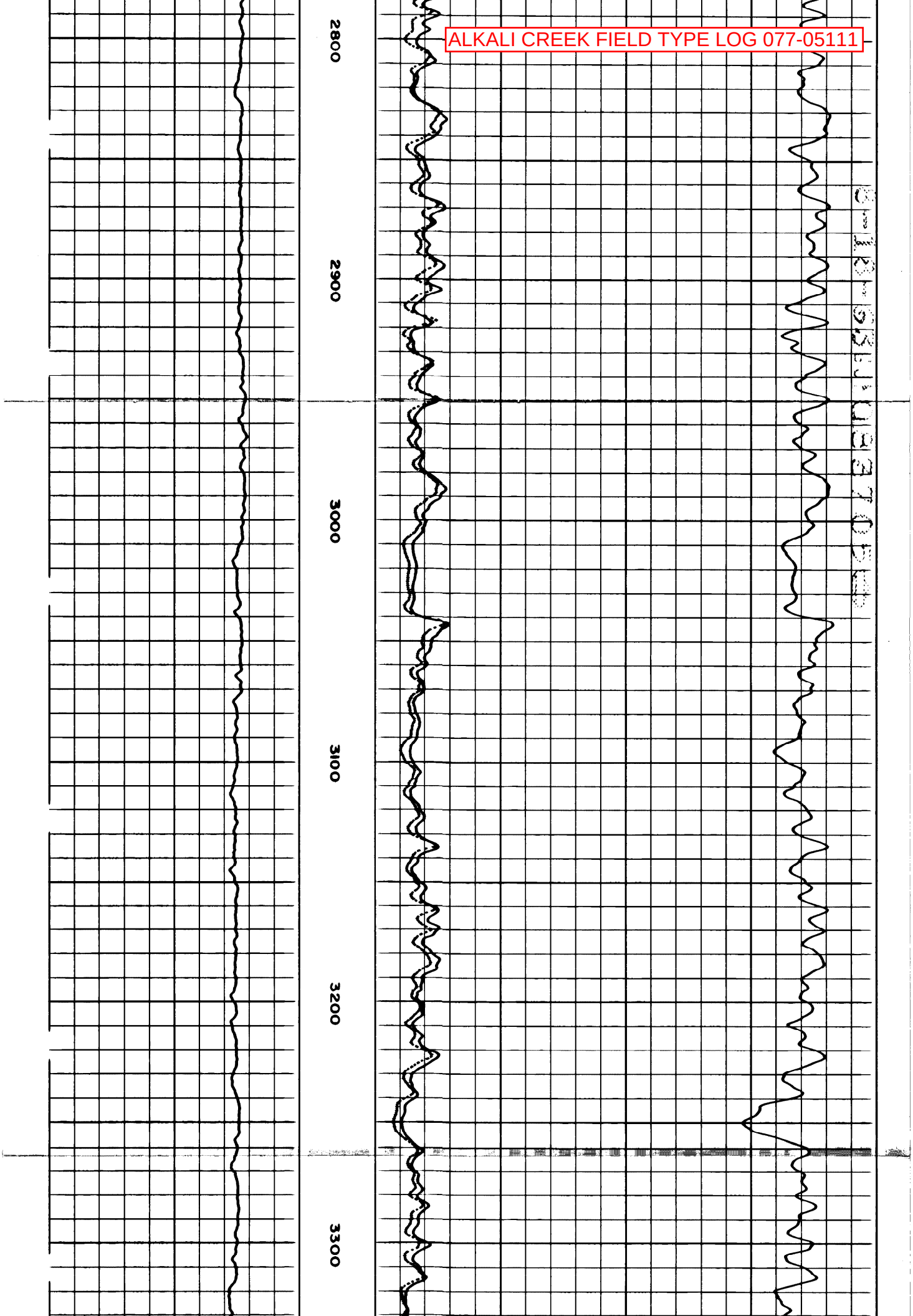

6 — FF40
INDUCTION
400
200
0
600
400
ALKALI CREEK FIELD TYPE LOG 077-05111
10
RESISTIVITY
-ohms. m²/m
A - 16" - M
SHORT NORMAL
0
100
0
1000
INDUCTION
0
100
0
1000
Wasatch Formation at Surface
0300
0400
0500

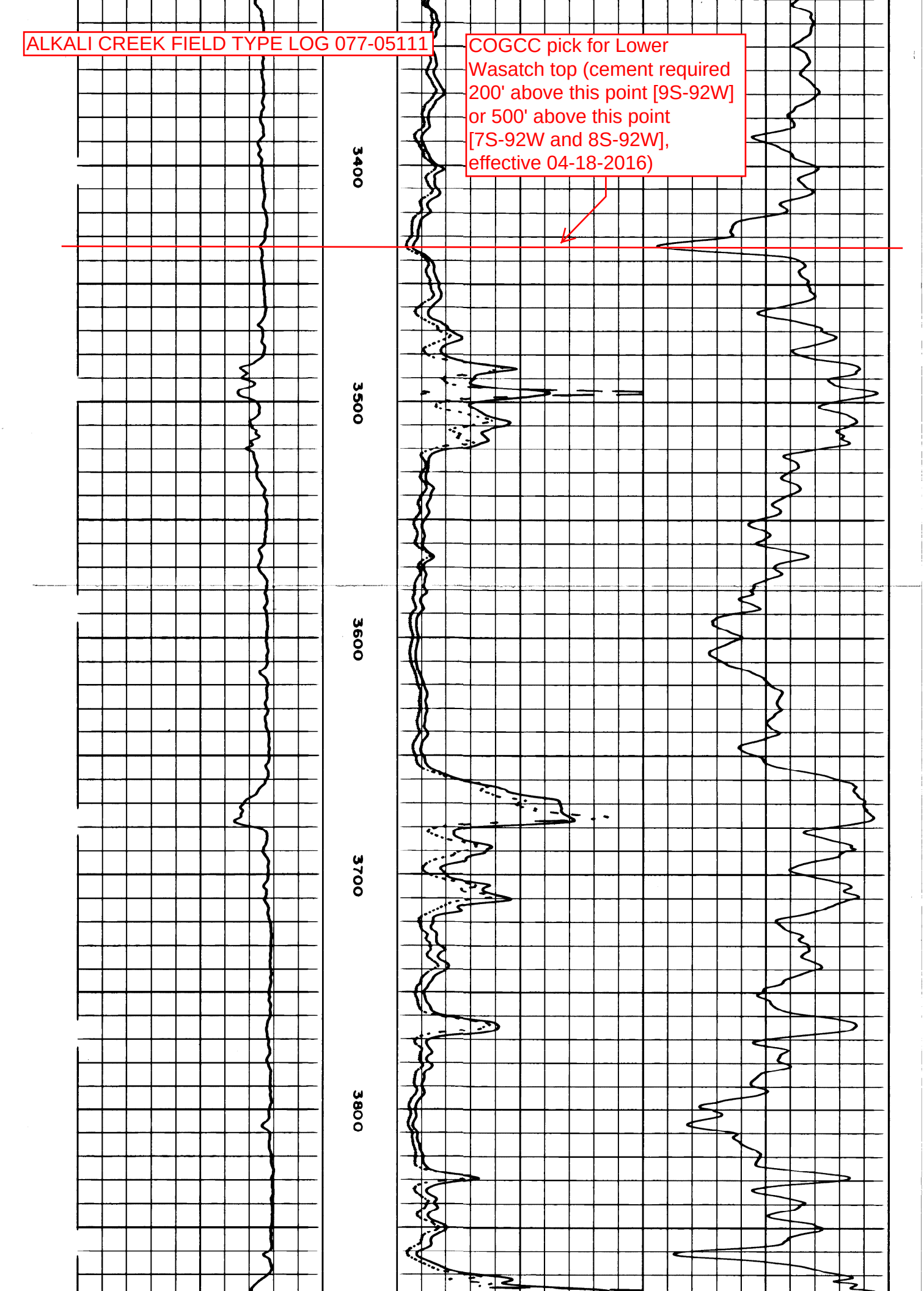

ALKALI CREEK FIELD TYPE LOG 077-05111
Groundwater isolation required above this point in the Wasatch Formation (cover with surface casing and extend at least 50' below this point)
0700
0800
0900
1000
1100

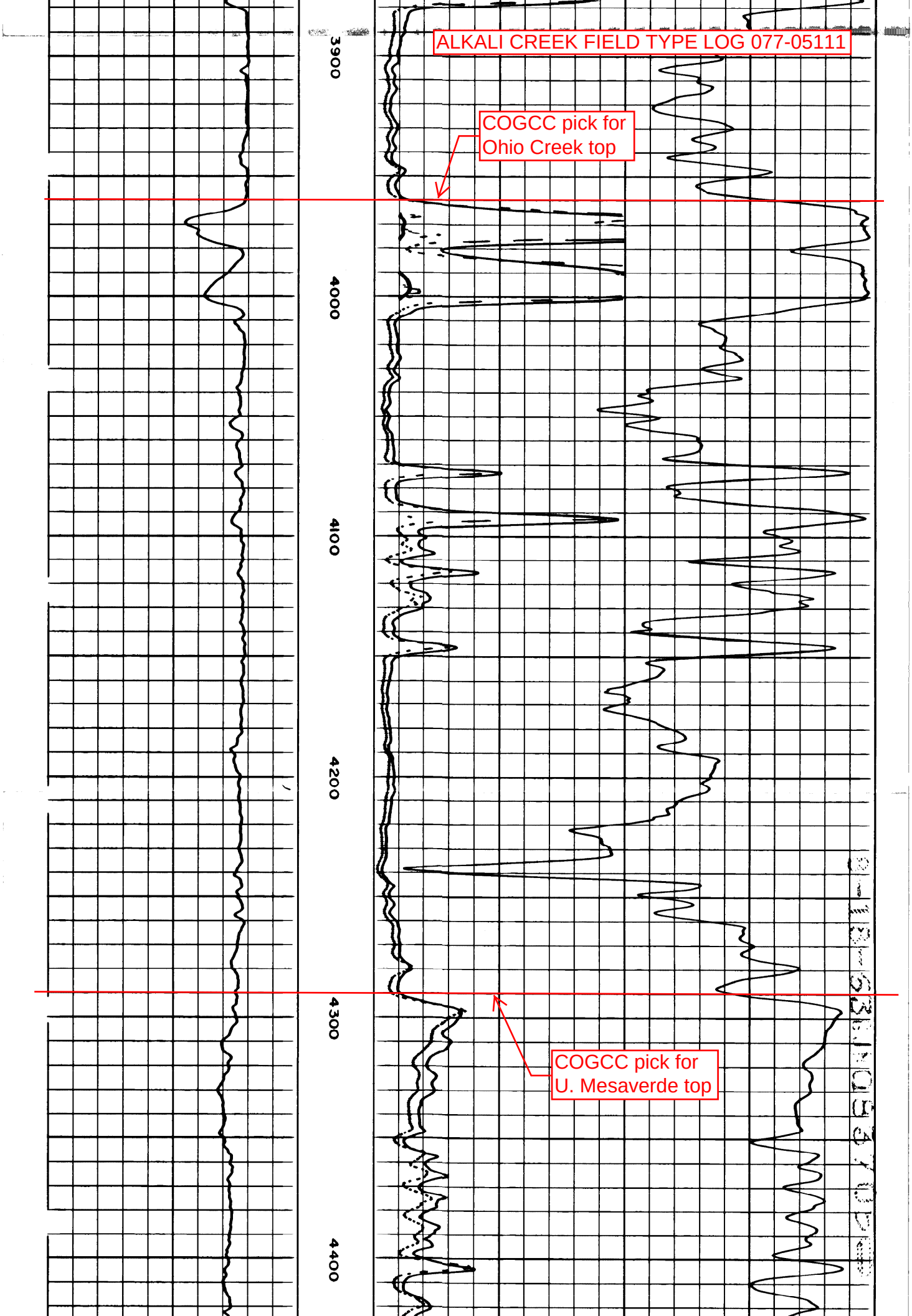

ALKALI CREEK FIELD TYPE LOG 077-05111
1200
1300
1400
1500
1600

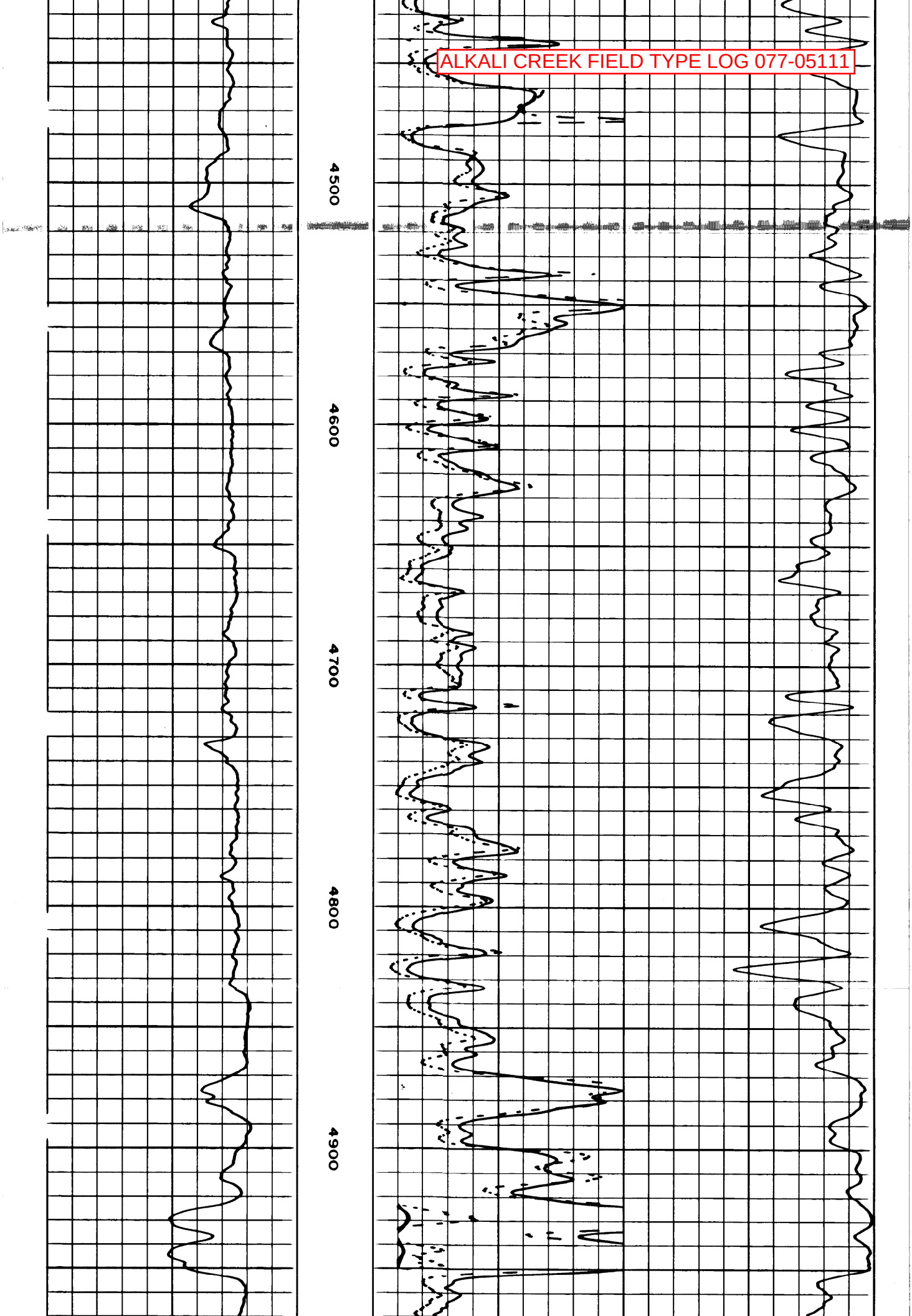

ALKALI CREEK FIELD TYPE LOG 077-05111
COGCC pick for Wasatch G Sand top (upper interval)
COGCC pick for Wasatch G Sand top (lower interval)
1700
1800
1900
2000
2100
2200

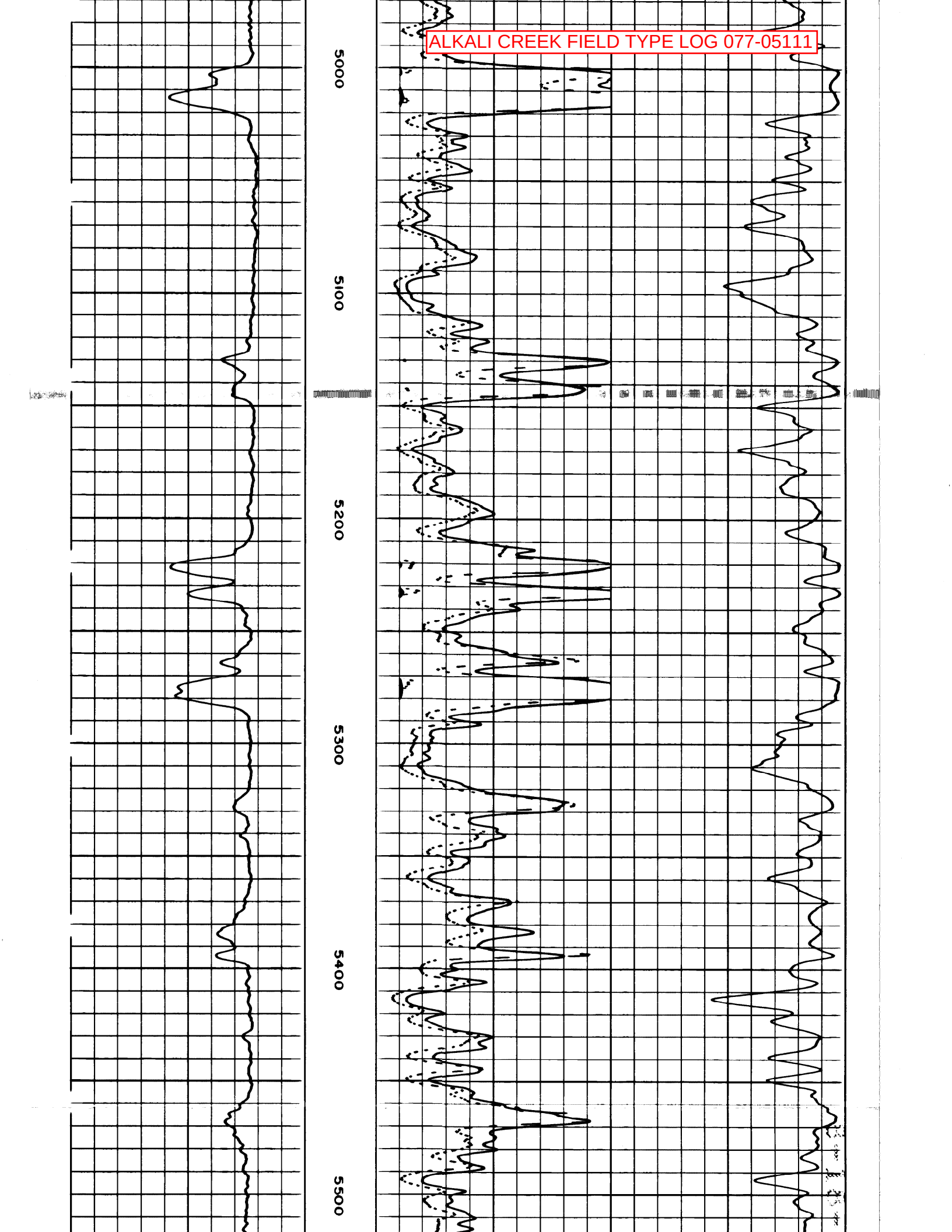

ALKALI CREEK FIELD TYPE LOG 077-05111
COGCC pick for
Fort Union top
2300
2400
2500
2600
2700

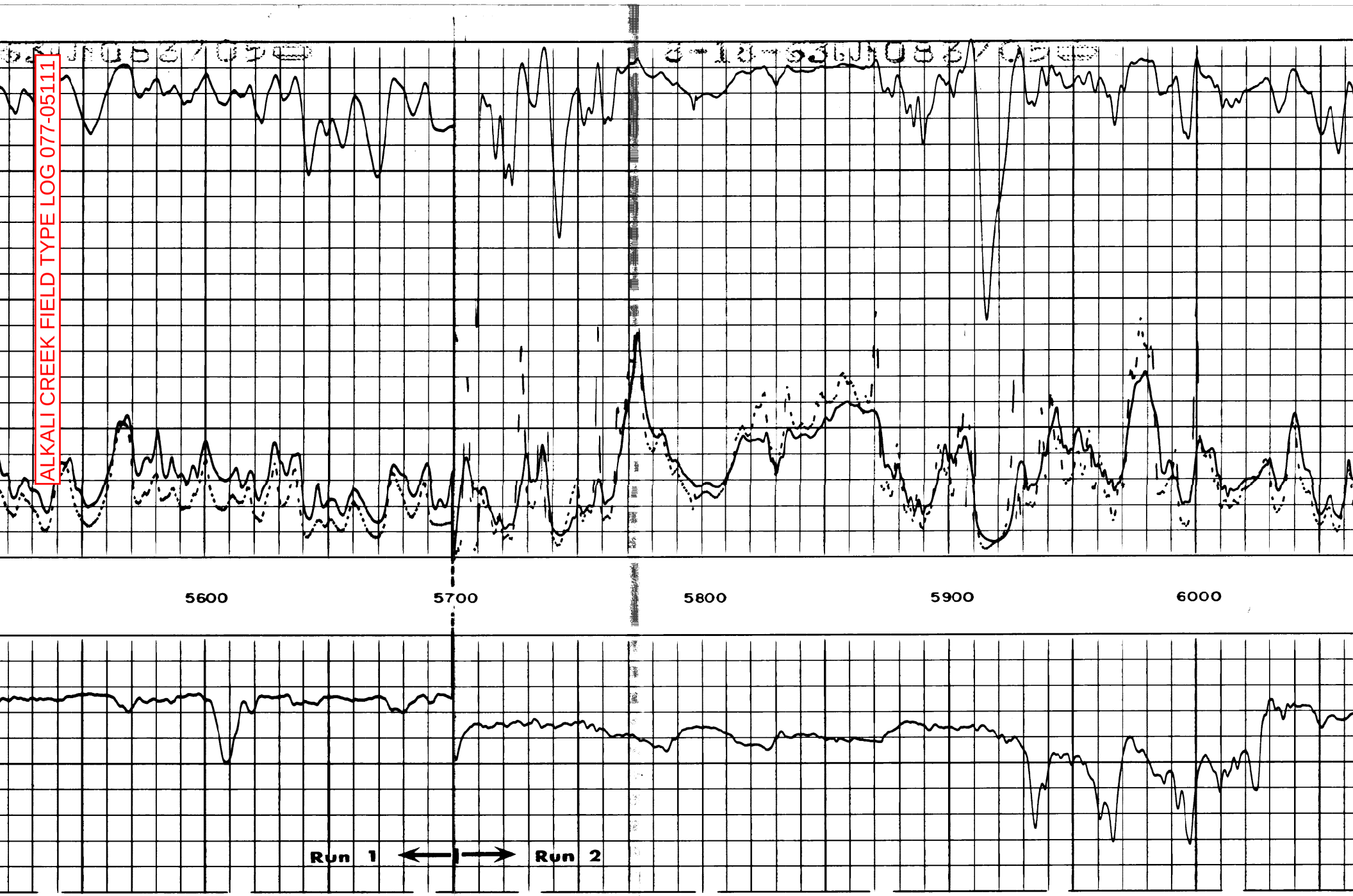

ALKALI CREEK FIELD TYPE LOG 077-05111
2800
2900
3000
3100
3200
3300

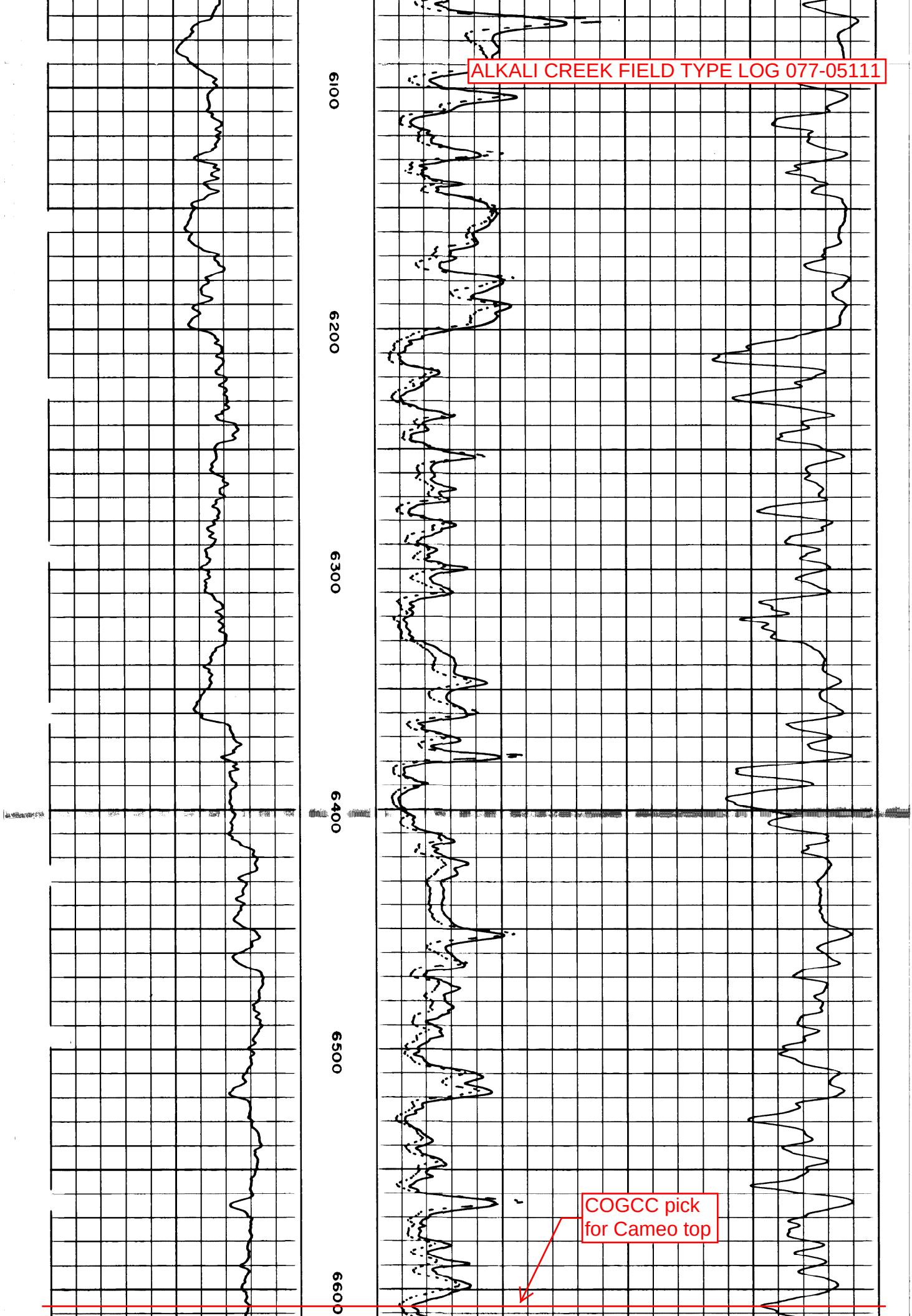

ALKALI CREEK FIELD TYPE LOG 077-05111
COGCC pick for Lower Wasatch top (cement required 200' above this point [9S-92W] or 500' above this point [7S-92W and 8S-92W], effective 04-18-2016)
3400
3500
3600
3700
3800

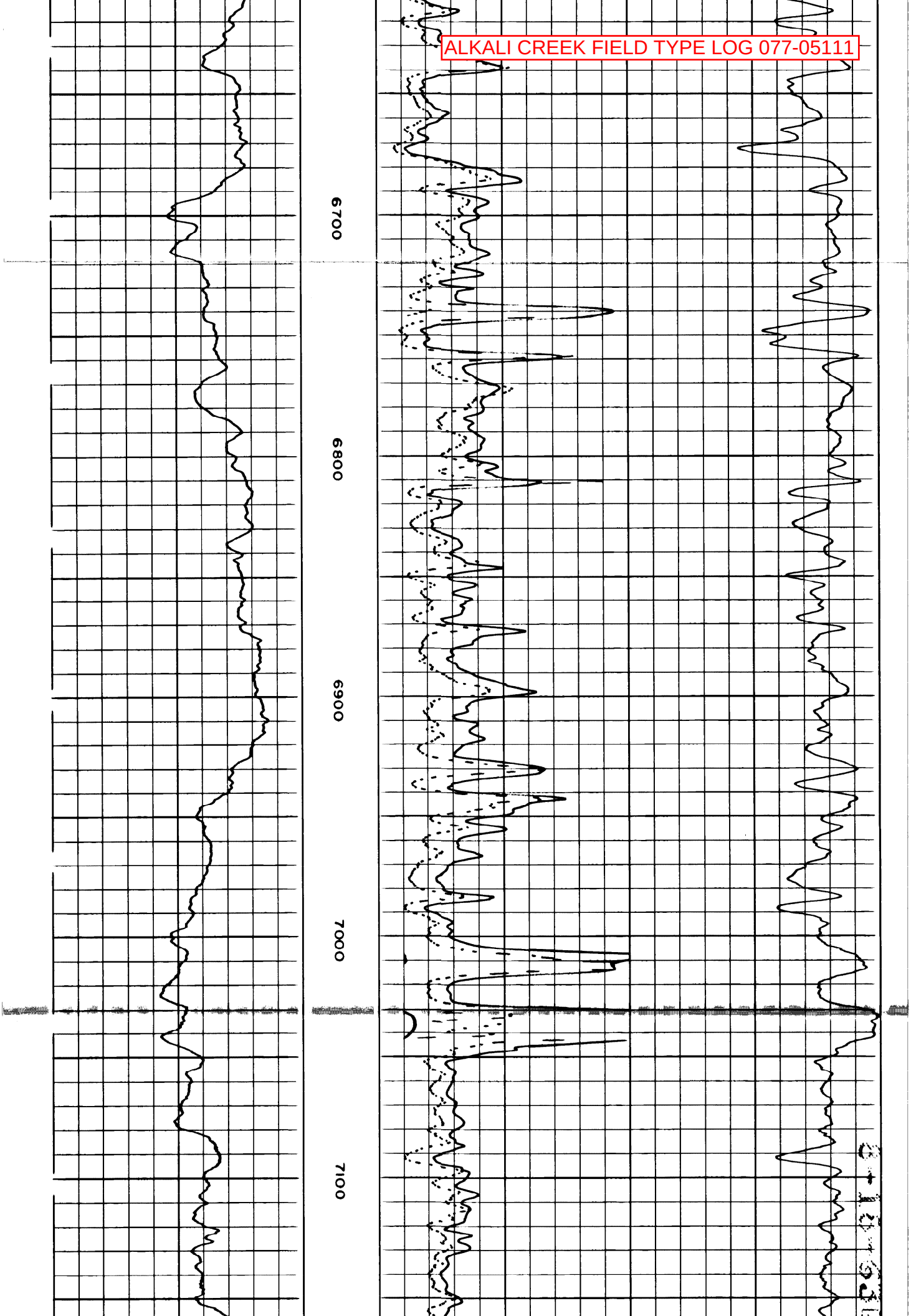

ALKALI CREEK FIELD TYPE LOG 077-05111
COGCC pick for
Ohio Creek top
COGCC pick for
U. Mesaverde top
3900
4000
4100
4200
4300
4400

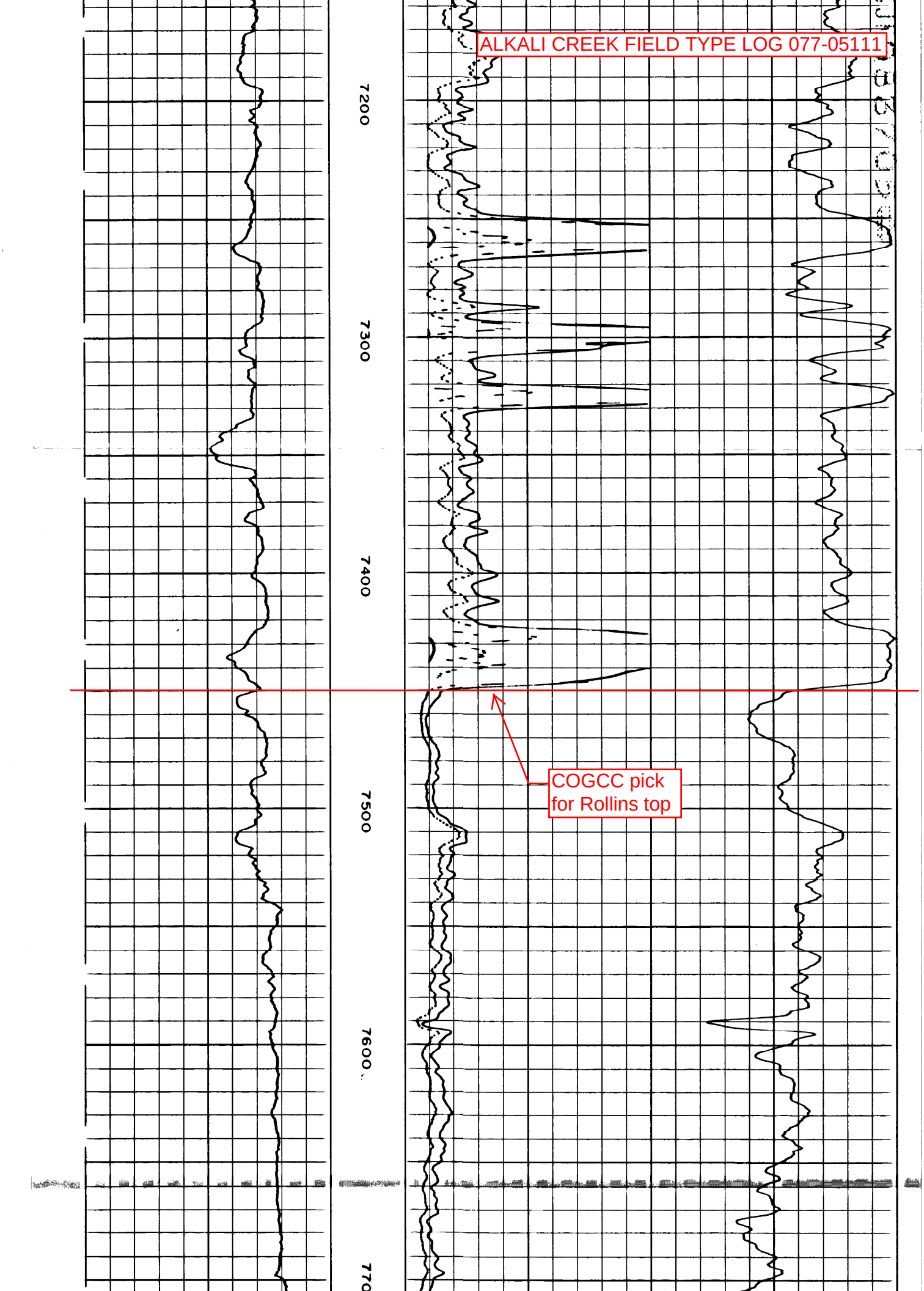

ALKALI CREEK FIELD TYPE LOG 077-05111
4500
4600
4700
4800
4900

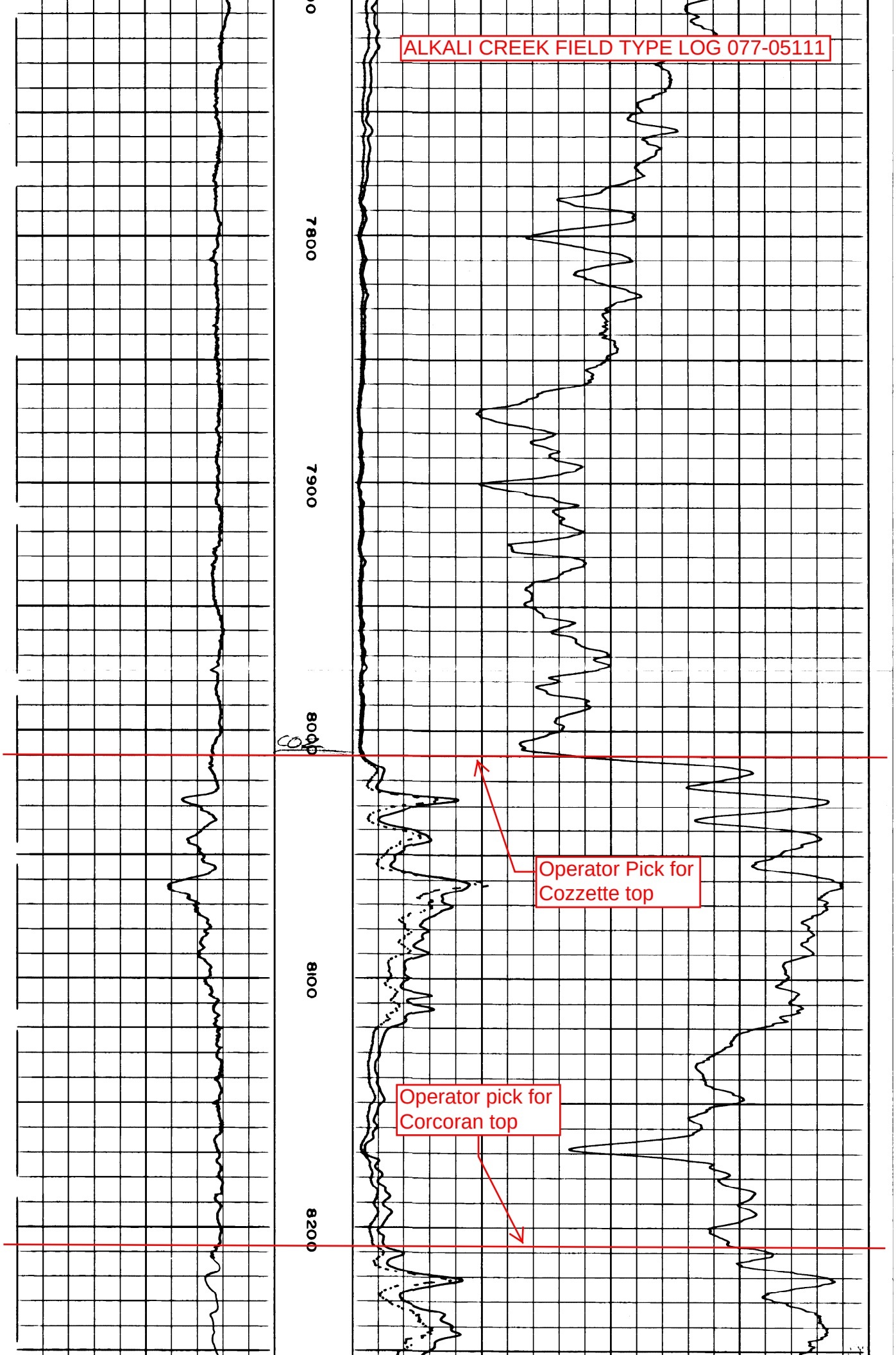

ALKALI CREEK FIELD TYPE LOG 077-05111
5000
5100
5200
5300
5400
5500


ALKALI CREEK FIELD TYPE LOG 077-05111
5600
5700
5800
5900
6000
Run 1
Run 2

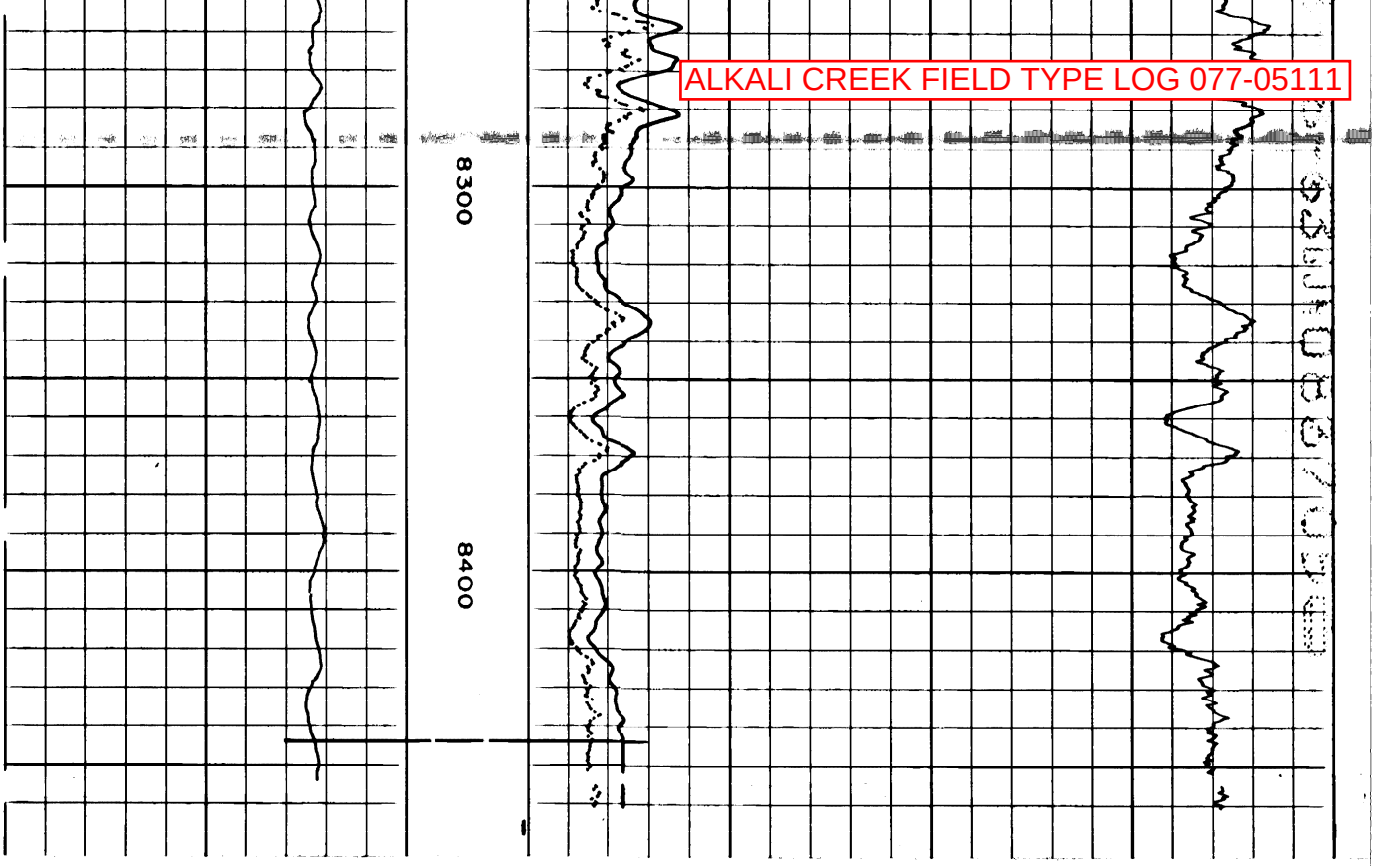

ALKALI CREEK FIELD TYPE LOG 077-05111
6100
6200
6300
6400
6500
6600
COGCC pick
for Cameo top


ALKALI CREEK FIELD TYPE LOG 077-05111
6700
6800
6900
7000
7100


ALKALI CREEK FIELD TYPE LOG 077-05111
7200
7300
7400
7500
7600
COGCC pick
for Rollins top


ALKALI CREEK FIELD TYPE LOG 077-05111
7800
7900
8000
8100
8200
Operator Pick for Cozzette top
Operator pick for Corcoran top

ALKALI CREEK FIELD TYPE LOG 077-05111



A - 16" - M
SHORT NORMAL
0 100
0 1000

INDUCTION
0 100
0 1000

RESISTIVITY
ohms – m^2/m

6 FF40
INDUCTION
400 200 0
600 400

– 10 +

SPONTANEOUS-POTENTIAL
millivolts

DEPTHS

CONDUCTIVITY
millimhos/m = $\frac{1000}{\text{ohms} - m^2/m}$

COMPANY PACIFIC NATURAL GAS EXPLORATION CO.

WELL EAST BUZZARD CREEK # 31-2

FIELD WILDCAT

COUNTY MESA STATE COLORADO

SWSC FR 8445
SWSC TD 8446
DRLR TD 8450
Elev:
KB 7729
DF -
GL 7717

0011-2EW8

COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056112

FIELD NAME	**BALDY CREEK**
FIELD NUMBER	**5180**

LOCATION

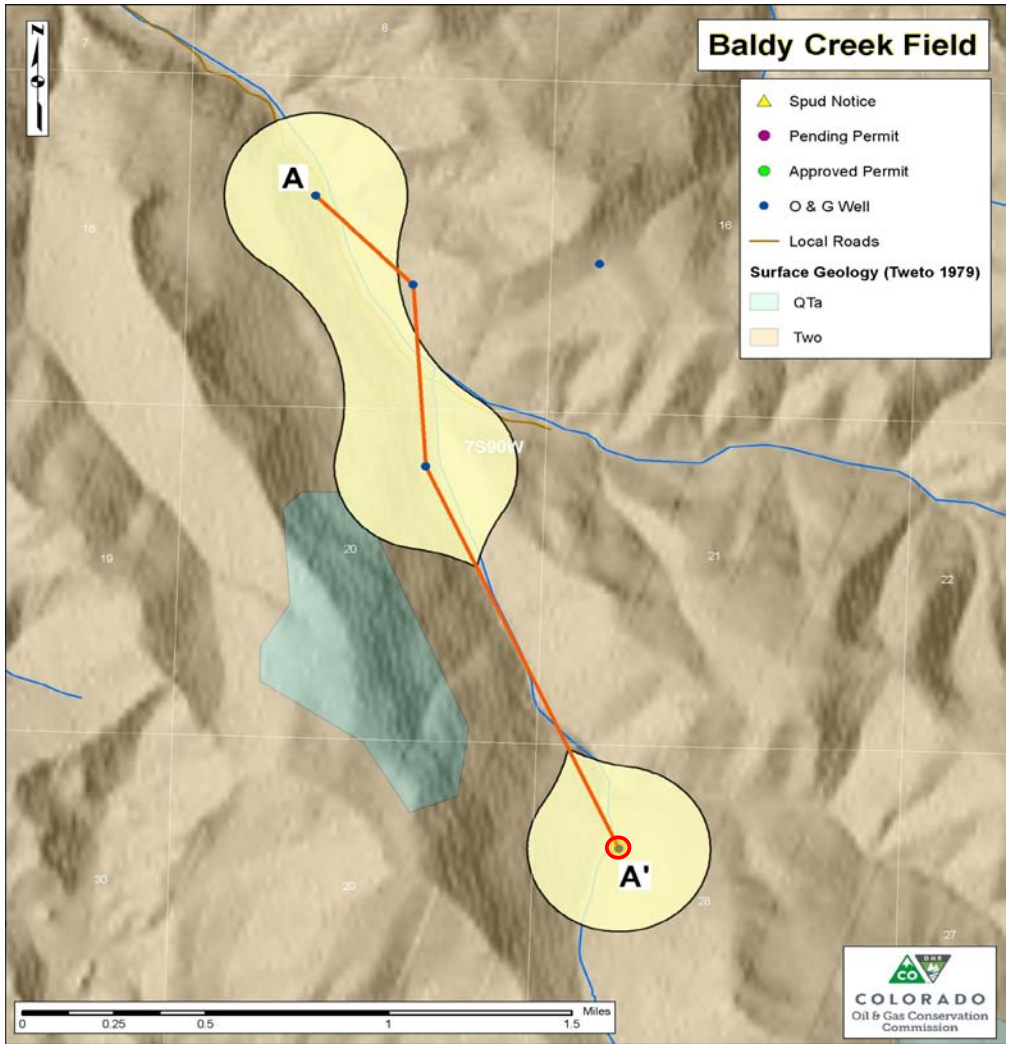
Basin	Piceance
Township(s)	7S
Range(s)	90W

SURFACE GEOLOGY

Surface Geology consists of isolated areas of alluvium underlain by the Wasatch Formation.

GEOLOGIC STRUCTURE

None within the field boundaries on COGCC's 250K GIS Geology layer. A northwest-southeast trending syncline is present east of the field, and a northwest-southeast trending, southwesterly-dipping monocline (the Grand Hogback Monocline along the northeastern edge of the basin) is present further to the north and east.



Type Log Well

COGCC OIL AND GAS FIELD SCOUT CARD
BALDY CREEK #5180

STRATIGRAPHY				A - Northwest			A' - Southeast
			API Number =>	045-06175	045-05056	045-06263	045-06280
			Surface Elevation =>	7,924	8,001	8,233	8,795
All depths are measured depths			Well Type =>	Vertical	Vertical	Vertical	Vertical
Group	Formation	Interval/Member	Isolation Concern	Log Top	Log Top	Log Top	Log Top
	Alluvium		Water		0		
	Wasatch	Upper	Shallow Water	0	140	0	0
	Wasatch	G-Sand*	None	2,151/2,312*	2,150/2,294*	2,004/2,182*	1,752/1,980*
	Wasatch	Fort Union*	None	2,630*	2,593*	2,391*	2,304*
	Wasatch	Middle	None				
	Wasatch	Lower*	Water	4,490*	4,400*	4,260*	4,080*
Mesaverde	Williams Fork	Ohio Creek	Water	4,752*	4,715*	4,560*	4,470*
Mesaverde	Williams Fork	U. Mesaverde	Water	5,107*	5,055*	4,940*	4,762*
Mesaverde	Williams Fork	Top of Gas	Gas				
Mesaverde	Williams Fork	Cameo	Gas	8,900**			8,070
Mesaverde	Iles	Rollins	Gas	9,125	9,060*	8,960*	8,885*
	Mancos Tongue		None	9,355	9,355*	9,240*	9,253*
Mesaverde	Iles	Cozzette	Gas	9,800	9,726*	9,652	9,563
Mesaverde	Iles	Corcoran	Gas	10,042	9,950*	9,882	9,791
	Mancos		Possible Gas	10,220	10,140	10,200*	10,110*
	Niobrara		Possible Gas				

Annotated Type Log for 045-06280: COGCC Document Number 2056081

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

*** Tops for Cameo and below are sample tops reported on the Geologic Report for 045-06175, COGCC Document No. 605310.*

WATER RESOURCE ISOLATION

Alluvium, Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde
The deepest water well in the vicinity of the field is 290' (likely Wasatch)

PRODUCING ZONE ISOLATION

Primary Objectives: Iles Formation of Mesaverde Group (Rollins, Cozzette, and Corcoran)

UNDERGROUND INJECTION CONTROL

None in this field.

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

None for this field.

COGCC OIL AND GAS FIELD SCOUT CARD
BALDY CREEK #5180

HISTORIC WELL CONSTRUCTION

Surface casing setting depths are typically about 1,000'. Production casing generally terminates in the Mancos Formation. Production casing cement may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 10% TVD required for well control and to cover water resources in the upper interval of the Wasatch Formation. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. New Standards require cementing intermediate (if used) or production casing at least 500' above Lower Wasatch sands, as shown on the annotated type log for this field.

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug above Ohio Creek and across Lower Wasatch (squeeze to 500' above Lower Wasatch if no annular cement coverage); stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000-foot intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug.

NOTES

Detailed geologic description of formations, gas shows, and water flows in COGCC Document No. 605310, pp 14-17. Stray gas shows noted in Wasatch, and water flows noted in Ohio Creek.
Outside of Bradenhead Monitoring Area, but operator bradenhead monitoring is recommended (no specific reporting requirement).

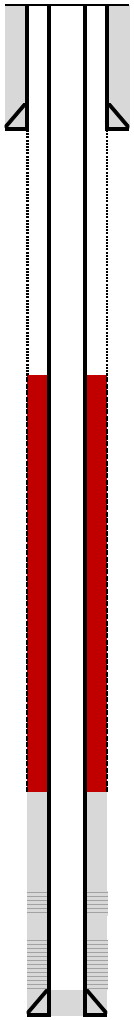
ISOLATION REQUIREMENTS FOR TYPICAL WELLS

Date 04/18/2016 **COGCC Document No.** 2056113

FIELD NAME **BALDY CREEK**
FIELD NUMBER **5180**

LOCATION
Basin Piceance
Township(s) 7S
Range(s) 90W

Depth	Formation/Member
0	Alluvium/ U. Wasatch
1,000	
2,000	Wasatch G
3,000	
4,000	L. Wasatch
	Ohio Creek
5,000	U. Mesaverde
6,000	
7,000	
8,000	
	Cameo
9,000	Rollins
	Cozzette
	Corcoran
10,000	

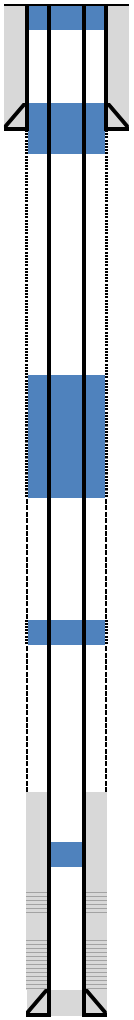


Casing and Cement Coverage

New Cement Standard
Cement must provide coverage across Ohio Creek and L. Wasatch (500' above L. Wasatch), in addition to productive interval coverage.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of the Mesaverde Group, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	Alluvium/ U. Wasatch
1,000	
2,000	Wasatch G
3,000	
4,000	L. Wasatch
	Ohio Creek
5,000	U. Mesaverde
6,000	
7,000	
8,000	
	Cameo
9,000	Rollins
	Cozzette
	Corcoran
10,000	



Plug Placement

Surface plug

Surface casing shoe plug

Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 feet); not shown on this figure

Squeeze plug across Ohio Creek and L. Wasatch (top of plug 500' above L. Wasatch)

Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 feet)

Plug above Iles Completions

BALDY CREEK FIELD TYPE LOG 045-06280
COGCC Document Number 2056081
04-18-2016

COMPANY DOME PETROLEUM CORPORATION

WELL BALDY CREEK 3-28

FIELD BALDY CREEK

County GARFIELD State COLO.

Sec. 28 Twp. 7S Rge. 90W

5 W NW

045-06280

COMPANY DOME PETROLEUM CORPORATION

WELL BALDY CREEK 3-28

FIELD BALDY CREEK

COUNTY GARFIELD STATE COLORADO

Location

Other Services:
FF-MSG
CDLN-G

Permanent Datum GROUND LEVEL Elev. 8795
Log Measured From KELLY BUSHING 15 Ft. Above Perm. Datum
Drilling Measured From KELLY BUSHING

Elev.: K.B. 8810
D.F.
G.L. 8795

DUAL INDUCTION GUARD LOG

Date	10-29-80		
Run No.	ONE		
Depth—Driller	10130		
Depth—Welex	10129		
Btm. Log Inter.	10120		
Top Log Inter.	990		
Casing—Driller	10 5/8 @ 1000	@	@
Casing—Welex	1000		
Bit Size	8 3/4		
Type Fluid in Hole	BENEX		
Dens. | Visc.	9.3 | 40	|	|
pH | Fluid Loss	9.4 | 19.2 ml	| ml	| ml
Source of Sample	MUD TANK		
R_m @ Meas. Temp.	3.50 @80. °F	@ °F	@ °F
R_{mf} @ Meas. Temp.	3.03 @80 °F	@ °F	@ °F
R_{mc} @ Meas. Temp.	3.45 @80 °F	@ °F	@ °F
Source R_{mf} R_{mc}	MEASURED	|	|
R_m @ BHT	1.40 @200 °F	@ °F	@ °F
Time Since Circ.	6 HOURS		
Max. Rec. Temp.	200 °F @ T.D	°F @	°F @
Equip. | Location	1914 | RK SPRINGS	|	|
Recorded By	J. BROUGHTON & D. WACHTELL		
Witnessed By	MR. J. BROWNE & MR. B. DICKERSON		

RECEIVED
NOV 12 1980
COLO. OIL & GAS CONS. COMM.

Fold Here

Service Ticket No. 075937 Remarks:

Change in Mud Type or Additional Samples

Date | Sample No.	|	|
Depth—Driller		
Type Fluid in Hole		
Dens. | Visc.	|	|
ph | Fluid Loss	| ml	|
Source of Sample		
R_m @ Meas. Temp.	@ °F	@ °F
R_{mf} @ Meas. Temp.	@ °F	@ °F
R_{mc} @ Meas. Temp.	@ °F	@ °F
Source: R_{mf} | R_{mc}	|	|
R_m @ BHT	@ °F	@ °F
R_{mf} BHT	@ °F	@ °F
R_{mc} BHT	@ °F	@ °F

SCALE CHANGES

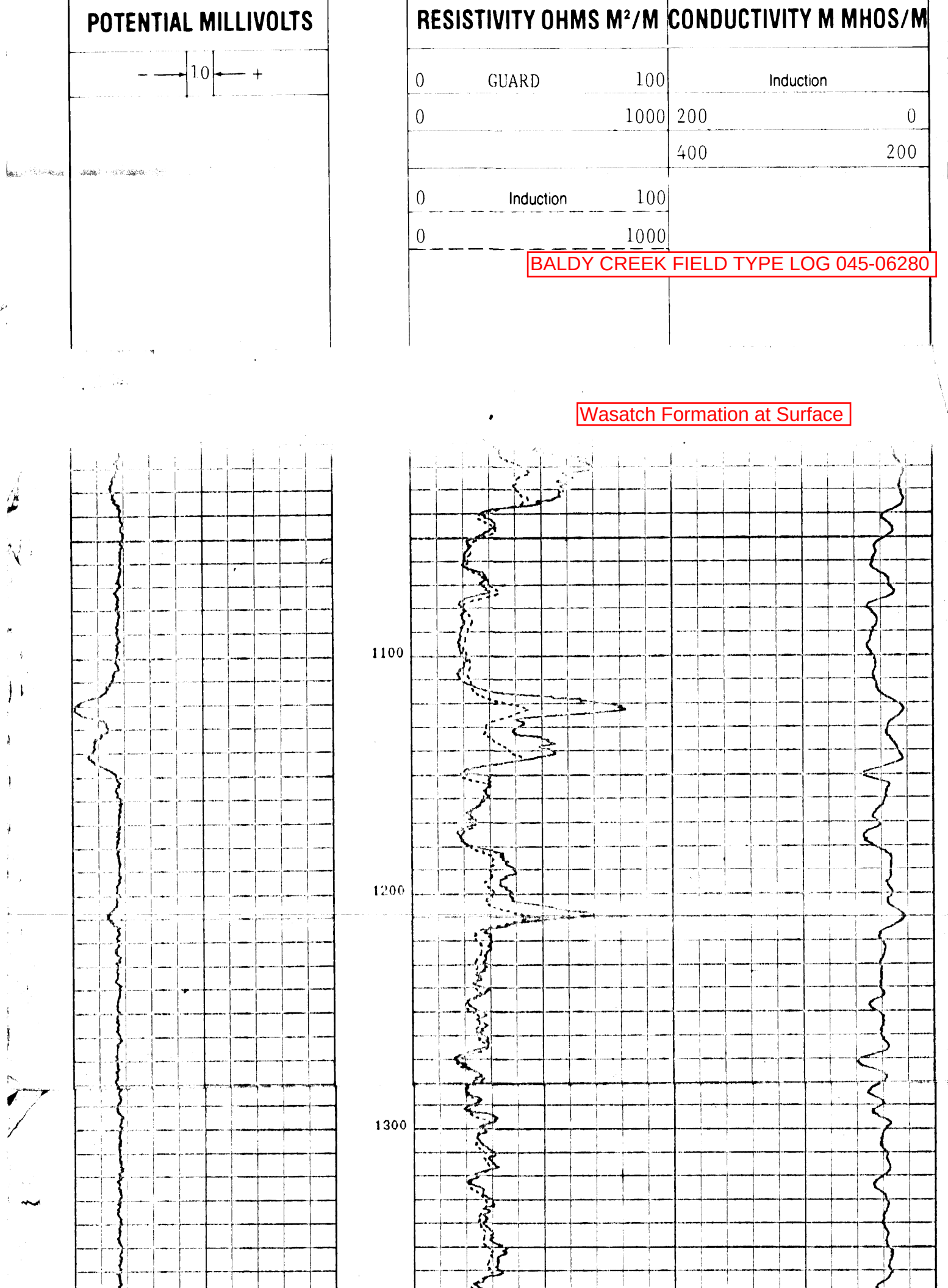
Type Log	Depth	Scale Up Hole	Scale Down Hole
		NO CHANGES	

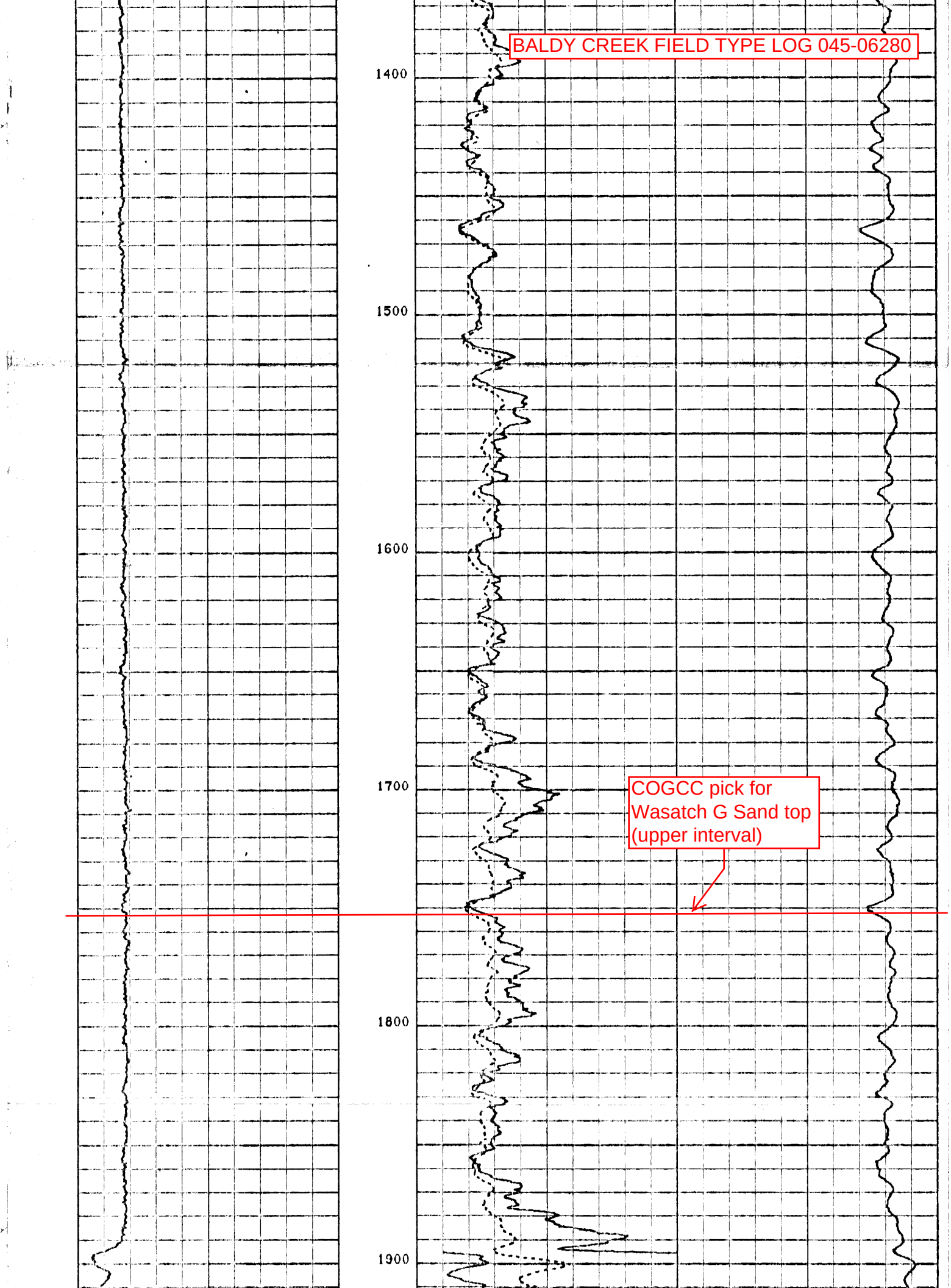
EQUIPMENT DATA

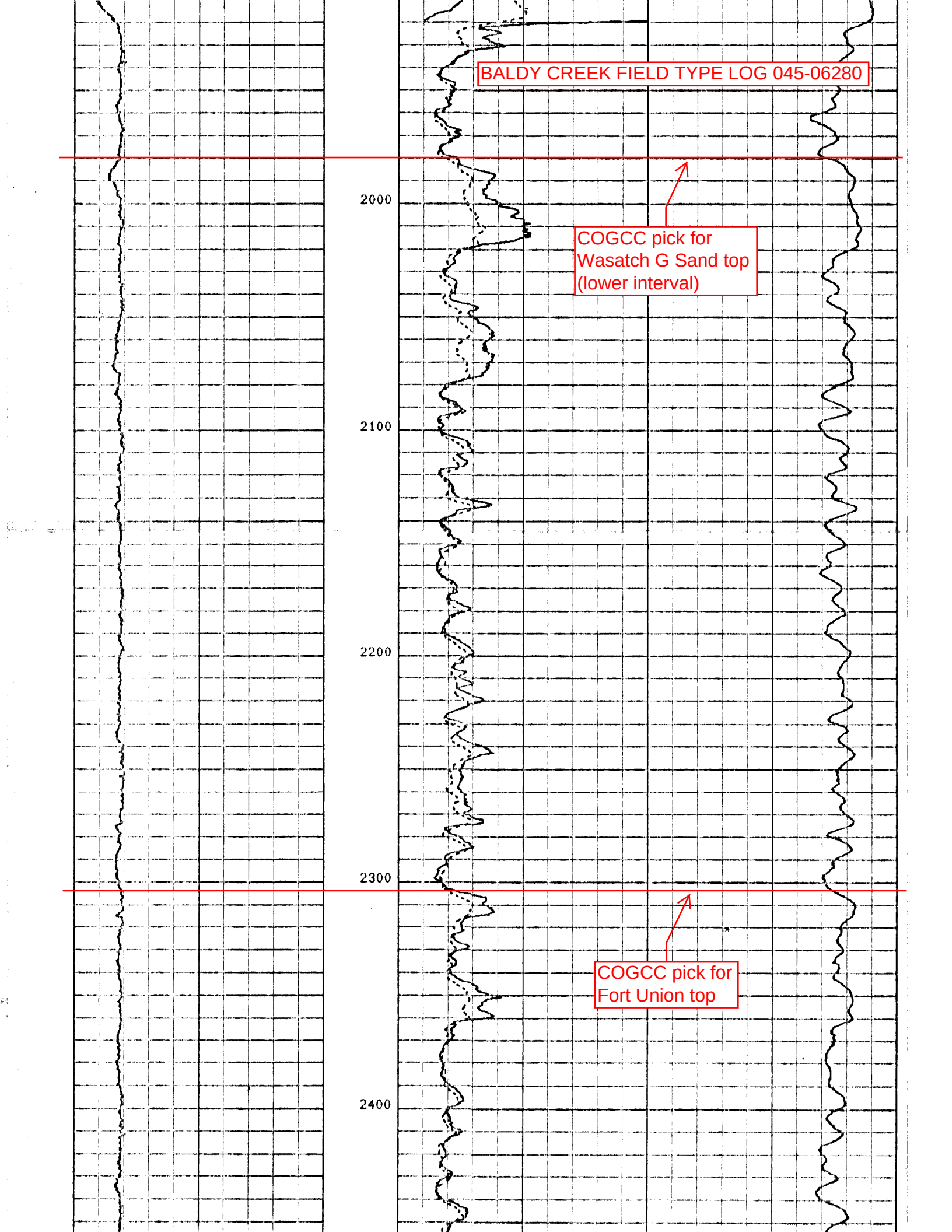
Run No.	Tool Type and No.	Pad Type	Tool Position	Other
ONE	196A		1½"S.O.	

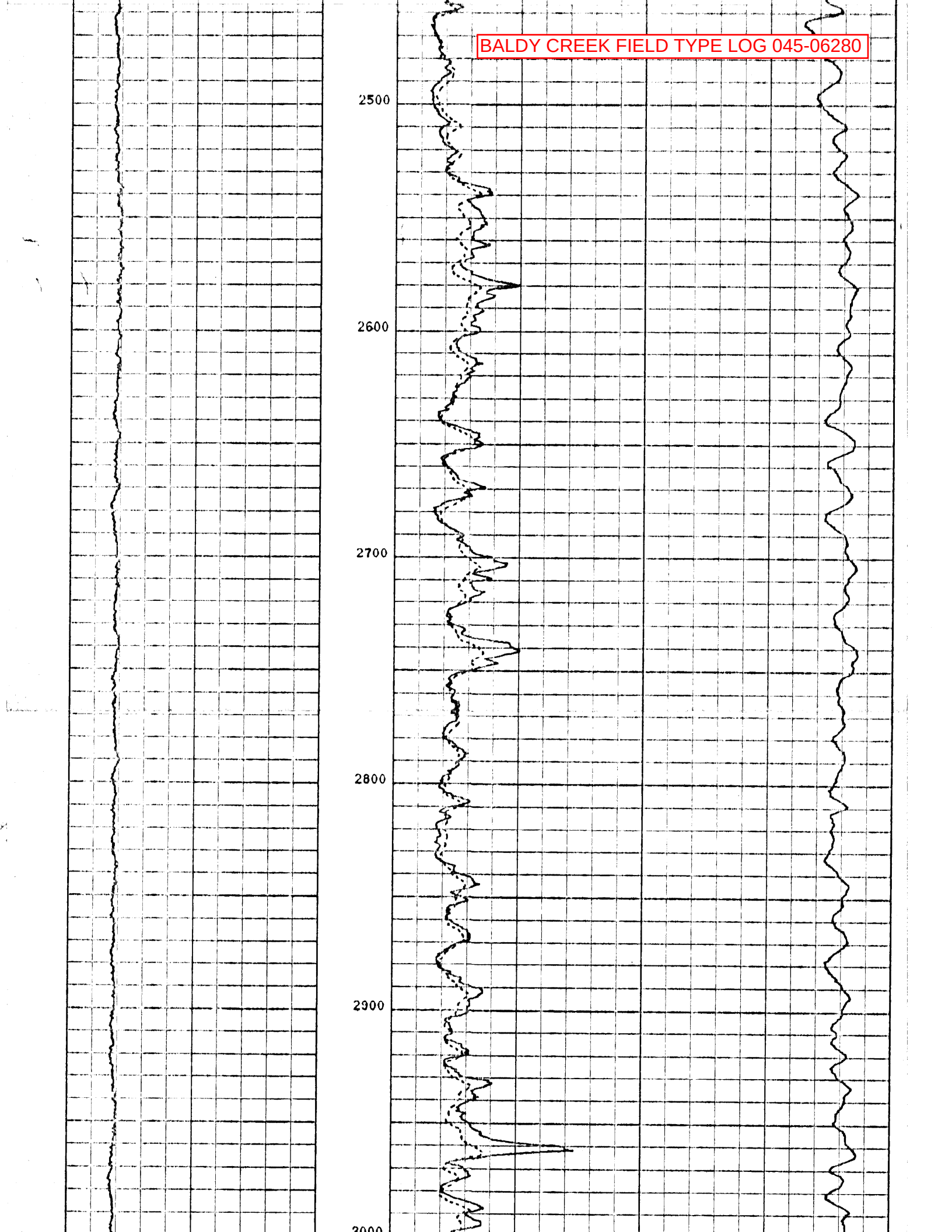
Welex does not guarantee the accuracy of any interpretation of log data, conversion of log data to physical rock parameters, or recommendations which may be given by Welex personnel or which may appear on the log or in any other form. Any user of such data, interpretations, conversions, or recommendations agrees that Welex is not responsible, except where due to gross negligence or wilful misconduct, for any loss, damages, or expenses resulting from the use thereof.

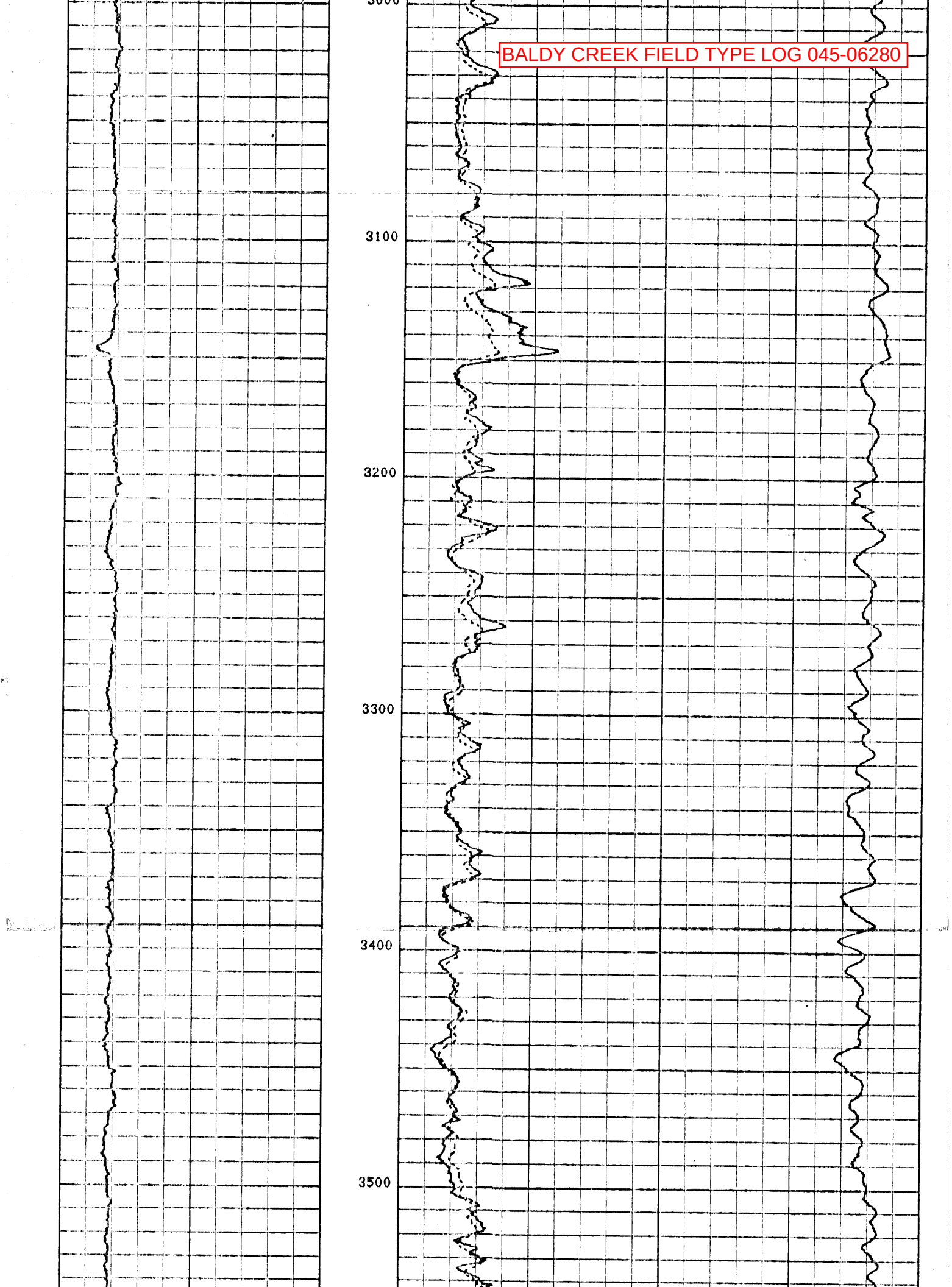
2" = 100'

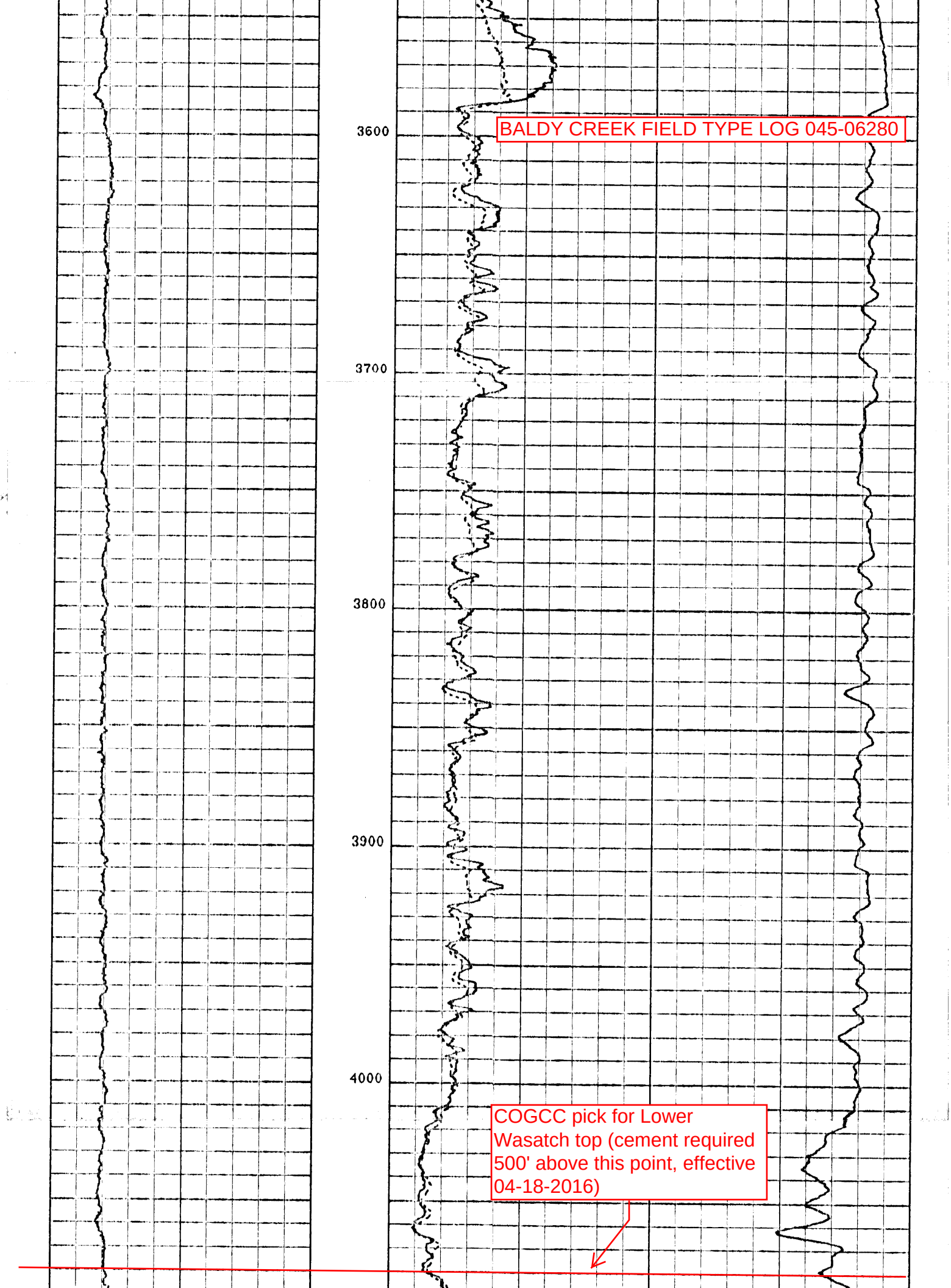

POTENTIAL MILLIVOLTS
10
RESISTIVITY OHMS M²/M
0 GUARD 100
0 1000
0 Induction 100
0 1000
CONDUCTIVITY M MHOS/M
Induction
200 0
400 200
BALDY CREEK FIELD TYPE LOG 045-06280
Wasatch Formation at Surface
1100
1200
1300

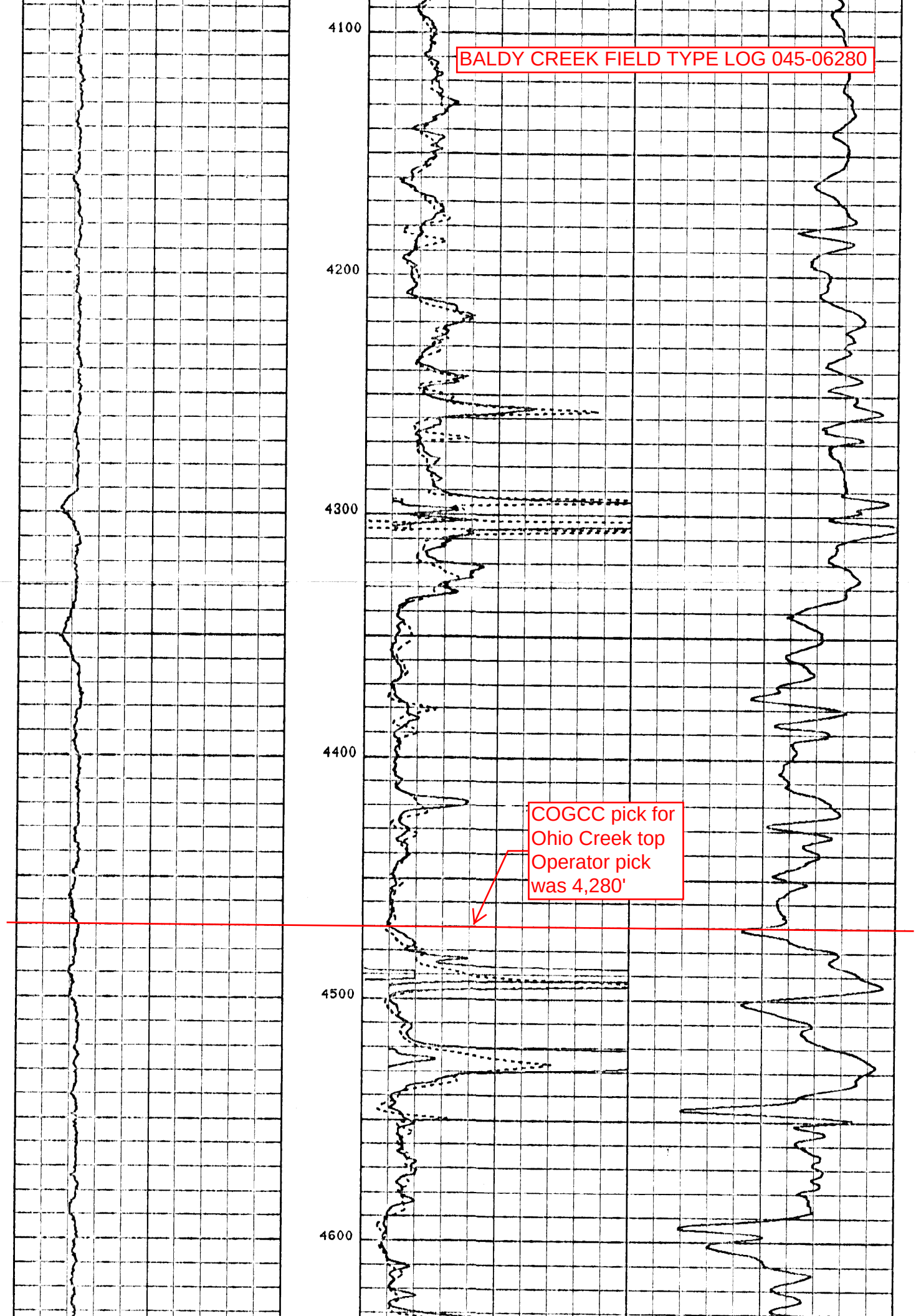

BALDY CREEK FIELD TYPE LOG 045-06280
1400
1500
1600
1700
1800
1900
COGCC pick for
Wasatch G Sand top
(upper interval)

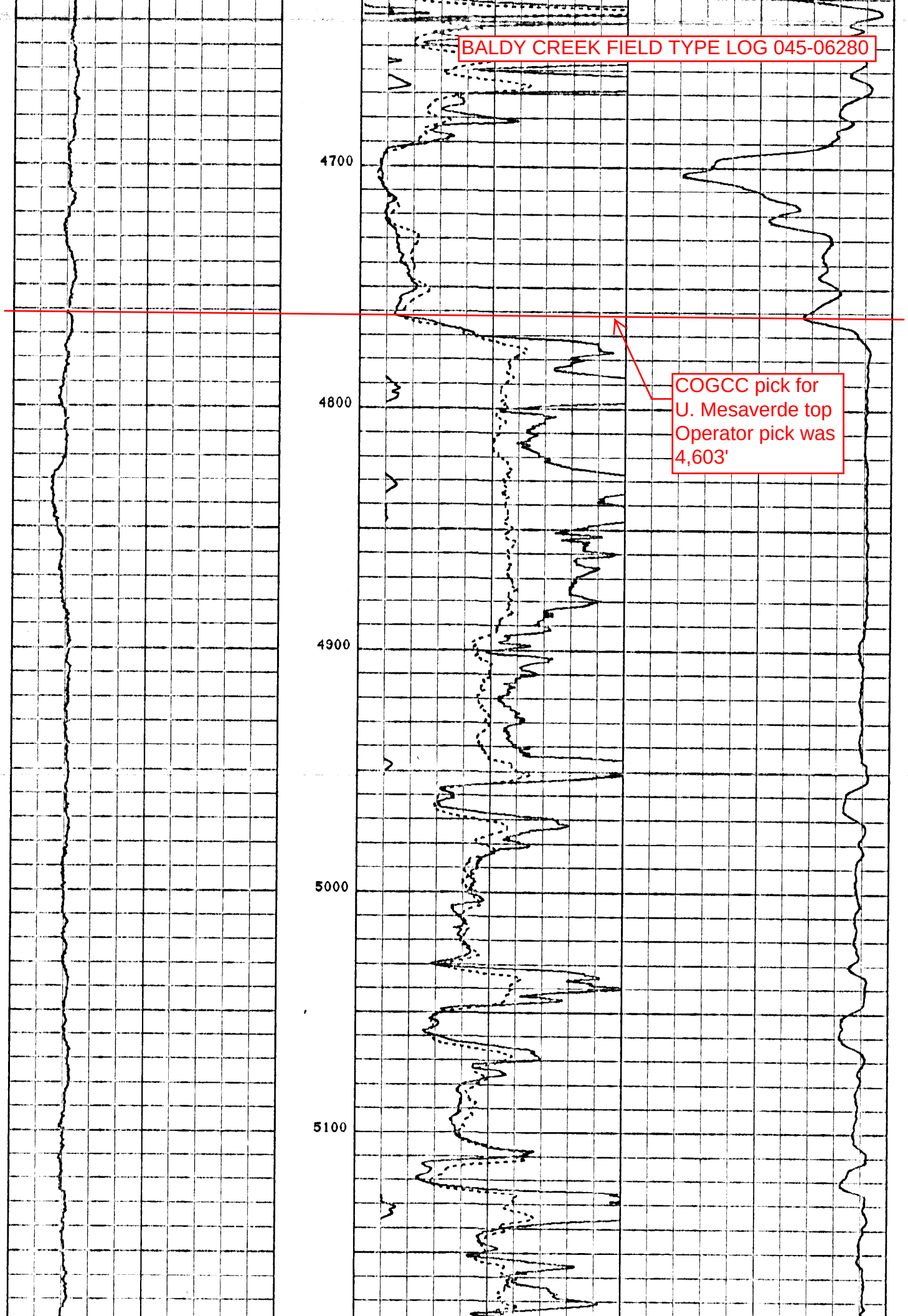

BALDY CREEK FIELD TYPE LOG 045-06280
2000
2100
2200
2300
2400
COGCC pick for Wasatch G Sand top (lower interval)
COGCC pick for Fort Union top

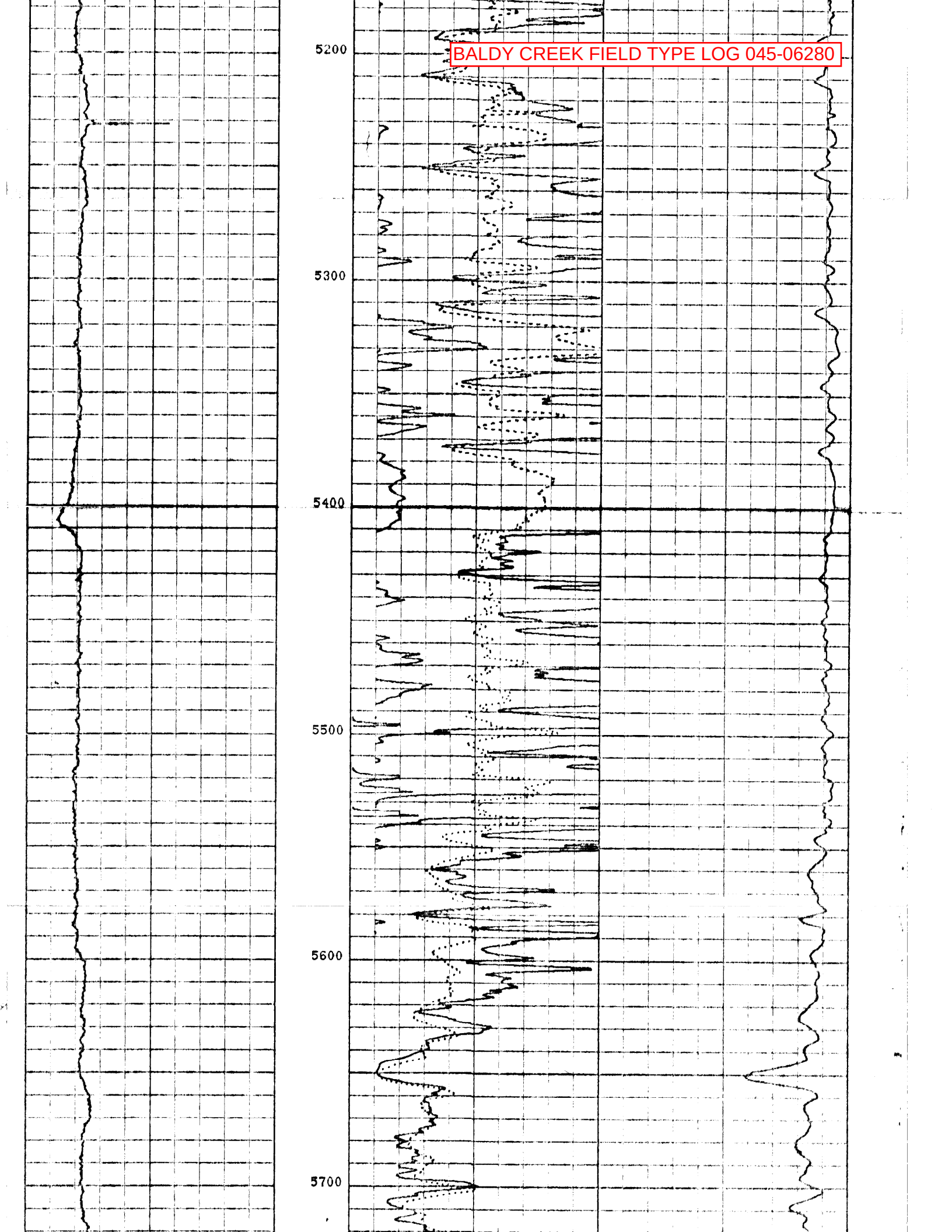

BALDY CREEK FIELD TYPE LOG 045-06280
2500
2600
2700
2800
2900
3000

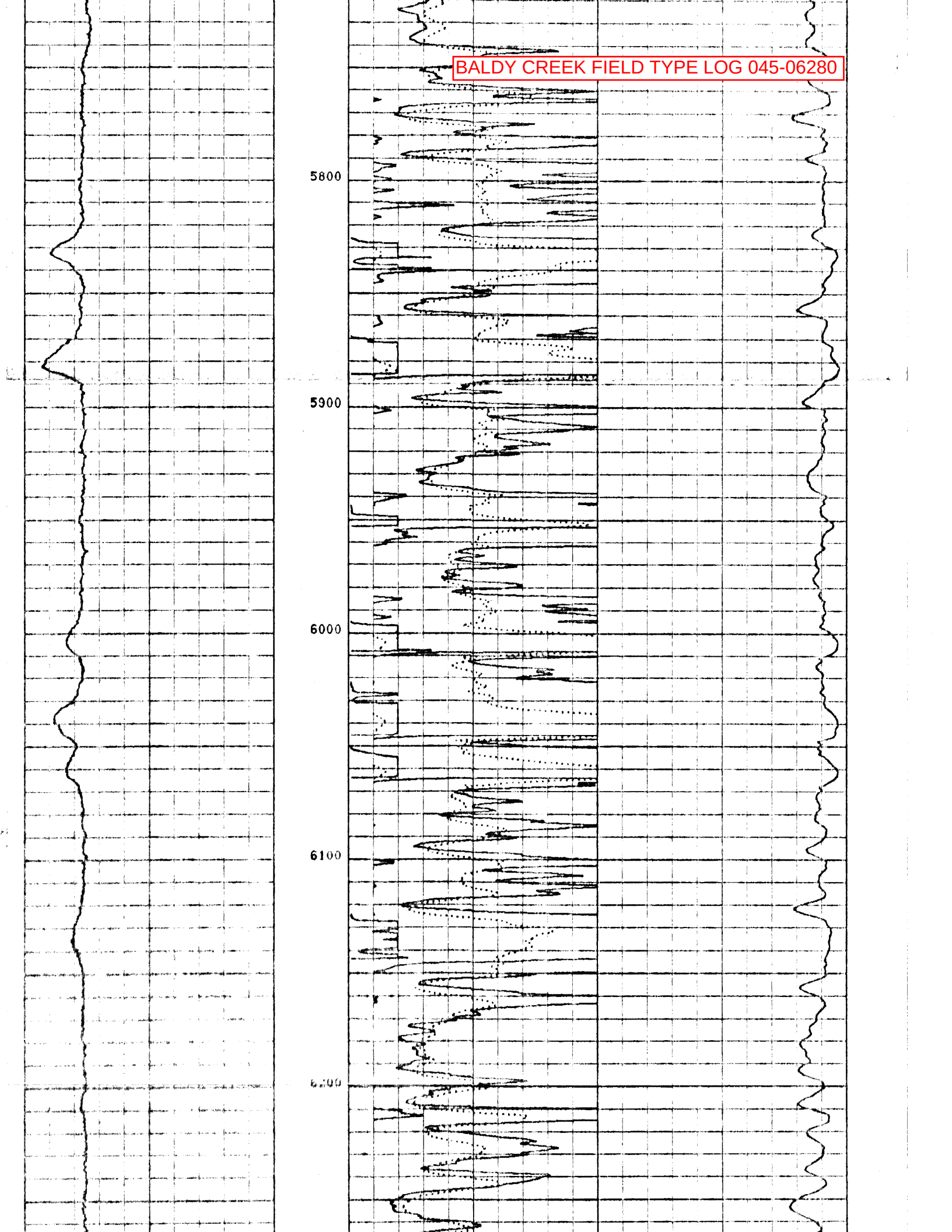

BALDY CREEK FIELD TYPE LOG 045-06280
3100
3200
3300
3400
3500

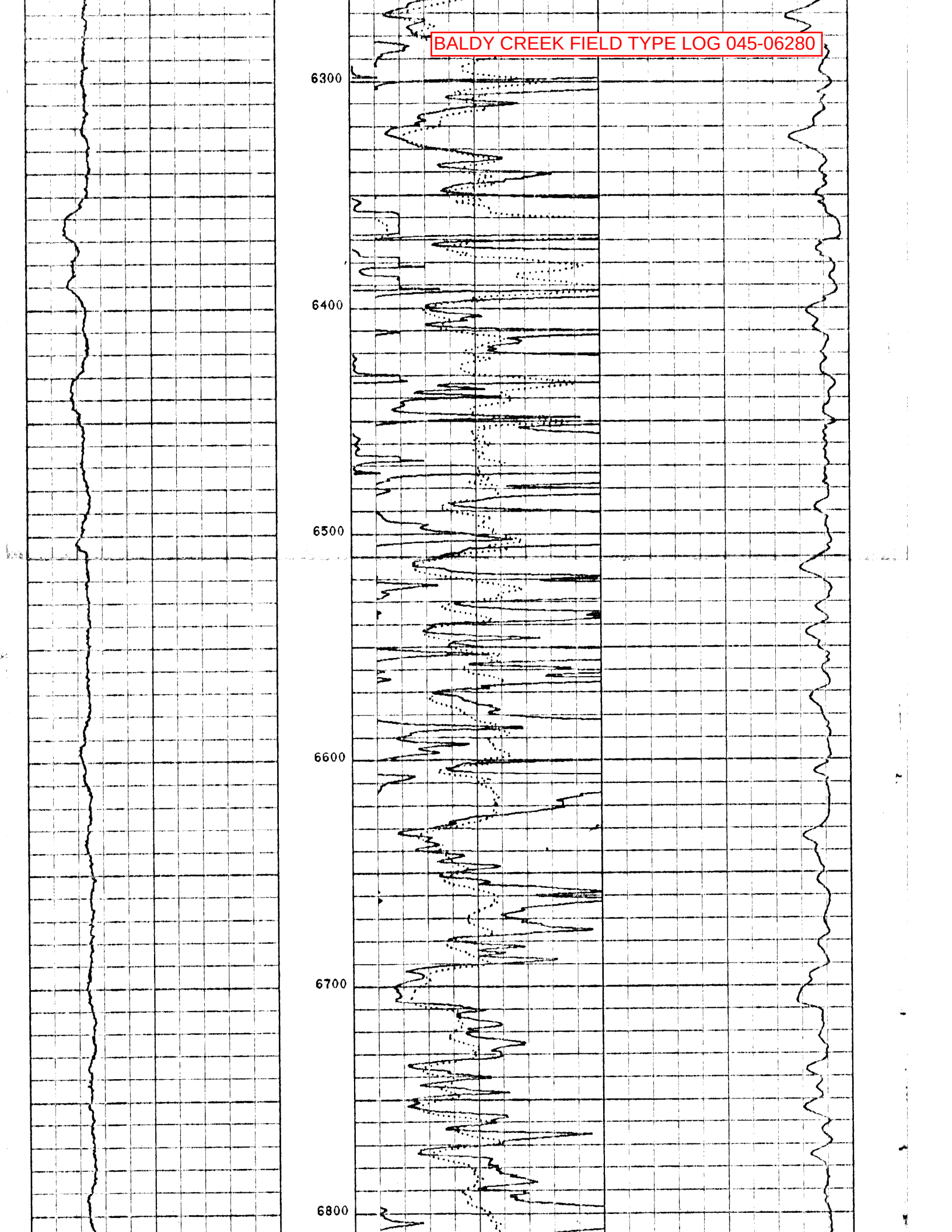

BALDY CREEK FIELD TYPE LOG 045-06280
3600
3700
3800
3900
4000
COGCC pick for Lower Wasatch top (cement required 500' above this point, effective 04-18-2016)

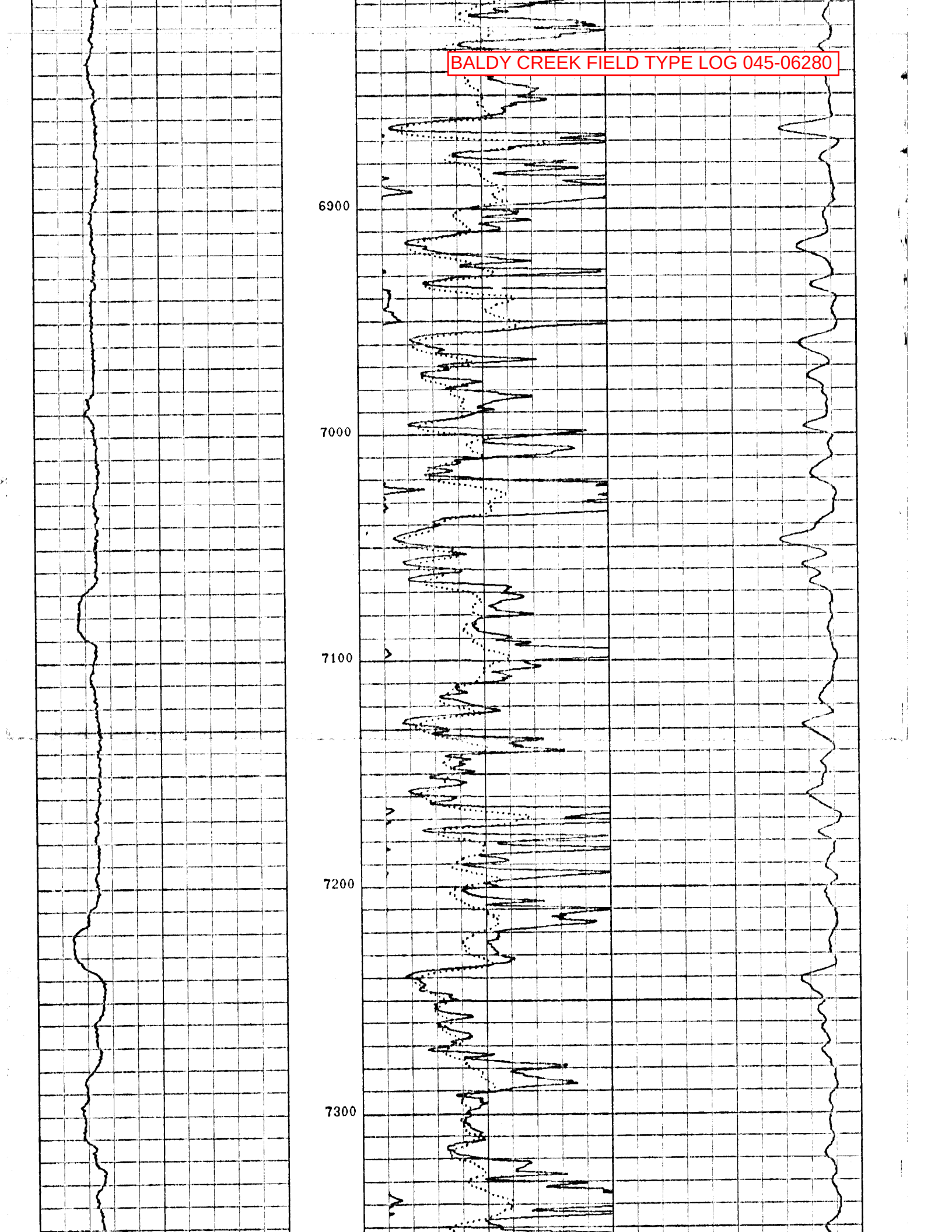

BALDY CREEK FIELD TYPE LOG 045-06280
4100
4200
4300
4400
4500
4600
COGCC pick for
Ohio Creek top
Operator pick
was 4,280'

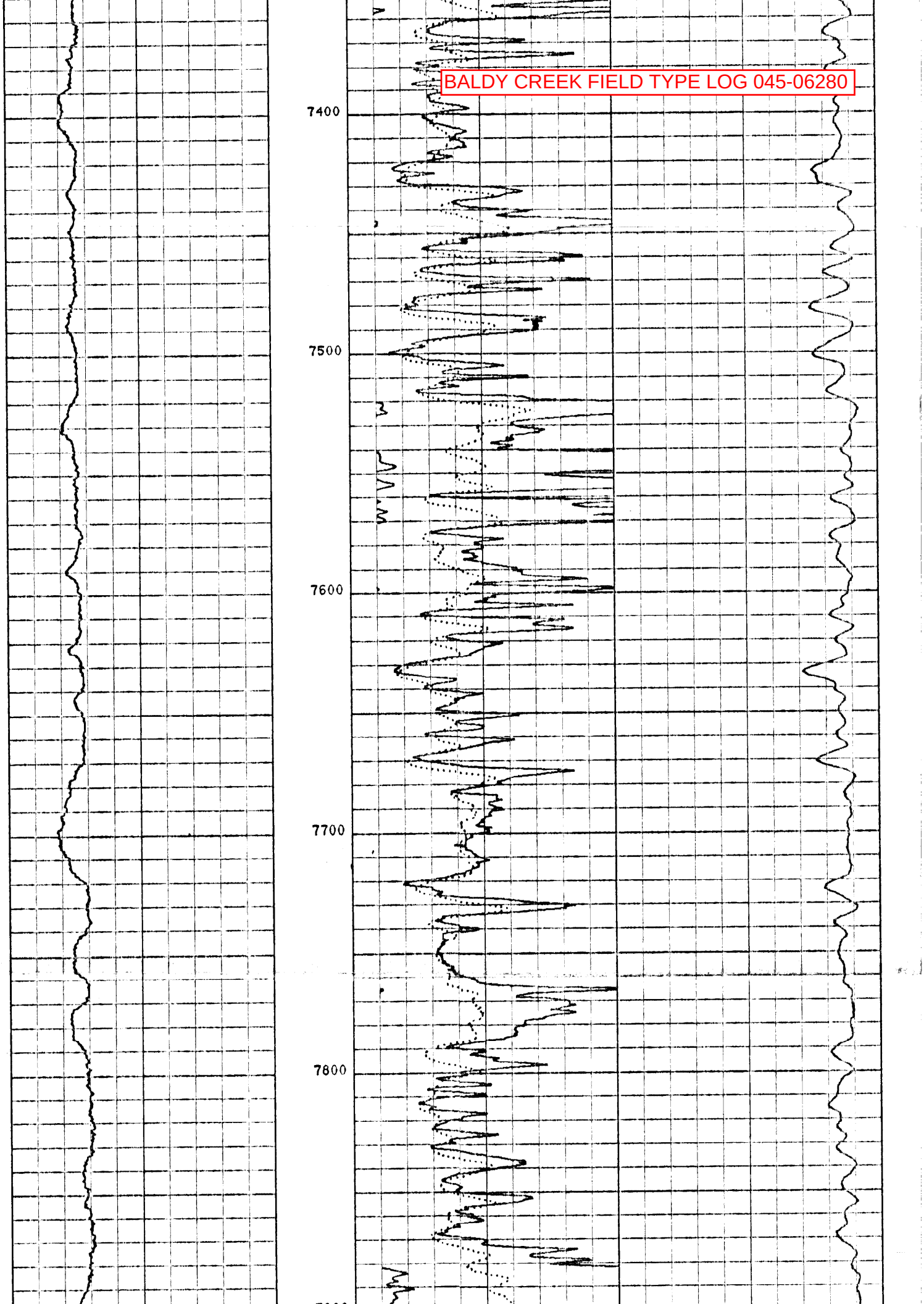

BALDY CREEK FIELD TYPE LOG 045-06280
4700
4800
4900
5000
5100
COGCC pick for
U. Mesaverde top
Operator pick was
4,603'

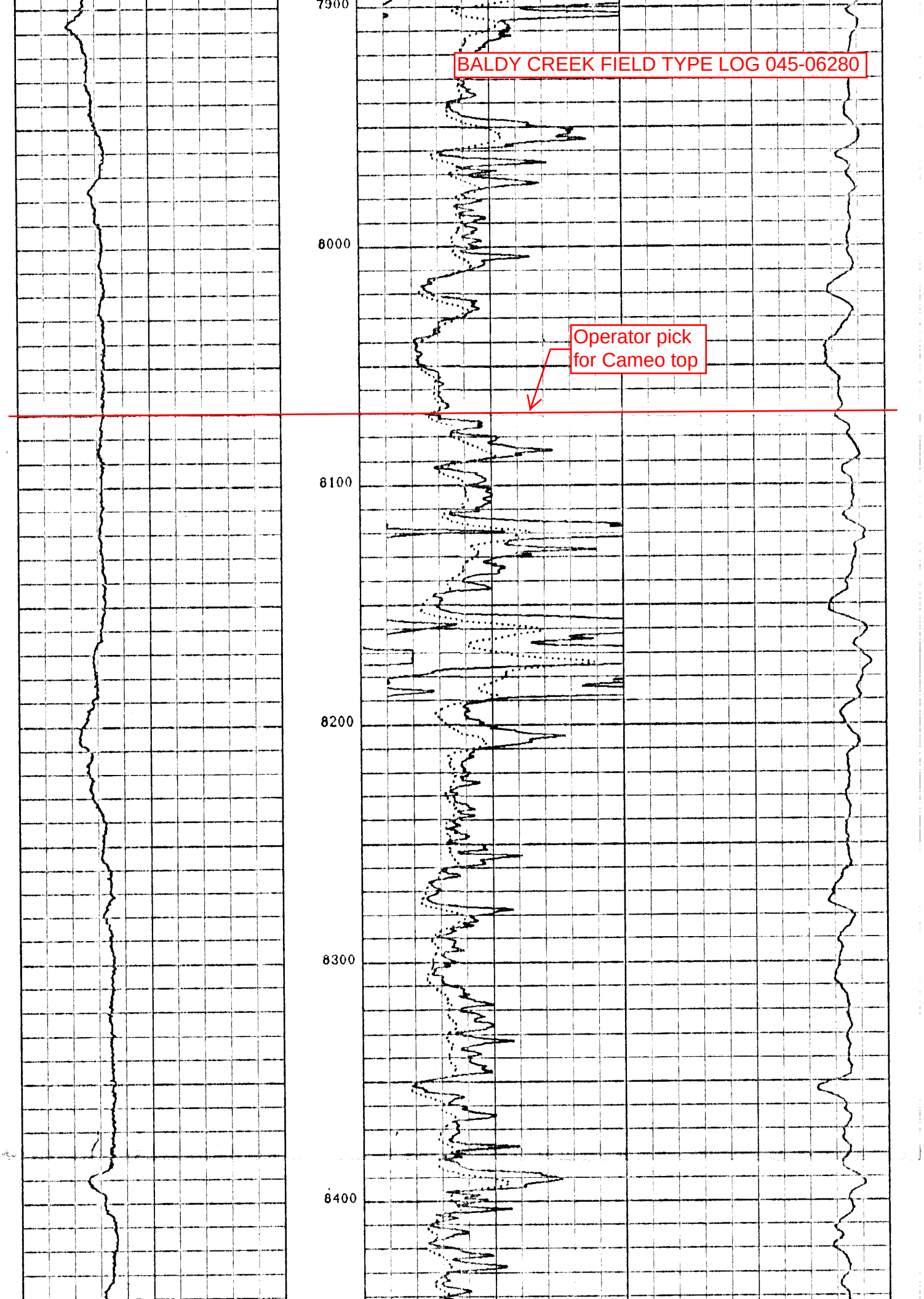

BALDY CREEK FIELD TYPE LOG 045-06280
5200
5300
5400
5500
5600
5700

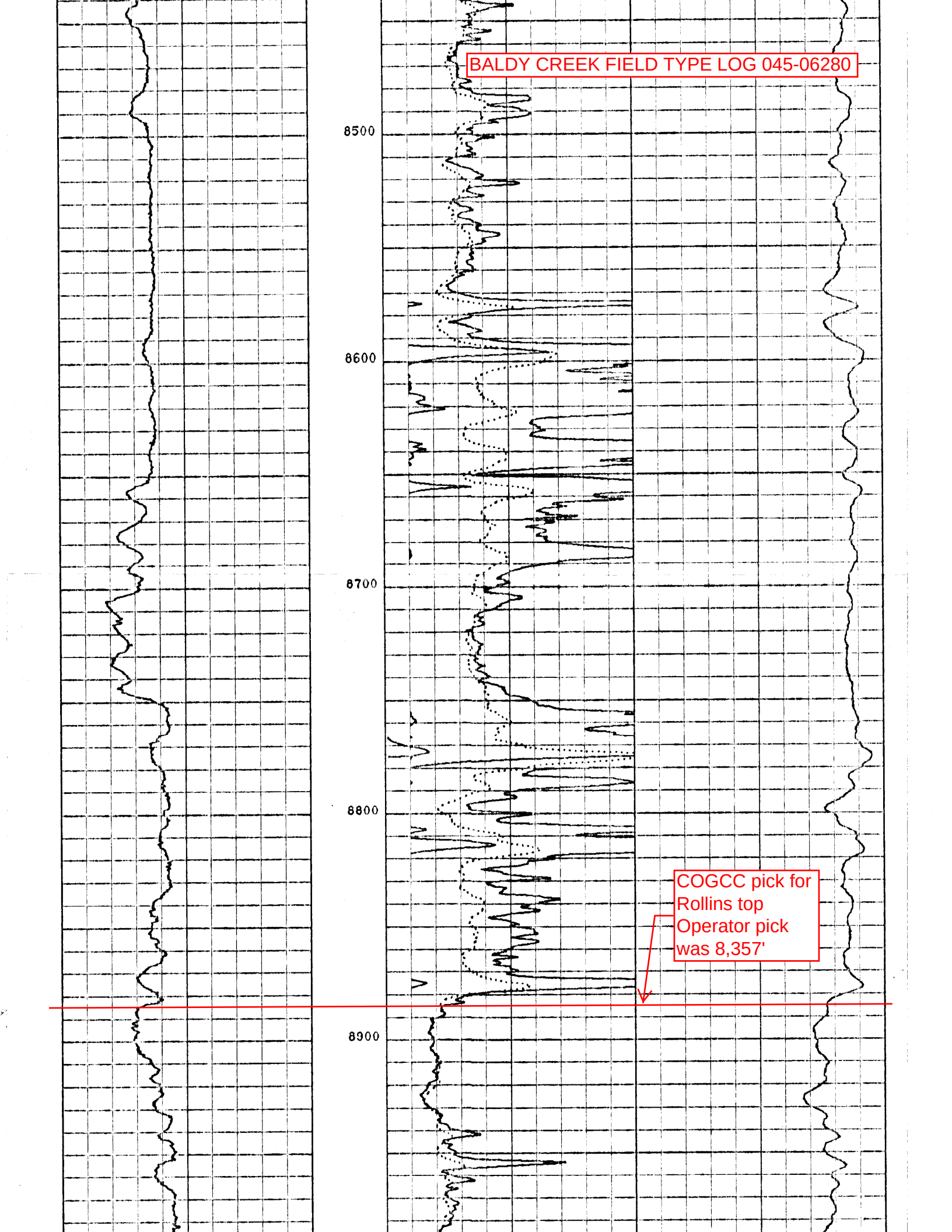

BALDY CREEK FIELD TYPE LOG 045-06280
5800
5900
6000
6100

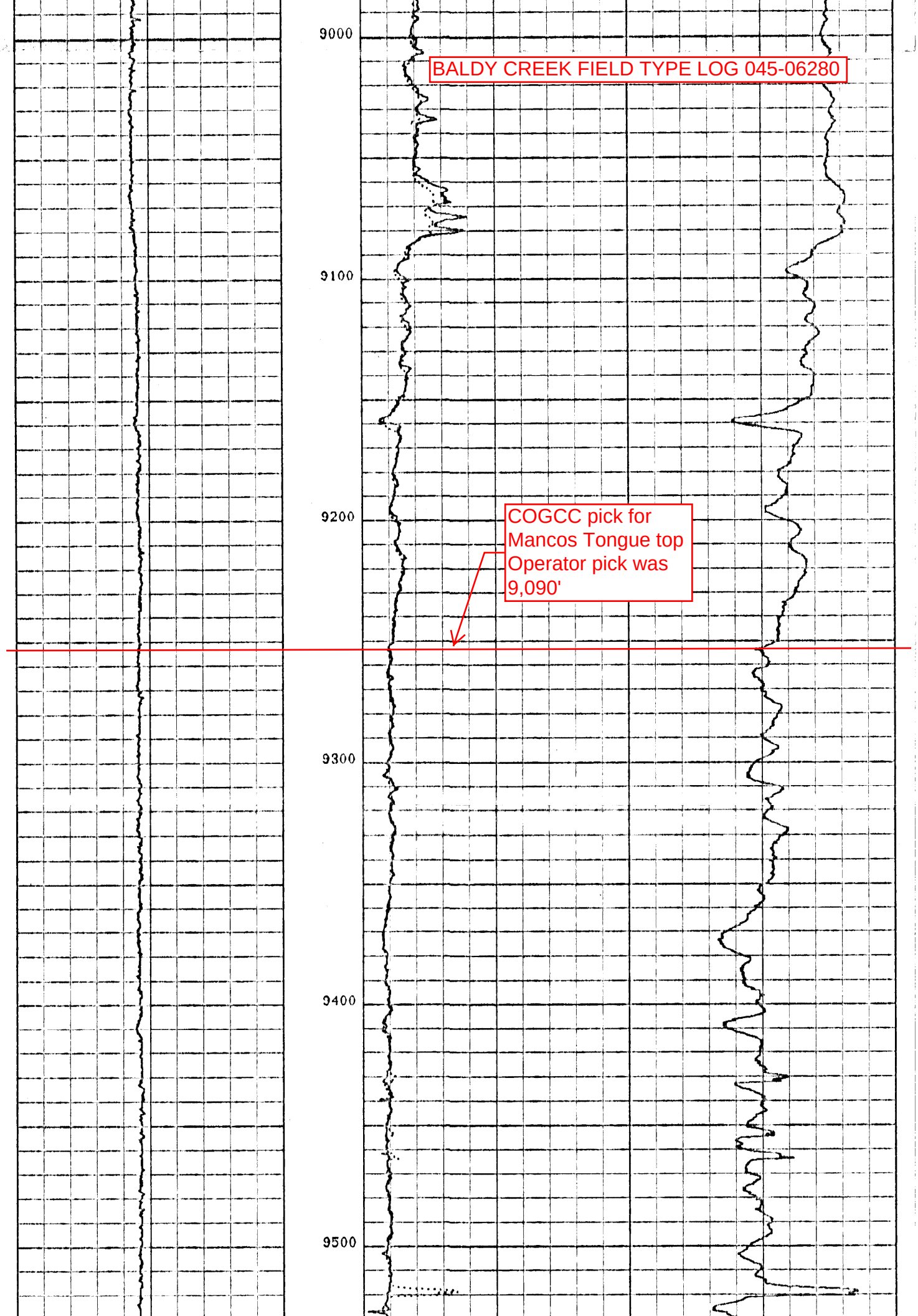

BALDY CREEK FIELD TYPE LOG 045-06280
6300
6400
6500
6600
6700
6800

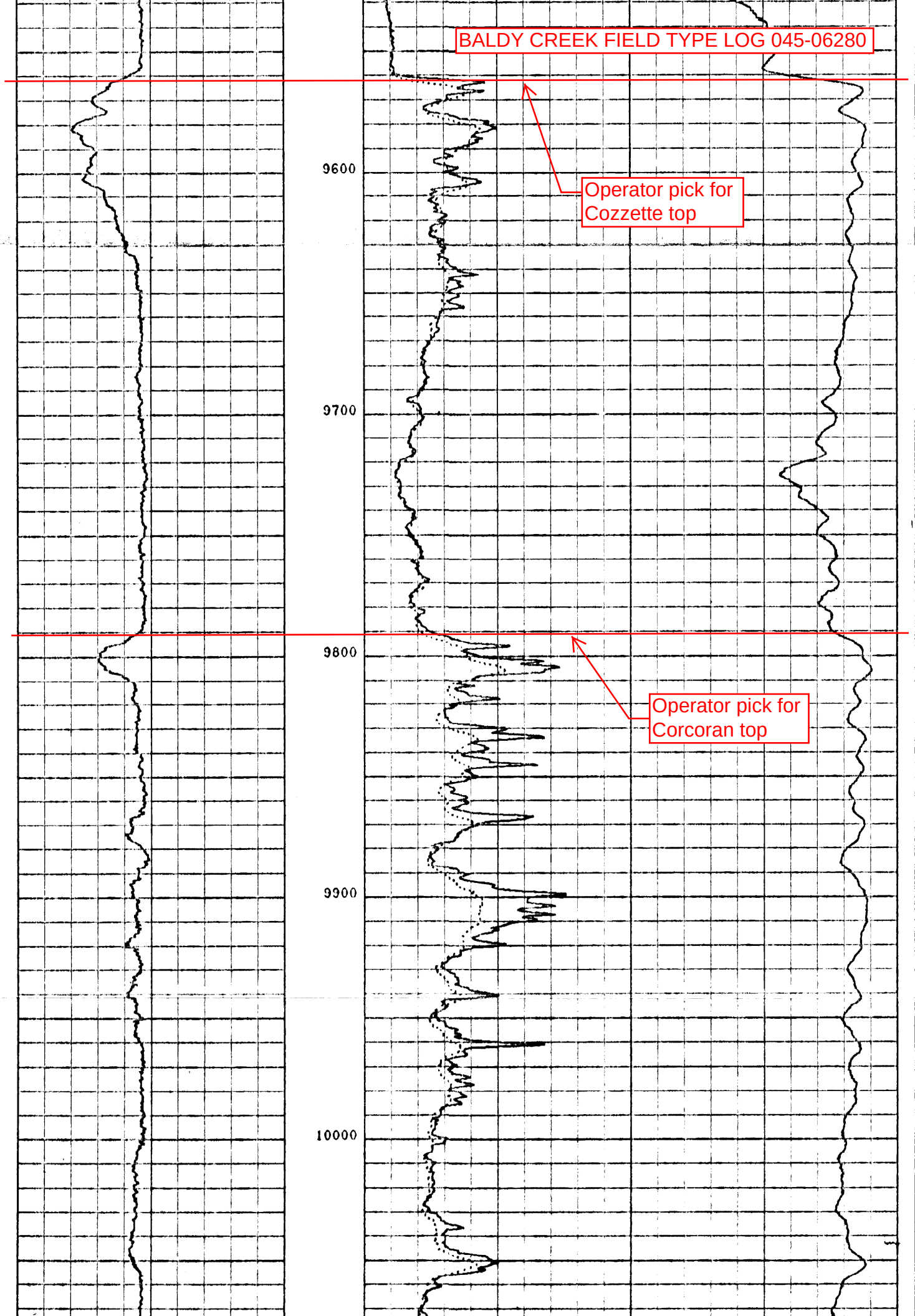

BALDY CREEK FIELD TYPE LOG 045-06280
6900
7000
7100
7200
7300

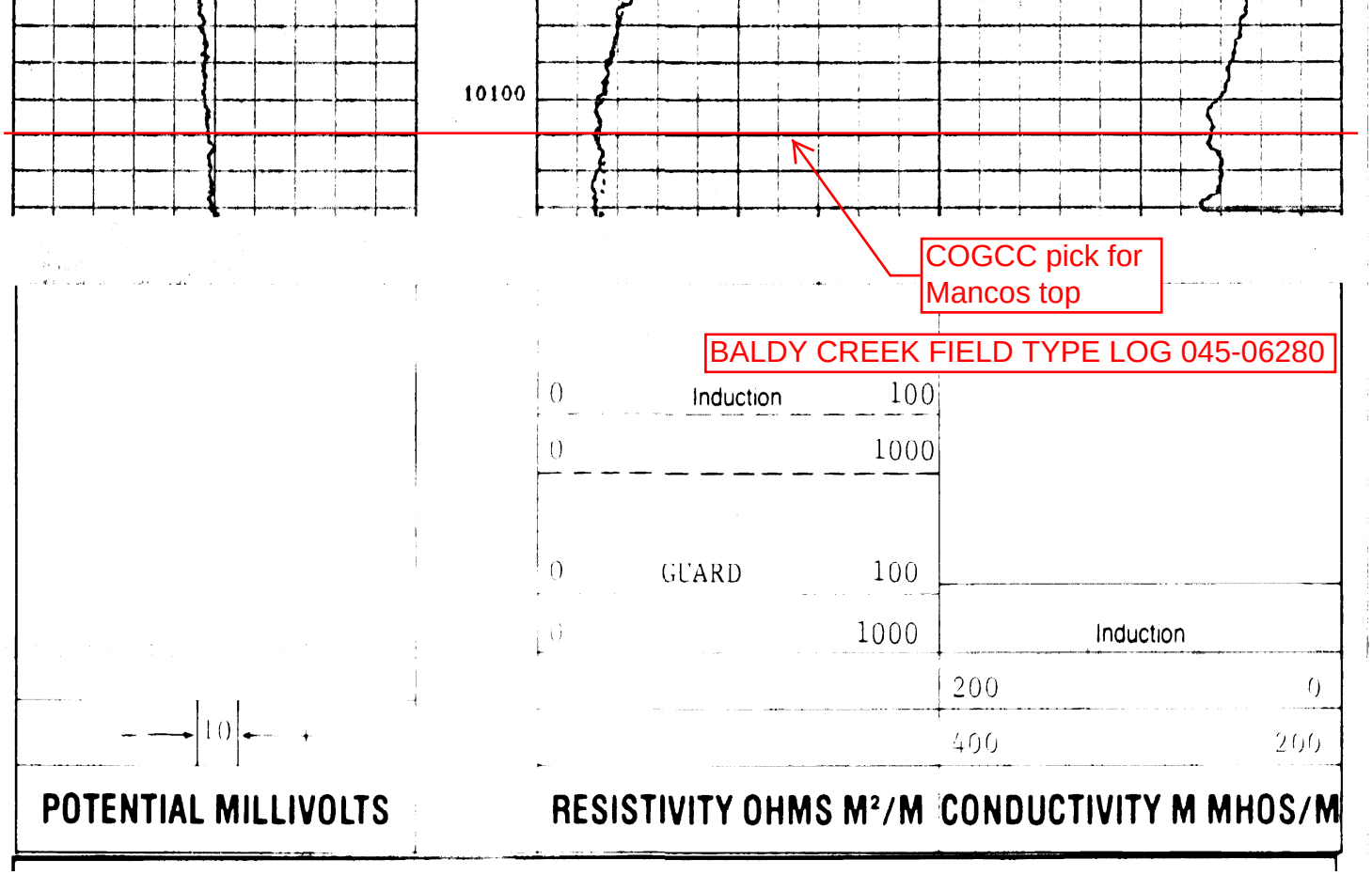

BALDY CREEK FIELD TYPE LOG 045-06280
7400
7500
7600
7700
7800


BALDY CREEK FIELD TYPE LOG 045-06280
Operator pick
for Cameo top
7900
8000
8100
8200
8300
8400


BALDY CREEK FIELD TYPE LOG 045-06280
8500
8600
8700
8800
8900
COGCC pick for
Rollins top
Operator pick
was 8,357'


9000
9100
9200
9300
9400
9500
BALDY CREEK FIELD TYPE LOG 045-06280
COGCC pick for Mancos Tongue top
Operator pick was 9,090'


BALDY CREEK FIELD TYPE LOG 045-06280
Operator pick for Cozzette top
Operator pick for Corcoran top
9600
9700
9800
9900
10000


10100
COGCC pick for Mancos top
BALDY CREEK FIELD TYPE LOG 045-06280
0
Induction
100
0
1000
0
GUARD
100
0
1000
Induction
200
0
400
200
10
POTENTIAL MILLIVOLTS
RESISTIVITY OHMS M²/M
CONDUCTIVITY M MHOS/M

COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056195

FIELD NAME	**BRUSH CREEK**
FIELD NUMBER	**7562**

LOCATION

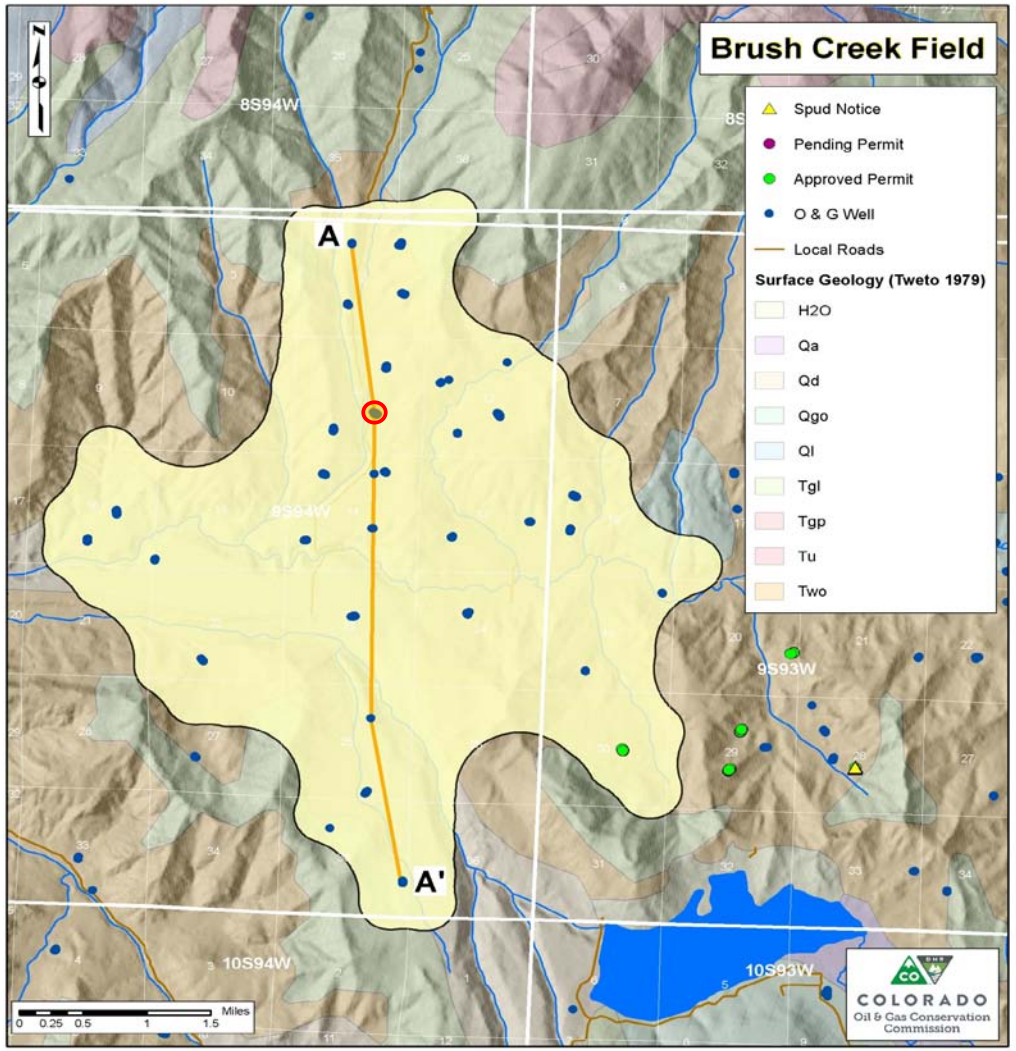
Basin	Piceance
Township(s)	9S
Range(s)	93W to 94W

SURFACE GEOLOGY

Surface Geology generally consists of Wasatch Formation, with a swath of glacial drift trending northwest to southeast in the southwestern portion of the field. Alluvium is present above the Wasatch Formation along the eastern fringe of the field and along creeks. The Green River Formation outcrops, overlying the Wasatch Formation, in the north-central and northwestern portions of the field. Glacial drift overlies the Wasatch Formation in the extreme northern and southern portions of the field.

GEOLOGIC STRUCTURE

None present within this field or nearby on COGCC's 250K GIS Geology layer.



Type Log Well

COGCC OIL AND GAS FIELD SCOUT CARD
BRUSH CREEK #7562

				A - North				A' - South
STRATIGRAPHY			**API Number =>**	**077-08911**	**077-08345**	**077-08573**	**077-08444**	**077-09139**
			Surface Elevation =>	**7,965**	**7,400**	**7,277**	**7,366**	**7,732**
All depths are measured depths			**Well Type =>**	**Directional**	**Vertical**	**Vertical**	**Vertical**	**Directional**
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water	0		0		
	Glacial Drift		Water				0	
	Green River		Water					0
	Wasatch	Upper	Shallow Water		0			
	Wasatch	G-Sand*	Possible Gas / UIC	2,810/2,958*	2,192/2,342*	2,058/2,213*	1,900/2,063*	2,256/2,404*
	Wasatch	Fort Union*	None	3,290*	2,680*	2,558*	2,410*	2,719*
	Wasatch	Middle	None					
	Wasatch	Lower*	Water	4,667*	4,090*	3,866*	3,657*	3,992*
Mesaverde	Williams Fork	Ohio Creek	Water / UIC	4,870*	4,243*	4,006*	3,820*	4,264*
Mesaverde	Williams Fork	U. Mesaverde	Water	5,245	4,550*	4,366*	4,116*	4,580*
Mesaverde	Williams Fork	Top of Gas	Gas					
Mesaverde	Williams Fork	Cameo	Gas	7,775	7,128	7,036	6,646	7,079
Mesaverde	Iles	Rollins	Gas	8,207	7,430*	7,272	7,060*	7,502*
Mesaverde	Iles	Cozzette	Gas	8,630	7,847*	7,689	7,520	
Mesaverde	Iles	Corcoran	Gas	8,816	8,046*	7,886	7,680	
	Mancos		Possible Gas		8,229*	8,071		
	Niobrara		Possible Gas		10,884**			
	Frontier		Possible Gas		11,884**			
	Dakota		Possible Gas		12,334/12,399**			
	Morrison		Possible Gas		12,626**			
	Entrada		Possible Gas		13,131			
	Chinle		None		13,300			
	Weber		Possible Gas		14,007			

Type Logs for 077-08345: COGCC Document Numbers 2056196 (shallow - surface to 8570' MD) and 2056197 (deep - 12670' to 14445' MD)

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; however, Wasatch G is completed in a shallow well in the adjacent Buzzard Creek Field to the north, 077-08637, NWNE 14-9S-93W; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

*** No log available to verify depth to top of Niobrara, Frontier, Dakota, or Morrison Formations in 077-08345; Dakota tops are for top of silt and top of sand; tops below Mancos are shown as reported by operator.*

WATER RESOURCE ISOLATION

Alluvium, glacial drift, the Green River Formation, and Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde. The deepest water well within the field is 360', likely screened in glacial drift or the underlying Wasatch Formation.

PRODUCING ZONE ISOLATION

Primary Objectives: Mesaverde Group (Williams Fork, Cameo, Rollins, Cozzette, and Corcoran)

Secondary Objectives: Wasatch G was produced in one shallow well (077-08697, plugged and abandoned in 2012); Mancos/Niobrara produced in one deep horizontal well (077-10163); Mancos completed in one deep directional well (077-10094); Frontier and Mowry are also potential objectives, cited in Commission Order Nos. 429-13 and 429-14.

COGCC OIL AND GAS FIELD SCOUT CARD
BRUSH CREEK #7562

UNDERGROUND INJECTION CONTROL

API Number	Well Name and Number	Type	Zone	Sample Top	Sample Bottom	TDS	Source
077-08815	McDaniel #11-16	Disposal	Williams Fork	4,984	5,055	29,920	SWAB - 10/20/2006
077-08969	Blackman #14-13	Source	Williams Fork - Corcoran	5,261	7,609	14,203	WH - 2/16/2007
077-09004	Blackman #15-9	Source	Williams Fork - Corcoran	5,498	7,866	20,575	WH - 2/13/2007
077-08970	Blackman #14-12	Source	Williams Fork - Corcoran	5,548	7,649	21,749	WH - 2/16/2007
077-08968	Blackman #14-14	Source	Williams Fork - Corcoran	5,648	7,703	21,311	WH - 2/13/2007
077-09095	Currier #26-15	Source	Williams Fork - Corcoran	5,667	7,703	12,486	WH - 2/13/2007
077-08696	Brush Creek Ranch #14-10	Source	Williams Fork - Iles	5,814	7,844	21,052	WH - 2/13/2007
077-10188	Jensen #17-13B	Source	Williams Fork	5,922	7,466	24,238	SEP - 6/18/2012
077-08907	McDaniel #14-1	Source	Williams Fork - Corcoran	5,924	7,986	17,338	WH - 2/13/2007
077-08972	Blackman #14-5	Source	Williams Fork - Corcoran	5,929	8,009	23,318	WH - 2/16/2007
077-09097	Currier #26-14	Source	Williams Fork	5,958	7,277	22,600	WH - 3/22/2007
077-08985	Blackman #23-4	Source	Williams Fork - Corcoran	5,974	7,947	19,771	WH - 2/13/2007
077-09035	Gipp #13-9	Source	Williams Fork	5,990	7,345	27,982	WH - 2/14/2007
077-09041	Gipp #13-15	Source	Williams Fork	6,015	7,732	17,767	WH - 3/11/2007
077-09008	Gunderson #13-14	Source	Williams Fork - Corcoran	6,023	8,125	24,315	WH - 2/13/2007
077-08971	Blackman #14-6	Source	Williams Fork - Corcoran	6,044	8,060	26,567	WH - 2/16/2007
077-08842	Brush Creek Ranch #14-11	Source	Williams Fork - Corcoran	6,050	8,130	18,976	WH - 2/13/2007
077-08986	Blackman #23-3	Source	Williams Fork - Corcoran	6,053	8,121	24,802	WH - 2/13/2007
077-09034	Gipp #13-8	Source	Williams Fork	6,071	7,426	17,938	WH - 2/14/2007
077-08957	McDaniel #11-15	Source	Williams Fork - Corcoran	6,074	8,182	41,097	WH - 3/22/2007
077-09036	Gipp #13-16	Source	Williams Fork - Corcoran	6,118	8,225	33,978	WH - 3/11/2007
077-09005	Blackman #15-8	Source	Williams Fork - Corcoran	6,164	8,221	18,676	WH - 2/16/2007
077-08841	Brush Creek Ranch #14-16	Source	Williams Fork	6,175	7,160	25,443	WH - 3/23/2007
077-08905	McDaniel #13-4	Source	Williams Fork	6,217	7,603	25,927	WH - 2/13/2007
077-08883	McDaniel #14-7	Source	Williams Fork - Corcoran	6,314	8,155	27,782	WH - 2/13/2007
077-08815	McDaniel #11-16	Source	Williams Fork - Iles	6,498	8,375	22,340	WH - 3/8/2005
077-08938	McDaniel #2-1	Source	Williams Fork - Corcoran	6,586	8,891	41,718	WH - 8/10/2006
077-09061	Gunderson #13-3	Source	Williams Fork - Corcoran	6,598	8,648	25,342	WH - 2/13/2007
077-08818	McDaniel #11-8	Source	Williams Fork - Iles	6,629[1]	8,430	21,979	WH - 3/8/2005
077-08860	Brush Creek Ranch #14-15	Source	Williams Fork - Iles	6,639	8,022	16,027	WH - 3/23/2007
077-08839	Gunderson Federal #12-7	Source	Williams Fork - Corcoran	6,703	8,785	74,557	WH - 2/13/2007
077-08906	McDaniel #2-9	Source	Williams Fork - Corcoran	6,729	8,830	24,800	WH - 3/22/2007
077-09082	Gunderson Federal #13-2	Source	Williams Fork - Corcoran	6,849	8,885	42,305	WH - 2/13/2007
077-08903	McDaniel #2-16	Source	Williams Fork - Corcoran	6,914	8,969	32,800	WH - 3/20/2007
077-08910	McDaniel #2-4	Source	Williams Fork - Corcoran	7,089	9,087	27,465	WH - 8/10/2006
077-08902	McDaniel #2-15	Source	Williams Fork - Corcoran	7,192	9,004	34,809	WH - 8/10/2006
077-08837	McElwain #12-12	Source	Cameo - Rollins	7,943[2]	8,649	23,433	WH - 3/2/2005

Aquifer Exemption: McDaniel #11-16 (Williams Fork) NWSE/4 Section 11, T9S, R94W (The injection formation TDS concentration was 29,920 mg/l; while an aquifer exemption was noticed and approved, it was not required by Rule 324B because of the high formation TDS [above 10,000 mg/l]).

"Source" wells are sorted in order from shallowest to deepest "Sample Top" depth below the "Disposal" well.

(1) Sample collected from the Williams Fork - Iles completion with a top perforation of 6629' prior to completing additional, shallower perforations in the Williams Fork Formation.

(2) Sample collected from the Cameo - Rollins completion with a top perforation of 7,943' prior to completing additional, shallower perforations in the Williams Fork Formation.

COGCC OIL AND GAS FIELD SCOUT CARD
BRUSH CREEK #7562

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

429-1 (5/20/1985)	Mesaverde (including Cozzette and Corcoran): established 160-acre drilling and spacing units, 600' from quarter-section boundaries.
Various (2005-06)	Mesaverde: allowed three additional wells per 160-acre unit (40-acre well density)
Various (2006-09)	Mesaverde (Williams Fork and Iles): allowed 10-acre well density in certain parts of the field, 100' / 200' from 160-acre units. Allowed wells to be drilled vertically or directionally from common pads, with one pad per quarter-quarter section.
429-13 (2/22/2011)	Mesaverde Group and Deeper Formations: established an approximate 885.16-acre drilling and spacing unit for vertical and directional wells targeting the Mesaverde Group (Williams Fork and Iles) and Deeper formations (Mancos, Niobrara, Frontier, and Mowry), 200' from unit boundaries and one pad per quarter-quarter.
429-14 (1/23/2012)	Mesaverde Group and Deeper Formations: established one 160-acre drilling and spacing unit with 10-acre well density for vertical and directional wells targeting the Mesaverde Group and Deeper formation objectives (Mancos, Niobrara, Frontier, and Mowry), 600' from unit line, 100' well-to-well spacing and one pad per quarter-quarter.

HISTORIC WELL CONSTRUCTION

Other than four older wells with surface casing set from 369' to 536', surface casing setting depths generally range from 1,000' to 2,000'. Production casing generally terminates in the Iles or underlying Mancos formations. Production casing cement may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 5% TVD required for well control in Mesa County (10% TVD recommended) and to cover water resources in the upper interval of the Wasatch Formation. Recommend setting depth of 1,000' or greater, based on limited available log data for surface to 1,000' and past practices in the field. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. New Standards require cementing intermediate (if used) or production casing at least 200' above Lower Wasatch sands, as shown on the annotated type log for this field. Cement coverage (stage cement or increased primary cement for intermediate [if used] or production casing) is also required across the Wasatch G within one mile of productive Wasatch G wells.

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug across Ohio Creek and across Lower Wasatch (squeeze to 200' above Lower Wasatch if no annular cement coverage); Wasatch G plug if productive within one mile; stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000-foot intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug. Larger surface casing shoe plugs should be considered for wells with less than 1,000' of surface casing.

NOTES

The eastern portion of this field in R93W is located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.

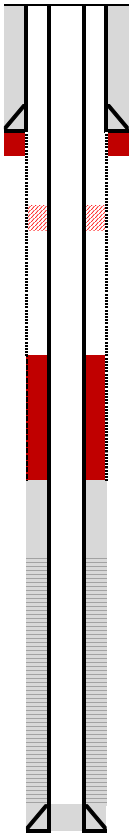
ISOLATION REQUIREMENTS FOR TYPICAL WELLS

Date 04/18/2016 **COGCC Document No.** 2056198

FIELD NAME **BRUSH CREEK**
FIELD NUMBER **7562**

LOCATION
Basin Piceance
Township(s) 9S
Range(s) 93W to 94W

Depth	Formation/Member
0	Alluvium/ Glacial Drift/ Green River/ U. Wasatch
1,000	
2,000	Wasatch G
3,000	
4,000	L. Wasatch Ohio Creek U. Mesaverde
5,000	
	Top of Gas
6,000	
7,000	Cameo Rollins Cozzette Corcoran
8,000	



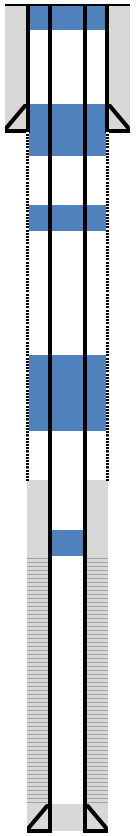
Casing and Cement Coverage

New Surface Casing Standard
Minimum 5% TVD (10% recommended) or cover all apparent water resources in the U. Wasatch, whichever is more stringent. Recommend 1,000 ft or greater based on potential water resources apparent on induction logs

New Cement Standard
Cement must provide coverage across Ohio Creek and 200 ft above L. Wasatch, in addition to productive interval coverage. Add Wasatch G coverage (stage cement, as shown here or increase primary coverage) within one mile of productive Wasatch G wells.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of U. Mesaverde, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	Alluvium/ Glacial Drift/ Green River/ U. Wasatch
1,000	
2,000	Wasatch G
3,000	
4,000	L. Wasatch Ohio Creek U. Mesaverde
5,000	
	Top of Gas
6,000	
7,000	Cameo Rollins Cozzette Corcoran
8,000	



Plug Placement

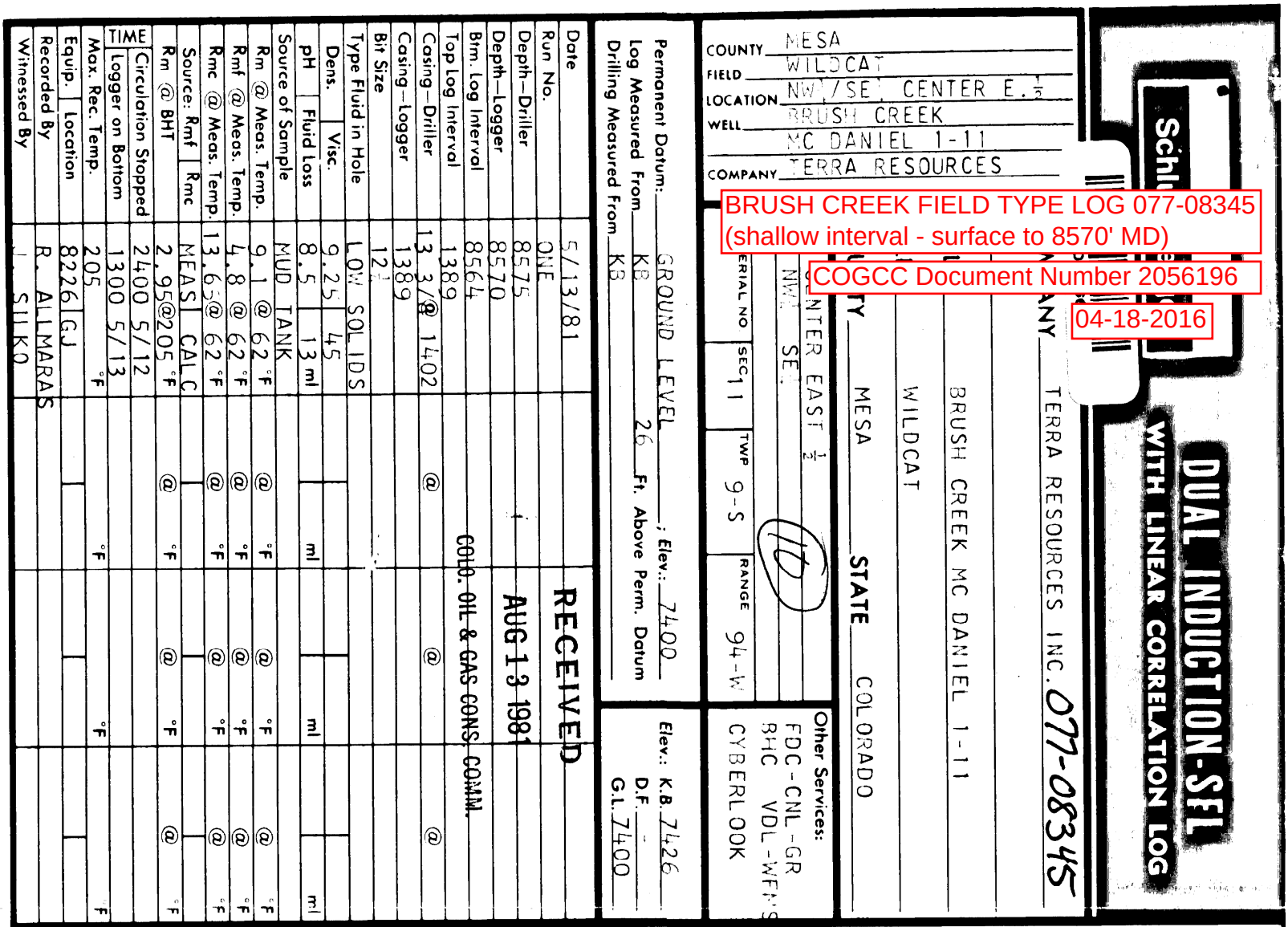
Surface plug

Surface casing shoe plug
Set deeper shoe plug if casing depth < 1,000 ft

Wasatch G plug if productive within one mile
Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 ft)

Squeeze plug across Ohio Creek and across L. Wasatch (top of plug 200 ft above L. Wasatch)

Plug in casing above Mesaverde Group Completions



FOLD HERE

The well name, location and borehole reference data were furnished by the customer.

Run No.	ONE			
Service Order No.	204000			
Fluid Level	FULL			
Salinity ppm. cl	400			
Speed F.P.M.	60			

EQUIPMENT DATA

Panel No.	IEM	BC 529			
Cart No.	DIC	DA 521			
Sonde No.	DIS	EC 529			
Mem. Panel No.		CSU			
G.R. Panel No.	NLM	BC 1115			
G.R. Cart No.	SGC	JC 2291			
Tape Recorder - (TTR)		-			
Depth Encoder - (DRE)		-			
Pressure Wheel - (CPW)		-			
Type Centralizers		RUBBER FIN			
Stand Off - Inches		1.5			

CALIBRATION DATA

SBR	2			
Sonde Error - ILM	8.2			
Sonde Error - ILD	5.71			
G.R. BKG. - CPS.	34.31			
G.R. Source - CPS.	199.2			
S.E. Set In Hole - Depth	-			
S.E. Corr. - Hole Size	-			

LOGGING DATA

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

REMARKS

LOGGING DATA					
SBR	2				
S.E. Log - ILM	8.2				
S.E. Log - ILD	5.71				
G.R. Scale per 100 Div.	200				
G.R. - T.C.	AUTO				
G.R. Sens.	165				

BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

PARAMETERS

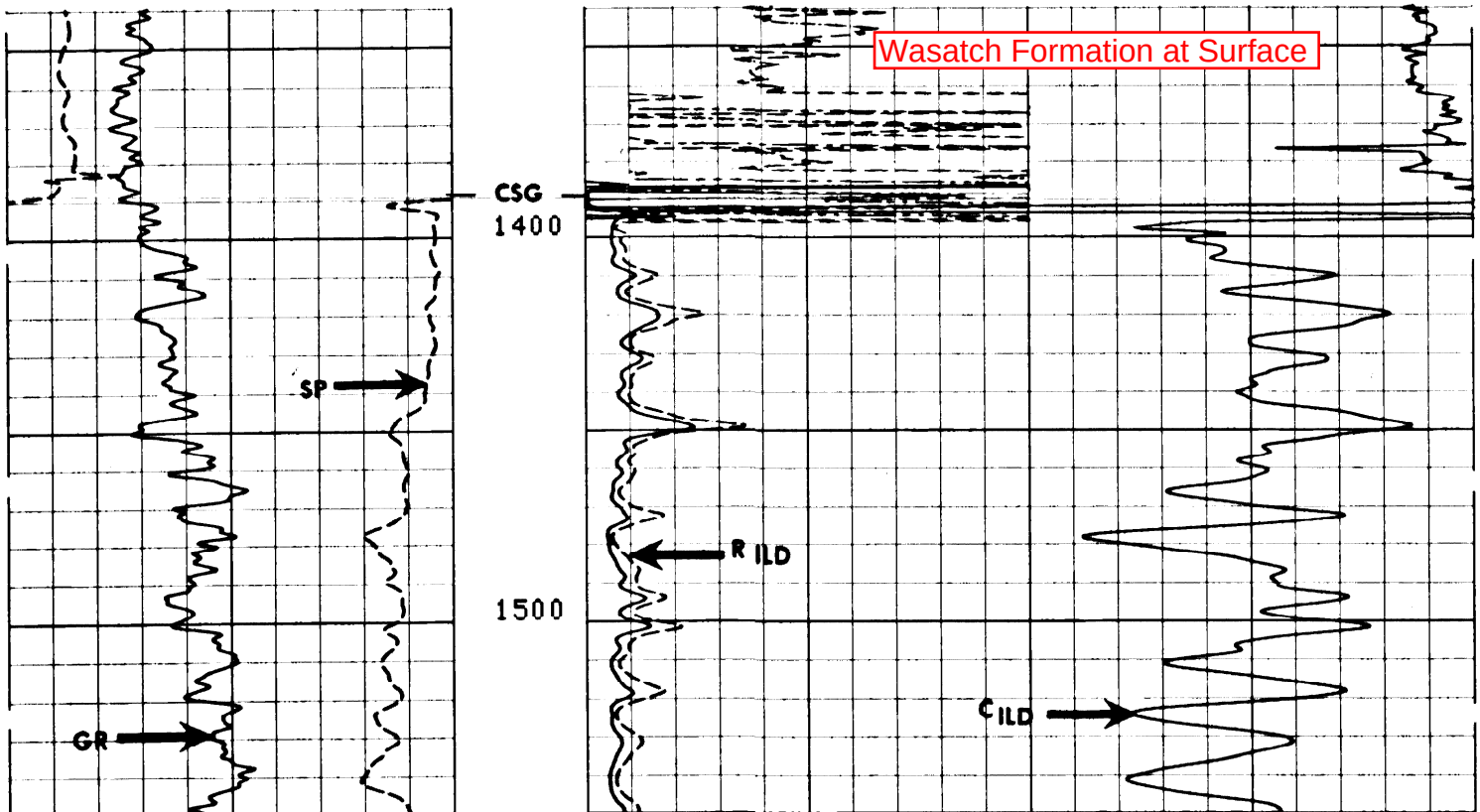
NAME	UNIT	VALUE	NAME	UNIT	VALUE	NAME	UNIT	VALUE
DTM	US/F	51.30	CDTS		100.0	BS	INCH	12.25
SBR	OHMM	2.000	DSEC	MM/M	5.71	DTF	US/F	189.0
FPHI		PHIX	MSEC	MM/M	8.20			
DD		0.0	BHS		OPEN			

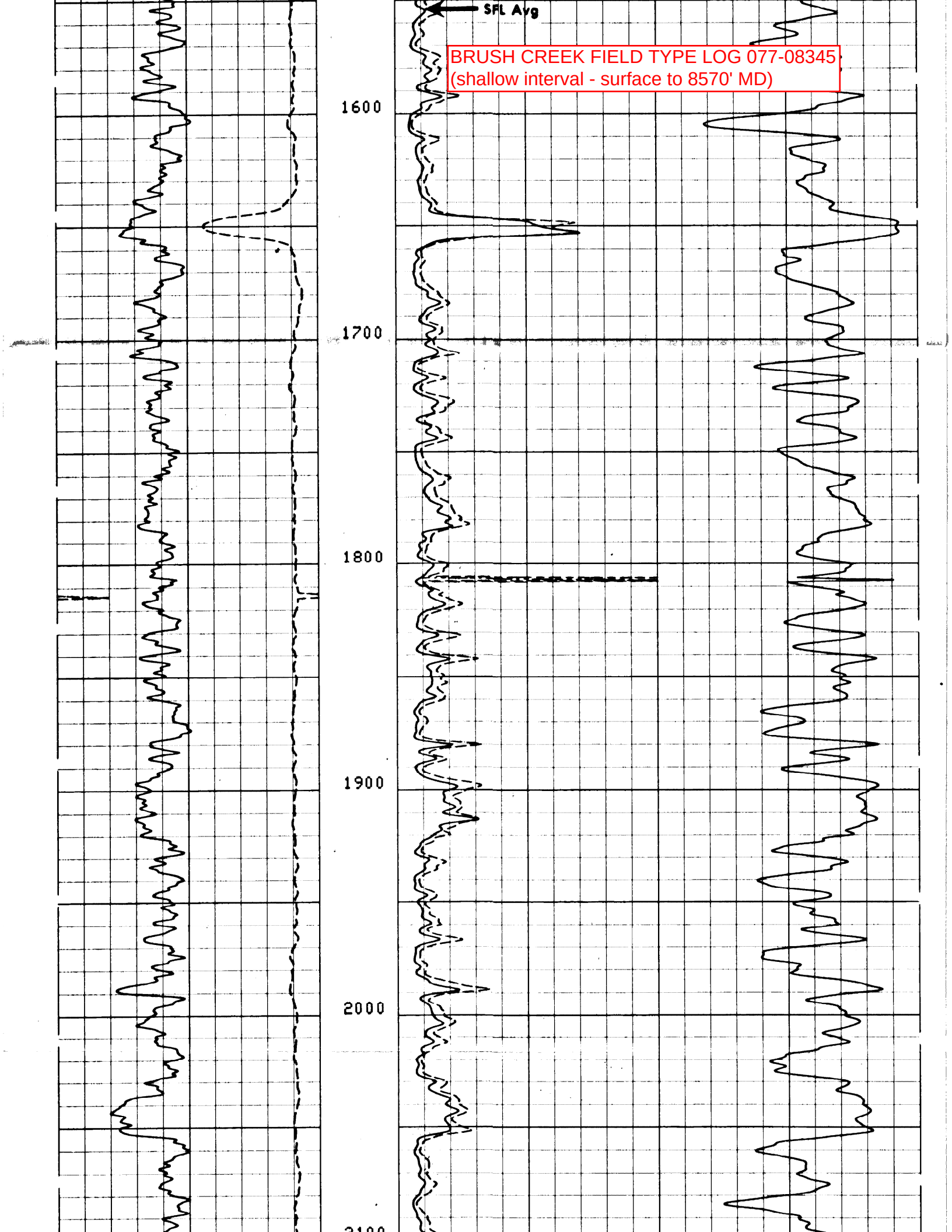
GR (GAPI)		ILD (OHMM)	
200.0	400.0	0.0	100.0
GR (GAPI)		SFLA(OHMM)	
0.0	200.0	0.0	100.0
SP (MV)		CILD(MM/M)	
-150.0	0.0	400.0	0.0

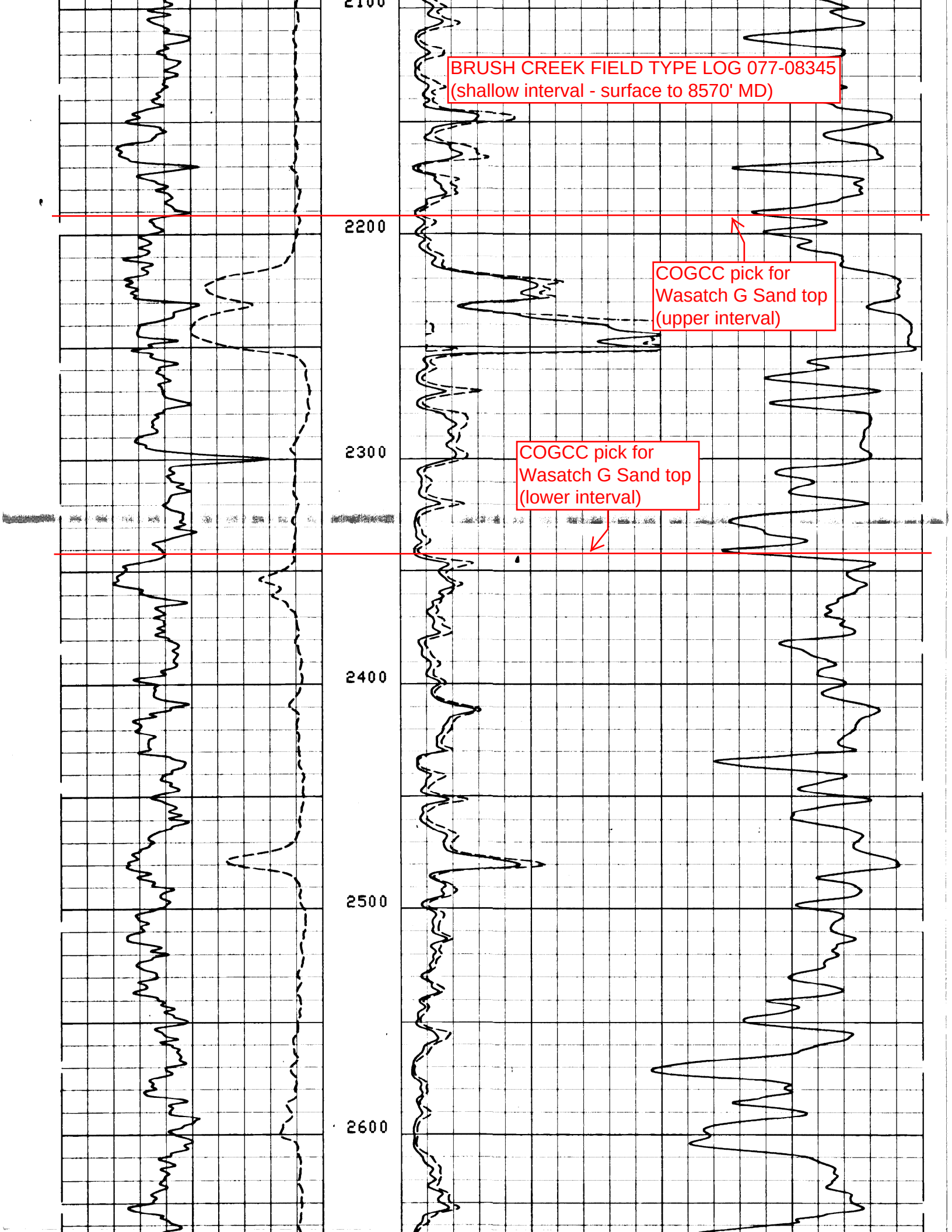
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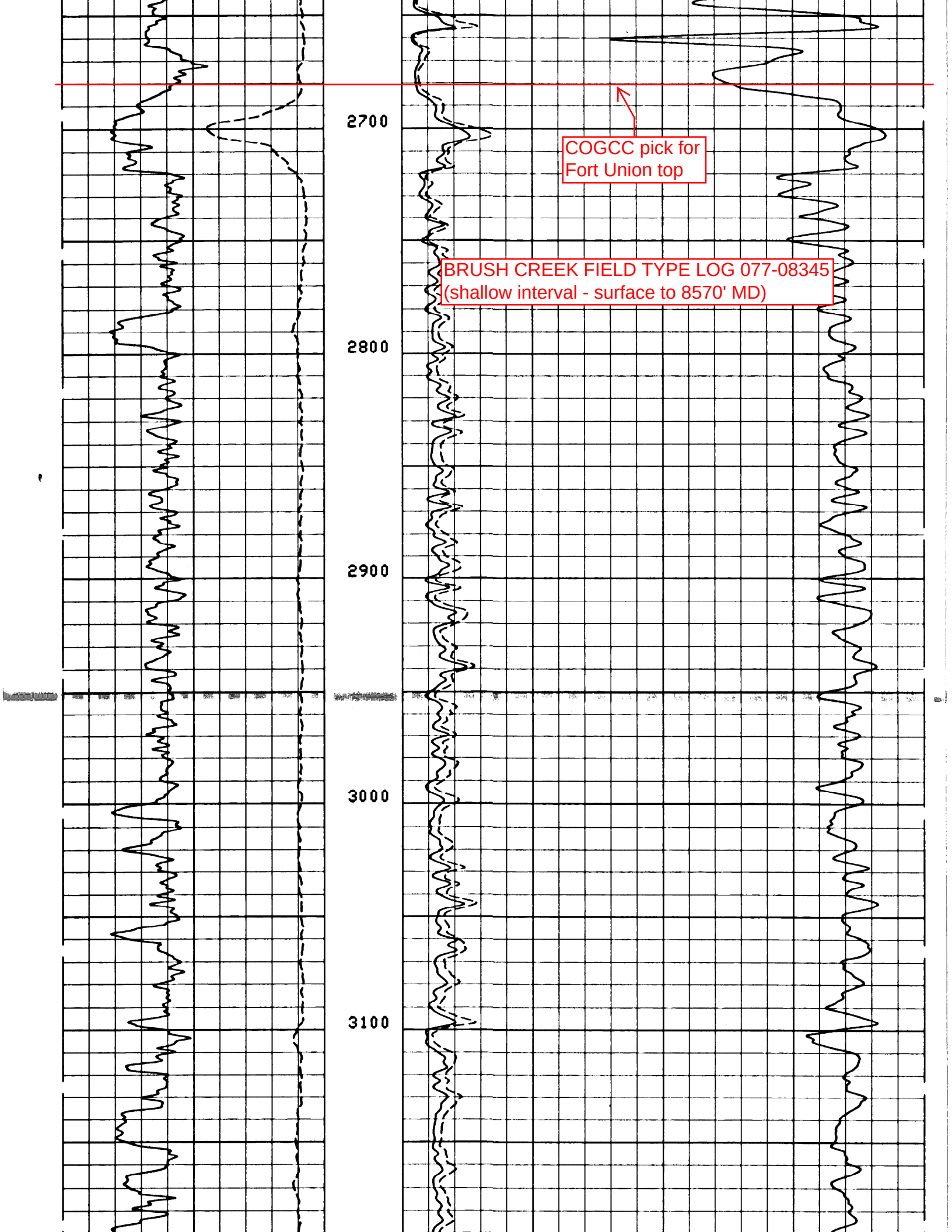
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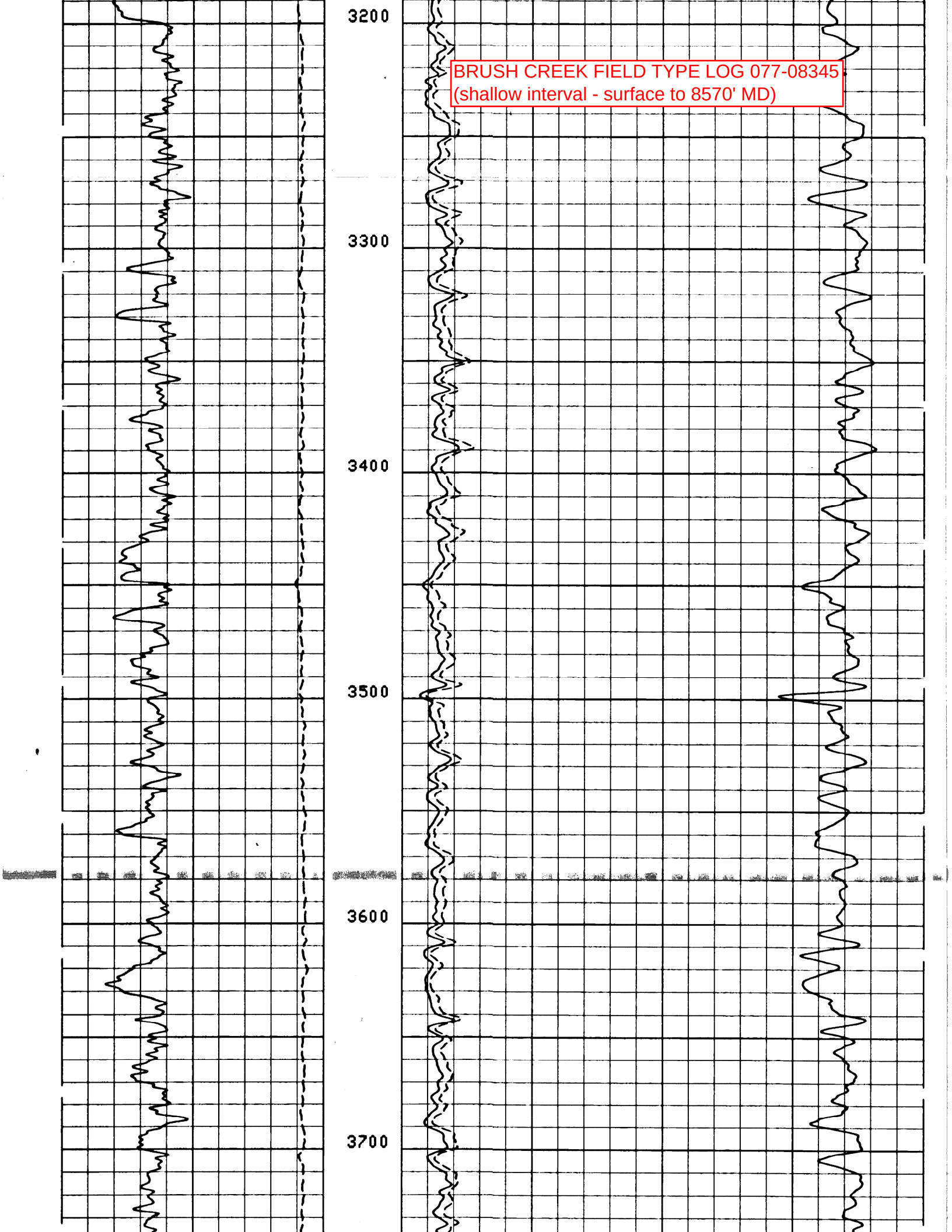
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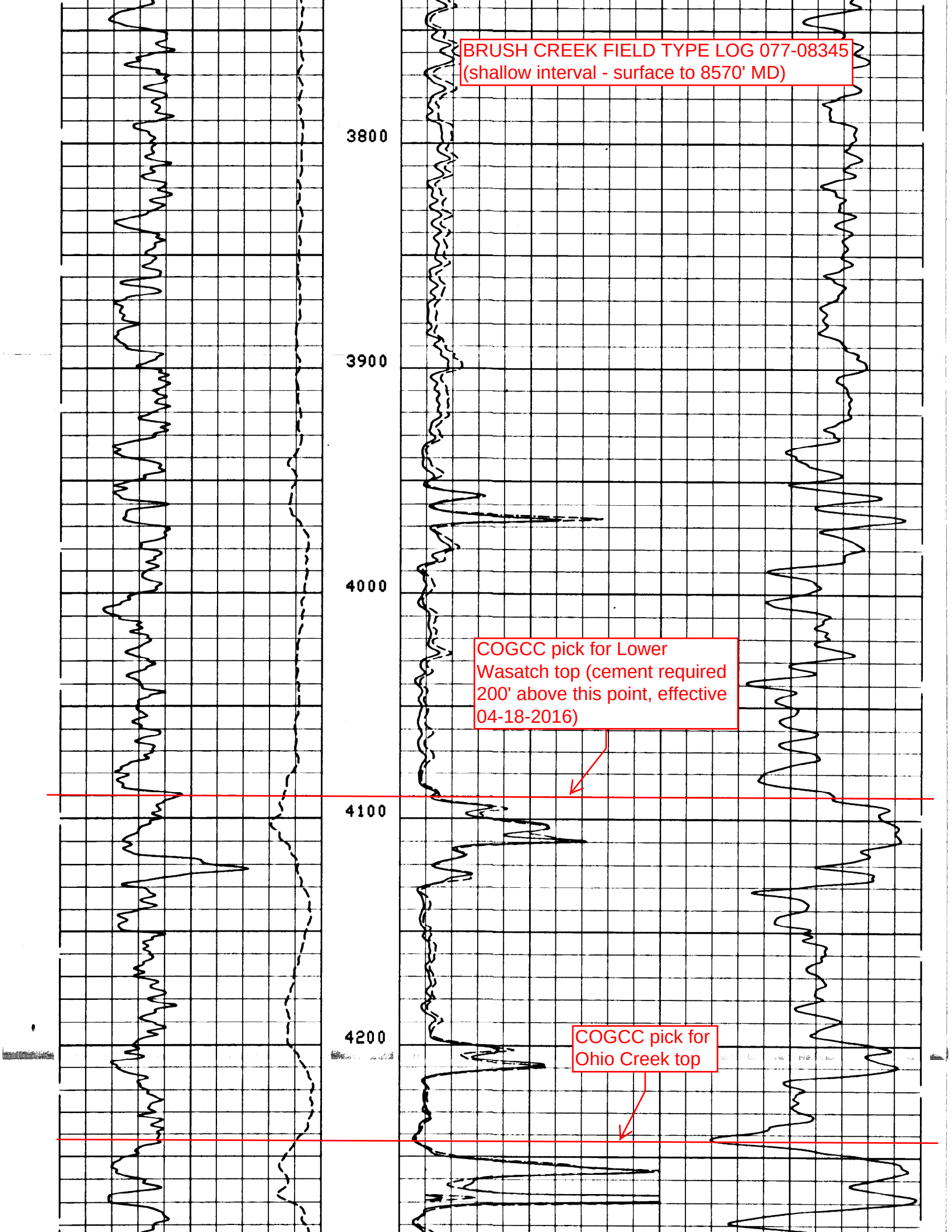


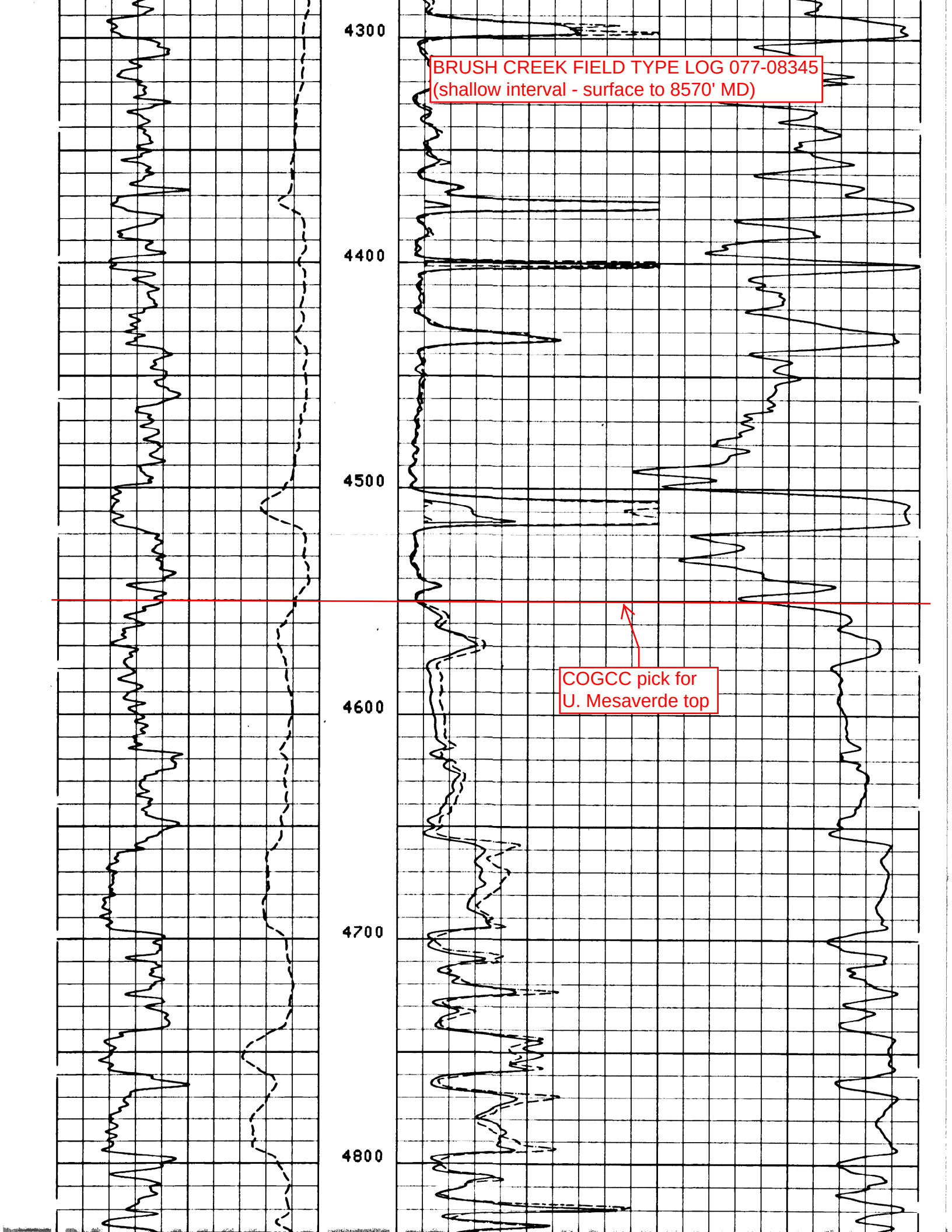

SFL Avg
BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
1600
1700
1800
1900
2000

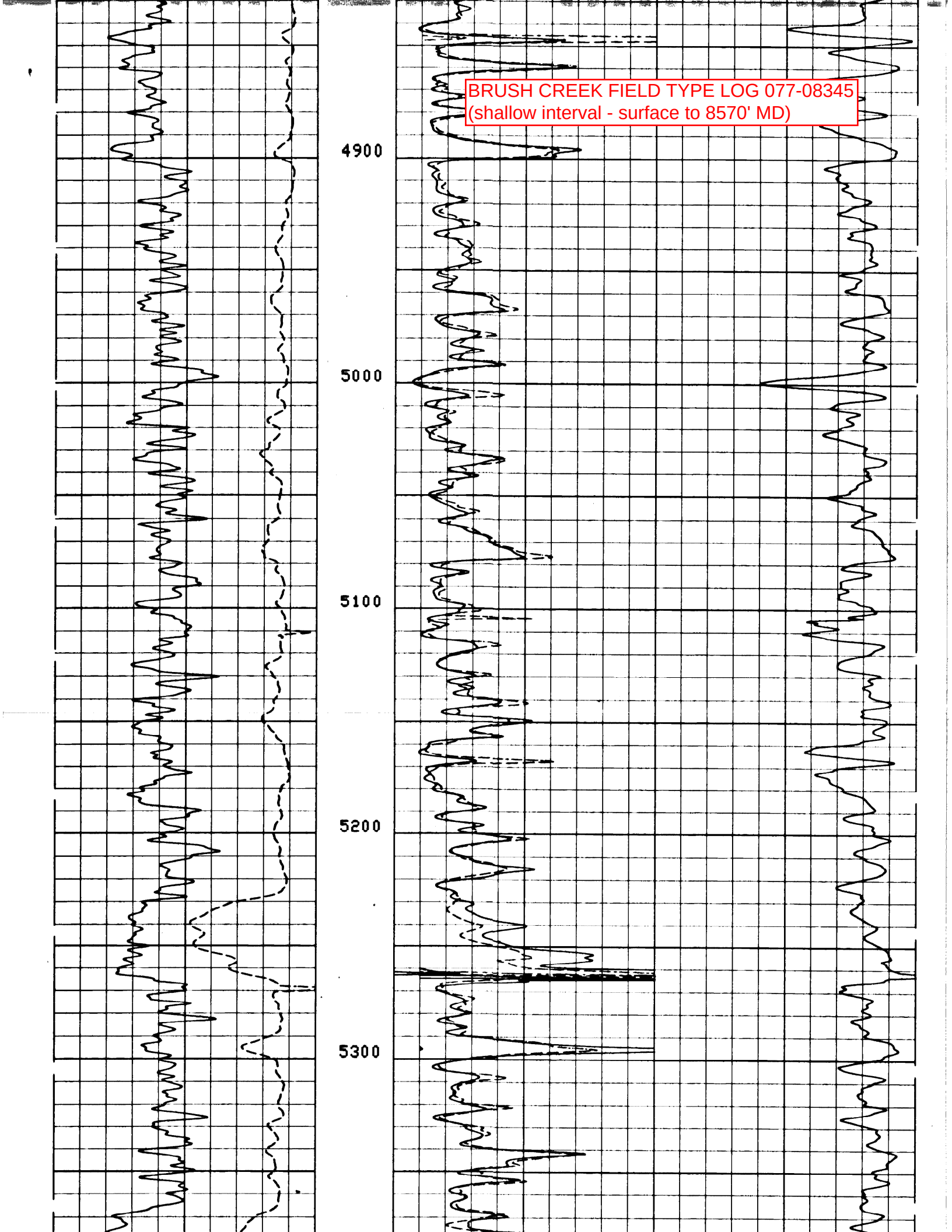

BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
COGCC pick for
Wasatch G Sand top
(upper interval)
COGCC pick for
Wasatch G Sand top
(lower interval)
2100
2200
2300
2400
2500
2600

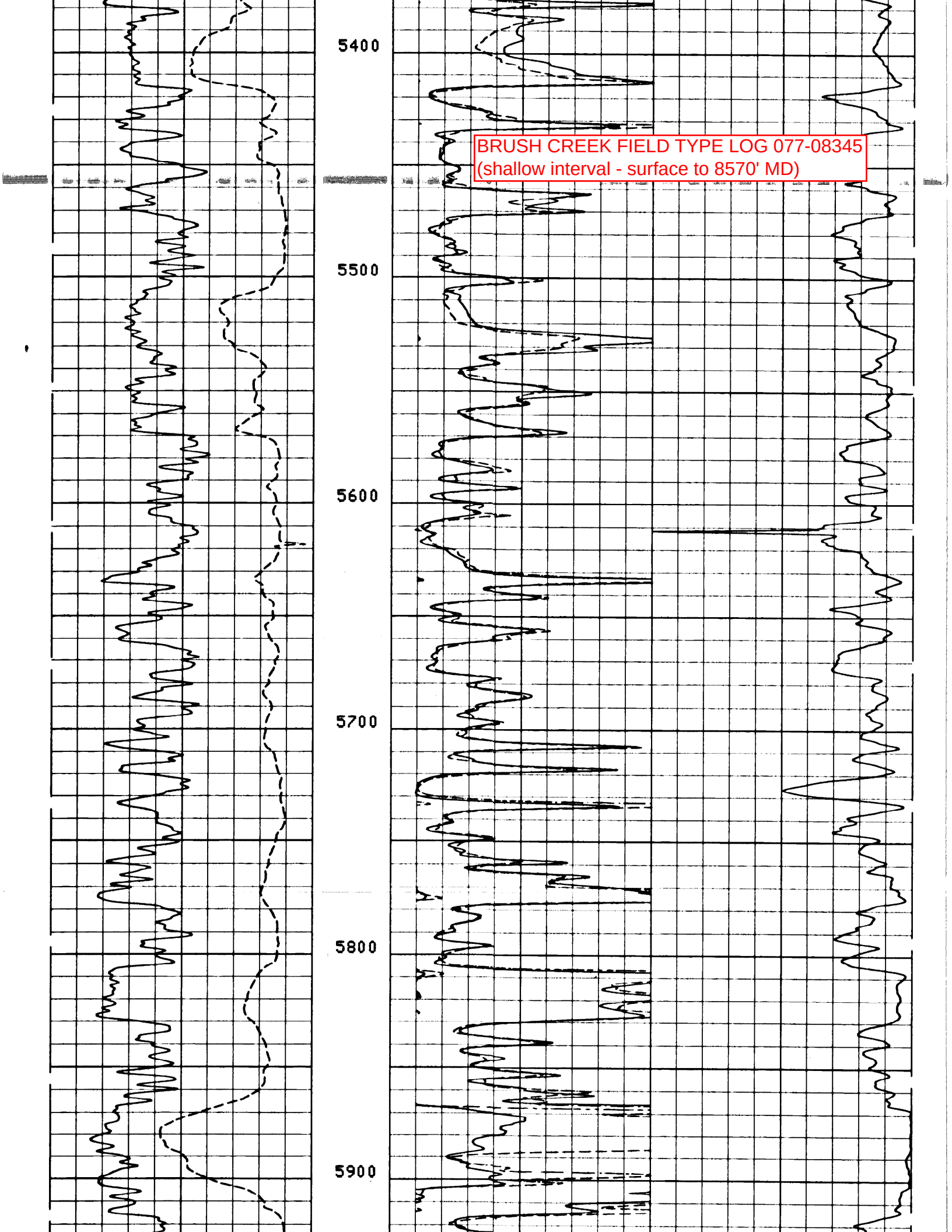

2700
2800
2900
3000
3100
COGCC pick for
Fort Union top
BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)

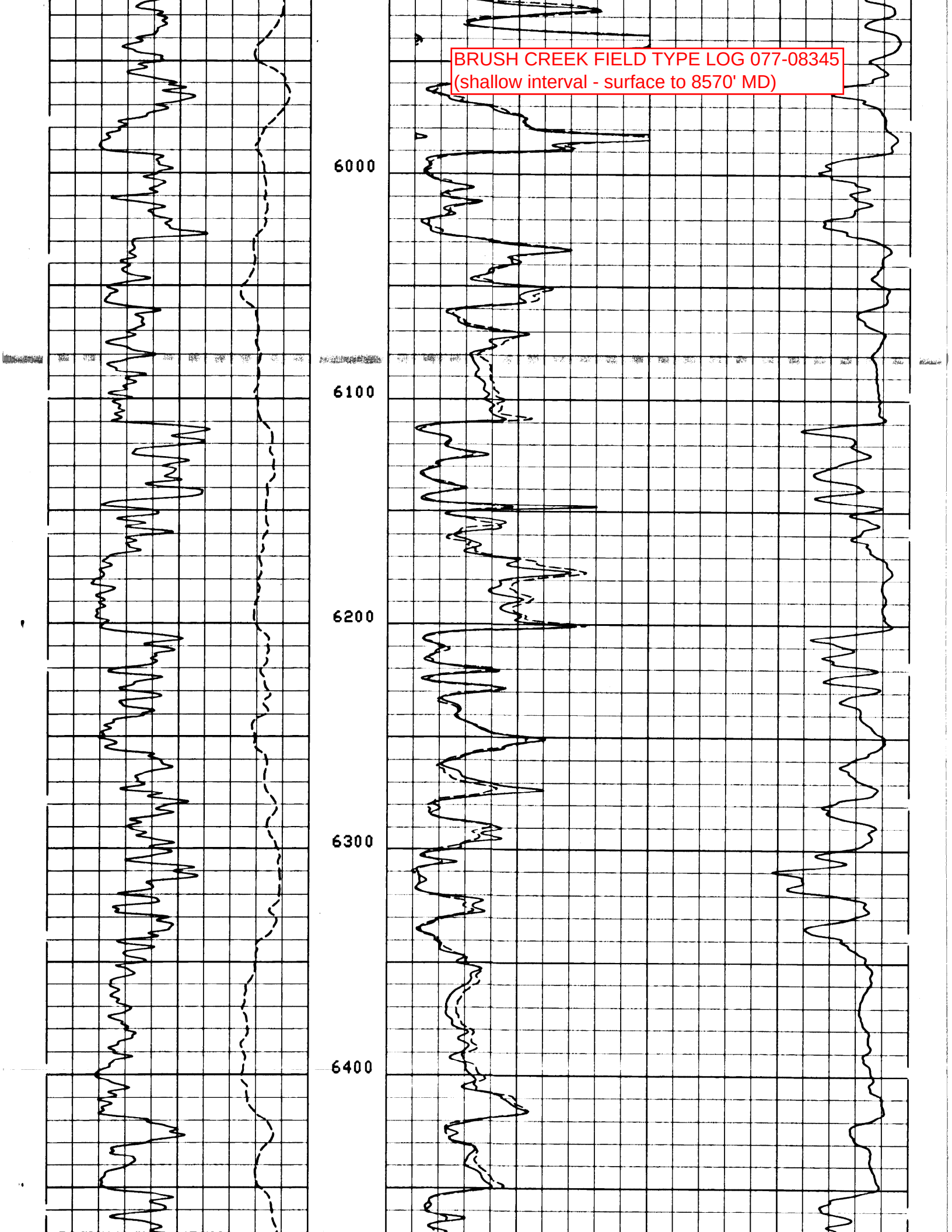

BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
3200
3300
3400
3500
3600
3700

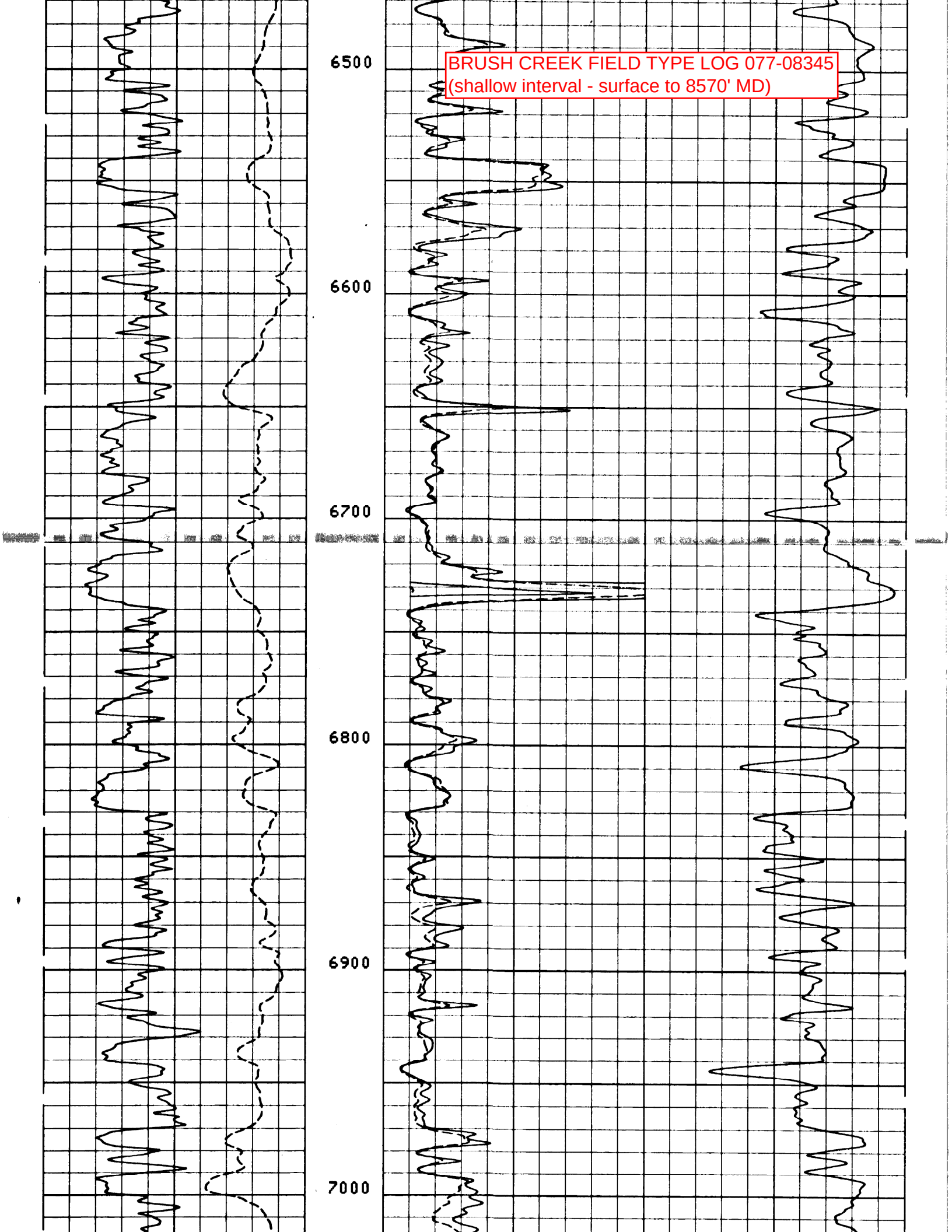

BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
3800
3900
4000
COGCC pick for Lower Wasatch top (cement required 200' above this point, effective 04-18-2016)
4100
4200
COGCC pick for Ohio Creek top

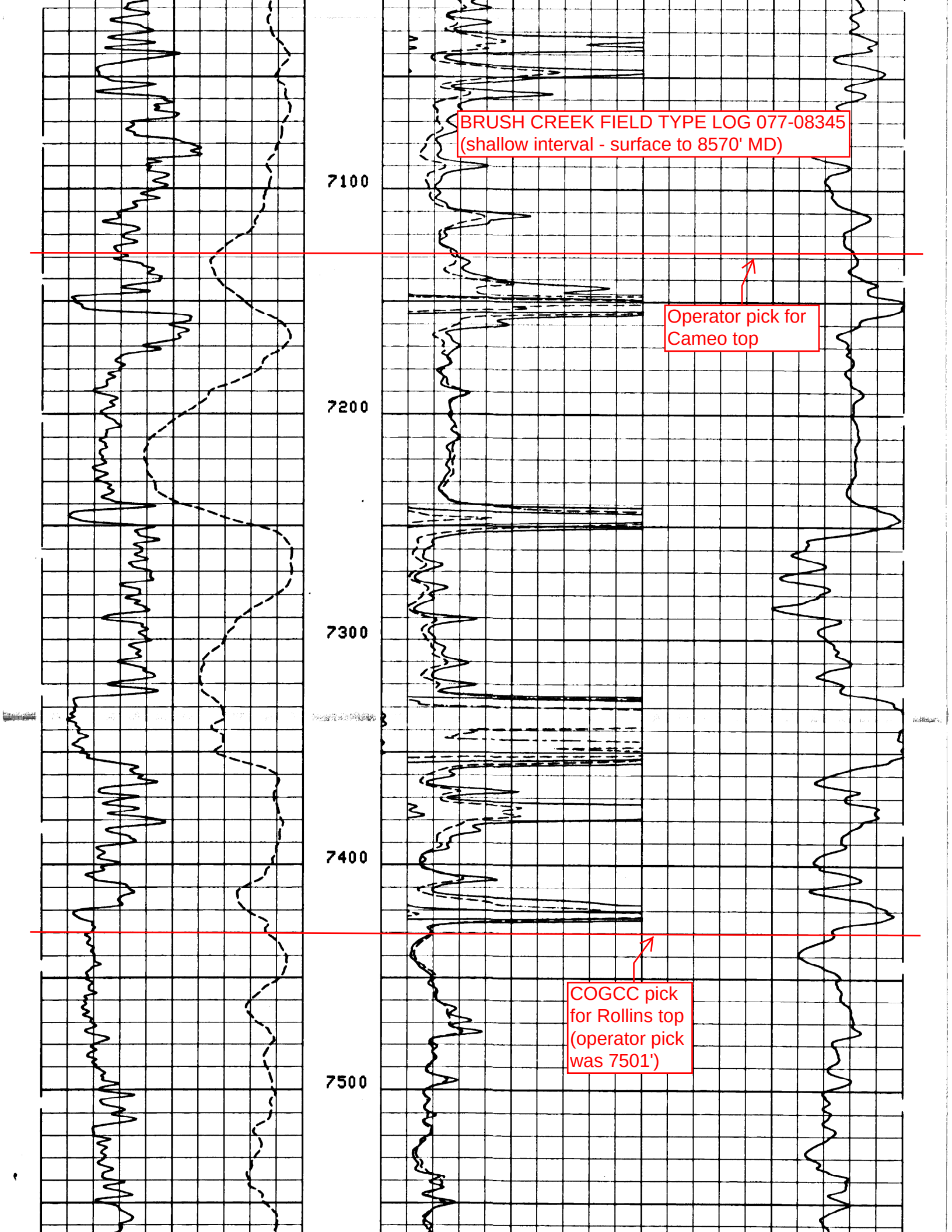

4300
4400
4500
4600
4700
4800
BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
COGCC pick for
U. Mesaverde top

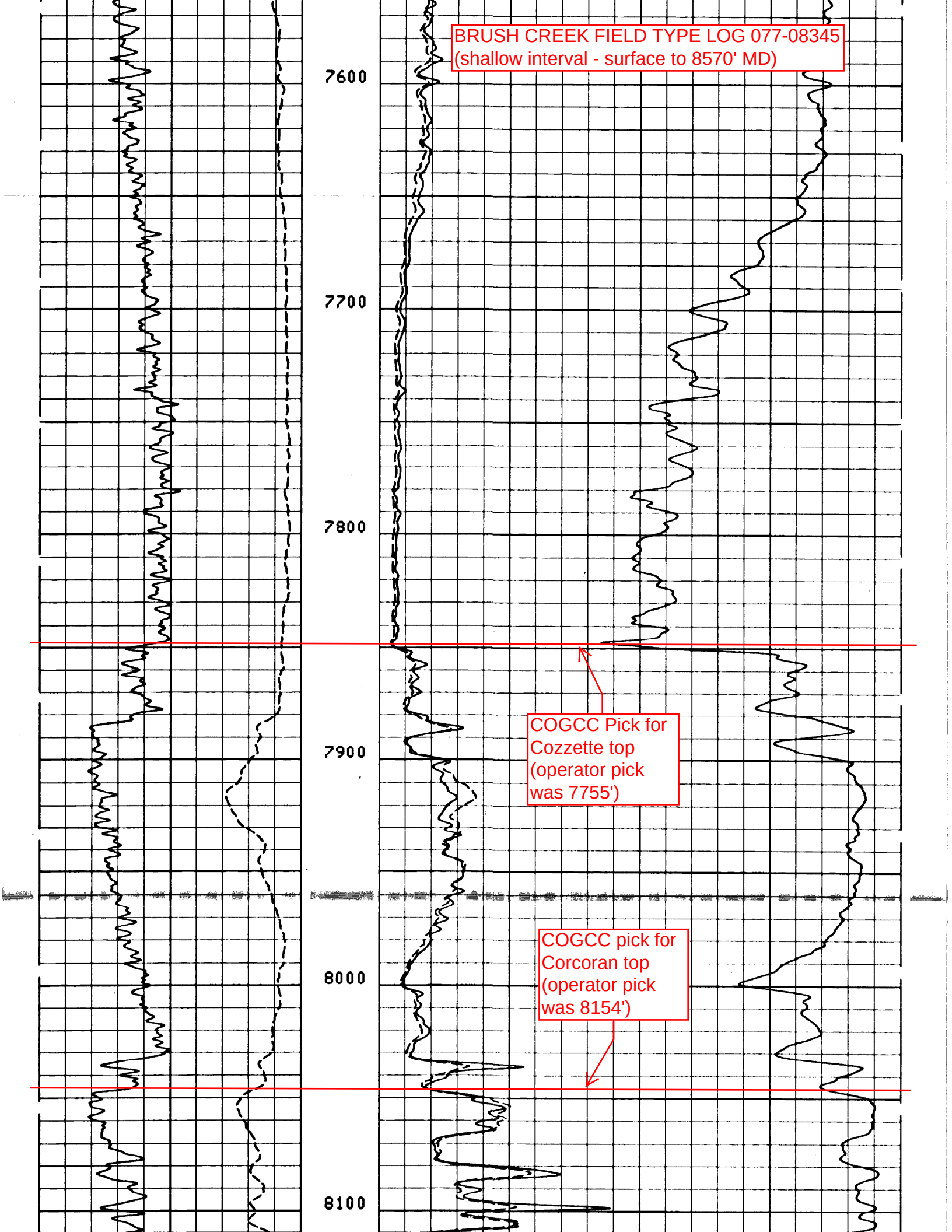

BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
4900
5000
5100
5200
5300

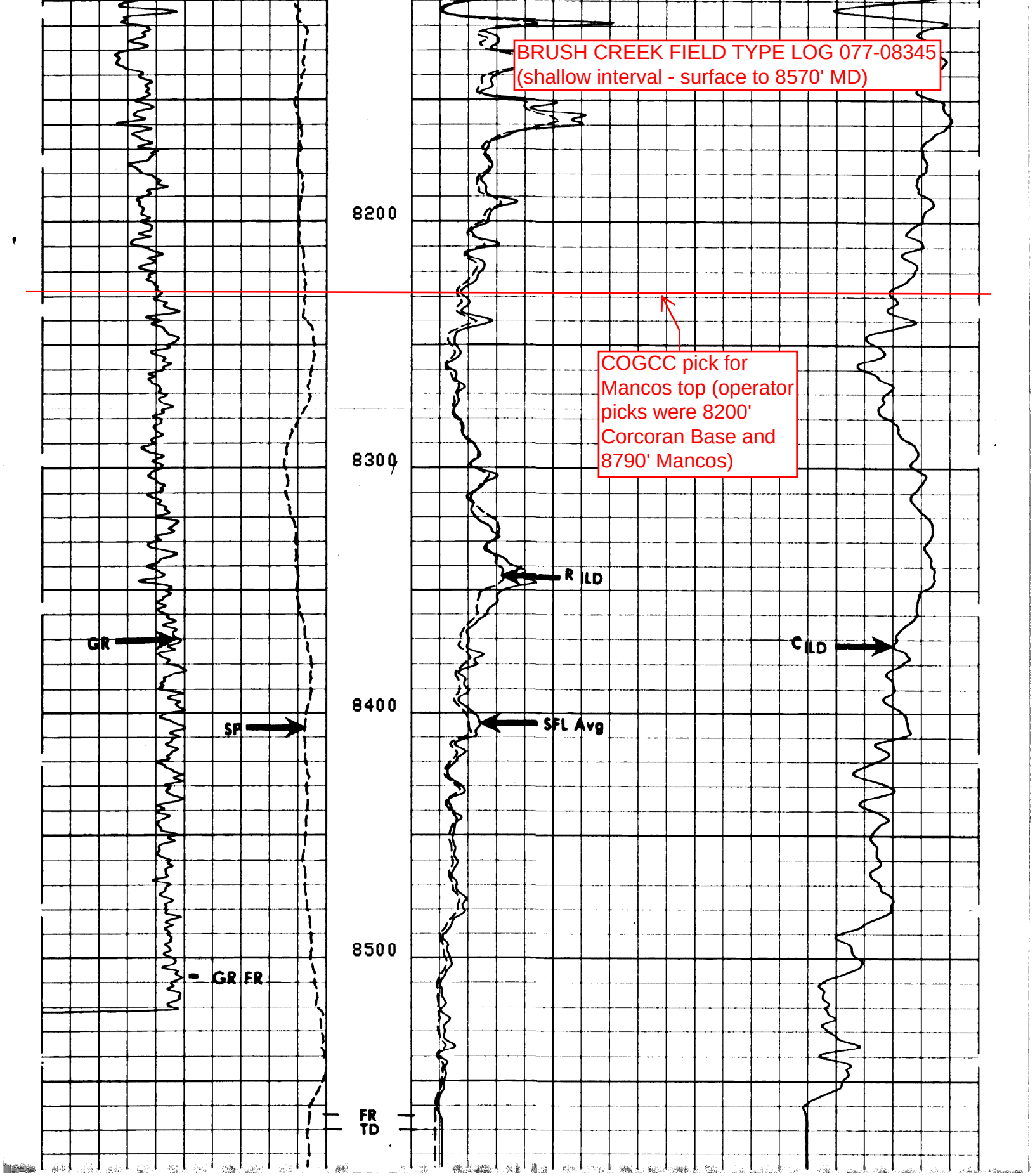

5400
5500
5600
5700
5800
5900
BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)


BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
6000
6100
6200
6300
6400


BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
6500
6600
6700
6800
6900
7000


BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
7100
Operator pick for
Cameo top
7200
7300
7400
COGCC pick
for Rollins top
(operator pick
was 7501')
7500


BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
7600
7700
7800
7900
8000
8100
COGCC Pick for
Cozzette top
(operator pick
was 7755')
COGCC pick for
Corcoran top
(operator pick
was 8154')


BRUSH CREEK FIELD TYPE LOG 077-08345
(shallow interval - surface to 8570' MD)
8200
8300
8400
8500
COGCC pick for Mancos top (operator picks were 8200' Corcoran Base and 8790' Mancos)
R ILD
C ILD
GR
SP
SFL Avg
GR FR
FR
TD

Schlumberger

DUAL INDUCTION-SFL
WITH LINEAR CORRELATION LOG

COMPANY TERRA RESOURCES INC.

WELL BRUSH CREEK McDANIEL 1-11

FIELD WILDCAT

COUNTY MESA STATE COLORADO

LOCATION NW 1/4 SE 1/4 CENTER E. 1/2

SEC. 11 TWP 9S RANGE 94W

Other Services: FDC-CNL-GR, BHC-GR, CYBERLOOK

Permanent Datum: GROUND LEVEL Elev.: 7400

Log Measured From KB 26 Ft. Above Perm. Datum

Drilling Measured From KB

Elev.: K.B. 7426, D.F. -, G.L. 7400

BRUSH CREEK FIELD TYPE LOG 077-08345
(deep interval - 12670 to 14445' MD)

COGCC Document Number 2056197

04-18-2016

077-08345

RECEIVED
AUG 13 1981
COLO. OIL & GAS CONS. COMM.

Date	8/7/81			
Run No.	THREE			
Depth–Driller	14452			
Depth–Logger	14451			
Btm. Log Interval	14445			
Top Log Interval	12670			
Casing–Driller	7 @ 12662	@	@	@
Casing–Logger	12670			
Bit Size	5.875			
Type Fluid in Hole	FGM			
Dens. / Visc.	10.0 / 45			
pH / Fluid Loss	8.9 / 9 ml		ml	ml
Source of Sample	MUD TANK			
Rm @ Meas. Temp.	1.94 @ 80 °F	@ °F	@ °F	@ °F
Rmf @ Meas. Temp.	1.61 @ 80 °F	@ °F	@ °F	@ °F
Rmc @ Meas. Temp.	2.91 @ 80 °F	@ °F	@ °F	@ °F
Source: Rmf / Rmc	MEAS / CALC			
Rm @ BHT	.46 @ 338 °F	@ °F	@ °F	@ °F
TIME: Circulation Stopped	0330 8/7			
TIME: Logger on Bottom	1130 8/7			
Max. Rec. Temp.	338 °F	°F	°F	°F
Equip. / Location	8244 / GJ			
Recorded By	JOHN STEKO			
Witnessed By	TAYLOR			

FOLD HERE

The well name, location and borehole reference data were furnished by the customer.

Run No.	THREE			
Service Order No.	244121			
Fluid Level	FULL			
Salinity ppm. cl	2400			
Speed F.P.M.	30			

EQUIPMENT DATA

Panel No.	IFM	BC 1037			
Cart No.	DIC	DA 397			
Sonde No.	DIS	EA 574			
Mem. Panel No.	-	-			
G.R. Panel No.	NLM	BC 1037			
G.R. Cart No.	SGC	JC 2056			
Tape Recorder - (TTR)		-			
Depth Encoder - (DRE)		-			
Pressure Wheel - (CPW)		-			
Type Centralizers		RUBBER			
Stand Off - Inches		1.0			

CALIBRATION DATA

SBR	PLEASE			
Sonde Error - ILM	SEE			
Sonde Error - ILD	CALIBRATION			
G.R. BKG. - CPS.	SUMMARY			
G.R. Source - CPS.				
S.E. Set In Hole - Depth				
S.E. Corr. - Hole Size				

LOGGING DATA

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

REMARKS

OPERATORS: GARY SCARBROUGH
CALVIN LEWIS

HEL TOOL OPERATOR:
MARK DENNIS

LOGGING DATA

SBR			
S.E. Log - ILM			
S.E. Log - ILD			
G.R. Scale per 100 Div.			
G.R. - T.C.			
G.R. Sens.			

All interpretations are opinions based on inferences from electrical or other measurements ... pretations, and we shall not, except in the case of gross or willful negligence on our part ... sustained by anyone resulting from any interpretation made by any of our officers, agents ... Conditions as set out in our current Price Schedule

BRUSH CREEK FIELD TYPE LOG 077-08345
(deep interval - 12670 to 14445' MD)

Unlogged interval reported formation tops between shallow log (Document No. 2056196) and this deep log:
Niobrara - 10884' MD
Frontier - 11884' MD
Dakota Silt - 12334' MD
Dakota Sand - 12399' MD
Morrison - 12626' MD

AFTER SURVEY TOOL CHECK SUMMARY

PERFORMED: 81/08/07
PROGRAM FILE: IS (VERSION 18.2 35/35/35)

DITD TOOL CHECK

	ZERO		PLUS		
	BEFORE	AFTER	BEFORE	AFTER	UNITS
ILD	0.0	-0.2	499.8	509.4	MM/M
ILM	0.0	0.1	499.9	503.9	MM/M
SFL	0.0	0.1	499.9	410.7	MM/M

ILM SONDE ERROR CORRECTION : 6.4 MM/M
ILD SONDE ERROR CORRECTION : 2.9 MM/M

FILE

15

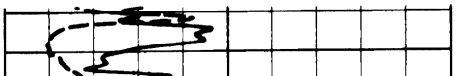
PARAMETERS

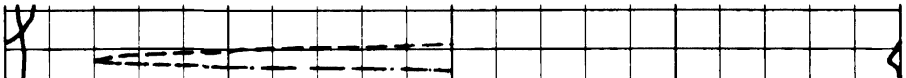
NAME	UNIT	VALUE	NAME	UNIT	VALUE	NAME	UNIT	VALUE
SBR	OHMM	2.000	DSEC	MM/M	2.950	BS	INCH	5.875
FPHI		PHIX	MSEC	MM/M	6.410			
DO		-15.00	BHS		OPEN			

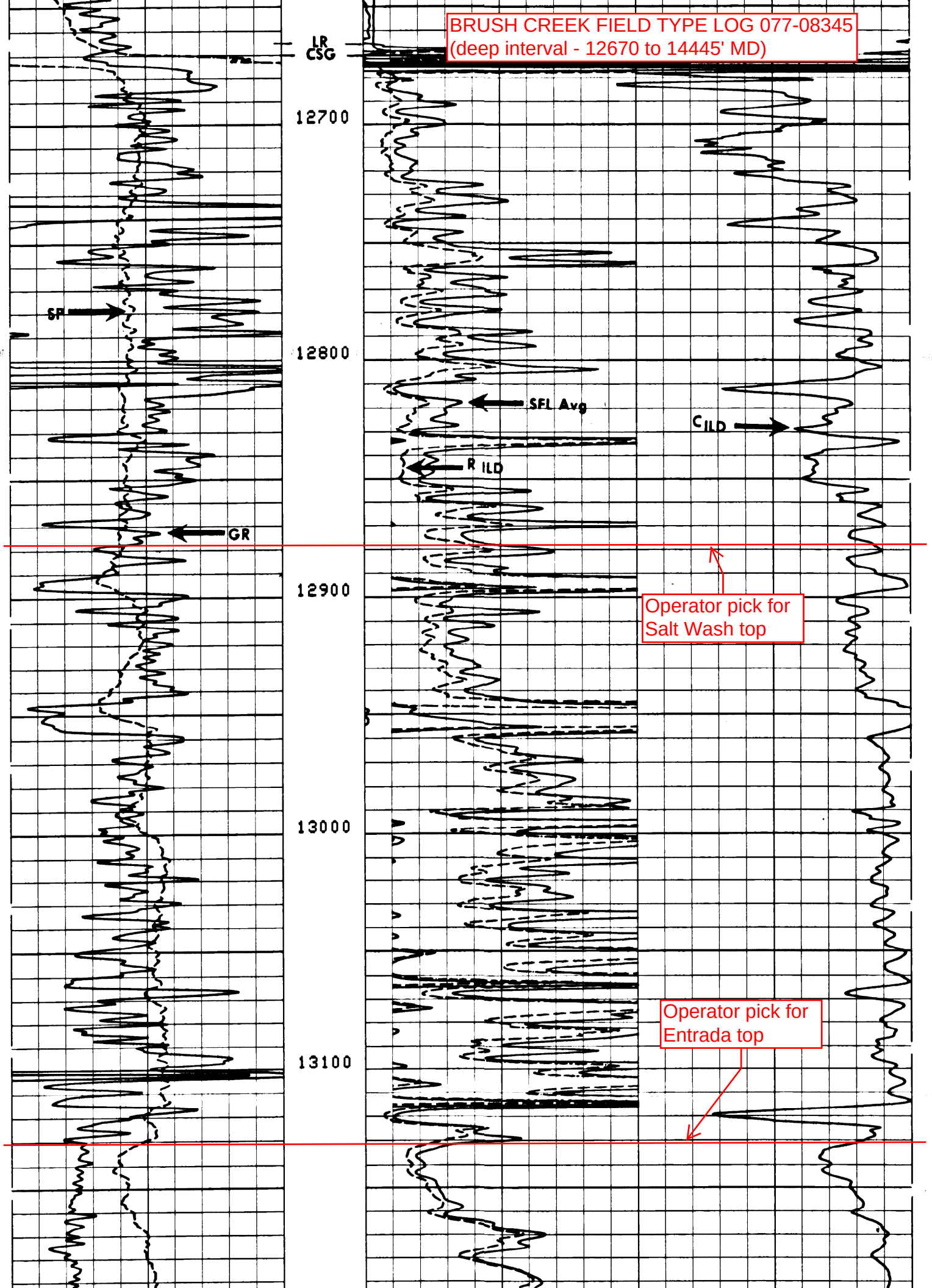
GR (GAPI)		ILD (OHMM)	
200.0	400.0	0.0	100.0
GR (GAPI)		SFLA(OHMM)	
0.0	200.0	0.0	100.0
SP (MV)		CILD(MM/M)	
-100.0	0.0	400.0	0.0

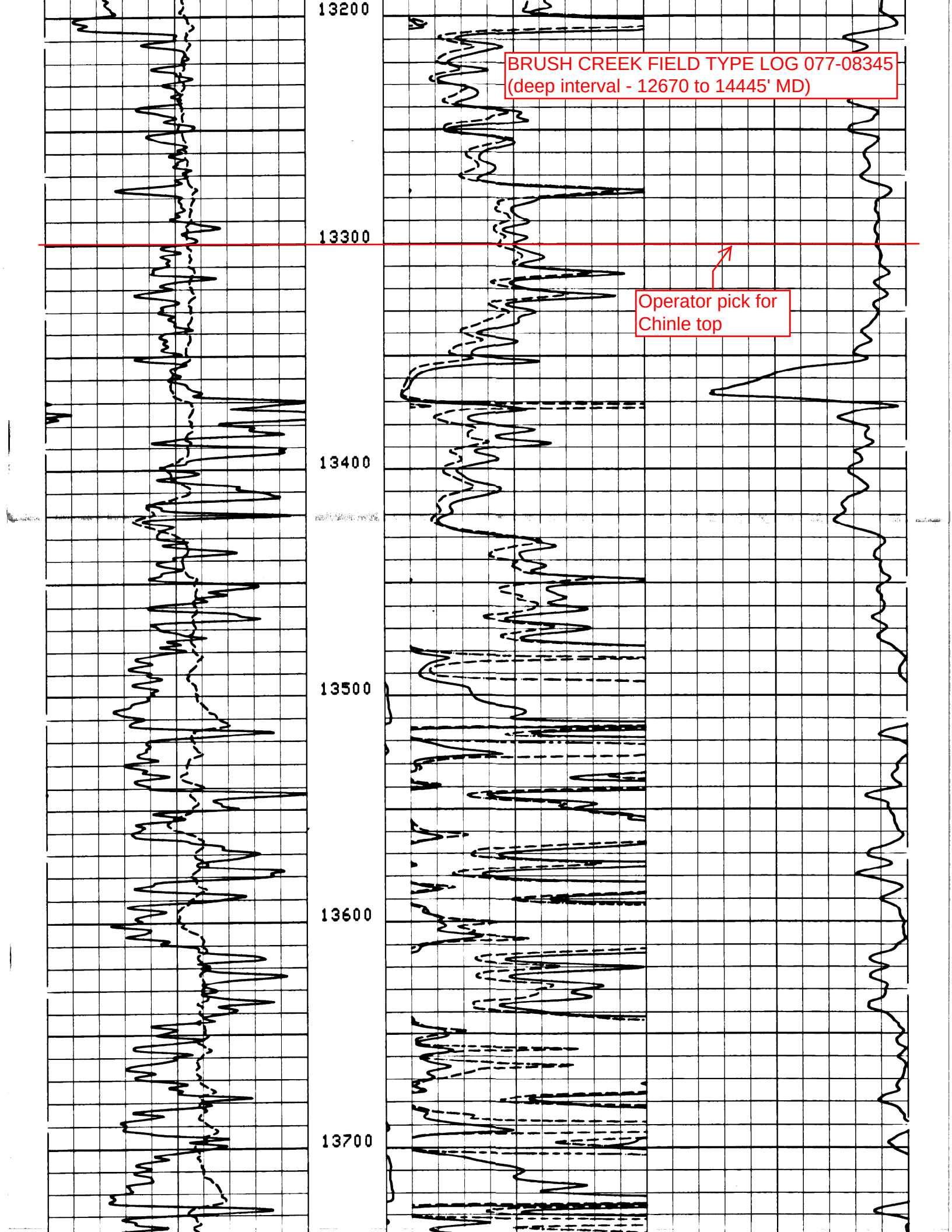
FILE

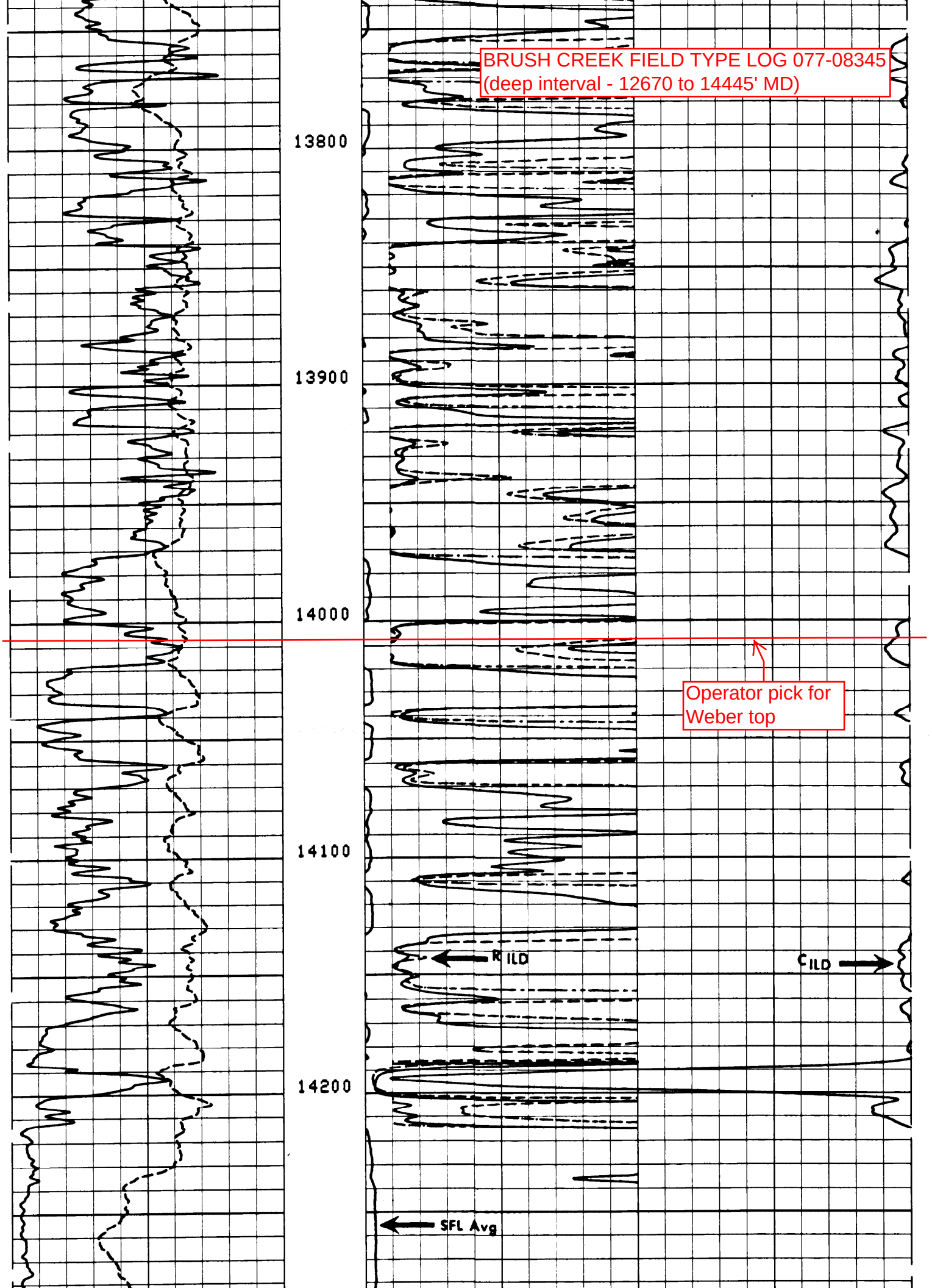
103

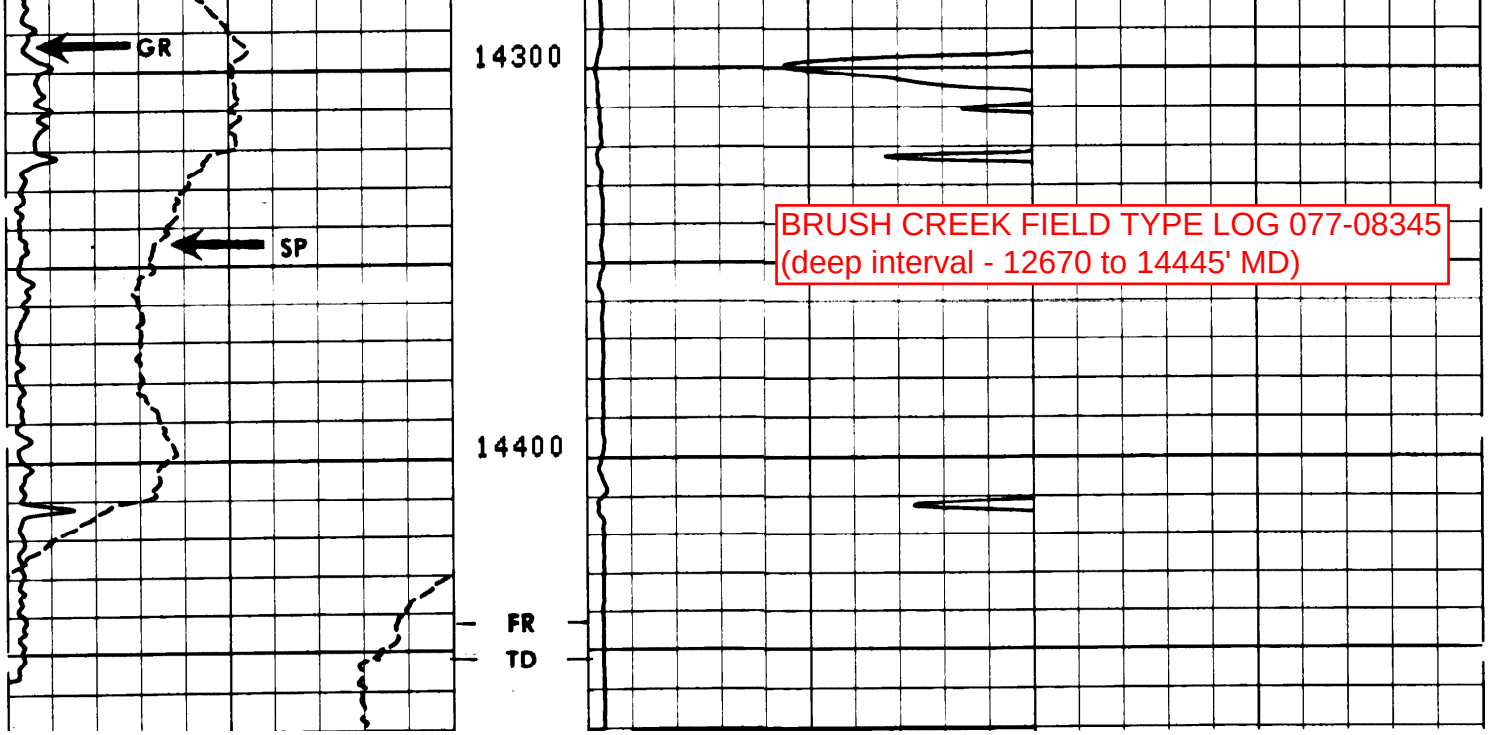





BRUSH CREEK FIELD TYPE LOG 077-08345
(deep interval - 12670 to 14445' MD)
LR
CSG
12700
SP
12800
SFL Avg
C ILD
R ILD
GR
12900
Operator pick for
Salt Wash top
13000
Operator pick for
Entrada top
13100


13200
13300
13400
13500
13600
13700
BRUSH CREEK FIELD TYPE LOG 077-08345
(deep interval - 12670 to 14445' MD)
Operator pick for
Chinle top


BRUSH CREEK FIELD TYPE LOG 077-08345
(deep interval - 12670 to 14445' MD)
13800
13900
14000
14100
14200
Operator pick for
Weber top
R ILD
C ILD
SFL Avg


GR
SP
14300
14400
FR
TD
BRUSH CREEK FIELD TYPE LOG 077-08345
(deep interval - 12670 to 14445' MD)

COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056121

FIELD NAME	**BUZZARD CREEK**
FIELD NUMBER	**9500**

LOCATION

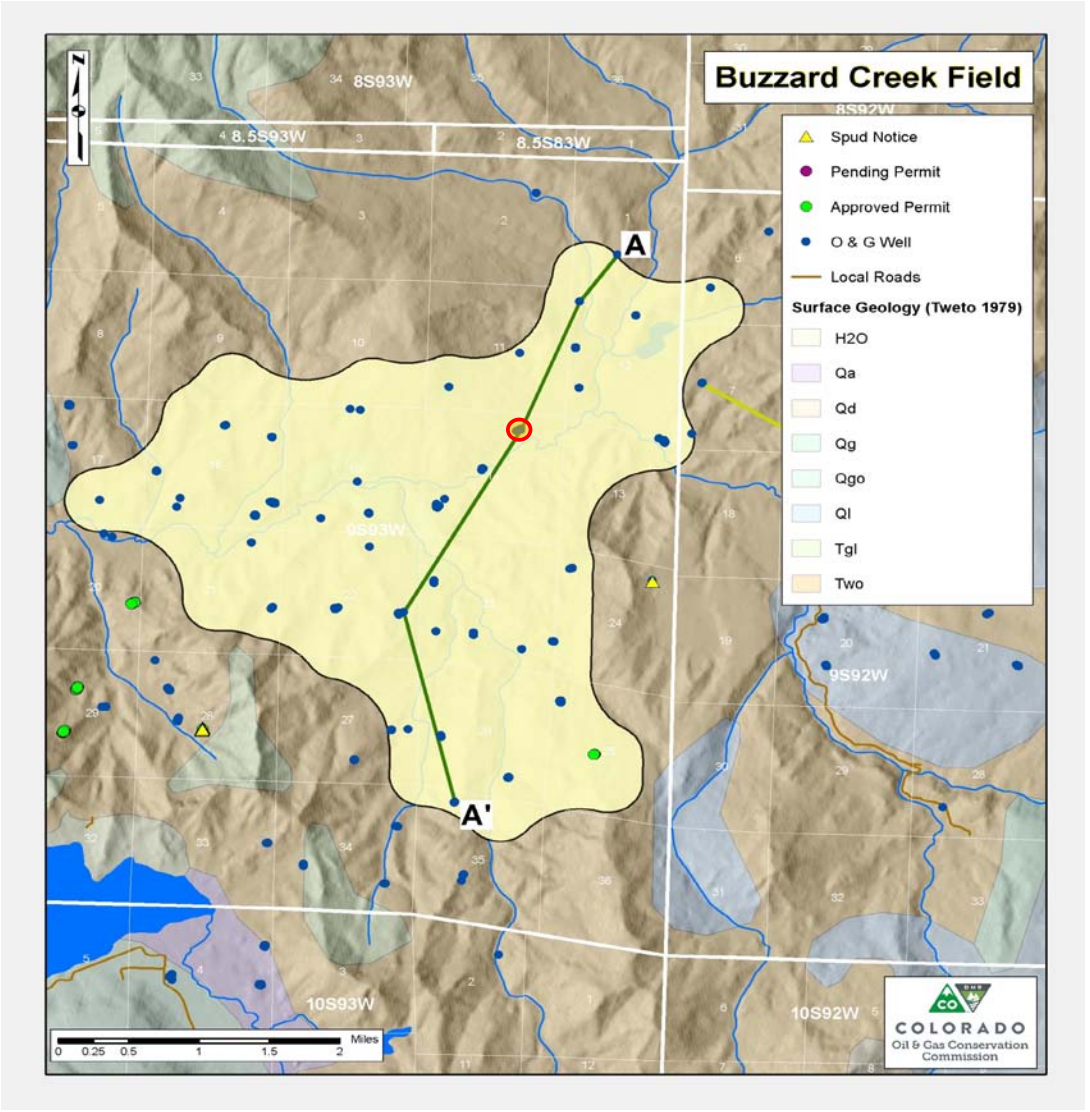
Basin	Piceance
Township(s)	9S
Range(s)	92W to 93W

SURFACE GEOLOGY

Surface Geology consists of alluvium in the central, northeastern, and western portions of the field, underlain by the Wasatch Formation. The Wasatch Formation outcrops at surface throughout most of the field. The Green River Formation outcrops near the southwestern boundary of the field.

GEOLOGIC STRUCTURE

None present within this field or nearby on COGCC's 250K GIS Geology layer.



Type Log Well

COGCC OIL AND GAS FIELD SCOUT CARD
BUZZARD CREEK #9500

				A - South				A' - North
STRATIGRAPHY			**API Number =>**	**077-09476**	**077-09708**	**077-08753**	**077-05106**	**077-08850**
			Surface Elevation =>	**7,956**	**7,641**	**7,407**	**7,592**	**7,716**
All depths are measured depths			**Well Type =>**	**Directional**	**Directional**	**Directional**	**Vertical**	**Directional**
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water					
	Green River		Water					
	Wasatch	Upper	Shallow Water	0	0	0	0	0
	Wasatch	G-Sand*	Possible Gas	2,886/2,998*		2,600/2,728*	2,670/2,810*	
	Wasatch	Fort Union*	None	3,290*		3,109*	3,210*	
	Wasatch	Middle	None					
	Wasatch	Lower*	Water	4,434*	4,180*	4,407*	4,164*	
Mesaverde	Williams Fork	Ohio Creek	Water / UIC	4,730*	4,566*	4,606*	4,440*	
Mesaverde	Williams Fork	U. Mesaverde	Water	5,152*	4,945	4,940*	4,890*	
Mesaverde	Williams Fork	Top of Gas**	Gas	6,652 tog**		6,316 tp**		6,430 tp**
Mesaverde	Williams Fork	Cameo	Gas	7,835	7,205	7,532		
Mesaverde	Iles	Rollins	Gas	8,201	7,925	7,920	8,005*	8,361
Mesaverde	Iles	Cozzette	Gas / UIC	8,725	8,531	8,470	8,530*	8,890
Mesaverde	Iles	Corcoran	Gas	8,902	8,702	8,640	8,720*	9,090
	Mancos		Possible Gas	9,043*	8,926			
	Morapos		Possible Gas		9,535			
	Niobrara		Possible Gas		12,057			
	Frontier		Possible Gas		13,206			
Dakota	Dakota		Possible Gas					

Annotated Type Log for 077-08753: COGCC Document Number 2056078

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; however, Wasatch G is completed in a shallow well, 077-08637, NWNE 14-9S-93W; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

*** Top of Gas (tog), as reported by operator or top Williams Fork production perforation (tp)*

WATER RESOURCE ISOLATION

Alluvium, Green River, Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde
The deepest water well within the vicinity of the field is 310' (likely Wasatch)

PRODUCING ZONE ISOLATION

Primary Objectives: Mesaverde Group (Williams Fork, Cameo, Rollins, Cozzette, and Corcoran)
Secondary Objectives: Wasatch (G-Sand) and Mancos (A-Sand and B-Sand)

COGCC OIL AND GAS FIELD SCOUT CARD
BUZZARD CREEK #9500

UNDERGROUND INJECTION CONTROL

API Number	Well Name and Number	Type	Zone	Sample Top	Sample Bottom	TDS	Source
077-08765	Buzzard Creek 22-3	Disposal	Ohio Creek	N/A	N/A	7,000 (est.)	2.5 miles south[1]
077-07331	Buzzard Creek #14-6	Source	Williams Fork	5,941	7,245	28,435	SEP - 7/22/2008
077-08728	Buzzard Creek #14-1	Source	Williams Fork	6,135	7,682	25,100	TANK - 7/22/2008
077-08730	Buzzard Creek #15-10	Source	Williams Fork	6,146	7,228	30,094	SEP - 7/22/2008
077-08722	Buzzard Creek #12-5	Source	Williams Fork	6,234	7,541	18,265	SEP - 7/22/2008
077-08627	Buzzard Creek #15-15	Source	Williams Fork	6,400	7,605	40,524	SEP - 7/22/2008
077-10091	Bruton #19-10C	Source	Williams Fork	6,539	7,729	23,523	SEP - 6/18/2012
077-10092	Bruton #30-02B	Source	Williams Fork	6,585	7,749	21,918	SEP - 6/18/2012
077-10093	Bruton #19-06C	Source	Williams Fork	6,594	7,897	24,211	SEP - 6/18/2012
077-08737	Buzzard Creek #16-12	Source	Williams Fork - Cozzette	5,846	8,050	26,159	WH - 7/23/2008
077-08844	Currier Fed #10-15 (BC15)	Source	Williams Fork - Cozzette	6,495	8,748	27,479	WH - 7/23/2008
077-08754	Buzzard Creek #15-16	Source	Williams Fork - Iles	6,204	8,604	25,194	SEP - 7/22/2008
077-08881	Currier #9-15 (BB16)	Source	Williams Fork - Iles	6,357	8,696	21,690	WH - 7/23/2008
077-08732	Buzzard Creek #15-12	Source	Williams Fork - Iles	6,412	8,450	10,081	WH - 7/23/2008
077-08850	Currier #1-13 (BK1)	Source	Williams Fork - Iles	6,430	9,228	20,135	SEP - 7/22/2008
077-08750	Buzzard Creek #16-10	Source	Williams Fork - Iles	6,434	8,560	24,305	WH - 7/23/2008
077-08746	Buzzard Creek #21-1	Source	Williams Fork - Iles	6,485	8,571	36,352	WH - 7/23/2008
077-08836	Werne #14-12 (BL14-9)	Source	Williams Fork - Iles	6,502	8,396	31,018	SEP - 7/22/2008
077-08731	Buzzard Creek #16-1	Source	Williams Fork - Iles	6,668	8,346	6,275	WH - 7/23/2008
077-05106	Buzzard Creek #12-4	Disposal	Cozzette	8,562	8,566	30,203	SEP - 7/22/2008
077-08723	Buzzard Creek #12-12	Source	Cozzette - Corcoran	6,382	8,701	16,812	SEP - 7/22/2008
077-10094	Bruton #19-14B	Source	Mancos			23,883	SEP - 6/18/2012

"Source" wells are sorted in order from shallowest to deepest "Sample Top" depth

(1) TDS concentration reportedly estimated from wells located approximately 2.5 miles to the south

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

369-1 (4/20/1981)	Mesaverde Group: Recognizes all Mesaverde Group formations as a **Common Source** of supply. Establishes 320-acre drilling and spacing units, 600' from unit line.
369-2 (9/20/2004)	Establishes a Bradenhead Monitoring Area, including the Buzzard Creek Field.
369-3 (5/25/2007)	Mesaverde Group: Amends prior orders to allow 20-acre spacing in certain parts of the field, 200' from unit line, 400' well-to-well spacing and one pad per quarter-quarter.
Various	Mesaverde Group: Amends prior orders to allow 10-acre spacing in certain parts of the field, 100' / 200' from unit lines and one pad per quarter-quarter.
369-9 (1/23/2012)	Mesaverde Group and Deeper Formations: Establishes 160-acre drilling and spacing units for vertical and directional wells targeting the Mesaverde Group and Deeper formation objectives (Mancos, Morapos, Niobrara, and Frontier), 600' from unit line, 100' well-to-well spacing and one pad per quarter-quarter.

COGCC OIL AND GAS FIELD SCOUT CARD
BUZZARD CREEK #9500

HISTORIC WELL CONSTRUCTION

Surface casing setting depths generally range from 400' to 2,400', with greater than 1,000' set in most wells. Production casing generally terminates in the Iles or underlying Mancos formations. Production casing cement may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 5% TVD required for well control in Mesa County (10% TVD recommended) and to cover water resources in the upper interval of the Wasatch Formation. Recommend setting depth of 1,000' or greater, based on potential water resources apparent on induction logs with shallow-set surface casing. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. New Standards require cementing intermediate (if used) or production casing at least 200' above Lower Wasatch sands, as shown on the annotated type log for this field. Cement coverage (stage cement or increased primary cement for intermediate [if used] or production casing) is also required across the Wasatch G within one mile of productive Wasatch G wells.

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug across Ohio Creek and across Lower Wasatch (squeeze to 200' above Lower Wasatch if no annular cement coverage); Wasatch G plug if productive within one mile; stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000-foot intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug. Larger surface casing shoe plugs should be considered for wells with less than 1,000' of surface casing.

NOTES

This field is located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.

Well Control: Controlled gas kick reported for 077-09912 on 3/29/2011 while drilling in the Mancos Formation.

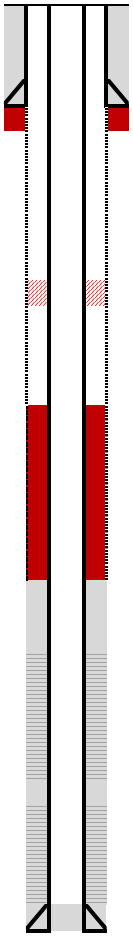
ISOLATION REQUIREMENTS FOR TYPICAL WELLS

Date 04/18/2016 **COGCC Document No.** 2056122

FIELD NAME **BUZZARD CREEK**
FIELD NUMBER **9500**

LOCATION
Basin Piceance
Township(s) 9S
Range(s) 92W to 93W

Depth	Formation/Member
0	Alluvium/ Green River/ U. Wasatch
1,000	
2,000	
	Wasatch G
3,000	
4,000	
	L. Wasatch
	Ohio Creek
5,000	U. Mesaverde
6,000	
	Top of Gas
7,000	
	Cameo
8,000	Rollins
	Cozzette
	Corcoran
9,000	



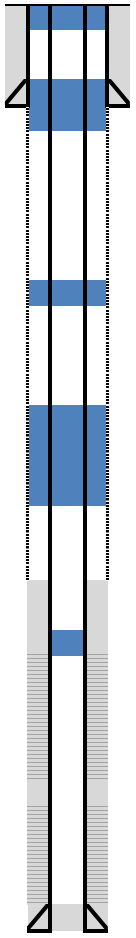
Casing and Cement Coverage

New Surface Casing Standard
Minimum 5% TVD (10% recommended) or cover all apparent water resources in the U. Wasatch, whichever is more stringent. Recommend 1,000 ft or greater based on potential water resources apparent on induction logs

New Cement Standard
Cement must provide coverage across Ohio Creek and 200 ft above L. Wasatch, in addition to productive interval coverage. Add Wasatch G coverage (stage cement, as shown here or increase primary coverage) within one mile of productive Wasatch G wells.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of U. Mesaverde, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	Alluvium/ Green River/ U. Wasatch
1,000	
2,000	
	Wasatch G
3,000	
4,000	
	L. Wasatch
	Ohio Creek
5,000	U. Mesaverde
6,000	
	Top of Gas
7,000	
	Cameo
8,000	Rollins
	Cozzette
	Corcoran
9,000	



Plug Placement

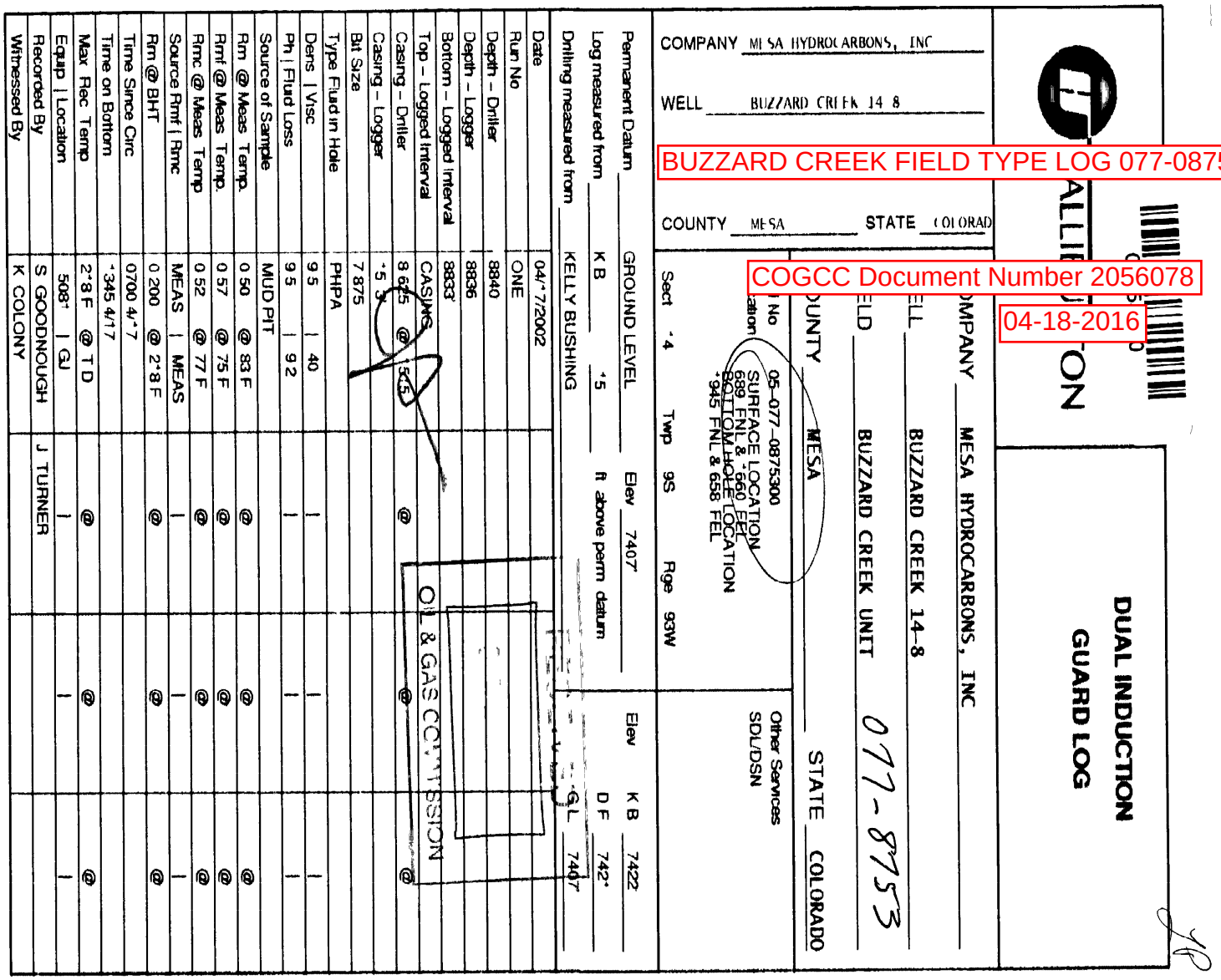
Surface plug

Surface casing shoe plug
Set deeper shoe plug if casing depth < 1,000 ft

Wasatch G plug if productive within one mile
Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 ft)

Squeeze plug across Ohio Creek and across L. Wasatch (top of plug 200 ft above L. Wasatch)

Plug in casing above Mesaverde Group Completions



COMPANY MESA HYDROCARBONS, INC

WELL BUZZARD CREEK 14-8

COUNTY MESA STATE COLORADO

DUAL INDUCTION GUARD LOG

BUZZARD CREEK FIELD TYPE LOG 077-08753

COGCC Document Number 2056078

04-18-2016

077-08753

Permanent Datum	GROUND LEVEL	Elev 7407'	
Log measured from	K B 15'	ft above perm datum	
Drilling measured from	KELLY BUSHING		
Date	04/7/2002		
Run No	ONE		
Depth – Driller	8840		
Depth – Logger	8836		
Bottom – Logged Interval	8833'		
Top – Logged Interval	CASING		
Casing – Driller	8 625 @ 1505	@	@
Casing – Logger	1505		
Bit Size	7 875		
Type Fluid in Hole	PHPA		
Dens | Visc	9 5 | 40		
Ph | Fluid Loss	9 5 | 9 2		
Source of Sample	MUD PIT		
Rm @ Meas Temp	0 50 @ 83 F	@	@
Rmf @ Meas Temp	0 57 @ 75 F	@	@
Rmc @ Meas Temp	0 52 @ 77 F	@	@
Source Rmf | Rmc	MEAS | MEAS	|	|
Rm @ BHT	0 200 @ 218 F	@	@
Time Since Circ	0700 4/7		
Time on Bottom	1345 4/17		
Max Rec Temp	218 F @ TD	@	@
Equip | Location	5081 | GJ	|	|
Recorded By	S GOODNOUGH	J TURNER	
Witnessed By	K COLONY		

Sect 4 Twp 9S Rge 93W

API No 05-077-0875300

SURFACE LOCATION 689 FNL & 660 FEL

BOTTOM HOLE LOCATION 945 FNL & 658 FEL

Other Services SDL/DSN

Elev	K B 7422		
	D F 742'		
	G L 7407		

OIL & GAS CONSERVATION COMMISSION

Fold Here

Service Ticket No	1803730	API Serial No	05-077-0875300	PGM Version	XL v4 63		
CHANGE IN MUD TYPE OR ADDITIONAL SAMPLES				RESISTIVITY SCALE CHANGES			
Date | Sample No				Type Log	Depth	Scale Up Hole	Scale Down Hole
Depth – Driller							
Type Fluid in Hole							
Dens | Visc							
Ph | Fluid Loss							
Source of Sample				RESISTIVITY EQUIPMENT DATA			
Rm @ Meas Temp	@	@		Run No	Tool Type & No	Pad Type	Tool Pos	Other
Rmf @ Meas Temp	@	@		ONE	DILT #109481	N/A	1 5 SO	
Rmc @ Meas Temp	@	@		ONE	SGRD #Y109481	N/A	1 5" SO	
Source Rmf | Rmc	CALC | CALC							
Rm @ BHT	0 200 @ 218 F	@						
Rmf @ BHT	0 228 @ 218 F	@						
Rmc @ BHT	0 208 @ 218 F	@						

EQUIPMENT DATA

GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No	ONE	Run No		Run No	ONE	Run No	ONE
Serial No	108617	Serial No		Serial No	IY65PG27	Serial No	108736
Model No	NGRT	Model No		Model No	SDL	Model No	DSN-II
Diameter	3 625"	No of Cent		Diameter	4 5	Diameter	3 625'
Detector Model No	102A	Spacing		Log Type	GAMMA	Log Type	THERMAL
Type	SCINT			Source Type	CS137	Source Type	AM241BE
Length	4	LSA [Y / N]		Serial No	2189 GW	Serial No	DSN-80
Distance to Source	10	FWDA [Y / N]		Strength	1 5 CI	Strength	19 5 CI

LOGGING DATA

GENERAL				GAMMA		ACOUSTIC			DENSITY			NEUTRON		
Run	Depth		Speed	Scale		Scale			Scale			Scale		
No	From	To	Ft / Min	L	R	L	R	Matrix	L	R	Matrix	L	R	Matrix
ONE	TD	CSG	REC	0	150				30%	-10%	2 68	30%	-10%	SAND
											GM/CC			

BUZZARD CREEK FIELD TYPE LOG 077-08753

DIRECTIONAL INFORMATION

Maximum Deviation	20	deg @		KOP	

Remarks

DIND-SDL-DSN-GR WERE RUN IN COMBINATION
A H V CALCULATED FOR 4 5" CASING
CHLORIDES REPORTED 5300 PPM
HOLE RUGOSITY AND TENSION PULLS AFFECT THE TOOLS RESPONSE
GAMMA API OF 213 WAS USED AS REQUESTED
AHVT = 2388 250 FT^3 BHVT = 3198 372 FT^3 (CALCULATED FROM T.D TO SURFACE CASING)
MAXIMUM HOLE DEVIATION = 20 DEGREES

YOUR CREW TODAY: S. MILLER, A CARR RIG: TRUE #19
THANK YOU FOR CHOOSING HALLIBURTON ENERGY SERVICES, GRAND JUNCTION (970)523-3600

HALLIBURTON DOES NOT GUARANTEE THE ACCURACY OR ANY INTERPRETATION OF THE LOG DATA CONVERSION OF LOG DATA TO PHYSICAL ROCK PARAMETERS OR RECOMMENDATIONS WHICH MAY BE GIVEN BY HALLIBURTON PERSONNEL OR WHICH APPEAR ON THE LOG OR IN ANY OTHER FORM. ANY USER OF SUCH DATA INTERPRETATIONS CONVERSIONS OR RECOMMENDATIONS AGREE THAT HALLIBURTON IS NOT RESPONSIBLE EXCEPT WHERE DUE TO GROSS NEGLIGENCE OR WILLFUL MISCONDUCT FOR ANY LOSS DAMAGES OR EXPENSE RESULTING FROM THE USE THEREOF.

HALLIBURTON

Current EXCELL-2000 Parameter Values

Depth: 419.417
Date: 17-Apr-2002 15:50
Service Number: 2100
Software Version: 4.64

Mnemonic	Tool	Parameter Description	Value	Units
PERF	DITSHD	PERFORATED INTERVAL	NO	
TD	DITSHD	TOTAL DEPTH	8836	FT
CS_ANT	DITSHD	CASING DEPTH (FOR ANNOTATION)	1513.	FT
GR_OK	GAMMA	DO GAMMA CALCULATIONS?	YES	
CASED	SHARED	CASED HOLE?	NO	
CASEOD	SHARED	CASING DIAMETER (OD)	4 5	Inches
MUDWT	SHARED	BOREHOLE FLUID WEIGHT	9 5	Pounds/Gal
GRSO	GAMMA	GAMMA RAY STANDOFF	0	Inches
BS	SHARED	BIT SIZE	7 875	Inches
DSN_OK	DSN II	DO DSN II CALCULATIONS?	YES	
DRILL	DSN_II	TPL - NEUTRON IN SLEEVE?	NO	
BADHOL	DSN_II	DSN BAD HOLE CORRECTION	NO	
NLITH	DSN_II	NEUTRON LITHOLOGY	SAND	
DSNSO	DSN_II	DSN STANDOFF	0	Inches
DSNTMP	DSN_II	DSN II TEMPERATURE CORRECTION	NONE	
DSNPRS	DSN_II	DSN II PRESSURE CORRECTION	NONE	
RHOFLU	SHARED	FLUID DENSITY	1.	Grams/CC
XPHLOC	XP_RWA	CROSSPLOT SELECTION FOR XPHI	XPLT	
ARCHA	XP_RWA	ARCHIE A	0.62	
ARCHM	XP_RWA	ARCHIE M	2.15	
FSEL	XP_RWA	POROSITY SELECTION FOR F (RWA)	DEN	
SDL_OK	SDL	DO SDL CALCULATIONS?	YES	
BARITE	SDL	ANY BARITE IN MUD?	YES	
AIR	SDL	AIR FILLED BOREHOLE?	NO	
RHOMAT	SDL	MATRIX DENSITY	2.68	Grams/CC
CAL_OK	CALSDL	DO CALIPER CALCULATIONS?	YES	
AHVOK	CALSDL	DO ANNULAR VOLUME CALCULATION?	YES	
DI_OK	DIND	DO DUAL INDUCTION CALCULATION?	YES	
SG_OK	SGRD	DO SHORT GUARD CALCULATIONS?	YES	

MAIN CONDUCTIVITY PASS

2"=100'

BUZZARD CREEK FIELD TYPE LOG 077-08753

HALLIBURTON

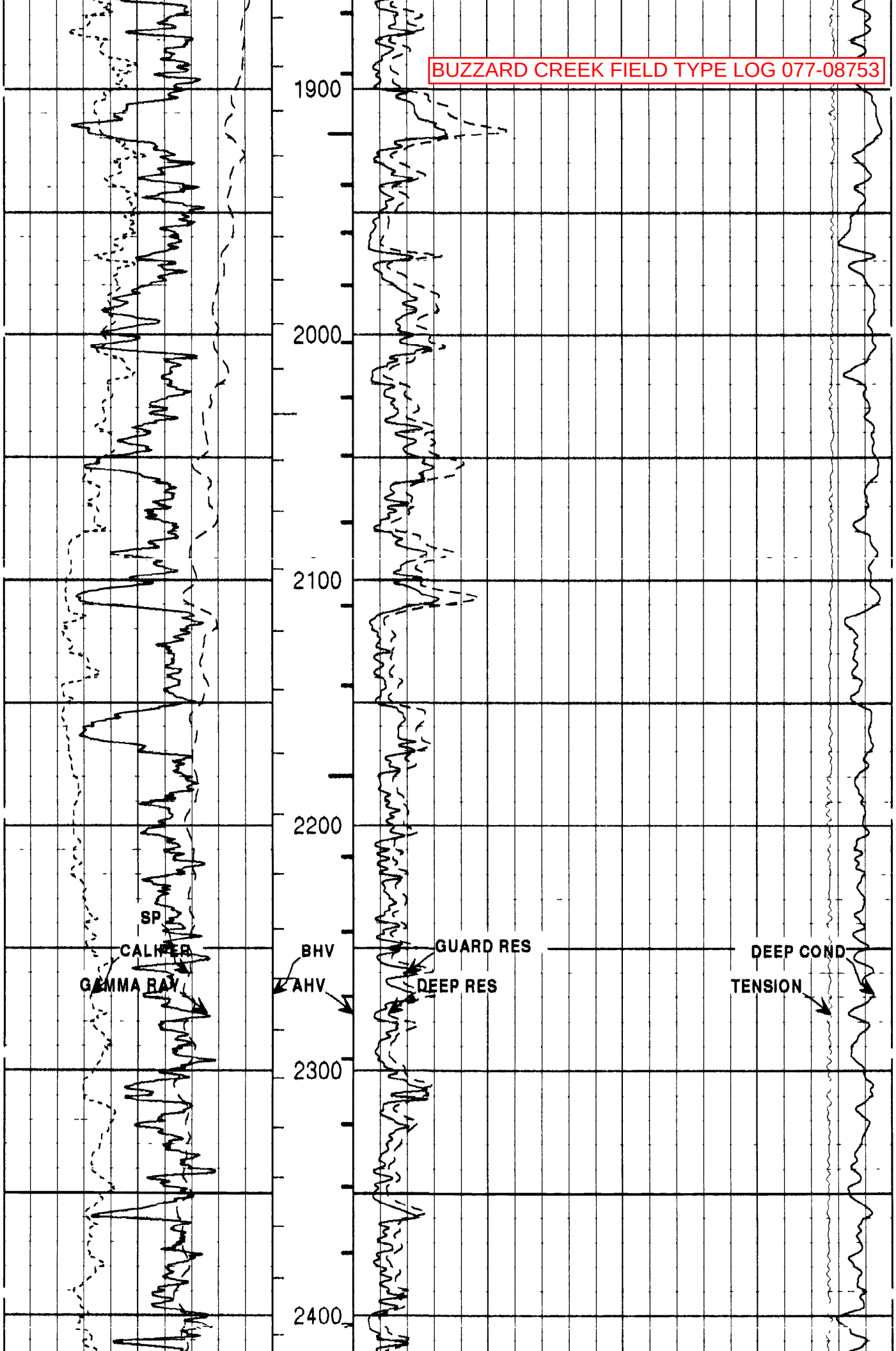
Version No 4 64 1 hc 3 0
Data File mesa_bcu14-8trp 3 dls
Format File /field_data/data2/mesa_bcu14-8trp/DIL2IN spc
Plot Time 2002-04-17 16 25 38
Log Time 2002-04-17 13 47 54
Top Depth 1444 83
Bottom Depth 8847 50

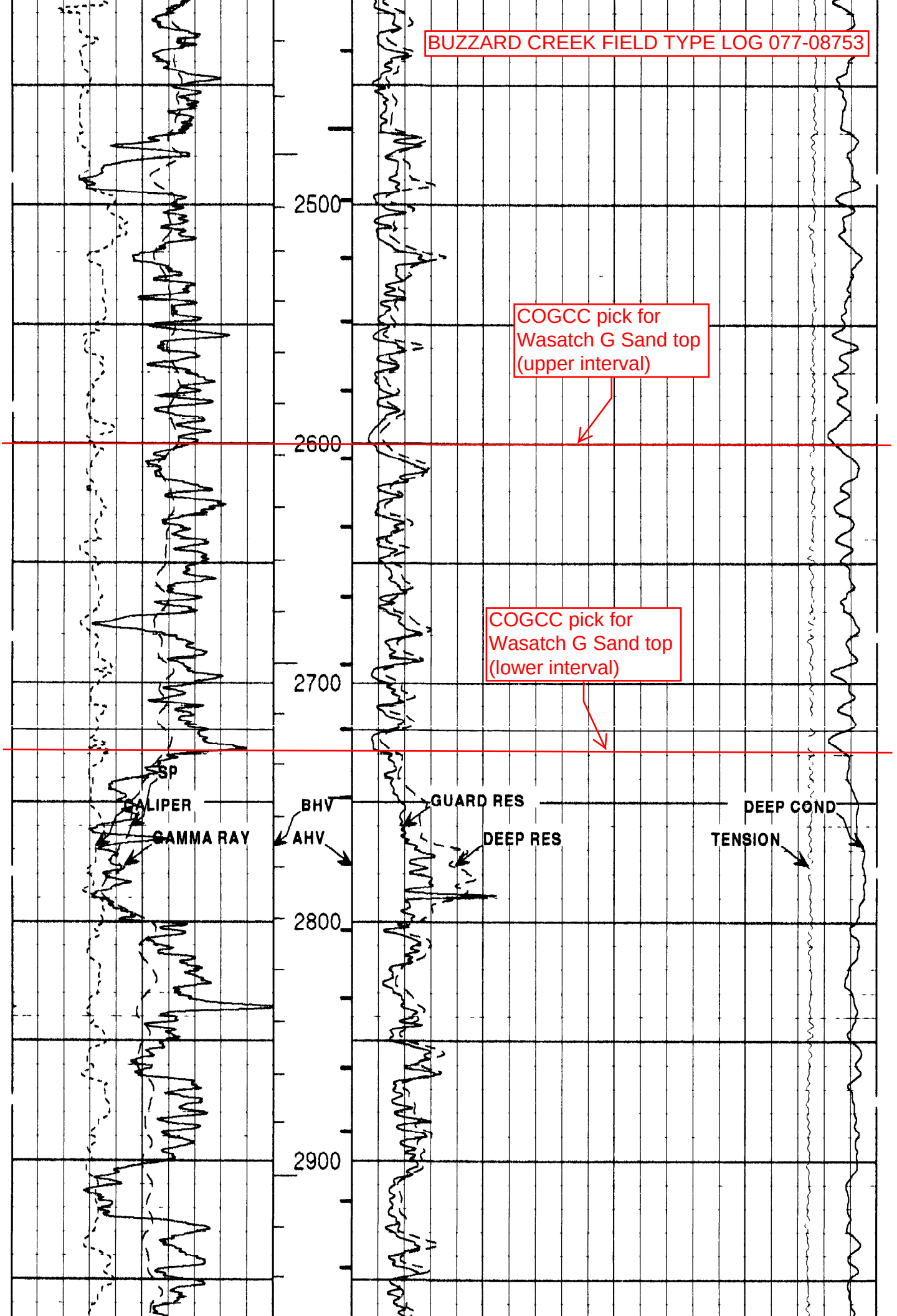
GAMMA RAY 0 API COUNTS 150
CALIPER 6 INCHES 16
SP -100 +100
AHV 50 FT 0
BHV 0 FT 50
1600 FT
DEEP 0 OHM-M 100
GUARD RES 0 OHM-M 100
TENSION 10000 POUNDS 0
DEEP COND 500 MMHO 0

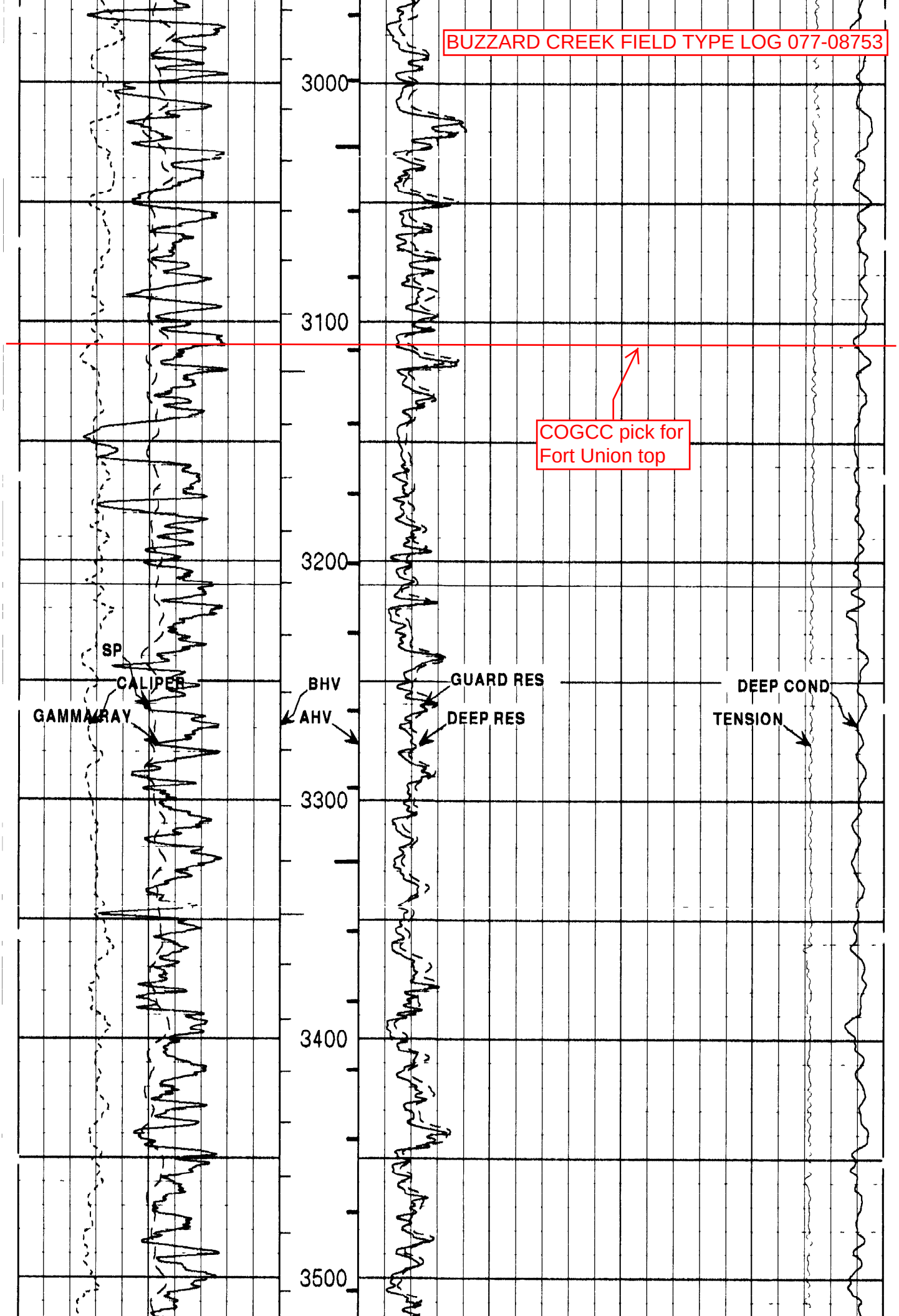
Wasatch Formation at Surface

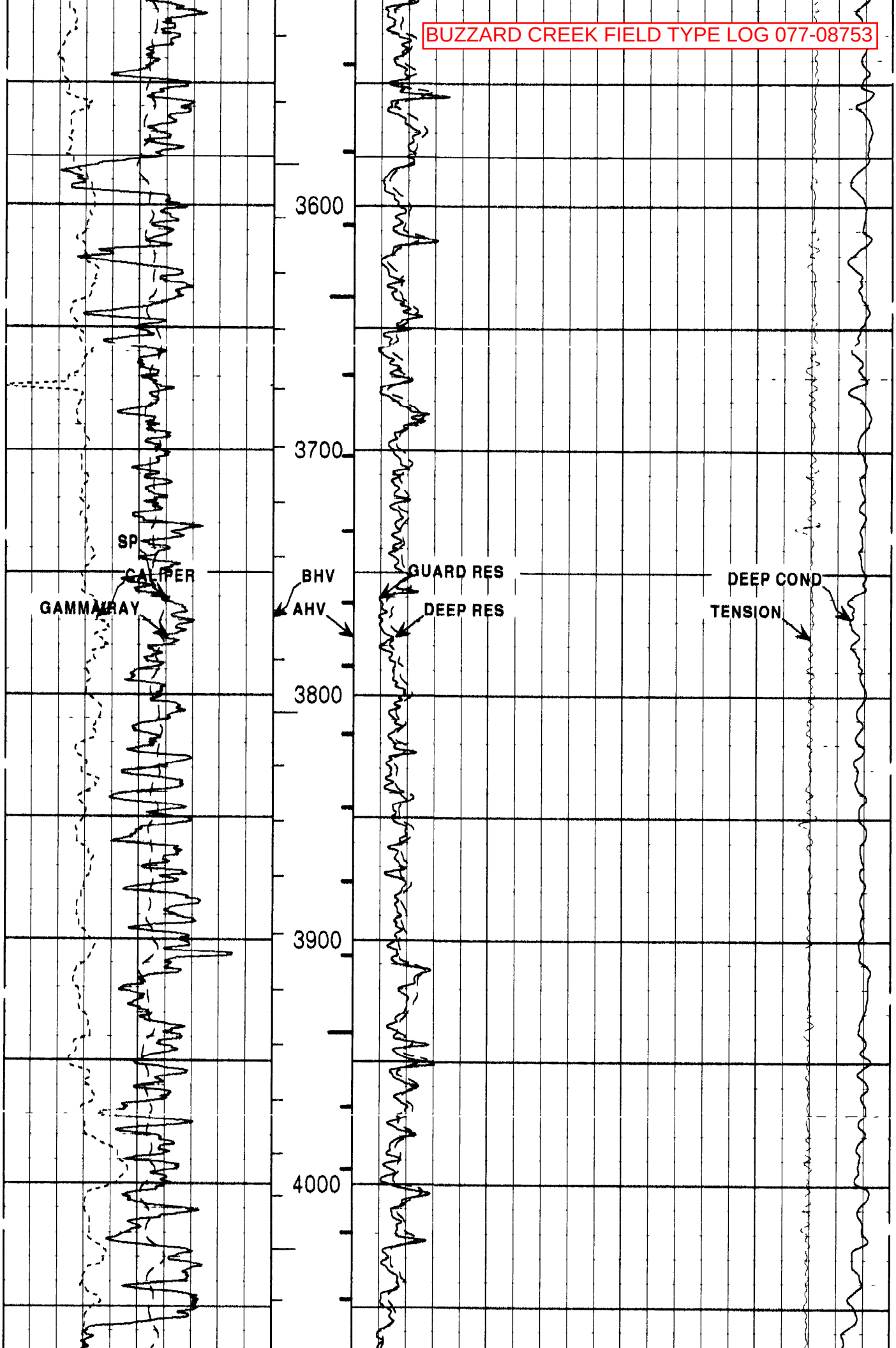
1500
CASING
1600
1700
1800

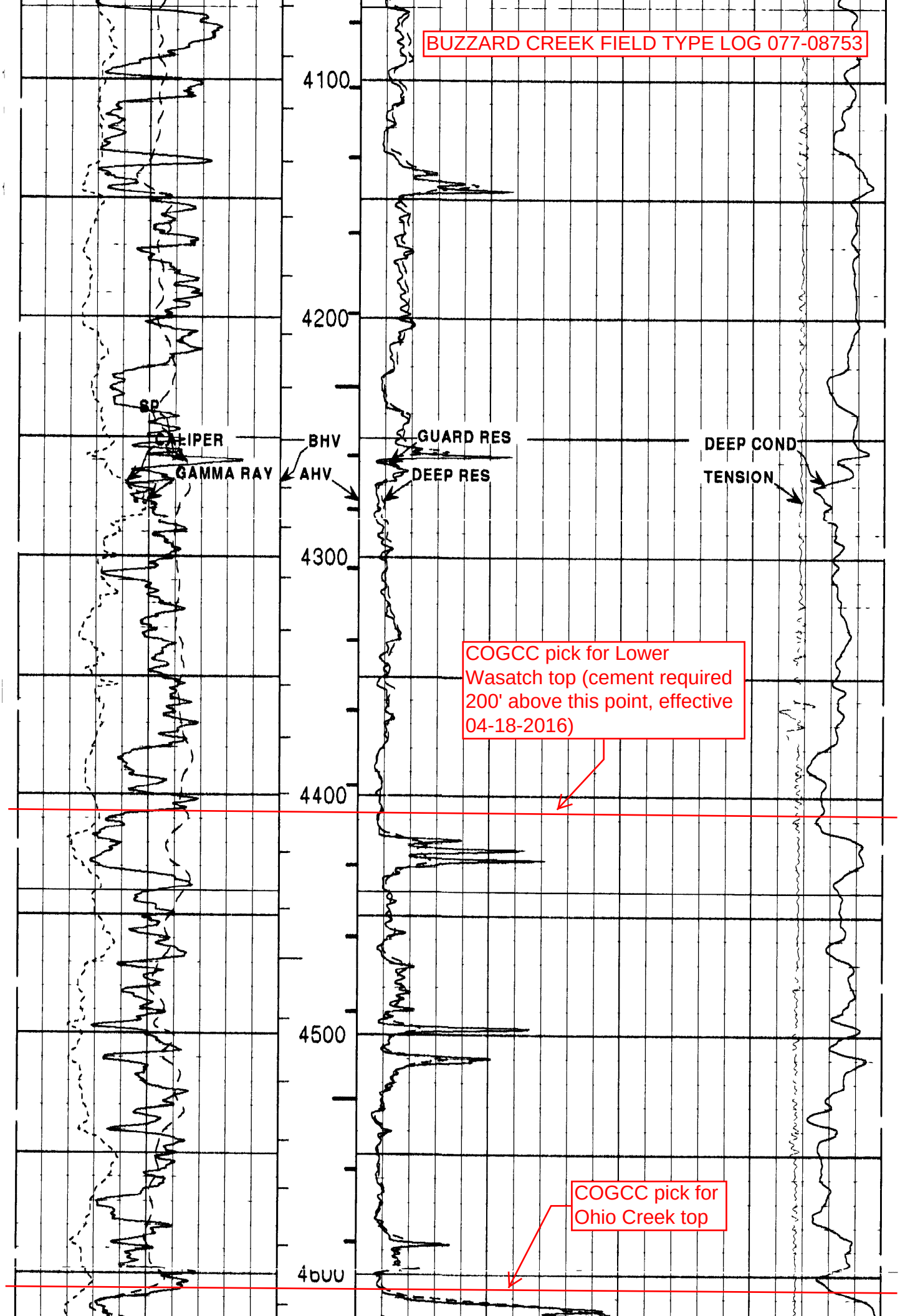
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION

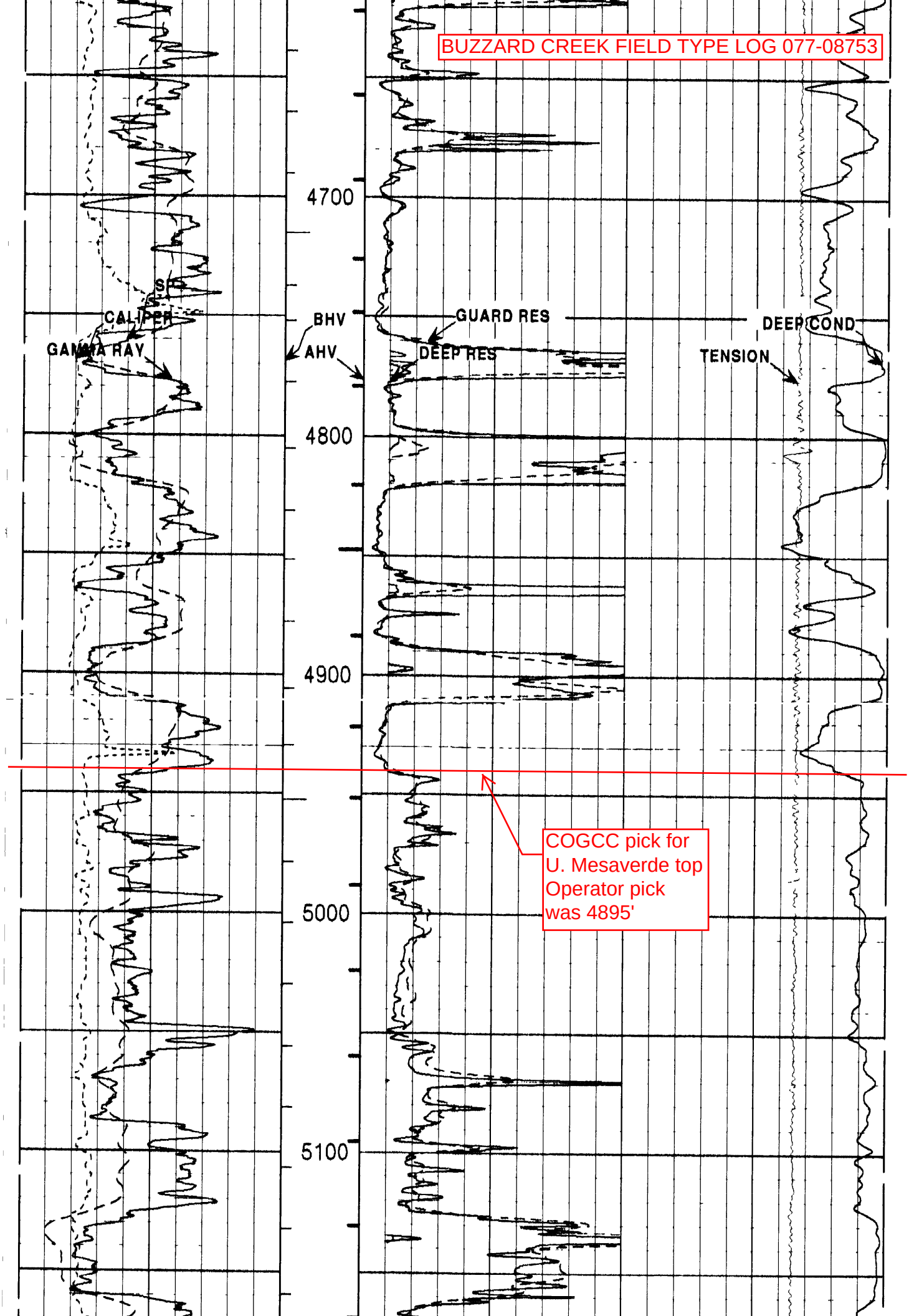

BUZZARD CREEK FIELD TYPE LOG 077-08753
1900
2000
2100
2200
2300
2400
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION

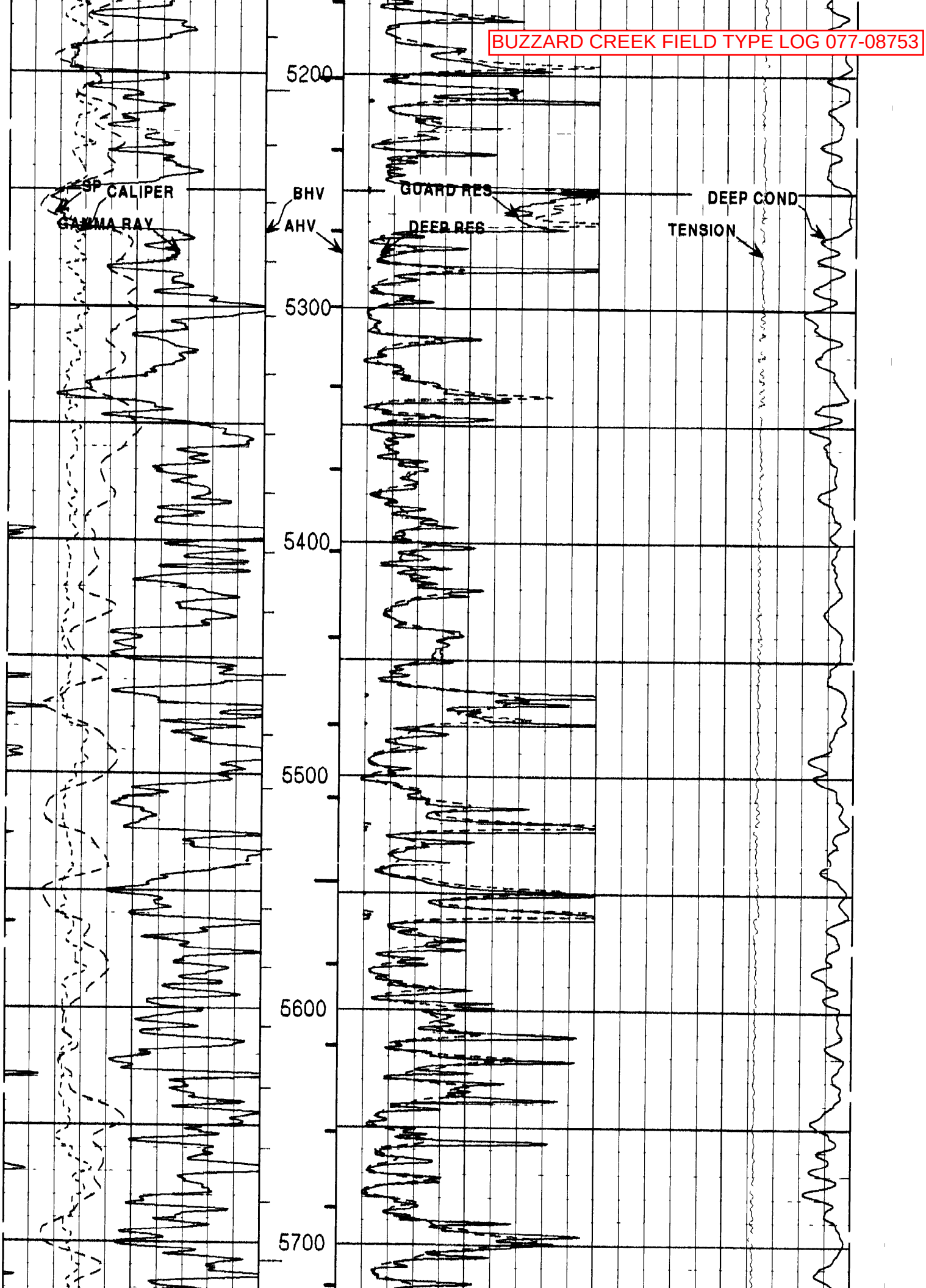

BUZZARD CREEK FIELD TYPE LOG 077-08753
2500
2600
2700
2800
2900
COGCC pick for Wasatch G Sand top (upper interval)
COGCC pick for Wasatch G Sand top (lower interval)
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION

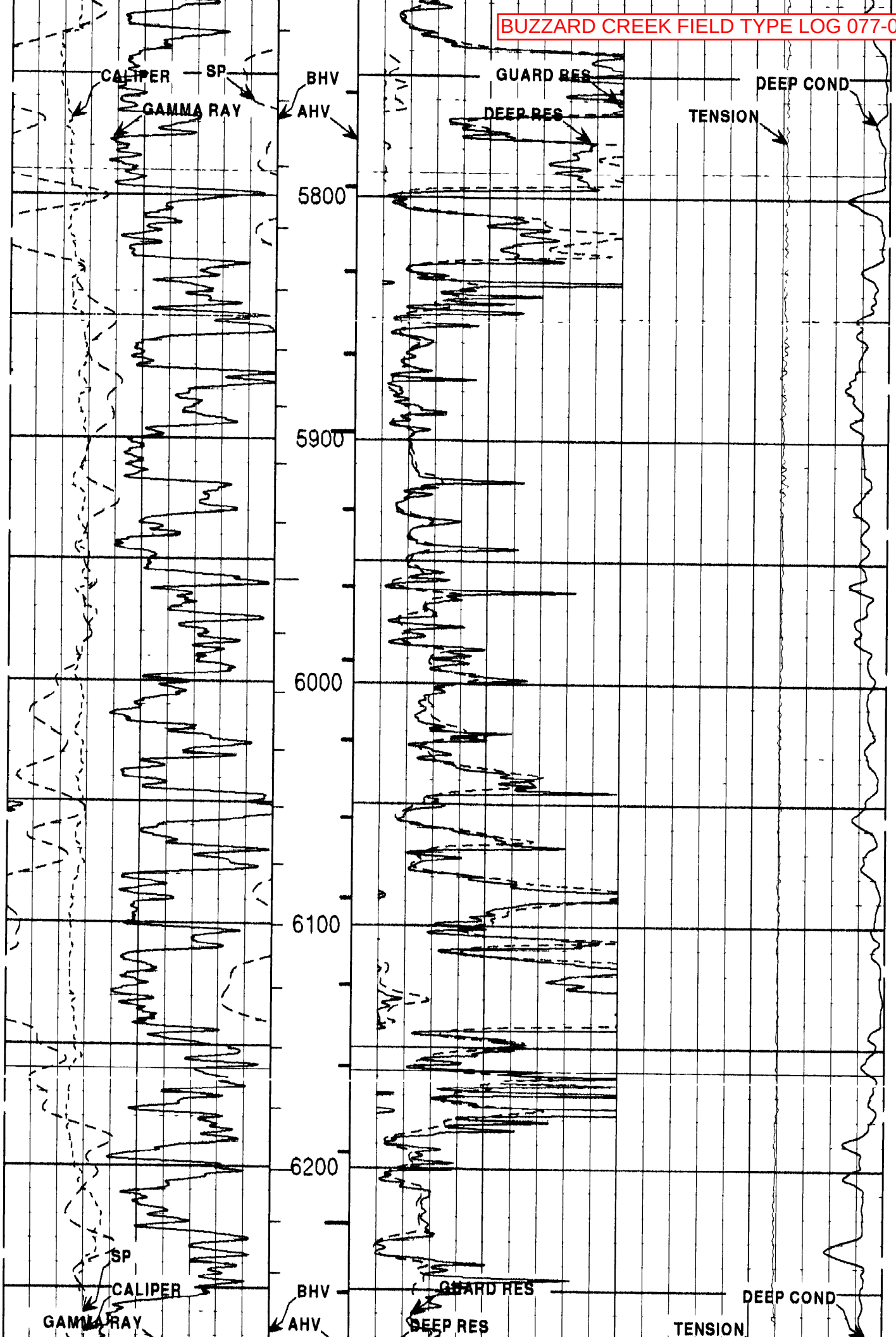

BUZZARD CREEK FIELD TYPE LOG 077-08753
3000
3100
3200
3300
3400
3500
COGCC pick for
Fort Union top
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION

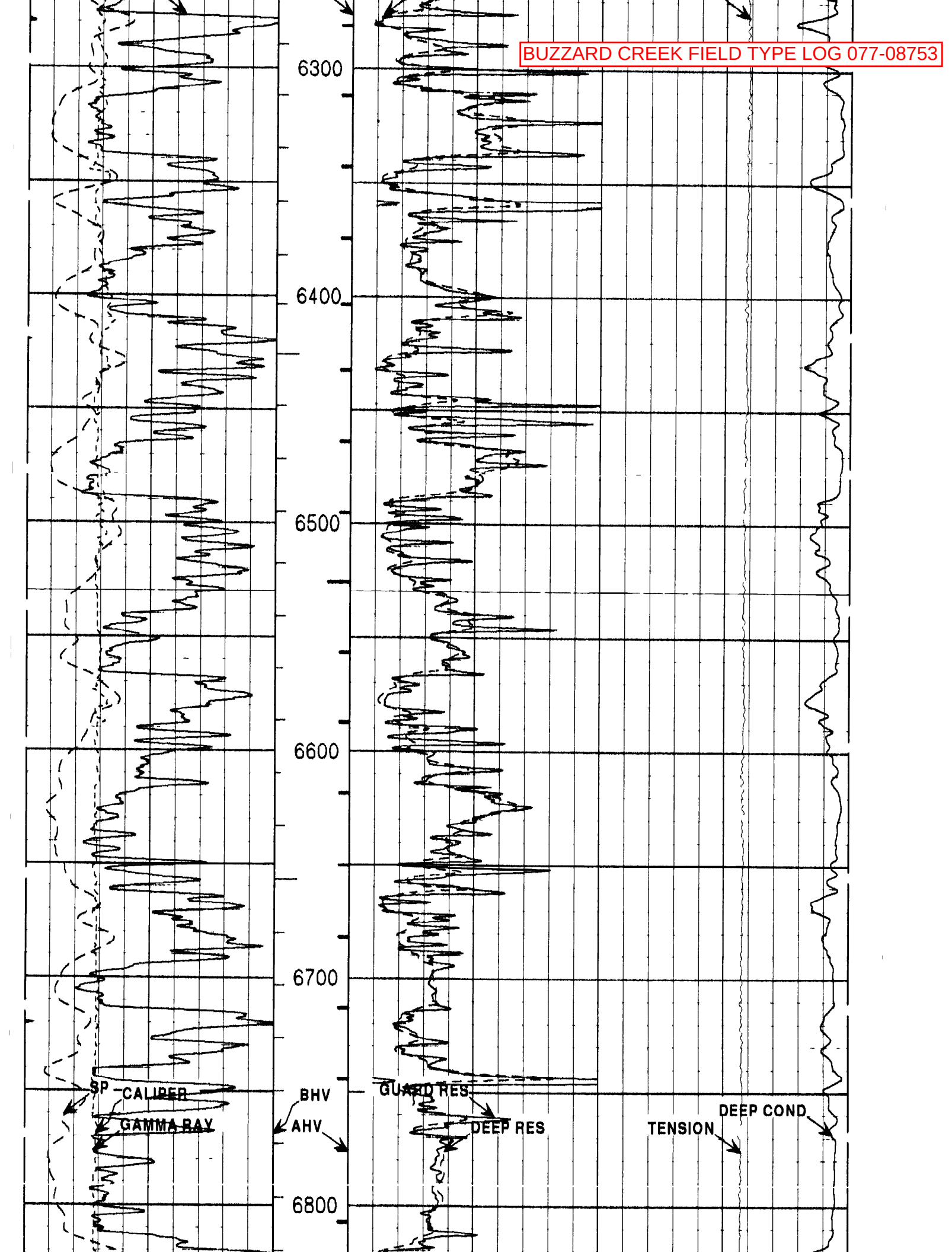

BUZZARD CREEK FIELD TYPE LOG 077-08753
3600
3700
3800
3900
4000
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION

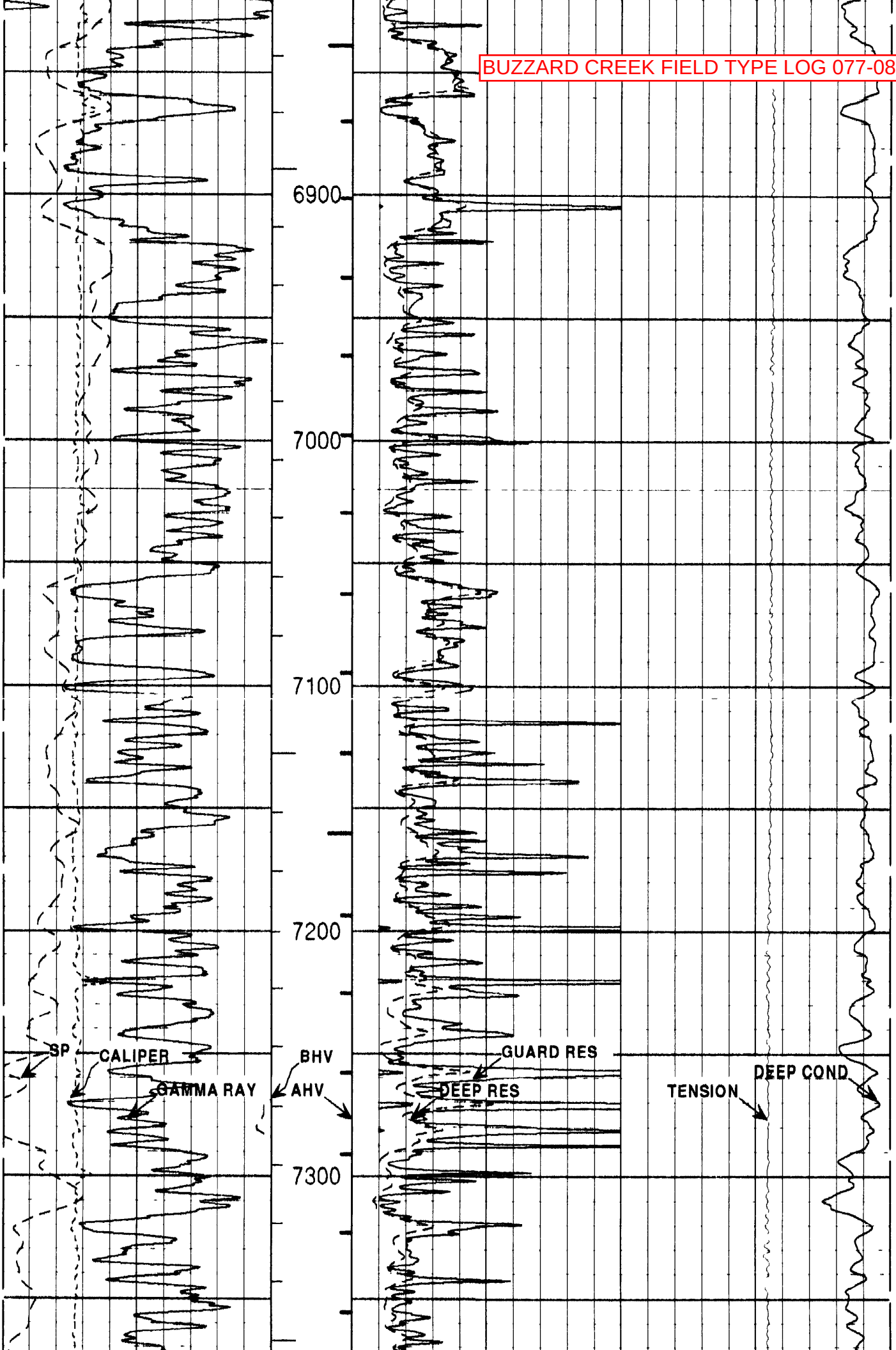

BUZZARD CREEK FIELD TYPE LOG 077-08753
4100
4200
4300
4400
4500
4600
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION
COGCC pick for Lower Wasatch top (cement required 200' above this point, effective 04-18-2016)
COGCC pick for Ohio Creek top

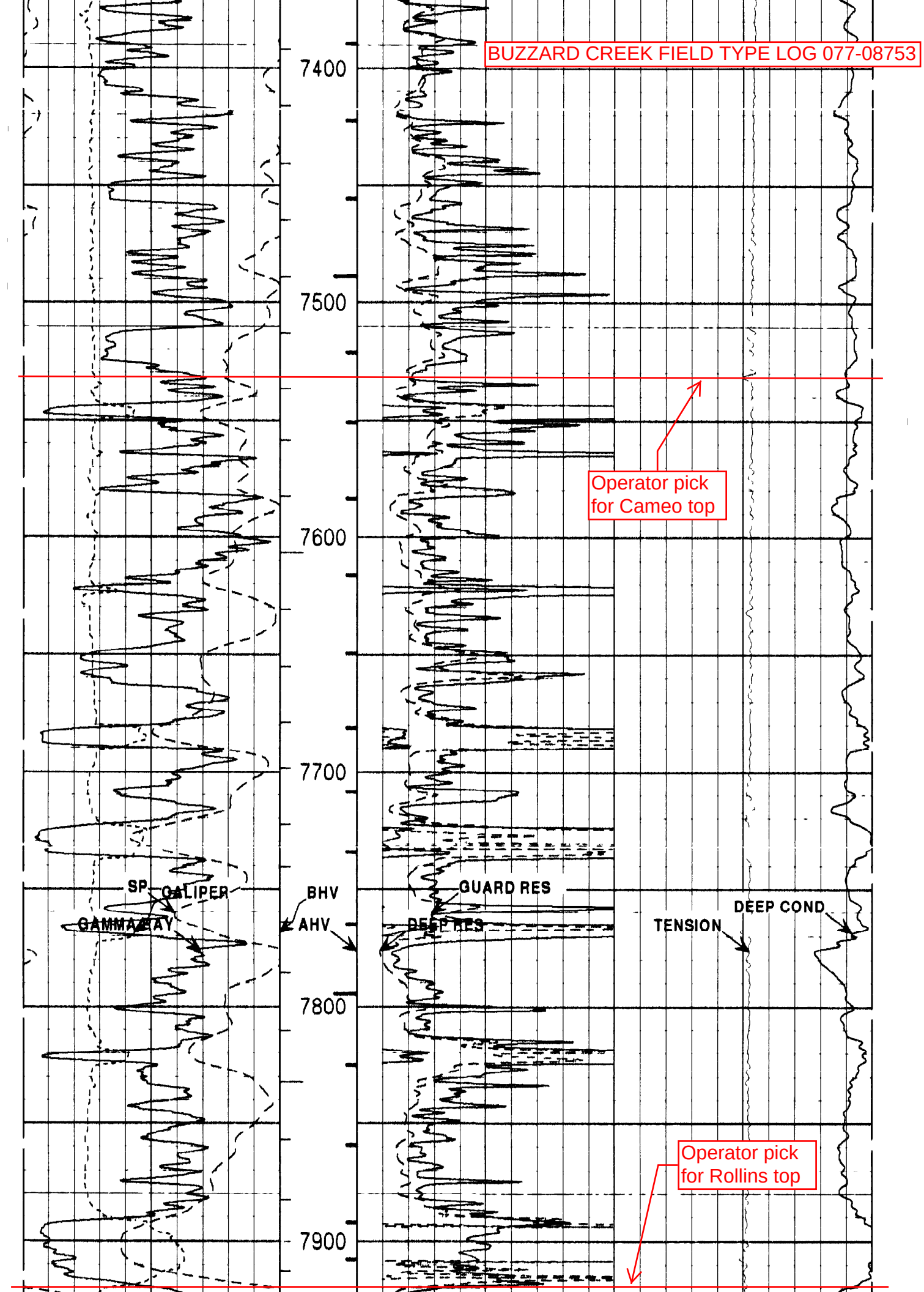

BUZZARD CREEK FIELD TYPE LOG 077-08753
4700
4800
4900
5000
5100
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION
COGCC pick for
U. Mesaverde top
Operator pick
was 4895'

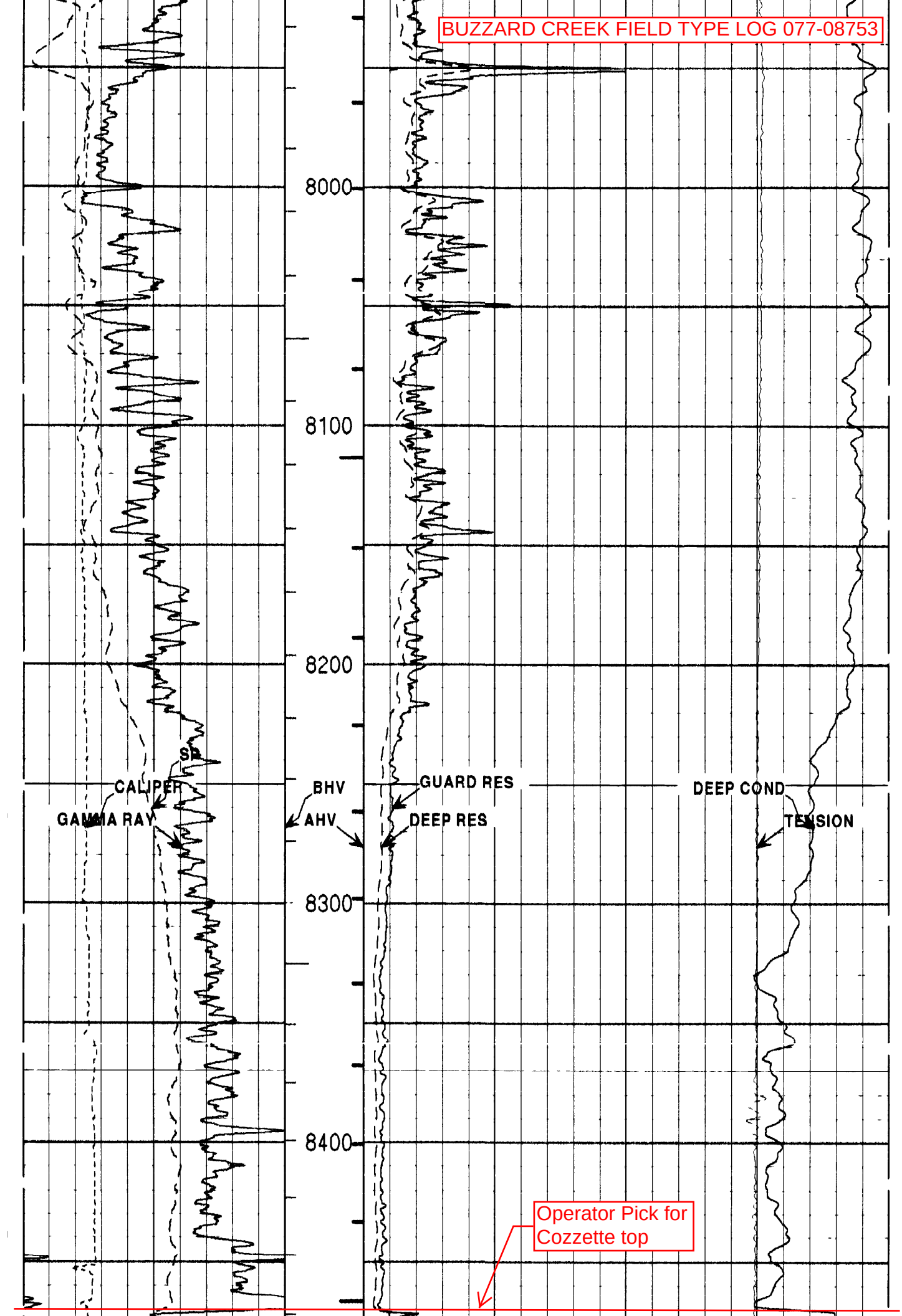

BUZZARD CREEK FIELD TYPE LOG 077-08753
5200
5300
5400
5500
5600
5700
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION

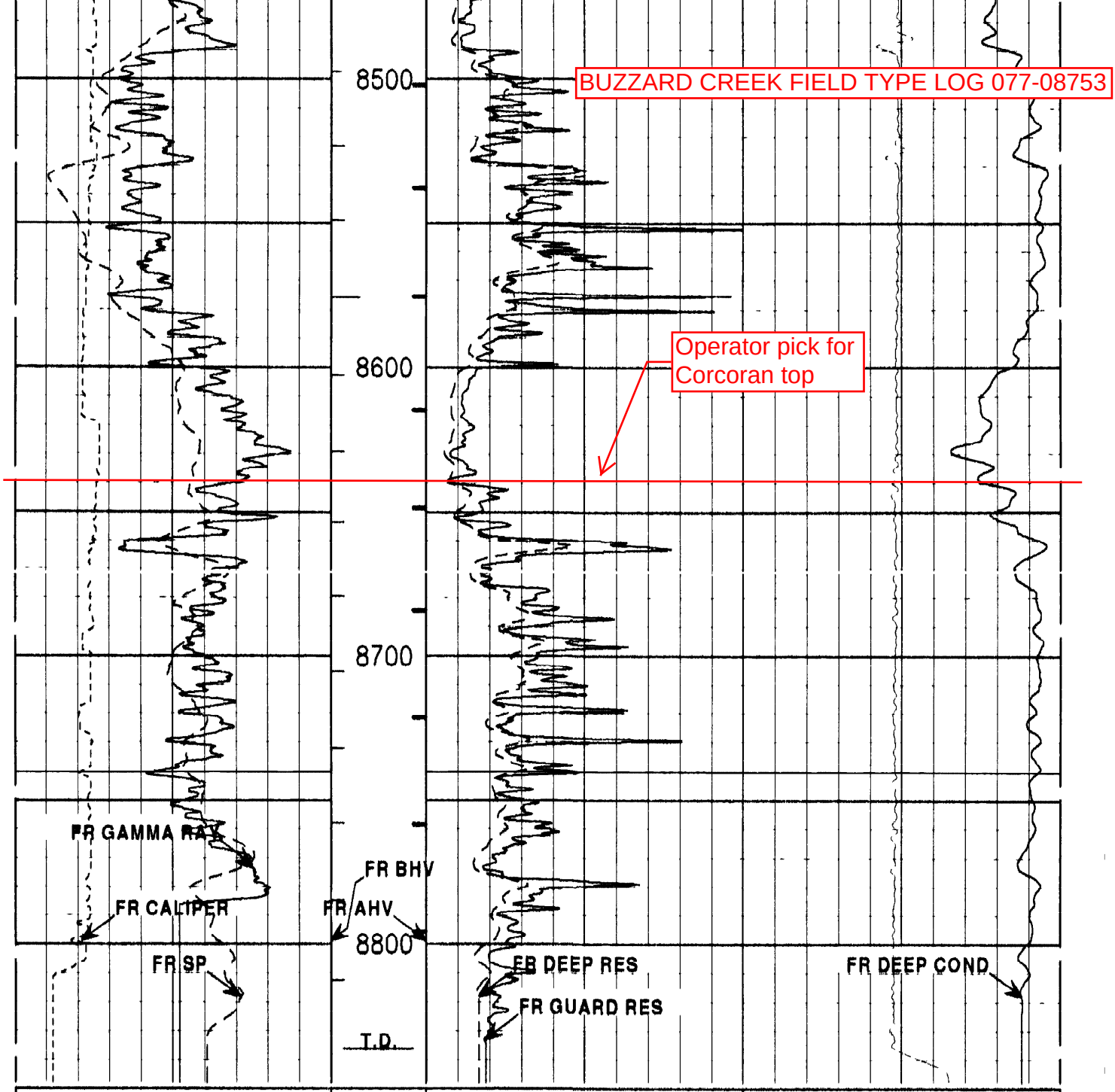

BUZZARD CREEK FIELD TYPE LOG 077-08753
CALIPER
SP
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION
5800
5900
6000
6100
6200
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION


BUZZARD CREEK FIELD TYPE LOG 077-08753
6300
6400
6500
6600
6700
6800
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
TENSION
DEEP COND


BUZZARD CREEK FIELD TYPE LOG 077-08753
6900
7000
7100
7200
7300
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
TENSION
DEEP COND


BUZZARD CREEK FIELD TYPE LOG 077-08753
7400
7500
7600
7700
7800
7900
Operator pick for Cameo top
Operator pick for Rollins top
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
TENSION
DEEP COND


BUZZARD CREEK FIELD TYPE LOG 077-08753
8000
8100
8200
8300
8400
SP
CALIPER
GAMMA RAY
BHV
AHV
GUARD RES
DEEP RES
DEEP COND
TENSION
Operator Pick for
Cozzette top



HALLIBURTON

Version No	4 64 I hc 3 0
Data File	mesa_bcu14-8trp 3 cls
Format File	/field_data/data2/mesa_bcu14-8trp/DIL2IN spc
Plot Time	2002-04-17 16 18 26
Log Time	2002-04-17 13 47 54
Top Depth	1444 83
Bottom Depth	8847 50

COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056117

FIELD NAME	**DIVIDE CREEK**
FIELD NUMBER	**16900**

LOCATION

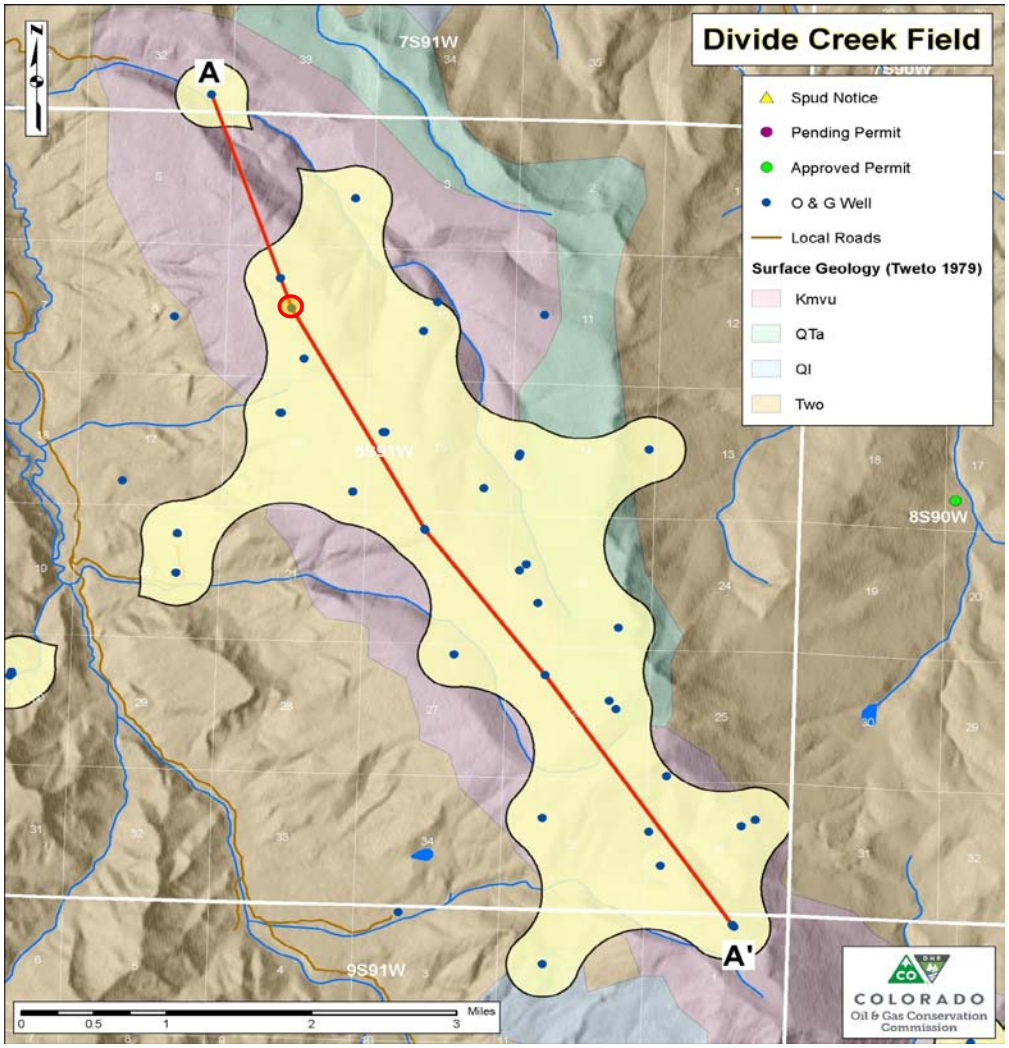
Basin	Piceance
Township(s)	7S to 9S
Range(s)	90W to 91W

SURFACE GEOLOGY

Surface Geology consists of alluvium along the eastern side of the field and landslide deposits near the northern and southern ends of the field, underlain by the Wasatch Formation. The Mesaverde Group outcrops in the center, along the long axis of the field.

GEOLOGIC STRUCTURE

A northwest - southeast trending anticline is present on COGCC's 250K GIS Geology layer through the long axis of the field; a northwest-southeast trending, northeasterly-sloping monocline is present within two miles west of the field.



Type Log Well

COGCC OIL AND GAS FIELD SCOUT CARD
DIVIDE CREEK #16900

				A - Northwest				A' - Southeast
STRATIGRAPHY			**API Number =>**	**045-65361**	**045-05208**	**077-08586**	**077-08590**	**077-08812**
			Surface Elevation =>	**7,581**	**8,943**	**9,432**	**9,762**	**10,226**
All depths are measured depths			**Well Type =>**	**Vertical**	**Vertical**	**Vertical**	**Vertical**	**Directional**
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water					
	Landslide Deposit		Water					
	Wasatch	Upper*	Shallow Water					
	Wasatch	Middle*	None					
Mesaverde	Wasatch	Lower*	Water					
Mesaverde	Williams Fork	U. Mesaverde	Water	0	0	0	0	0
Mesaverde	Williams Fork	Top of Gas	Gas					
Mesaverde	Williams Fork	Cameo	Gas	2,580		2,952	2,777	
Mesaverde	Iles	Rollins	Gas	3,260*	3,925	3,745	3,695	4,131
Mesaverde	Iles	Cozzette	Gas / UIC	3,917	4,583			4,529
Mesaverde	Iles	Corcoran	Gas / UIC	4,160	4,845			4,793
	Mancos		Possible Gas					5,010*
	Niobrara		Possible Gas					10,191
	Frontier		Possible Gas					
Dakota	Dakota		Possible Gas					11,752
	Morrison		Possible Gas					

Annotated Type Log for 045-05208: COGCC Document Number 2056079

** COGCC log picks ("Upper Wasatch" and "Middle Wasatch" are intervals that may include multiple formation members and may be present along the eastern and western fringes of the field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

WATER RESOURCE ISOLATION

Alluvium, Landslide Deposits, Wasatch, Ohio Creek, and Upper Mesaverde.
The deepest water well within the vicinity of the field is 290' (likely Wasatch)

PRODUCING ZONE ISOLATION

Primary Objectives: Mesaverde Group (Cameo, Rollins, Cozzette, and Corcoran)
Secondary Objective: Williams Fork (interval above Cameo) and Mancos (completed in one well)

UNDERGROUND INJECTION CONTROL

API Number	Well Name and Number	Type	Zone	Sample Top	Sample Bottom	TDS	Source
045-05208	Divide Creek Unit #12-WD	Disposal	Corcoran	4,853	4,951	19,548	SWAB - 10/6/1983
045-05208	Divide Creek Unit #12-WD	Disposal	Cozzette	4,605	4,655	18,415	TBG - 5/28/1985
045-05022	Divide Creek Unit #6	Source	Mesaverde	0	570	4,076	SURF OH - 10/10/1975
045-06467	Divide Creek Unit #21	Source	Cameo Coal	3,659	3,739	9,910	SWAB OH - 9/27/1984
045-06467	Divide Creek Unit #21	Source	Cameo Coal	3,659	3,739	10,402	SWAB OH - 9/27/1984

COGCC OIL AND GAS FIELD SCOUT CARD
DIVIDE CREEK #16900

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

143-1 (6/23/1959)	Mesaverde Group: Recognizes all Mesaverde Group formations as a **Common Source** of gas. Establishes 640-acre drilling and spacing units, 900' from unit line. Minimum 250' surface casing requirement and leakoff testing required.
Various	Various orders delete certain lands from the requirements of 143-1, in favor of tighter spacing (reverts to statewide requirements).
1-107 (9/20/2004)	Establishes a Bradenhead Monitoring Area, including the Divide Creek Field.

HISTORIC WELL CONSTRUCTION

Surface casing setting depths generally range from 300' to 700' in older wells. Newer wells have surface casing setting depths of 900' or deeper (up to 2,500'). Production casing generally terminates in the Iles Formation. Some wells have intermediate casing. Production casing cement may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and any overlying formations (where present).

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 250' (per Commission order) or 10% TVD required for well control (Cementing NTO), whichever is more stringent to cover water resources in the Wasatch Formation. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. Recommend cementing intermediate or production casing at least 200' into the surface casing for full coverage of these zones, including the Wasatch Formation, if not otherwise covered by surface casing. Full cement coverage area is defined for sections and partial sections within an approximate one-mile buffer around the Mesaverde outcrop.

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug above Ohio Creek (if present) and across Lower Wasatch (squeeze to 500' above Lower Wasatch, if present with no annular cement coverage); stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000-foot intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug. Larger surface casing shoe plugs should be considered for wells with less than 1,000' of surface casing.

NOTES

This field is located within the Mamm Creek Field Cementing Notice to Operators Area (Cementing NTO). Special requirements and Form 2 Conditions of Approval apply.
This field is located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.
Well Control: Controlled gas kick reported for 077-10210 on 9/22/2013 while drilling in the Niobrara Formation.

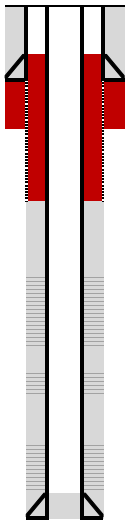
ISOLATION REQUIREMENTS FOR TYPICAL WELLS

Date 04/18/2016 **COGCC Document No.** 2056118

FIELD NAME **DIVIDE CREEK**
FIELD NUMBER **16900**

LOCATION
Basin Piceance
Township(s) 7S to 9S
Range(s) 90W to 91W

Depth	Formation/Member
0	U. Mesaverde
1,000	
2,000	
3,000	Cameo
	Rollins
4,000	
	Cozzette
	Corcoran
5,000	



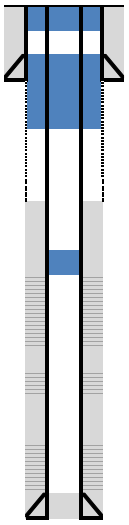
Casing and Cement Coverage

New Surface Casing Standard
Minimum 250', 10% TVD, or cover all apparent water resources in the Wasatch Formation (where present), whichever is more stringent.

New Cement Standard
Full coverage required up into surface casing.

Typical Older Well Configuration
TOC covers productive intervals, but full cement coverage of the Mesaverde Group may be lacking.

Depth	Formation/Member
0	U. Mesaverde
1,000	
2,000	
3,000	Cameo
	Rollins
4,000	
	Cozzette
	Corcoran
5,000	



Plug Placement

Surface plug

Surface casing shoe plug

Set deeper shoe plug if casing depth < 1,000 feet

Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 feet); not shown on this figure

Plug above Mesaverde Group Completions

DIVIDE CREEK FIELD TYPE LOG 045-05208

COGCC Document Number 2056079

04-18-2016

SCHLUMBERGER INDUCTION-ELECTRICAL LOG

SCHLUMBERGER WELL SURVEYING CORPORATION
Houston, Texas

COUNTY GARFIELD, COLO.
FIELD DIVIDE CREEK
WELL DIVIDE CREEK UNIT # 12
COMPANY SUN OIL COMPANY

045052O8

Location: SE - NW 6
Sec. 9 Twp. 8S Rge. 91W

COMPANY SUN OIL COMPANY
WELL DIVIDE CREEK UNIT # 12
FIELD DIVIDE CREEK UNIT
COUNTY GARFIELD STATE COLORADO

Other Services: A-SL. CDM S-GR/C

Permanent Datum: G.L. Elev. 8943
Log Measured From K.B., 12.4 Ft. Above Perm. Datum
Drilling Measured From K.B.

Elev.: K.B. 8955.4
D.F. -
G.L. 8943

Date	11-4-64		
Run No.	ONE		
Depth—Driller	5360		
Depth—Logger	5366		
Btm. Log Interval	5365		
Top Log Interval	307		OIL & GAS
Casing—Driller	9 5/8" @ 306	@	CONSERVATION COMMISSION @
Casing—Logger	307		
Bit Size	7 7/8"		
Type Fluid in Hole	CHEMICAL		
Dens. / Visc.	9.1 / 68		ml
pH / Fluid Loss	7.2 / 4.6 ml		
Source of Sample	FLOW LINE		
R_m @ Meas. Temp.	3.6 @ 68 °F	@ °F	@ °F
R_{mf} @ Meas. Temp.	3.25 @ 68 °F	@ °F	@ °F
R_{mc} @ Meas. Temp.	- @ - °F	@ °F	@ °F
Source: R_{mf} / R_{mc}	PRESSCHART		
R_m @ BHT	1.7 @ 149 °F	@ °F	@ °F
Time Since Circ.	4 HOURS		
Max. Rec. Temp.	147 °F		°F
Equip. / Location	2598 / G.J.		
Recorded By	MONTGOMERY		
Witnessed By	HEBERTSON		

NOV10 1964

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REMARKS

Changes in Mud Type or Additional Samples			Scale Changes			
Date / Sample No.			Type Log	Depth	Scale Up Hole	Scale Down Hole
Depth—Driller						
Type Fluid in Hole						
Dens. / Visc.						
ph / Fluid Loss		ml				
Source of Sample			Equipment Data			
R_m @ Meas. Temp.	@ °F	@ °F	Run No.	Tool Type	Tool Position	Other
R_{mf} @ Meas. Temp.	@ °F	@ °F				
R_{mc} @ Meas. Temp.	@ °F	@ °F				
Source: R_{mf} / R_{mc}						
R_m @ BHT	@ °F	@ °F				
R_{mf} @ BHT	1.5 @ 147 °F	@ °F				
R_{mc} @ BHT	1.5 @ 147 °F	@ °F				

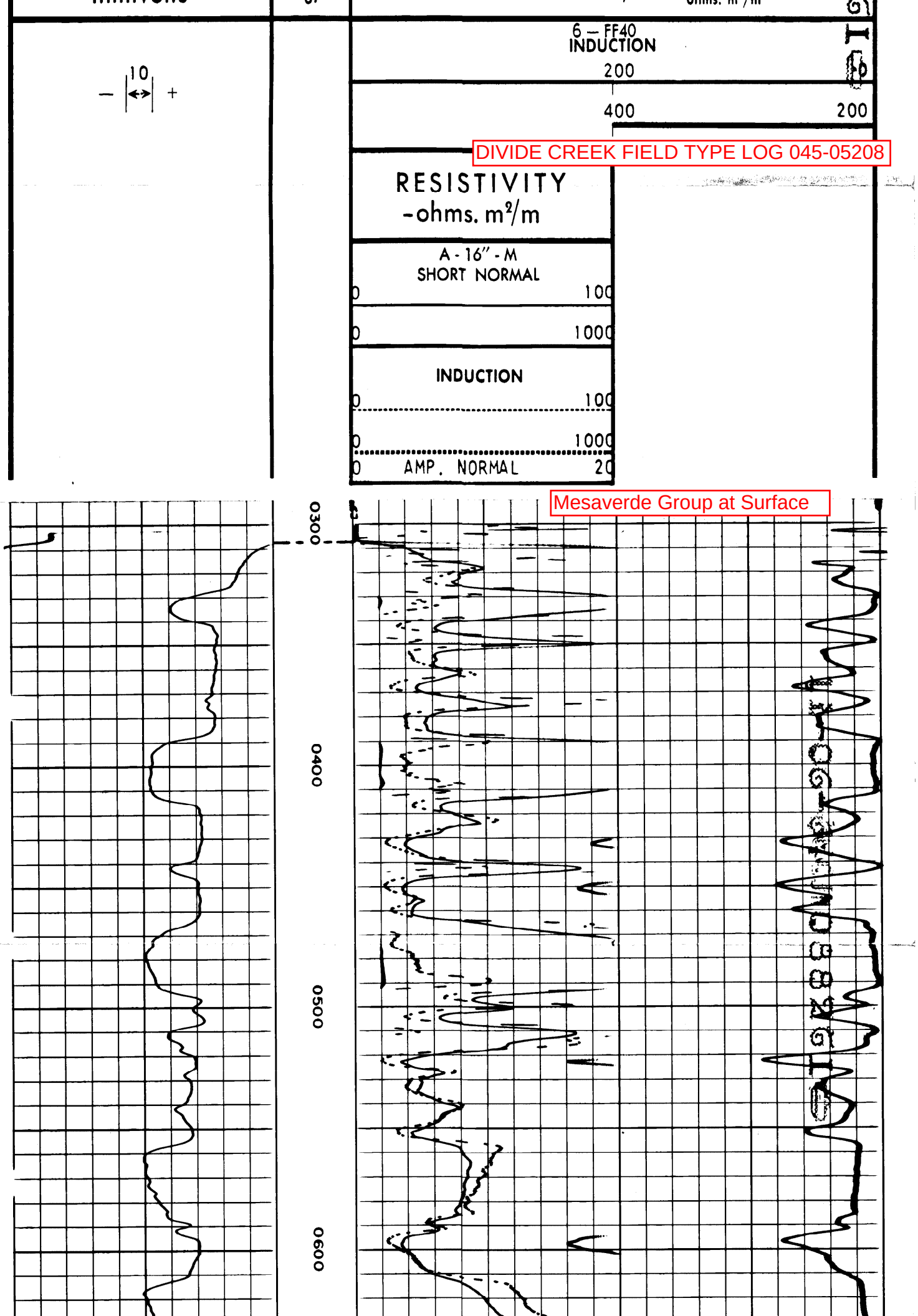
C.D.: USED S.O.: = 1 1/2"
Equip. Used: CART. No. F
PANEL No. F 71
SONDE No. M
SBR 4

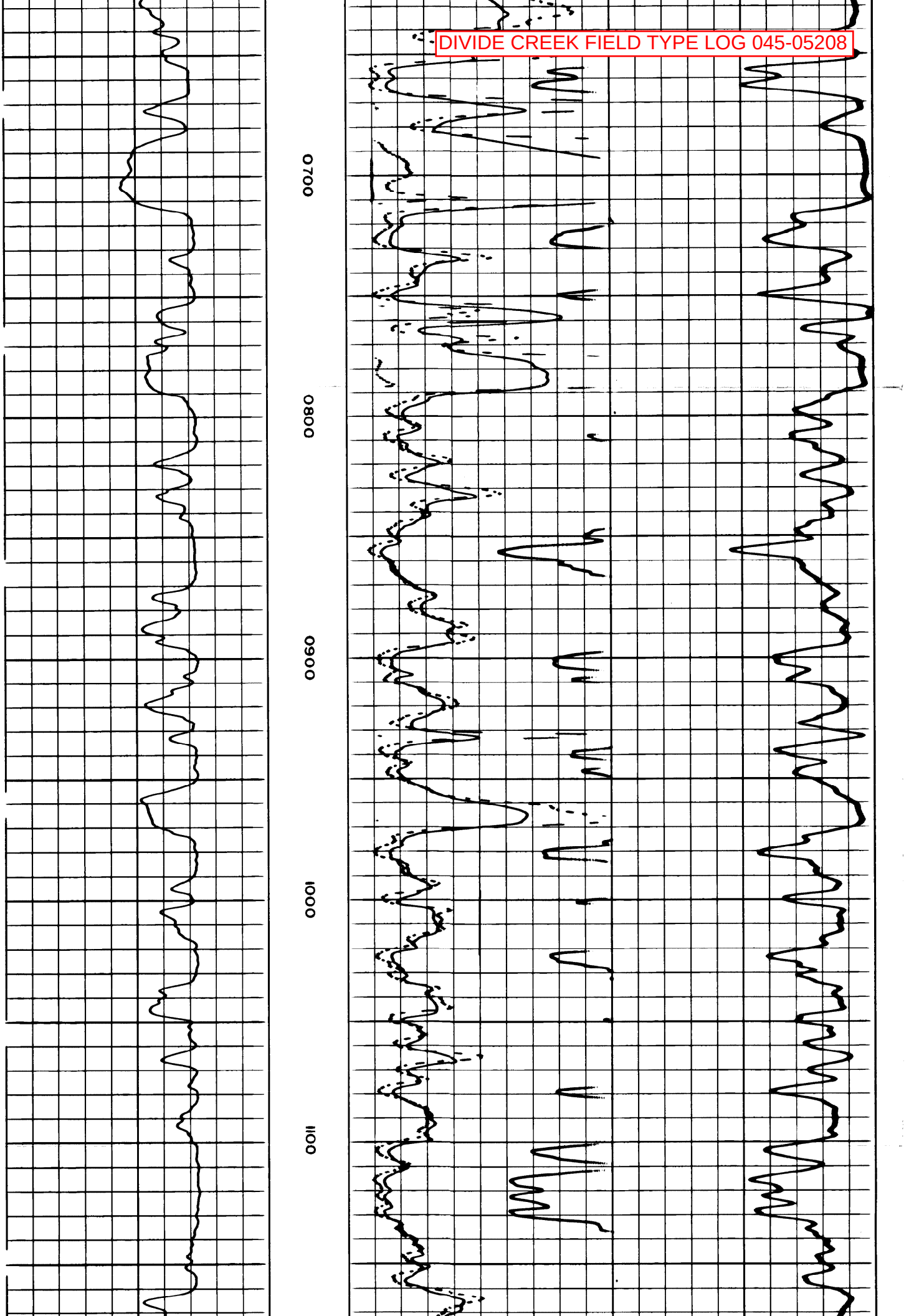
1-106-8-45 JN 0 8 82

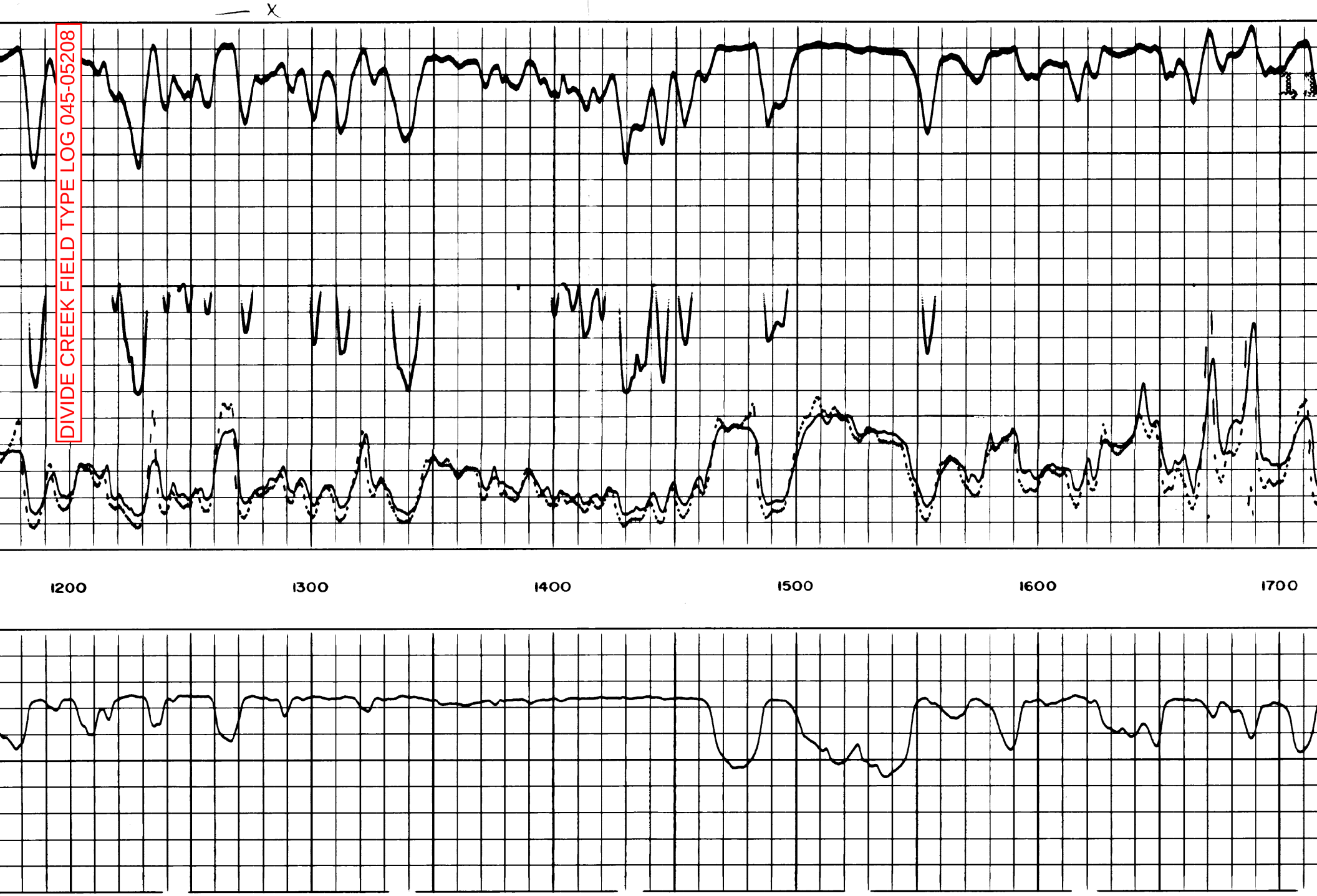
SPONTANEOUS-POTENTIAL
millivolts

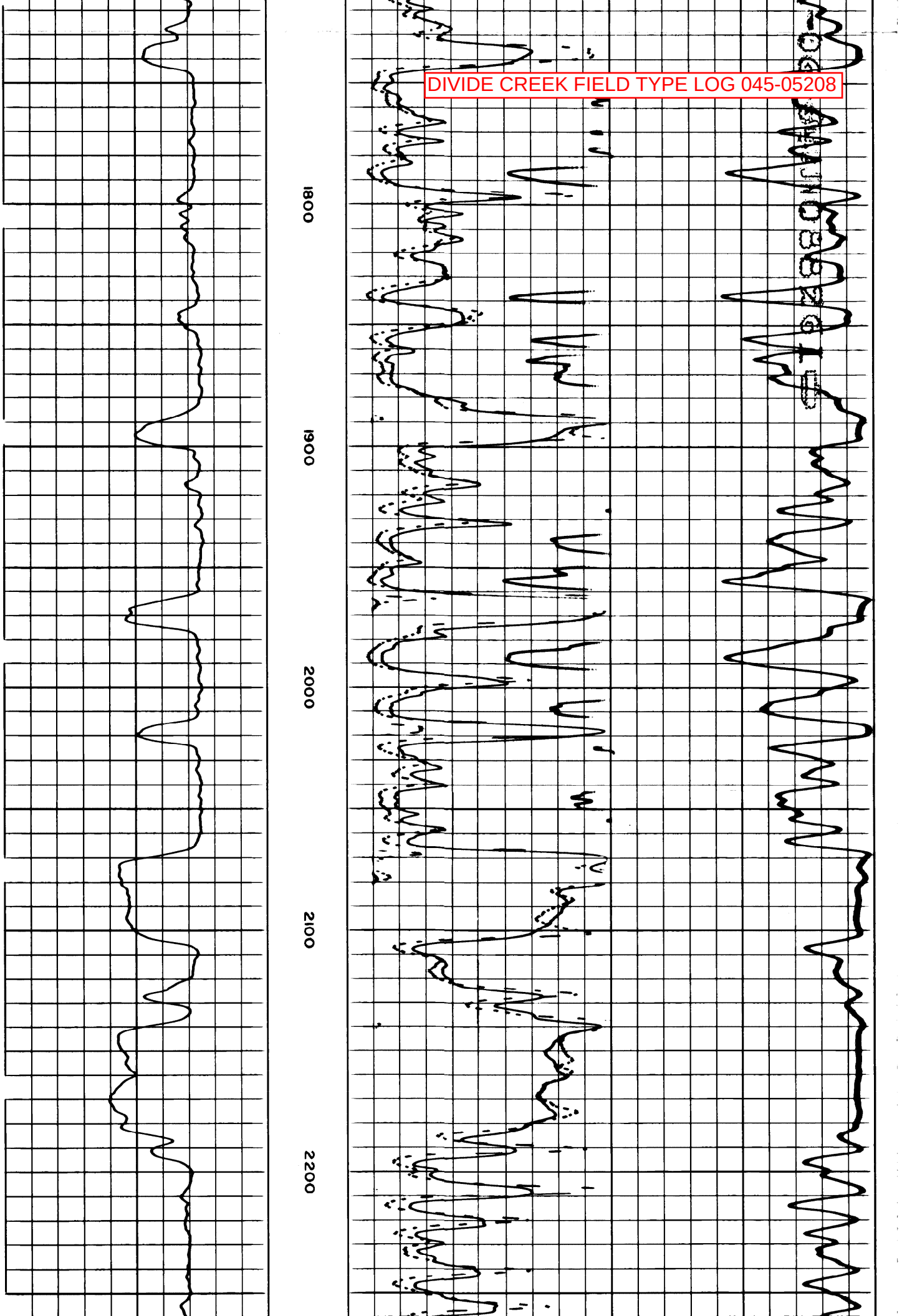
DEPTHS

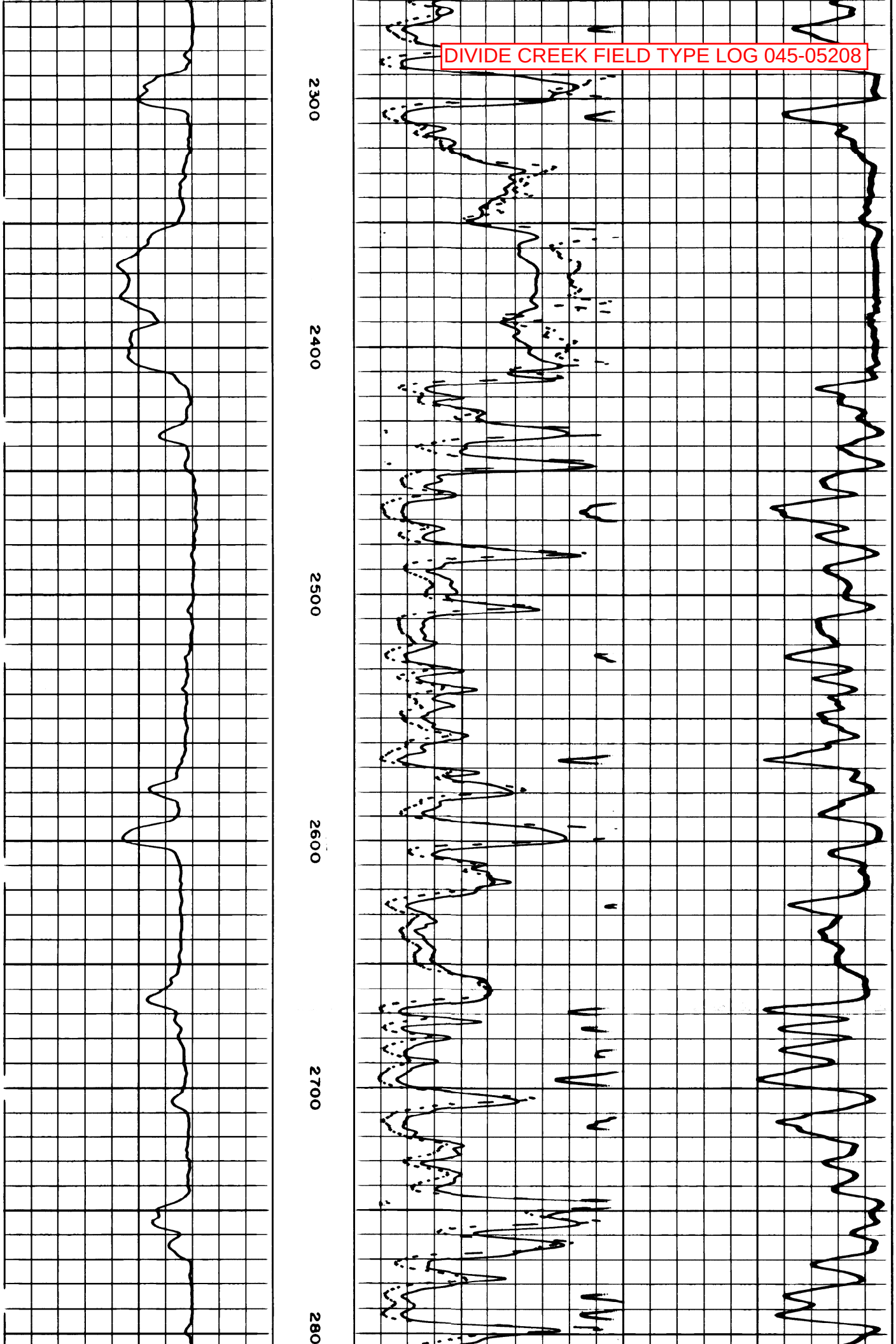
CONDUCTIVITY
millimhos/m = $\frac{1000}{\text{ohms-m}^2/\text{m}}$

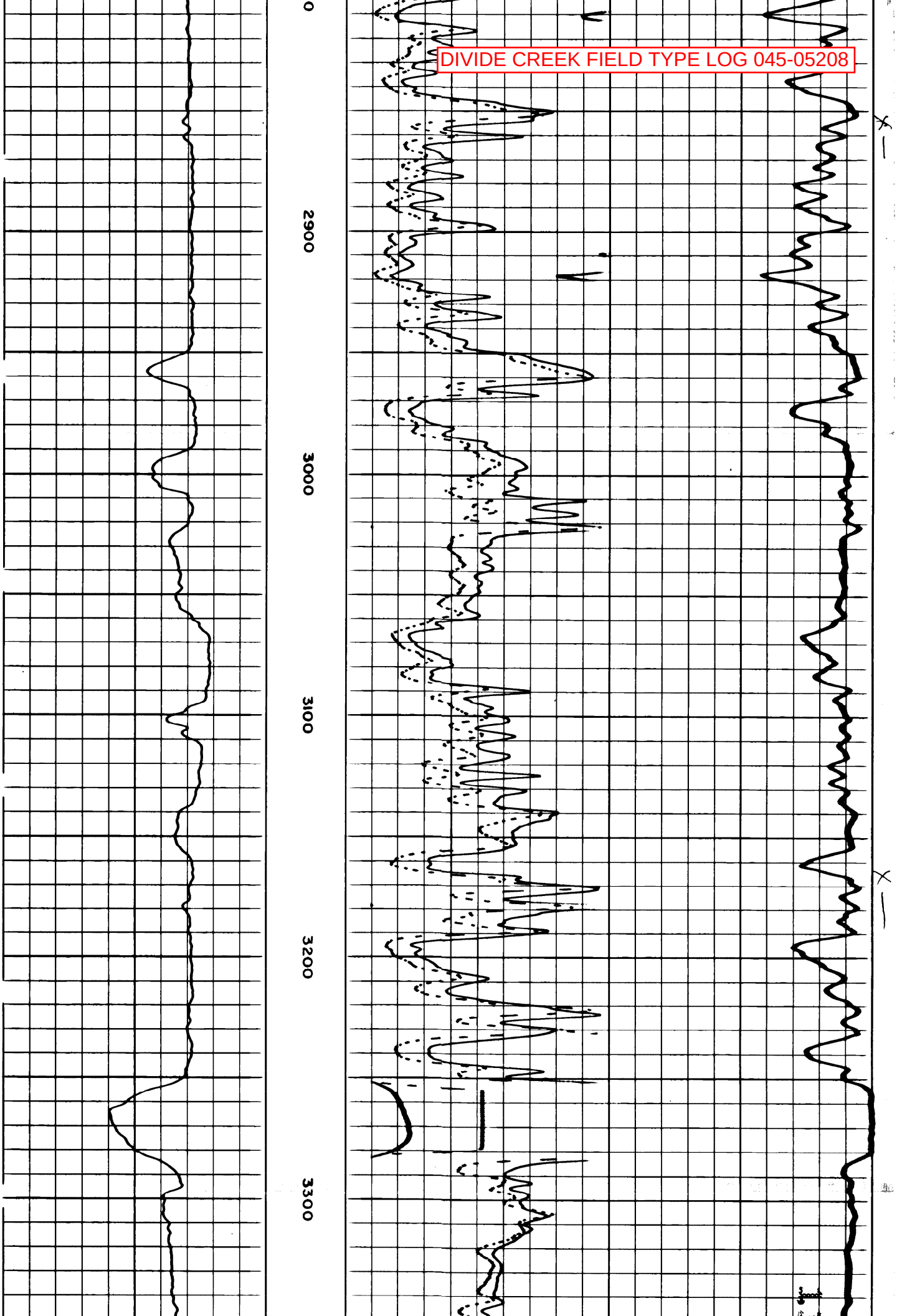

10
6 — FF40
INDUCTION
200
400
200
DIVIDE CREEK FIELD TYPE LOG 045-05208
RESISTIVITY
-ohms. m²/m
A - 16" - M
SHORT NORMAL
0
100
0
1000
INDUCTION
0
100
0
1000
0
AMP. NORMAL
20
Mesaverde Group at Surface
0300
0400
0500
0600


DIVIDE CREEK FIELD TYPE LOG 045-05208
0700
0800
0900
1000
1100

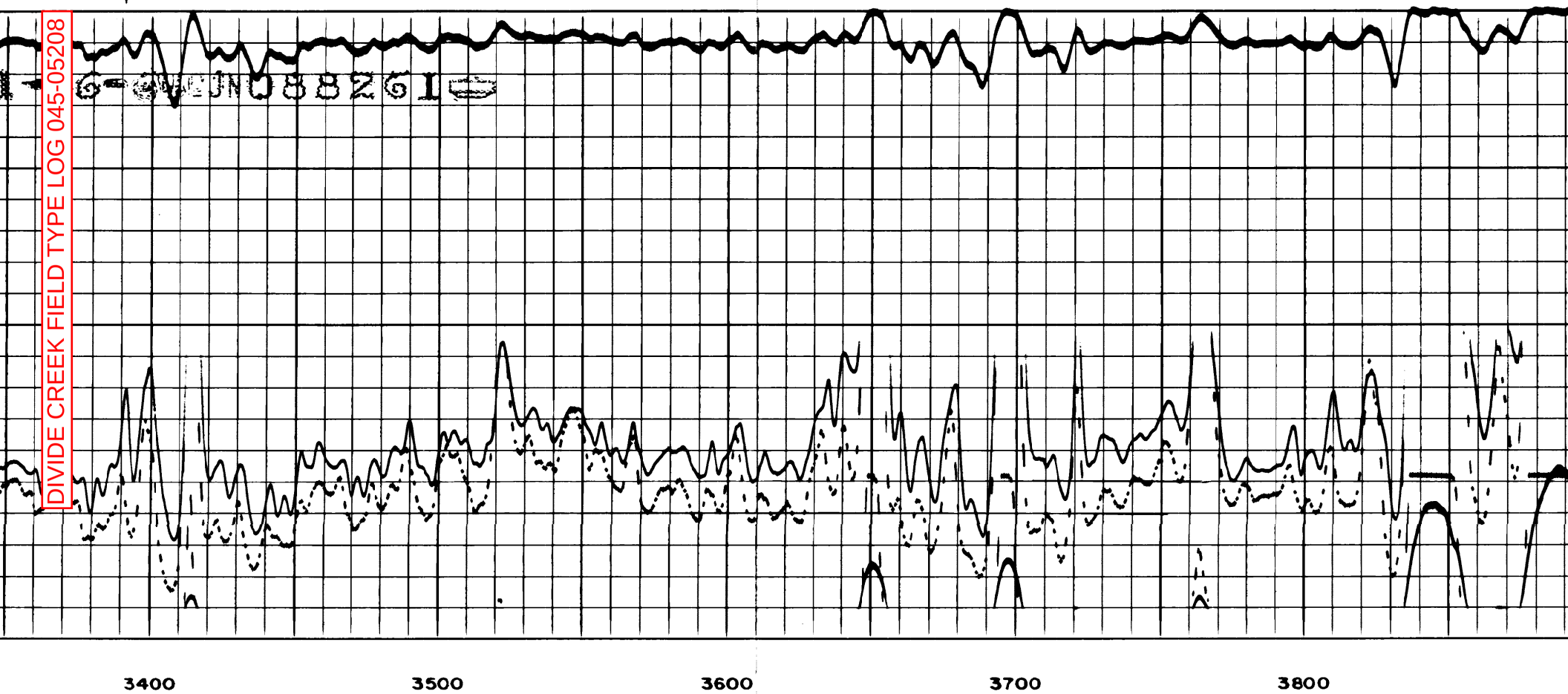

DIVIDE CREEK FIELD TYPE LOG 045-05208
1200
1300
1400
1500
1600
1700


DIVIDE CREEK FIELD TYPE LOG 045-05208
1800
1900
2000
2100
2200

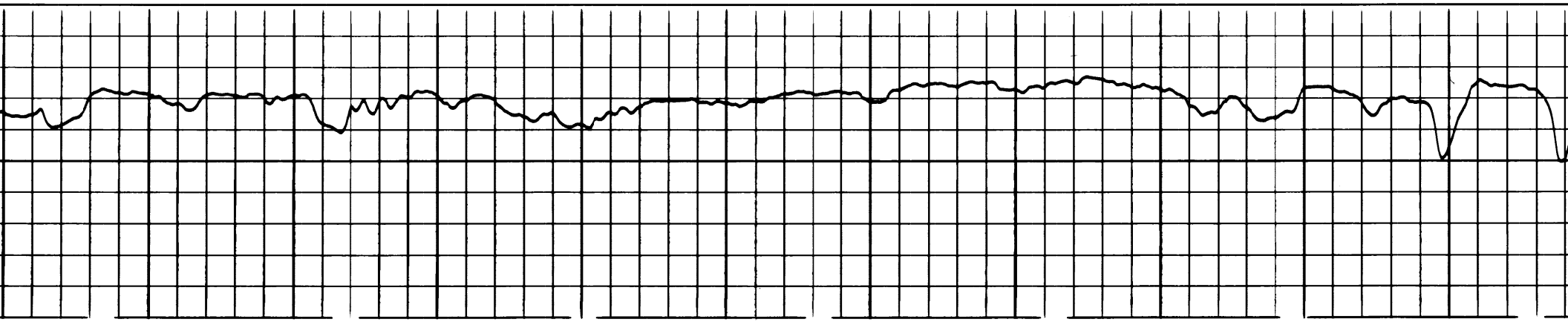

DIVIDE CREEK FIELD TYPE LOG 045-05208
2300
2400
2500
2600
2700
2800

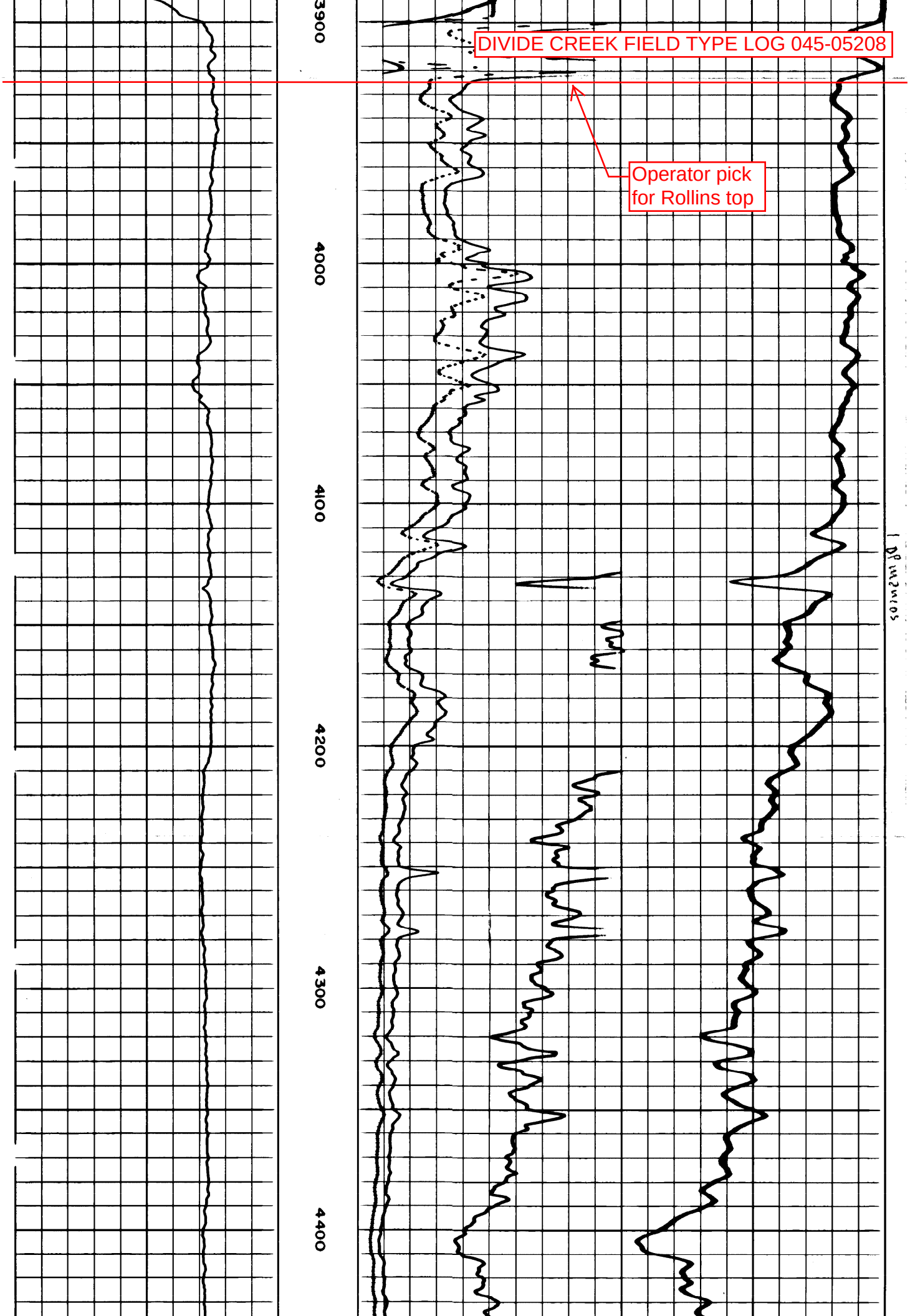

DIVIDE CREEK FIELD TYPE LOG 045-05208
2900
3000
3100
3200
3300

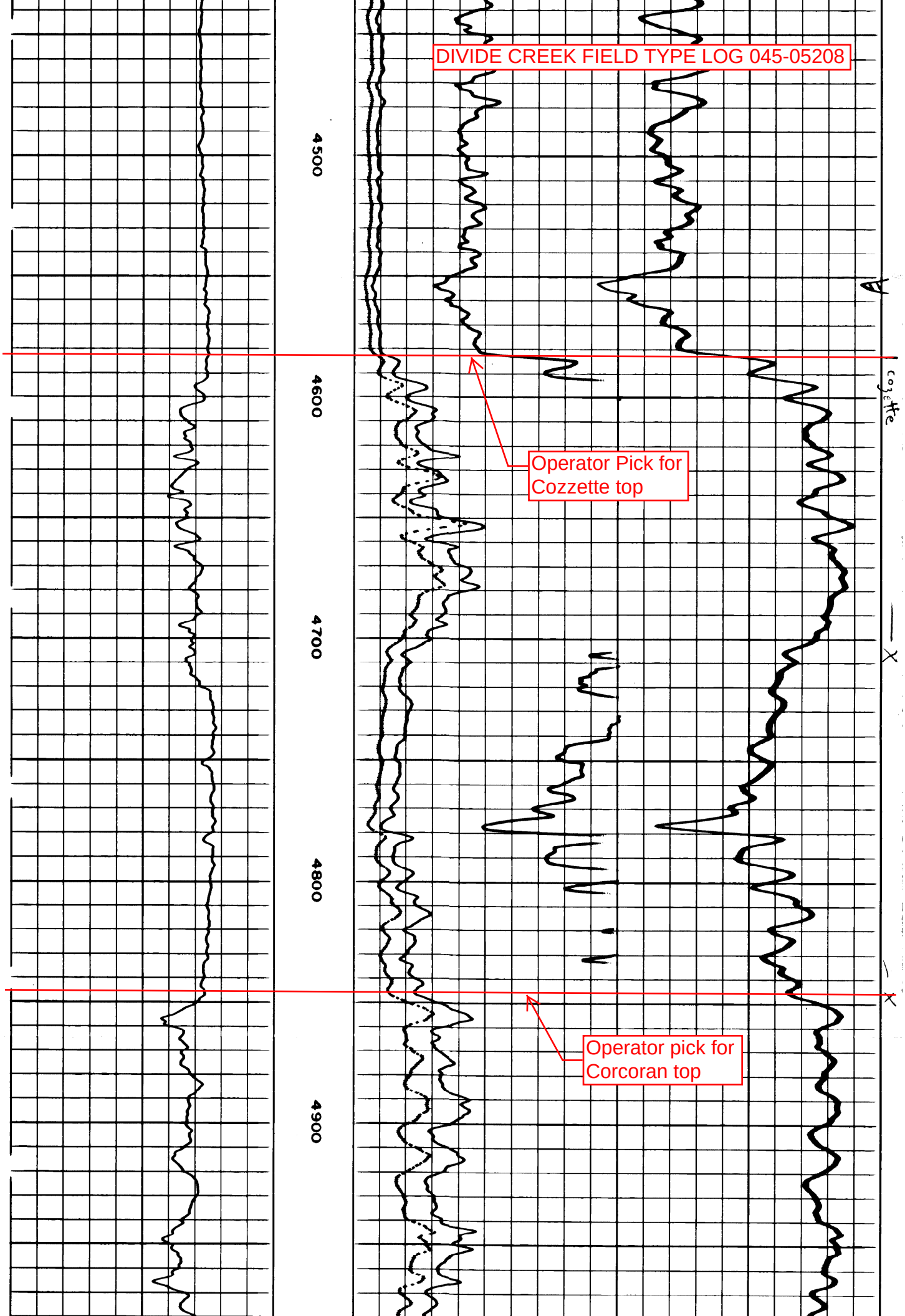
DIVIDE CREEK FIELD TYPE LOG 045-05208

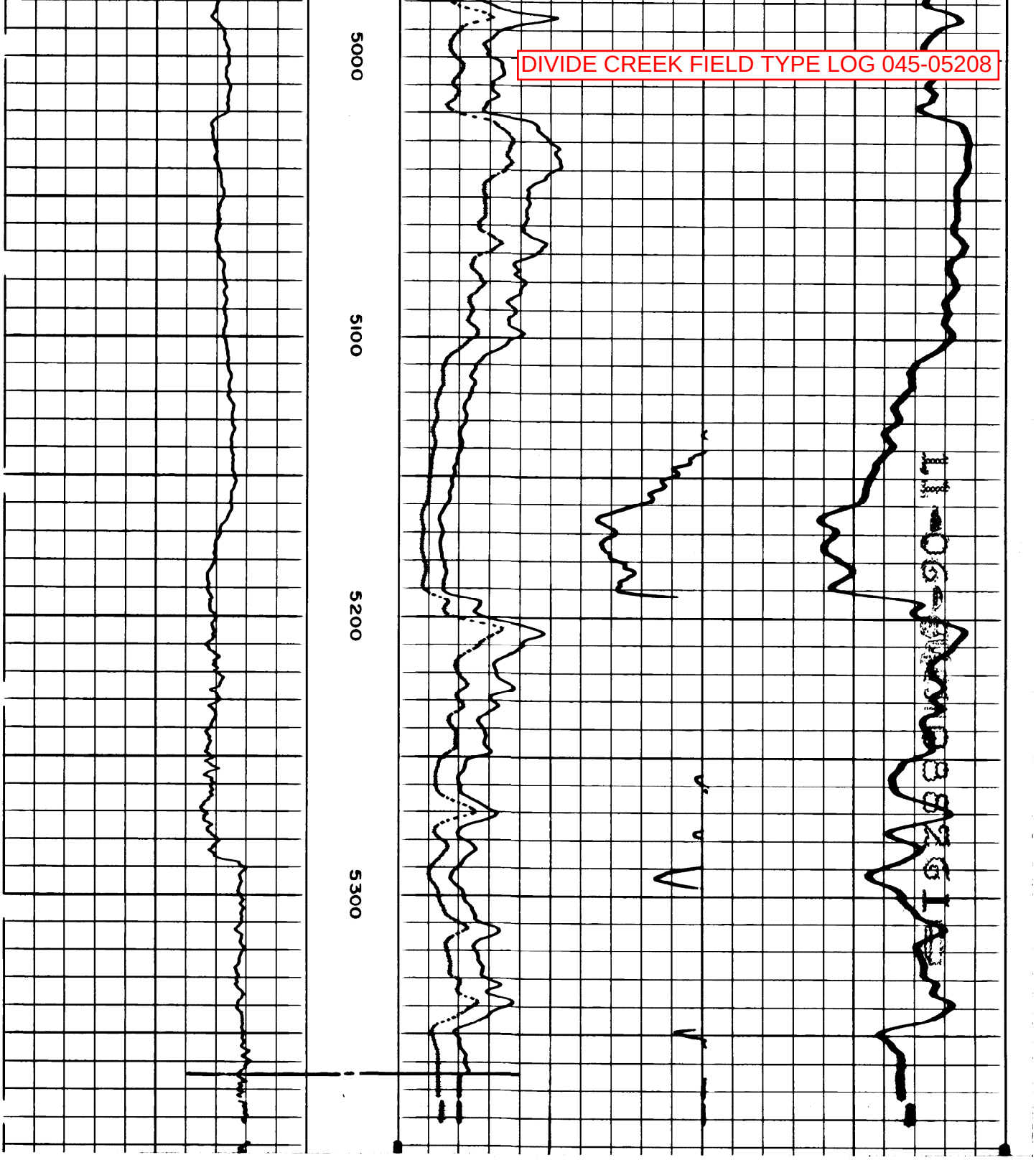


3400 3500 3600 3700 3800




DIVIDE CREEK FIELD TYPE LOG 045-05208
Operator pick
for Rollins top
3900
4000
4100
4200
4300
4400


DIVIDE CREEK FIELD TYPE LOG 045-05208
4500
4600
4700
4800
4900
Operator Pick for Cozzette top
Operator pick for Corcoran top


DIVIDE CREEK FIELD TYPE LOG 045-05208
5000
5100
5200
5300
A-16"-M
SHORT NORMAL
0
100
0
1000
INDUCTION
0
100
0
1000
0
AMP. NORMAL
20
RESISTIVITY
ohms - m²/m
SWSC-1100

ohms – m²/m

6 - FF40
INDUCTION

200 0

400 200

10
– ↔ +

SPONTANEOUS-POTENTIAL millivolts	DEPTHS	CONDUCTIVITY millimhos/m = 1000 / ohms – m²/m

COMPANY SUN OIL COMPANY

WELL DIVIDE CREEK UNIT # 12

FIELD DIVIDE CREEK

COUNTY GARFIELD STATE COLORADO

SWSC FR 5365
SWSC TD 5366
DRLR TD 5360
Elev:
KB 8955.4
DF -
GL 8943

DIVIDE CREEK FIELD TYPE LOG 045-05208

COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056115

FIELD NAME	**KOKOPELLI**
FIELD NUMBER	**47525**

LOCATION

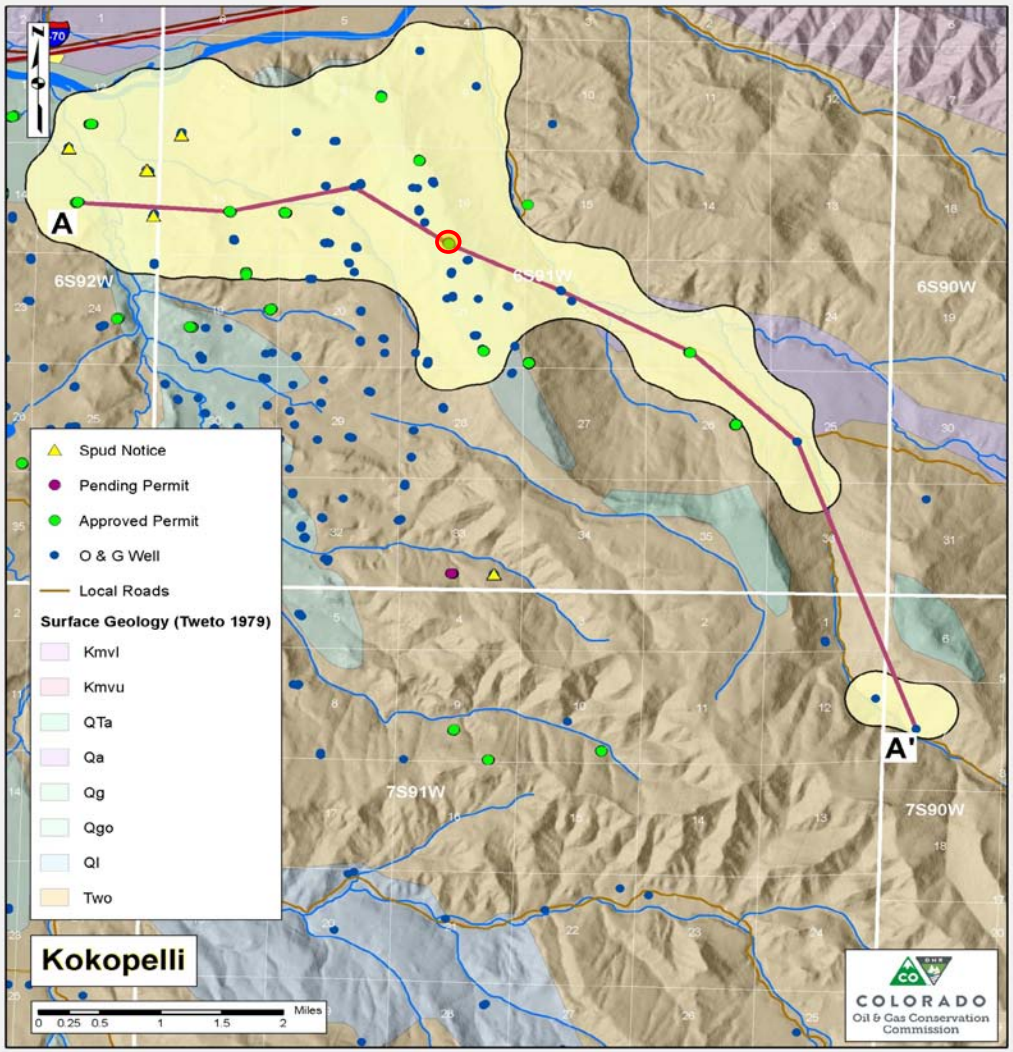
Basin	Piceance
Township(s)	6S to 7S
Range(s)	90W to 92W

SURFACE GEOLOGY

Surface Geology consists of isolated areas of alluvium underlain by the Wasatch Formation.

GEOLOGIC STRUCTURE

None within the field boundaries on COGCC's 250K GIS Geology layer. The northwestern terminus of a northwest-southeast trending syncline is present near the southeast end of the field. A northwest-southeast trending, southwesterly-dipping monocline (the Grand Hogback Monocline along the northeastern edge of the basin) is present within three miles of most of the field.



Type Log Well

COGCC OIL AND GAS FIELD SCOUT CARD
KOKOPELLI #47525

				A - Northwest							A' - Southeast
STRATIGRAPHY			**API Number =>**	**045-18168**	**045-19485**	**045-06718**	**045-14576**	**045-20268**	**045-16111**	**045-18450**	**045-20350**
			Surface Elevation =>	**5,650**	**5,850**	**6,139**	**6,792**	**6,186**	**6,327**	**6,696**	**7,614**
All depths are measured depths			**Well Type =>**	**Directional**	**Directional**	**Vertical**	**Directional**	**Directional**	**Directional**	**Directional**	**Directional**
Group	**Formation**	**Interval/ Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water	0			0		0		
	Wasatch	Upper	Shallow Water		0	0		0		0	0
	Wasatch	G-Sand*	None	753/862*	418/543*	---/553*	1,120/1,262*	---/872*	---/1,080*	1,588/1,728*	2,234/2,342*
	Wasatch	Fort Union*	None	1,256*	932*	944*	1,650*	1,260*	1,404*	2,082*	2,800*
	Wasatch	Middle	None								
	Wasatch	Lower*	Water	3,132*	2,770*	2,610*	3,356*	2,983*	3,234*	3,940*	4,666*
Mesaverde	Williams Fork	Ohio Creek	Water	3,330*	2,972*	2,750	3,543*	3,140*	3,360*	4,034*	4,786*
Mesaverde	Williams Fork	U. Mesaverde	Water	3,600*	3,219	3,210	3,914	3,422	3,630*	4,417	5,126
Mesaverde	Williams Fork	Top of Gas	Gas					4,520		6,018	5,977
Mesaverde	Williams Fork	Cameo	Gas	6,216	6,569			6,833	7,138	7,833	8,767
Mesaverde	Iles	Rollins	Gas	7,221	6,856		7,497	7,079	7,309	8,054	9,054
Mesaverde	Iles	Cozzette	Gas / UIC				8,047		7,912		
Mesaverde	Iles	Corcoran	Gas / UIC				8,242		8,098		
	Mancos		Possible Gas								
	Niobrara		Possible Gas								

Annotated Type Log for 045-14576: COGCC Document Number 2056080

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

WATER RESOURCE ISOLATION

Alluvium, Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde
The deepest water well within the field is 380' (likely Wasatch)

PRODUCING ZONE ISOLATION

Primary Objectives: Mesaverde Group (Williams Fork, Cameo, Rollins, Cozzette, and Corcoran)
Secondary Objectives: One well completed in the Mancos Formation (045-22460).

UNDERGROUND INJECTION CONTROL

API Number	Well Name and Number	Type	Zone	Sample Top	Sample Bot.	TDS	Source
045-18532	Kokopelli SWD #9-12D	Disposal	Cozzette - Corcoran	7,585	7,935	26,820	SWAB - 11/17/2009
045-13275	Jolley #17-4D	Source	Williams Fork - Rollins	4,131	6,988	16,503	WH - 8/19/2009
045-13712	Jolley #17-3D	Source	Williams Fork - Rollins	4,330	7,141	16,333	WH - 8/19/2009
045-18166	Valley Farms #I5	Source	Williams Fork - Rollins	5,513	7,355	13,763	SEP - 4/20/2010
045-18168	Valley Farms #I10	Source	Williams Fork - Rollins	5,580	7,319	14,299	SEP - 4/20/2010

COGCC OIL AND GAS FIELD SCOUT CARD
KOKOPELLI #47525

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

513-1 (12/19/1994)	Williams Fork: Recognizes all members of the Williams Fork Formation as a **Common Source** of supply. Establishes 320-acre drilling and spacing units.
513-2 (12/2/1999)	Williams Fork: Amends Order 513-1 to allow eight wells per drilling and spacing unit (40-acre spacing).
1-107 (9/20/2004)	Establishes a Bradenhead Monitoring Area, including the Kokopelli Field.
513-3 (2/12/2007)	Williams Fork and Iles: Recognizes the Williams Fork and Iles Formations as a **Common Source** of supply. Amends Order 513-1 to allow 16 wells per drilling and spacing unit (20-acre spacing), with wells 200 feet from unit lines.
Various	Williams Fork and Iles: Amends Order 513-1 to allow 32 wells per drilling and spacing unit (10-acre spacing), with wells 100 feet from unit lines and one pad per quarter-quarter.
513-5 (1/13/2009)	Iles: Establishes 320-acre drilling and spacing units for Iles-only wells.

HISTORIC WELL CONSTRUCTION

Surface casing setting depths generally range from 750' to 1,900'. Production casing generally terminates in the Iles Formation. Production casing cement may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 10% TVD required for well control and to cover water resources in the upper interval of the Wasatch Formation. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. New Standards require cementing intermediate (if used) or production casing at least 500' above Lower Wasatch sands, as shown on the annotated type log for this field.

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug above Ohio Creek and across Lower Wasatch (squeeze if no annular cement coverage); stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000-foot intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug.

NOTES

Portions of this field are located within the Mamm Creek Field Cementing Notice to Operators Area. Special requirements and Form 2 Conditions of Approval apply.

Portions of this field are located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.

ISOLATION REQUIREMENTS FOR TYPICAL WELLS

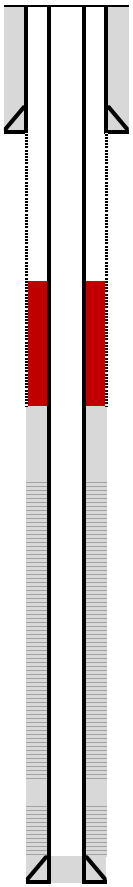
Date 04/18/2016 **COGCC Document No.** 2056116

FIELD NAME **KOKOPELLI**
FIELD NUMBER **47525**

LOCATION
Basin Piceance
Township(s) 6S to 7S
Range(s) 90W to 92W

Note: Depths to formation tops differ significantly with changes of ground surface elevation and geologic structure across the field. Refer to the Stratigraphy chart on the Field Scout Card. These wellbore diagrams reflect average depths in a small portion of the field. Also refer to standards in adjacent fields for guidance.

Depth	Formation/Member
0	Alluvium/ U. Wasatch
1,000	Wasatch G
2,000	
3,000	L. Wasatch Ohio Creek U. Mesaverde
4,000	
	Top of Gas
5,000	
6,000	
7,000	Cameo Rollins
8,000	Cozzette Corcoran



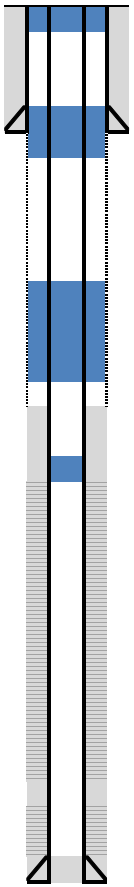
Casing and Cement Coverage

Surface Casing Standard
Minimum 10% TVD or cover all apparent water resources in the U. Wasatch, whichever is more stringent

New Cement Standard
Cement must provide coverage across Ohio Creek and L. Wasatch (500' above L. Wasatch), in addition to productive interval coverage.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of U. Mesaverde, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	Alluvium/ U. Wasatch
1,000	Wasatch G
2,000	
3,000	L. Wasatch Ohio Creek U. Mesaverde
4,000	
	Top of Gas
5,000	
6,000	
7,000	Cameo Rollins
8,000	Cozzette Corcoran



Plug Placement

Surface plug

Surface casing shoe plug

Squeeze plug across Ohio Creek and L. Wasatch (top of plug 500' above L. Wasatch)

Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 feet); not shown on this figure

Plug in casing above Mesaverde Group Completions

045-14576

KOKOPELLI FIELD TYPE LOG 045-14576

COGCC Document Number 2056080

04-18-2016

HALLIBURTON

HIGH RESOLUTION INDUCTION

COMPANY ORION ENERGY PARTNERS, L.P.
WELL JOLLEY 16-1
FIELD GARFIELD
COUNTY COLORADO
STATE

COMPANY ORION ENERGY PARTNERS, L.P.
WELL JOLLEY 16-1
FIELD KOKOPELLI
COUNTY GARFIELD STATE COLORADO

API No. 0504514576
Location 663' FSL & 2000' FWL: FROM SESW

Other Services:
RWCH
DSN
SDL

Sect. 16 Twp. 06S Rge. 91W

Permanent Datum	GL	Elev. 6792.0 ft	Elev.: K.B. 6809.0 ft
Log measured from	KB	17.0 ft above perm. Datum	D.F. 6808.0 ft
Drilling measured from	KB		G.L. 6792.0 ft
Date	04-Jan-08 15:00		
Run No.	2		
Depth - Driller	8636.0 ft		
Depth - Logger	8626.0 ft		
Bottom - Logged Interval	8616.0 ft		
Top - Logged Interval	20.0 ft		
Casing - Driller	8.625 in @ 1036.0 ft	@	@
Casing - Logger	1020.0 ft		
Bit Size	7.875 in	@	@
Type Fluid in Hole	PHPA		
Density / Viscosity	9.3 ppg / 51.00 s/qt		
PH / Fluid Loss	7.00 pH / 9.5 cptm		
Source of Sample	FLOWLINE		
Rm @ Meas. Temperature	2.87 ohmm @ 52.00 degF	@	@
Rmf @ Meas. Temperature	2.08 ohmm @ 54.00 degF	@	@
Rmc @ Meas. Temperature	3.12 ohmm @ 54.00 degF	@	@
Source Rmf / Rmc	CHART / CHART		
Rm @ BHT	0.91 ohmm @ 179.0 degF	@	@
Time Since Circulation	5.0 hr		
Time on Bottom	04-Jan-08 17:38		
Max. Rec. Temperature	179.0 degF @ 8635.0 ft	@	@
Equipment / Location	10026059 / CASPER, WY		
Recorded By	STEPHEN GRAY		
Witnessed By	DON FINDLEY		

RECEIVED
FEB 12 2008
COGCC

KK

Fold here

Service Ticket No.: 5592276 API Serial No.: 0504514576 PGM Version: WL INSITE R2.0 (Build 12)

CHANGE IN MUD TYPE OR ADDITIONAL SAMPLE

Date	Sample No.	Type Log	Depth	Scale Up Hole	Scale Down Hole
Depth-Driller					
Type Fluid in Hole					
Density	Viscosity				
Ph	Fluid Loss				
Source of Sample					

RESISTIVITY SCALE CHANGES

RESISTIVITY EQUIPMENT DATA

	Run No.	Tool Type & No.	Pad Type	Tool Pos.	Other
Rm @ Meas. Temp	@	@			
Rmf @ Meas. Temp.	@	ONE	HRIDE A013	N/A	1.5" S.O.
Rmc @ Meas. Temp.	@				N/A
Source Rmf / Rmc	/				
Rm @ BHT	@				
Rmf @ BHT	@				
Rmc @ BHT	@				

EQUIPMENT DATA

GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No.	ONE	Run No.		Run No.	ONE	Run No.	ONE
Serial No.	A072	Serial No.		Serial No.	DA02	Serial No.	108804
Model No.	D4TG	Model No.		Model No.	SDL-DC	Model No.	DSB-II
Diameter	3.625"	No. of Cent.		Diameter	4"	Diameter	3.625"
Detector Model No.	102-T	Spacing		Log Type	GAM-GAM	Log Type	NEU-NEU
Type	SCINT			Source Type	Cs137	Source Type	Am241Be
Length	8"	LSA [Y/N]		Serial No.	2770GW	Serial No.	DSN-79
Distance to Source	10"	FWDA [Y/N]		Strength	1.5 Ci	Strength	18.5 Ci

LOGGING DATA

GENERAL		GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run		Scale		Scale		Scale		Scale	
Depth		Speed		Matrix		Matrix		Matrix	
From									
To									

No.	From	To	Number	L	R	L	R		L	R		L	R	
ONE	8626'	20'	REC	0	200				0.30	-0.10	2.68	0.30	-0.10	SAND

KOKOPELLI FIELD TYPE LOG 045-14576

DIRECTIONAL INFORMATION

Maximum Deviation @ KOP @

Remarks: RWCH-GR-DSN-SDL-HRI WERE RUN IN COMBINATION.
AHV CALCULATED USING 4.5 INCH PRODUCTION CASING.
TENSION PULLS MAY AFFECT TOOL RESONSE.

LATITUDE: 39.31 N.
LONGITUDE: 107.33 W.
CREW: R DAVIS, C. BREED & M. HUTCHISON.
THANK YOU FOR USING HALLIBURTON ENERGY SERVICES, CASPER, WY. ***307-473-8200*** RIG: SST #3.

HALLIBURTON DOES NOT GUARANTEE THE ACCURACY OF ANY INTERPRETATION OF THE LOG DATA, CONVERSION OF LOG DATA TO PHYSICAL ROCK PARAMETERS OR RECOMMENDATIONS WHICH MAY BE GIVEN BY HALLIBURTON PERSONNEL OR WHICH APPEAR ON THE LOG OR IN ANY OTHER FORM. ANY USER OF SUCH DATA, INTERPRETATIONS, CONVERSIONS, OR RECOMMENDATIONS AGREES THAT HALLIBURTON IS NOT RESPONSIBLE EXCEPT WHERE DUE TO GROSS NEGLIGENCE OR WILLFUL MISCONDUCT, FOR ANY LOSS, DAMAGES, OR EXPENSES RESULTING FROM THE USE THEREOF.

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PARAMETERS REPORT

Depth (ft)	Tool Name	Mnemonic	Description	Value	Units
TOP					
	SHARED	BS	Bit Size	7.875	in
	SHARED	UBS	Use Bit Size instead of Caliper for all applications.	No	
	SHARED	MDWT	Borehole Fluid Weight	9.300	ppg
	SHARED	RMUD	Mud Resistivity	2.870	ohmm
	SHARED	TRM	Temperature of Mud	52.0	degF
	SHARED	OBM	Oil Based Mud System?	No	
	SHARED	CSD	Logging Interval is Cased?	No	
	SHARED	ICOD	AHV Casing OD	4.500	in
	SHARED	ST	Surface Temperature	25.0	degF
	SHARED	TD	Total Well Depth	8626.00	ft
	SHARED	BHT	Bottom Hole Temperature	179.0	degF
	Rwa / CrossPlot	XPOK	Process Crossplot?	Yes	
	Rwa / CrossPlot	FCHO	Select Source of F	Automatic	
	Rwa / CrossPlot	AFAC	Archie A factor	0.6200	
	Rwa / CrossPlot	MFAC	Archie M factor	2.1500	
	Rwa / CrossPlot	RMFR	Rmf Reference	0.10	ohmm
	Rwa / CrossPlot	TMFR	Rmf Ref Temp	75.00	degF
	Rwa / CrossPlot	RWA	Resistivity of Formation Water	0.05	ohmm
	D4TG	GROK	Process Gamma Ray?	Yes	
	D4TG	GRSO	Gamma Tool Standoff	0.000	in
	D4TG	GEOK	Process Gamma Ray EVR?	No	
	DSN_II	DNOK	Process DSN?	Yes	
	DSN_II	DEOK	Process DSN EVR?	No	

DSN_II	NLIT	Neutron Lithology	Sandstone	
DSN_II	DNSO	DSNTool Standoff	0.000	in
DSN_II	DNTP	Temperature Correction Type	None	
DSN_II	DPRS	DSN Pressure Correction Type	None	
DSN_II	SHCO	View More Correction Options	No	
DSN_II	UTVD	Use TVD for Gradient Corrections?	No	
DSN_II		Logging Horizontal Water Tank?	No	
SDL_DC	DNOK	Process Density?	Yes	
SDL_DC	DNOK	Process Density EVR?	No	
SDL_DC	AD	Is Hole Air Drilled?	No	
SDL_DC	CB	Use Calibration Blocks?	No	
SDL_DC	SPVT	SDLT Pad Temperature Valid?	Yes	
SDL_DC	MDTP	Weighted Mud Correction Type?	None	
SDL_DC	DMA	Formation Density Matrix	2.680	g/cc
SDL_DC	DFL	Formation Density Fluid	1.000	g/cc
SDL_DC	CLOK	Process Caliper Outputs?	Yes	
HRID-SP	HRE	Do HRI Induction Calculation?	Yes	
HRID-SP	DFLE	Do DFL Calculation?	Yes	
HRID-SP	PYRI	Pyrite Switch	Off	
HRID-SP	CSDP	Casing Depth	0.0	ft
HRID-SP	HDSP	Spike Reduction Filter Type	DELTA	
HRID-SP	HRTC	Temperature Correction Source	None	
HRID-SP	MMRS	Hrimap Minimum Resistivity	0.20	
HRID-SP	MXRS	Hrimap Maximum Resistivity	200.00	

BOTTOM

Data: ORION_16_1_TR\0002 TRIPLE_DITS\IDLE

Date: 04-Jan-08 19:25:07

HALLIBURTON

Plot Time: 04-Jan-08 19:43:22
Plot Range: 20 ft to 8640 ft
Data: ORION_16_1_TR\Well Based\DAQ-0002-002.07\
Plot File: \\HRI\2IN_HRI

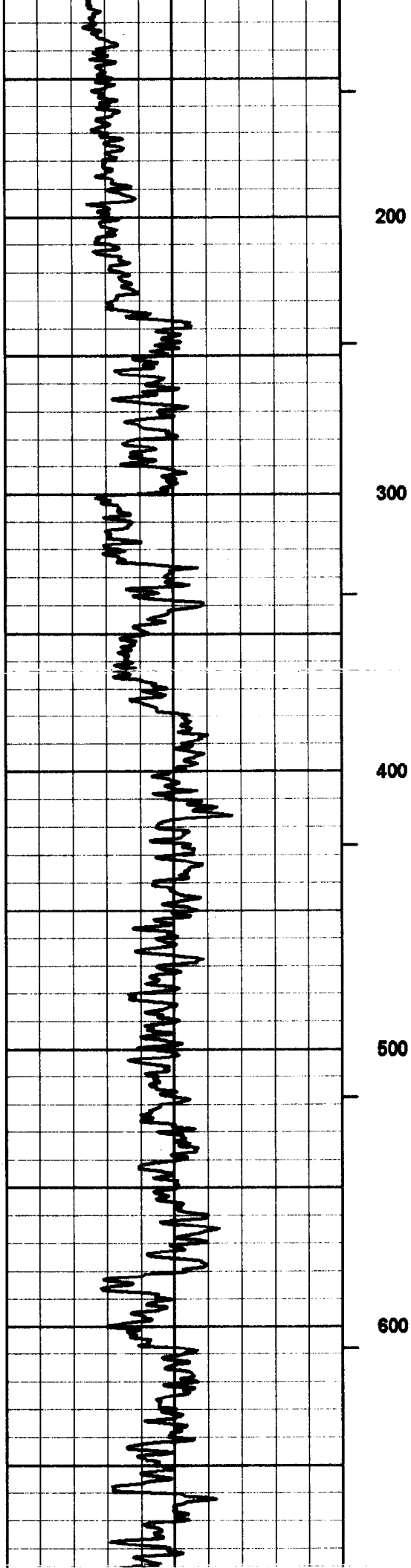
KOKOPELLI FIELD TYPE LOG 045-14576

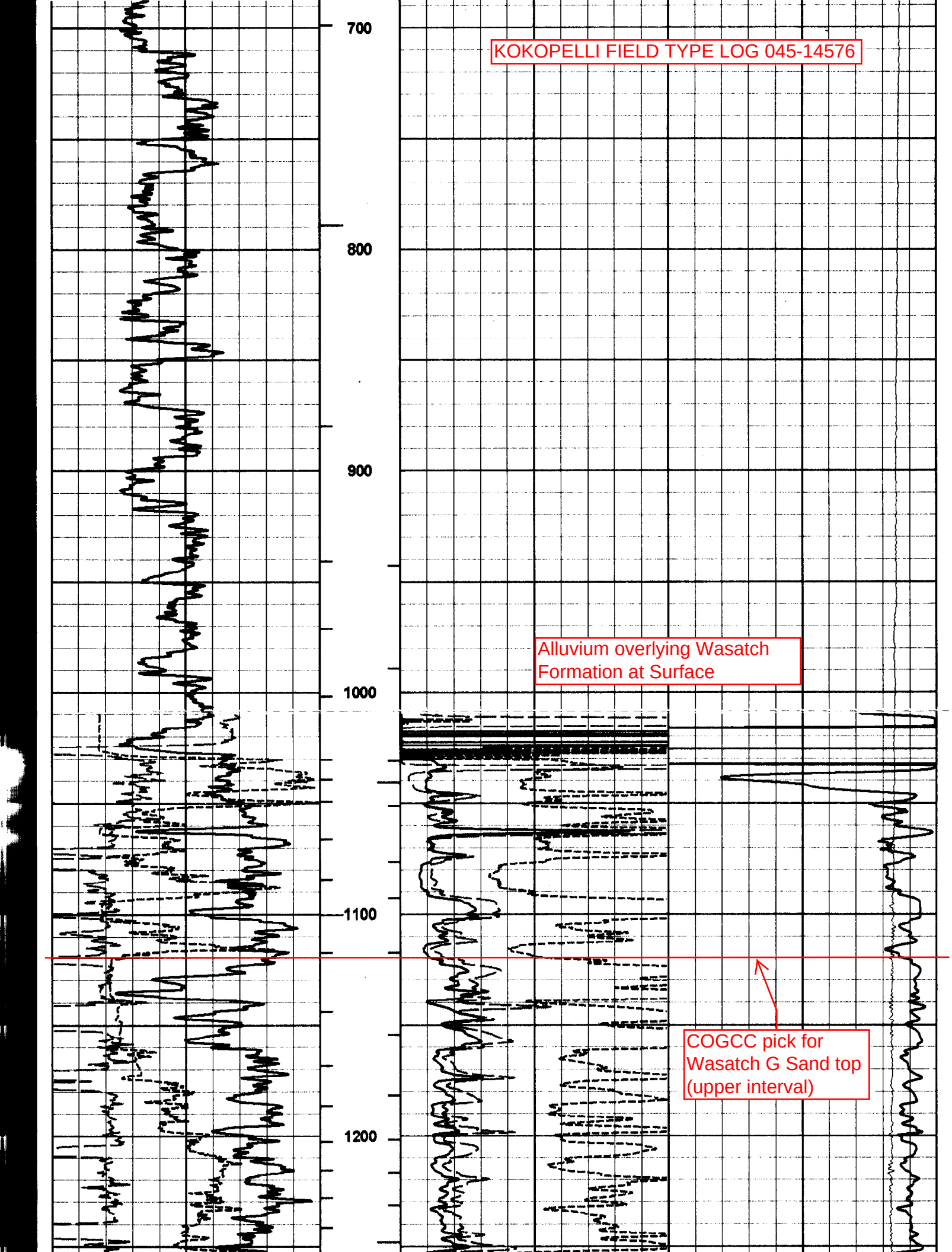
MAIN PASS 2"=100'

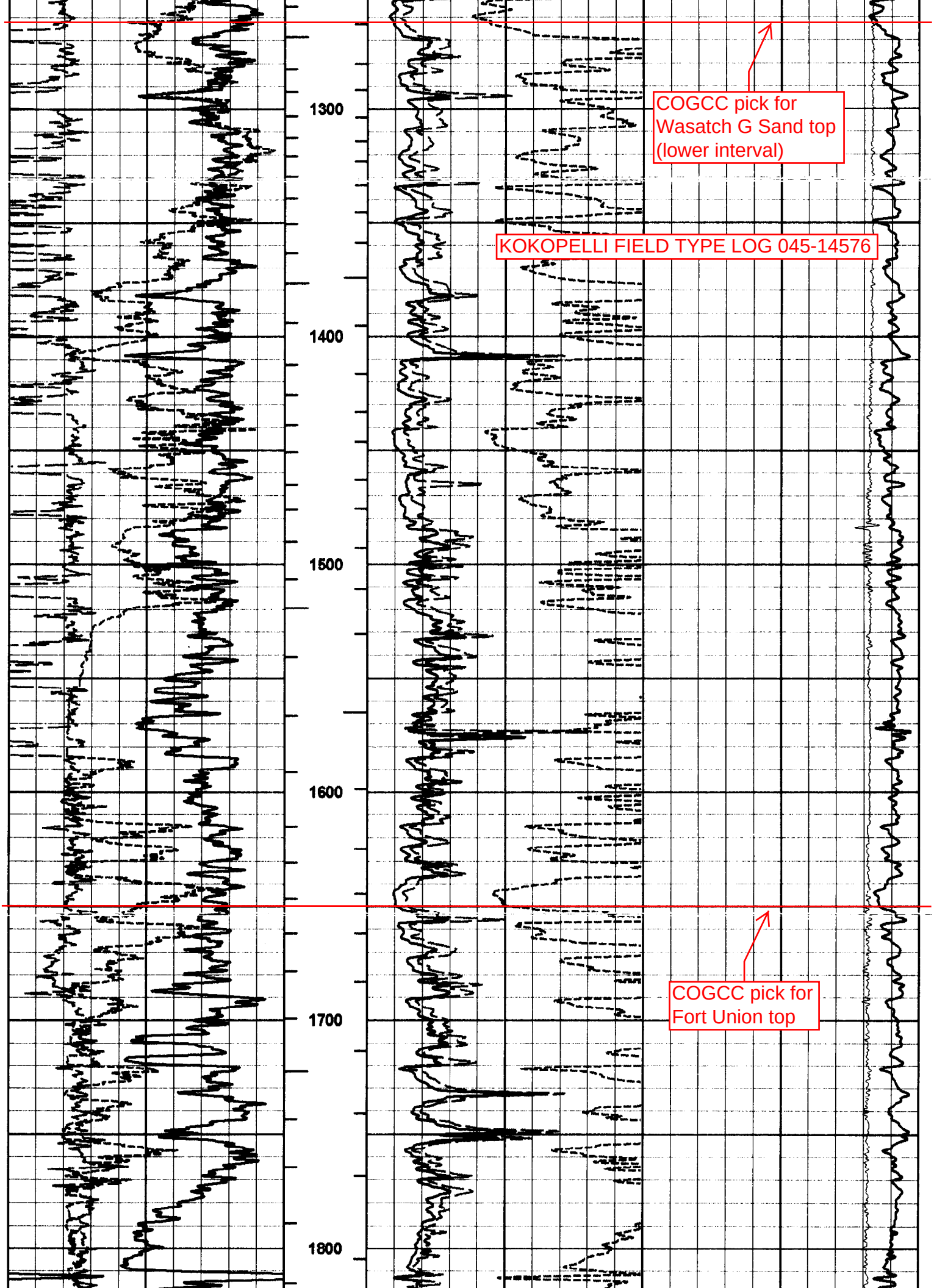
6	Caliper	16		0	Dig Focused Laterolog	100	
	inches				ohm-metre		
0	SP	100		0	Amp DFL	20	10K Tension 0
	millivolts				ohm-metre		pounds
0	Gamma API	150	1 : 600	0	Hri Deep Resistivity	100	500 Hri Deep Conductivity 0
	api				ohm-metre		mmho per metre

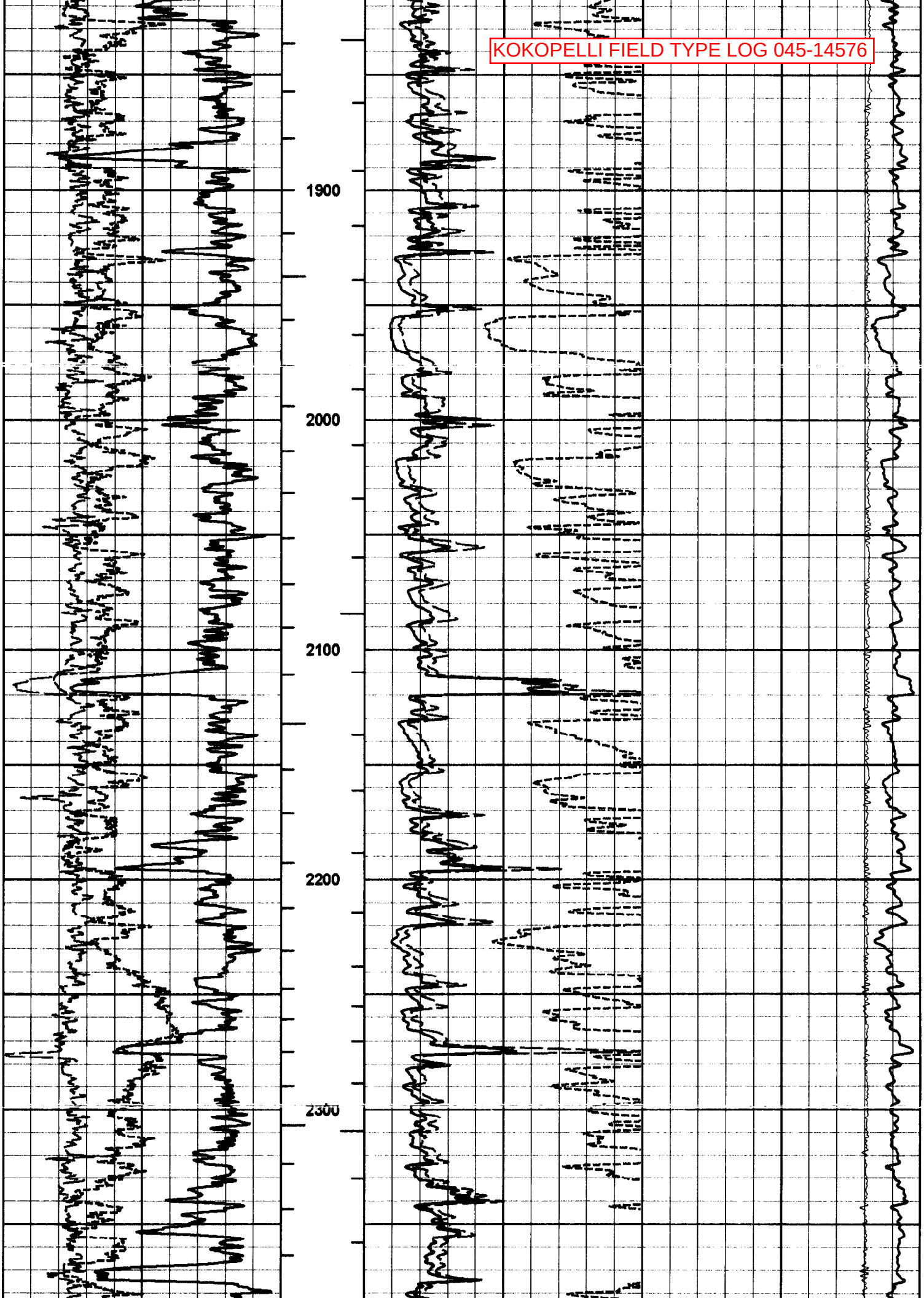
100

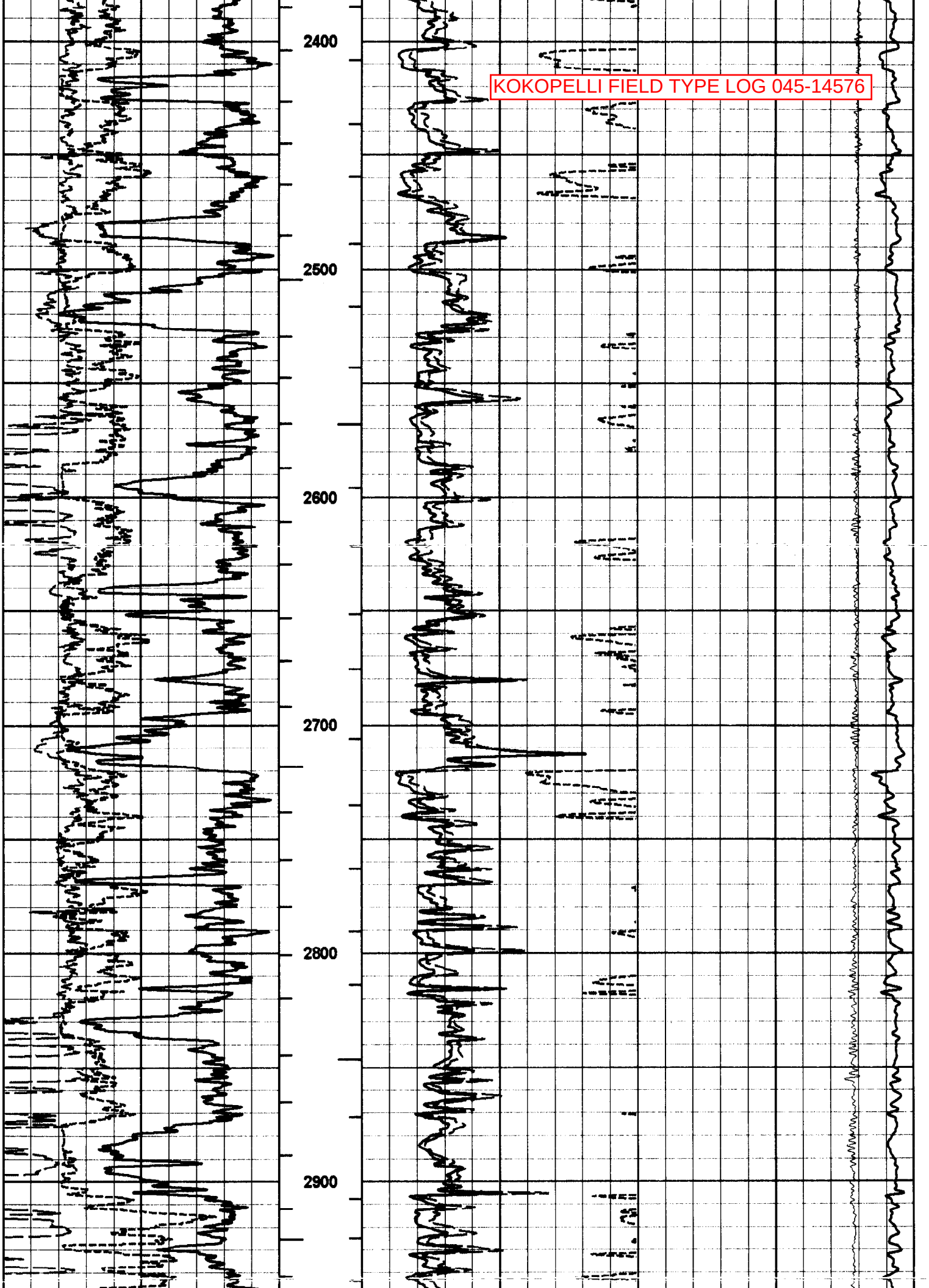
KOKOPELLI FIELD TYPE LOG 045-14576

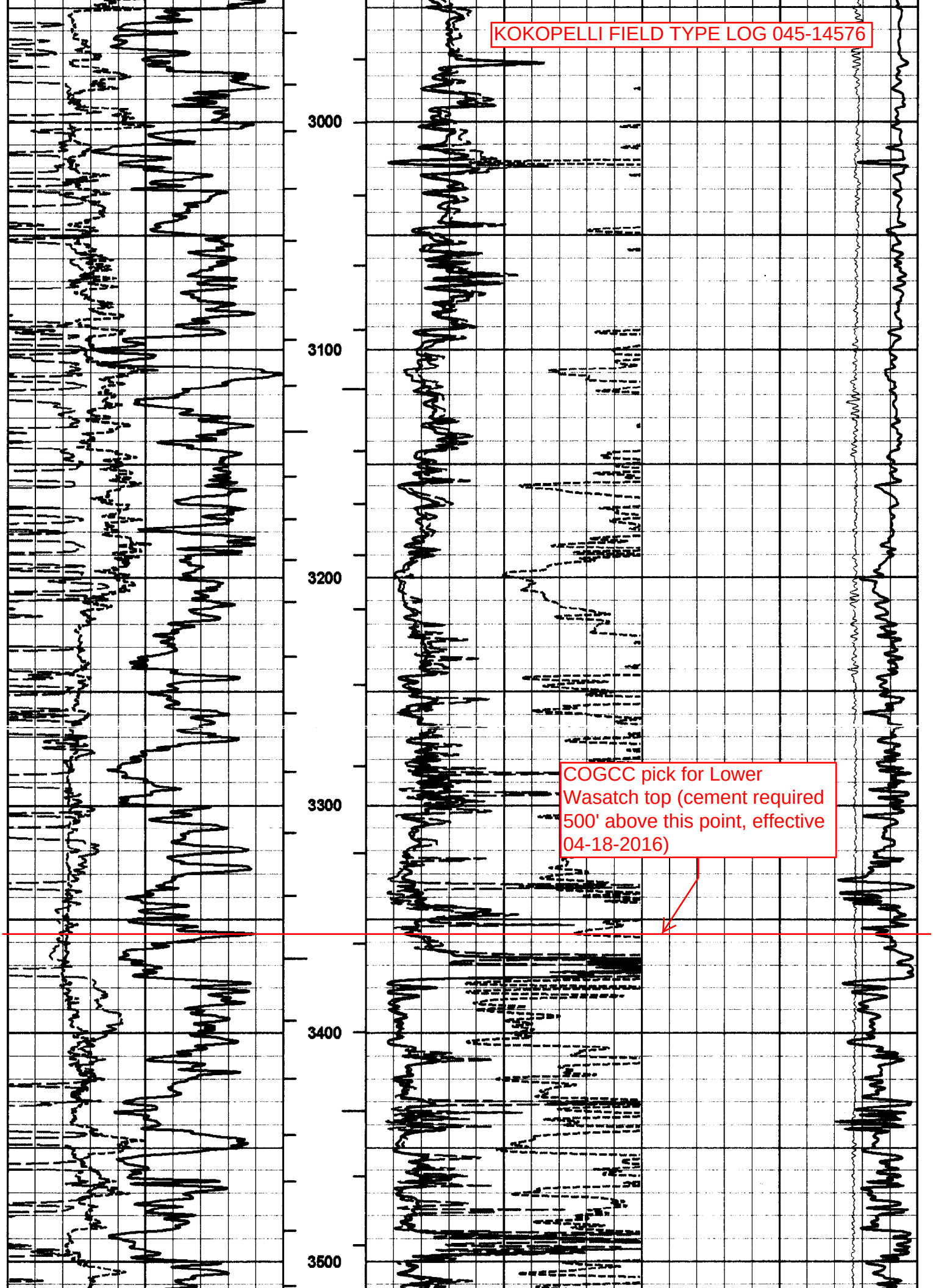


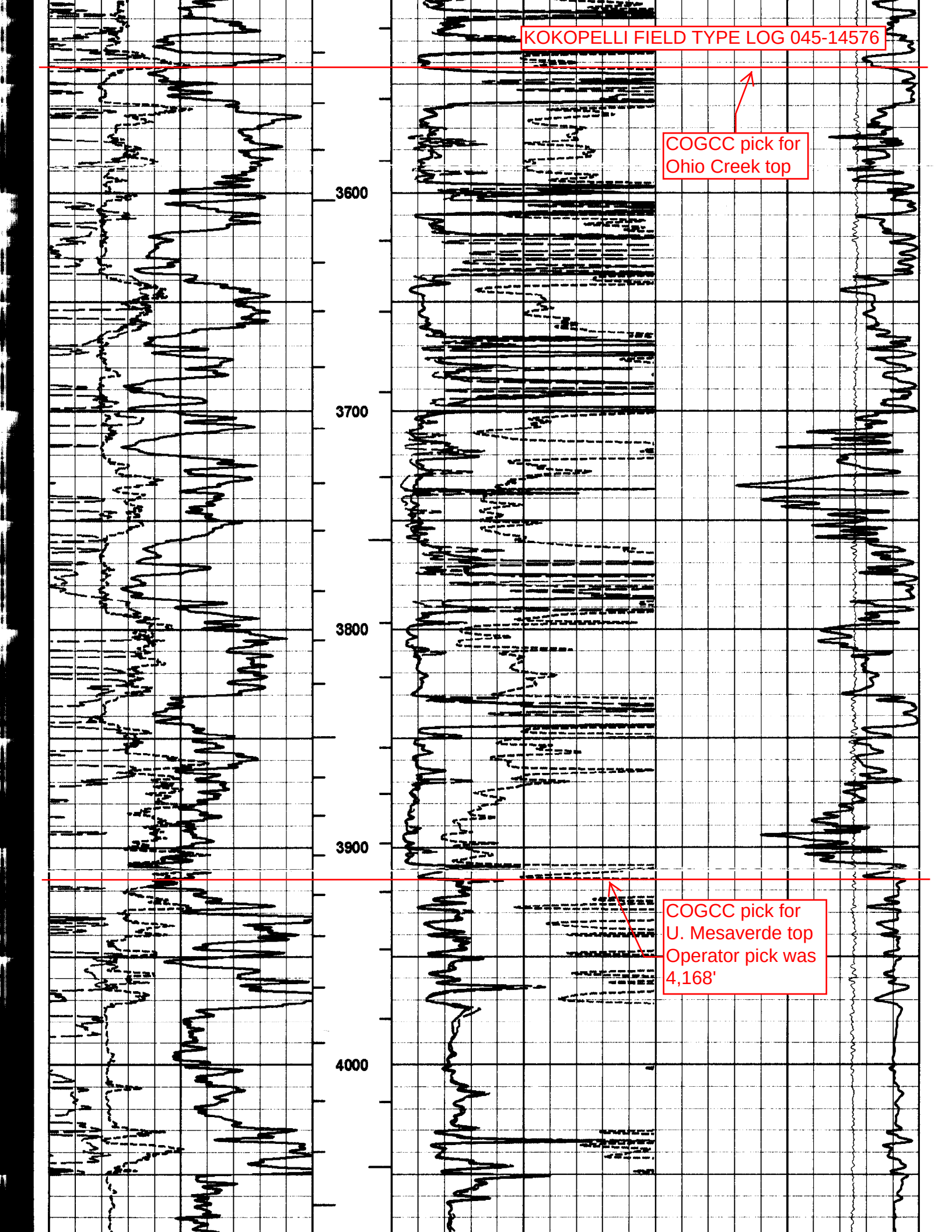

KOKOPELLI FIELD TYPE LOG 045-14576
700
800
900
1000
1100
1200
Alluvium overlying Wasatch Formation at Surface
COGCC pick for Wasatch G Sand top (upper interval)

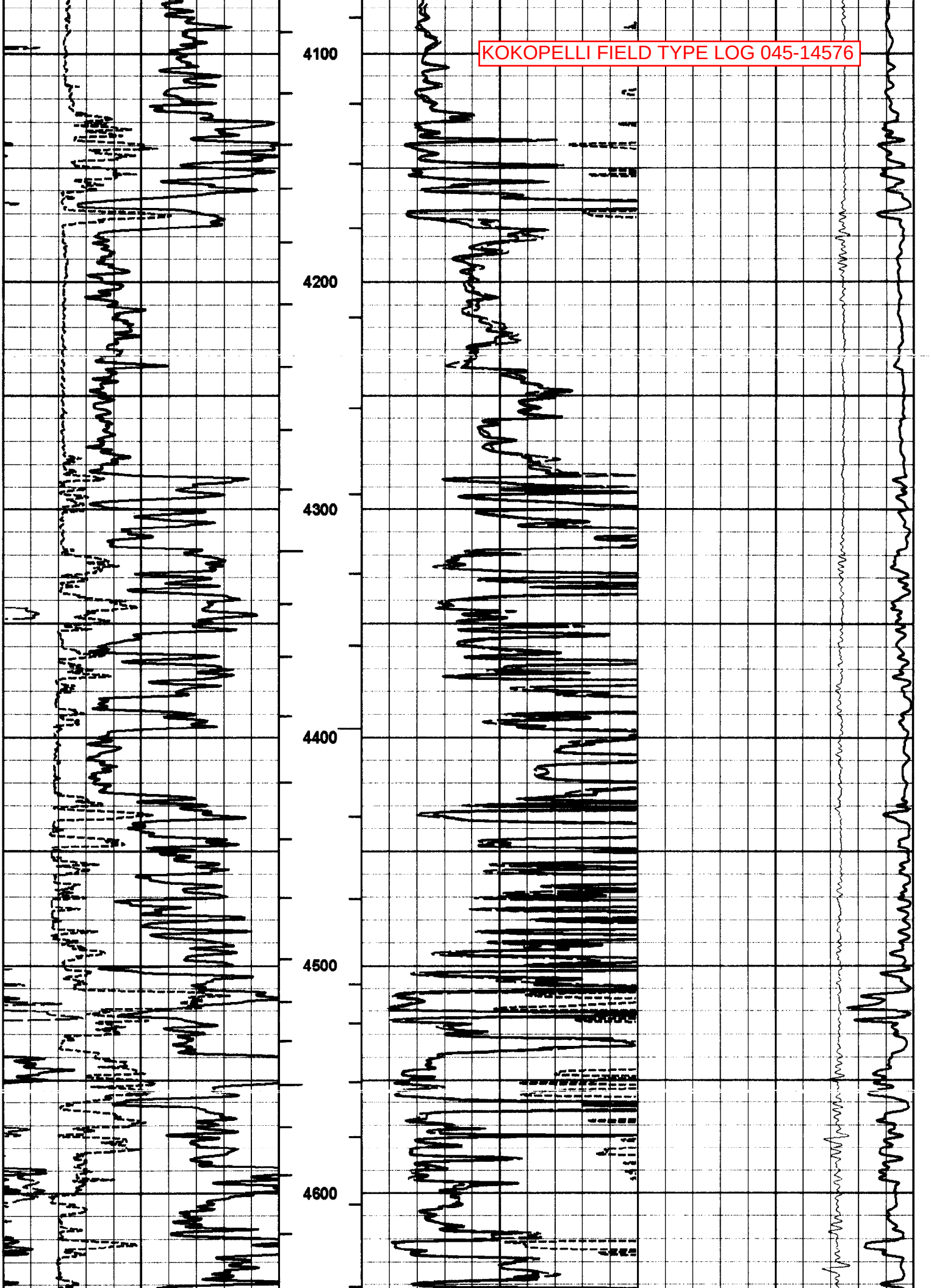

1300
1400
1500
1600
1700
1800
COGCC pick for
Wasatch G Sand top
(lower interval)
KOKOPELLI FIELD TYPE LOG 045-14576
COGCC pick for
Fort Union top

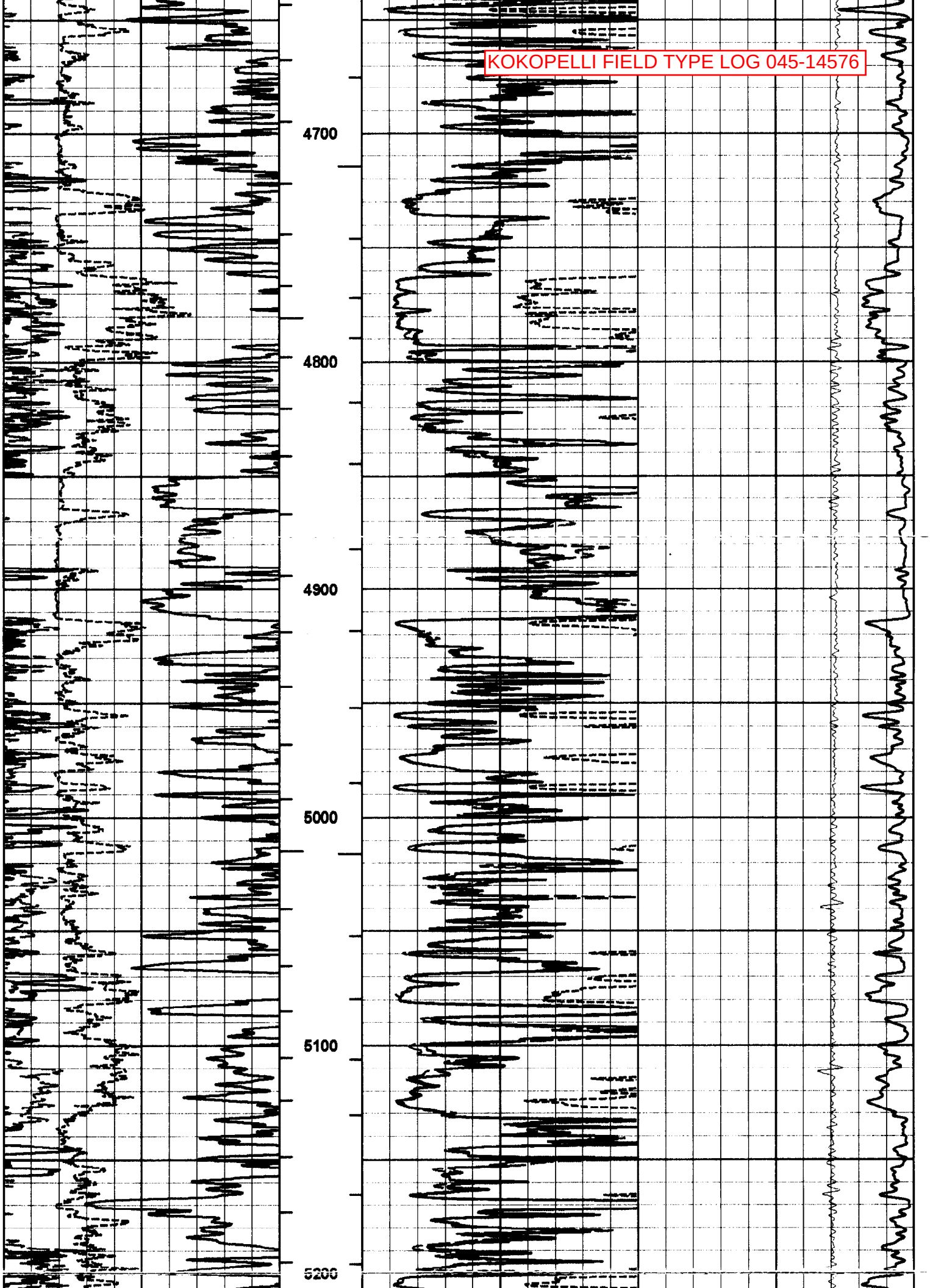

KOKOPELLI FIELD TYPE LOG 045-14576
1900
2000
2100
2200
2300

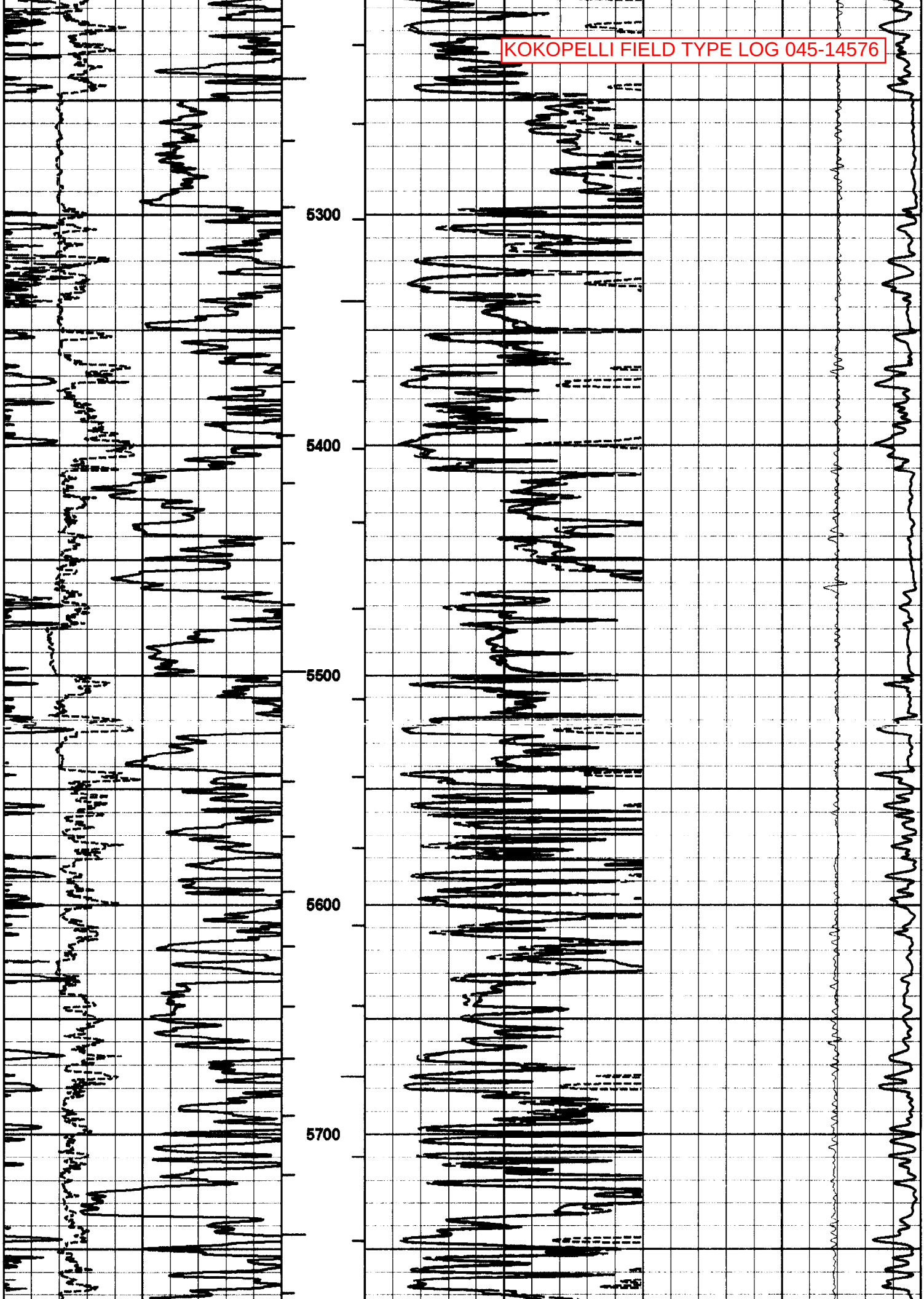

KOKOPELLI FIELD TYPE LOG 045-14576
2400
2500
2600
2700
2800
2900

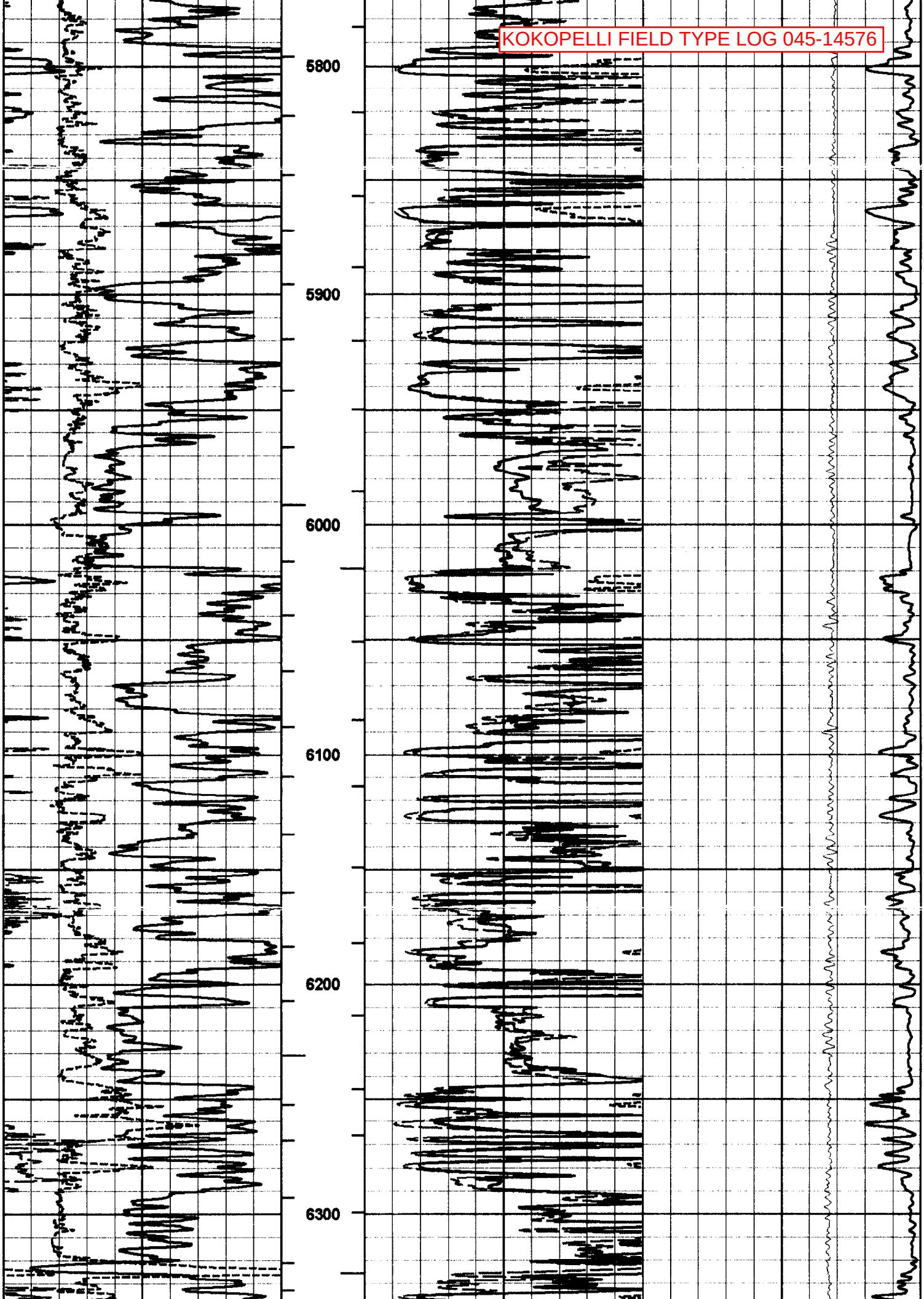

KOKOPELLI FIELD TYPE LOG 045-14576
3000
3100
3200
3300
3400
3500
COGCC pick for Lower Wasatch top (cement required 500' above this point, effective 04-18-2016)

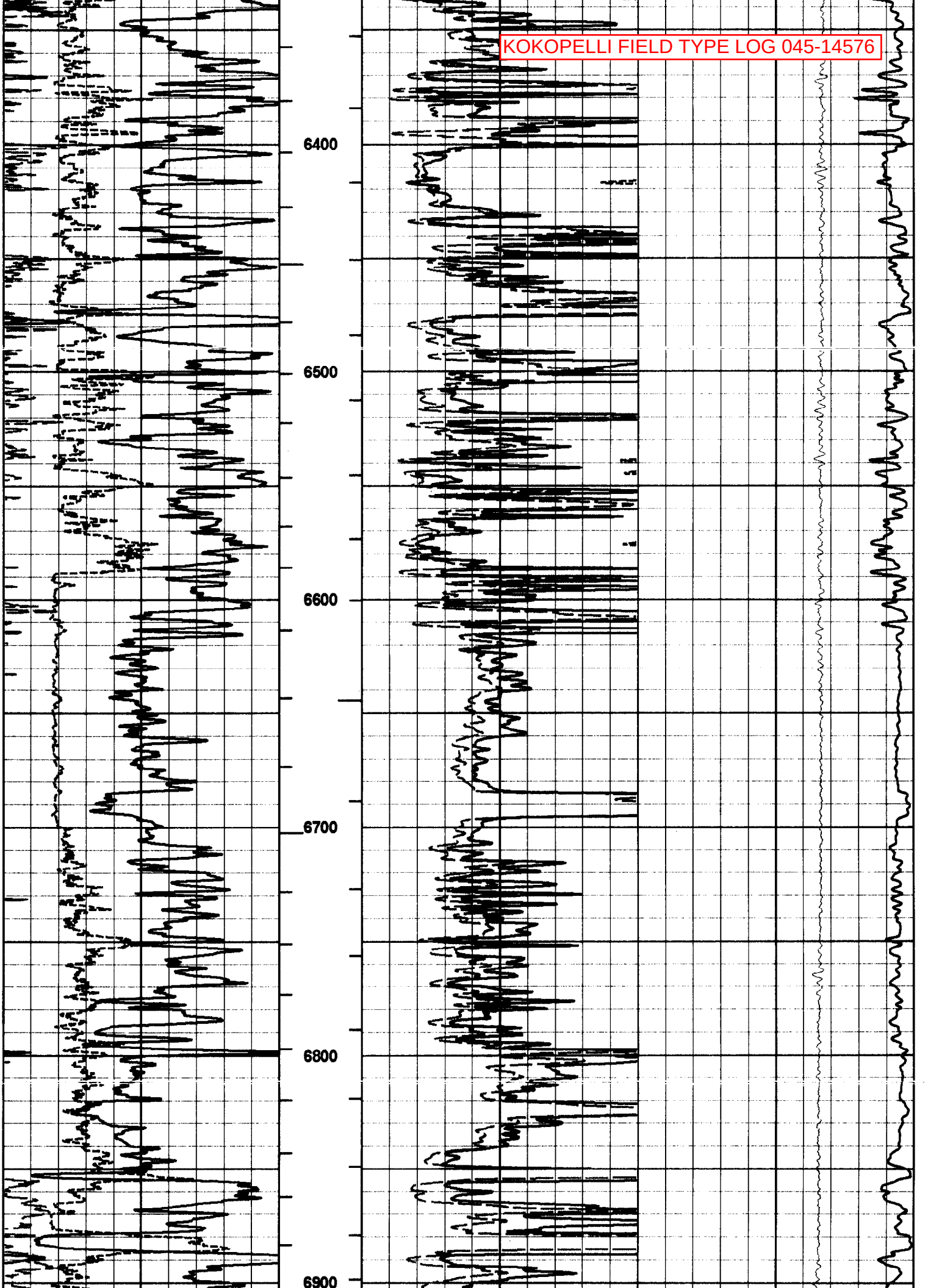

KOKOPELLI FIELD TYPE LOG 045-14576
COGCC pick for
Ohio Creek top
3600
3700
3800
3900
COGCC pick for
U. Mesaverde top
Operator pick was
4,168'
4000

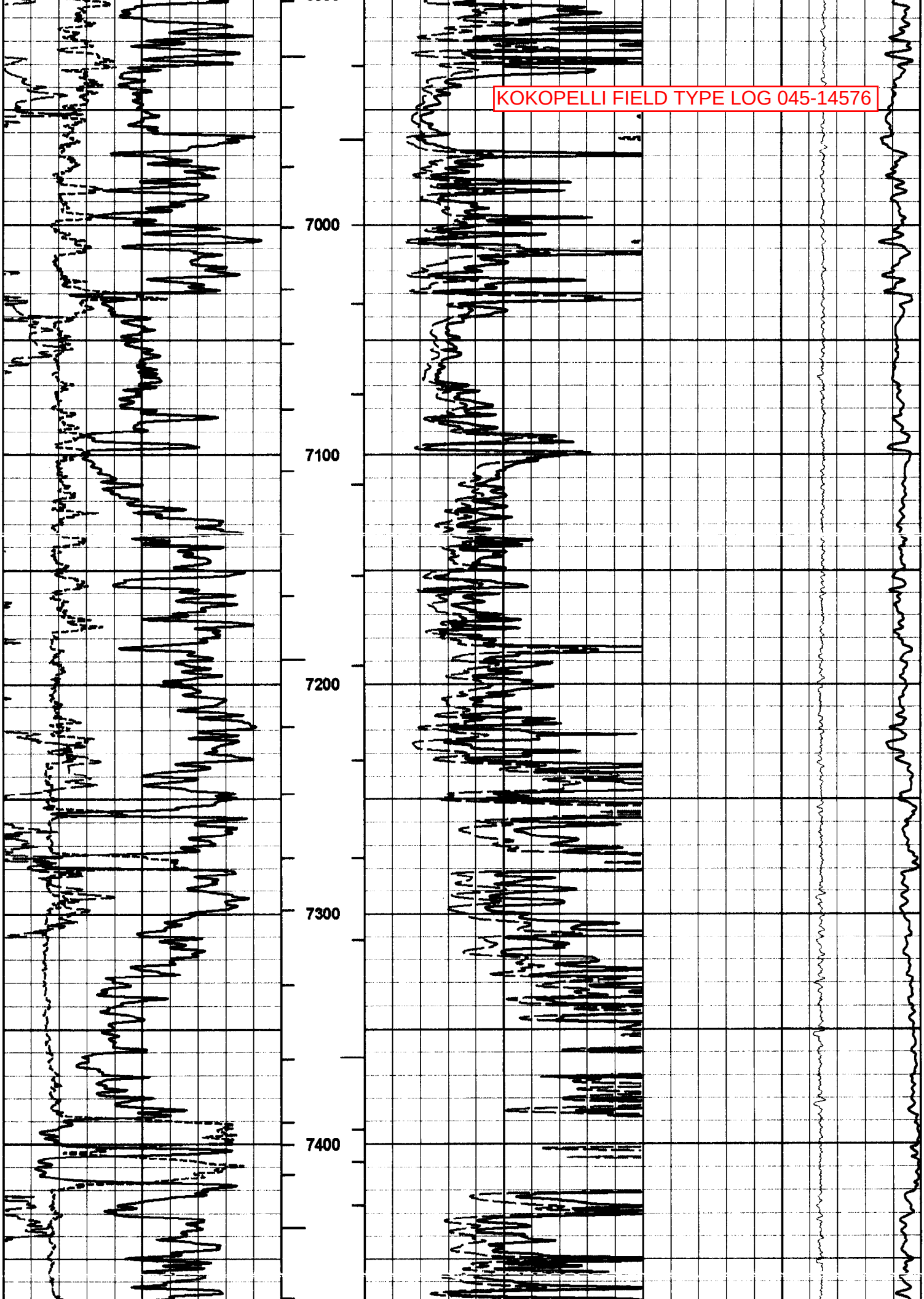

KOKOPELLI FIELD TYPE LOG 045-14576
4100
4200
4300
4400
4500
4600

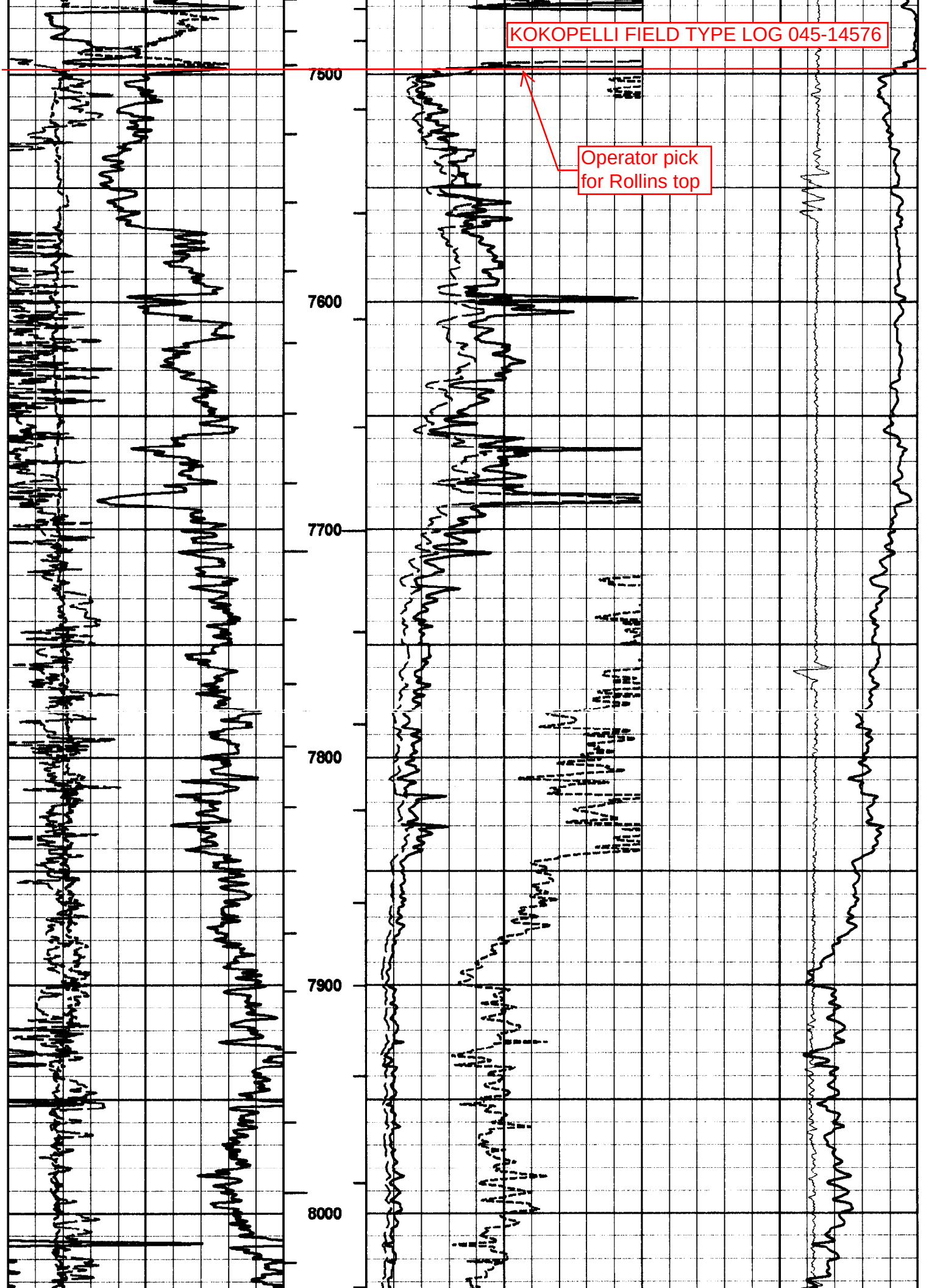

KOKOPELLI FIELD TYPE LOG 045-14576
4700
4800
4900
5000
5100
5200

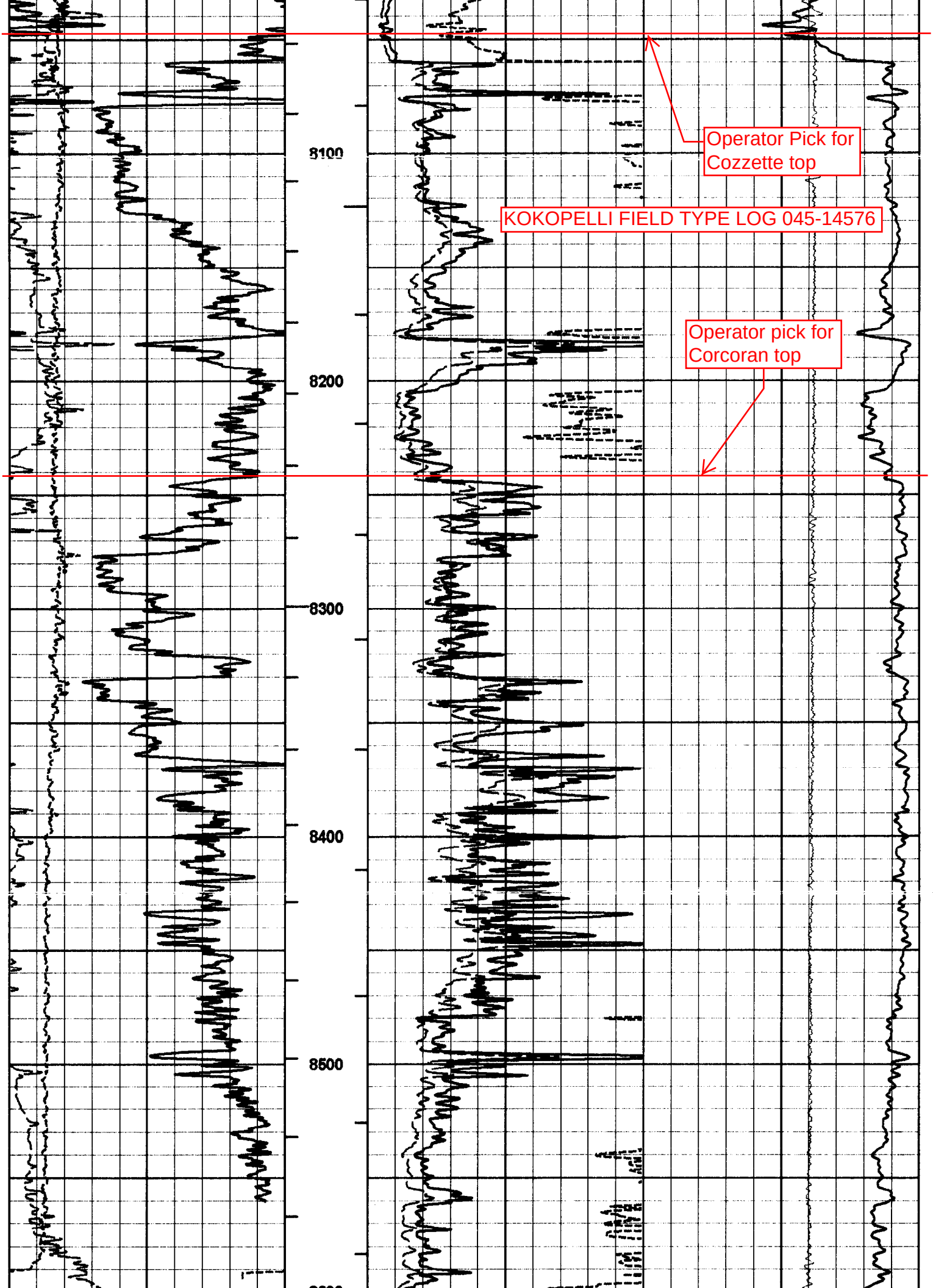

KOKOPELLI FIELD TYPE LOG 045-14576
5300
5400
5500
5600
5700

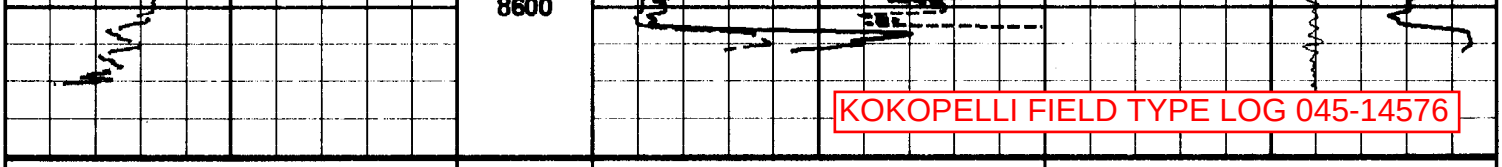

KOKOPELLI FIELD TYPE LOG 045-14576
5800
5900
6000
6100
6200
6300


KOKOPELLI FIELD TYPE LOG 045-14576
6400
6500
6600
6700
6800
6900


KOKOPELLI FIELD TYPE LOG 045-14576
7000
7100
7200
7300
7400


KOKOPELLI FIELD TYPE LOG 045-14576
Operator pick
for Rollins top
7500
7600
7700
7800
7900
8000


Operator Pick for Cozzette top
KOKOPELLI FIELD TYPE LOG 045-14576
Operator pick for Corcoran top
8100
8200
8300
8400
8500



KOKOPELLI FIELD TYPE LOG 045-14576

0	Gamma API	150	1 : 600	0	Hri Deep Resistivity	100	500	Hri Deep Conductivity	0
	api				ohm-metre			mmho per metre	
0	SP	100		0	Amp DFL	20	10K	Tension	0
	millivolts				ohm-metre			pounds	
6	Caliper	16		0	Dig Focused Laterolog	100			
	inches				ohm-metre				

HALLIBURTON

Plot Time: 04-Jan-08 19:43:28
Plot Range: 20 ft to 8640 ft
Data: ORION_16_1_TR\Well Based\DAQ-0002-002.07\
Plot File: \\HR\2IN_HPI

MAIN PASS 2"=100'

COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056127

FIELD NAME	**MAMM CREEK**
FIELD NUMBER	**52500**

LOCATION

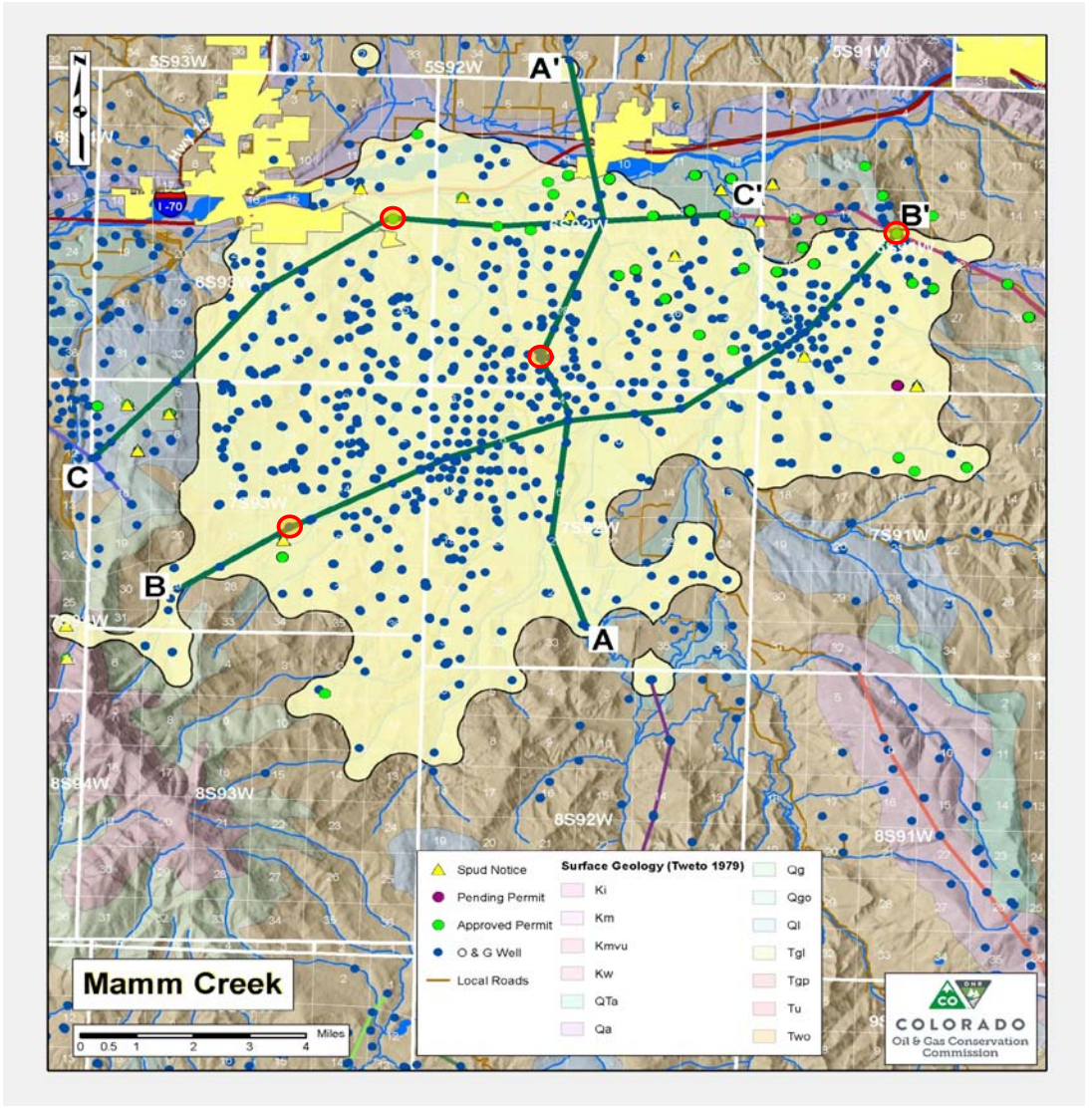
Basin	Piceance
Township(s)	5S to 8S
Range(s)	91W to 93W

SURFACE GEOLOGY

The Wasatch Formation outcrops at surface throughout most of the field. The Colorado River generally flows from east to west along the northern fringe of the field. Most of the field is south of the Colorado River. Alluvium is prevalent along the Colorado River and tributary creeks. Landslide deposits are present in the western portion of the field along Ramsey Gulch (primarily in 7S93W). The Green River Formation is present, overlying the Wasatch Formation, in the extreme southwestern portion of the field at higher elevations, approaching the eastern end of Battlement Mesa.

GEOLOGIC STRUCTURE

The northwestern extension of a northwest - southeast trending anticline is present on COGCC's 250K GIS Geology layer in the southeast portion of the field (7S92W) . A northwest-southeast trending, southwesterly-dipping monocline (the Grand Hogback Monocline along the northeastern edge of the basin) is present within three miles of the extreme northeastern portion of the field (bordering Kokopelli Field) and the extreme northern portion of the field (locally known as Peach Valley).



Type Log Wells

COGCC OIL AND GAS FIELD SCOUT CARD
MAMM CREEK 52500

				A - North						A' - South
STRATIGRAPHY			**API Number =>**	**045-19924**	**045-14368**	**045-07254**	**045-07149**	**045-13428**	**045-06844**	**045-06723**
			Surface Elevation =>	**5,650**	**5,519**	**5,742**	**6,069**	**6,358**	**6,290**	**6,551**
All depths are measured depths			**Well Type =>**	**Directional**	**Directional**	**Vertical**	**Vertical**	**Directional**	**Vertical**	**Vertical**
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water			0			0	0
	Landslide Deposit		Water							
	Uinta		Water							
	Green River		Water							
	Wasatch	Upper	Shallow Water	0	0		0	0		
	Wasatch	G-Sand*	Possible Gas	1,074/1,192*	922/1,018*					
	Wasatch	Fort Union*	None	1,560*	1,452*					
	Wasatch	Middle	UIC							
	Wasatch	Lower*	Water / UIC	3,448*	3,346*	2,168*	1,920*	2,060*	1,629*	2,262*
Mesaverde	Williams Fork	Ohio Creek	Water / UIC	3,642*	3,498*	2,525*	2,190*	2,258*	1,890*	2,490*
Mesaverde	Williams Fork	U. Mesaverde	Water / UIC	4,022	3,758*	2,875*	2,540*	2,570*	2,330	2,730*
Mesaverde	Williams Fork	Top of Gas	Gas		5,587	4,570		4,320		
Mesaverde	Williams Fork	Cameo	Gas	6,594	6,400					
Mesaverde	Iles	Rollins	Gas / UIC	7,738	7,402					5,994*
Mesaverde	Iles	Cozzette	Gas / UIC		7,959					6,596*
Mesaverde	Iles	Corcoran	Gas / UIC		8,189					6,810*
	Mancos		Possible Gas		8,404					7,260*
	Niobrara		Possible Gas		11,757					10,404
	Frontier		Possible Gas		12,038*					11,555*
	Mowry		Possible Gas		13,026					11,622*
Dakota	Dakota		Possible Gas							11,890*
	Morrison		Possible Gas							12,118*
San Rafael	Curtis		None							12,548*
San Rafael	Entrada		Possible Gas							12,630*
	Chinle		None							12,760*
	Weber		Possible Gas							12,958*
	Maroon		None							12,968*
	Leadville		Possible Gas							17,800

Annotated Type Log for 045-07254: COGCC Document Number 2056191

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

COGCC OIL AND GAS FIELD SCOUT CARD
MAMM CREEK 52500

				B - Southwest							B' - Northeast
STRATIGRAPHY			**API Number =>**	**045-15910**	**045-06899**	**045-07040**	**045-06907**	**045-09306****	**045-10341**	**045-07152**	**045-14576**
			Surface Elevation =>	**7,676**	**6,889**	**6,165**	**6,103**	**6,160**	**5,911**	**5,978**	**6,792**
All depths are measured depths			**Well Type =>**	**Directional**	**Vertical**	**Vertical**	**Vertical**	**Vertical**	**Directional**	**Vertical**	**Directional**
Group	**Formation**	**Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water		0	0			0		0
	Landslide Deposit		Water								
	Uinta		Water								
	Green River		Water								
	Wasatch		Shallow Water	0			0	0		0	
	Wasatch	G-Sand*	Possible Gas	3,758/3928*	2,630/2820*	820/1,003*		194/278*	784/878*	780/860*	1,120/1,262*
	Wasatch	Fort Union*	None	4,276	3,154*	1,307*		736*	1,373*	1,352*	1,650*
	Wasatch	Middle	UIC								
	Wasatch	Lower*	Water / UIC	5,610*	4,800*	2,660*	1,910*	2,094*	2,754*	2,730*	3,356*
Mesaverde	Williams Fork	Ohio Creek	Water / UIC	5,895*	5,070*	3,038*	2,330*	2,325*	3,095*	3,040*	3,543*
Mesaverde	Williams Fork	U. Mesaverde	Water / UIC	6,389	5,266*	3,302*	2,522*	2,652*	3,386	3,400*	3,914*
Mesaverde	Williams Fork	Top of Gas	Gas	7,546					4,535 tog***	4,134	
Mesaverde	Williams Fork	Cameo	Gas		7,962	6,802	6,088				
Mesaverde	Iles	Rollins	Gas / UIC	9,838	8,580	6,930		6,299	6,971		7,497
Mesaverde	Iles	Cozzette	Gas / UIC	10,370							8,047
Mesaverde	Iles	Corcoran	Gas / UIC	10,582							8,242
	Mancos		Possible Gas								
	Niobrara		Possible Gas								

Annotated Type Log for 045-06899: COGCC Document Number 2056128
Annotated Type Log for 045-14576: COGCC Document Number 2056080 (Kokopelli Field)

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

** Schwartz 2-15B (O2) - well associated with West Divide Creek seep.

**** Top of Gas (tog), as reported by operator or top Williams Fork production perforation (tp)*

COGCC OIL AND GAS FIELD SCOUT CARD
MAMM CREEK 52500

				Rulison Field		Mamm Creek Field				Kokopelli Field
				C - West						C' - East
STRATIGRAPHY			**API Number =>**	**045-18422**	**045-18259**	**045-09997**	**045-15178**	**045-14190**	**045-14368**	**045-18168**
			Surface Elevation =>	**7,357**	**7,602**	**6,313**	**5,492**	**5,665**	**5,519**	**5,650**
All depths are measured depths			**Well Type =>**	**Directional**	**Directional**	**Directional**	**Directional**	**Directional**	**Directional**	**Directional**
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water		0	0	0			0
	Landslide Deposit		Water	0						
	Uinta		Water							
	Green River		Water							
	Wasatch	Upper	Shallow Water					0	0	
	Wasatch	G-Sand*	Possible Gas (limited area	3,308/3,410*	3,667/3,777*	2,218/2,312*	1,326/1,424*	1,060/1,173*	922/1,018*	753/862*
	Wasatch	Fort Union*	None	3,820*	4,160*	2,694*	1,820*	1,530*	1,452*	1,256*
	Wasatch	Middle	UIC							
	Wasatch	Lower*	Water / UIC	5,390*	5,960*	4,492*	3,475*	3,340*	3,346*	3,132*
Mesaverde	Williams Fork	Ohio Creek	Water / UIC	5,510*	6,218*	4,800*	3,747*	3,618*	3,498*	3,330*
Mesaverde	Williams Fork	U. Mesaverde	Water / UIC	5,783*	6,550	5,118*	4,063	3,892	3,758*	3,600*
Mesaverde	Williams Fork	Top of Gas	Gas		8,158 tp**		5,930	5,887	5,587	
Mesaverde	Williams Fork	Cameo	Gas	8,476	9,470		6,686	6,617	6,400	6,216
Mesaverde	Iles	Rollins	Gas / UIC	9,352	10,318		7,753	7,604	7,402	7,221
Mesaverde	Iles	Cozzette	Gas / UIC				8,287	8,176	7,959	
Mesaverde	Iles	Corcoran	Gas / UIC				8,551	8,426	8,189	
	Mancos		Possible Gas						8,404	
	Niobrara		Possible Gas						11,757	
	Frontier		Possible Gas						12,038*	
	Mowry		Possible Gas						13,026	
Dakota	Dakota		Possible Gas							

Annotated Type Log for 045-15178: COGCC Document Number 2056192

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

*** Top of Gas (tog), as reported by operator or top Williams Fork production perforation (tp)*

WATER RESOURCE ISOLATION

Alluvium, landslide deposits, Uinta, Green River, Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde.
Water wells are typically screened in alluvium or upper, weathered portions of the Wasatch Formation. Two water wells north of the Colorado River are 620' and 750' deep, but otherwise, all permitted water wells within the field have total depths of 600' or shallower.

COGCC OIL AND GAS FIELD SCOUT CARD
MAMM CREEK 52500

PRODUCING ZONE ISOLATION

Primary Objectives: Mesaverde Group (Williams Fork and Iles)

Secondary Objectives: Eight wells completed in the Wasatch Formation (production reported in two wells and one other well was tested then squeezed with cement, some other completions for UIC); two wells completed in the Sego Member of the Iles Formation (045-10599 and 045-18869); seven wells completed in the Mancos Formation; and one well completed in the Leadville Formation (045-06723).

UNDERGROUND INJECTION CONTROL

API Number	Well Name and No.	Type	Zone	Sample Top	Sample Bot.	TDS	Source
045-09403	HMU #14-8 (P11SW)	Disposal Fm	Wasatch[1]	N/A	N/A	8,200	WH - 6/9/2009
045-10146	MCU Disposal #3	Disposal Fm	Wasatch[1]	N/A	N/A	8,200	WH - 6/9/2009
045-10123	MCU Fed. Disp #2	Disposal	Wasatch	4,562	5,198	8,200	WH - 6/9/2009
045-11225	MCU Disposal #1	Disposal	Wasatch	4,108	4,962	27,000	LOG CALC - OGCC
045-07463	BJM Disposal #1	Disposal	Ohio Creek	N/A	N/A	4,350	White River Field UIC Facility ID 159065[2]
045-08973	Buerger Disposal #1	Disposal Test	Ohio Creek[3]	2,324	3,096	3,300	WH - 10/28/2010
045-19732	Maves #A1	Source	Williams Fork - Rollins	3,208	5,493	11,367	WH - 11/23/2010
045-06868	Daley #1	Source	Williams Fork	4,076	5,470	5,320	WH - 6/13/2005
045-06928	Broome #1	Source	Williams Fork	4,223	6,434	5,587	WH - 6/13/2005
045-10344	GGU Broome #34C-30-691	Source	Williams Fork	4,400	6,952	9,397	WH - 4/10/2006
045-10343	GGU Broome #44A-30-691	Source	Williams Fork - Rollins	4,442	7,028	10,559	WH - 4/10/2006
045-06819	Duane Scott #1	Source	Williams Fork	4,522	6,354	10,172	WH - 4/13/2006
045-08971	Buerger #16-14C (C21)	Disposal Fm	Williams Fork[4]	4,617	5,070	18,180	WH - 6/7/2003
045-13482	GGU Miller #11B-32-691	Source	Williams Fork	4,715	6,729	18,409	WH - 9/30/2005
045-13482	GGU Miller #11B-32-691	Source	Williams Fork	4,715	6,729	7,936	WH - 4/10/2006
045-10451	GGU Daley #11C-29-691	Source	Williams Fork	4,754	6,646	7,418	WH - 4/13/2006
045-13484	GGU Miller #11D-32-691	Source	Williams Fork	4,809	6,822	10,228	WH - 4/10/2006
045-09003	Buerger Disposal #2	Disposal Test	Williams Fork	4,832	5,324	16,422	FLOW - 6/7/2003
045-13499	Scott #34C-25-692	Source	Williams Fork - Rollins	4,867	7,026	9,728	WH - 4/13/2006
045-19582	GGU Daley #14A-19-691	Source	Williams Fork - Rollins	4,949	7,335	11,944	WH - 4/13/2006
045-13498	Scott #24B-25-692	Source	Williams Fork	5,000	6,727	5,415	WH - 7/8/2005
045-13498	Scott #24B-25-692	Source	Williams Fork	5,000	6,727	9,622	WH - 4/13/2006
045-10616	GGU Barge #12D-32-691	Source	Williams Fork	5,016	7,186	9,958	WH - 4/10/2006

COGCC OIL AND GAS FIELD SCOUT CARD
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UNDERGROUND INJECTION CONTROL

API Number	Well Name and No.	Type	Zone	Sample Top	Sample Bot.	TDS	Source
045-10339	GGU VanOrdstrand #33A-30-691	Source	Williams Fork	5,020	6,610	18,380	WH - 4/13/2006
045-19728	Fenno Ranch #A1	Source	Williams Fork - Rollins	5,045	6,628	10,201	WH - 11/23/2010
045-10341	GGU Broome #43A-30-691	Source	Williams Fork - Rollins	5,090	7,057	12,413	WH - 4/10/2006
045-10543	GGU Barge #12B-32-691	Source	Williams Fork	5,129	6,699	10,189	WH - 4/10/2006
045-10347	GGU VanOrdstrand #43C-30-691	Source	Williams Fork - Rollins	5,156	7,100	10,415	WH - 4/13/2006
045-10524	Ferguson 34D-27-692	Source	Williams Fork	5,268	6,675	13,036	WH - 4/13/2006
045-10522	Ferguson 44D-27-692	Source	Williams Fork	5,292	6,751	10,524	WH - 4/13/2006
045-10425	GGU Miller #13A-32-691	Source	Williams Fork	5,334	6,974	8,475	WH - 4/10/2006
045-06053	Benzel Disposal #1	Disposal	Williams Fork[5]	5,406	6,680	12,772	FLOW - 10/18/1974
045-10342	GGU Broome #44C-30-691	Source	Williams Fork	5,420	6,568	14,404	WH - 4/10/2006
045-19816	CSF #32C-09-07-91	Source	Williams Fork - Rollins	5,461	7,780	12,674	SEP - 2/1/2011
045-10393	Scott #24D-25-692	Source	Williams Fork - Rollins	5,516	7,270	14,937	WH - 4/13/2006
045-13751	O'Toole #A4	Source	Williams Fork - Iles	5,559	8,457	46,968	SEP - 1/7/2009
045-14516	Burckle #A11	Source	Williams Fork - Iles	5,673	8,547	32,940	SEP - 12/10/2008
045-12161	Valley Farms #C2	Source	Williams Fork - Iles	5,674	8,245	21,559	SEP - 12/8/2008
045-12055	Valley Farms #B6	Source	Williams Fork - Iles	5,780	8,698	29,391	SEP - 12/8/2008
045-10335	GGU VanOrdstrand #33C-30-691	Source	Williams Fork - Iles	5,870	7,836	17,645	WH - 4/13/2006
045-12189	Hangs #B1	Source	Williams Fork - Iles	5,909	8,926	47,143	SEP - 12/10/2008
045-15168	Norcross #A14	Source	Williams Fork - Iles	5,912	8,565	40,445	SEP - 12/8/2008
045-14673	Robinson #C13	Source	Williams Fork - Iles	5,970	8,755	29,336	SEP - 12/10/2008
045-13935	Robinson #A3	Source	Williams Fork - Iles	6,012	8,648	37,368	SEP - 12/9/2008
045-13629	Dever #A10	Source	Williams Fork - Iles	6,100	8,702	30,828	SEP - 12/8/2008
045-19905	Three Siblings #A1	Source	Williams Fork	6,124	6,930	11,667	WH - 11/23/2010
045-10849	River Ranch #A1	Source	Williams Fork - Iles	6,156	8,678	36,371	SEP - 12/9/2008
045-10851	River Ranch #B2	Source	Williams Fork - Iles	6,195	8,701	39,238	SEP - 12/9/2008
045-19723	CSF #34D-10-07-91	Source	Williams Fork	6,279	7,784	9,263	SEP - 2/1/2011
045-12293	North Bank #B2	Source	Williams Fork - Iles	6,305	8,919	47,434	SEP - 12/11/2008
045-16043	Gypsum Ranch #B13	Source	Williams Fork - Iles	6,306	9,038	35,684	SEP - 12/8/2008
045-10850	Island Park #B3	Source	Williams Fork	6,359	7,588	21,881	SEP - 12/8/2008
045-13222	Valley Farms #E10	Source	Williams Fork - Iles	6,444	8,294	34,476	SEP - 12/11/2008
045-17068	McPherson #A2	Source	Williams Fork - Iles	6,525	8,444	29,561	WH - 12/3/2008
045-16012	Valley Farms Fed. #F14	Disposal/Source	Williams Fork - Iles[6]	6,536	8,520	42,358	SEP - 12/11/2008

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API Number	Well Name and No.	Type	Zone	Sample Top	Sample Bot.	TDS	Source
045-19724	CSF #43D-10-07-91	Source	Williams Fork - Rollins	6,595	8,321	9,307	SEP - 2/1/2011
045-10901	Snyder #C1	Source	Williams Fork	6,596	7,924	23,985	SEP - 12/8/2008
045-15131	Weinreis #A2	Source	Williams Fork - Iles	6,599	8,684	38,668	SEP - 12/10/2008
045-13927	Gentry #E1	Source	Williams Fork - Iles	6,640	8,482	38,111	SEP - 12/9/2008
045-14666	Robinson #C5	Source	Williams Fork - Iles	6,672	8,671	34,607	SEP - 1/7/2009
045-12337	Hangs #A2	Source	Williams Fork - Iles	6,689	8,510	37,553	SEP - 12/10/2008
045-13752	O'Toole #A3	Source	Williams Fork - Iles	6,795	8,522	34,924	SEP - 12/11/2008
045-12398	Snyder #A10	Source	Williams Fork - Iles	6,811	8,800	34,617	SEP - 12/8/2008
045-14941	Dever #C3	Source	Williams Fork - Iles	6,862	8,818	84,210	SEP - 12/9/2008
045-14109	Valley Farms #D13	Source	Williams Fork - Iles	6,866	8,644	35,138	SEP - 12/11/2008
045-15297	Gentry #C10	Source	Williams Fork - Iles	6,938	8,816	27,003	SEP - 12/10/2008
045-14188	Gentry #B10	Source	Williams Fork - Iles	6,987	8,717	27,557	SEP - 12/9/2008
045-14512	Gypsum Ranch #A4	Source	Williams Fork - Iles	7,031	9,098	31,329	SEP - 12/8/2008
045-08134	Brynildson #14C-20-692	Disposal Fm	Rollins[7]	7,914	8,070	23,648	WH - 1/11/2005
045-13222	Valley Farms #E10	Disposal Fm	Cozzette[8]	7,962	8,046	12,398	SWAB - 5/26/2009
045-12082	Valley Farms #D3	Disposal/Source	Cozzette - Corcoran	8,065	8,407	50,186	SEP - 12/11/2008
045-13803	GGU Rodreick #21B-31-691 SWD	Disposal	Cozzette - Corcoran	7,435	7,725	15,000	Estimate
045-05064	Schaeffer Disposal #1	Disposal	Cozzette - Corcoran	8,200	8,626	19,308	SWAB - 7/3/2005
045-09501	Benzel Disp. #2 (J26NWB)	Disposal	Cozzette - Corcoran	8,338	8,744	15,656	WH - 8/23/2005
045-11169	Scott #41D-36-692 SWD	Disposal/Source	Corcoran[9]	7,838	7,928	13,183	SWAB - 4/20/2006
045-13222	Valley Farms #E10	Disposal Fm	Corcoran[8]	8,190	8,294	13,871	SWAB - 4/29/2009
045-16241	River Ranch #C9	Source	Mancos	8,921	11,405	38,443	SEP - 12/9/2008
045-13614	North Bank #C10	Source	Mancos	9,825	11,972	32,070	SEP - 12/11/2008
045-14368	Dixon #B8	Source	Mancos	11,575	13,321	50,202	SEP - 12/10/2008

Aquifer Exemptions: BJM Disposal #1 (Ohio Creek) [data may not be representative of actual Ohio Creek Formation concentration] and MCU Federal Disposal #2 (Atwell Gulch Member of Wasatch) [tops reported as 3298' Molina Member, 3509' G-Sand interval, and 3764' Atwell Gulch Member of Wasatch]

Data in this table is listed first by zone from shallowest to deepest, then by Sample Top depth.

(1) Sample appears to have been collected from offset well 045-10123 on 6/9/2009 with a P11SW sample name. The Wasatch Formation was not completed in 045-09403 and 045-10146 until 5/25/2013 and 6/7/2012, respectively.

(2) At the time of the UIC Application, the sample was considered representative of the Ohio Creek Formation. The sample was collected from a well in the White River Dome Field, Rio Blanco County, approximately 54 miles NW of 045-07463. COGCC staff's opinion in 2016 is that this TDS concentration cannot be considered representative of Ohio Creek water quality in the Mamm Creek Field.

(3) Designated the Ohio Creek Formation by the operator, but in 2016 COGCC staff contends that this interval is entirely Upper Mesaverde.

(4) Perfs added from 4,260' to 4,429' on 6/9/2003 after collecting this sample. This sample was a representative formation sample for the Buerger #2 (045-09003) UIC application.

(5) Sample collected from the Williams Fork gas producing zone prior to recompleting the well for injection into the Cozzette - Corcoran.

(6) This sample was a representative formation sample for the Valley Farms #F4 (045-14287) UIC application.

(7) This sample was a representative formation sample for the Scott #41D-36-692 SWD (045-11169) UIC application.

(8) This sample was a representative formation sample for the Valley Farms #D3 (045-12082) UIC application.

(9) This sample was a representative formation sample for the Circle B Land #33A-35-692 SWD (045-18493) and Specialty #13A-28-692 SWD (045-14054) UIC applications.

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COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

191-1 (12/14/1965)	Mesaverde: Recognizes the Mesaverde as a **Common Source** of supply. Established 640-acre drilling and spacing units Order specifies minimum 350' surface casing with size and weight of casing approved by COGCC. Requires sufficient cement be used to fill the annular space behind the pipe to the surface.
191-2 (5/18/1981)	Rescinds 191-1 and makes lands subject to the general rules and regulations.
191-3 (7/19/1982)	Mesaverde: Established 640-acre drilling and spacing units, 990' from unit boundary. Recognizes the Cozzette and Corcoran to be part of the Upper Mancos formation as a **Common Source** of supply with the Mesaverde.
191-4 (2/22/1994)	Expand areas of 640-acre drilling and spacing.
191-5 (10/20/1997)	Mesaverde including Williams Fork: decreased spacing unit size to 40 acres, 400' from unit line, 800' well-to-well in one section (16 wells per 640 acres).
1V-276 (8/16/2004)	West Divide Creek Seep Order Finding Violation: Moratorium on drilling within 2 miles of the Divide Creek Seep until the appropriate safety precautions are set forth in the Notice to All Operators Drilling Wells to the Mesaverde Group or Deeper in the Mamm Creek Field, Garfield County, effective July 23, 2004 (Cementing NTO); penalty assigned to EnCana Oil & Gas (USA) Inc. for the Schwartz 2-15B well.
Various	Williams Fork and Iles: established 640, 320, 160, and 80-acre drilling and spacing units in certain parts of the field with 10 acre well density (no more than 4 wells on one pad per quarter quarter section, to be drilled vertically or directionally), 100' from boundary lines or 200' (Williams Fork) / 400' (Iles) from boundaries if offset wells are not 10-acre spaced.
191-12 (7/11/2005)	Allows drilling by BBC in a portion of the Order 1V-276 moratorium area. Requires compliance with 2004 Cementing NTO, Bradenhead Testing and Reporting Requirements for the Mamm Creek Field (Aug 23, 2004), BBC's Ground Water and Methane Monitoring Plan, walking surveys within 1/2 mile of drill site, surface water samples prior to drilling and after completion, monthly monitoring of surface water during drilling, and defines sampling analytes. Requires gas compositional and stable isotope analysis if methane detected at > 2 mg/L. Requires compliance with BBC's Additional Subsurface Data Collection Plan (including Wasatch gas sample collection during drilling surface hole, if practibable). Requires compliance with BBC's Mamm Creek Field Operations Plan dated Dec 2004 and concerns and conditions expressed in the July 4, 2005 correspondence from Garfield County's consultant, Dr. Geoffrey Thyne. Sample results were to be submitted to to augment hydrogeologic study.
191-22 (9/20/2004)	Established Bradenhead Monitoring Area, including the Mamm Creek Field.
191-23 (4/24/2006)	Eliminated the Order 1V-276 drilling moratorium area within 2 miles of Divide Creek Seep. Operators drilling in the area are required to comply with the Cementing NTO.
Various	Mancos Group: established various drilling and spacing units with 10 acre well density (no more than 4 wells on one pad per quarter quarter section) for the Mancos Group, including the Mancos, Niobrara, and Mowry Formations, 100' from boundary lines or 400' from boundaries if offset wells are not 10-acre spaced.
Various	Williams Fork: Established horizontal wellbore spacing units

HISTORIC WELL CONSTRUCTION

Historic surface casing setting depths vary throughout the field as a function of age of the well and ground surface elevation. Old wells drilled during early development of the field commonly have surface casing setting depths ranging from 200' to 500' deep. Effective 11/20/1997, the minimum surface casing setting depth standard was changed to 10% TVD for all Williams Fork gas wells drilled in Garfield County, which includes this entire field. Effective 2/9/2007, the minimum surface casing setting depth was increased to 15% TVD for wells drilled in the East Mamm Creek Area. Surface casing setting depths for newer wells are generally set between 1,000' to 3,000', but deeper surface casing (3,000' to 4,000') has been used in isolated areas of the field. Production casing generally terminates in the Iles Formation or the underlying Mancos Formation. Production casing cement (or intermediate casing cement, if used) may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 10% TVD (or 15% TVD in the East Mamm Creek Area) for well control and to cover water resources in the upper interval of the Wasatch Formation. Recommend setting depth of at least 50 feet below the Wasatch Formation top for high-elevation wells that must drill through the Green River Formation, if that criterion is more stringent than the 10% TVD criterion. Check for deep alluvium on offset logs with wells drilled near the Colorado River, but a cursory review of wells with shallow surface casing of 300' to 400' near the river showed that minimum surface casing setting depths will likely provide full coverage of alluvium. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. New Standards require cementing intermediate (if used) or production casing at least 200' above Lower Wasatch sands in the southwest portion of Township 7S-93W (Sections 19, 20, 29, 30, 31, and 32) and the northwest portion of Township 8S-93W (Sections 5 and 6), or at least 500' above Lower Wasatch sands in the northern, central, and eastern portions of the field to the northeast of the Molina/Atwell Gulch Middleton Creek UIC Area, or 200' above the Molina Member top within an area inclusive of a one-mile buffer around the Middleton Creek UIC Area.

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PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug above Ohio Creek and across Lower Wasatch (squeeze if no annular cement coverage); stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000-foot intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug. Consider setting plug(s) from 1,000' to surface for shallow surface casing strings that are less than 1,000 feet deep.

WELL CONTROL

Well control events summarized below were controlled without incident. The 2004 Schwartz 2-15B (O2) underground blowout to West Divide Creek was uncontrolled until cement remediation was performed, with gas kicks encountered in the Wasatch (rare occurrence) and Williams Fork. Well Control events have been reported in 6S-92W, 6S-93W, 7S-91W, 7S-92W, 7S-93W, and 7S-94W.
Well Control Reports (Form 23s) by Year: 2003 (1), 2004 (1), 2005 (1), 2006 (1), 2007 (2), 2008 (3), 2009 (5), 2010 (9), 2011 (18), 2012 (18), 2013 (3), 2014 (none), and 2015 (none). Reporting was inconsistent prior to 2009, when requirements for Form 23 reporting was emphasized with the operators.
Form 23s by Formation: Williams Fork (40), Iles [including Sego Member] (14), and Mancos/Niobrara (9)

NOTES

Except for T5S, the entire field is located within the Mamm Creek Field Cementing Notice to Operators Area. Special requirements and Form 2 Conditions of Approval apply.
Except for T5S, the entire field is located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.
An Uranium Mill Tailings Remedial Action area is located along I-70 and the Colorado River to the northwest of the field in 6S93W. Special requirements and Form 2 Conditions of Approval apply.
Hydrogen Sulfide: Detectable concentration reported in T7S, R93W (Section 12), during blowdown of a former UIC disposal well prior to plugging and abandonment of the well.

ISOLATION REQUIREMENTS FOR TYPICAL WELLS

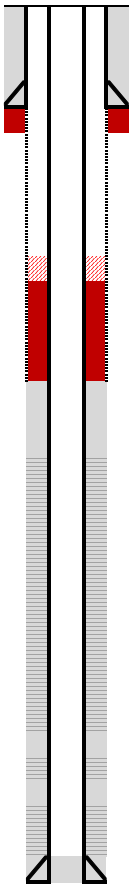
Date 04/18/2016 **COGCC Document No.** 2056129

FIELD NAME **MAMM CREEK**
FIELD NUMBER **52500**

LOCATION
Basin Piceance
Township(s) 5S to 8S
Range(s) 91W to 93W

Note: Depths to formation tops differ significantly with changes of ground surface elevation and geologic structure across the field. Refer to the Stratigraphy chart on the Field Scout Card. These wellbore diagrams reflect average depths in a small portion of the field. Also refer to standards in adjacent fields for guidance.

Depth	Formation/Member
0	Green River/ Landslide Deposit/ Alluvium/ U. Wasatch
1,000	Wasatch G
2,000	
3,000	L. Wasatch Ohio Creek U. Mesaverde
4,000	
	Top of Gas
5,000	
6,000	
7,000	Cameo
	Rollins
8,000	Cozzette Corcoran



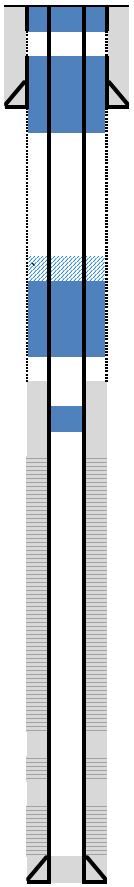
Casing and Cement Coverage

New Surface Casing Standard
Minimum 10% TVD (15% in East Mamm Creek Area) or cover all apparent water resources in the Green River (if present) and U. Wasatch, whichever is more stringent

New Cement Standard
Cement must provide coverage across Ohio Creek and Lower Wasatch, in addition to productive interval coverage. Increase to 500' above Lower Wasatch coverage if well is in Lower Wasatch 500' Coverage Area. Increase to 200' above Molina top in Atwell Gulch/ Molina UIC area.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of U. Mesaverde, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	Green River/ Landslide Deposit/ Alluvium/ U. Wasatch
1,000	Wasatch G
2,000	
3,000	L. Wasatch Ohio Creek U. Mesaverde
4,000	
	Top of Gas
5,000	
6,000	
7,000	Cameo
	Rollins
8,000	Cozzette Corcoran



Plug Placement

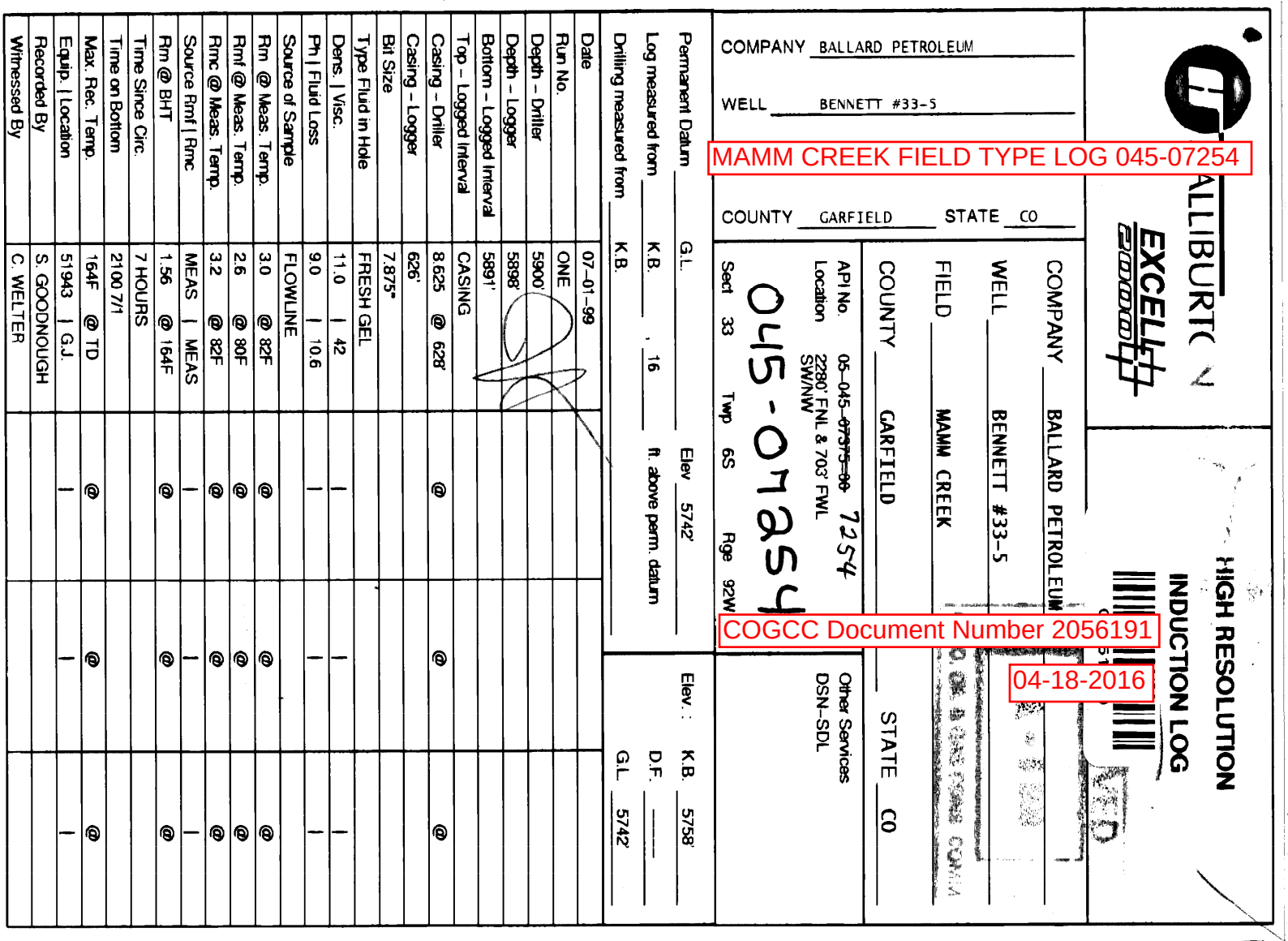
Surface plug

Surface casing shoe plug
Set deeper shoe plug if casing depth < 1,000 feet

Squeeze plug across Ohio Creek and L. Wasatch (top of plug 500' above L. Wasatch if well is in Lower Wasatch 500' Coverage Area)
Add Atwell Gulch and Molina in UIC area

Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 feet); not shown on this figure

Plug in casing above Mesaverde Group Completions



HALLIBURTON
EXCELL 2000
HIGH RESOLUTION INDUCTION LOG

COMPANY BALLARD PETROLEUM
WELL BENNETT #33-5
FIELD MAMM CREEK
COUNTY GARFIELD STATE CO

MAMM CREEK FIELD TYPE LOG 045-07254

COMPANY BALLARD PETROLEUM
WELL BENNETT #33-5
FIELD MAMM CREEK
COUNTY GARFIELD STATE CO

API No. 05-045-~~07375-00~~ 7254
Location 2280' FNL & 703' FWL SW/NW
Sect 33 Twp 6S Rge 92W

045-07254

COGCC Document Number 2056191

04-18-2016

Other Services
DSN-SDL

Permanent Datum G.L. Elev. 5742'
Log measured from K.B. 16 ft. above perm. datum
Drilling measured from K.B.

Elev.:	K.B.	5758'	
	D.F.		
	G.L.	5742'	

Date	07-01-99		
Run No.	ONE		
Depth – Driller	5900'		
Depth – Logger	5898'		
Bottom – Logged Interval	5891'		
Top – Logged Interval	CASING		
Casing – Driller	8.625 @ 628'	@	
Casing – Logger	626'		
Bit Size	7.875"		
Type Fluid in Hole	FRESH GEL		
Dens. | Visc.	11.0 | 42	|	
Ph | Fluid Loss	9.0 | 10.6	|	
Source of Sample	FLOWLINE		
Rm @ Meas. Temp.	3.0 @ 82F	@	
Rmf @ Meas. Temp.	2.6 @ 80F	@	
Rmc @ Meas. Temp.	3.2 @ 82F	@	
Source Rmf | Rmc	MEAS | MEAS	|	
Rm @ BHT	1.56 @ 164F	@	
Time Since Circ.	7 HOURS		
Time on Bottom	2100 7/1		
Max. Rec. Temp.	164F @ TD	@	
Equip. | Location	51943 | G.J.	|	
Recorded By	S. GOODNOUGH		
Witnessed By	C. WELTER		

Fold Here

Service Ticket No.:	94518	API Serial No.:	05-045-07375-00
PGM Version:	XL v3.40		

CHANGE IN MUD TYPE OR ADDITIONAL SAMPLES

Date | Sample No.	|	|
Depth – Driller		
Type Fluid in Hole		
Dens. | Visc.	|	|
Ph | Fluid Loss	|	|
Source of Sample		
Rm @ Meas. Temp.	@	@
Rmf @ Meas. Temp.	@	@
Rmc @ Meas. Temp.	@	@
Source Rmf | Rmc	CALC | CALC	|
Rm @ BHT	1.56 @ 164F	@
Rmf @ BHT	1.32 @ 164F	@
Rmc @ BHT	1.66 @ 164F	@

RESISTIVITY SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

RESISTIVITY EQUIPMENT DATA

Run No.	Tool Type & No.	Pad Type	Tool Pos.	Other
ONE	HRIDE #A205	NA	1.5" SO	

EQUIPMENT DATA

GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No.	ONE	Run No.		Run No.	ONE	Run No.	ONE
Serial No.	108589	Serial No.		Serial No.	B5022	Serial No.	108784
Model No.	NGRT	Model No.		Model No.	SDL	Model No.	DSN II
Diameter	3.625"	No. of Cent.		Diameter	4.5"	Diameter	3.625"
Detector Model No.	102A	Spacing		Log Type	GAM/GAM	Log Type	THERMAL
Type	SCINT.			Source Type	CS137	Source Type	AM241BE
Length	4'	LSA [Y / N]		Serial No.	2189	Serial No.	DSN-80
Distance to Source	10'	FWDA [Y / N]		Strength	1.5 CI	Strength	18.5 CI

LOGGING DATA

GENERAL		GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No.	ONE	Run No.	ONE	Run No.		Run No.	ONE	Run No.	ONE
Date	07-01-99	Logging Speed	30	Logging Speed		Logging Speed	30	Logging Speed	30
Time	2100 7/1	Sensitivity	20	Sensitivity		Sensitivity	20	Sensitivity	20
Max. Rec. Temp.	164F @ TD	Time Constant	3	Time Constant		Time Constant	3	Time Constant	3
Equip. | Location	51943 | G.J.	Tool Position	CENTER	Tool Position		Tool Position	CENTER	Tool Position	CENTER
Recorded By	S. GOODNOUGH	Depth Offset		Depth Offset		Depth Offset		Depth Offset	
Witnessed By	C. WELTER								

GENERAL				GAMMA		ACOUSTIC			DENSITY			NEUTRON		
Run	Depth		Speed	Scale		Scale			Scale			Scale		
No.	From	To	Ft / Min	L	R	L	R	Matrix	L	R	Matrix	L	R	Matrix
ONE	TD	CSG	REC	0	150				30%	-10%	2.68	30%	-10%	SAND
											GM/CC			

MAMM CREEK FIELD TYPE LOG 045-07254

Remarks:

HRI SDL DSN GR WERE RUN IN COMBINATION.
A.H.V. COMPUTED FOR 4.5" CASING.
A.H.V. = 2545 FT^3 B.H.V. = 3090 FT^3
MUD CONTAINED BARITE WHICH MAY EFFECT THE DENSITY READINGS.
CHLORIDES = 500 PPM

CREW: J. BREESE, E. ROBLES RIG: SST #3
THANK YOU FOR CHOOSING H.E.S. GRAND JUNCTION. (970) 523-1661

HALLIBURTON DOES NOT GUARANTEE THE ACCURACY OF ANY INTERPRETATION OF THE LOG DATA, CONVERSION OF LOG DATA TO PHYSICAL ROCK PARAMETERS OR RECOMMENDATIONS WHICH MAY BE GIVEN BY HALLIBURTON PERSONNEL OR WHICH APPEAR ON THE LOG OR IN ANY OTHER FORM. ANY USER OF SUCH DATA, INTERPRETATIONS, CONVERSIONS, OR RECOMMENDATIONS AGREES THAT HALLIBURTON IS NOT RESPONSIBLE EXCEPT WHERE DUE TO GROSS NEGLIGENCE OR WILLFUL MISCONDUCT, FOR ANY LOSS, DAMAGES, OR EXPENSES RESULTING FROM THE USE THEREOF.

HALLIBURTON

Current EXCELL-2000 Parameter Values
Depth: 1694.417
Date: 01-Jul-1999 19:49

Mnemonic	Tool	Parameter Description	Value	Units
PERF	DITSHD	PERFORATED INTERVAL	NO	
TD	DITSHD	TOTAL DEPTH	5900.	FT
GR_OK	GAMMA	DO GAMMA CALCULATIONS?	YES	
CASED	SHARED	CASED HOLE?	NO	
CASEOD	SHARED	CASING DIAMETER (OD)	4.5	Inches
MUDWT	SHARED	BOREHOLE FLUID WEIGHT	11.	Pounds/Gal.
GRSO	GAMMA	GAMMA RAY STANDOFF	0.	Inches
BS	SHARED	BIT SIZE	7.875	Inches
DSN_OK	DSN_II	DO DSN II CALCULATIONS?	YES	
DRILL	DSN_II	TPL - NEUTRON IN SLEEVE?	NO	
BADHOL	DSN_II	DSN BAD HOLE CORRECTION	NO	
NLITH	DSN_II	NEUTRON LITHOLOGY	SAND	
DSNSO	DSN_II	DSN STANDOFF	0.	Inches
DSNTMP	DSN_II	DSN II TEMPERATURE CORRECTION	NONE	
DSNPRS	DSN_II	DSN II PRESSURE CORRECTION	NONE	
SDL_OK	SDL	DO SDL CALCULATIONS?	YES	
BARITE	SDL	ANY BARITE IN MUD?	YES	
AIR	SDL	AIR FILLED BOREHOLE?	NO	
RHOFLU	SDL	FLUID DENSITY	1.	G/CC
RHOMAT	SDL	MATRIX DENSITY	2.68	Grams/CC
CAL_OK	CALSDL	DO CALIPER CALCULATIONS?	YES	
AHVOK	CALSDL	DO ANNULAR VOLUME CALCULATION?	YES	
HRI_OK	HRIDE	DO HRI INDUCTION CALCULATION?	YES	
DFL_OK	HRIDE	DO DFL CALCULATIONS?	YES	
PYRITE	HRIDE	PYRITE SWITCH	NO	OHMM
CASING	HRIDE	CASING DEPTH	0.	Feet
HRIDSP	HRIDE	SPIKE REDUCTION FILTER TYPE?	DELT	
HRITC	HRIDE	HRI TEMPERATURE CORRECTION	NONE	
CTEM	HRIDE	CONST TEMPERATURE	75.	
BHT	HRIDE	BOTTOM HOLE TEMPERATURE	175.	Degrees F.
TSURF	HRIDE	SURFACE TEMPERATURE	60.	Degrees F.
BHD	HRIDE	BOTTOM HOLE DEPTH	10000.	Feet
SP	HRIDE	USE DIGITAL SP?	NO	
RMUD	HRIDE	MUD RESIST AT SURFACE (0=Air)	2.	OHMM
TRM	HRIDE	TEMPERATURE OF MUD	75.	DEGF
RRMIN	HRIDE	MINIMUM RESISTIVITY FOR MAP?	0.2	OHMM
RRMAX	HRIDE	MAXIMUM RESISTIVITY FOR MAP?	200.	OHMM

CONDUCTIVITY MAIN PASS 2"=100'

HALLIBURTON
EXCELL 2000

Version No: 1 hc:3.0
Data File: FINAL.cls
Format File: /field_data/data2/ballard_33-5/HRI2IN.spc
Plot Time: 07-02-99 00:50:02
Database Time: 07-01-99 22:24:43

MAMM CREEK FIELD TYPE LOG 045-07254

Top Depth: 601.00
Bottom Depth: 5909.75

GAMMA RAY	AHV	DEEP	TENSION
0 API COUNTS 150	50 FT3 0	0 OHM-M 100	10000 POUNDS 0
CALIPER	BHV	DFL	DEEP COND.
6 INCHES 16	0 FT3 50	0 OHM-M 100	250 MMHO 0
SP			
-]10[+	1:600 FT.		

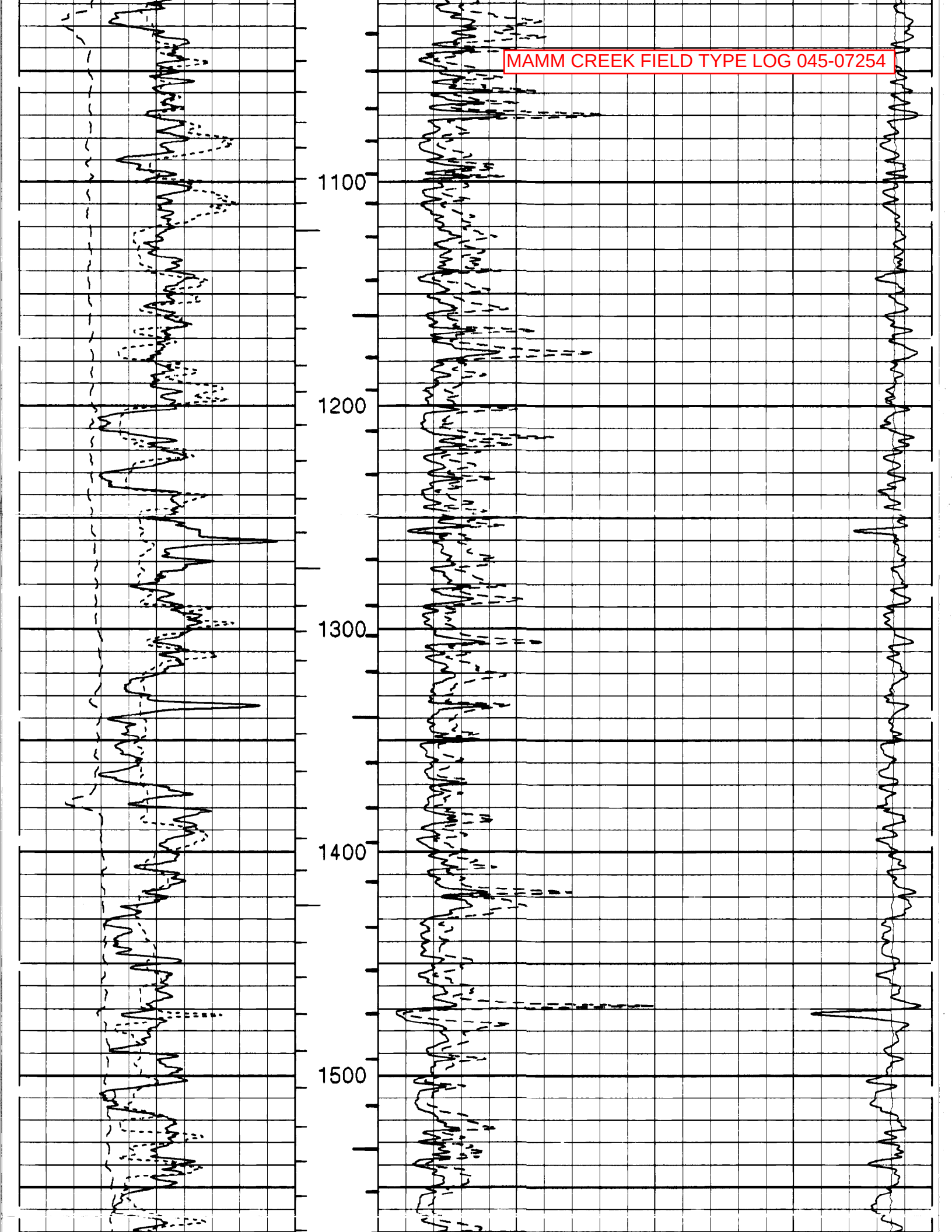
Alluvium at Surface
Underlain by Wasatch Formation

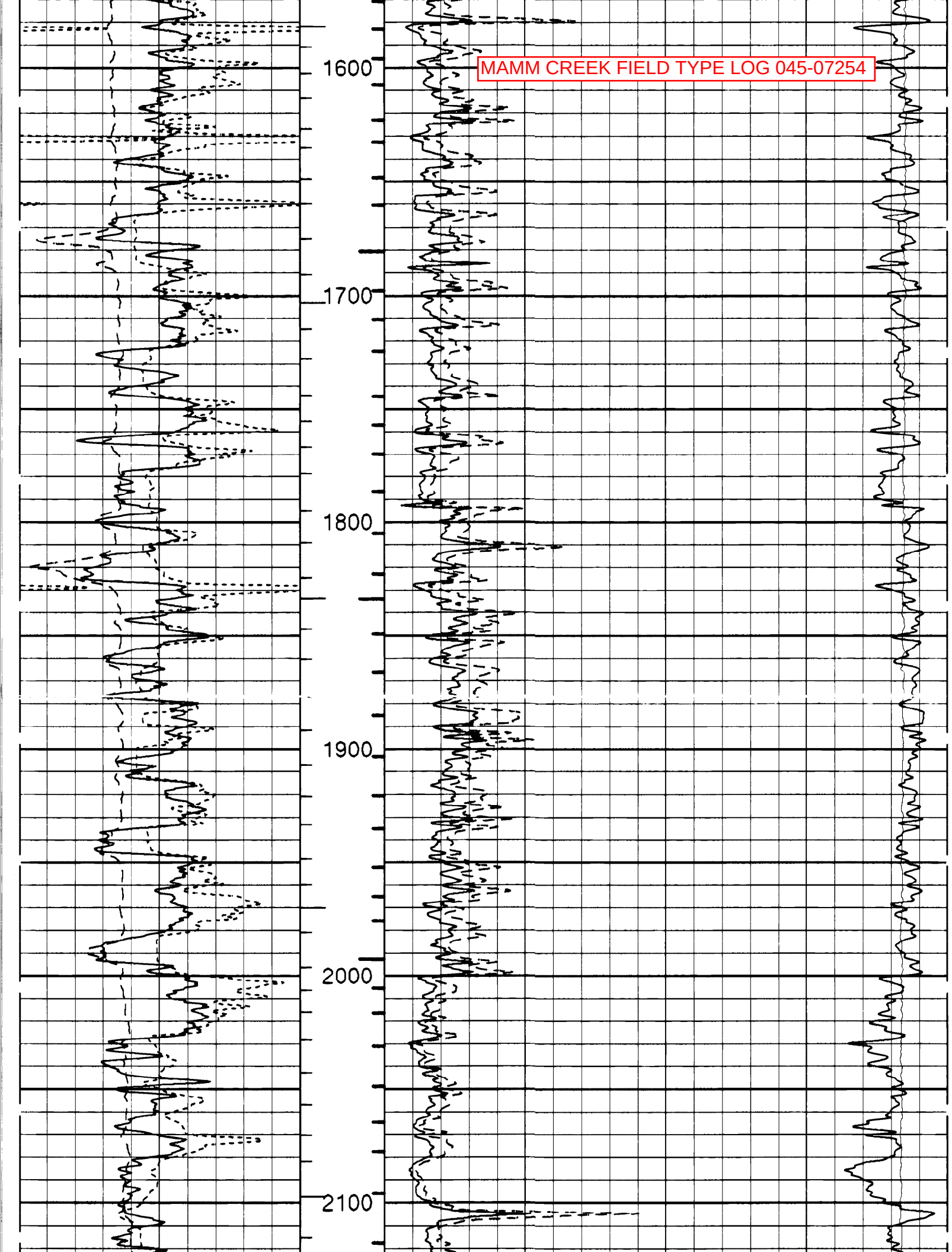
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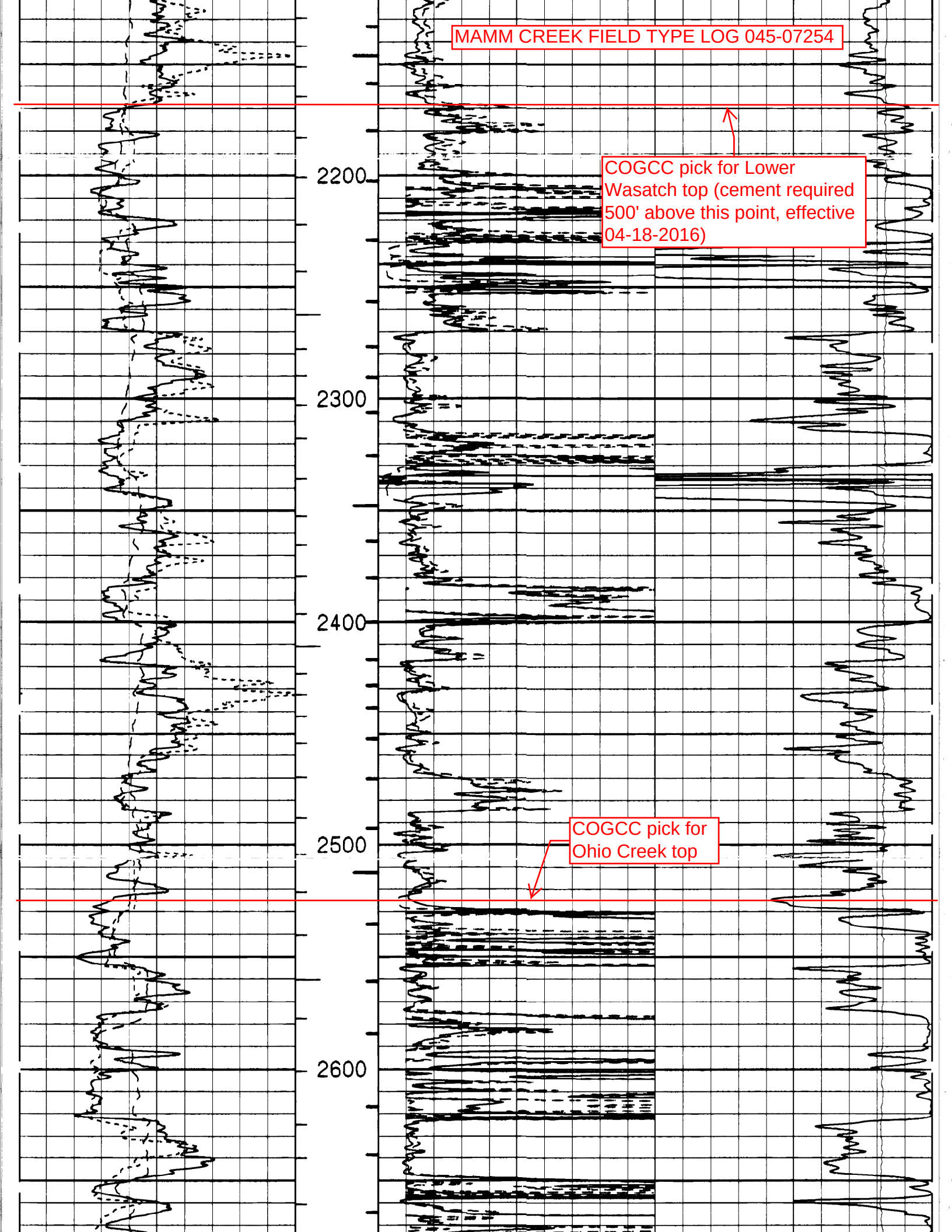
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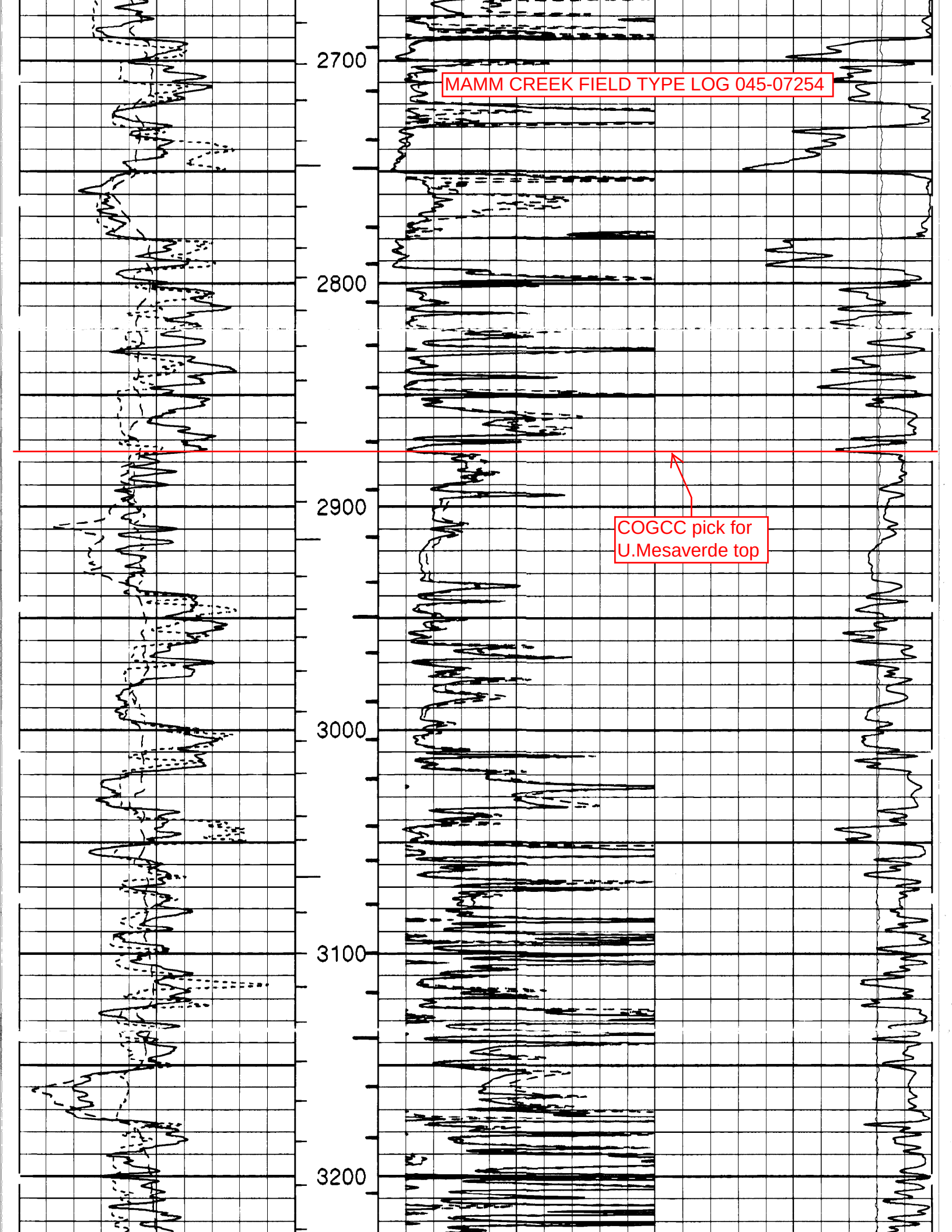
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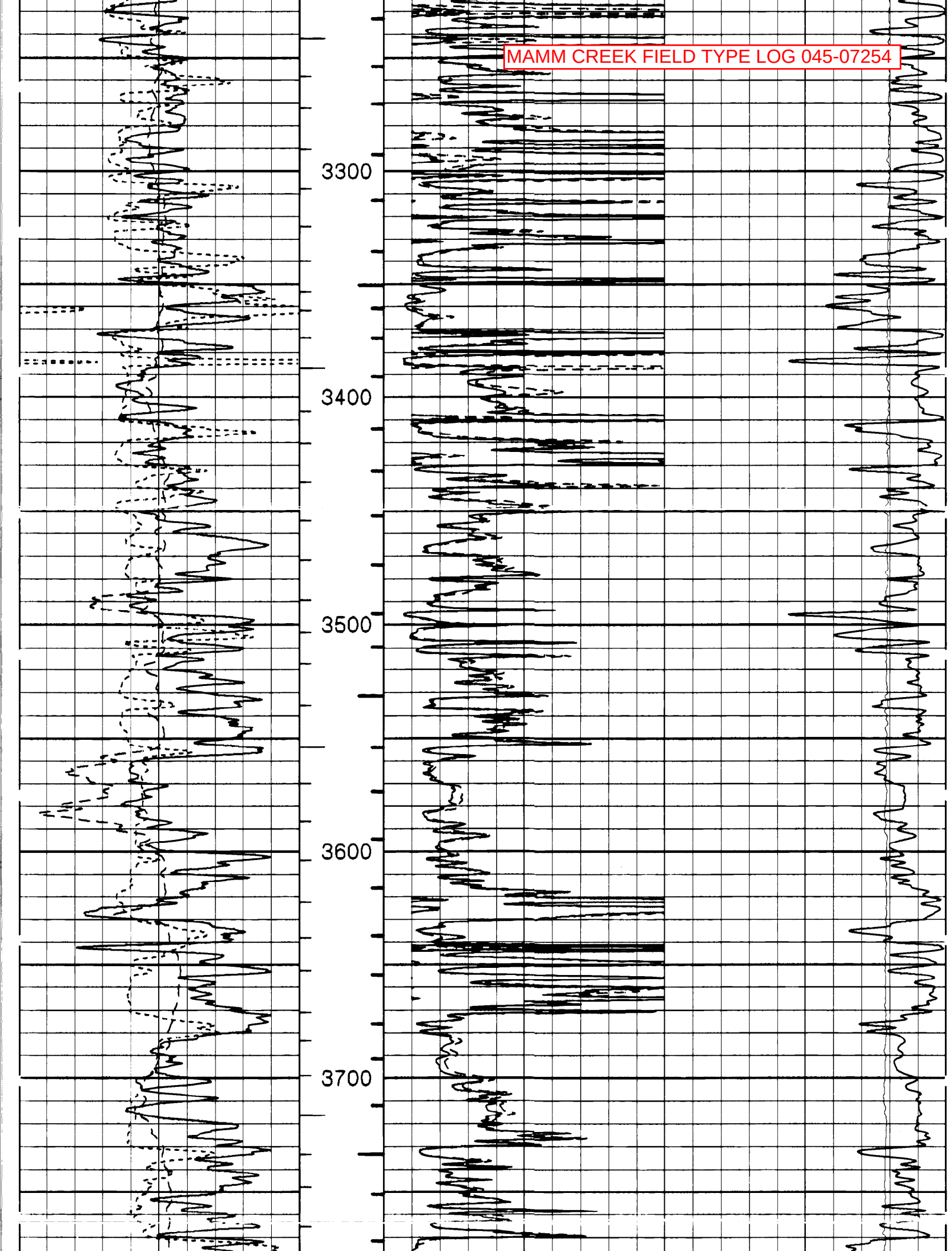
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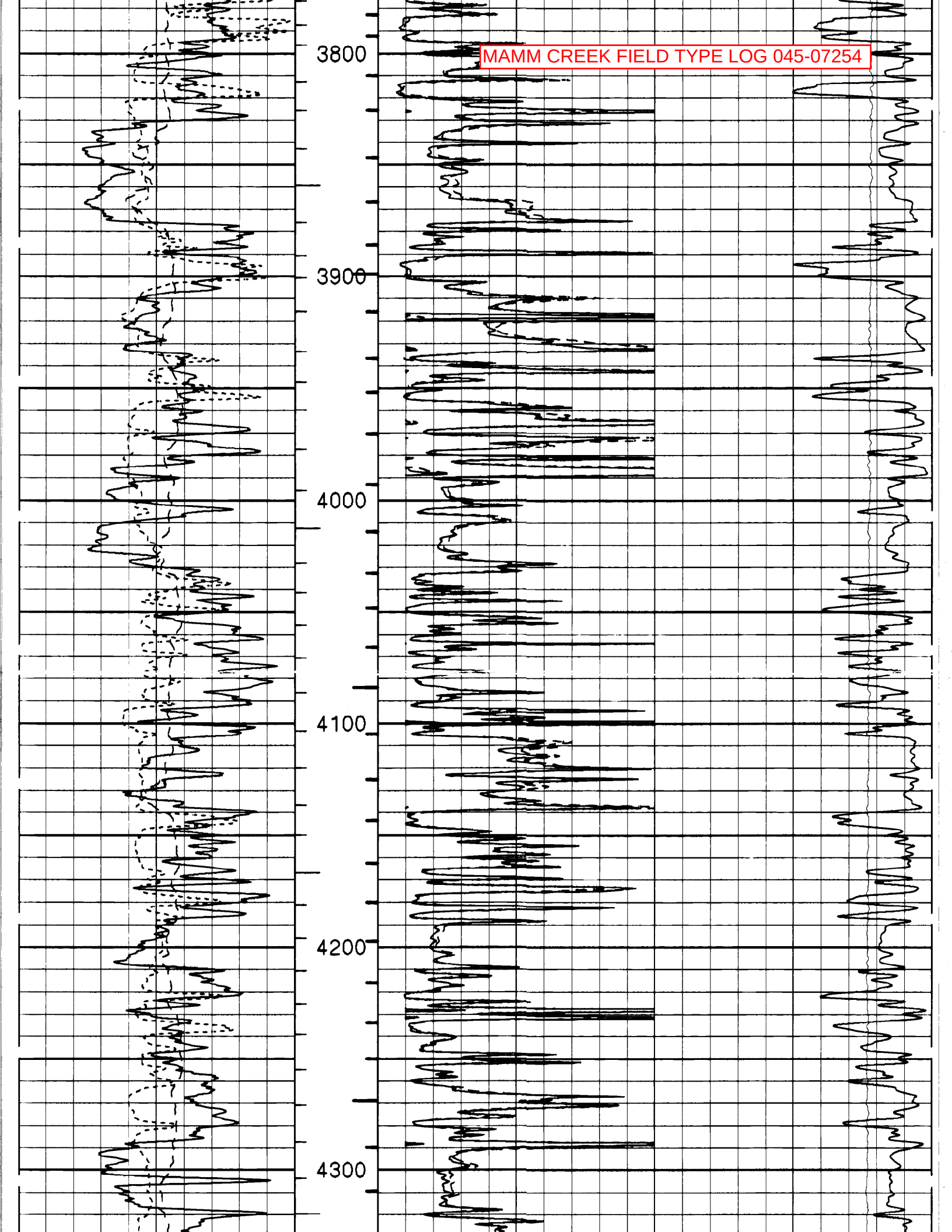

MAMM CREEK FIELD TYPE LOG 045-07254
1100
1200
1300
1400
1500

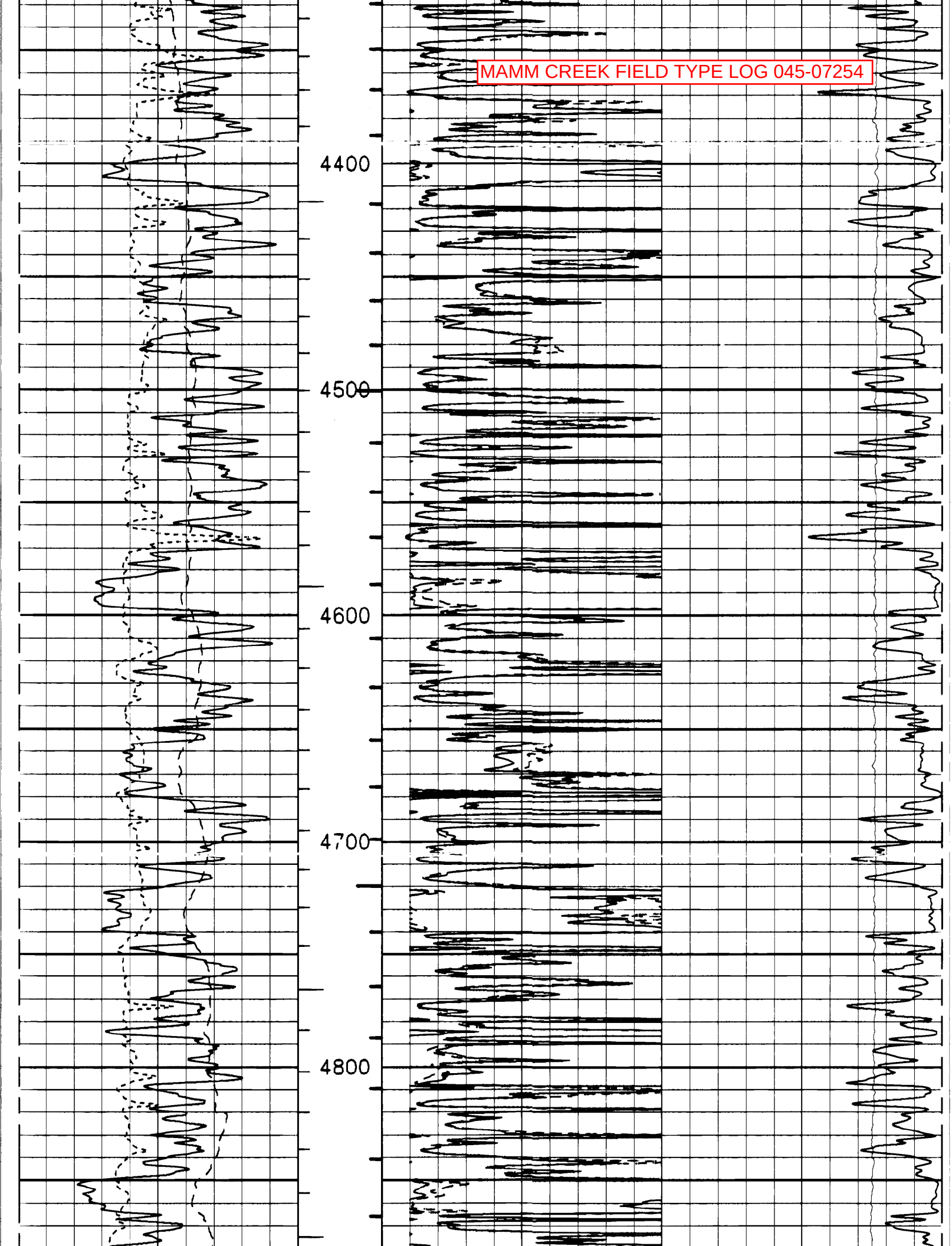

MAMM CREEK FIELD TYPE LOG 045-07254
1600
1700
1800
1900
2000
2100

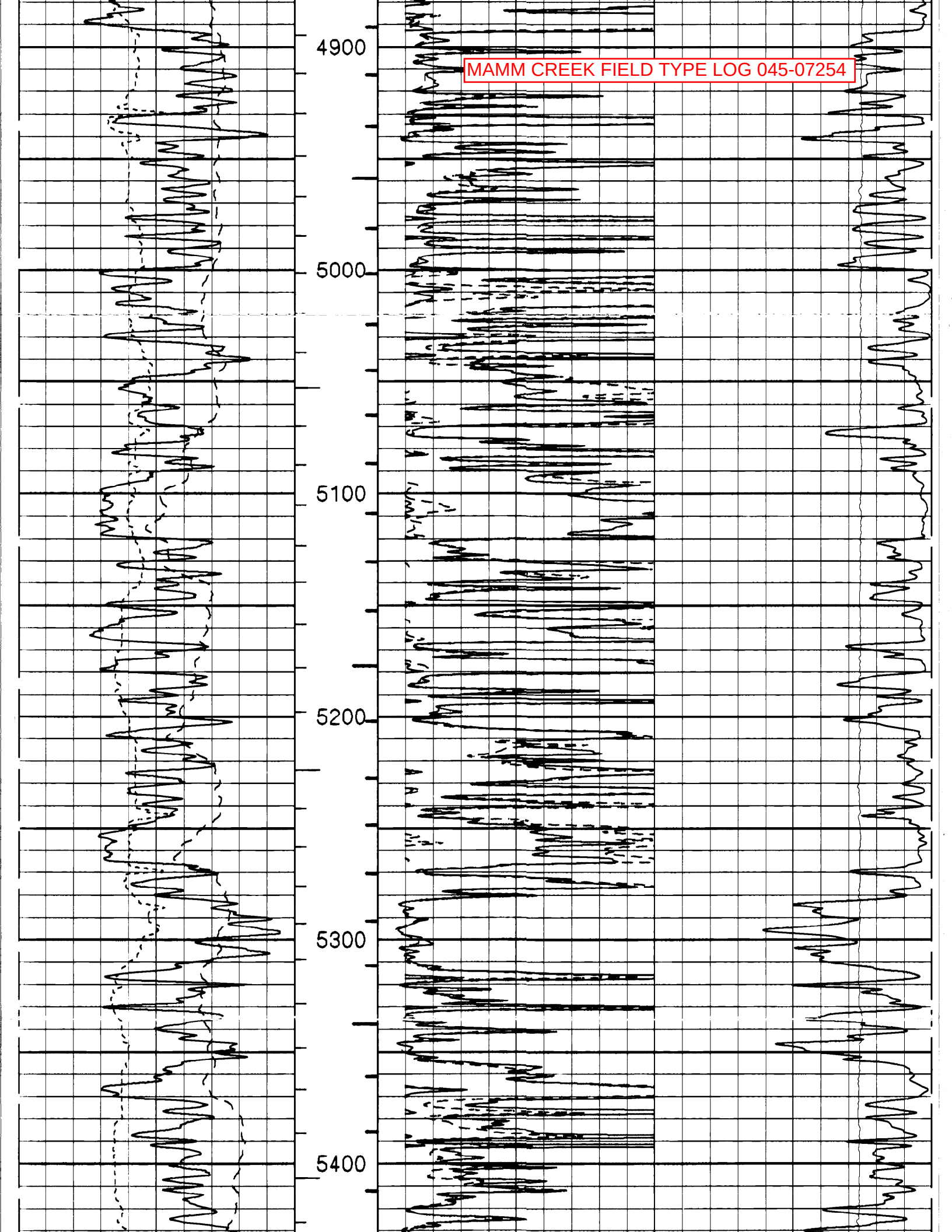

MAMM CREEK FIELD TYPE LOG 045-07254
COGCC pick for Lower Wasatch top (cement required 500' above this point, effective 04-18-2016)
2200
2300
2400
2500
2600
COGCC pick for Ohio Creek top

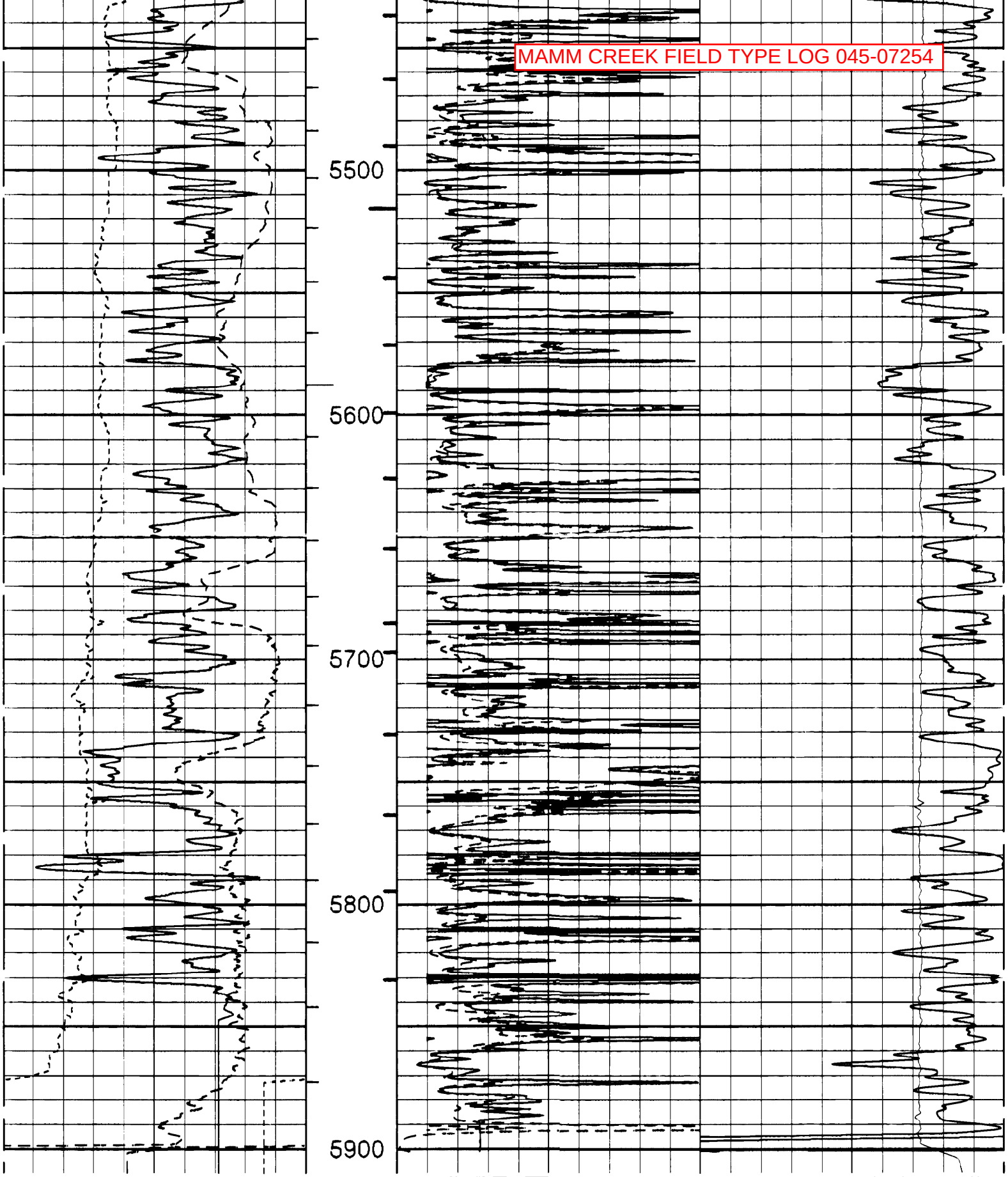

MAMM CREEK FIELD TYPE LOG 045-07254
2700
2800
2900
3000
3100
3200
COGCC pick for
U.Mesaverde top


MAMM CREEK FIELD TYPE LOG 045-07254
3300
3400
3500
3600
3700


MAMM CREEK FIELD TYPE LOG 045-07254
3800
3900
4000
4100
4200
4300


MAMM CREEK FIELD TYPE LOG 045-07254
4400
4500
4600
4700
4800


MAMM CREEK FIELD TYPE LOG 045-07254
4900
5000
5100
5200
5300
5400



1:600 FT.

SP
-110+

CALIPER
6 INCHES 16

GAMMA RAY
0 APICOUNTS 150

BHV
0 FT3 50

AHV
50 FT3 0

DFL
0 OHM-M 100

DEEP
0 OHM-M 100

DEEP COND.
250 MMHO 0

TENSION
10000 POUNDS 0

Version No: 1 hc:3.0

HALLIBURTON

EXCELL

Data File: FINAL.cls

Format File: /field_data/data2/ballard_33-5/HRI2IN.spc

Plot Time: 07-02-99 00:47:46

Database Time: 07-01-99 22:24:43

Top Depth: 601.00

Bottom Depth: 5909.75

MAMM CREEK FIELD TYPE LOG 045-07254

MAMM CREEK FIELD TYPE LOG 045-06899
COGCC Document Number 2056128
04-18-2016

DUAL INDUCTION SFL
WITH LINEAR CORRELATION PLOT

COMPANY SNYDER OIL CORPORATION
WELL PARKER RANCH #22-7
FIELD WILDCAT
COUNTY GARFIELD STATE COLORADO

API SERIAL NO.	SECT.	TWP.	RANGE
05-045-6899	22	7S	93W

LOCATION 1521' FNL, 2428' FEL
SW NE

Other Services:
DIL-GR
FDC-CNL-GR
LOGNET
FLOPPIES

Permanent Datum	GROUND LEVEL	Elev.	8389.0 F
Log Measured From	KELLY BUSHING	20.5 F	above Perm. Datum
Drilling Measured From	KELLY BUSHING		

Elev.: K.B. 8389.5 F
D.F. 8388.5 F
G.L. 8389.0 F

Date	23-SEP-1994		
Run No.	ONE		
Depth Driller	9540.0 F		
Depth Logger (Schl.)	9536.0 F		
Btm. Log Interval	9530.0 F		
Top Log Interval	200 F		
Casing-Driller	13.5" @ 493.0 F		
Casing-Logger	492.0 F		
Bit Size	7.7/8"		
Type Fluid in Hole	GEL CHEM		
Dens.	9.10 LB/G		40.0 S
Visc.			
pH	8.9		9.0 C3
Fld. Loss			
Source of Sample	MUD PIT		
Rm @ Meas. Temp.	7.300 OHMM @	64.0 DEGF	@
Rmf @ Meas. Temp.	4.550 OHMM @	64.0 DEGF	@
Rmc @ Meas. Temp.	11.02 OHMM @	64.0 DEGF	@
Source: Rmf / Rmc	PRESSED	CALCULATED	
Rm @ BHT	2.703 OHMM @	185. DEGF	@
Time Circulation Ended	00:00 23-SEPT-1994		
Time Logger on Bottom	SEE LOG INSERTS		
Max. Rec. Temp.	185. DEGF		
Equip. Location	3220	FORT MORGAN	
Recorded By	BRIAN BELBAKER		
Witnessed By			

RECEIVED
MAY 12 1995
COLO. OIL & GAS CONS. COMM.

#045-06899

All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretations made by any of our officers, agents or employees. These interpretations are also subject to Clause 4 of our General Terms and Conditions as set out in our current Price Schedule.

Run No.	ONE			
Service Order No.	653266			
Drilling Fluid Level	350.0 F			
Salinity	200.0 PPM			
Rmf @ BHT	1.683 OHMM	@	185. DEGF	@
Rmc @ BHT	4.075 OHMM	@	185. DEGF	@
Logging Speed	3600.0 F/HR			
EQUIPMENT DATA				
Tool Number 1	DIC-DA 1094			
Tool Number 2	DIS-EA 391			
Tool Number 3	DRS-B 3869			
Tool Number 4	NSC-E 2930			
Tool Number 5	PGD-G 2749			
Tool Number 6	GSR-J 1750			
Tool Number 7	CNC-HA 426			
Tool Number 8	NSR-F 2539			
Tool Number 9	SGC-SA 585			
Tool Number 10	TCM-AB 1144			
Tool Number 11	IEM-BD 1353			
Tool Number 12				

Tool Number 12

REMARKS:

THANK YOU FOR CALLING SCHLUMBERGER
RIG: ADCOR NICKLOS #36
1.5" STANDOFFS RUN ON DIL
DIL-LDT-CNL-GR RUN IN COMBINATION

MAMM CREEK FIELD TYPE LOG 045-06899

SWS CREW POGORELZ / SMELSER

ACCUMULATED INTEGRATION VALUES SUMMARY:

Integrated Hole Volume: 5780.87 F3 FROM 8640.00 F TO 490.000 F
Integrated Cement Volume: 4881.16 F3 FROM 8640.00 F TO 490.000 F
(ASSUMING 4.50000 IN O.D. CASING)

CHANGED PARAMETERS

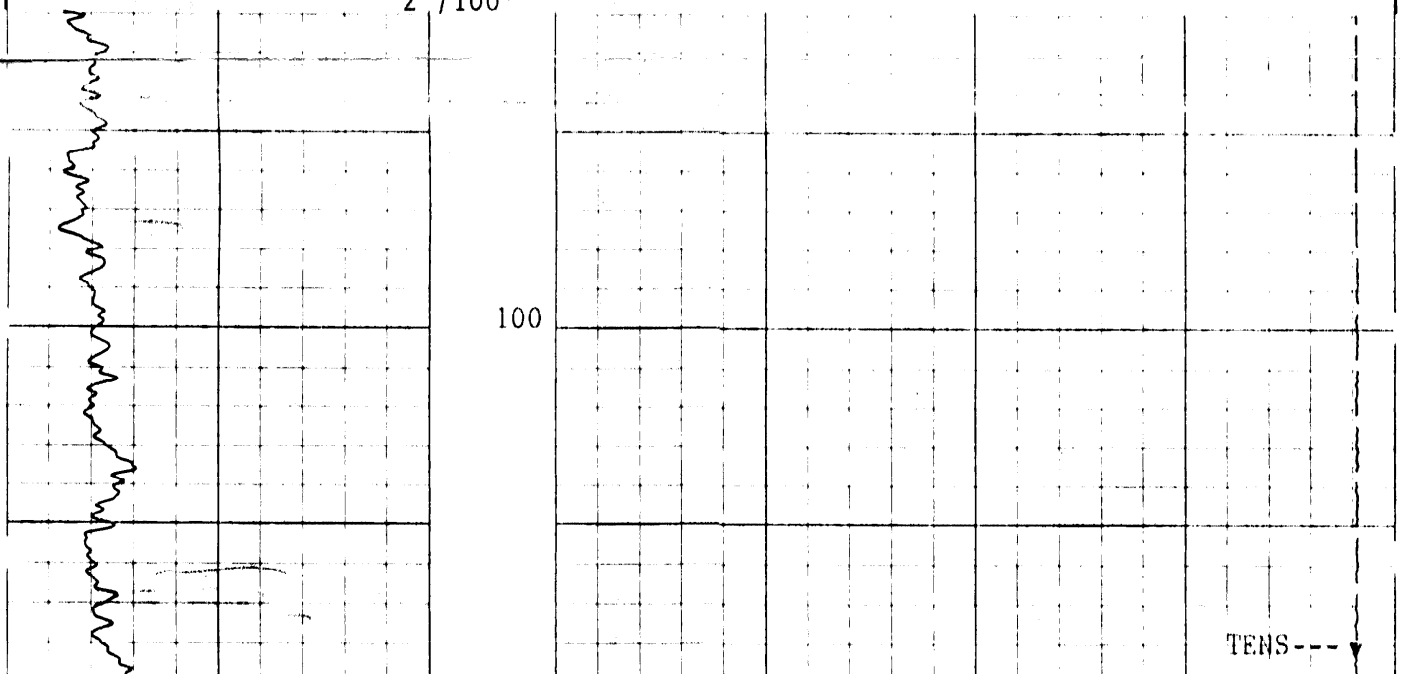
NAME	VALUE	UNIT	DEPTH (F)	NAME	VALUE	UNIT	DEPTH (F)
DPPM HISP			4469.5				

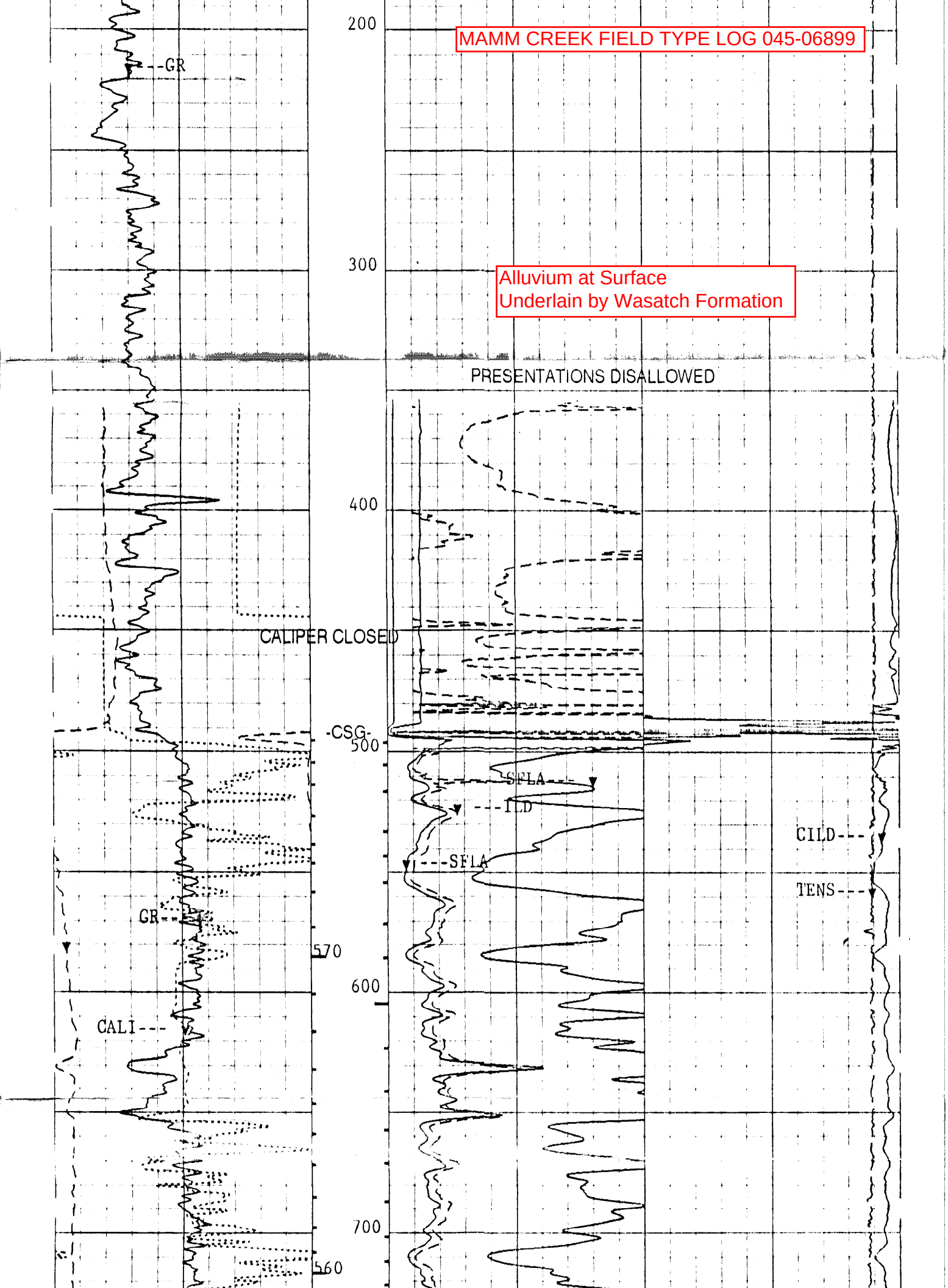
GR(GAPI) 0.0 200.00		SFLA(OHMM) 0.0 10.000	
SP(MV) 160.0 40.000		ILD(OHMM) 0.0 50.000	CILD(MM/M) 1000.0 0.0
CALI(IN) 6.0000 16.000		SFLA(OHMM) 0.0 50.000	TENS(LBF) 10000. 0.0
GAMMA RAY BACKUP			

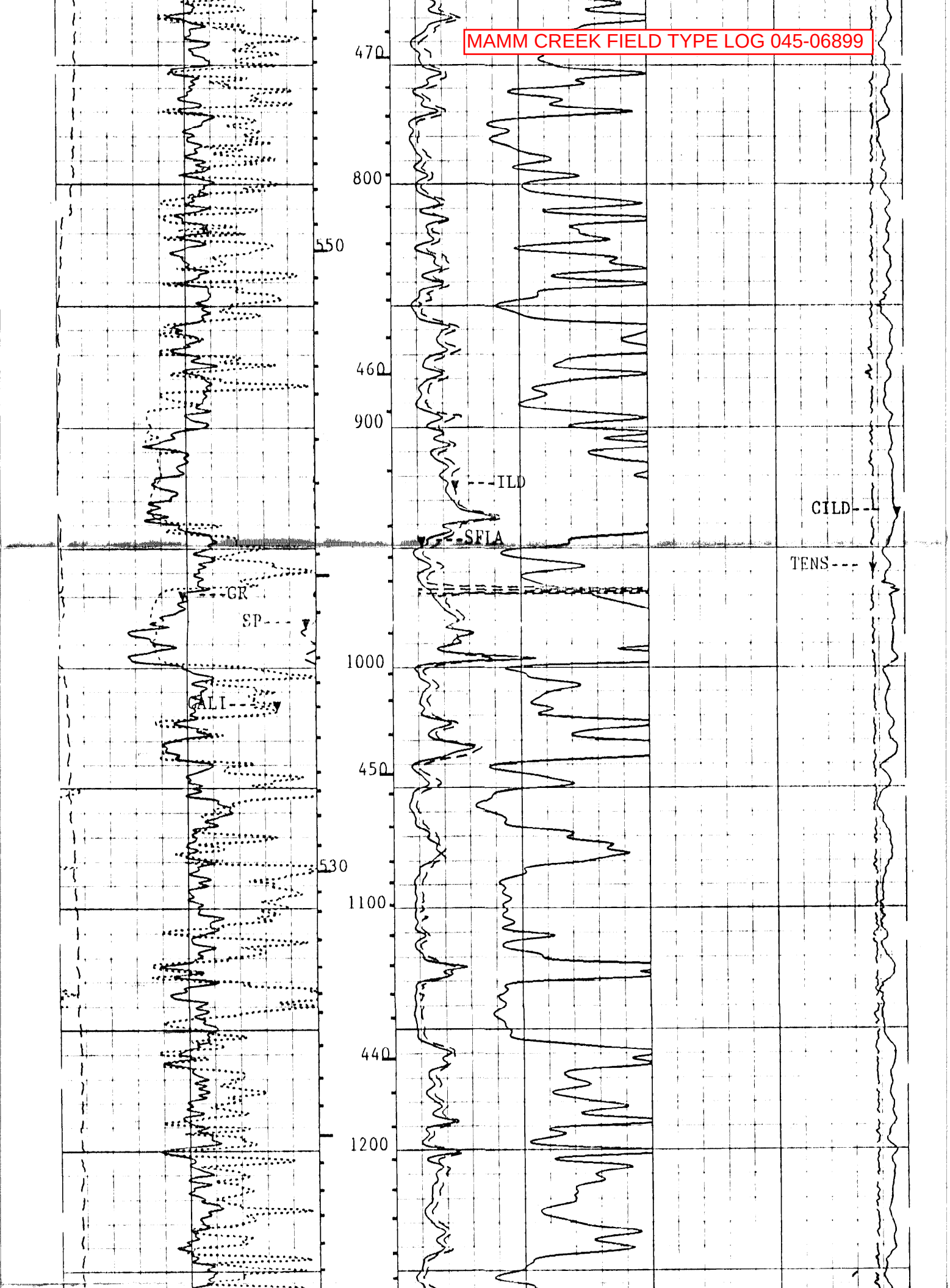
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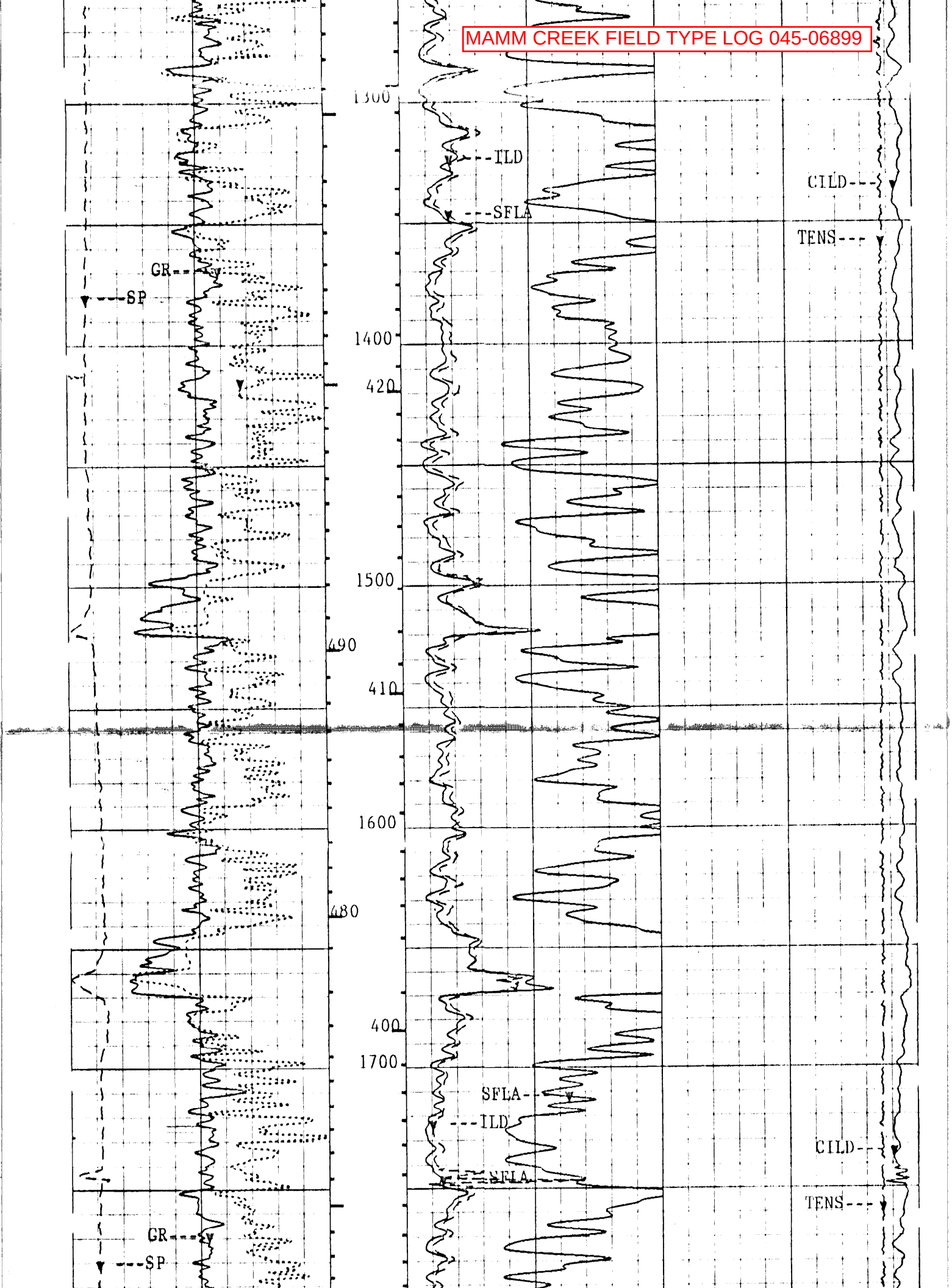
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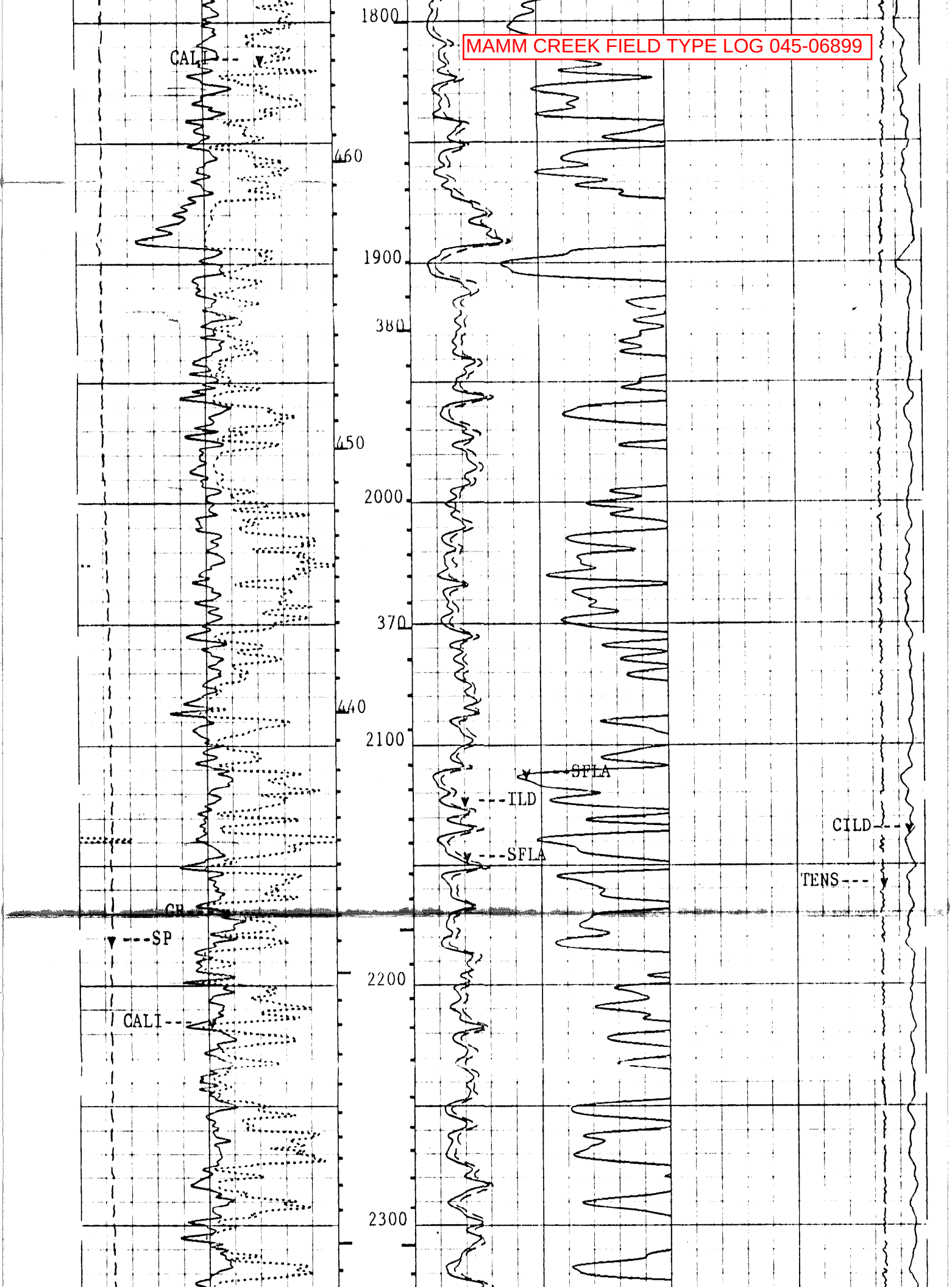
2"/100'

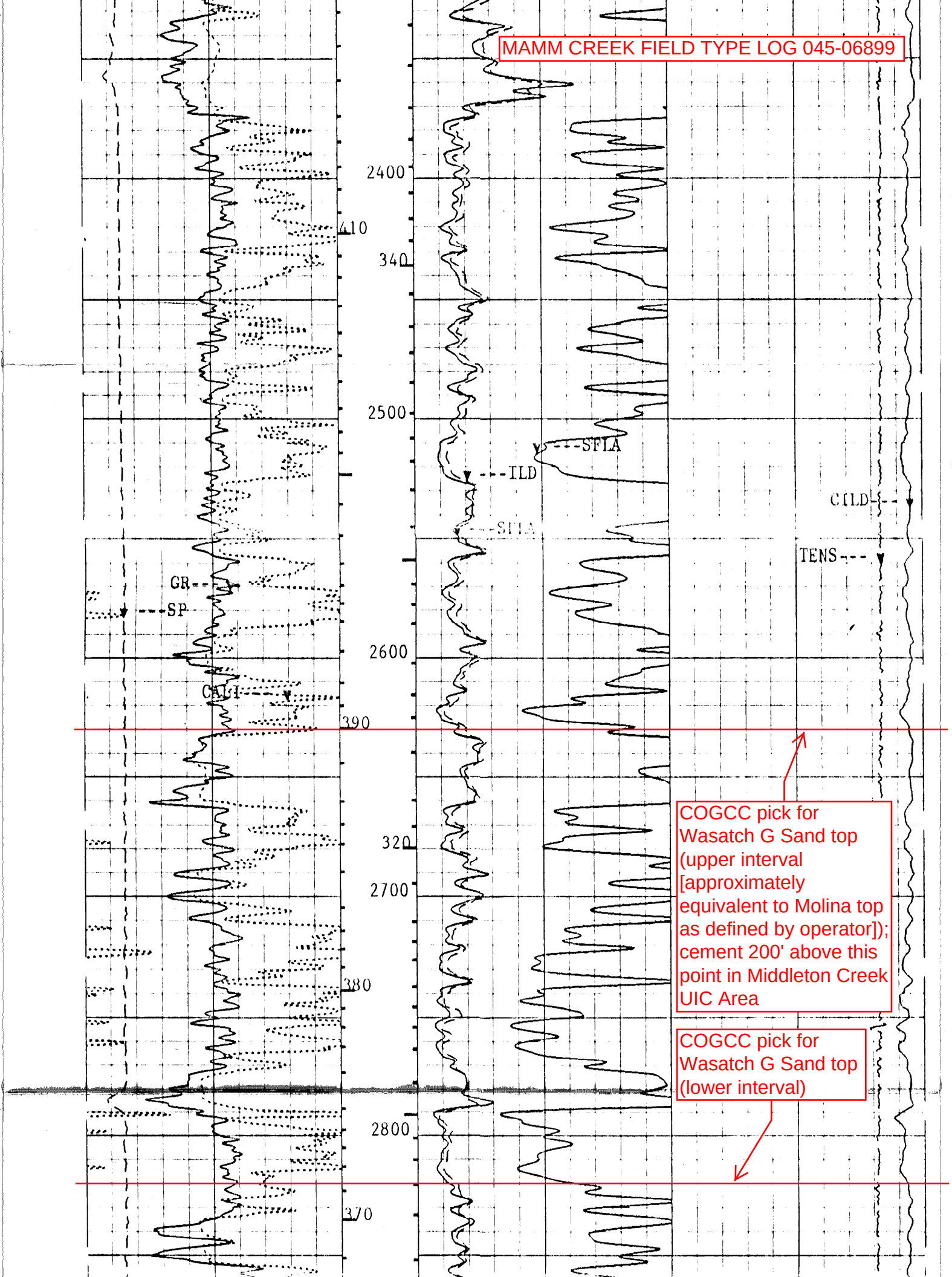


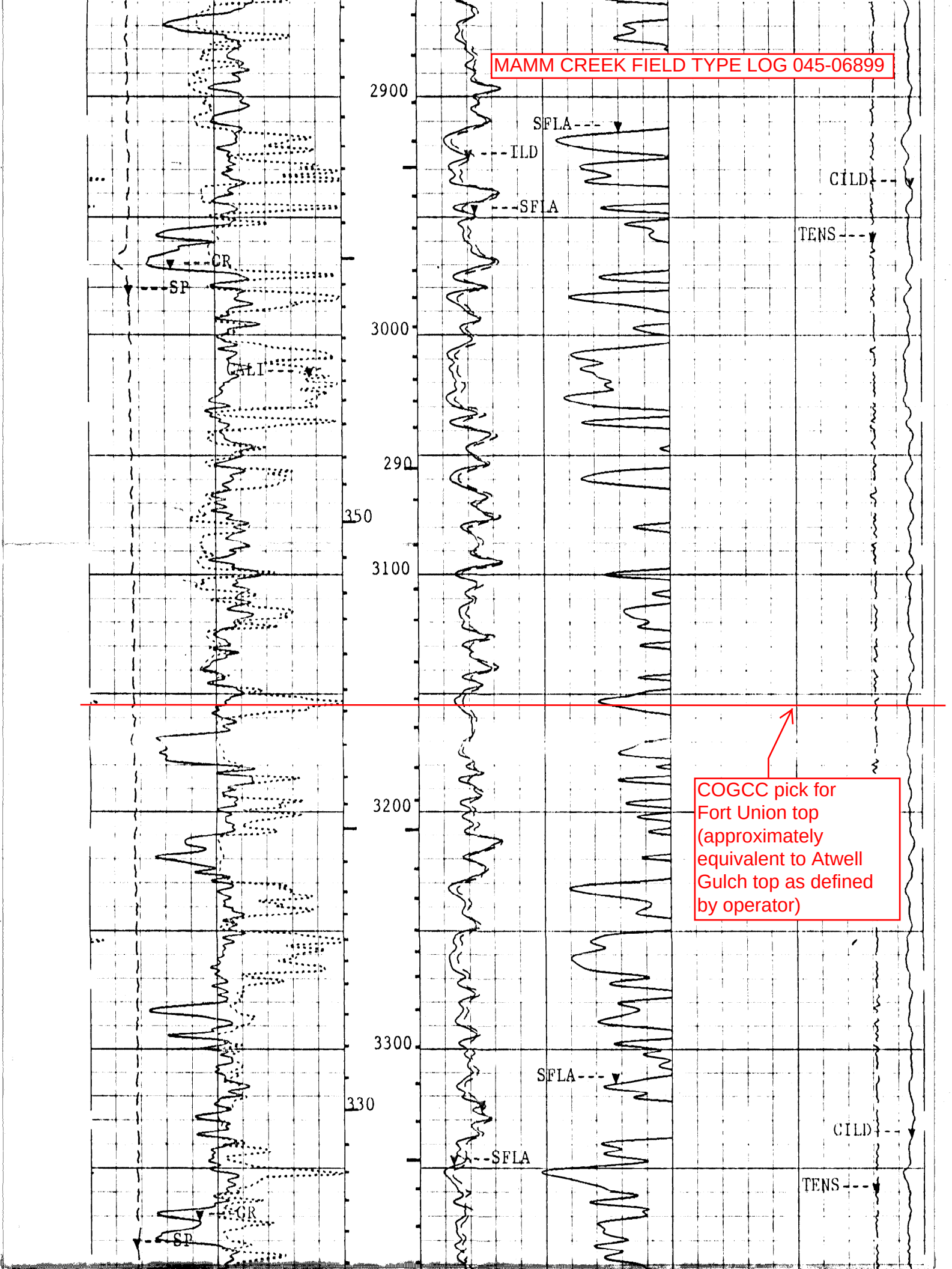

MAMM CREEK FIELD TYPE LOG 045-06899
Alluvium at Surface
Underlain by Wasatch Formation
PRESENTATIONS DISALLOWED
CALIPER CLOSED
-CSG-
GR
CALI
SFLA
ILD
CILD
TENS
200
300
400
500
600
700
570
560

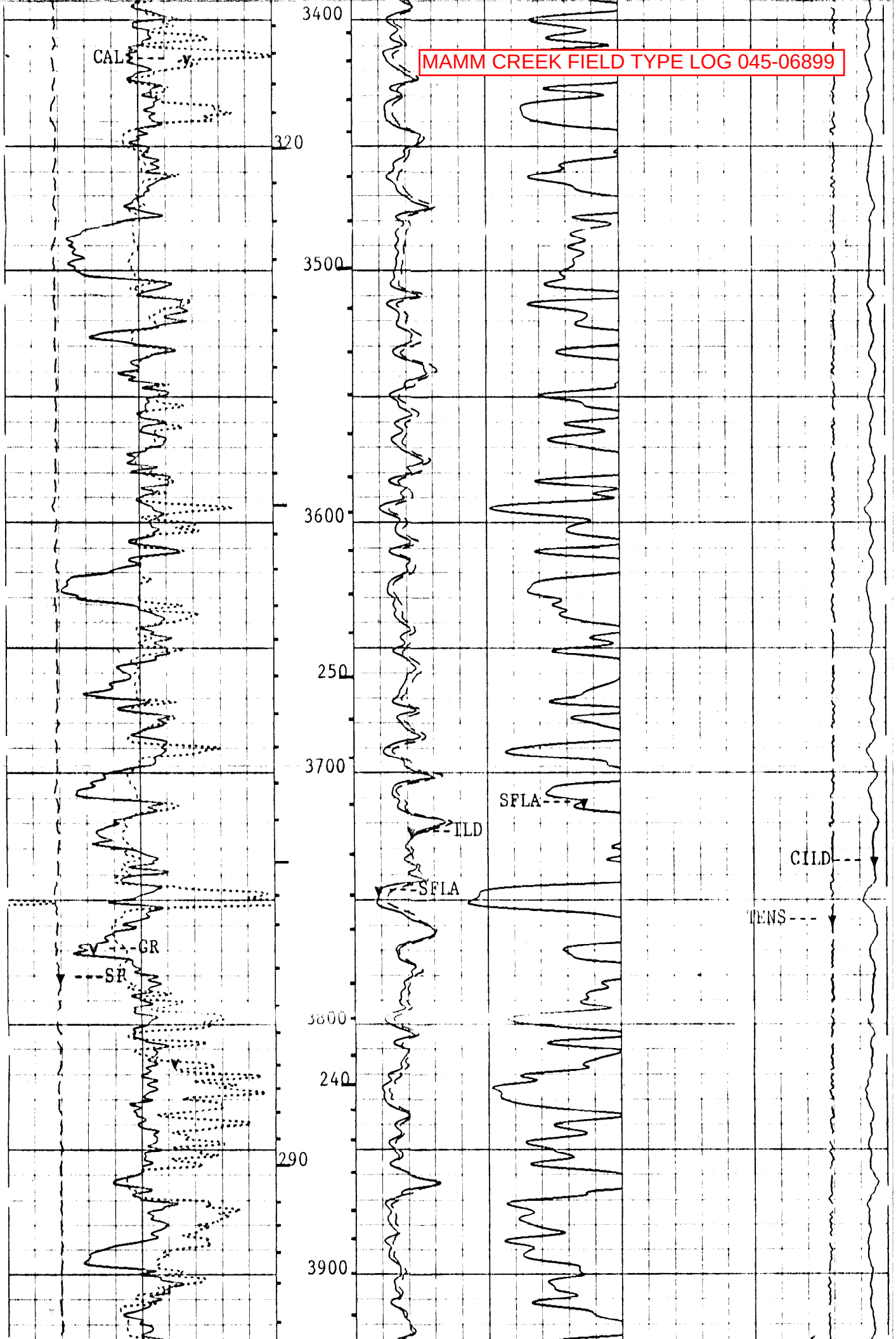

MAMM CREEK FIELD TYPE LOG 045-06899
470
800
550
460
900
---ILD
CILD--
---SFLA
TENS---
---GR
SP---
1000
ALI---
450
530
1100
440
1200

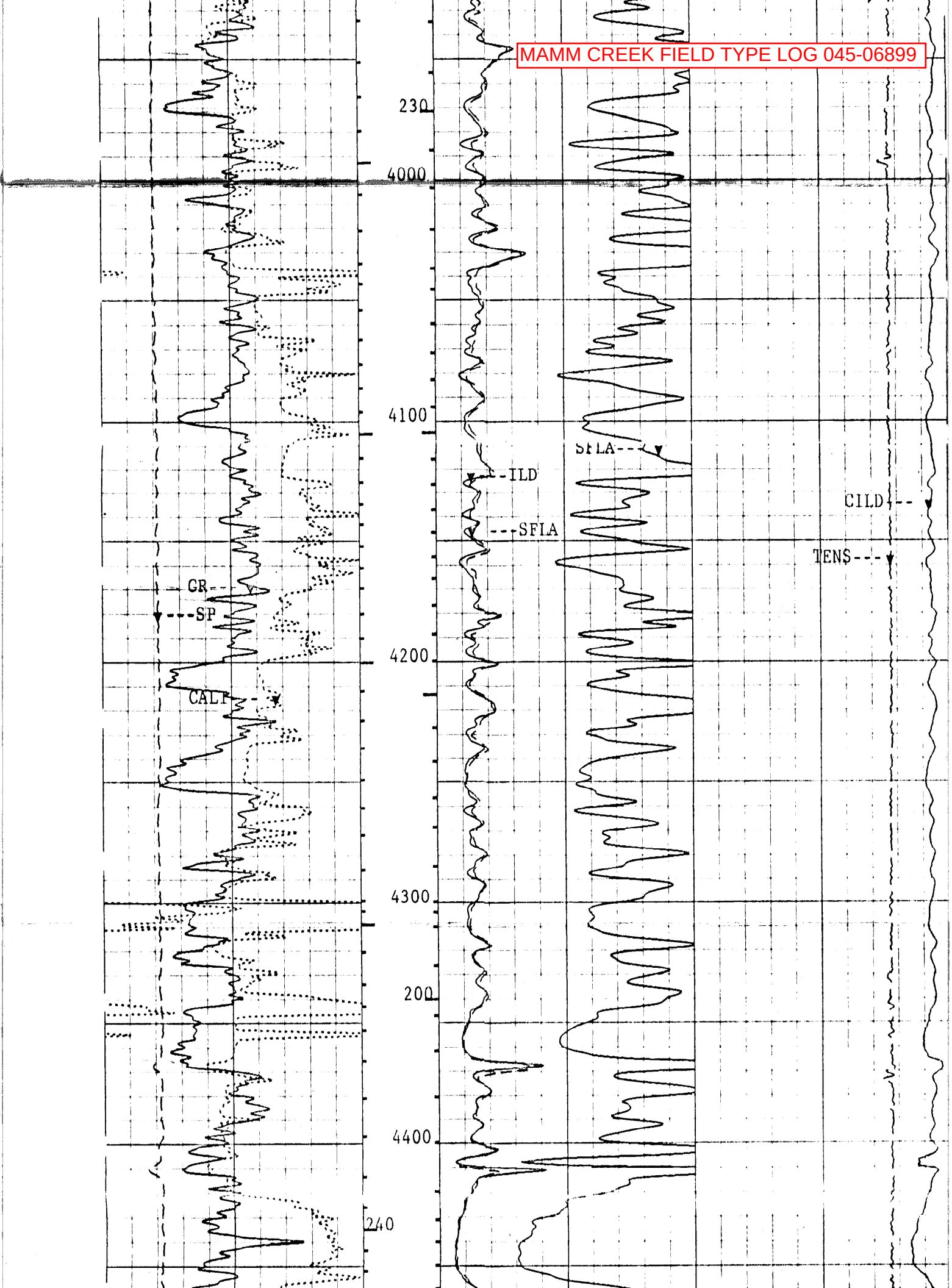

MAMM CREEK FIELD TYPE LOG 045-06899
1300
ILD
SFLA
CILD
TENS
GR
SP
1400
420
1500
490
410
1600
480
400
1700
SFLA
ILD
SFLA
CILD
TENS
GR
SP

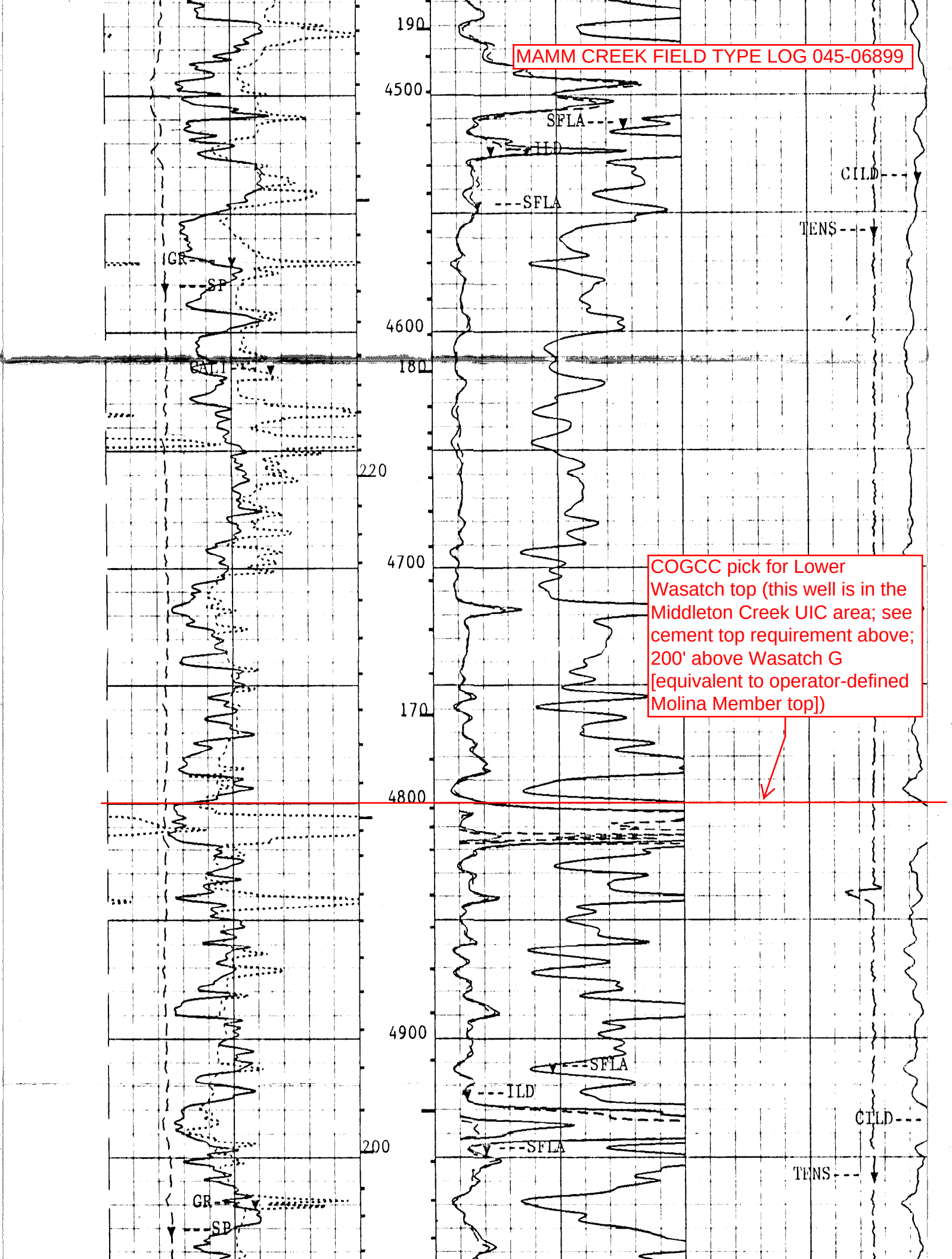

MAMM CREEK FIELD TYPE LOG 045-06899
CALI
1800
460
1900
380
450
2000
370
440
2100
SFLA
ILD
SFLA
CILD
TENS
CP
SP
2200
CALI
2300

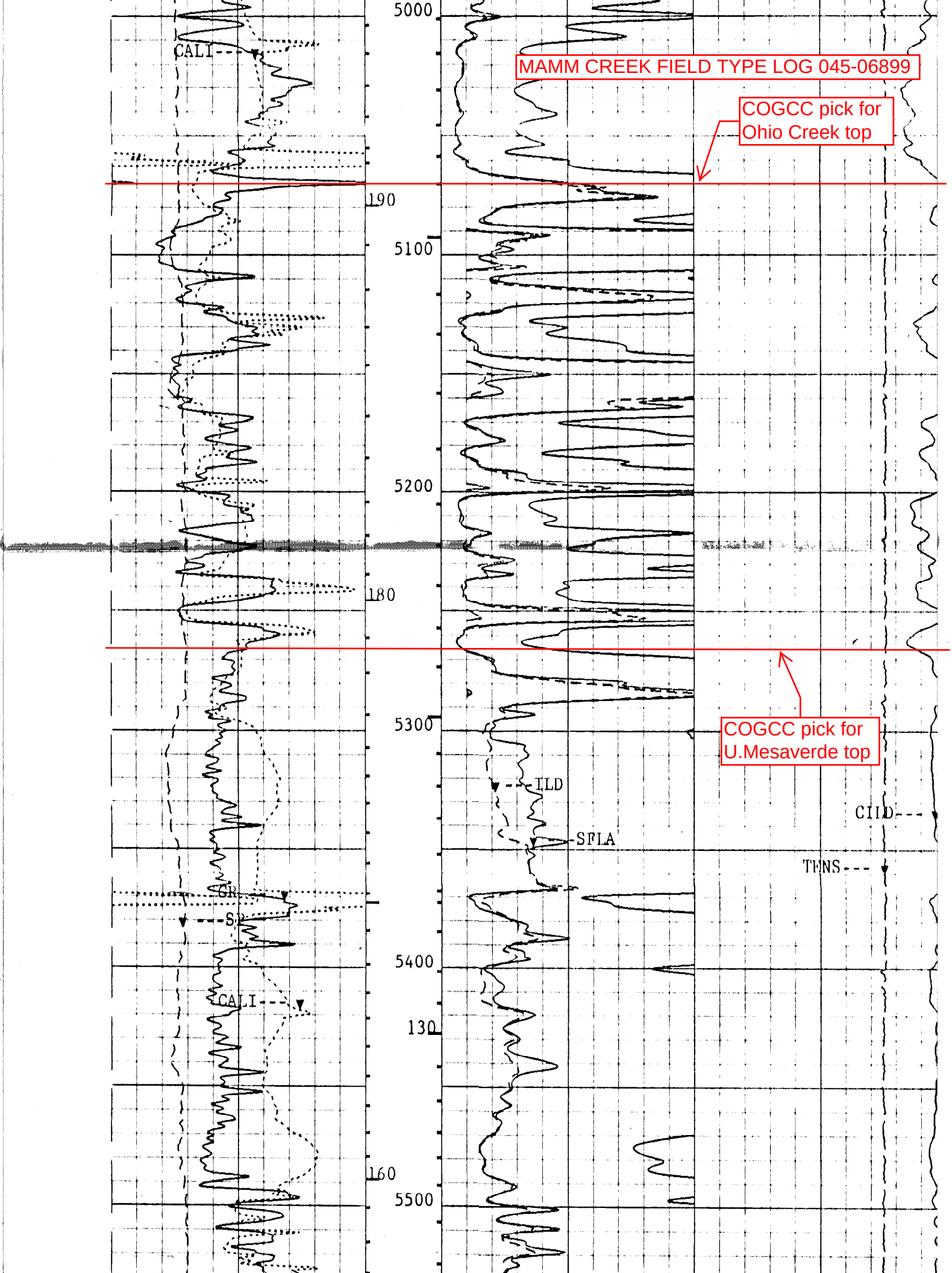

MAMM CREEK FIELD TYPE LOG 045-06899
2400
410
340
2500
SFLA
ILD
CILD
SFLA
TENS
GR
SP
2600
CALI
390
320
2700
380
COGCC pick for Wasatch G Sand top (upper interval [approximately equivalent to Molina top as defined by operator]); cement 200' above this point in Middleton Creek UIC Area
COGCC pick for Wasatch G Sand top (lower interval)
2800
370

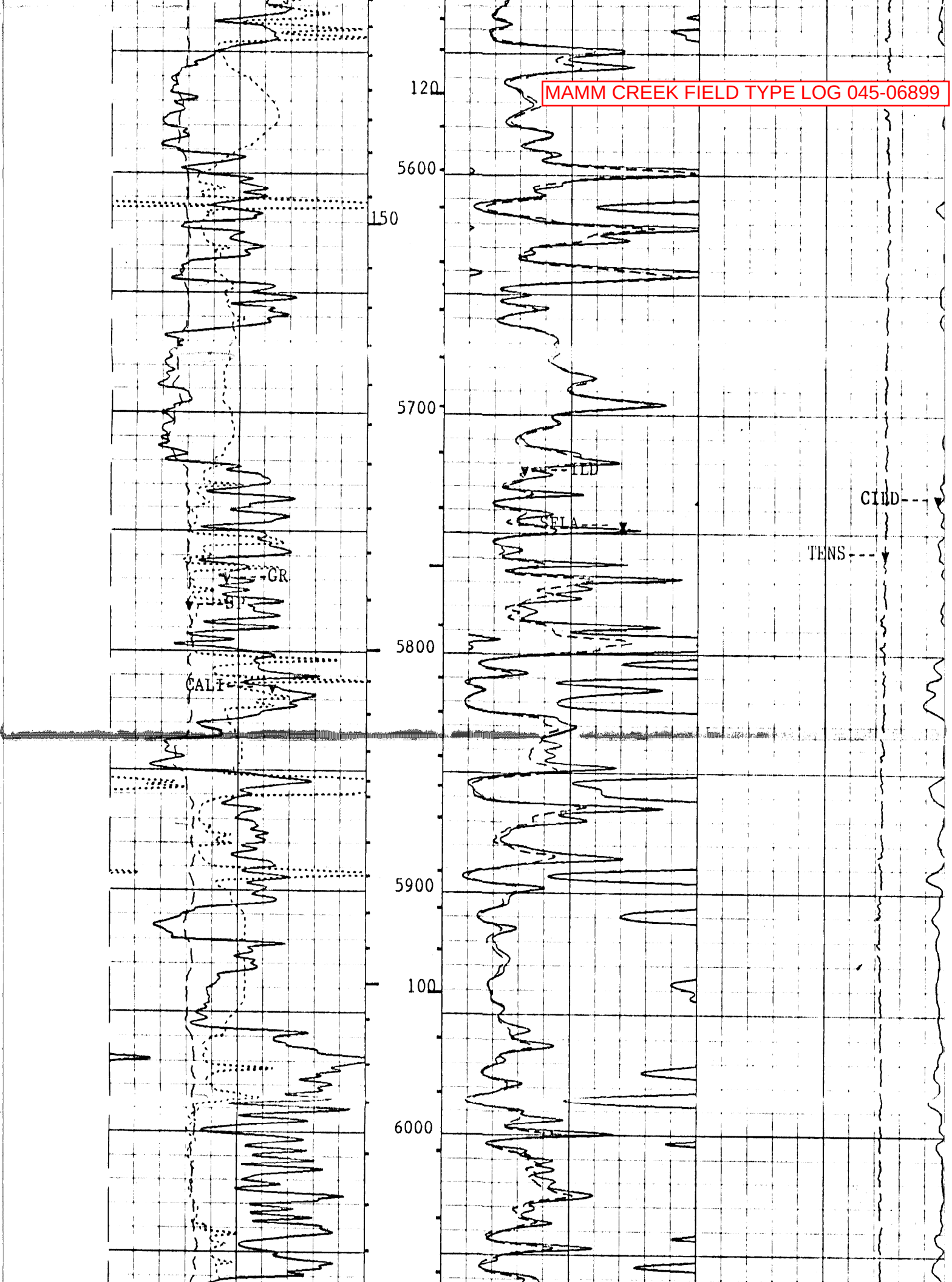

MAMM CREEK FIELD TYPE LOG 045-06899
2900
SFLA
ILD
CILD
SFLA
TENS
CR
SP
3000
LI
290
350
3100
3200
COGCC pick for Fort Union top (approximately equivalent to Atwell Gulch top as defined by operator)
3300
SFLA
330
CILD
SFLA
TENS
CR
SP

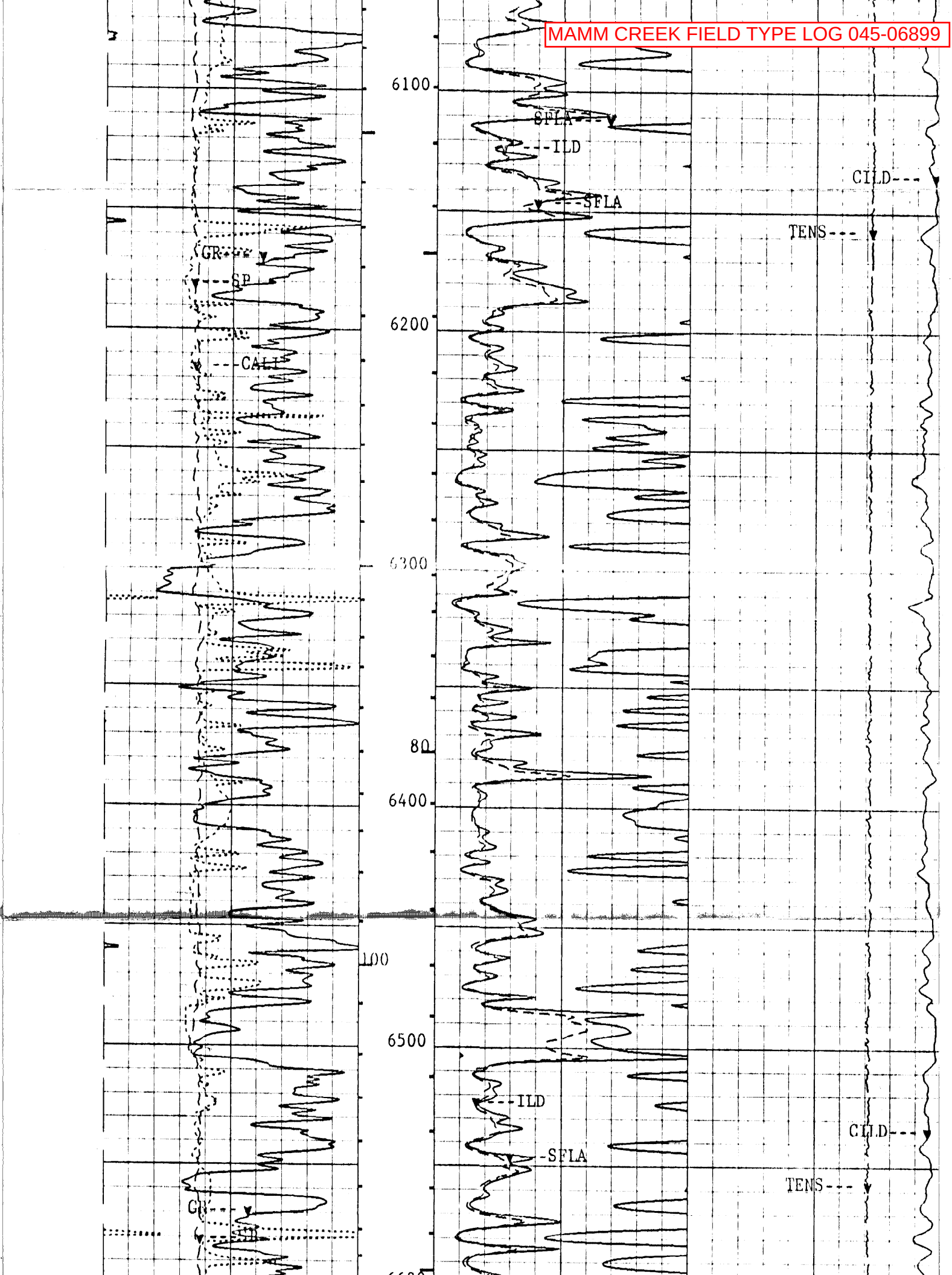

MAMM CREEK FIELD TYPE LOG 045-06899
CAL
320
3400
3500
3600
250
3700
SFLA
ILD
SFLA
CILD
TENS
GR
SP
3800
240
290
3900

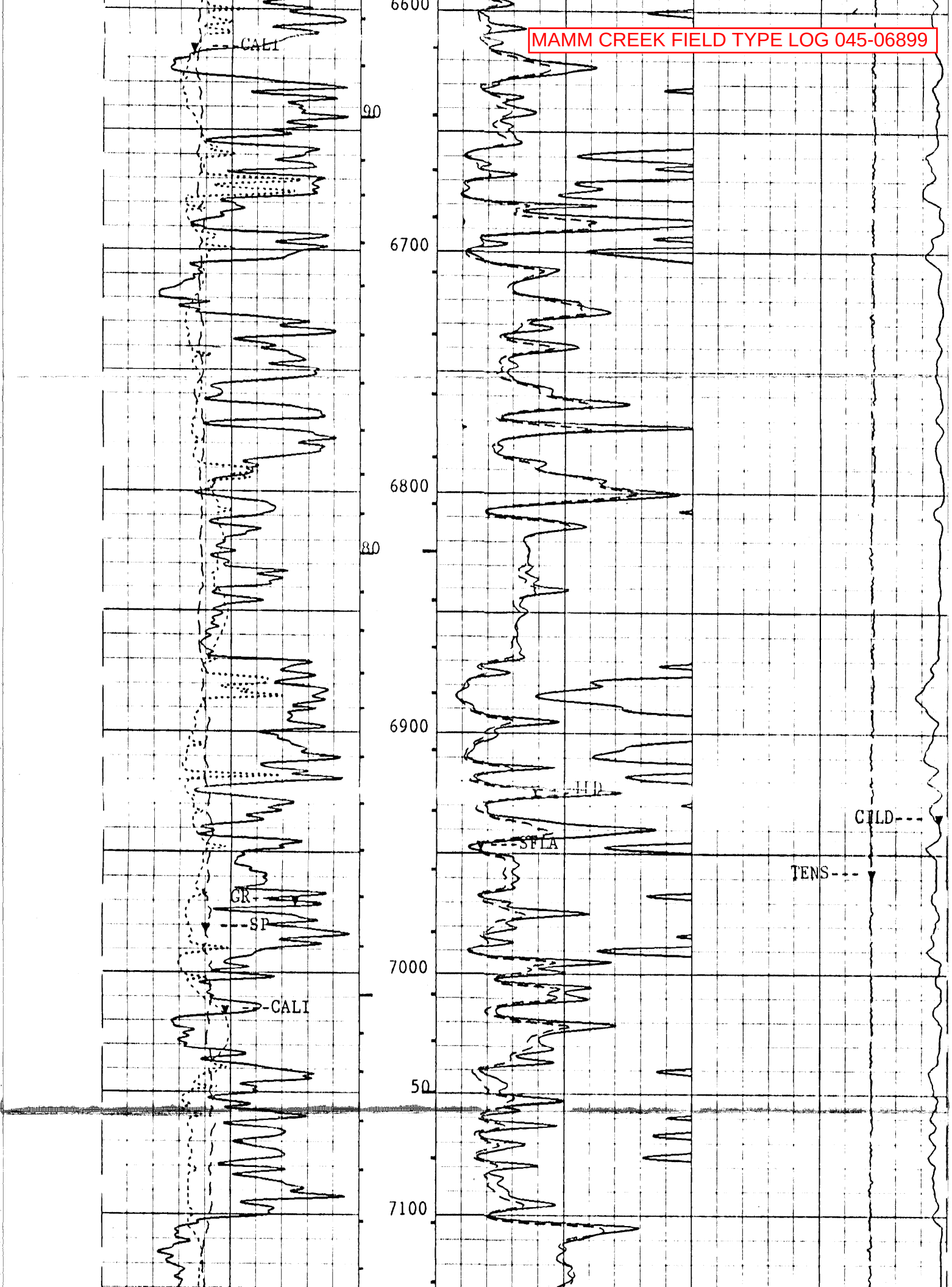

MAMM CREEK FIELD TYPE LOG 045-06899
230
4000
4100
4200
4300
200
4400
240
ILD
SFIA
CILD
TENS
GR
SP
CALI

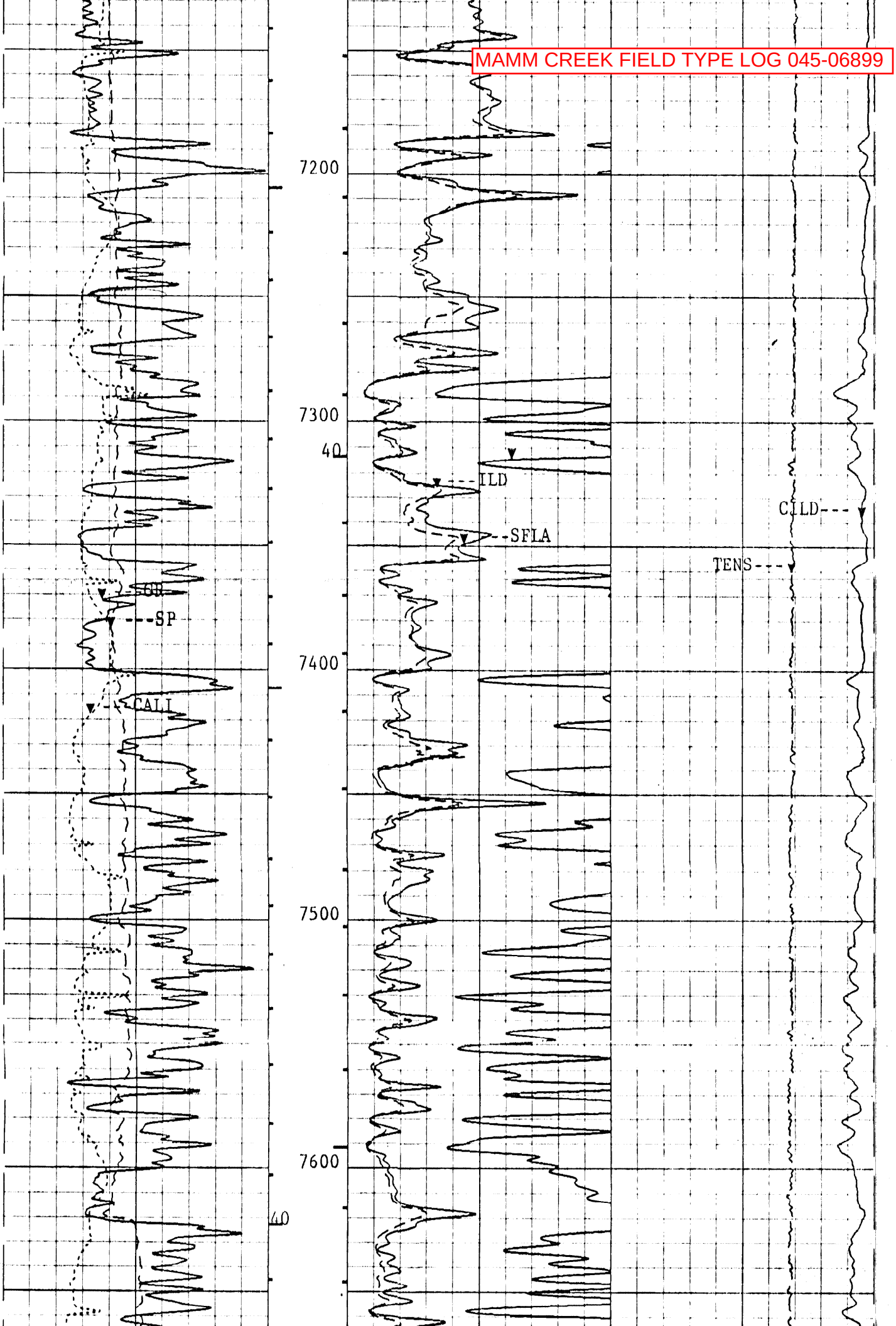

MAMM CREEK FIELD TYPE LOG 045-06899
190
4500
SFLA
ILD
CILD
---SFLA
TENS
GR
SP
4600
180
CALI
220
4700
COGCC pick for Lower Wasatch top (this well is in the Middleton Creek UIC area; see cement top requirement above; 200' above Wasatch G [equivalent to operator-defined Molina Member top])
170
4800
4900
---SFLA
---ILD
CILD
200
---SFLA
TENS
GR
SP

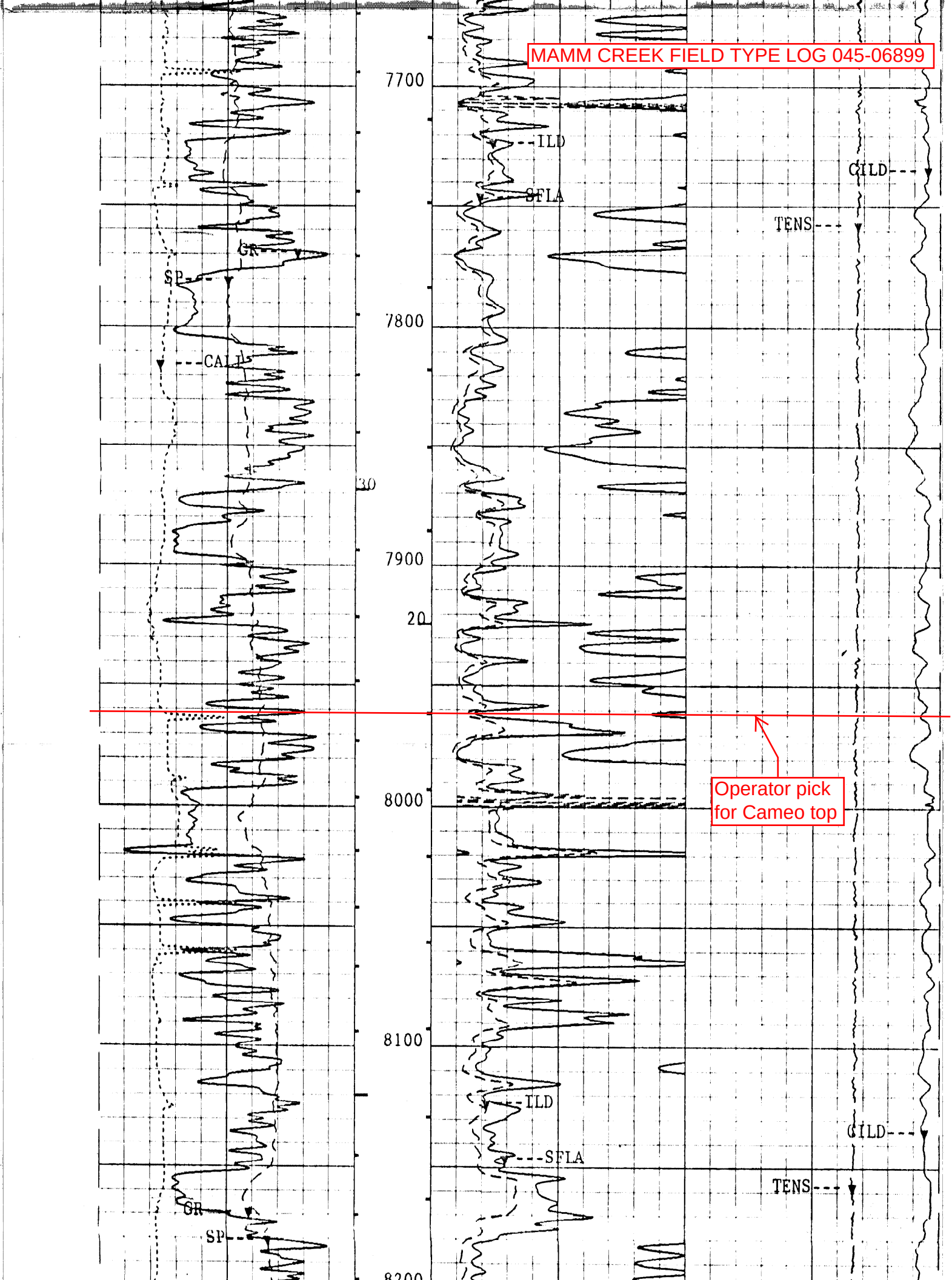

MAMM CREEK FIELD TYPE LOG 045-06899
COGCC pick for Ohio Creek top
COGCC pick for U.Mesaverde top
CALI
ILD
SFLA
CILD
TENS
GR
SP
CALI
5000
5100
5200
5300
5400
5500
190
180
170
160
150
140
130

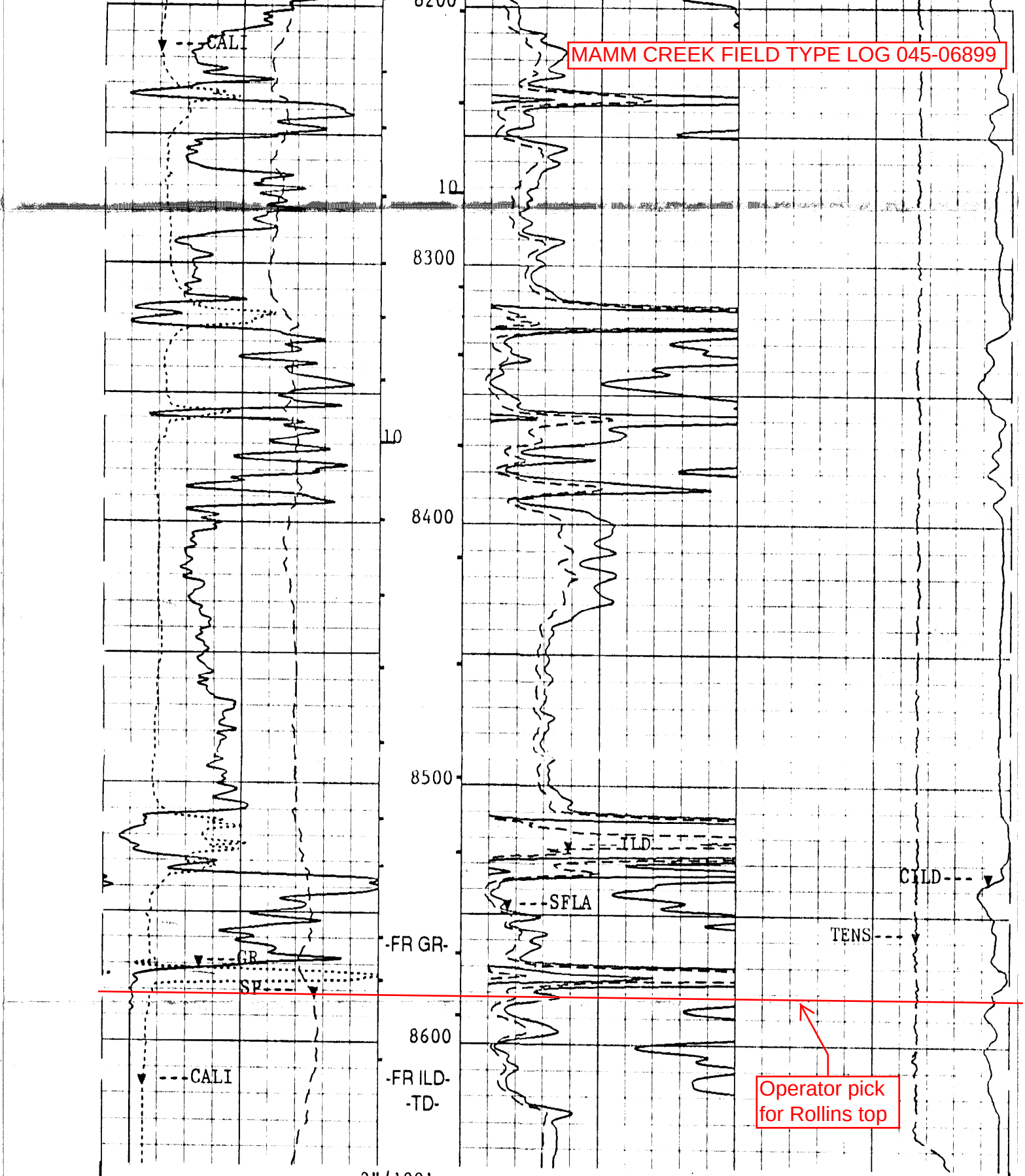

MAMM CREEK FIELD TYPE LOG 045-06899
120
5600
150
5700
ILD
CILD
SFLA
TENS
GR
5800
CALI
5900
100
6000


MAMM CREEK FIELD TYPE LOG 045-06899
6100
6200
6300
6400
6500
SFLA
ILD
CILD
TENS
GR
SP
CALI


MAMM CREEK FIELD TYPE LOG 045-06899
CALI
90
6600
6700
6800
80
6900
HD
SFLA
CILD
TENS
GR
SP
CALI
50
7000
7100


MAMM CREEK FIELD TYPE LOG 045-06899
7200
7300
40
ILD
SFLA
CILD
TENS
GR
SP
CALI
7400
7500
7600
40


MAMM CREEK FIELD TYPE LOG 045-06899
7700
7800
7900
8000
8100
8200
ILD
SFLA
CILD
TENS
GR
SP
CAL
30
20
Operator pick
for Cameo top


MAMM CREEK FIELD TYPE LOG 045-06899
---CALI
10
8300
10
8400
8500
ILD
---SFLA
CILD---
TENS---
-FR GR-
---GR
SP
8600
---CALI
-FR ILD-
-TD-
Operator pick
for Rollins top
2"/100'
CP 41.008
FILE 6
23-SEP-1994 07:35
INPUT FILE(S)
6
CREATION DATE
23-SEP-1994 07:32
GAMMA RAY BACKUP

GR(GAPI)		SFLA(OHMM)	
0.0	200.00	0.0	20.000
SP(MV)		ILD(OHMM)	CILD(MM/M)
-160.0	40.000	0.0	100.00	1000.0	0.0
CALI(IN)		SFLA(OHMM)	TENS(LBF)
6.0000	16.000	0.0	100.00	10000.	0.0

MAMM CREEK FIELD TYPE LOG 045-06899

045-15178

GA

MAMM CREEK FIELD TYPE LOG 045-15178
COGCC Document Number 2056192
04-18-2016

HALLIBURTON

HIGH RESOLUTION INDUCTION

COMPANY ANTERO RESOURCES CORPORATION

WELL NORCROSS A4

FIELD MAMM CREEK

COUNTY GARFIELD STATE CO

API No. 05045151780O

Location SURFACE HOLE: 1367' FSL & 1364' FWL

BOTTOM HOLE: 1212' FSL & 0720' FWL

Other Services: SDL / DSN

Sect. 13 Twp. 06S Rge. 93W

COMPANY ANTERO RESOURCES CORPORATION
WELL NORCROSS A4
COUNTY GARFIELD
STATE

Permanent Datum	GL	Elev. 5492.0 ft	Elev.: K.B. 5508.0 ft
Log measured from	KB	16.0 ft above perm. Datum	D.F. 5507.0 ft
Drilling measured from	KB		G.L. 5492.0 ft

Date		25-Jan-08 10:00					
Run No.		ONE					
Depth - Driller		8820.0 ft					
Depth - Logger		8820.0 ft					
Bottom - Logged Interval		8810.0 ft					
Top - Logged Interval		CSG.					
Casing - Driller		8.625 in	@ 967.0 ft	@		@	
Casing - Logger		970.0 ft					
Bit Size		7.875 in		@		@	
Type Fluid in Hole		LSND					
Density	Viscosity	10.2 ppg	36.00 s/qt				
PH	Fluid Loss	10.50 pH	4.2 cptm				
Source of Sample		MUD TANK					
Rm @ Meas. Temperature		2.63 ohmm	@ 57.50 degF	@		@	
Rmf @ Meas. Temperature		2.11 ohmm	@ 57.90 degF	@		@	
Rmc @ Meas. Temperature		3.15 ohmm	@ 58.20 degF	@		@	
Source Rmf	Rmc	MEAS.	MEAS.				
Rm @ BHT		0.75 ohmm	@ 218.0 degF	@		@	
Time Since Circulation		14.0 hr					
Time on Bottom		25-Jan-08 12:00					
Max. Rec. Temperature		218.0 degF	@ 8820.0 ft	@		@	
Equipment	Location	10549593	GJ.				
Recorded By		C. GULLETT					
Witnessed By		J. KENNEDY					

RECEIVED
JUN 17 2008
COGCC

KK

Fold here

Service Ticket No.: 5642016 API Serial No.: 05045151780O PGM Version: WL INSITE R2.0 (Build 22)

CHANGE IN MUD TYPE OR ADDITIONAL SAMPLE

RESISTIVITY SCALE CHANGES

	Sample No.	Type Log	Depth	Scale Up Hole	Scale Down Hole
Date					
Depth-Driller					
Type Fluid in Hole					
Density	Viscosity				
Ph	Fluid Loss				
Source of Sample					
Rm @ Meas. Temp					
Rmf @ Meas. Temp.					
Rmc @ Meas. Temp.					
Source Rmf	Rmc				
Rm @ BHT					
Rmf @ BHT					
Rmc @ BHT					

EQUIPMENT DATA

RESISTIVITY EQUIPMENT DATA

	Run No.	Tool Type & No.	Pad Type	Tool Pos.	Other
	ONE	HRID-148S2524	N/A	1.5" S.O.	N/A

GAMMA

	Run No.	Serial No.	Model No.	Diameter
	ONE	034	D4TGX	3.625"

ACOUSTIC

	Run No.	Serial No.	Model No.	No. of Cent.

DENSITY

	Run No.	Serial No.	Model No.	Diameter
	ONE	1458M069	SDL_DC	4.5"

NEUTRON

	Run No.	Serial No.	Model No.	Diameter
	ONE	108734	DSN_II	3.625"

Detector Model No.	D4TG	Spacing		Log Type	GAMMA-GAMMA	Log Type	THERMAL
Type	SCINT.			Source Type	Cs137	Source Type	Am241Be
Length	8"	LSA [Y/N]		Serial No.	2189GW	Serial No.	DSN-60
Distance to Source	16.3'	FWDA [Y/N]		Strength	1.5 Ci	Strength	18.5 Ci

LOGGING DATA

GENERAL				GAMMA		ACOUSTIC			DENSITY			NEUTRON		
Run	Depth		Speed	Scale		Scale		Matrix	Scale		Matrix	Scale		Matrix
No.	From	To	ft/min	L	R	L	R		L	R		L	R	
ONE	T.D.	CSG.	REC.	0	200				30%	-10%	2.68	30%	-10%	SAND

MAMM CREEK FIELD TYPE LOG 045-15178

DIRECTIONAL INFORMATION

Maximum Deviation	0.00 deg	@	0.00 ft	KOP	@ 0.00 ft

Remarks:

RWCH-D4TGX-DSN-SDL-HRI WERE RAN IN COMBINATION.

A.H.V. CALCULATED FOR 5.5" CASING.

TENSION PULLS AND HOLE RUGOSITY MAY AFFECT LOG QUALITY.

CHLORIDES REPORTED AT 1600 mg/L.

LATITUDE: 39.52°N // LONGITUDE: 107.72°W.

YOUR CREW TODAY IS: A. LEWIS AND J. WILKERSON. RIG: FRONTIER #14

THANK YOU FOR CHOOSING HALLIBURTON ENERGY SERVICES - GRAND JUNCTION, CO - (970)-523-3600.

HALLIBURTON DOES NOT GUARANTEE THE ACCURACY OF ANY INTERPRETATION OF THE LOG DATA, CONVERSION OF LOG DATA TO PHYSICAL ROCK PARAMETERS OR RECOMMENDATIONS WHICH MAY BE GIVEN BY HALLIBURTON PERSONNEL OR WHICH APPEAR ON THE LOG OR IN ANY OTHER FORM. ANY USER OF SUCH DATA, INTERPRETATIONS, CONVERSIONS, OR RECOMMENDATIONS AGREES THAT HALLIBURTON IS NOT RESPONSIBLE EXCEPT WHERE DUE TO GROSS NEGLIGENCE OR WILLFUL MISCONDUCT, FOR ANY LOSS, DAMAGES, OR EXPENSES RESULTING FROM THE USE THEREOF.

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PARAMETERS REPORT

Depth (ft)	Tool Name	Mnemonic	Description	Value	Units
TOP					
	SHARED	BS	Bit Size	7.875	in
	SHARED	UBS	Use Bit Size instead of Caliper for all applications.	No	
	SHARED	MDWT	Borehole Fluid Weight	10.300	ppg
	SHARED	RMUD	Mud Resistivity	2.000	ohmm
	SHARED	TRM	Temperature of Mud	75.0	degF
	SHARED	OBM	Oil Based Mud System?	No	
	SHARED	CSD	Logging Interval is Cased?	No	
	SHARED	ICOD	AHV Casing OD	5.500	in
	SHARED	ST	Surface Temperature	75.0	degF
	SHARED	TD	Total Well Depth	8820.00	ft
	SHARED	BHT	Bottom Hole Temperature	200.0	degF
	Rwa / CrossPlot	XPOK	Process Crossplot?	Yes	
	Rwa / CrossPlot	FCHO	Select Source of F	Automatic	
	Rwa / CrossPlot	AFAC	Archie A factor	0.6200	
	Rwa / CrossPlot	MFAC	Archie M factor	2.1500	
	Rwa / CrossPlot	RMFR	Rmf Reference	0.10	ohmm

CrossPlot				
Rwa / CrossPlot	TMFR	Rmf Ref Temp	75.00	degF
Rwa / CrossPlot	RWA	Resistivity of Formation Water	0.05	ohmm
D4TGX	GROK	Process Gamma Ray?	Yes	
D4TGX	GRSO	Gamma Tool Standoff	0.000	in
D4TGX	GEOK	Process Gamma Ray EVR?	No	
DSN_II	DNOK	Process DSN?	Yes	
DSN_II	DEOK	Process DSN EVR?	No	
DSN_II	NLIT	Neutron Lithology	Sandstone	
DSN_II	DNSO	DSNTool Standoff	0.000	in
DSN_II	DNTP	Temperature Correction Type	None	
DSN_II	DPRS	DSN Pressure Correction Type	None	
DSN_II	SHCO	View More Correction Options	No	
DSN_II	UTVD	Use TVD for Gradient Corrections?	No	
DSN_II		Logging Horizontal Water Tank?	No	
SDL_DC	DNOK	Process Density?	Yes	
SDL_DC	DNOK	Process Density EVR?	No	
SDL_DC	AD	Is Hole Air Drilled?	No	
SDL_DC	CB	Use Calibration Blocks?	No	
SDL_DC	SPVT	SDLT Pad Temperature Valid?	Yes	
SDL_DC	MDTP	Weighted Mud Correction Type?	Barite	
SDL_DC	DMA	Formation Density Matrix	2.680	g/cc
SDL_DC	DFL	Formation Density Fluid	1.000	g/cc
SDL_DC	CLOK	Process Caliper Outputs?	Yes	
HRID-SP	HRE	Do HRI Induction Calculation?	Yes	
HRID-SP	DFLE	Do DFL Calculation?	Yes	
HRID-SP	PYRI	Pyrite Switch	Off	
HRID-SP	CSDP	Casing Depth	950.0	ft
HRID-SP	HDSP	Spike Reduction Filter Type	DELTA	
HRID-SP	HRTC	Temperature Correction Source	None	
HRID-SP	MMRS	Hrimap Minimum Resistivity	0.20	
HRID-SP	MXRS	Hrimap Maximum Resistivity	200.00	

BOTTOM

Data: ANT_NORCROSS_A4\0001 TRIPLE_DITS\006 25-Jan-08 12:24 Up @9829.8f

Date: 26-Jan-08 13:47:08

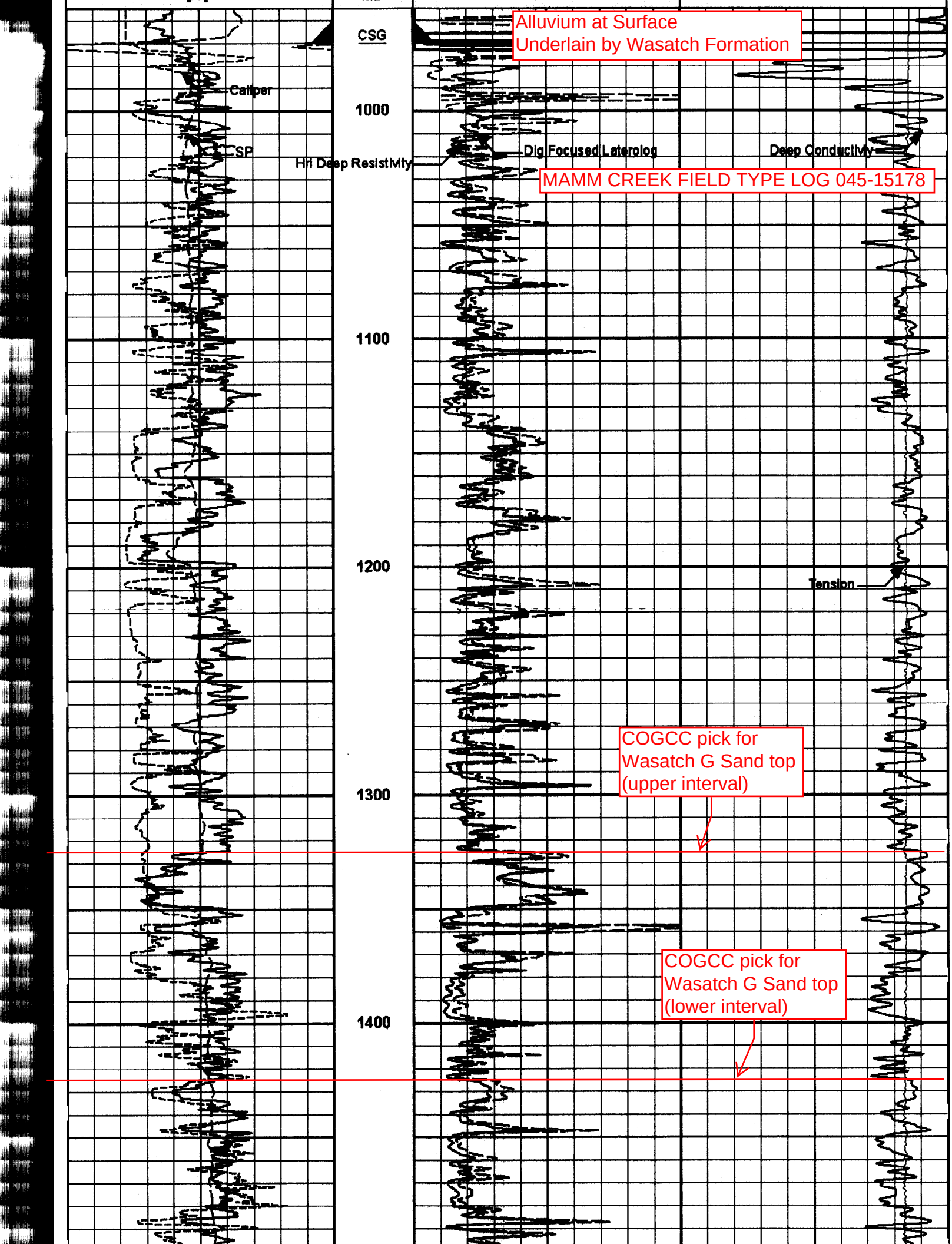
MAMM CREEK FIELD TYPE LOG 045-15178

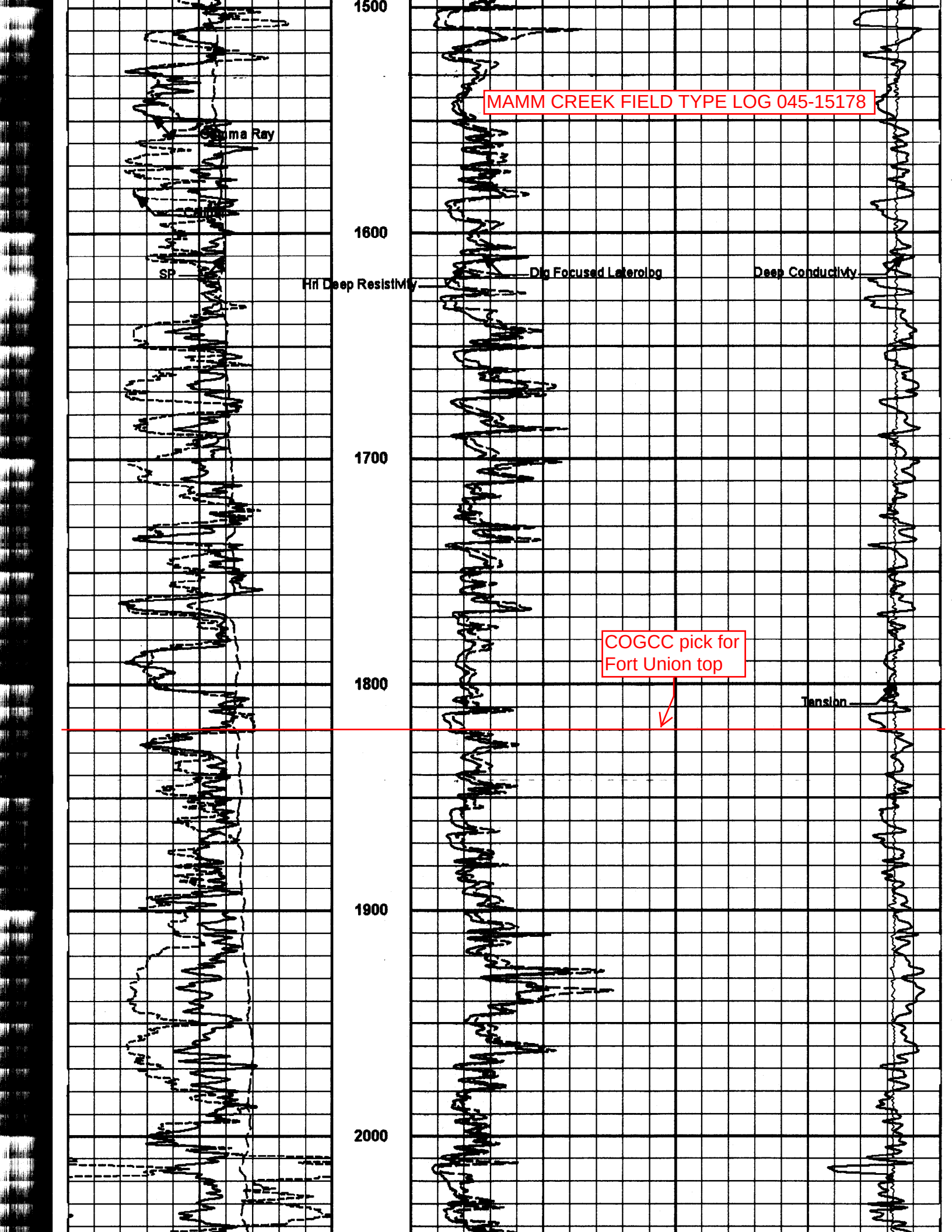
HALLIBURTON

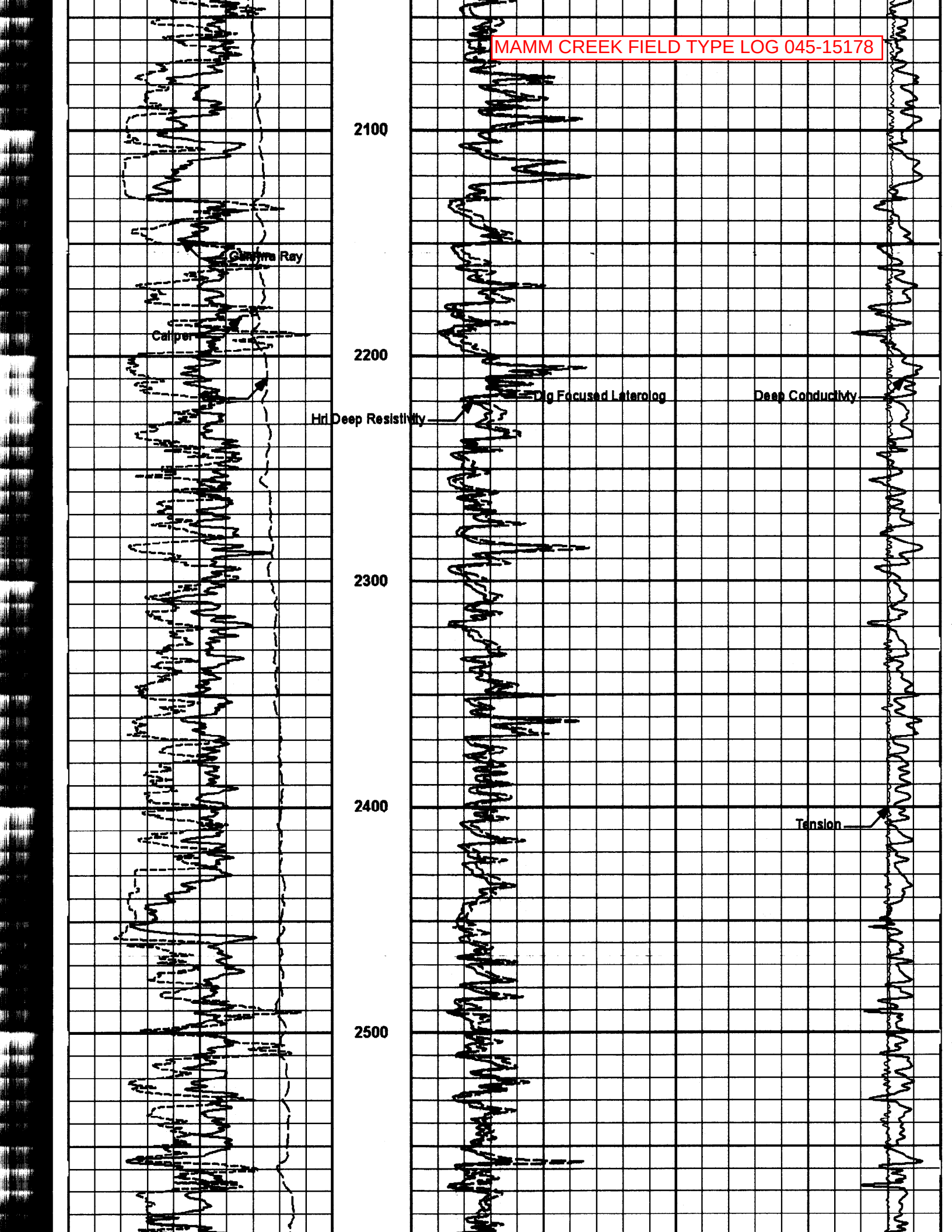
Plot Time: 25-Jan-08 15:31:34
Plot Range: 955 ft to 9830 ft
Data: ANT_NORCROSS_A4\Well Based\MAIN PASS - CASING\
Plot File: \\-LOCAL-\ANT_NORCROSS_A4\0001 TRIPLE_DITS\INDUCTION\HRI_2IN

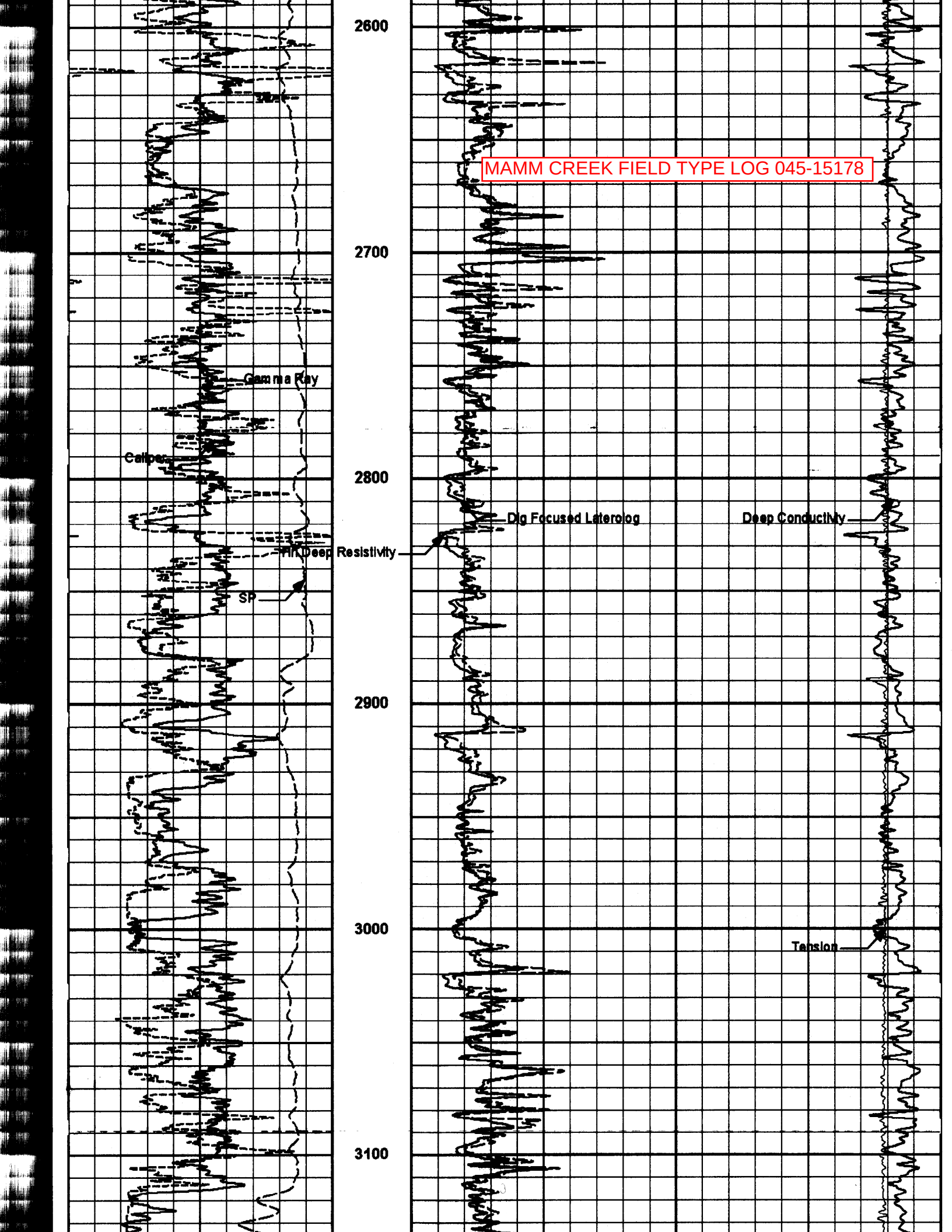
MAIN PASS 2" = 100'

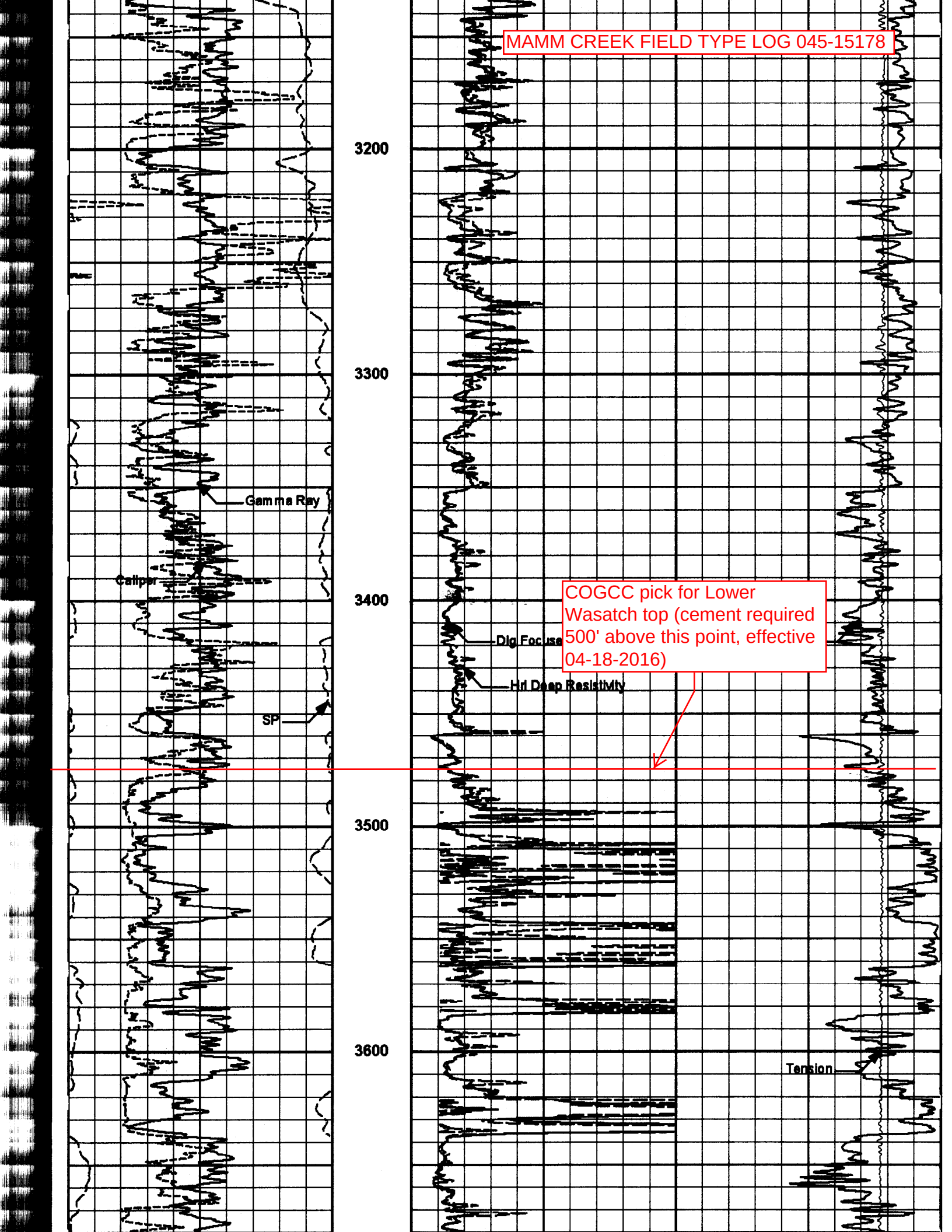
6	Caliper	16		500	Deep Conductivity	0	
inches				mmo/m			
0	Gamma Ray	200		0	HDRS	100	
api				ohmm			
SP			1 : 600 ft	0	DFL	100	10000 Tension 0
-110[+			MD	ohmm			lbs

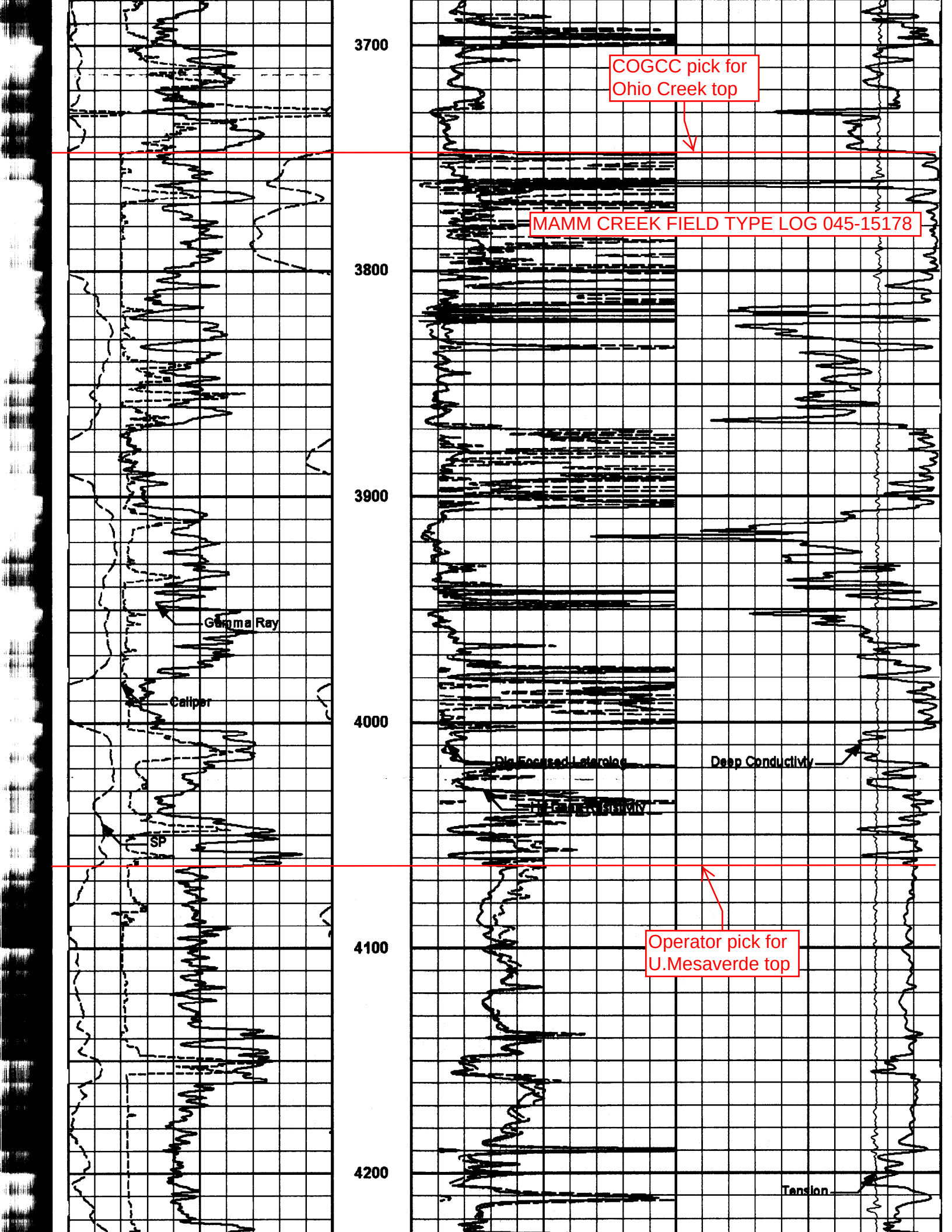

Alluvium at Surface
Underlain by Wasatch Formation
CSG
Caliper
1000
SP
Hri Deep Resistivity
Dig Focused Laterolog
Deep Conductivity
MAMM CREEK FIELD TYPE LOG 045-15178
1100
1200
Tension
COGCC pick for
Wasatch G Sand top
(upper interval)
1300
COGCC pick for
Wasatch G Sand top
(lower interval)
1400

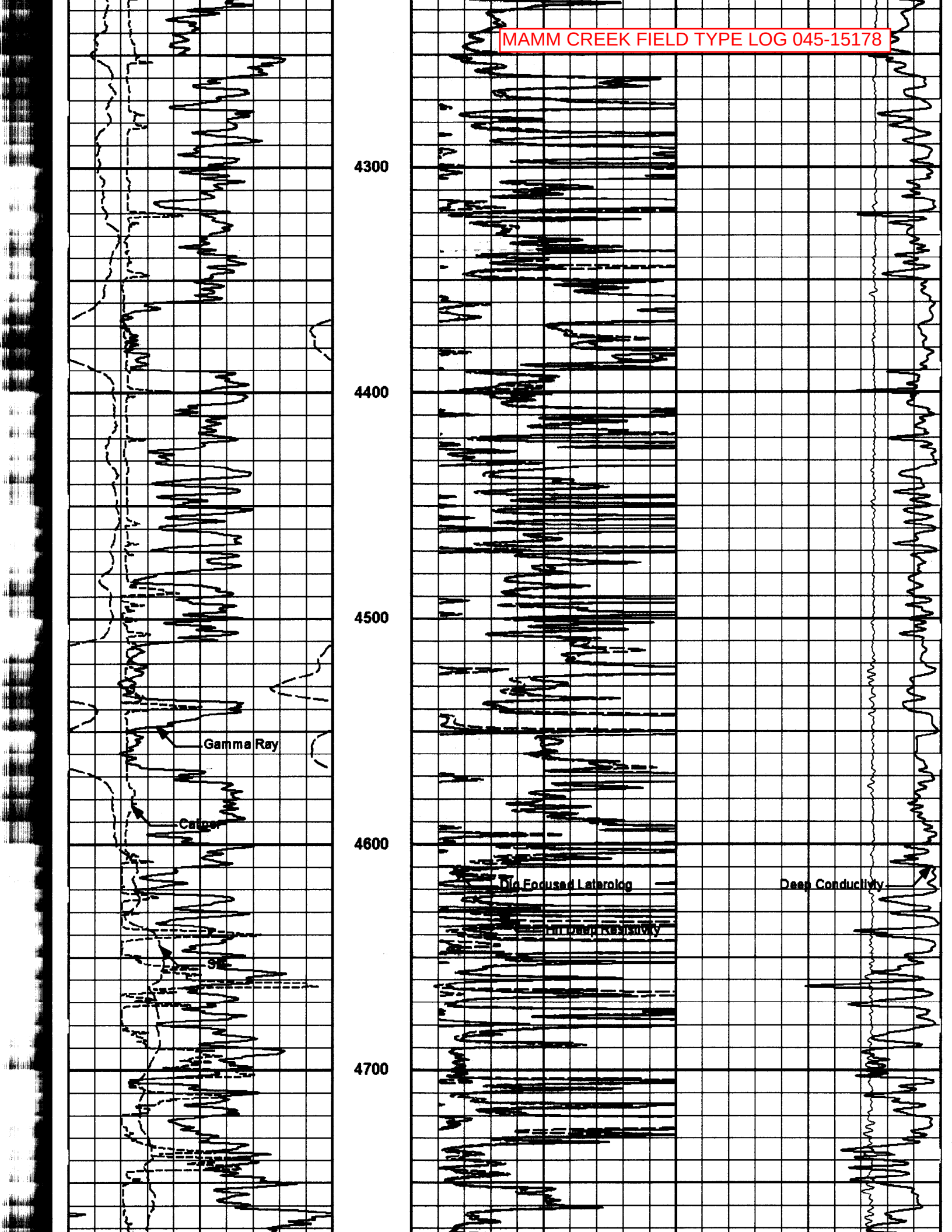

MAMM CREEK FIELD TYPE LOG 045-15178
Gamma Ray
SP
Hri Deep Resistivity
Dig Focused Laterolog
Deep Conductivity
Tension
1500
1600
1700
1800
1900
2000
COGCC pick for
Fort Union top

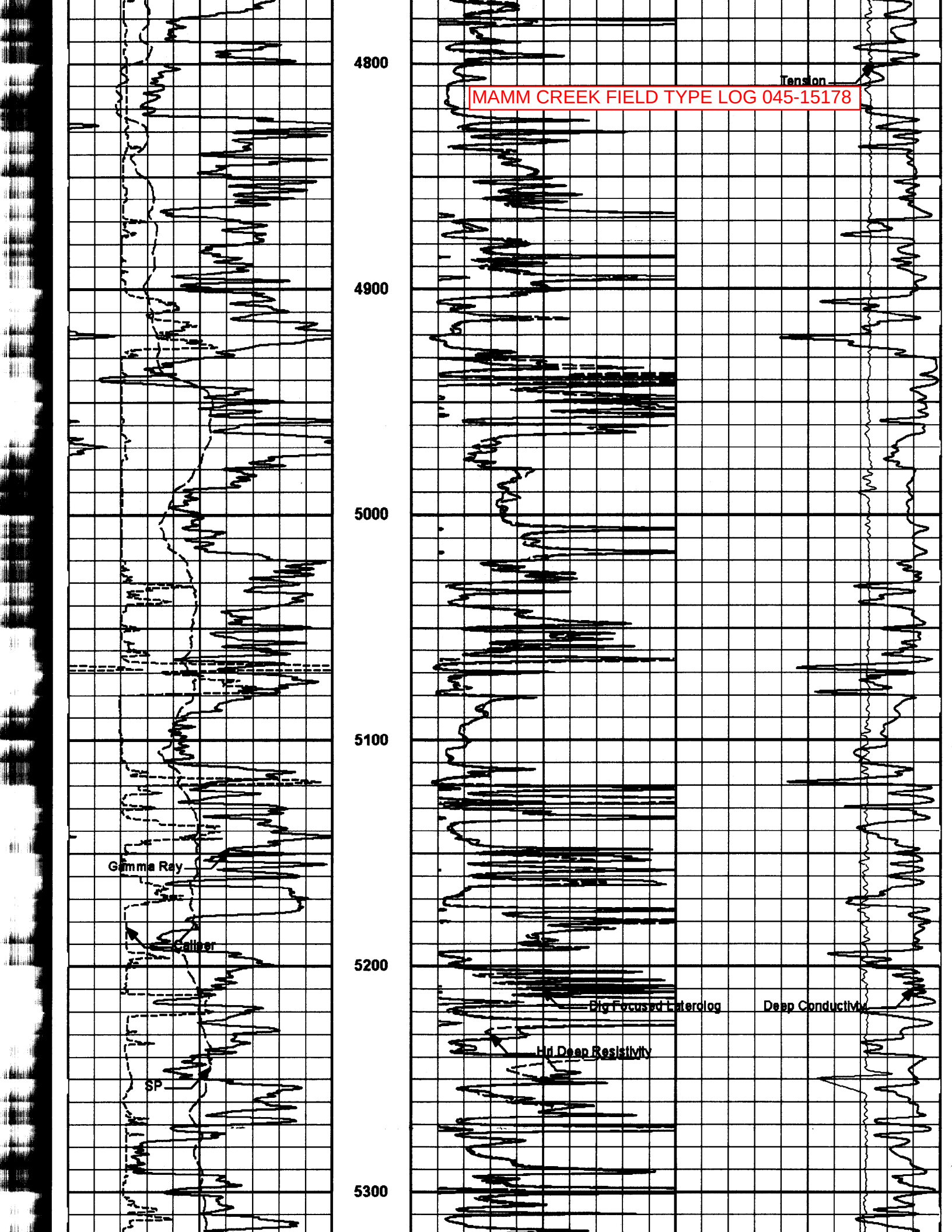

MAMM CREEK FIELD TYPE LOG 045-15178
2100
2200
2300
2400
2500
Gamma Ray
Caliper
Hrl Deep Resistivity
Dig Focused Laterolog
Deep Conductivity
Tension

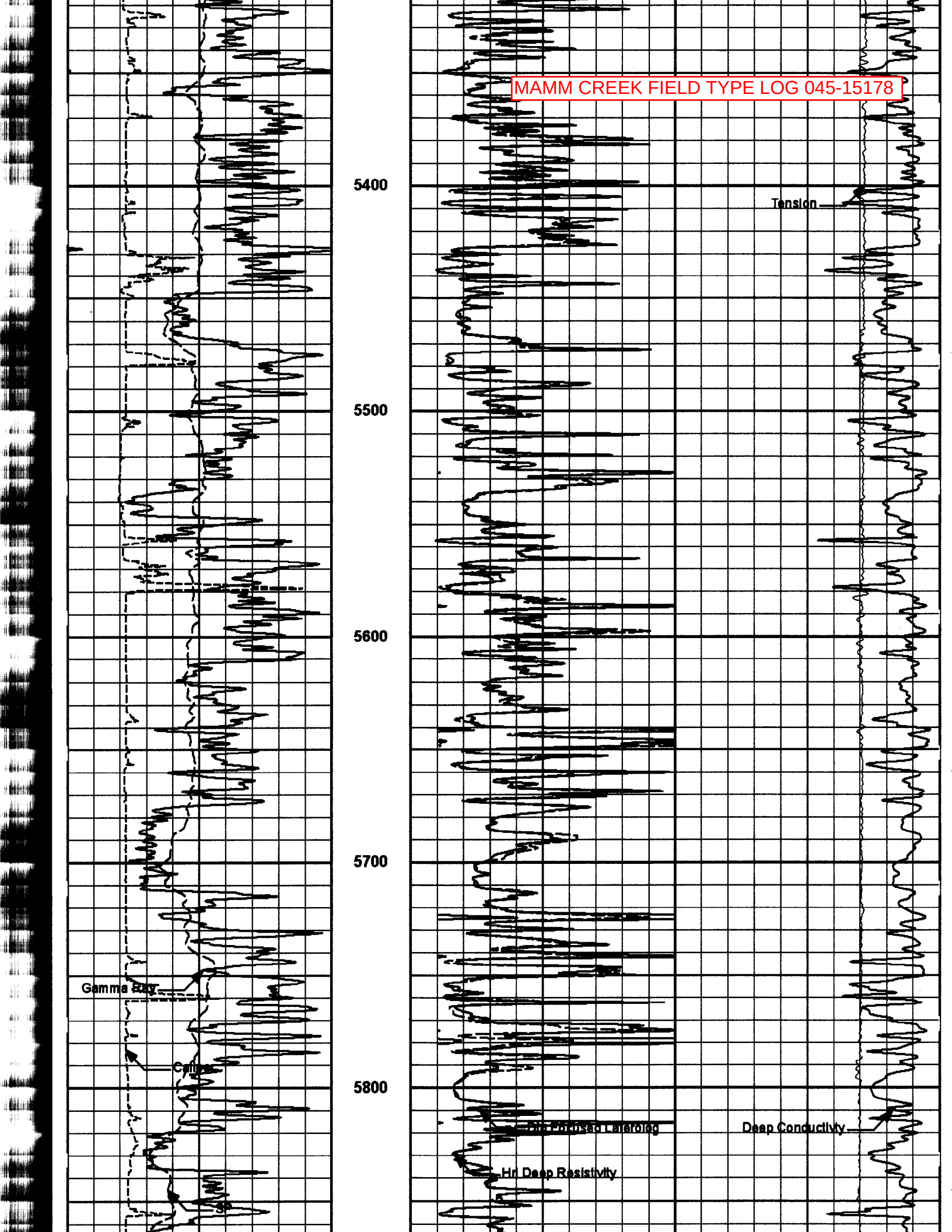

MAMM CREEK FIELD TYPE LOG 045-15178
2600
2700
2800
2900
3000
3100
Gamma Ray
Caliper
Dig Focused Laterolog
Deep Conductivity
HR Deep Resistivity
SP
Tension

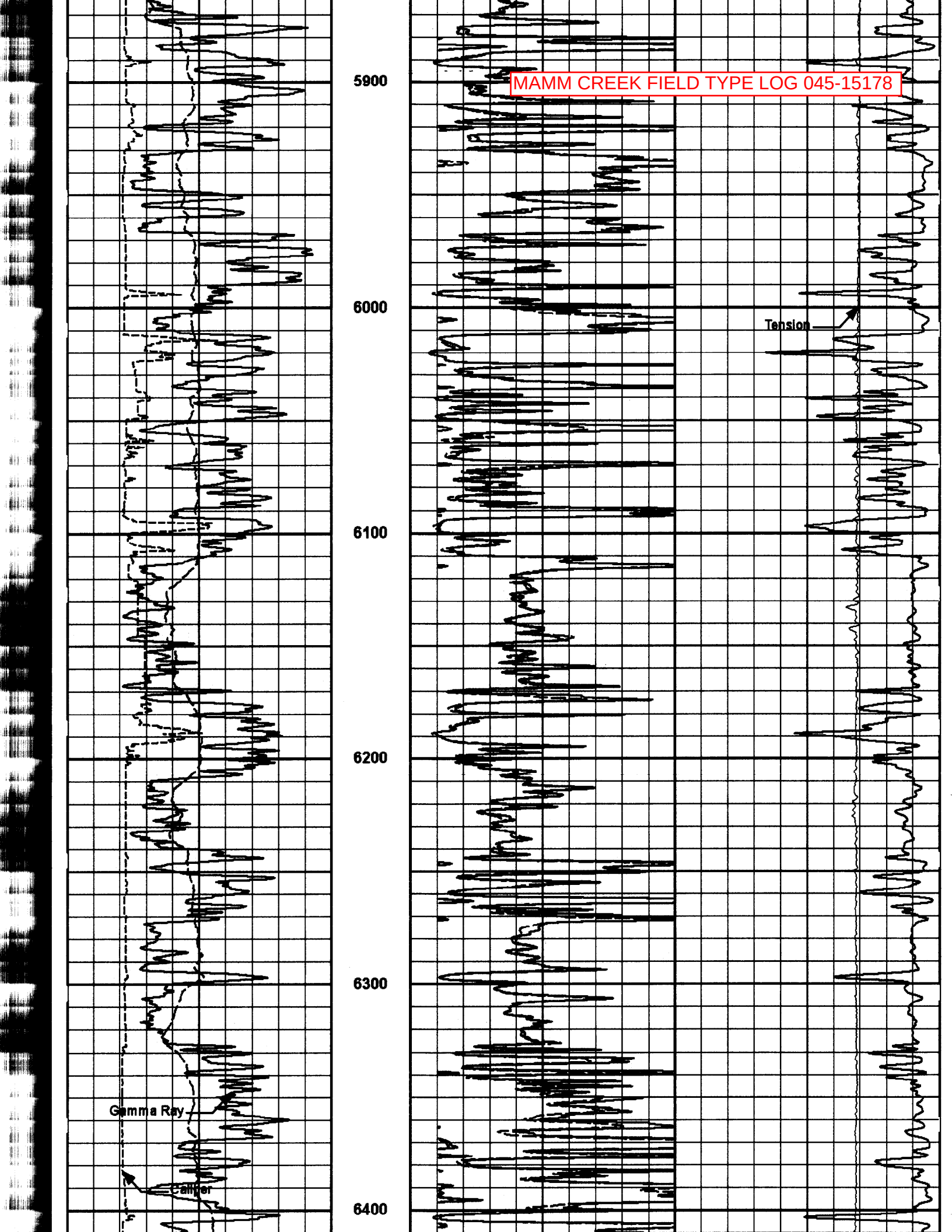

MAMM CREEK FIELD TYPE LOG 045-15178
3200
3300
3400
3500
3600
Gamma Ray
Caliper
SP
Dlg Focuse
Hri Deep Resistivity
Tension
COGCC pick for Lower Wasatch top (cement required 500' above this point, effective 04-18-2016)

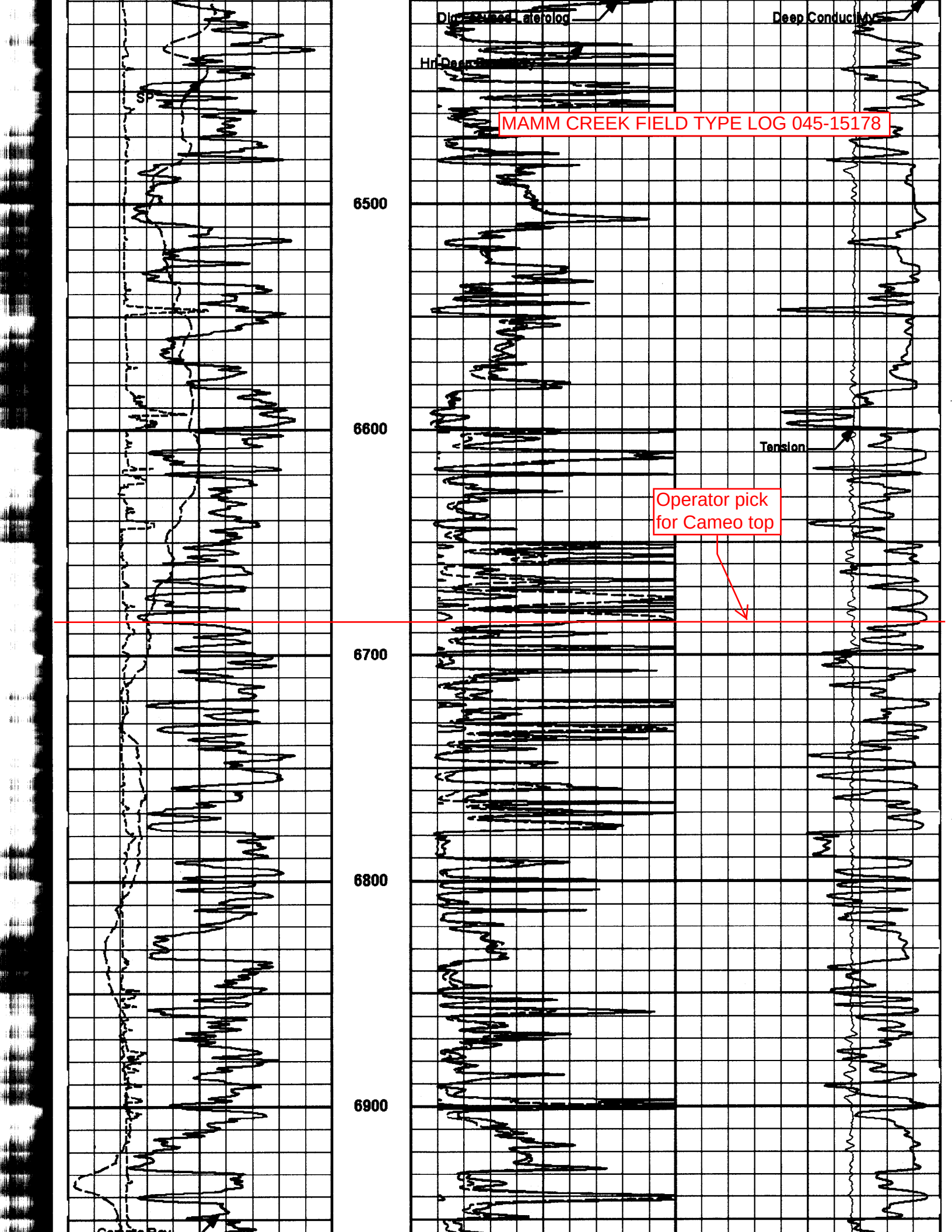

3700
3800
3900
4000
4100
4200
COGCC pick for
Ohio Creek top
MAMM CREEK FIELD TYPE LOG 045-15178
Gamma Ray
Caliper
SP
Deep Conductivity
Operator pick for
U.Mesaverde top
Tension

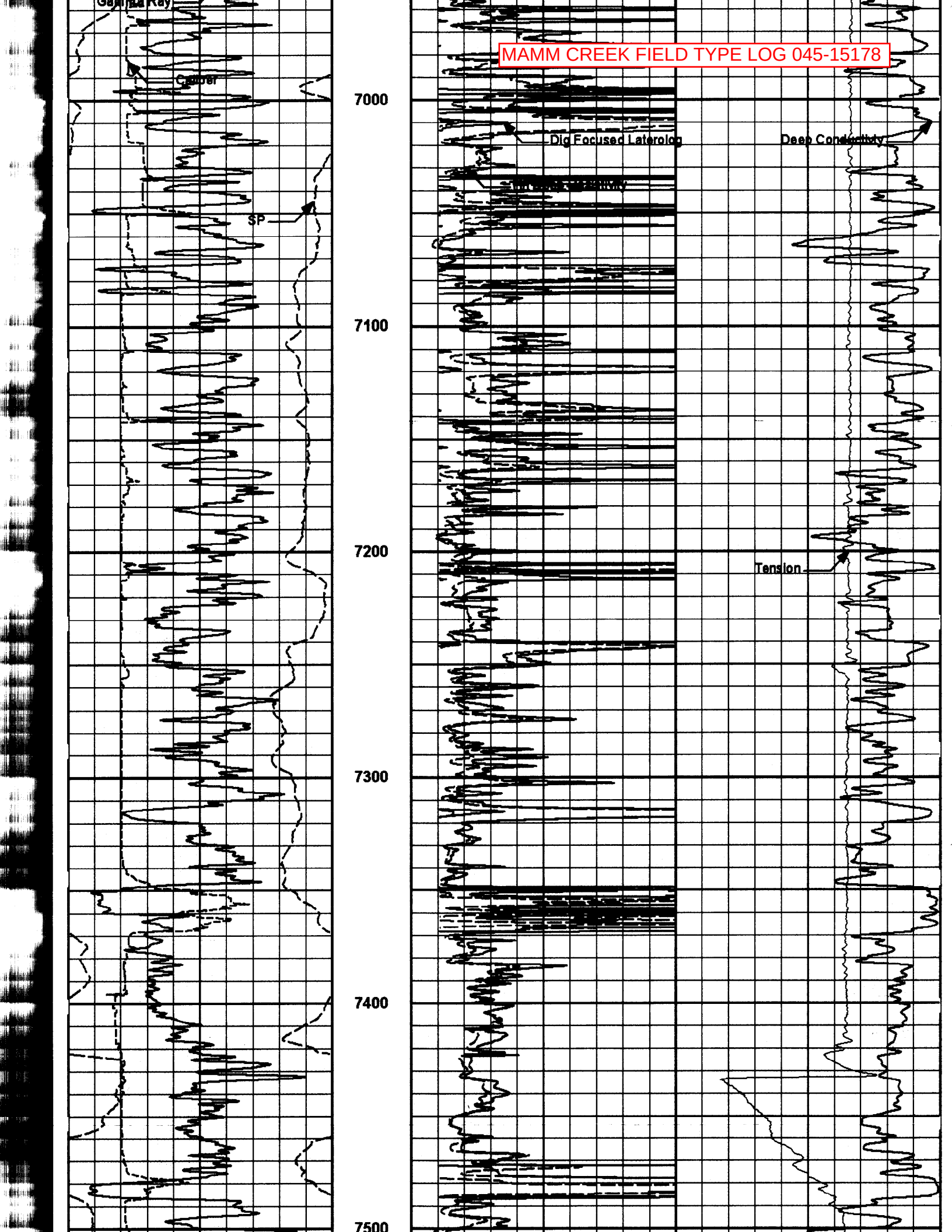

MAMM CREEK FIELD TYPE LOG 045-15178
4300
4400
4500
4600
4700
Gamma Ray
Caliper
Deep Conductivity

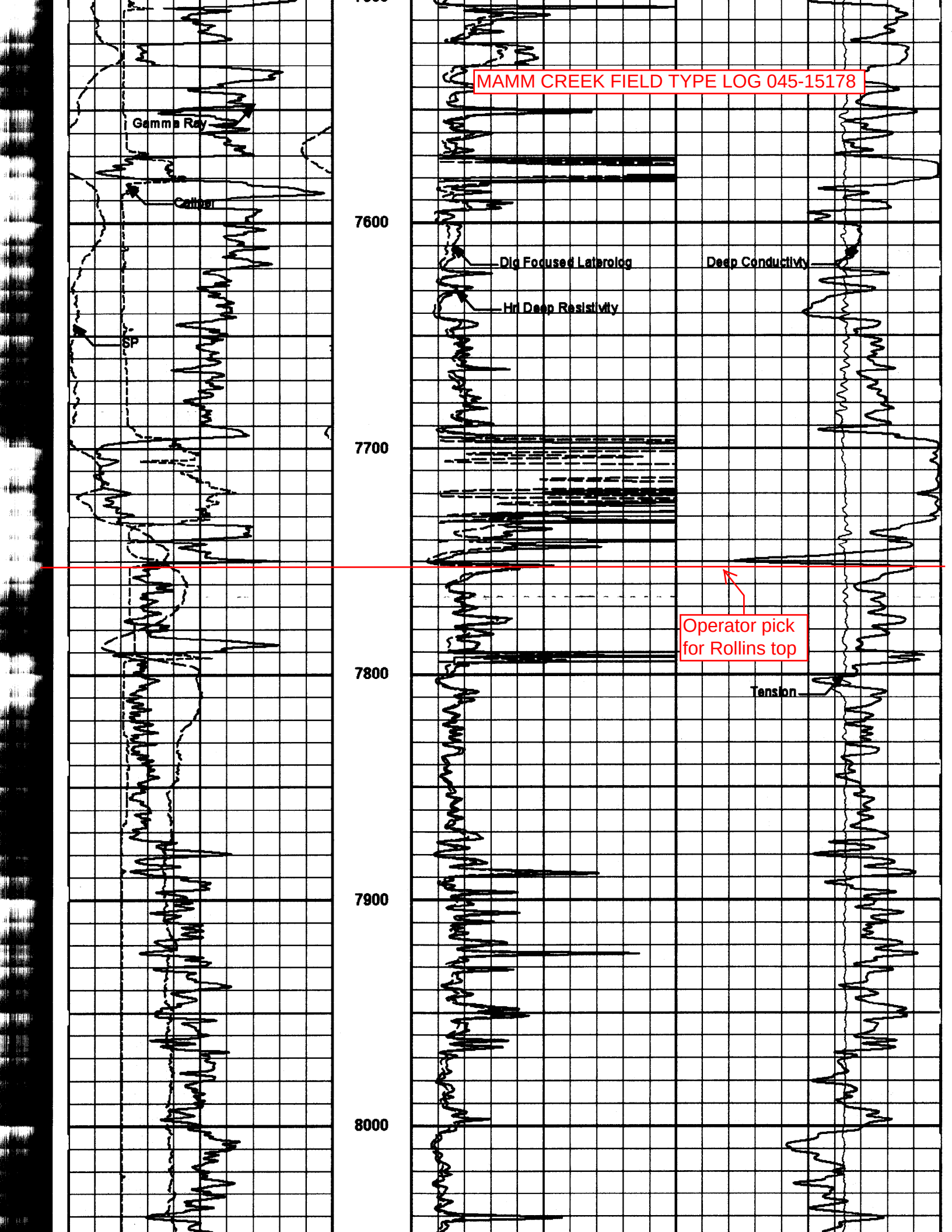

MAMM CREEK FIELD TYPE LOG 045-15178
4800
4900
5000
5100
5200
5300
Tension
Gamma Ray
Caliper
SP
Dig Focused Laterolog
Deep Conductivity
Hri Deep Resistivity

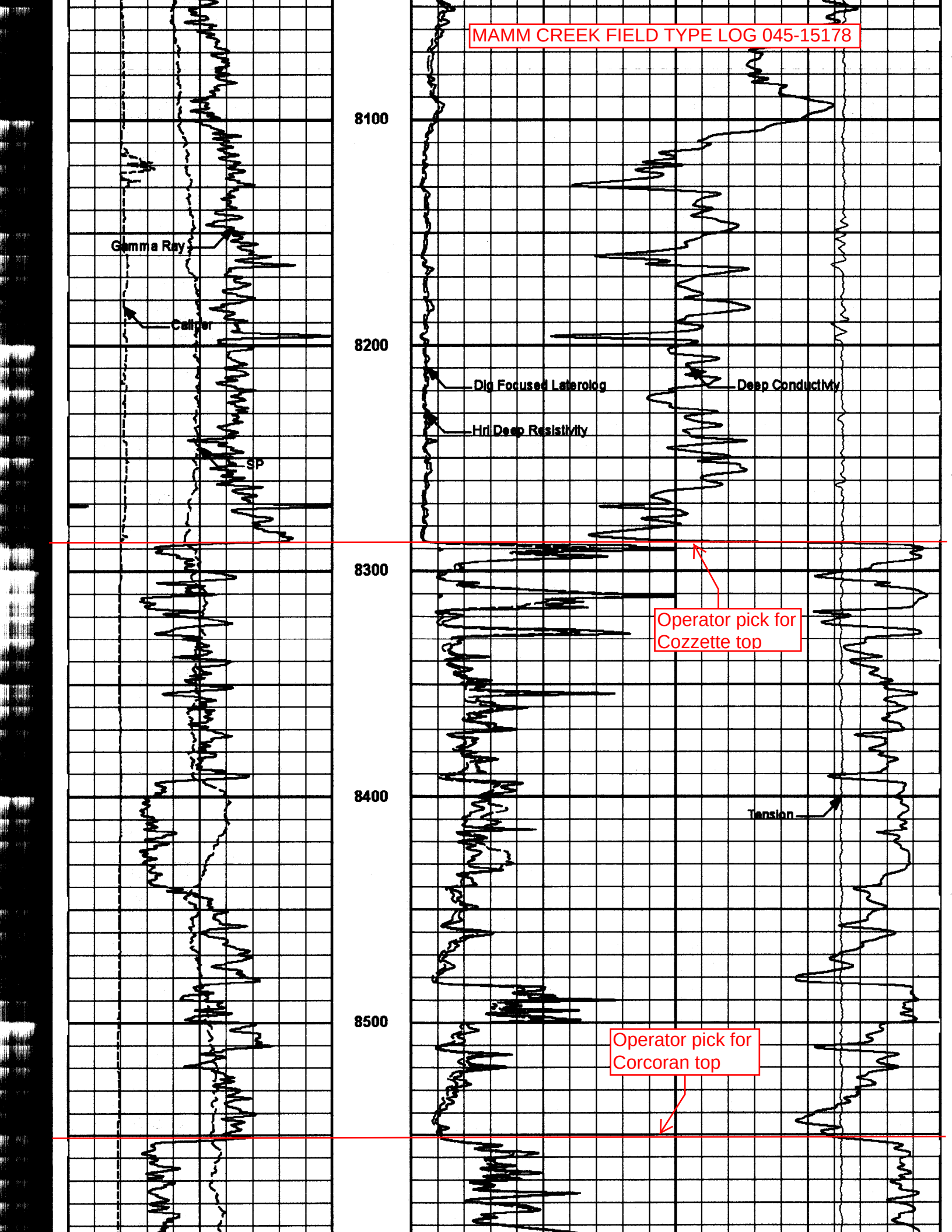

MAMM CREEK FIELD TYPE LOG 045-15178
5400
5500
5600
5700
5800
Tension
Gamma Ray
Caliper
Dlt Focused Laterolog
Hr Deep Resistivity
Deep Conductivity

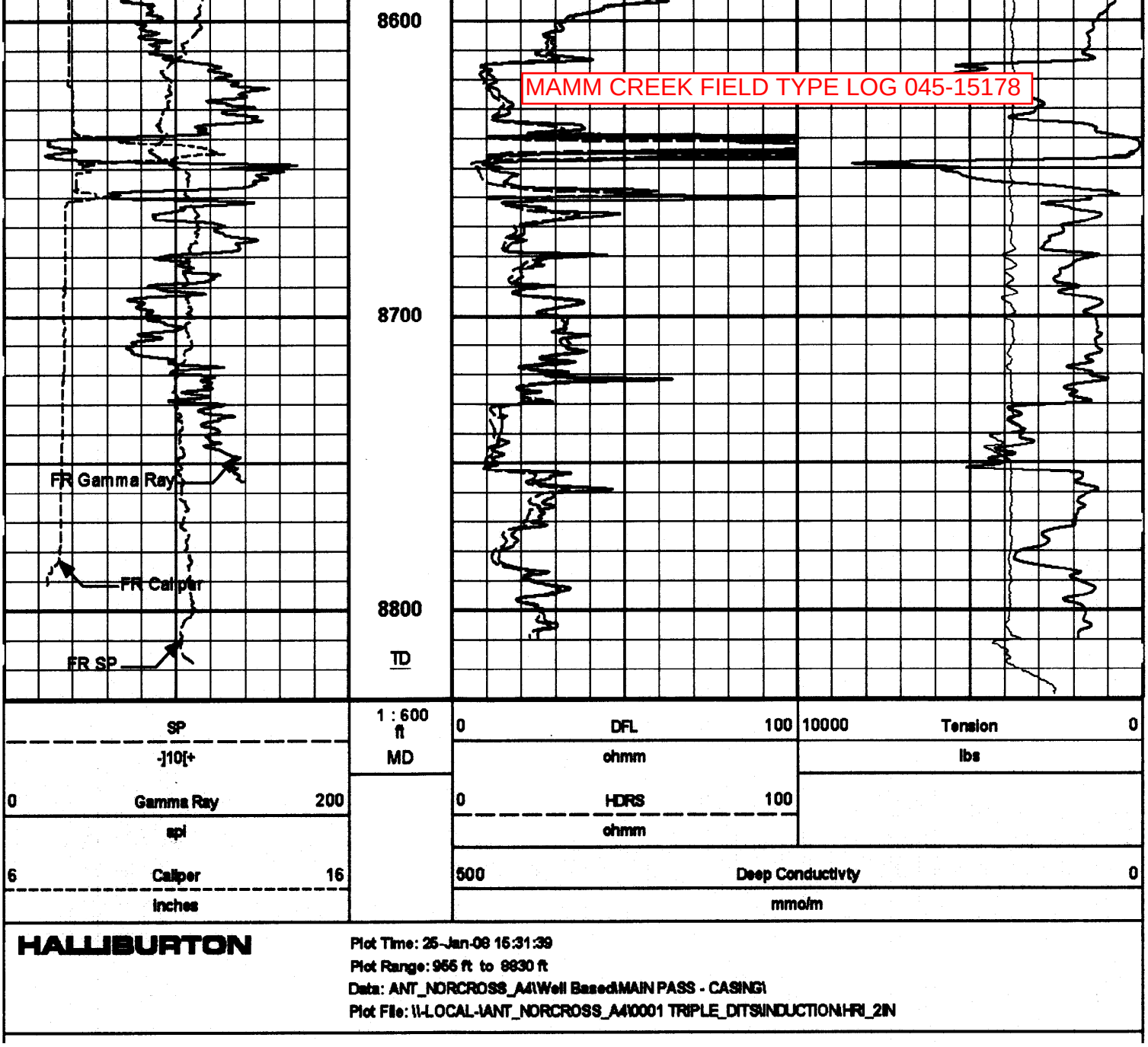

MAMM CREEK FIELD TYPE LOG 045-15178
5900
6000
6100
6200
6300
6400
Tension
Gamma Ray
Caliper


MAMM CREEK FIELD TYPE LOG 045-15178
Deep Conductivity
SP
6500
6600
Tension
Operator pick
for Cameo top
6700
6800
6900


MAMM CREEK FIELD TYPE LOG 045-15178
Gamma Ray
Caliper
SP
Dig Focused Laterolog
Deep Conductivity
Tension
7000
7100
7200
7300
7400
7500


MAMM CREEK FIELD TYPE LOG 045-15178
Gamma Ray
Caliper
SP
7600
7700
7800
7900
8000
Dlg Focused Laterolog
Hri Deep Resistivity
Deep Conductivity
Operator pick
for Rollins top
Tension


MAMM CREEK FIELD TYPE LOG 045-15178
8100
8200
8300
8400
8500
Gamma Ray
Caliper
SP
Dig Focused Laterolog
Hri Deep Resistivity
Deep Conductivity
Tension
Operator pick for Cozzette top
Operator pick for Corcoran top



SP	1 : 600 ft	0 DFL 100 ohmm / 10000 Tension 0 lbs
-]10[+	MD	
0 Gamma Ray 200 api		0 HDRS 100 ohmm
6 Caliper 16 inches		500 Deep Conductivty 0 mmo/m

HALLIBURTON

Plot Time: 25-Jan-08 15:31:39
Plot Range: 955 ft to 9830 ft
Data: ANT_NORCROSS_A4\Well Based\MAIN PASS - CASING\
Plot File: \\-LOCAL-\ANT_NORCROSS_A4\0001 TRIPLE_DITS\INDUCTION\HRI_2IN

COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056125

FIELD NAME	**RULISON**
FIELD NUMBER	**75400**

LOCATION

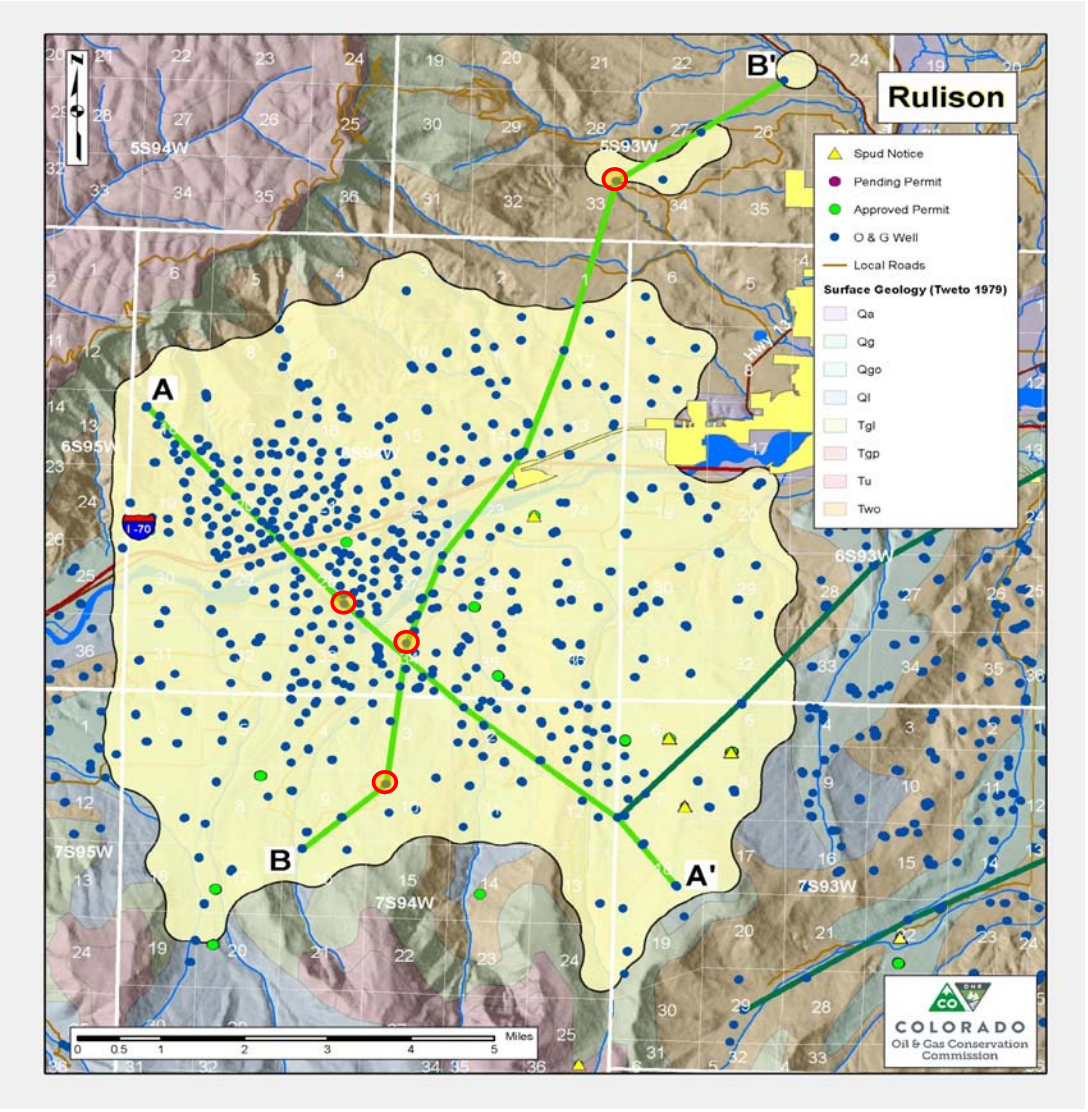
Basin	Piceance
Township(s)	5S to 7S
Range(s)	93W to 95W

SURFACE GEOLOGY

Surface Geology consists of the Green River Formation overlying the Wasatch Formation in higher elevation areas to the south (near the top of Battlement Mesa). The Colorado River generally flows from east to west through the north-central portion of the field. Landslide deposits are prevalent in areas with steep slopes, primarily on the south side of the valley. Alluvium is prevalent along the Colorado River and tributary creeks, primarily on the south side of the valley. These other Tertiary formations are underlain by the Wasatch Formation, which outcrops at the surface in the valley and along larger tributaries at lower elevations.

GEOLOGIC STRUCTURE

None within this field on COGCC's 250K GIS Geology layer. However, northwestern extensions of anticlines and synclines to the east of this field may affect structure to a limited extent, particularly in the eastern and northeastern portions of this field. A northwest-southeast trending, southwesterly-dipping monocline (the Grand Hogback Monocline along the northeastern edge of the basin) is present within three miles of the extreme northeastern portion of the field.



Type Log Wells

COGCC OIL AND GAS FIELD SCOUT CARD
RULISON #75400

				A - Northwest					A' - Southeast
STRATIGRAPHY			**API Number =>**	**045-09956**	**045-06975**	**045-06595**	**045-07181**	**045-18422**	**045-09224**
			Surface Elevation =>	**6,164**	**5,443**	**5,205**	**5,869**	**7,357**	**8,554**
All depths are measured depths			**Well Type =>**	**Directional**	**Drifted**	**Vertical**	**Vertical**	**Directional**	**Directional**
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water		0				0
	Landslide Deposit		Water			0	0	0	
	Uinta		Water						
	Green River		Water						
	Wasatch	Upper	Shallow Water	0					
	Wasatch	G-Sand*	Gas	2,810/2,964*	1,831/1,960*	1,303/1,457*	1,830/1,954*	3,308/3,410*	4,732/4,836*
	Wasatch	Fort Union*	None	3,344*	2,333*	1,810*	2,303*	3,820*	5,310*
	Wasatch	Middle	None						
	Wasatch	Lower*	Water	4,633*	3,674*	3,383*	3,860*	5,390*	6,876*
Mesaverde	Williams Fork	Ohio Creek	Water	4,925*	3,975*	3,662*	4,000*	5,510*	7,216*
Mesaverde	Williams Fork	U. Mesaverde	Water / UIC	5,298	4,321	3,825	4,279	5,783*	7,390*
Mesaverde	Williams Fork	Top of Gas	Gas						8,076
Mesaverde	Williams Fork	Cameo	Gas	7,927	7,010	6,558	7,016	8,476	
Mesaverde	Iles	Rollins	Gas	8,863	7,938	7,421		9,352	10,952
Mesaverde	Iles	Cozzette	Gas / UIC		8,282	7,762			
Mesaverde	Iles	Corcoran	Gas / UIC		8,576	8,044			
	Mancos		Possible Gas						
	Niobrara		Possible Gas						

Annotated Type Log for 045-06595: COGCC Document Number 2056089

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Operators commonly report the upper interval or the lower interval of the Wasatch G-Sand [as shown above], or some point in between, but not both; the Fort Union is not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

COGCC OIL AND GAS FIELD SCOUT CARD
RULISON #75400

				B - Southwest							B' - Northeast
STRATIGRAPHY			**API Number =>**	**045-06673**	**045-07186**	**045-07197**	**045-07680**	**045-06232**	**045-11942**	**045-10518**	**045-11304**
			Surface Elevation =>	**7,091**	**6,689**	**5,361**	**5,255**	**5,319**	**5,460**	**5,807**	**5,915**
All depths are measured depths			**Well Type =>**	**Vertical**	**Vertical**	**Vertical**	**Directional**	**Vertical**	**Directional**	**Directional**	**Directional**
Group	**Formation**	**Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water			0	0	0			
	Landslide Deposit		Water	0	0						
	Uinta		Water								
	Green River		Water								
	Wasatch	Upper	Shallow Water						0	0	0
	Wasatch	G-Sand*	Gas	3,210/3,377*	2,740/2,905*	1,321/1,457*	1,327/1,440*	1,694/1,833*	2,226/2,348*	3,273/3,393*	3,148/3,279*
	Wasatch	Fort Union*	None	3,743*	3,267*	1,830*	1,819*	2,258*	2,714*	3,750*	3,630
	Wasatch	Middle	None								
	Wasatch	Lower*	Water	4,836*	4,556*	3,008*	3,170*		4,270*	5,697*	5,800*
Mesaverde	Williams Fork	Ohio Creek	Water	5,194*	4,875*	3,340*	3,470*		4,600*	5,950*	6,125*
Mesaverde	Williams Fork	U. Mesaverde	Water / UIC	5,670	5,209	3,796	3,854		4,922	6,098	6,290*
Mesaverde	Williams Fork	Top of Gas	Gas								
Mesaverde	Williams Fork	Cameo	Gas	8,170	7,730	6,446	6,560		7,706	8,994	9,207
Mesaverde	Iles	Rollins	Gas	9,126			7,568*		8,669	9,841	10,134
Mesaverde	Iles	Cozzette	Gas / UIC								10,525
Mesaverde	Iles	Corcoran	Gas / UIC								
	Mancos		Possible Gas								
	Niobrara		Possible Gas								

Annotated Type Log for 045-07186: COGCC Document Number 2056093
Annotated Type Log for 045-07197: COGCC Document Number 2056192 (specifically illustrates variability of reported Fort Union, Ohio Creek, and Mesaverde log tops in the nearby MWX-1 well)
Annotated Type Log for 045-10518: COGCC Document Number 2056094

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Operators commonly report the upper interval or the lower interval of the Wasatch G-Sand [as shown above], or some point in between, but not both; the Fort Union is not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

WATER RESOURCE ISOLATION

Alluvium, landslide deposits, Uinta, Green River, Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde.
Water wells within the field are more prevalent on the south side of the valley. Water wells are typically screened in alluvium or upper, weathered portions of the Wasatch Formation. Two water wells within the field are 600' deep and several water wells are 300' to 500' deep, but the majority of water wells in the field are less than 300' deep. Operator's Geologic Prognosis for RWF 12-12 (045-11942, COGCC Document No. 1622320) indicates, "Water zones may be encountered within the upper portion of the Mesaverde." Several gas production wells were permitted as water wells by Laramie Energy II LLC. The operator informed COGCC staff that at the time, they assumed that water well permitting was required for produced water in those gas wells as potential tributary coalbed methane water sources. The gas well total depths are in the range of approximately 8,000' to 10,000', but they are not water supply wells.

PRODUCING ZONE ISOLATION

Primary Objectives: Wasatch G, Mesaverde Group (Williams Fork and Iles)
Secondary Objectives: Two vertical wells drilled, targeting the Mancos B and Niobrara (045-14756 and 045-22157)

COGCC OIL AND GAS FIELD SCOUT CARD
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UNDERGROUND INJECTION CONTROL

API Number	Well Name and No.	Type	Zone	Sample Top	Sample Bot.	TDS	Source
045-07465	Clough #RMV 215-21	Disposal	Williams Fork	4,483	5,208	14,379	SWAB1 - 3/26/2012
045-07465	Clough #RMV 215-21	Disposal	Williams Fork	4,483	5,208	17,695	SWAB2 - 3/26/2012
045-07465	Clough #RMV 215-21	Disposal	Williams Fork	4,483	5,208	19,748	SWAB3 - 3/26/2012
045-10389	Clough #RWF 623-21	Disposal	Williams Fork	4,124	5,229		N/A[1]
045-10469	Clough #RWF 434-21	Disposal	Williams Fork	4,055	5,261		N/A[1]
045-07325	Clough #RMV 94-21-H	Source	Corcoran	8,398	8,398	15,755	SWAB - 4/23/2012
045-07325	Clough #RMV 94-21-H	Source	Corcoran	8,398	8,398	18,200	SWAB - 8/9/2012
045-22176	Clough #RWF 911-28D	Disposal	Cozzette - Corcoran	8,180	8,608		N/A[2]
045-22333	Clough #RWF 933-19D	Disposal	Cozzette - Corcoran	9,017	9,394	17,119	WH - 7/7/2014

(1) Injection formation water sample not available. TDS data from offset well 045-07465 was used for the UIC Application.

(2) Injection formation water sample not available. TDS data from offset well 045-07325 (Corcoran sample) was used for the UIC Application.

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

139-1 (12/10/1959)	Mesaverde: Recognized the Mesaverde as a **Common Source** of supply. Established 640-acre drilling and spacing units, with wells no closer than 990' from quarter-section lines, located in NW/4 or SE/4 of each section. Order specified minimum 200' surface casing, formation integrity monitoring/testing requirements below the surface casing shoe (500 psi for 30 minutes with 100 psi leakoff allowance), minimum 100 sack cement requirement for production casing, production casing pressure testing requirements (1,000 psi for 30 minutes with 100 psi leakoff allowance), tubing required with top perforation limit to no more than 250' from the bottom of the tubing for oil wells, and installation of tubing, casing, and bradenhead valves.
139-2 (2/21/1961)	Wasatch: Established 640-acre drilling units, with wells no closer than 600 feet from section boundaries. Mesaverde: Reiterated certain requirements of Order 139-1.
Various (1967-68)	Orders related to instrumentation and nuclear emplacement wells for Project Rulison.
139-8 (7/16/1979)	Wasatch: Established 160-acre drilling and spacing units, with wells no closer than 600' from unit line, 1200' well-to-well spacing. Mesaverde: Established 320-acre drilling and spacing units, with wells no closer than 600' from unit line, 1200' well-to-well spacing.
139-14 (3/19/1990)	Mesaverde: **Common Source** of supply definition expanded to include Mesaverde, Cameo, Rollins, Cozzette, and Corcoran.
139-21 (6/14/1991)	Mesaverde: Defines interval to be spaced in certain parts of Townships 6S-93W and 7S-93W to include the interval from 5142' to 9950', as found on the Dual Induction Log for the R.H. Ranch #1 well (SWSW 34-6S-93W, located in the adjoining Mamm Creek Field, 045-06377, linear-scale log Document No. 1005953). COGCC staff correlates the referenced log interval to include all of the Mesaverde Group represented in the Stratigraphy chart shown above in this Field Scout Card document, including the bottom portion of the Ohio Creek Member of the Williams Fork Formation, down through all members of the Iles Formation. This order further specifies minimum 300' surface casing, and blow out preventors and kill line installation prior to drilling out surface casing. Initial and final completion reports, Form 5s required with geologic data, and Sundry Notices, Form 4s required for cathodic protection boreholes, to be permitted and constructed per State Division of Water Resources requirements.
Various (1992-93)	Mesaverde: **Common Source** of supply definition cited as Upper Mesaverde, Upper Cozzette, Lower Cozzette, and Corcoran. Defines intervals to be spaced in certain areas of Township 6S-94W and Township 7S-94W to include 3862' to 7666' (Upper Mesaverde, inclusive of the Rollins Member of the Iles Formation), 7830' to 7895' (Upper Cozzette), 7949' to 7996' (Lower Cozzette), and 8110' to 8270' (Corcoran), as found on the Dual Induction Log for the DOE/CER MWX #1 well (SWNW 34-6S-94W, 045-06325, now renamed as Superior MWX #1). The Upper Mesaverde (including Rollins) was assigned 320-acre drilling and spacing units, and the Cozzette and Corcoran were assigned 640-acre drilling and spacing units, with wells no closer than 600' from unit line, 1200' well-to-well spacing.
139-26 (2/22/1994)	Williams Fork: Defined the Williams Fork Formation of the Mesaverde Group as a **Common Source** of supply. Established 640-acre drilling and spacing units (with eight wells per unit) and 320-acre drilling and spacing units (with four wells per unit) in certain parts of this field, with wells no closer than 600' from unit line, 1200' well-to-well spacing (80-acre well spacing). Defines Williams Fork Formation to include the interval from 3,920' to 7,268', as found on the Dual Induction Log for the Barrett GV #53-34 well (SWNE 34-6S-95W, located in the adjoining Parachute Field, 045-06650, now renamed as Arco GV #53-34, Document No. 1036744). COGCC staff correlates the referenced log interval to include all of the Williams Fork Formation represented in the Stratigraphy chart shown above in this Field Scout Card document, excluding the Ohio Creek Member of the Williams Fork Formation.
139-27 (3/18/1994)	Williams Fork: Changed 80-acre density drilling and spacing unit setbacks in certain areas of the field to wells no closer than 400' from unit line, 800' well-to-well spacing.
139-28 (2/21/1995)	Williams Fork: First field order allowing 40-acre well density, with wells no closer than 400' from unit line, 800' well-to-well spacing.

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RULISON #75400

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

139-32 (1/7/1998)	Williams Fork: First field order allowing 20-acre well density, with wells no closer than 200' from unit line, 400' well-to-well spacing.
139-34 (10/31/2000)	Williams Fork: Amends prior orders to allow 20-acre spacing, 200' from unit line, 400' bottom hole well-to-well spacing. Requires compliance with Garfield County Notice to Operators for surface casing setting depth (10% of TVD), formation integrity tests, loss of well control notices to residents within one mile, water sampling, reclamation plans, and air emission controls within 1,000' of occupied buildings, among other requirements. Order requires additional wells to be drilled as multi-well pads.
139-37 (7/9/2001)	Williams Fork: First field order allowing 10-acre well density, with wells no closer than 200' from unit line.
139-38 (4/21/2003)	Williams Fork: Eliminates bottom hole well-to-well spacing requirement for 10-acre well density and allows bottom holes within 100' of unit boundaries for new wells.
139-43 (2/10/2004)	Project Rulison Area Half-Mile Hearing Requirement: "any wells proposed to be drilled within one half (½) mile of the Austral Oil Hayward #25-95 (R-E) Well in Lot 11 of the NE¼ SW¼ of Section 25, Township 7 South, Range 95 West, 6th P.M., a hearing before the Commission shall be held prior to approval of any Application for Permit-to-Drill, Form 2."
139-46 (3/22/2005)	Iles: First field order allowing 20-acre well spacing density, with wells no closer than 200' from unit line, 400' well-to-well spacing.
139-50 (9/26/2005)	Williams Fork and Iles: Requires that wells drilled to the Iles Formation shall be drilled only in connection with the drilling of Williams Fork Formation wells, using a single wellbore to reach both formations.
139-47 (6/6/2005)	First order requiring compliance with "Well Cementing Procedure and Reporting Requirements in the Notice to Operators Drilling Mesaverde Group or Deeper Wells in the Mamm Creek Field Area dated July 23, 2004," which applies to part of the Rulison Field.
139-56 (9/20/2004)	Established Bradenhead Monitoring Area, including part of the Rulison Field.
139-61 (6/5/2006)	Williams Fork and Iles: First field order allowing 10-acre well spacing density when drilling to both formations, with wells no closer than 100' from unit line.
139-78 (7/23/2007)	Wasatch: First field order for an 80-acre drilling and spacing unit, with one pad per 40 acres and wells no closer than 600' from unit line and 1200' from other Wasatch wells.
139-101 (9/22/2008)	Williams Fork and Iles: Field order allowing 9-acre well spacing density on two lots, with wells no closer than 100' from unit line.
139-113 (6/27/2011)	Deep Formations (Mancos, Niobrara, Frontier, and Mowry): First field order allowing 40-acre drilling and spacing units with 10-acre density, with wells no closer than 600' from unit line.
139-120 (7/28/2014)	Deep Formations (Mancos, Sego, Niobrara, Frontier, Mowry, and Dakota): 1280-acre exploratory drilling and spacing unit for up to 40 horizontal, vertical or directional wells within the unit, for the production from the Mancos (including the Sego Sandstone), Niobrara, Frontier, Mowry, and Dakota Formations, with the productive interval of the wellbore located no closer than 300' from the southern and northern unit boundaries and no more than 600' from the eastern and western unit boundaries, and no closer than 300' from the productive interval of any other wellbore located in the unit.

COGCC OIL AND GAS FIELD SCOUT CARD
RULISON #75400

HISTORIC WELL CONSTRUCTION

Historic surface casing setting depths vary throughout the field as a function of age of the well and ground surface elevation. Older wells drilled during early development of the field commonly have surface casing setting depths less than 1,000' deep. Effective 10/3/1997, the minimum surface casing setting depth standard was changed to 1,100' in the Rulison Overpressured Area, which includes most of this field. Surface casing setting depths for newer wells are generally set between 1,000' to 3,000', but deeper surface casing (3,000' to 4,000') has been used in isolated areas of the field. Production casing generally terminates in the Iles Formation or the underlying Mancos Formation. Wasatch G wells may terminate shallow at depths generally ranging from 2,000' to 3,500'. Production casing cement (or intermediate casing cement, if used) may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 1,100' (in the Rulison Overpressured Area) or 10% TVD for well control and to cover water resources in the upper interval of the Wasatch Formation; use the most stringent criteria. Recommend setting depth of at least 50 feet below the Wasatch Formation top for high-elevation wells that must drill through the Green River Formation. Check for deep alluvium on offset logs in wells drilled near the Colorado River (COGCC staff review of wells with shallow surface casing of 300' to 400' near the river showed that current, minimum surface casing setting depths will likely provide full coverage of alluvium). Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. New Standards require cementing intermediate (if used) or production casing at least 200' above Lower Wasatch sands in the western portion of the field (Ranges 94W and 95W), or at least 500' above Lower Wasatch sands in the eastern portion of the field (Range 93W).

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug above Ohio Creek and across Lower Wasatch (squeeze if no annular cement coverage); Wasatch G plug if produced within one mile; stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000' intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug. Consider setting plug(s) from 1,000' into the surface casing for shallow surface casing strings that are less than 1,000' deep.

WELL CONTROL

Except for a rig fire that occurred while drilling 045-15694 on 8/27/2008, well control events summarized below were controlled without incident. Well Control events have been reported in 6S-94W and 7S-94W.
Well Control Reports (Form 23s) by Year: 2008 (1), 2009 (4), 2010 (6), 2011 (8), 2012 (none), 2013 (4), 2014 (none), and 2015 (none). Reporting was inconsistent prior to 2009, when requirements for Form 23 reporting was emphasized with the operators.
Form 23s by Formation: Williams Fork (13) and Iles (10)

NOTES

The southwestern portion of the field is in the Project Rulison Sampling and Analysis Plan area. Special requirements and Form 2 Conditions of Approval apply.
The approximate western two thirds of the field is in the Rulison Overpressured Area. Special requirements and Form 2 Conditions of Approval apply.
The eastern portion of the field in R93W is located within the Mamm Creek Field Cementing Notice to Operators Area. Special requirements and Form 2 Conditions of Approval apply.
The eastern portion of the field in R93W is located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.
A Uranium Mill Tailings Remedial Action area is located along I-70 and the Colorado River in the northeast portion of the field. Special requirements and Form 2 Conditions of Approval apply.

ISOLATION REQUIREMENTS FOR TYPICAL WELLS

Date 04/18/2016

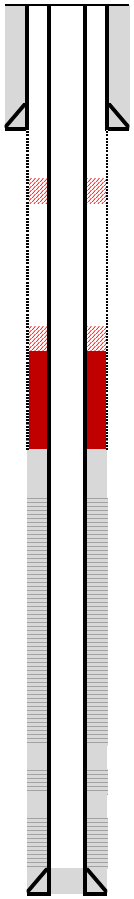
COGCC Document No. 2056126

FIELD NAME **RULISON**
FIELD NUMBER **75400**

LOCATION
Basin Piceance
Township(s) 5S to 7S
Range(s) 93W to 94W

Notes: Depths to formation tops differ significantly with changes of ground surface elevation across the field. Refer to the Stratigraphy chart on the Field Scout Card. These wellbore diagrams reflect average depths.
Cement isolation requirements of 500' above L. Wasatch are for Township 5S-93W (SE/4 and Sections 9, 13-16, 21, 28, and 33), Township 6S-93W (all, including any overlap with Mamm Creek Field), Township 6S-94W (Sections 1 and 12), and Township 7S-93W (Sections 5-8 and 17); cement isolation requirements of 200' above L. Wasatch are for other parts of the field to the west of those areas described above.

Depth	Formation/Member
0	Uinta/ Green River/ Landslide Deposit/ Alluvium/
1,000	U. Wasatch
	Wasatch G
2,000	
3,000	
	L. Wasatch
4,000	Ohio Creek
	U. Mesaverde
5,000	Top of Gas
6,000	
7,000	Cameo
	Rollins
8,000	
	Cozzette Corcoran



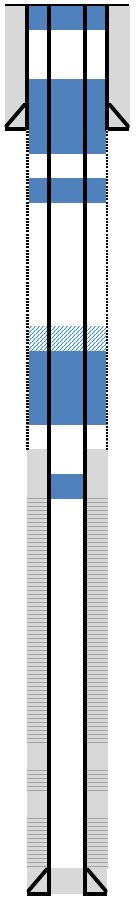
Casing and Cement Coverage

Surface Casing Standard
Minimum 10% TVD or cover all apparent water resources in the U. Wasatch, whichever is more stringent; 1,100 ft minimum in Rulison Overpressured Area (most of the field)

New Cement Standard
Cement must provide coverage across Ohio Creek and Lower Wasatch (200'/500' above Lower Wasatch), in addition to productive interval coverage. Add Wasatch G coverage (stage cement, as shown here, or increase primary coverage) within one mile of productive Wasatch G wells.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of U. Mesaverde, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	Uinta/ Green River/ Landslide Deposit/ Alluvium/
1,000	U. Wasatch
	Wasatch G
2,000	
3,000	
	L. Wasatch
4,000	Ohio Creek
	U. Mesaverde
5,000	Top of Gas
6,000	
7,000	Cameo
	Rollins
8,000	
	Cozzette Corcoran



Plug Placement

Surface plug

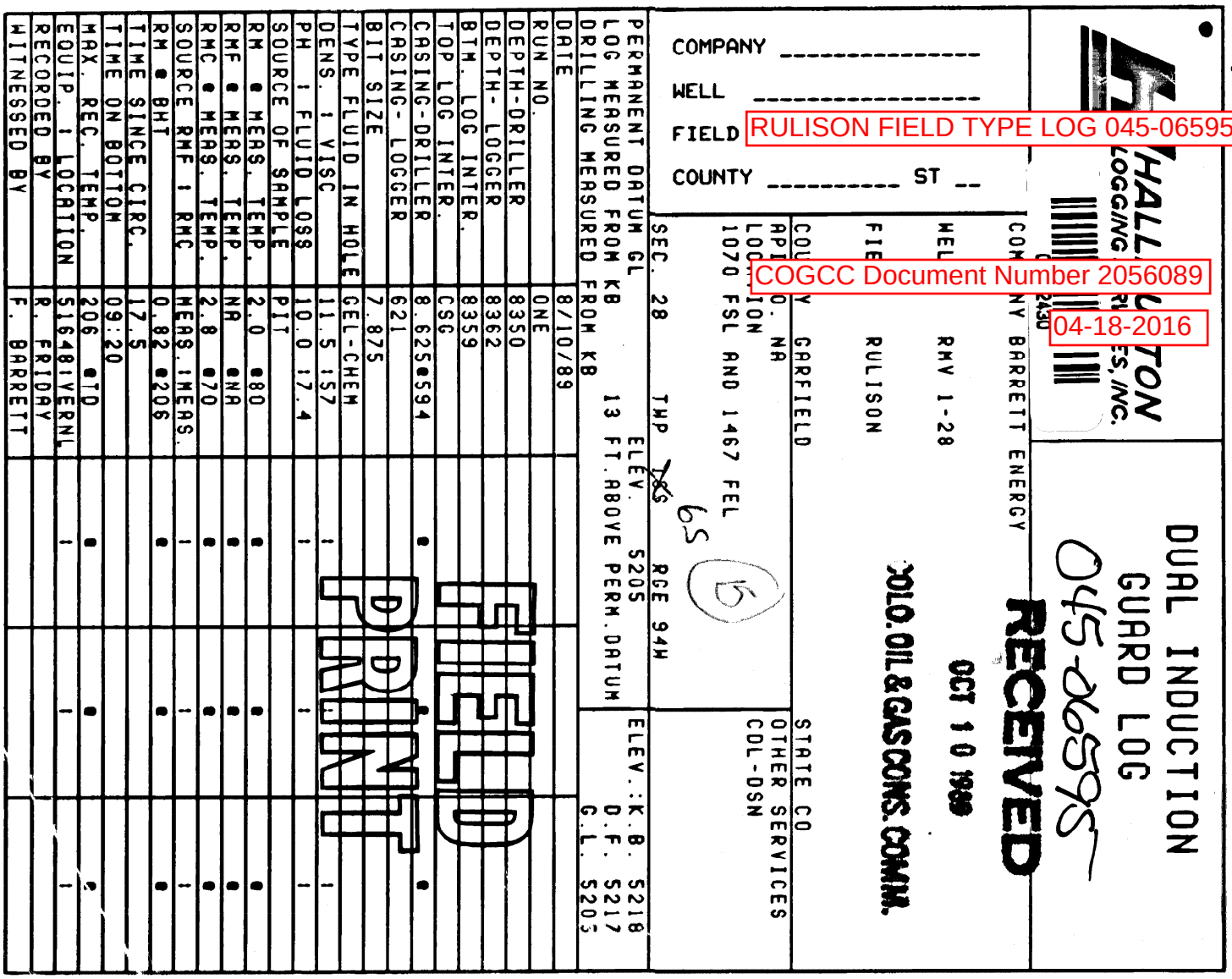
Surface casing shoe plug
Set deeper shoe plug if casing depth < 1,000 feet

Wasatch G plug if productive within one mile

Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 feet); not shown on this figure

Squeeze plug across Ohio Creek and L. Wasatch (top of plug 200'/500' above L. Wasatch)

Plug in casing above Mesaverde Group Completions



Fold Here

Service Ticket No.: 13945	API Serial No.: NA		PGM Version: 2.20 E				
Change in Mud Type or Additional Samples			RESISTIVITY SCALE CHANGES				
Date/Sample No.	/ / :	/ / :	Type Log	Depth	Scale Up Hole	Scale Down Hole	
Depth-Driller							
Type Fluid in Hole							
Dens. : Visc.	:	:					
pH. : Fluid Loss	:	:					
Source of Sample			RESISTIVITY EQUIPMENT DATA				
Rm @ Meas.Temp.	@	@	Run No	Tool Type & No	Pad Type	Tool Pos.	Other
Rmf @ Meas.Temp.	@	@	ONE	DILT #W109486		1.5 S.O.	
Rmc @ Meas.Temp.	@	@		SGRD #W108975		1.5 S.O.	
Source: Rmf:Rmc	:	:					
Rm @ BHT	0.82 @206	@					
Rmf @ BHT	NA @NA	@					
Rmc @ BHT	1.01 @206	@					

EQUIPMENT DATA

GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No.	ONE	Run No.		Run No.	ONE	Run No.	ONE
Serial No.	W108651	Serial No.		Serial No.	W112641	Serial No.	W108798
Model No.	434	Model No.		Model No.	465	Model No.	434
Diameter	3.625	No.of Cent.		Diameter	4.5	Diameter	3.625
Detector Model No.	NA	Spacing		Log Type	G/G	Log Type	N/N
Type	SCINT			Source Type	CS-137	Source Type	AMBE
Length	NA	LSA		Serial No.	SDL-078	Serial No.	DSN-15

Distance To Source	NA	FWDA		Strength	1.5 CI	Strength	19 CI

LOGGING DATA

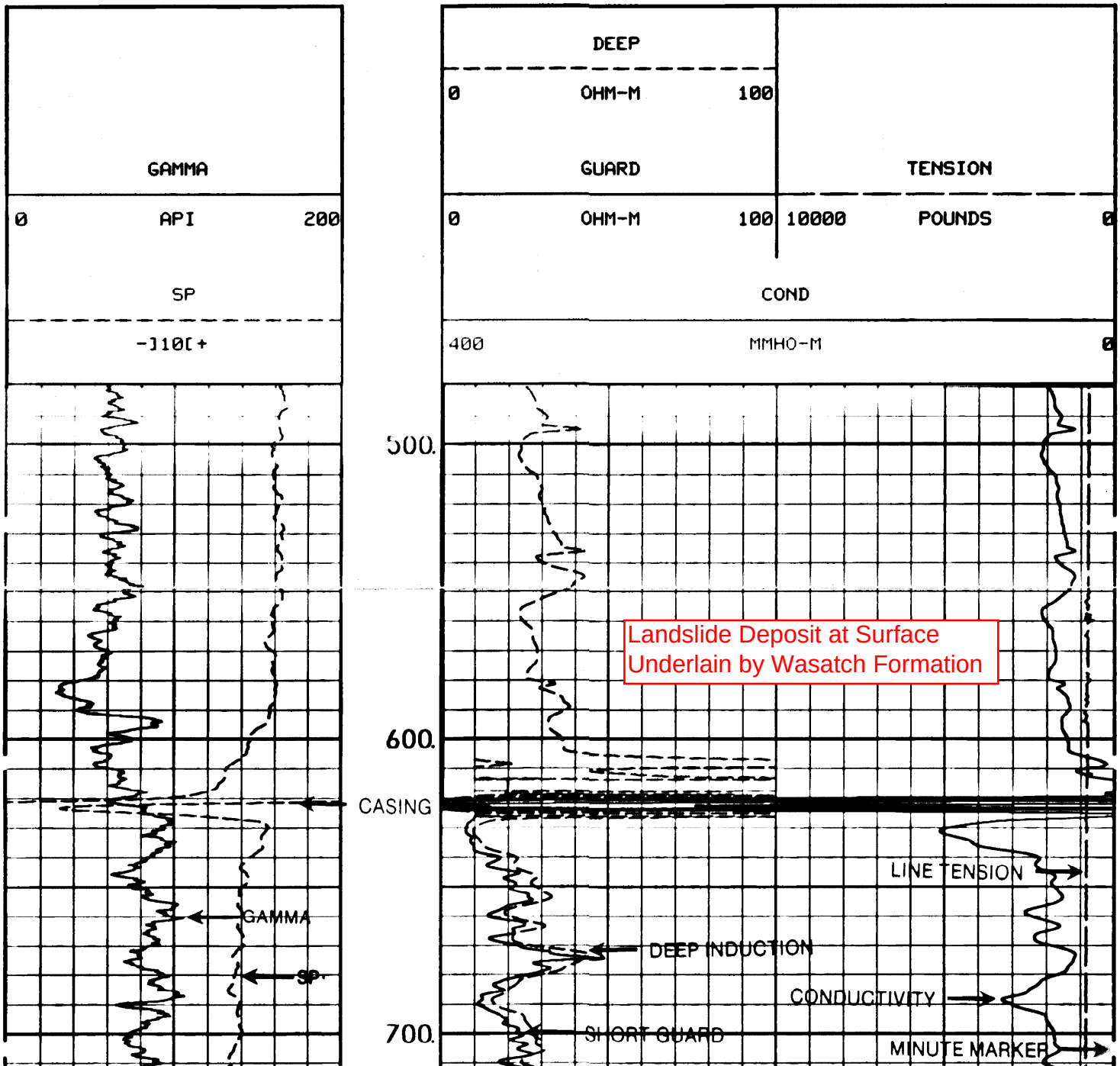
GENERAL				GAMMA		ACOUSTIC			DENSITY			NEUTRON		
Run	Depth		Speed	Scale		Scale			Scale			Scale		
No.	From	To	Ft/Min	L	R	L	R	Matrix	L	R	Matrix	L	R	Matrix
ONE	TD	CSG	60	0	200				30%	-10%	2.68	30%	-10%	SAND

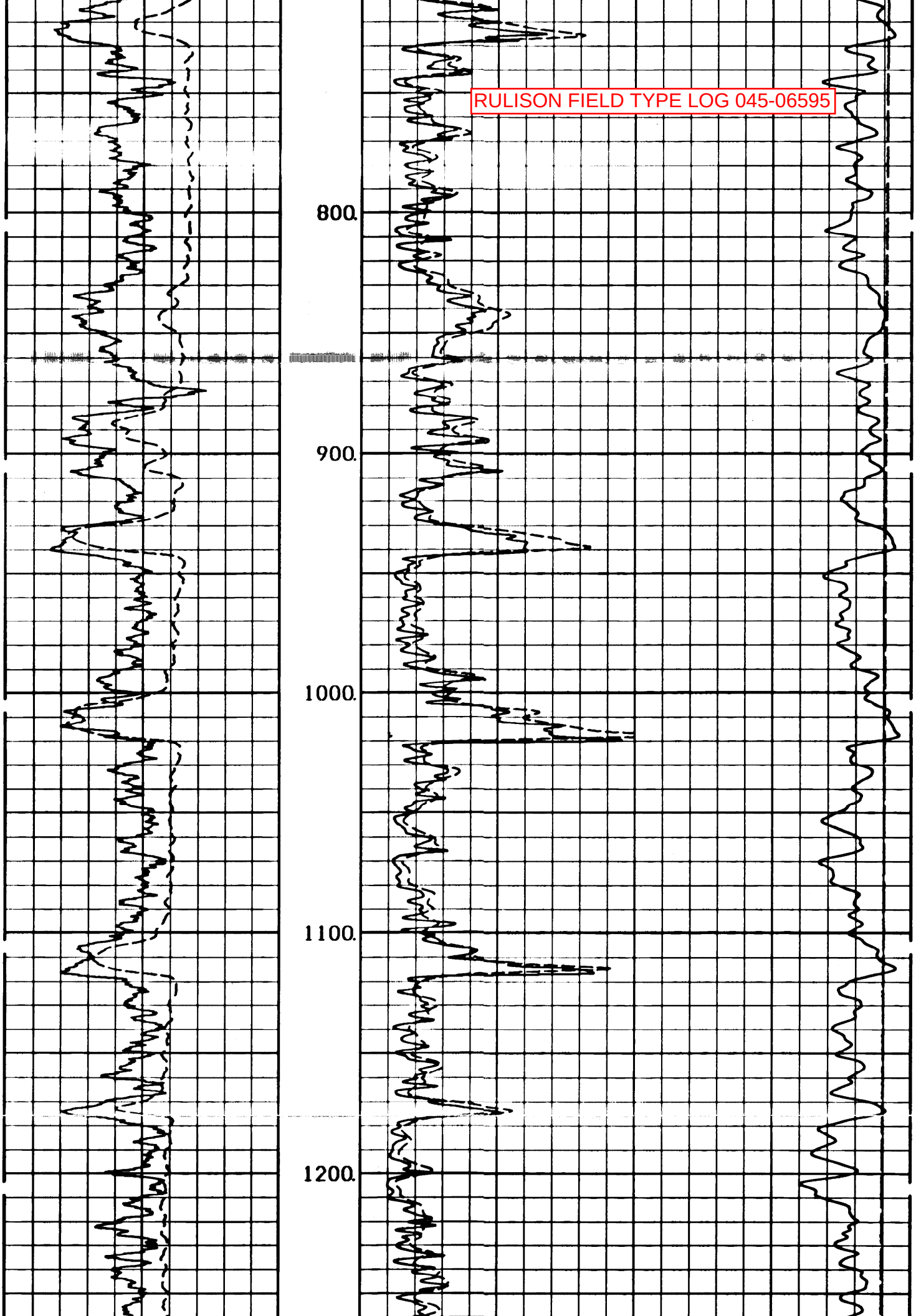
RULISON FIELD TYPE LOG 045-06595

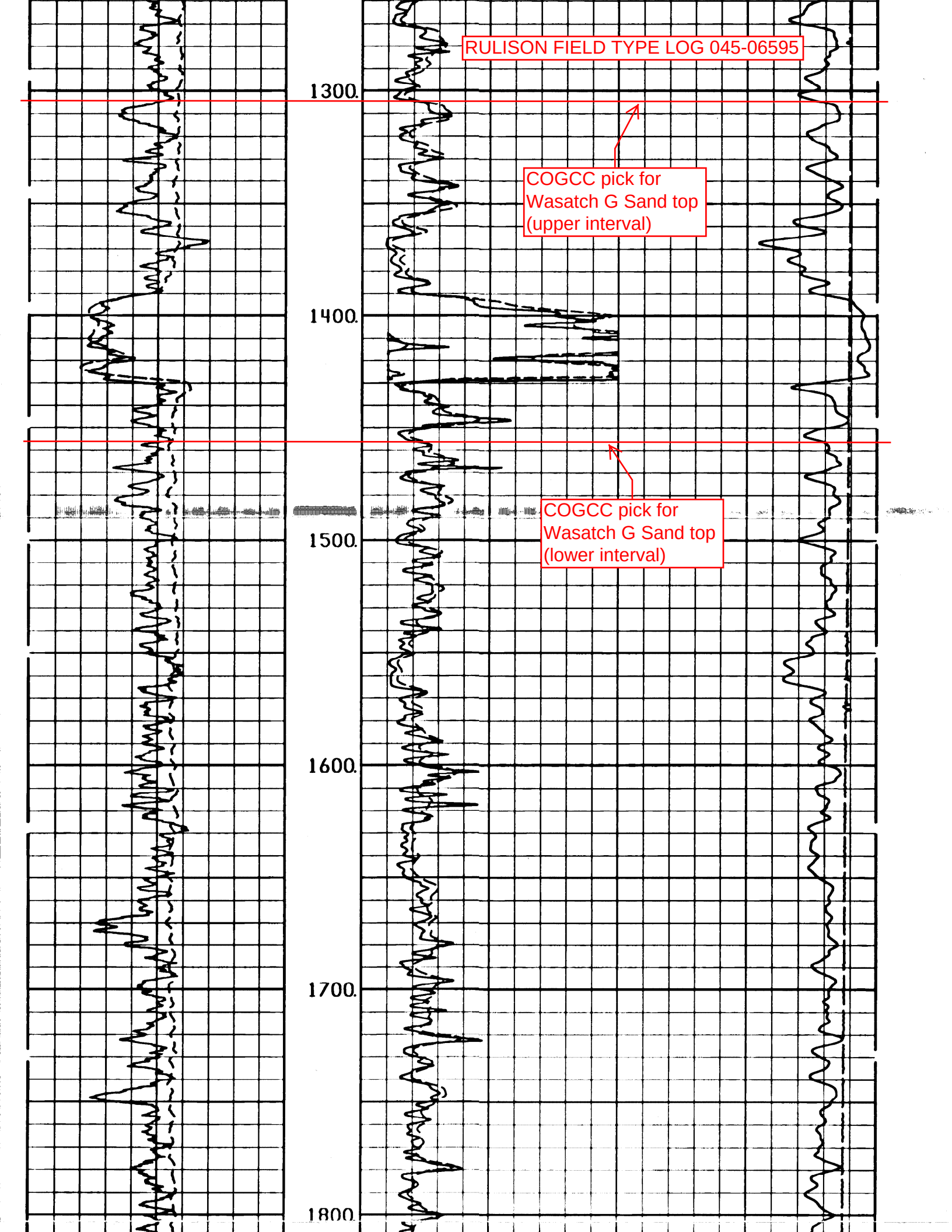
Remarks:

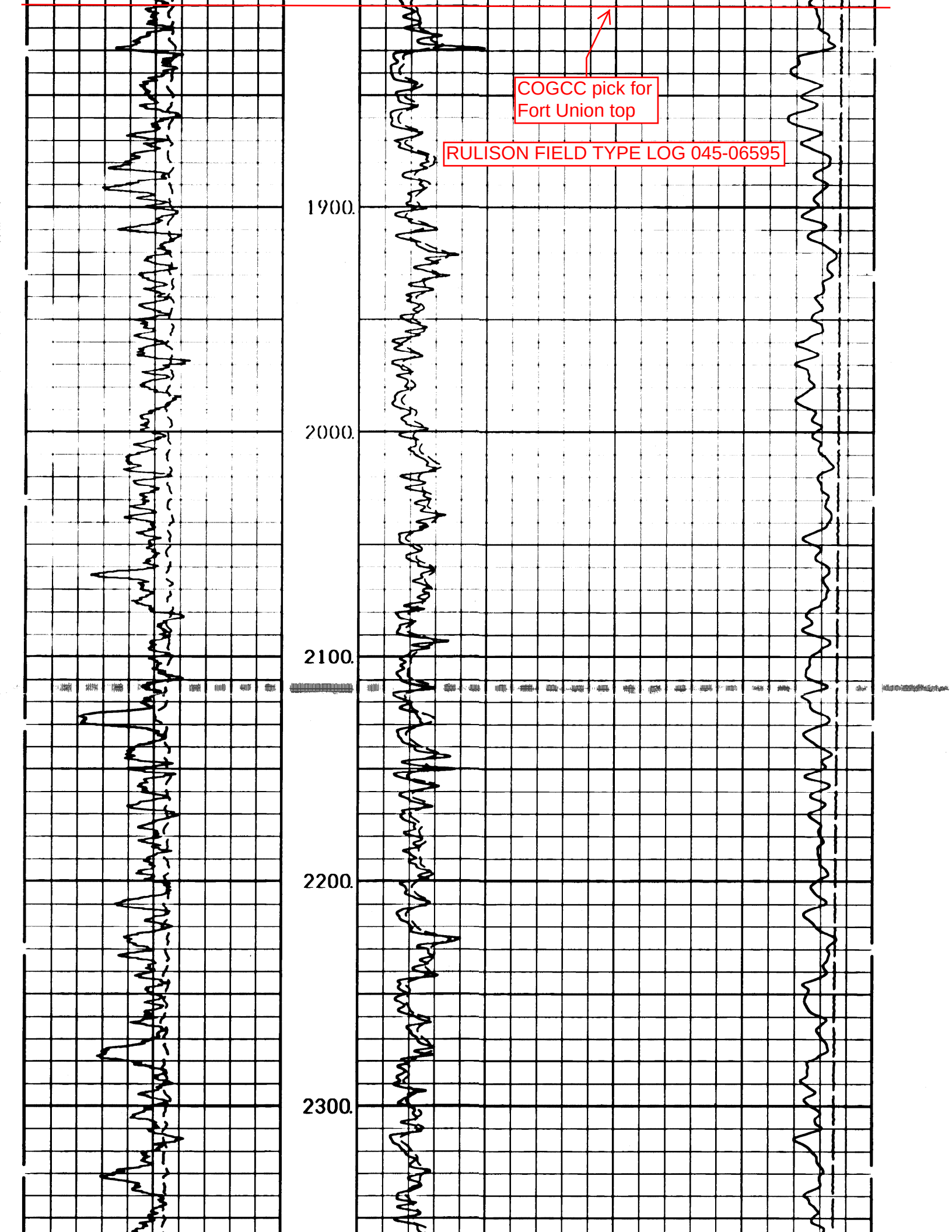
STOPPED 10 HOURS OF CIRCULATION AT 17:00 8-9-89
CDL-DSN RAN FIRST AT CUSTOMER REQUEST
CREW: C. EDMUNDS, M. HATCH RIG: SANDERS NO. 12

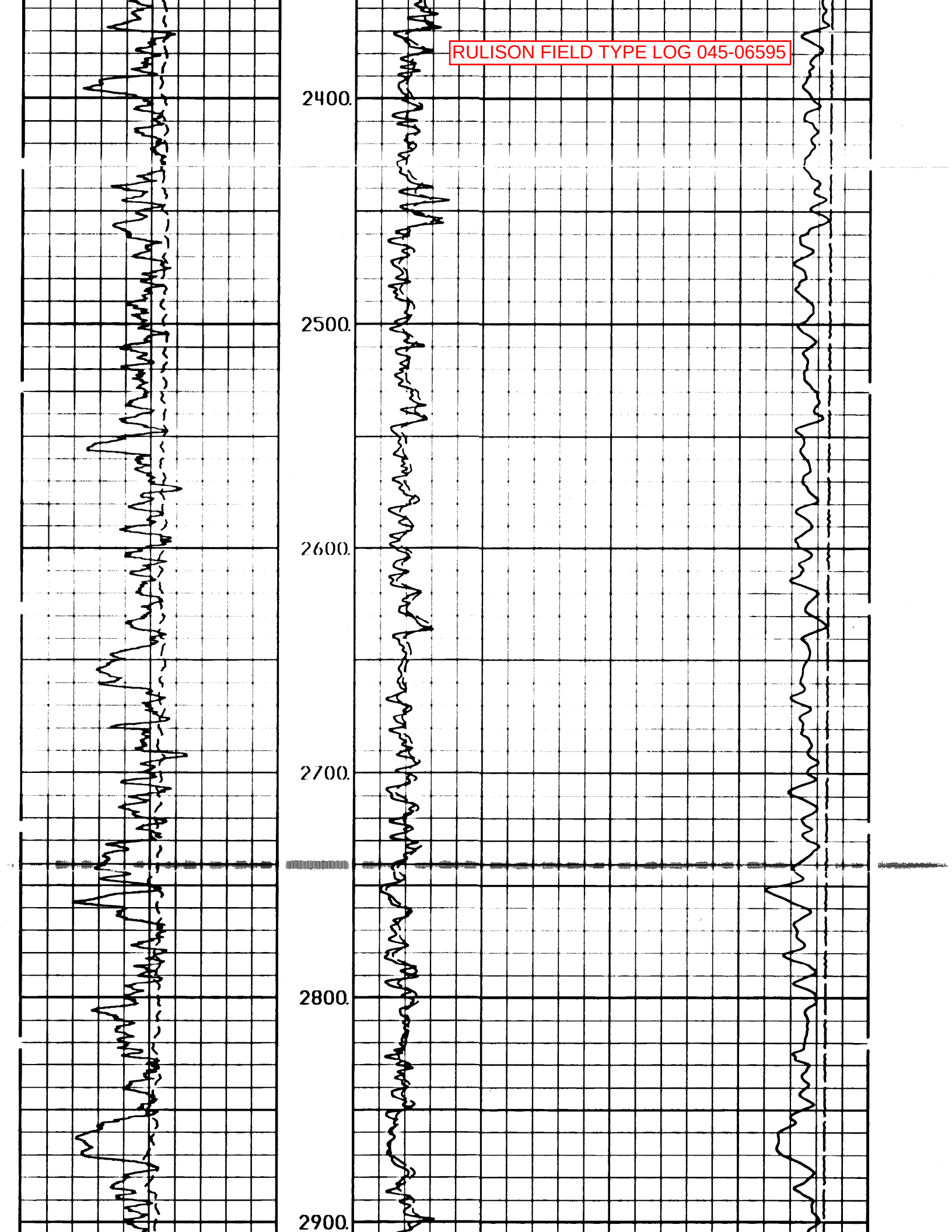
Halliburton Logging Services, Inc. does not guarantee the accuracy of any interpretation of log data, conversion of log data to physical rock parameters or recommendations which may be given by HLS personnel or which may appear on the log or in any other form. Any user of such data, interpretations, conversions or recommendations agrees that HLS is not responsible except where due to gross negligence or willful misconduct, for any loss, damages, or expenses resulting from the use thereof.

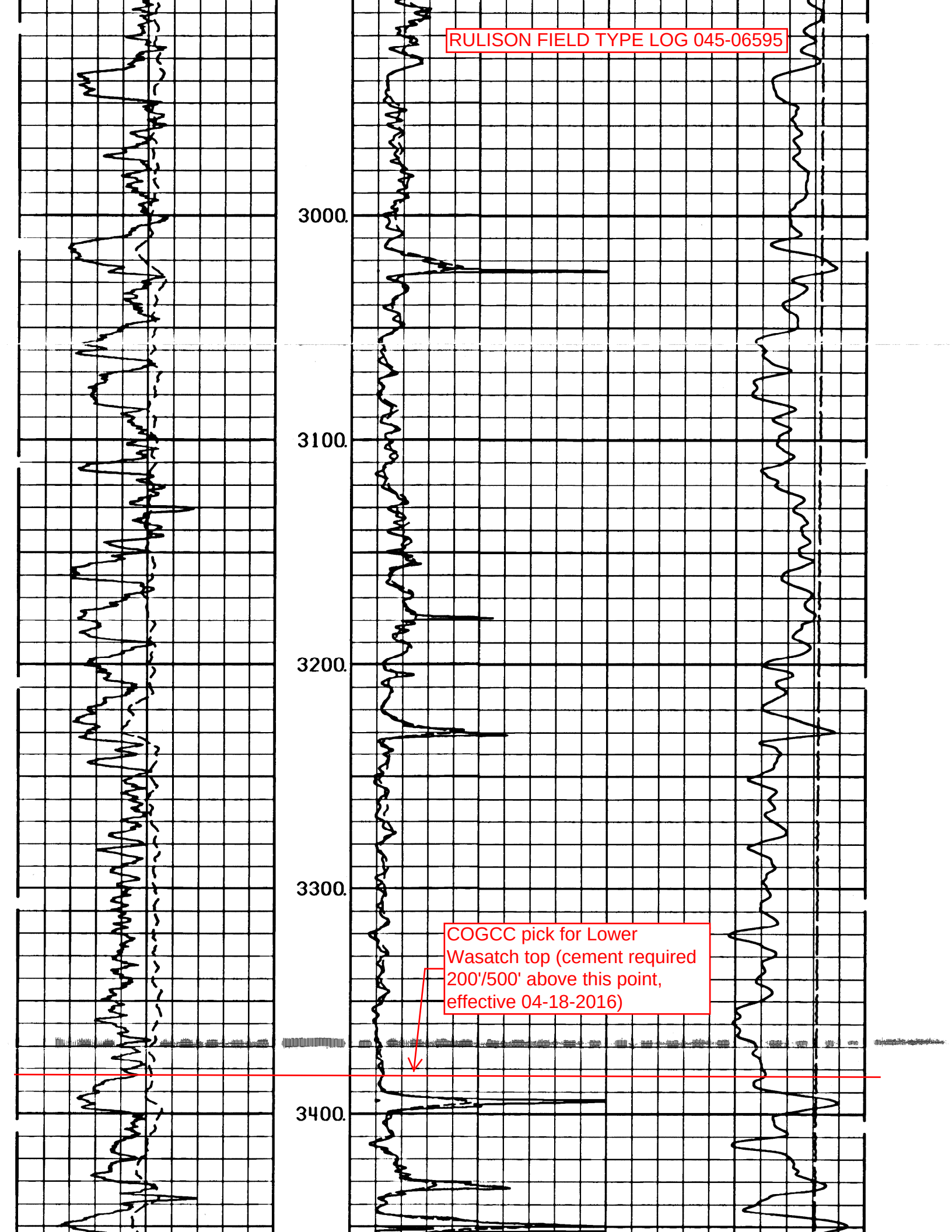


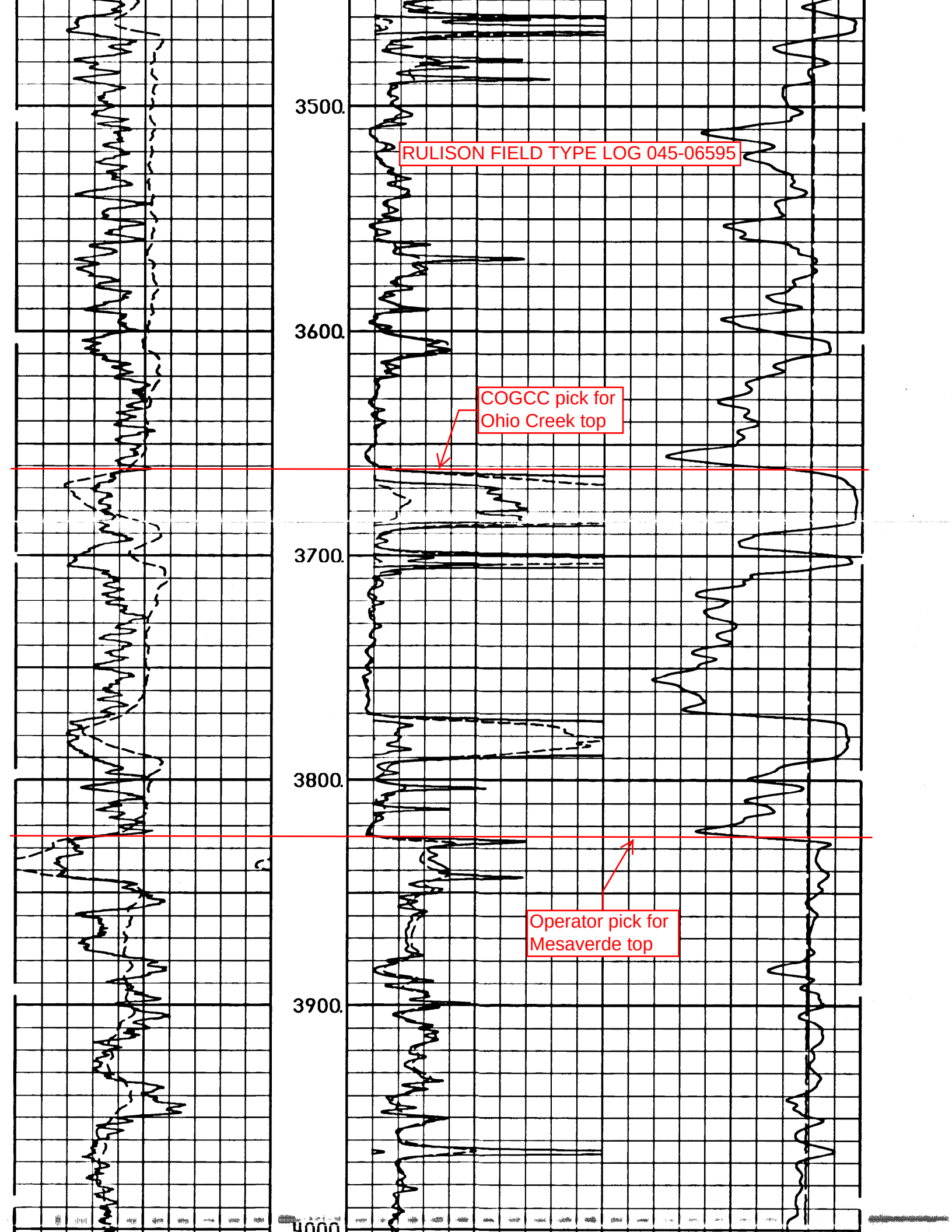

RULISON FIELD TYPE LOG 045-06595
800.
900.
1000.
1100.
1200.

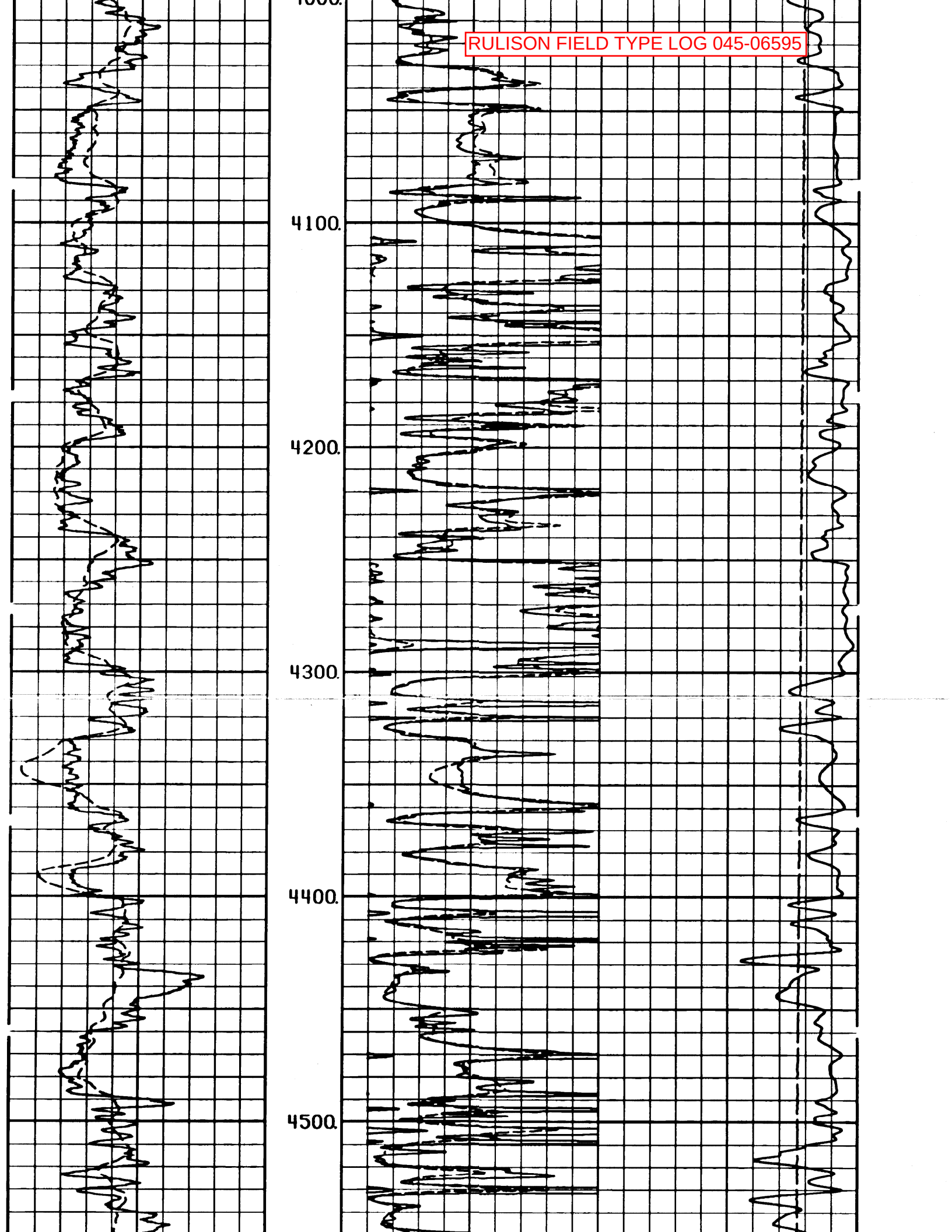

RULISON FIELD TYPE LOG 045-06595
1300.
1400.
1500.
1600.
1700.
1800.
COGCC pick for Wasatch G Sand top (upper interval)
COGCC pick for Wasatch G Sand top (lower interval)

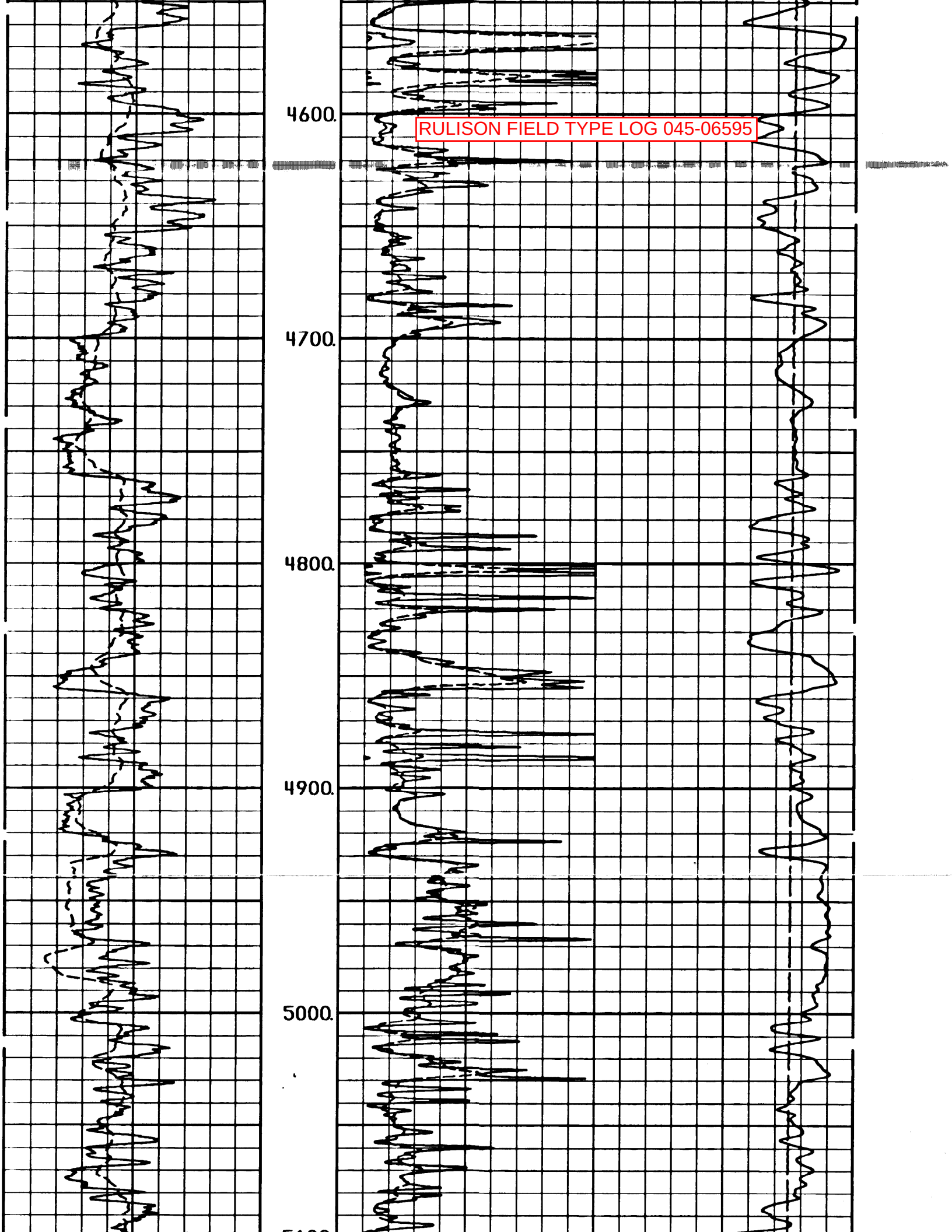

COGCC pick for
Fort Union top
RULISON FIELD TYPE LOG 045-06595
1900.
2000.
2100.
2200.
2300.

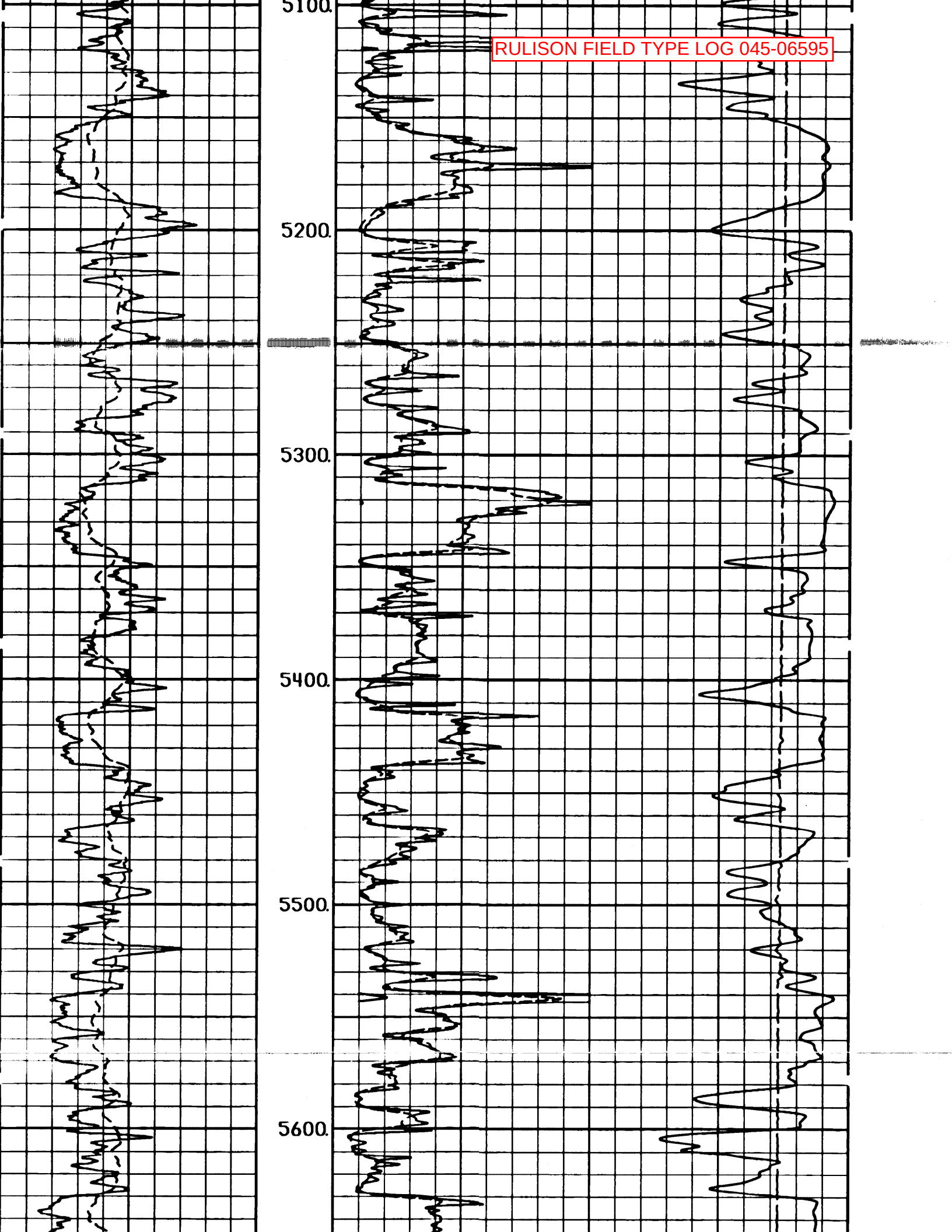

RULISON FIELD TYPE LOG 045-06595
2400.
2500.
2600.
2700.
2800.
2900.

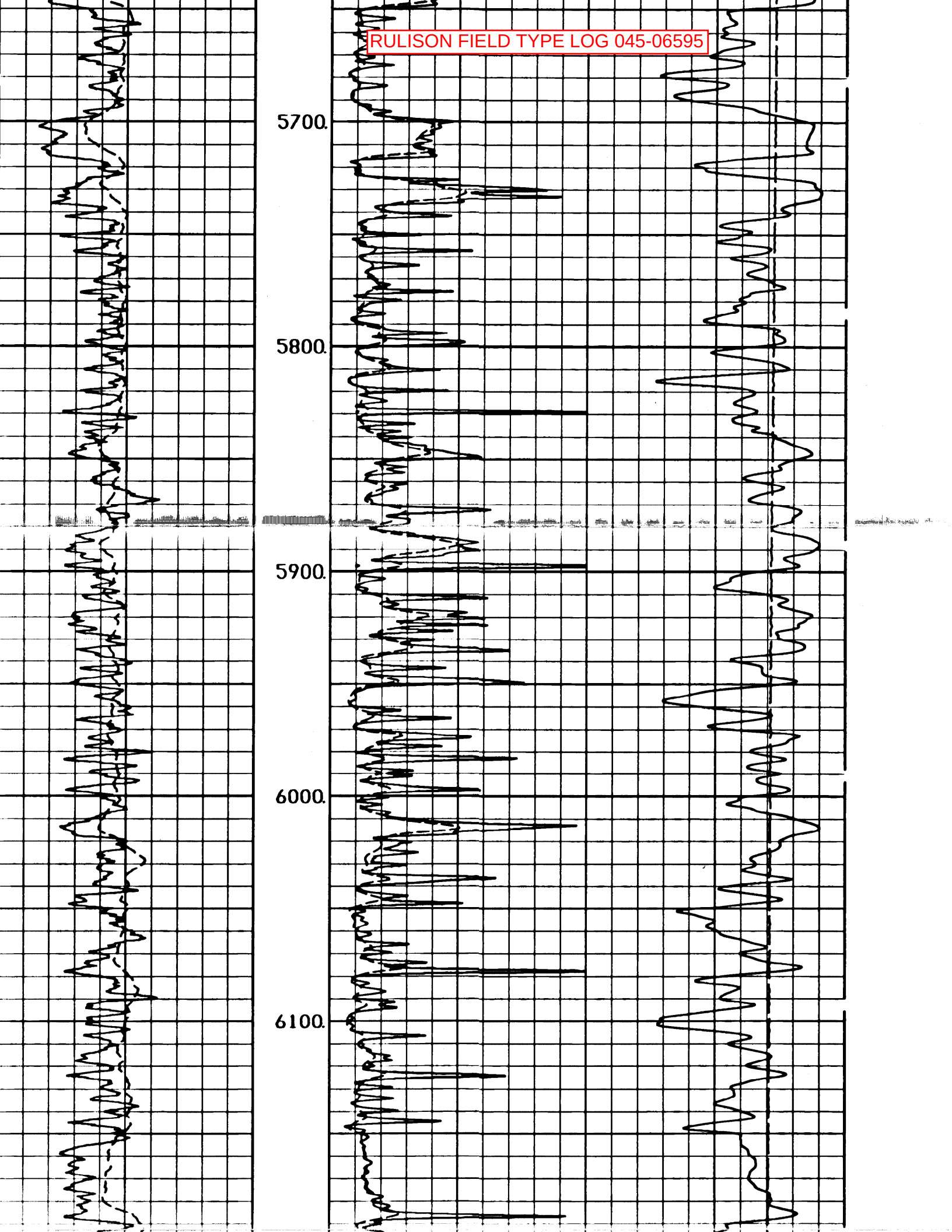

RULISON FIELD TYPE LOG 045-06595
3000.
3100.
3200.
3300.
3400.
COGCC pick for Lower Wasatch top (cement required 200'/500' above this point, effective 04-18-2016)

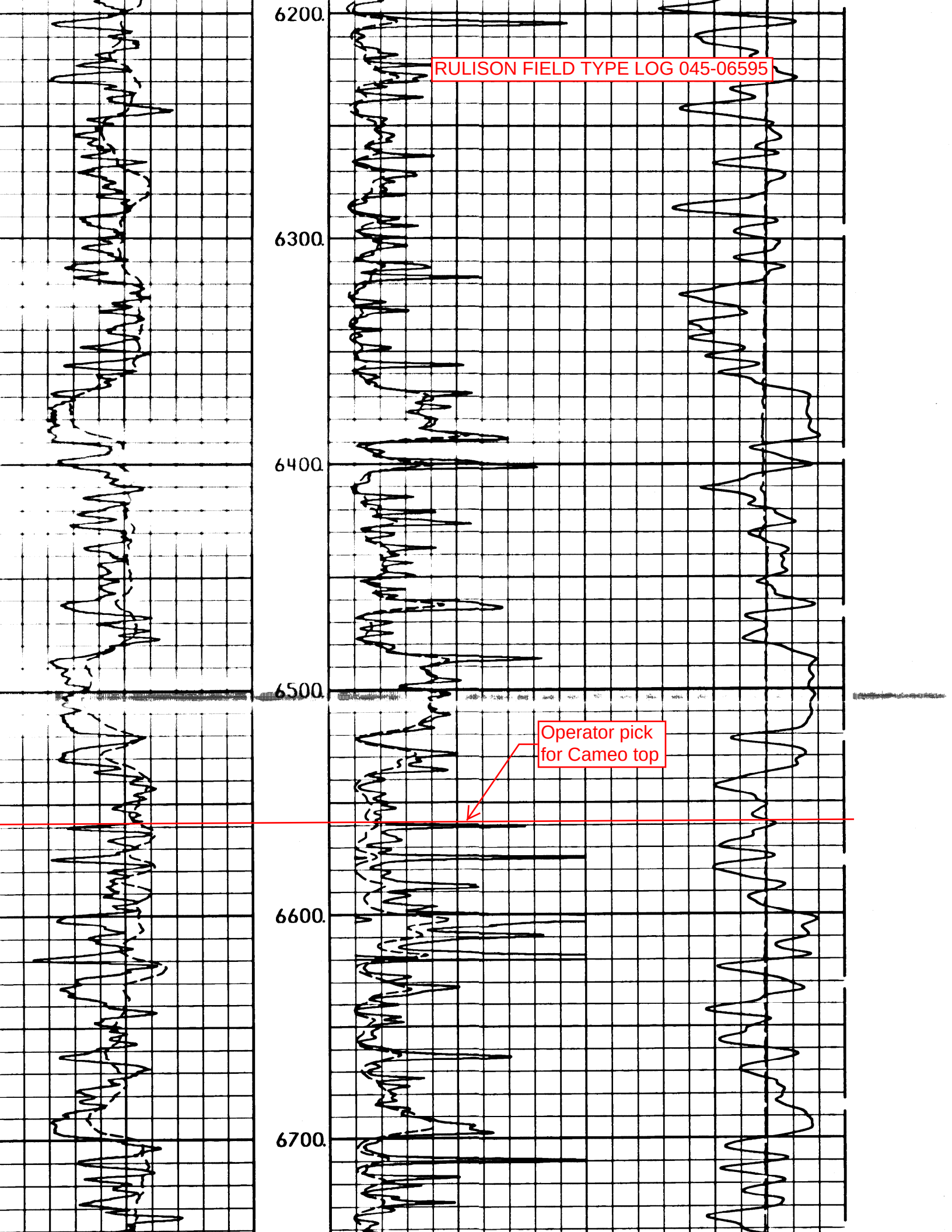

3500.
RULISON FIELD TYPE LOG 045-06595
3600.
COGCC pick for
Ohio Creek top
3700.
3800.
Operator pick for
Mesaverde top
3900.

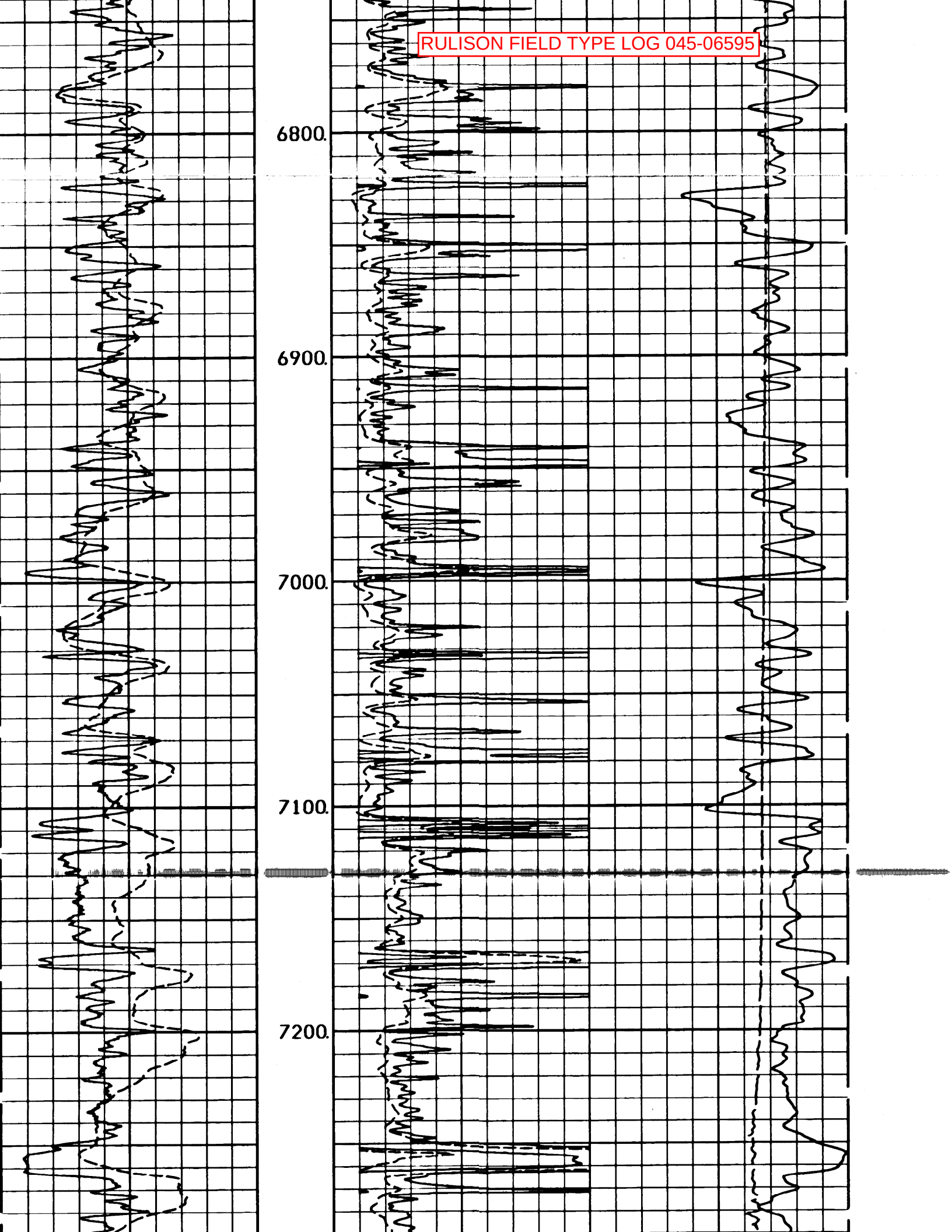

RULISON FIELD TYPE LOG 045-06595
4100.
4200.
4300.
4400.
4500.

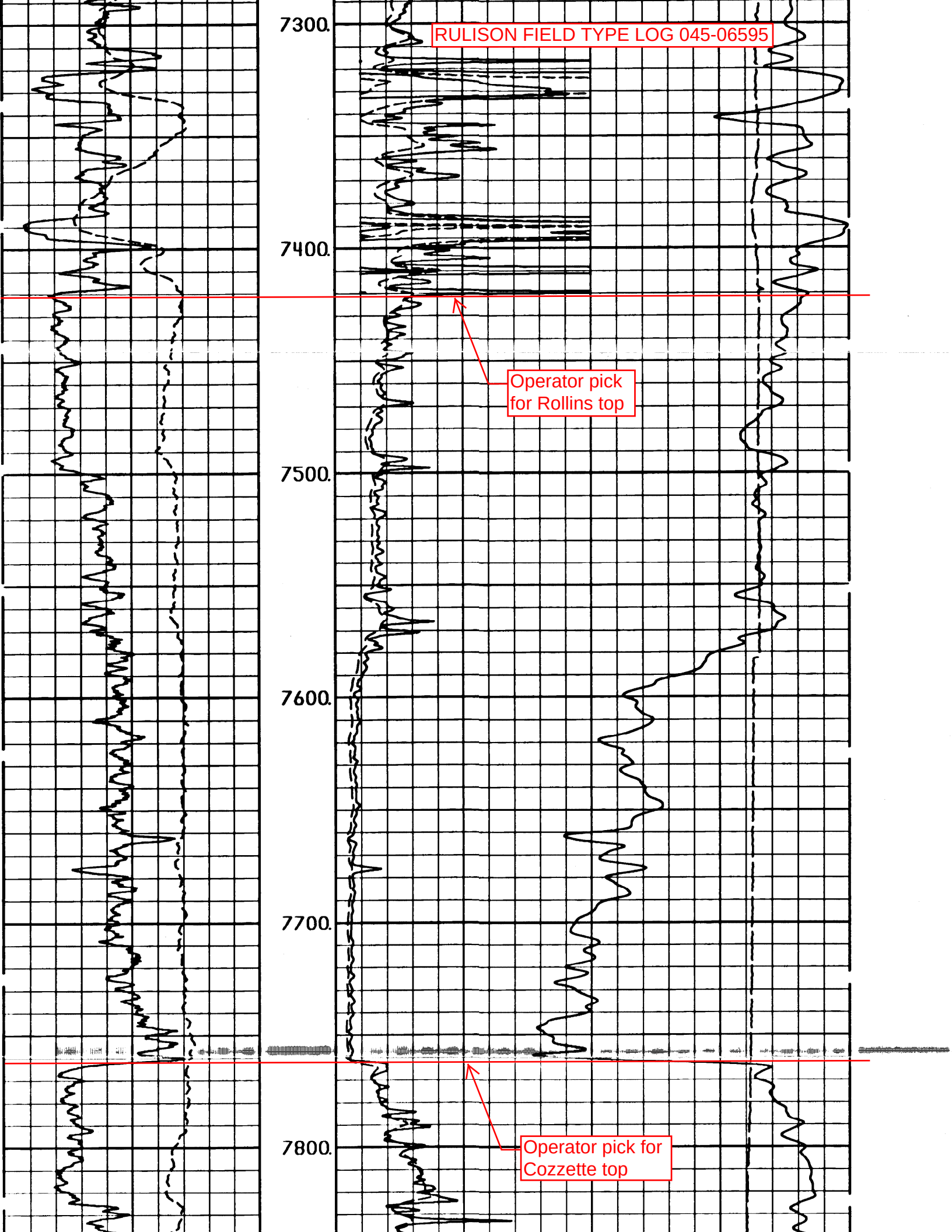

4600.
4700.
4800.
4900.
5000.
RULISON FIELD TYPE LOG 045-06595

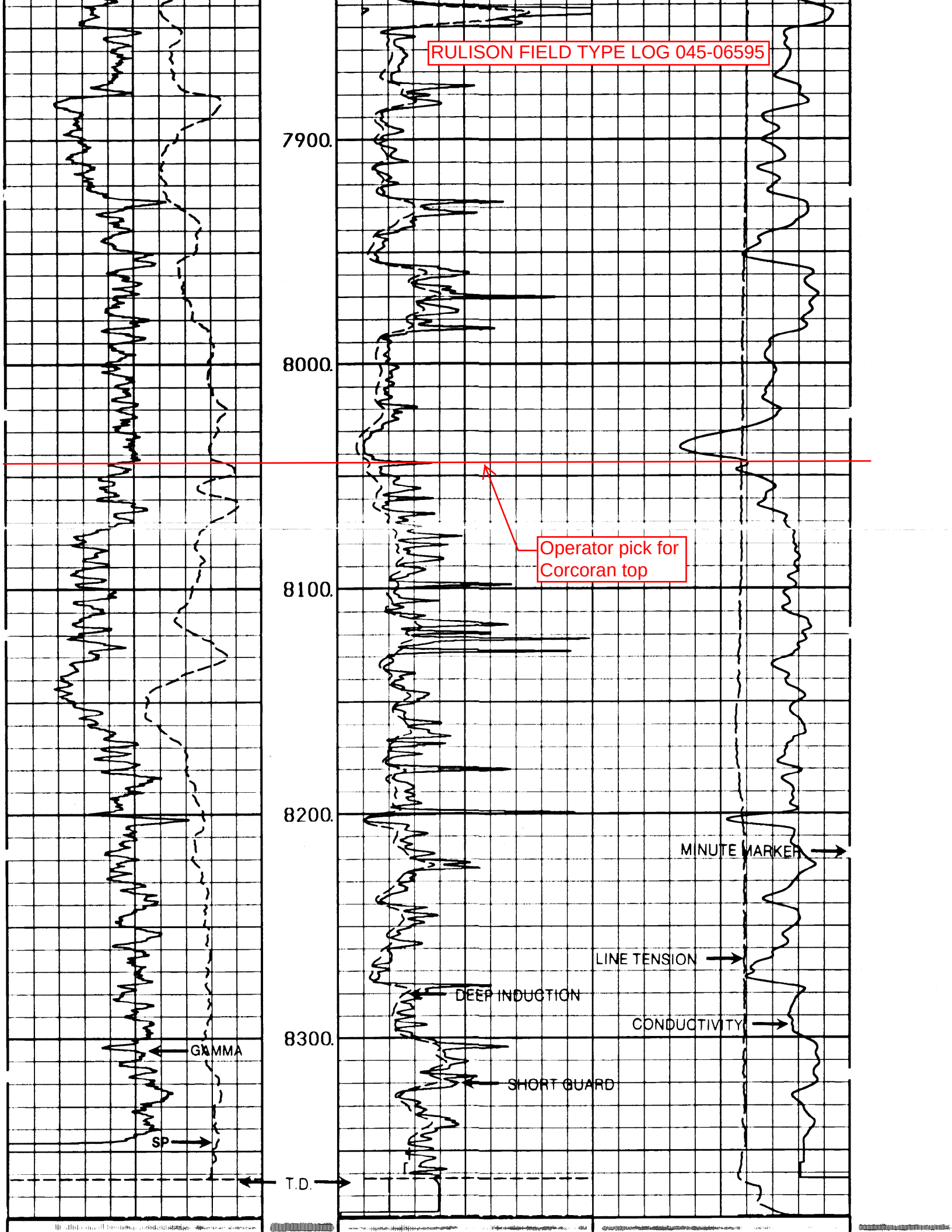

RULISON FIELD TYPE LOG 045-06595
5100.
5200.
5300.
5400.
5500.
5600.

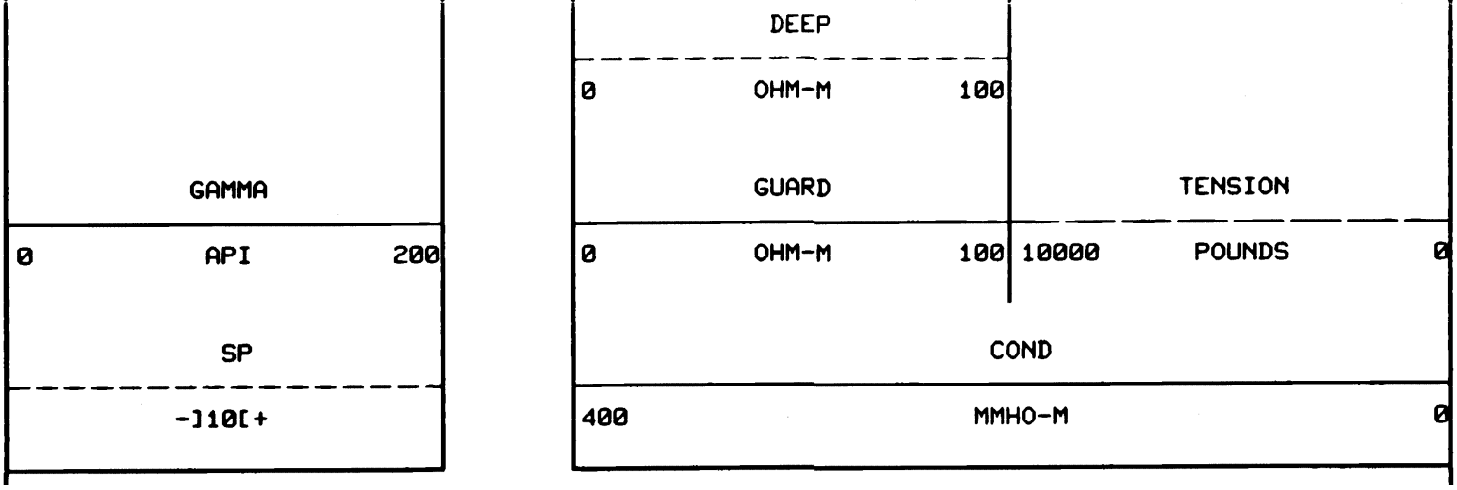

RULISON FIELD TYPE LOG 045-06595
5700.
5800.
5900.
6000.
6100.


RULISON FIELD TYPE LOG 045-06595
6200.
6300.
6400.
6500.
6600.
6700.
Operator pick
for Cameo top

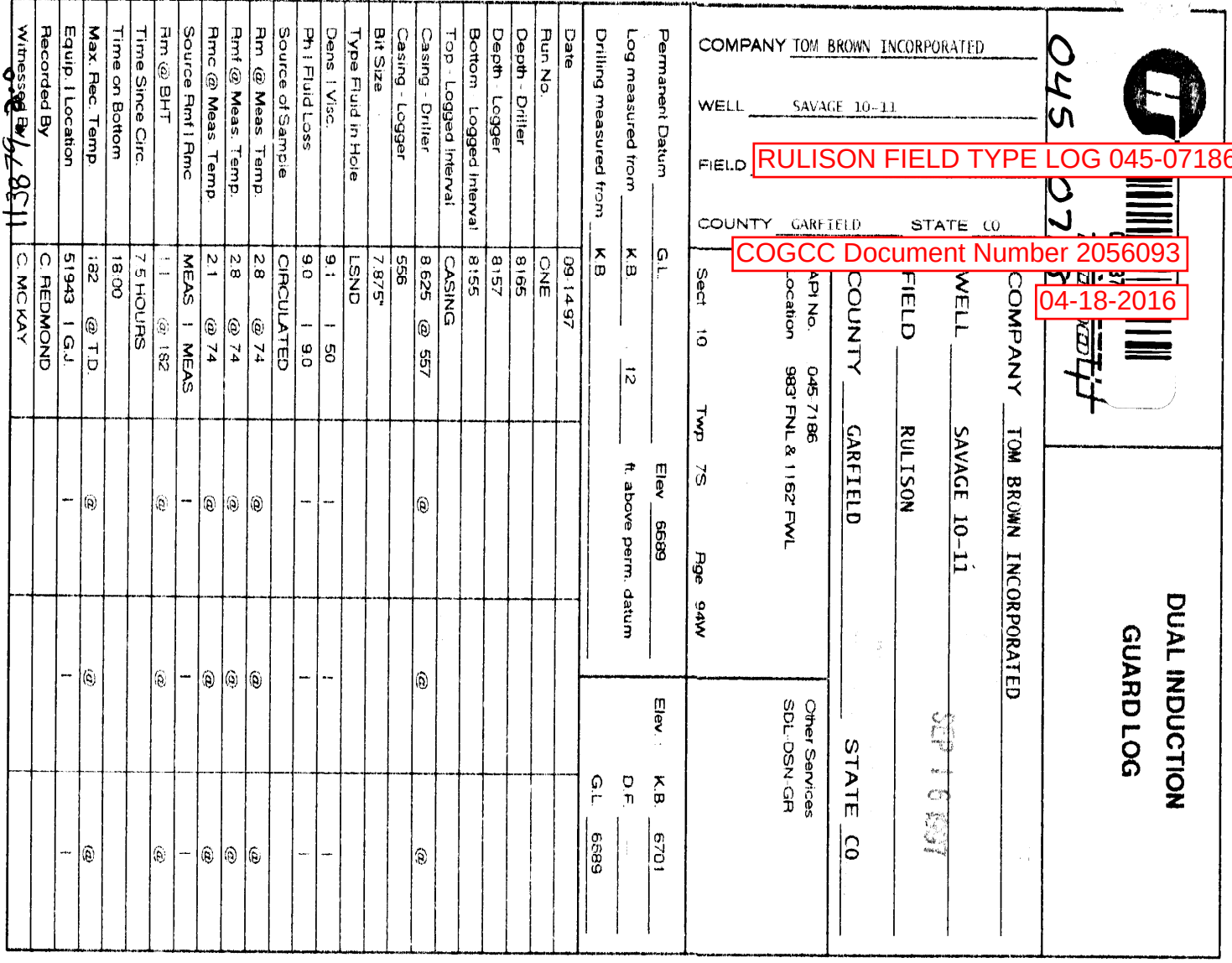

RULISON FIELD TYPE LOG 045-06595
6800.
6900.
7000.
7100.
7200.


RULISON FIELD TYPE LOG 045-06595
7300.
7400.
7500.
7600.
7700.
7800.
Operator pick for Rollins top
Operator pick for Cozzette top


RULISON FIELD TYPE LOG 045-06595
7900.
8000.
8100.
8200.
8300.
Operator pick for Corcoran top
MINUTE MARKER
LINE TENSION
DEEP INDUCTION
CONDUCTIVITY
SHORT GUARD
GAMMA
SP
T.D.



RULISON FIELD TYPE LOG 045-06595



DUAL INDUCTION
GUARD LOG

COMPANY TOM BROWN INCORPORATED
WELL SAVAGE 10-11
FIELD RULISON
COUNTY GARFIELD STATE CO
API No. 045-7186
Location 983' FNL & 1162' FWL
Sect 10 Twp 7S Rge 94W

Other Services
SDL-DSN-GR

Permanent Datum G.L. Elev. 6689
Log measured from K.B. 12 ft. above perm. datum
Drilling measured from K.B.

Date	09-14-97		
Run No.	ONE		
Depth - Driller	8165		
Depth - Logger	8157		
Bottom Logged Interval	8155		
Top Logged Interval	CASING		
Casing - Driller	8.625 @ 557	@	
Casing - Logger	556		
Bit Size	7.875"		
Type Fluid in Hole	LSND		
Dens. / Visc.	9.1 / 50	/	
Ph / Fluid Loss	9.0 / 9.0	/	
Source of Sample	CIRCULATED		
Rm @ Meas. Temp.	2.8 @ 74	@	
Rmf @ Meas. Temp.	2.8 @ 74	@	
Rmc @ Meas. Temp.	2.1 @ 74	@	
Source Rmf / Rmc	MEAS / MEAS	/	
Rm @ BHT	1.1 @ 182	@	
Time Since Circ.	7.5 HOURS		
Time on Bottom	18:00		
Max. Rec. Temp.	182 @ T.D.	@	
Equip. / Location	51943 / G.J.	/	
Recorded By	C. MCKAY		
Witnessed By	C. REDMOND		

Elev.: K.B. 6701 D.F. G.L. 6689

COMPANY TOM BROWN INCORPORATED
WELL SAVAGE 10-11
FIELD RULISON
COUNTY GARFIELD STATE CO

045 07186

RULISON FIELD TYPE LOG 045-07186

COGCC Document Number 2056093

04-18-2016

Fold Here

Service Ticket No. 271244 API Serial No. 045-7186 PGM Version: XL v3.05

CHANGE IN MUD TYPE OR ADDITIONAL SAMPLES

Date / Sample No.	/	/
Depth - Driller		
Type Fluid in Hole		
Dens. / Visc.	/	/
Ph / Fluid Loss	/	/
Source of Sample		
Rm @ Meas. Temp.	@	@
Rmf @ Meas. Temp.	@	@
Rmc @ Meas. Temp.	@	@
Source Rmf / Rmc	/	/
Rm @ BHT	1.1 @ 182	@
Rmf @ BHT	1.1 @ 182	@
Rmc @ BHT	0.9 @ 182	@

RESISTIVITY SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

RESISTIVITY EQUIPMENT DATA

Run No.	Tool Type & No.	Pad Type	Tool Pos.	Other
ONE	DILT #109481	NA	1.5" SO	
ONE	SGRD #108972	NA	1.5" SO	

EQUIPMENT DATA

GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No.	ONE	Run No.		Run No.	ONE	Run No.	ONE
Serial No.	108631	Serial No.		Serial No.	B5022	Serial No.	108736
Model No.	NGRT-A	Model No.		Model No.	SDLT-B	Model No.	DSN II
Diameter	3.625"	No. of Cent.		Diameter	4.5"	Diameter	3.625"
Detector Model No.	NA	Spacing		Log Type	GAM-GAM	Log Type	THERMAL
Type	SCINT			Source Type	CS-137	Source Type	AM241BE
Length	4"	LSA [Y / N]		Serial No.	2189	Serial No.	DSN-80
Distance to Source	12"	FWDA [Y / N]		Strength	1.5 CI	Strength	19 CI

LOGGING DATA

GENERAL	GAMMA	ACOUSTIC	DENSITY	NEUTRON

Run	Depth		Speed	Scale		Scale			Scale			Scale		
No.	From	To	Ft / Min	L	R	L	R	Matrix	L	R	Matrix	L	R	Matrix
ONE	TD	CASIN	REC	0	150				30	-10	2.68	30	-10	SAND
					GAPI						GM/CC			

RULISON FIELD TYPE LOG 045-07186

Remarks:

DIL-SDL-DSN-GR RAN IN COMBINATION.
AHV CALCULATED USING 5.5" CASING.

CREW: E. ROBLES, O. GARCIA RIG: CAZA 59

THANK YOU FOR CHOOSING H.E.S. GRAND JUNCTION.

HALLIBURTON DOES NOT GUARANTEE THE ACCURACY OF ANY INTERPRETATION OF THE LOG DATA, CONVERSION OF LOG DATA TO PHYSICAL ROCK PARAMETERS OR RECOMMENDATIONS WHICH MAY BE GIVEN BY HALLIBURTON PERSONNEL OR WHICH APPEAR ON THE LOG OR IN ANY OTHER FORM. ANY USER OF SUCH DATA, INTERPRETATIONS, CONVERSIONS, OR RECOMMENDATIONS AGREES THAT HALLIBURTON IS NOT RESPONSIBLE EXCEPT WHERE DUE TO GROSS NEGLIGENCE OR WILLFUL MISCONDUCT, FOR ANY LOSS, DAMAGES, OR EXPENSES RESULTING FROM THE USE THEREOF.

HALLIBURTON

Current EXCELL-2000 Parameter Values
Depth: 0.000
Date: 14-Sep-1997 15:24

Mnemonic	Tool	Parameter Description	Value	Units
PERF	DITSHD	PERFORATED INTERVAL	NO	
GR_OK	GAMMA	DO GAMMA CALCULATIONS?	YES	
CASED	SHARED	CASED HOLE?	NO	
CASEOD	SHARED	CASING DIAMETER (OD)	5.5	Inches
MUDWT	SHARED	BOREHOLE FLUID WEIGHT	9.1	Pounds/Gal.
GRSO	GAMMA	GAMMA RAY STANDOFF	0.	Inches
BS	SHARED	BIT SIZE	7.875	Inches
DSN_OK	DSN_II	DO DSN II CALCULATIONS?	YES	
DRILL	DSN_II	TPL - NEUTRON IN SLEEVE?	NO	
BADHOL	DSN_II	DSN BAD HOLE CORRECTION	NO	
NLITH	DSN_II	NEUTRON LITHOLOGY	SAND	
DSNSO	DSN_II	DSN STANDOFF	0.	Inches
DSNTMP	DSN_II	DSN II TEMPERATURE CORRECTION	NONE	
DSNPRS	DSN_II	DSN II PRESSURE CORRECTION	NONE	
SDL_OK	SDL	DO SDL CALCULATIONS?	YES	
BARITE	SDL	ANY BARITE IN MUD?	NO	
AIR	SDL	AIR FILLED BOREHOLE	NO	
RHOFLU	SHARED	FLUID DENSITY	1.	G/CC
RHOMAT	SDL	MATRIX DENSITY	2.68	Grams/CC
CAL_OK	CALSDL	DO CALIPER CALCULATIONS?	YES	
AHVOK	CALSDL	DO ANNULAR VOLUME CALCULATION?	YES	
FACTOK	FACMAN	DO FACT CALCULATIONS?	YES	
AHVOK	FACMAN	DO ANNULAR VOLUME CALCULATION?	YES	
DI_OK	DIND	DO DUAL INDUCTION CALCULATION?	YES	
SG_OK	SGRD	DO SHORT GUARD CALCULATIONS?	YES	
XPHLOC	XP_RWA	CROSSPLOT SELECTION FOR XPHI	XPLT	
ARCHA	XP_RWA	ARCHIE A	0.62	
ARCHM	XP_RWA	ARCHIE M	2.15	
FSEL	XP_RWA	POROSITY SELECTION FOR F	XPOR	

MAIN LOG 2"=100'

0 113879.2.1

HALLIBURTON
EXCELL

Version No: 3.05 ! hc:2.1
Data File: 0914_1513_s2100.3.dls
Control File: /field_data/data2/2INDIL.spc

Top Depth: 529.50
Bottom Depth: 8170.00

Raster File: 0914_1513_S2100.2INDIL

Plot Time: 09-14-97 19:46:27

Database Time: 09-14-97 17:53:11

GAMMA RAY	AHV	DEEP RES	DEEP COND
0 API COUNTS 150	FT3	0 OHMM 100	500 MMHO 0
CALIPER	BHV	AMP SGRD	
4 INCHES 14	FT3	0 OHMM 20	
SP	1:600	SH GUARD R	
20 MV 120	Ft	0 OHMM 100	

RULISON FIELD TYPE LOG 045-07186

Landslide Deposit at Surface
Underlain by Wasatch Formation

<CASING>

600

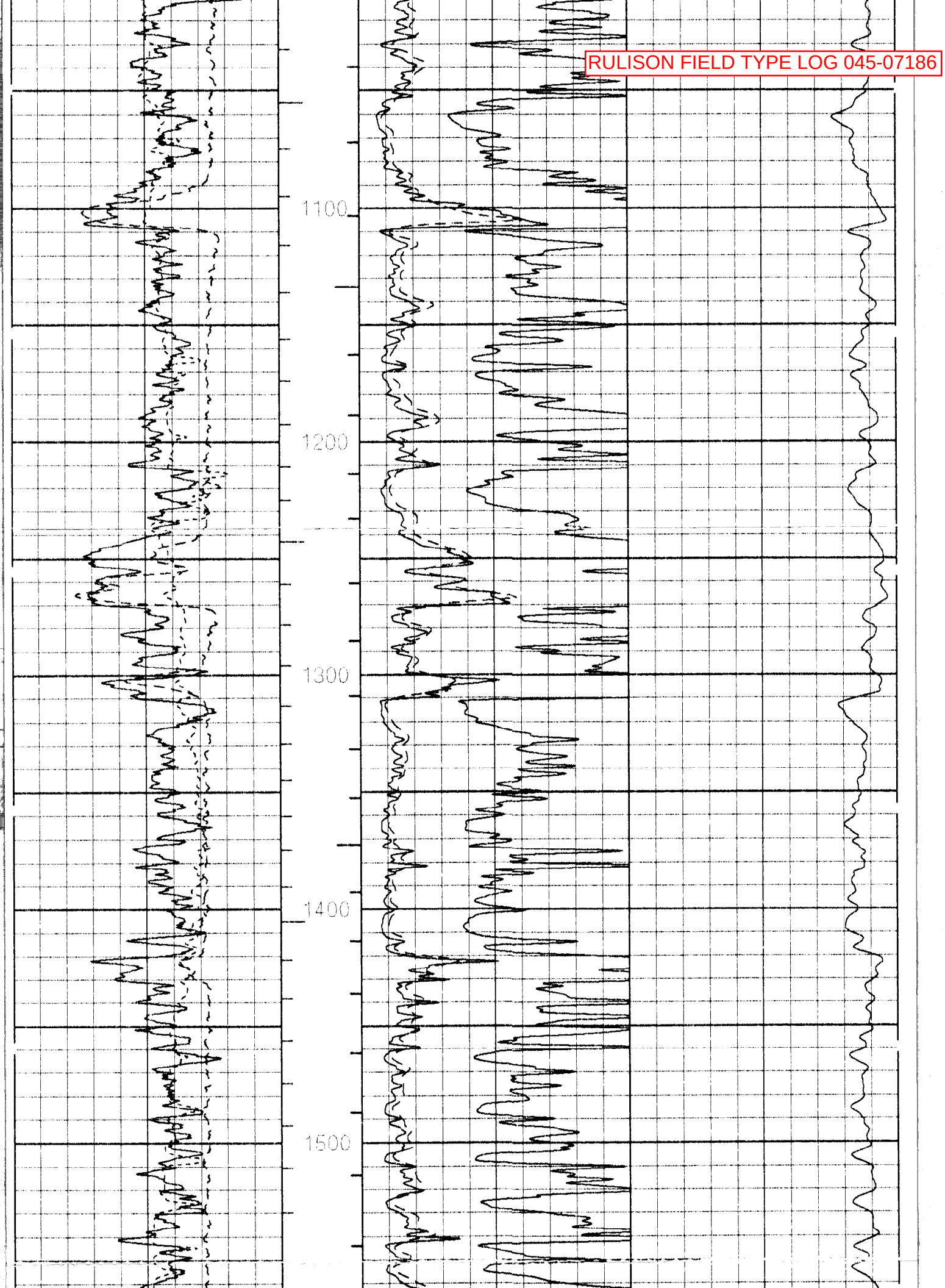
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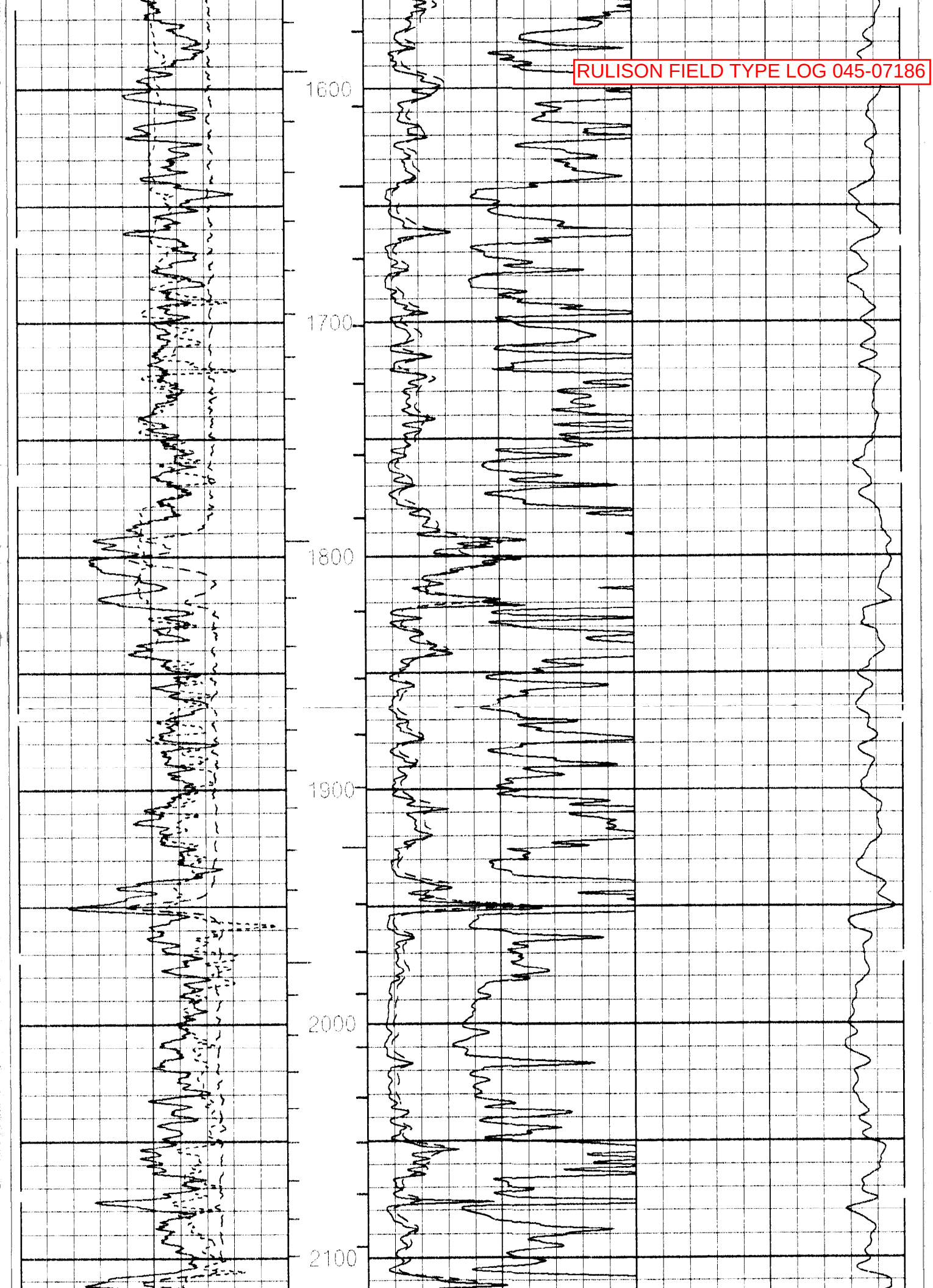
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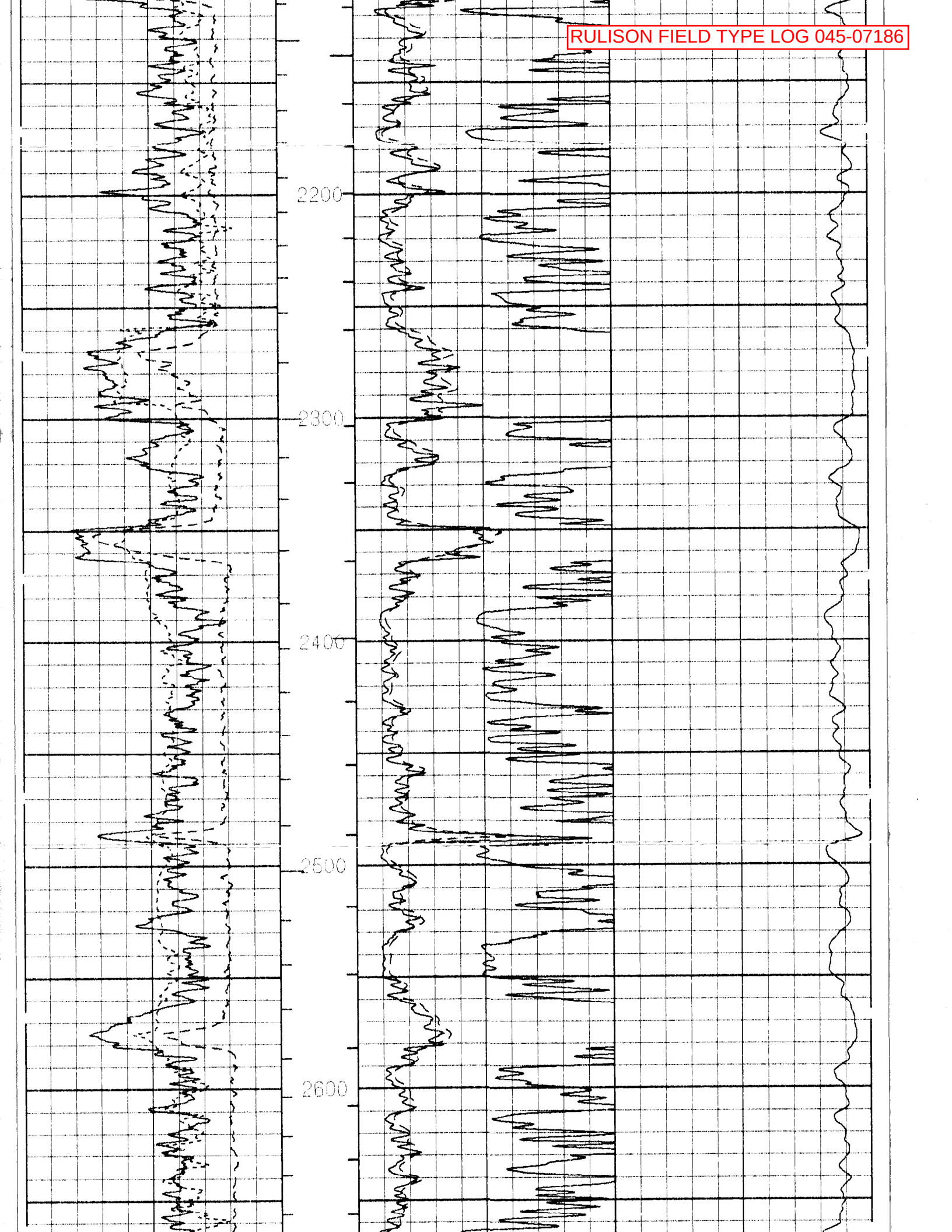
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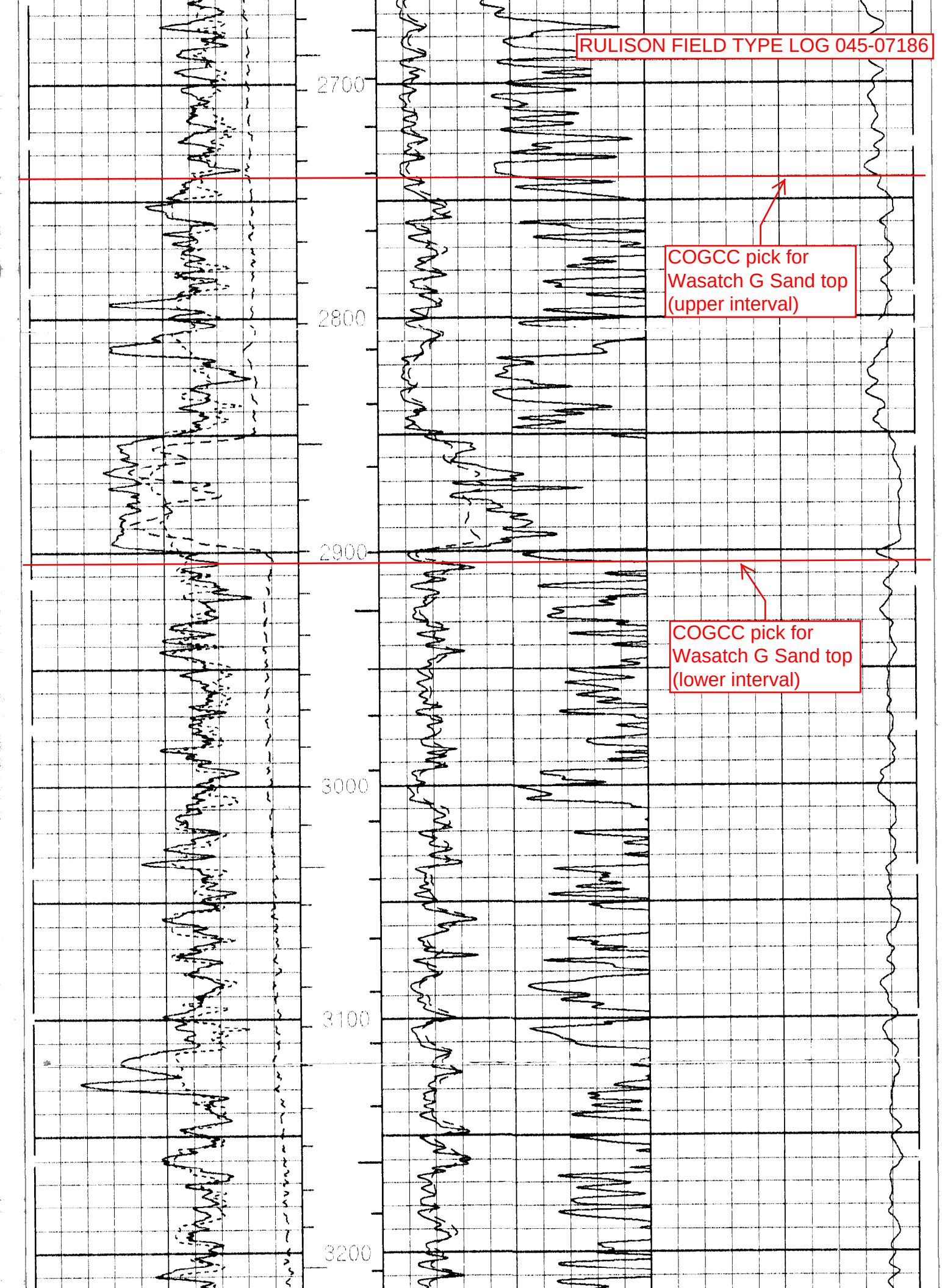
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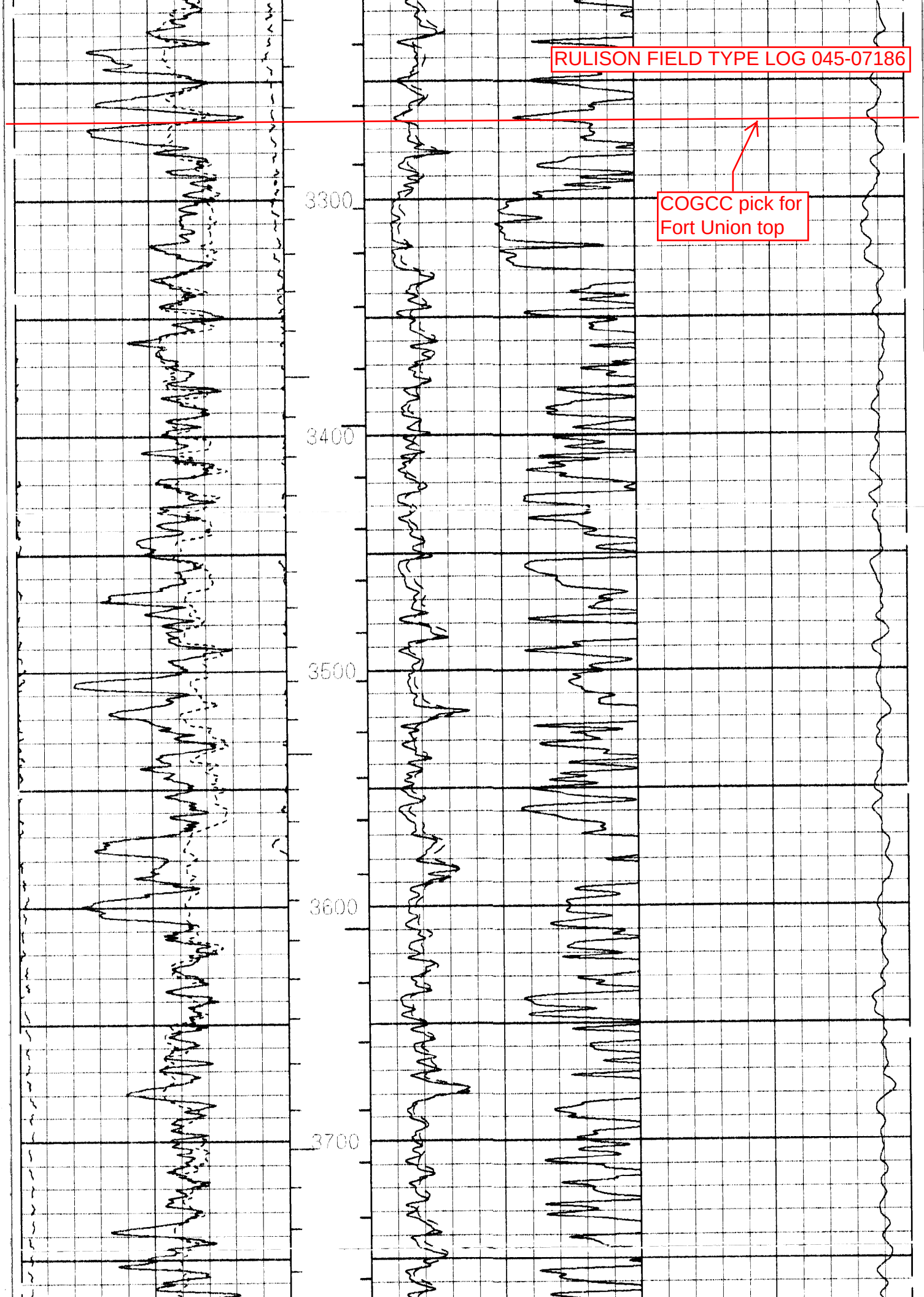
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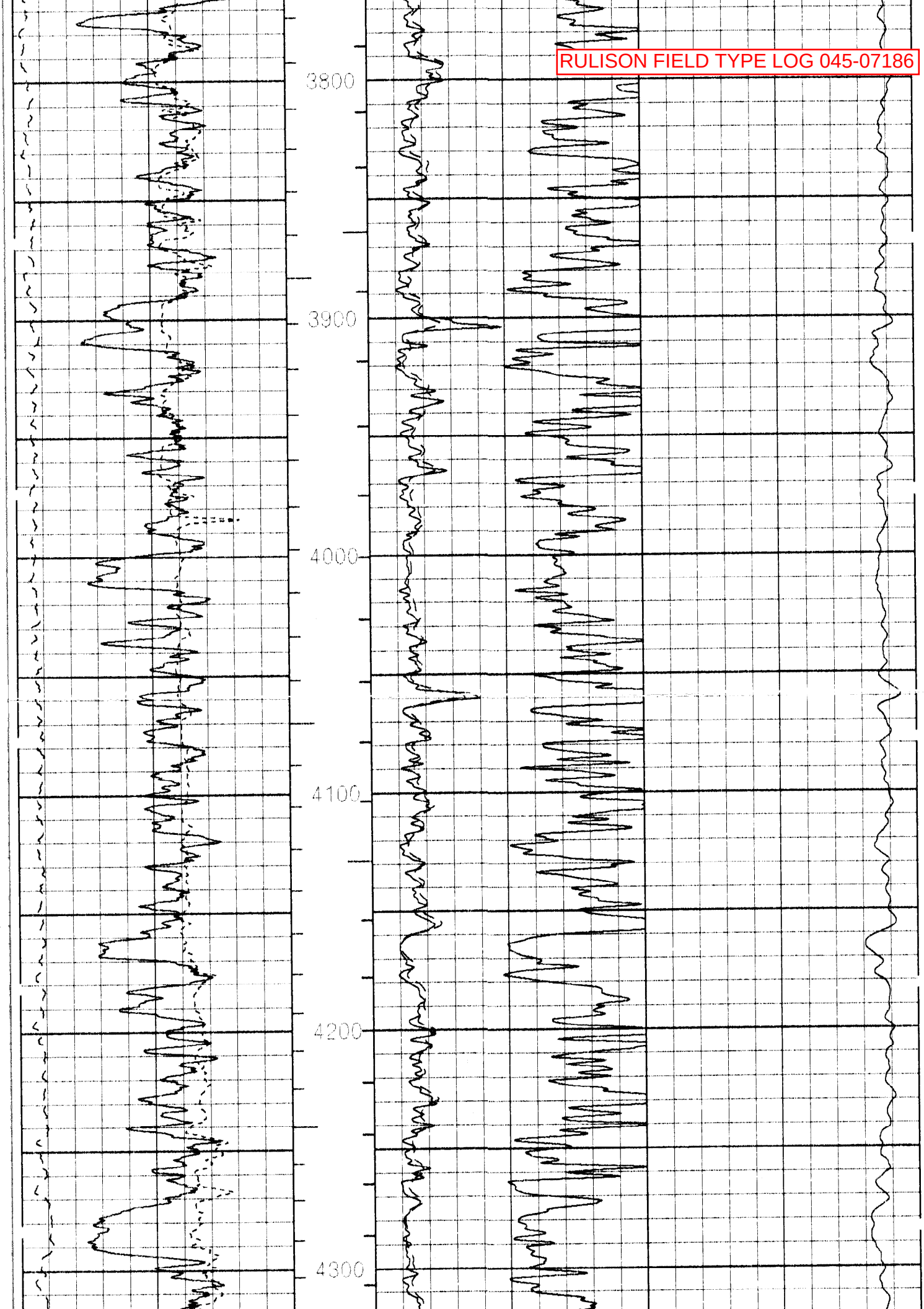

RULISON FIELD TYPE LOG 045-07186
1100
1200
1300
1400
1500

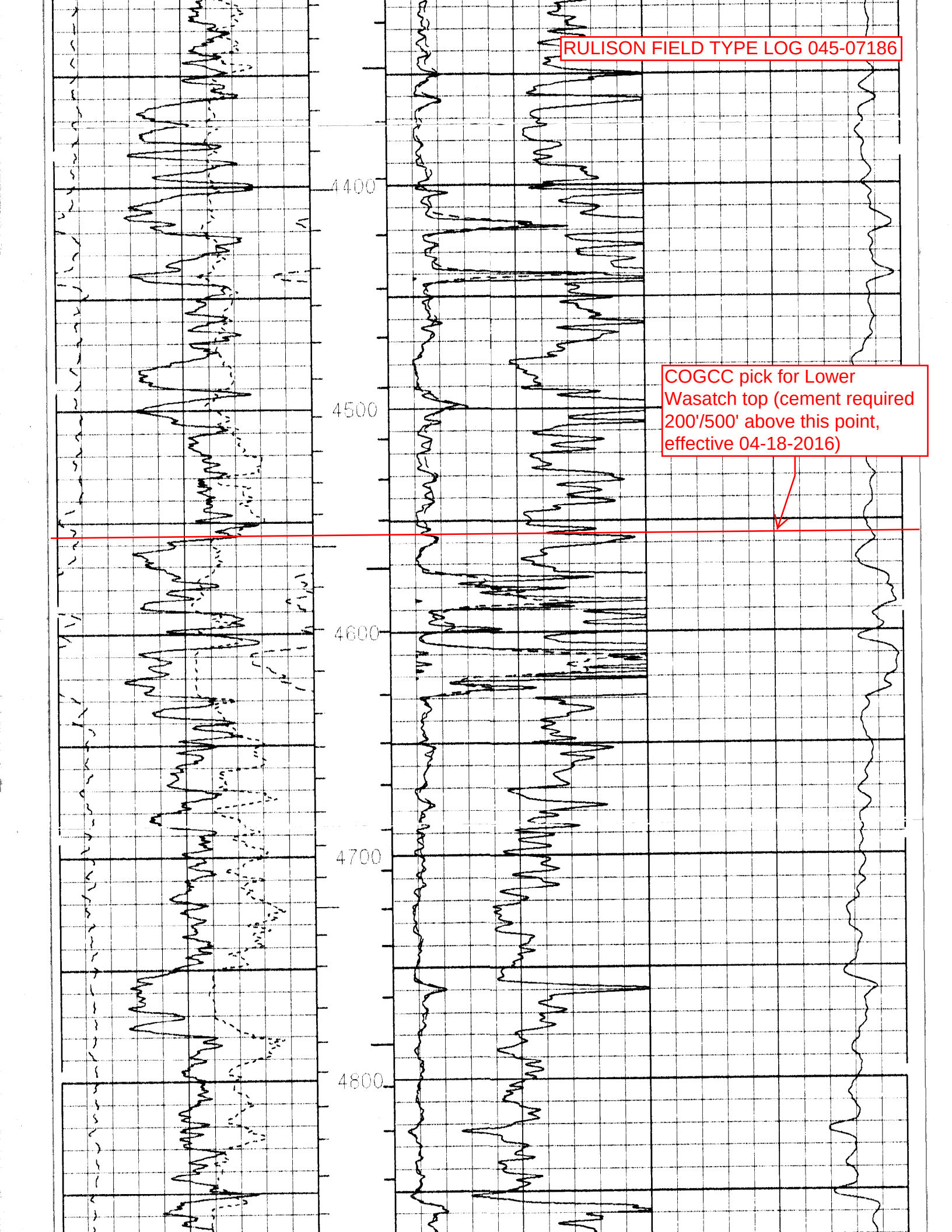

RULISON FIELD TYPE LOG 045-07186
1600
1700
1800
1900
2000
2100

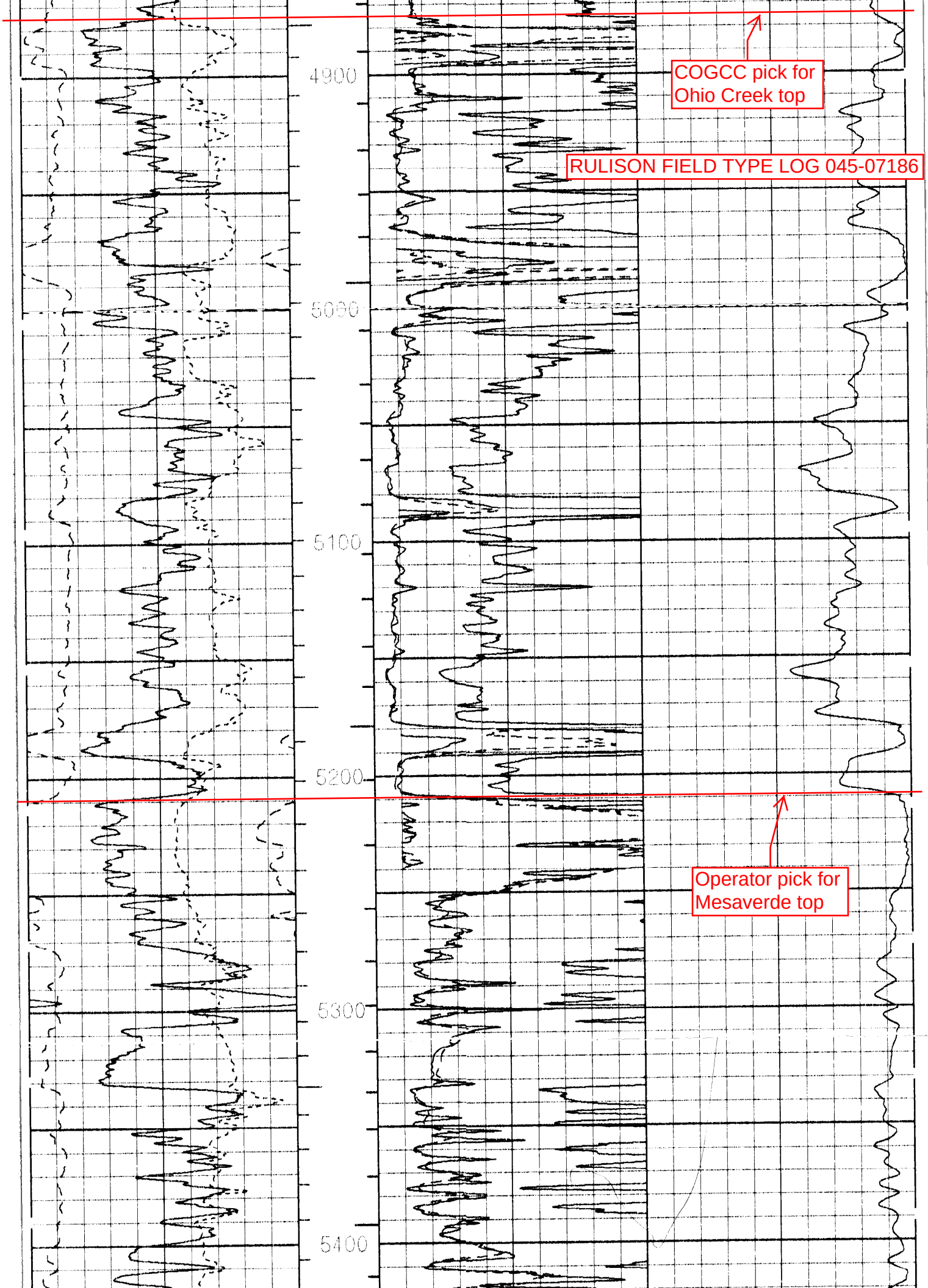

RULISON FIELD TYPE LOG 045-07186
2200
2300
2400
2500
2600

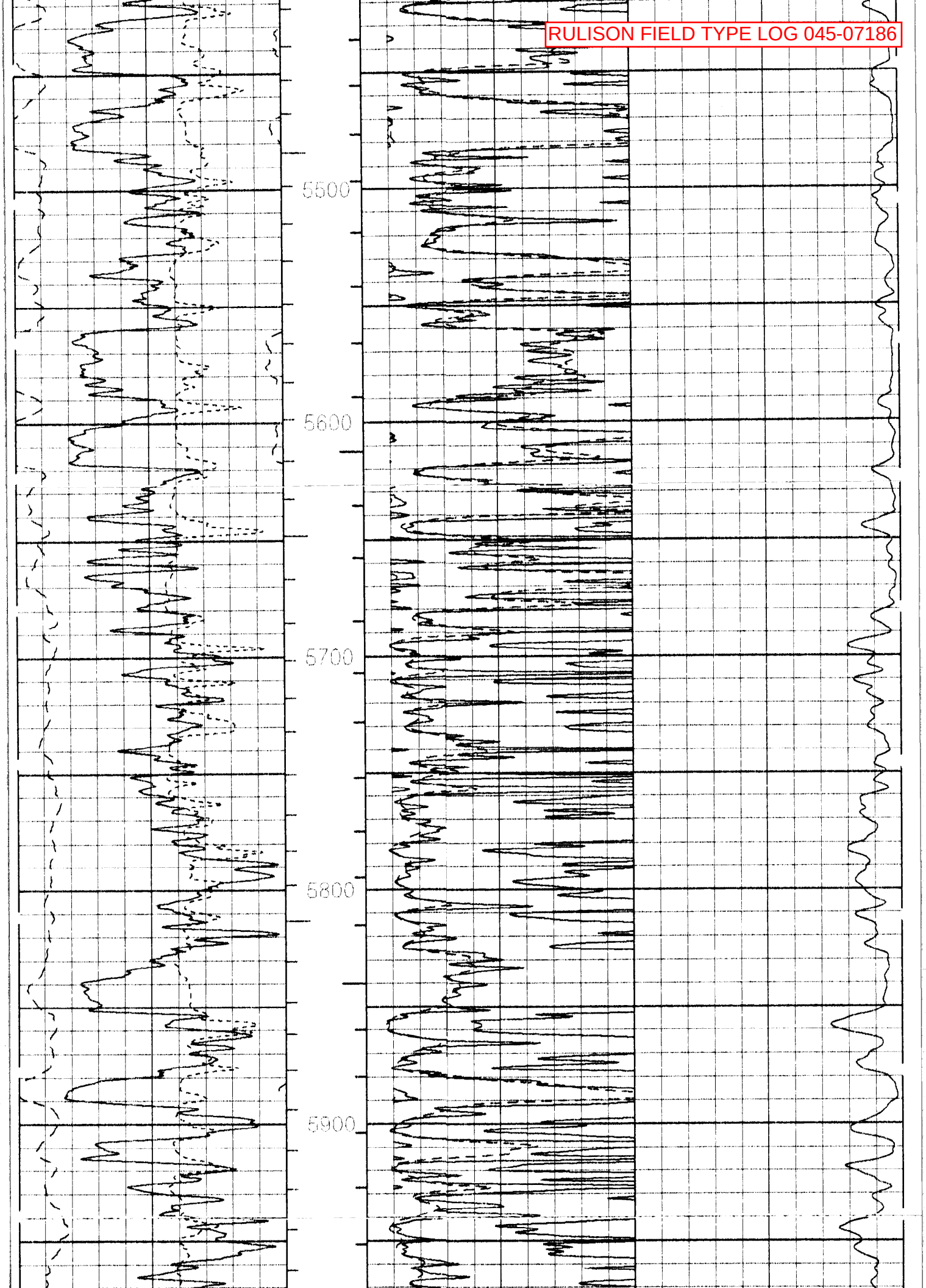

RULISON FIELD TYPE LOG 045-07186
2700
2800
2900
3000
3100
3200
COGCC pick for Wasatch G Sand top (upper interval)
COGCC pick for Wasatch G Sand top (lower interval)

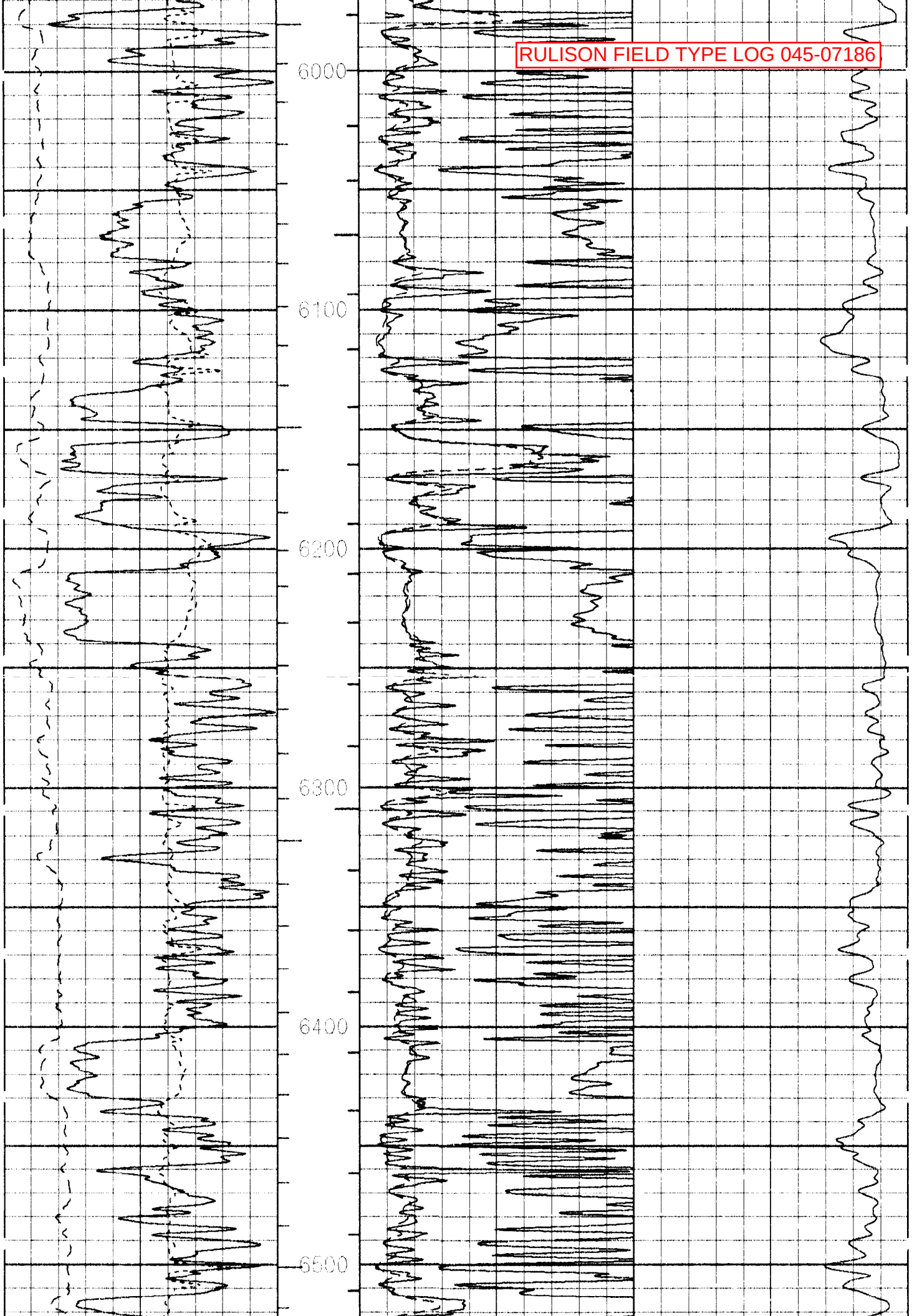

RULISON FIELD TYPE LOG 045-07186
COGCC pick for
Fort Union top
3300
3400
3500
3600
3700

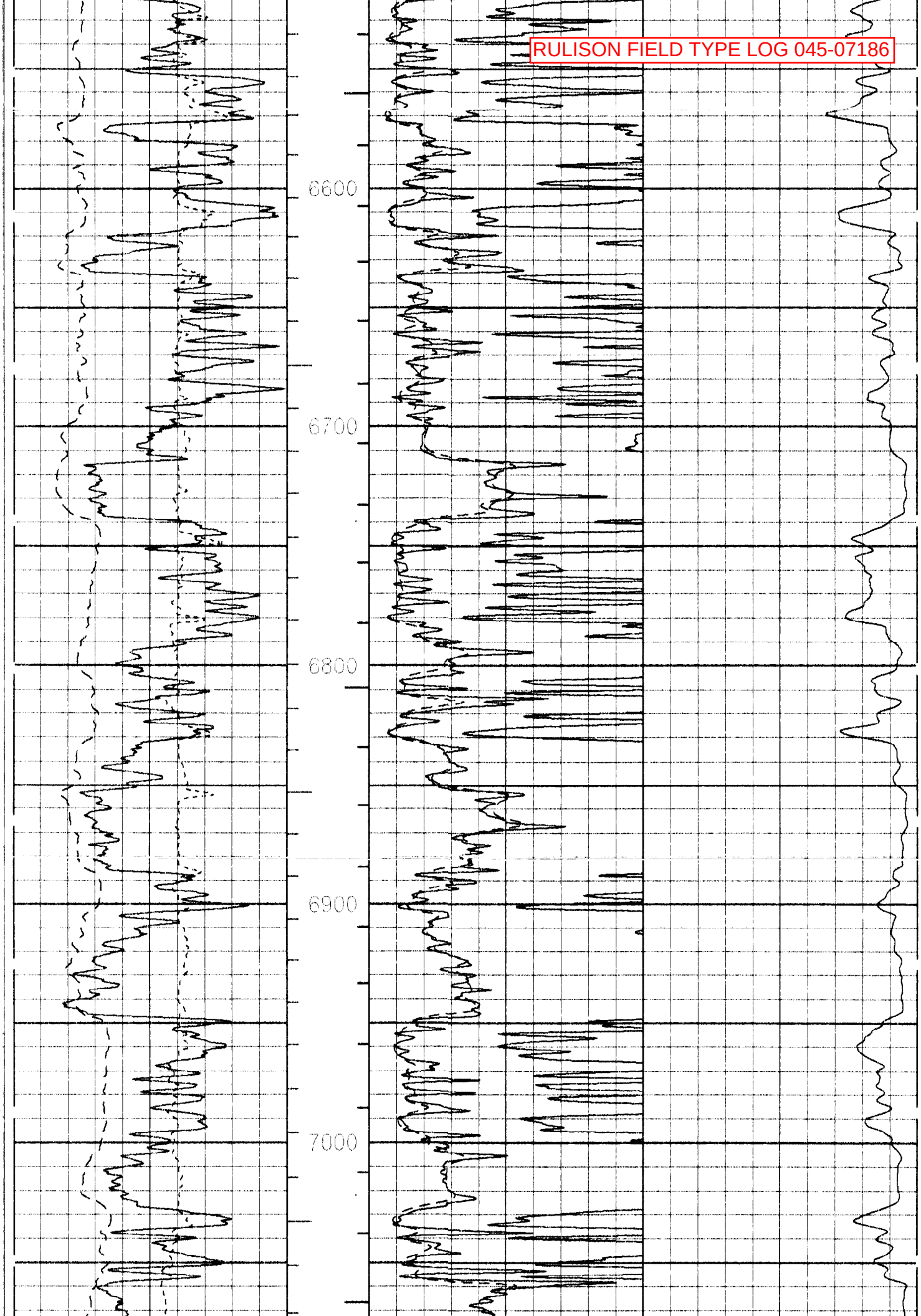

RULISON FIELD TYPE LOG 045-07186
3800
3900
4000
4100
4200
4300

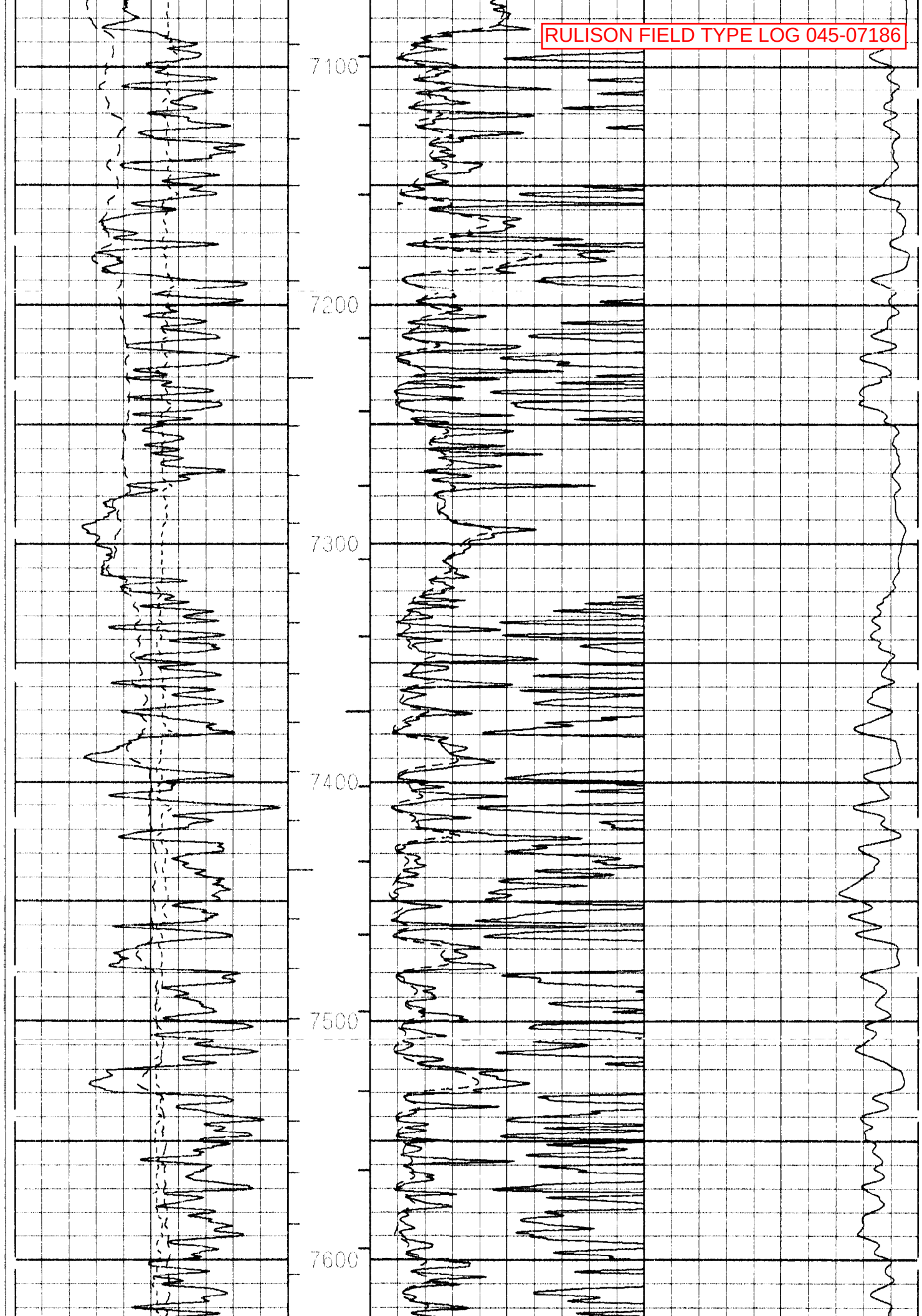

RULISON FIELD TYPE LOG 045-07186
4400
4500
4600
4700
4800
COGCC pick for Lower Wasatch top (cement required 200'/500' above this point, effective 04-18-2016)

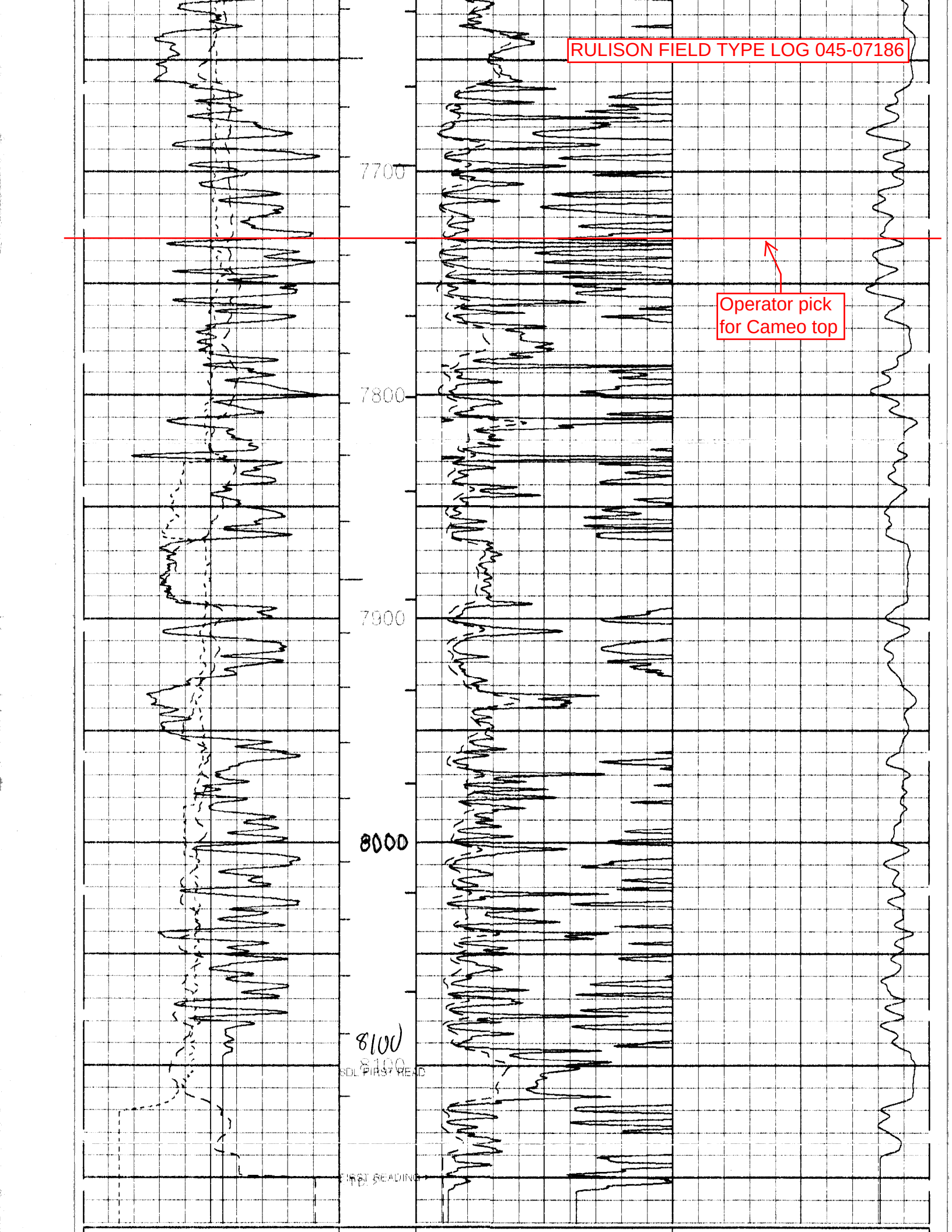

4900
5000
5100
5200
5300
5400
COGCC pick for
Ohio Creek top
RULISON FIELD TYPE LOG 045-07186
Operator pick for
Mesaverde top


RULISON FIELD TYPE LOG 045-07186
5500
5600
5700
5800
5900


RULISON FIELD TYPE LOG 045-07186
6000
6100
6200
6300
6400
6500


RULISON FIELD TYPE LOG 045-07186
6600
6700
6800
6900
7000


RULISON FIELD TYPE LOG 045-07186
7100
7200
7300
7400
7500
7600


RULISON FIELD TYPE LOG 045-07186
7700
7800
7900
8000
8100
8100
SDL FIRST READ
FIRST READING
Operator pick
for Cameo top

	SP		1600		SH GUARD R			
20	MV	120	Ft	0	OHMM	100		
	CALIPER		BHV		AMP SGRD			
4	INCHES	14	FT3	0	OHMM	20		
	GAMMA RAY		AHV		DEEP RES		DEEP COND	
0	API COUNTS	150	FT3	0	OHMM	100	500 MMHO	0

HALLIBURTON

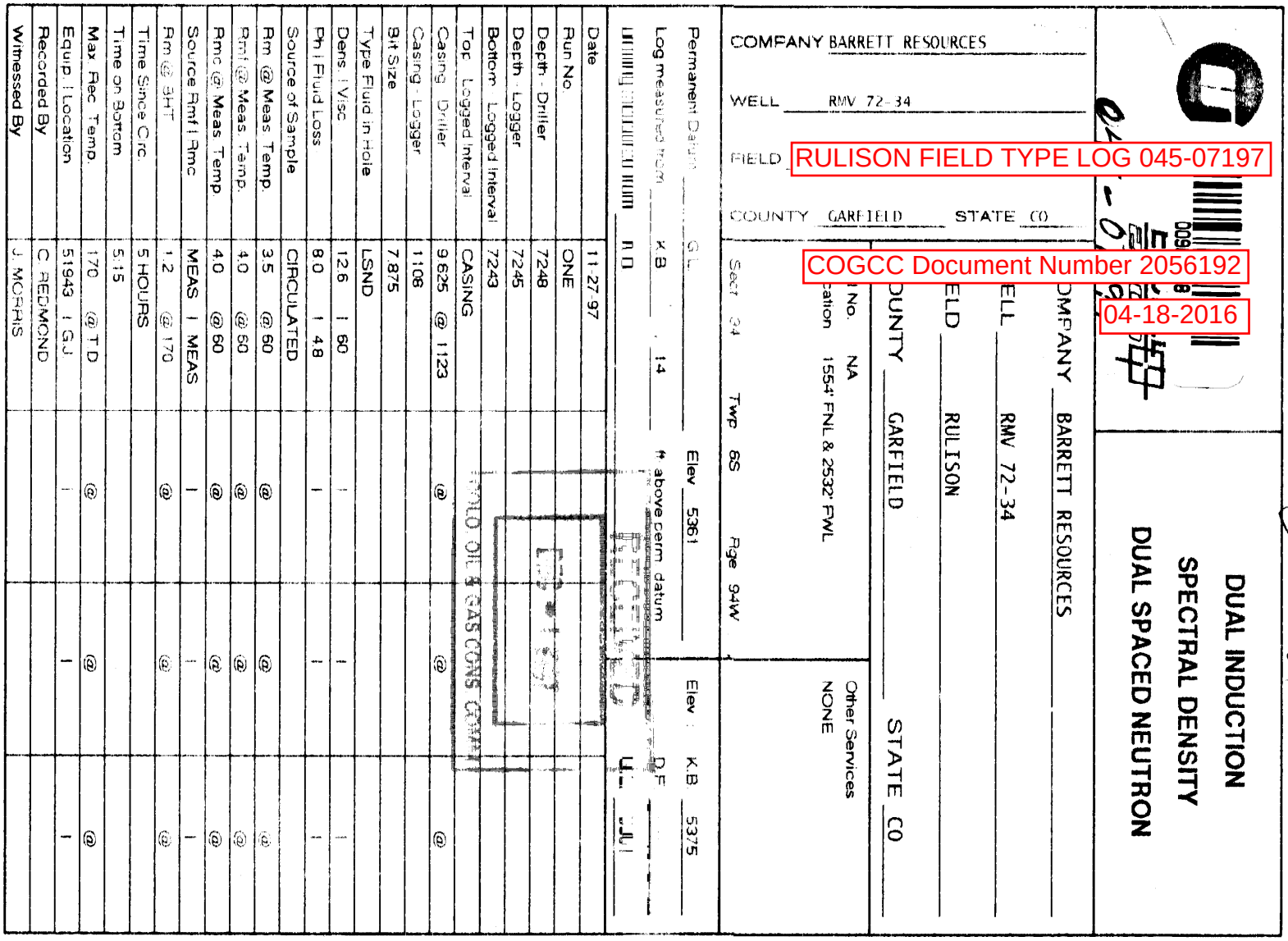
EXCELL

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Control File: /field_data/data2/2INDIL.spc
Raster File: 0914_1513_s2100.2INDIL

Top Depth: 529.50
Bottom Depth: 8170.00

Plot Time: 09-14-97 19:40:44
Database Time: 09-14-97 17:53:11

RULISON FIELD TYPE LOG 045-07186



Fold Here

Service Ticket No.: 270941		API Serial No.: [redacted]		PGM Version: XL v3.20			
CHANGE IN MUD TYPE OR ADDITIONAL SAMPLES				RESISTIVITY SCALE CHANGES			
Date / Sample No.	/	/		Type Log	Depth	Scale Up Hole	Scale Down Hole
Depth - Driller							
Type Fluid in Hole							
Dens. / Visc.	/	/					
Ph / Fluid Loss	/	/					
Source of Sample				RESISTIVITY EQUIPMENT DATA			
Rm @ Meas. Temp.	@	@		Run No.	Tool Type & No.	Pad Type	Tool Pos. / Other
Rmf @ Meas. Temp.	@	@		ONE	DILT #109737	NA	1.5" SO
Rmc @ Meas. Temp.	@	@		ONE	SGRD #114100	NA	1.5" SO
Source Rmf / Rmc	/	/					
Rm @ BHT	1.2 @ 170	@					
Rmf @ BHT	1.4 @ 170	@					
Rmc @ BHT	1.4 @ 170	@					

EQUIPMENT DATA

GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No.	ONE	Run No.		Run No.	ONE	Run No.	ONE
Serial No.	108589	Serial No.		Serial No.	85022	Serial No.	108784
Model No.	NGRT-A	Model No.		Model No.	SDLT-B	Model No.	DSN II
Diameter	3.625"	No. of Cent.		Diameter	4.5"	Diameter	3.625"
Detector Model No.	102A	Spacing		Log Type	GAM GAM	Log Type	THERMAL
Type	SCINT			Source Type	CS-137	Source Type	AM241BE
Length	4"	LSA [Y / N]		Serial No.	2189	Serial No.	DSN-80
Distance to Source	12"	FWDA [Y / N]		Strength	1.5 CI	Strength	19 CI

LOGGING DATA

GENERAL			GAMMA		ACOUSTIC			DENSITY			NEUTRON		
Run	Depth		Speed	Scale		Scale			Scale			Scale		
No.	From	To	Ft / Min	L	R	L	R	Matrix	L	R	Matrix	L	R	Matrix
ONE	TD	CASIN	REC	0	200				30	10	2.68	30	10	SAND
					GAPI						GM/CC			

RULISON FIELD TYPE LOG 045-07197

Remarks:

DIL-SDL-DSN-GR RAN IN COMBINATION.
AHV CALCULATED USING 5.5" CASING.

CREW: E. ROBLES, S. WALTON RIG: NABORS 457

THANK YOU FOR CHOOSING H.E.S. GRAND JUNCTION.

HALLIBURTON DOES NOT GUARANTEE THE ACCURACY OF ANY INTERPRETATION OF THE LOG DATA, CONVERSION OF LOG DATA TO PHYSICAL ROCK PARAMETERS OR RECOMMENDATIONS WHICH MAY BE GIVEN BY HALLIBURTON PERSONNEL OR WHICH APPEAR ON THE LOG OR IN ANY OTHER FORM. ANY USER OF SUCH DATA, INTERPRETATIONS, CONVERSIONS, OR RECOMMENDATIONS AGREES THAT HALLIBURTON IS NOT RESPONSIBLE EXCEPT WHERE DUE TO GROSS NEGLIGENCE OR WILLFUL MISCONDUCT, FOR ANY LOSS, DAMAGES, OR EXPENSES RESULTING FROM THE USE THEREOF.

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Current EXCELL-2000 Parameter Values

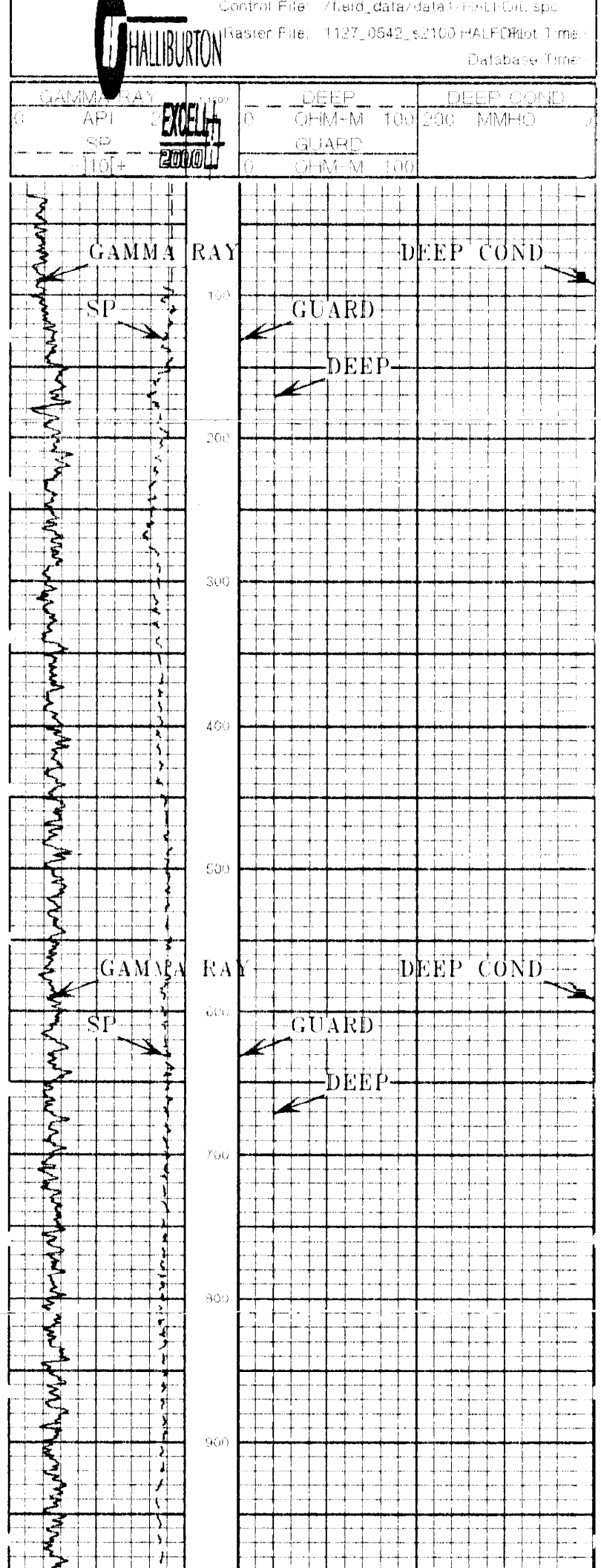
Depth: 0.000
Date: 27-Nov-1997 02:38

Mnemonic	Tool	Parameter Description	Value	Units
PERF	DITSHD	PERFORATED INTERVAL	NO	
GR_OK	GAMMA	DO GAMMA CALCULATIONS?	YES	
CASED	SHARED	CASED HOLE?	NO	
CASEOD	SHARED	CASING DIAMETER (OD)	5.5	Inches
MUDWT	SHARED	BOREHOLE FLUID WEIGHT	12.6	Pounds/Gal.
GRSO	GAMMA	GAMMA RAY STANDOFF	0.	Inches
BS	SHARED	BIT SIZE	7.875	Inches
DSN_OK	DSN_II	DO DSN II CALCULATIONS?	YES	
DRILL	DSN_II	TPL - NEUTRON IN SLEEVE?	NO	
BADHOL	DSN_II	DSN BAD HOLE CORRECTION	NO	
NLITH	DSN_II	NEUTRON LITHOLOGY	SAND	
DSNSO	DSN_II	DSN STANDOFF	0.	Inches
DSNTMP	DSN_II	DSN II TEMPERATURE CORRECTION	NONE	
DSNPRS	DSN_II	DSN II PRESSURE CORRECTION	NONE	
SDL_OK	SDL	DO SDL CALCULATIONS?	YES	
BARITE	SDL	ANY BARITE IN MUD?	YES	
AIR	SDL	AIR FILLED BOREHOLE	NO	
RHOFLU	SHARED	FLUID DENSITY	1.	G/CC
RHOMAT	SDL	MATRIX DENSITY	2.68	Grams/CC
CAL_OK	CALSDL	DO CALIPER CALCULATIONS?	YES	
AHVOK	CALSDL	DO ANNULAR VOLUME CALCULATION?	YES	
DI_OK	DIND	DO DUAL INDUCTION CALCULATION?	YES	
SG_OK	SGRD	DO SHORT GUARD CALCULATIONS?	YES	
XPHLOC	XP_RWA	CROSSPLOT SELECTION FOR XPHI	XPLT	
ARCHA	XP_RWA	ARCHIE A	0.62	
ARCHM	XP_RWA	ARCHIE M	2.15	
FSEL	XP_RWA	POROSITY SELECTION FOR F	DEN	
FACTOK	FACMAN	DO FACT CALCULATIONS?	NO	
AHVOK	FACMAN	DO ANNULAR VOLUME CALCULATION?	NO	

MAIN LOG 1"=100'

113894.2.1

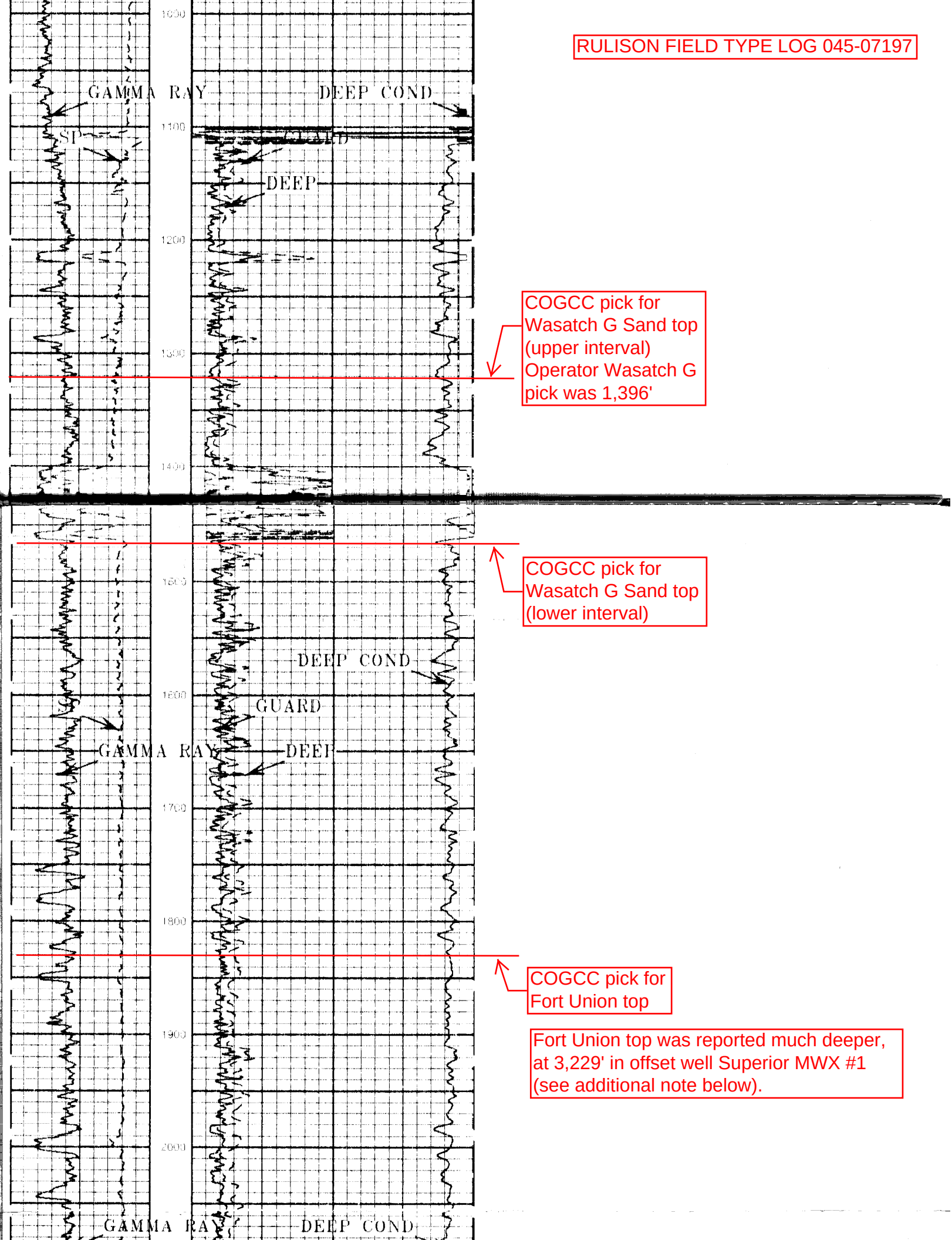
Version No: 3.20 | Rc:2.1 Top: Depth: 19.08
Data File: 1127_0542_s2100 | Version: Depth: 12/27/97

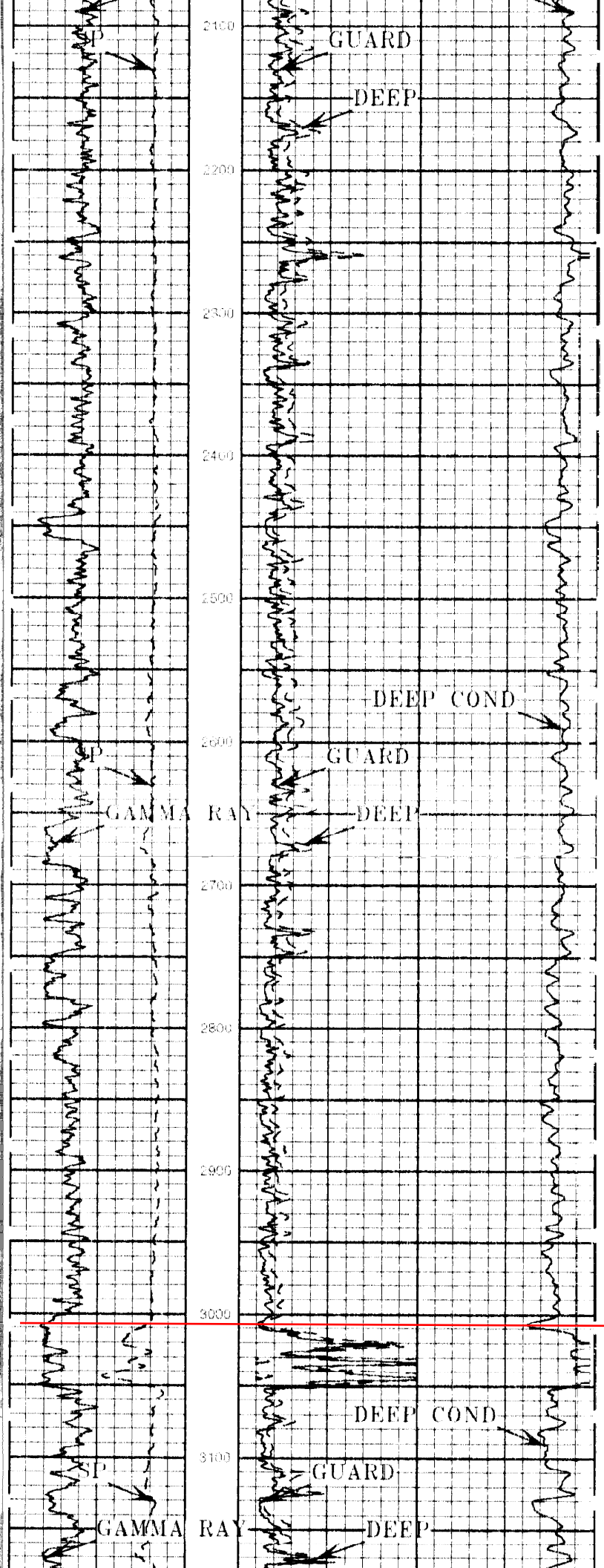


RULISON FIELD TYPE LOG 045-07197

This well, Savage RMV 72-34, is located approximately 1,830' ENE of Superior MWX #1 (045-06325), which is cited as a type log well for Commission Order Nos. 139-22, 139-23, and 139-25.
Log tops shown on this well correlate with other log tops shown in the Stratigraphy sections of Rulison Field Scout Card, COGCC Document No. 2056125.
However, differences are noted below for comparison to log tops reported by the operator for the Superior MWX #1 well (cited in Commission orders as DOE/CER MWX #1), which has a ground surface elevation of 5,355' (six feet lower than this well).

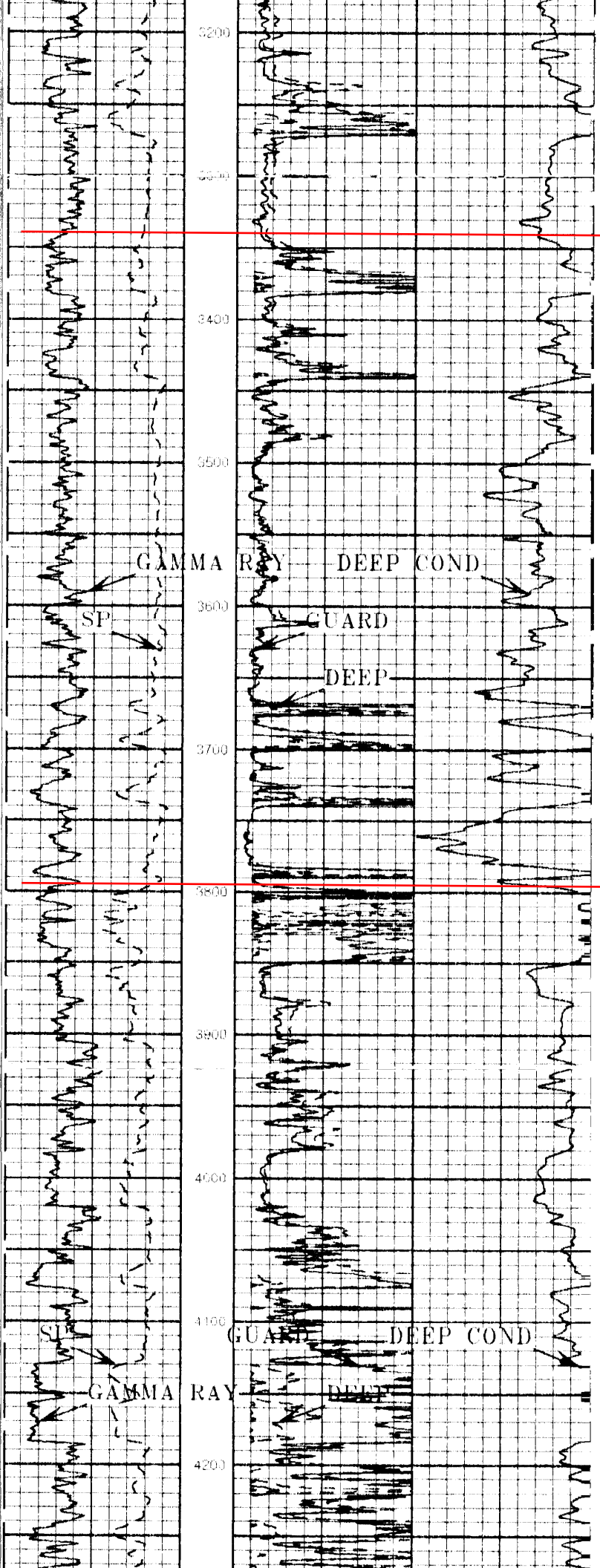
Alluvium at Surface Underlain by Wasatch Formation
Wasatch Formation top was reported at 19' in offset well Superior MWX #1 (below alluvium).


RULISON FIELD TYPE LOG 045-07197
GAMMA RAY
DEEP COND
SP
GUARD
DEEP
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
COGCC pick for Wasatch G Sand top (upper interval) Operator Wasatch G pick was 1,396'
COGCC pick for Wasatch G Sand top (lower interval)
COGCC pick for Fort Union top
Fort Union top was reported much deeper, at 3,229' in offset well Superior MWX #1 (see additional note below).



RULISON FIELD TYPE LOG 045-07197

COGCC pick for Lower Wasatch top (cement required 200'/500' above this point, effective 04-18-2016)



RULISON FIELD TYPE LOG 045-07197

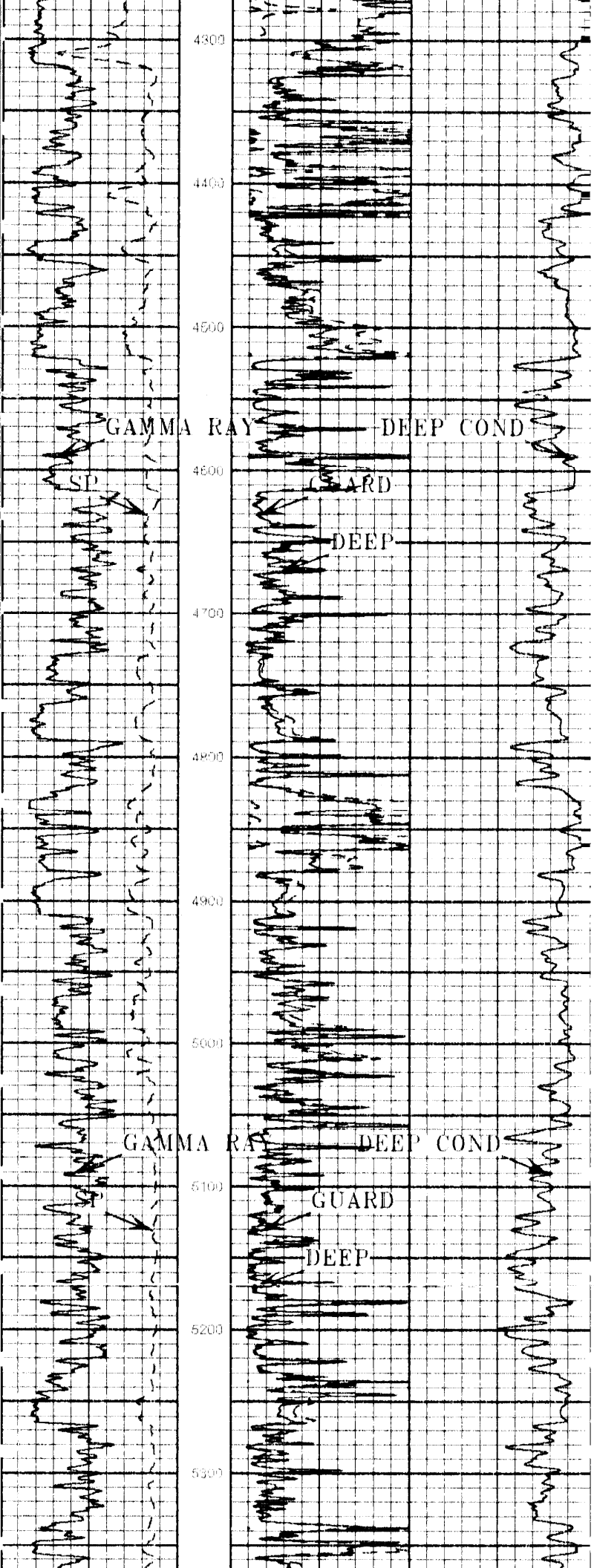
Fort Union top was reported at 3,229' in offset well Superior MWX #1 (considered to be part of the Lower Wasatch by COGCC on this log)

COGCC pick for Ohio Creek top

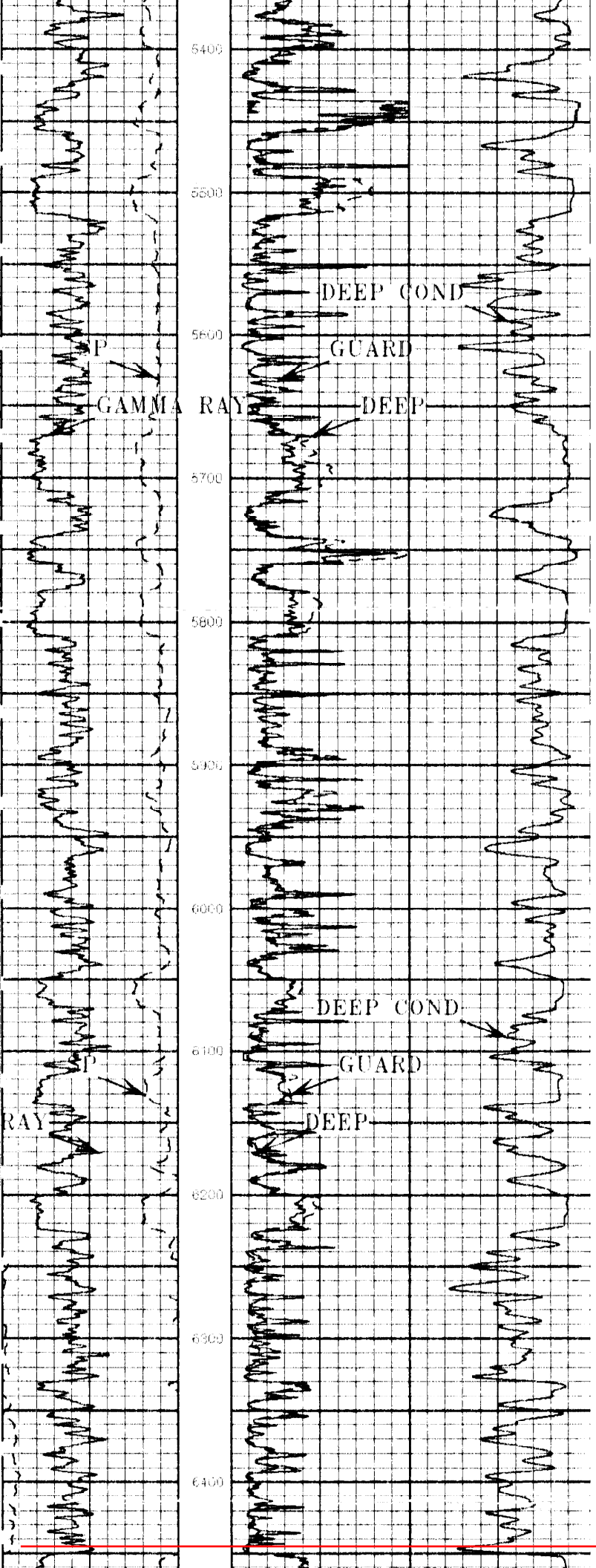
Operator pick for Mesaverde top

Ohio Creek top was reported at 3862' in offset well Superior MWX #1 (considered to be part of the Mesaverde by COGCC on this log). Mesaverde top was reported at 3901' in offset well Superior MWX #1.
Commission Order Nos. 139-22, 139-23, and 139-25 cite the Mesaverde top at 3,862' in Superior MWX #1 (consistent with the operator pick for the Ohio Creek top in that well).

RULISON FIELD TYPE LOG 045-07197

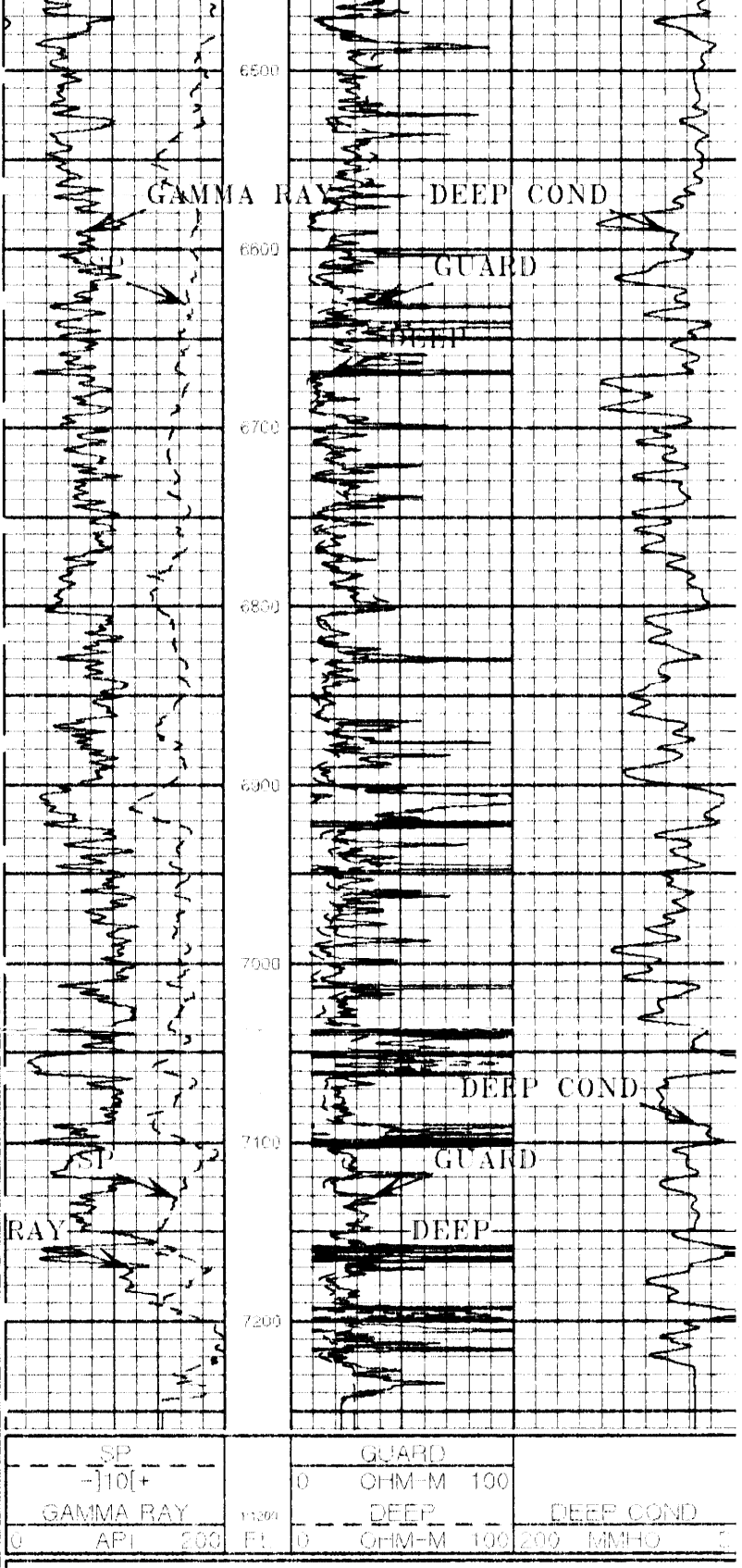


RULISON FIELD TYPE LOG 045-07197



Operator pick for Cameo top

RULISON FIELD TYPE LOG 045-07197



Version No: 3.20 : hc:2.1 Top Depth: 19.08

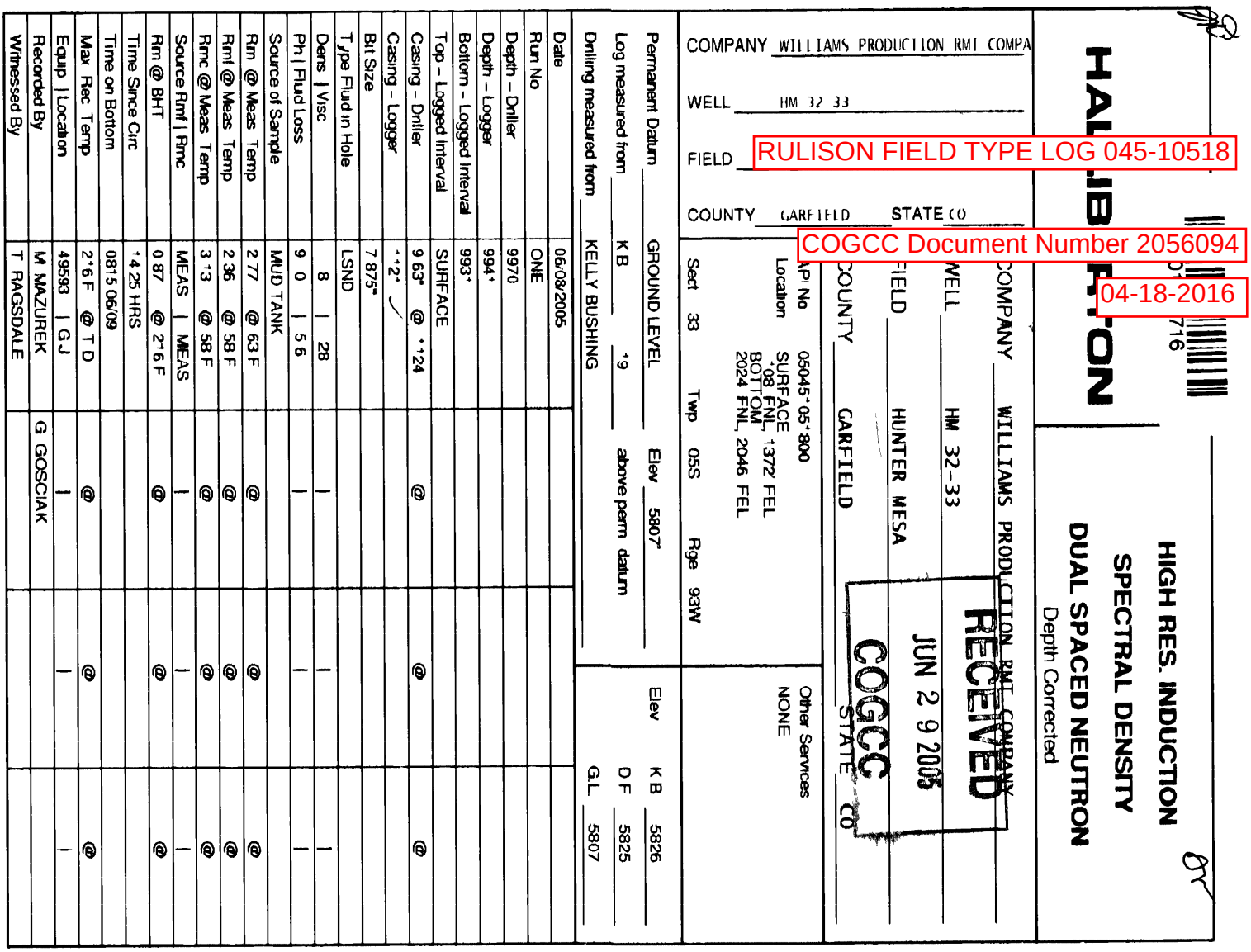
Data File: 1127_0542_s2100.150 Bottom Depth: 7260.00

Control File: /field_data/data1/HALFDIL.spc

Raster File: 1127_0542_s2100.HALFDIL Plot Time: 11-27-97 07:29:06

Database Time: 11-27-97 05:45:21

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Service Ticket No	3751053		API Serial No	050451051800		PGM Version	XL v5 1

CHANGE IN MUD TYPE OR ADDITIONAL SAMPLES			RESISTIVITY SCALE CHANGES			
Date | Sample No	|	|	Type Log	Depth	Scale Up Hole	Scale Down Hole
Depth - Driller						
Type Fluid						
In Hole						
Dens | Visc	|	|				
Ph | Fluid Loss	|	|				
Source of Sample						
Rm @ Meas Temp	2 77 @ 63 F	@	RESISTIVITY EQUIPMENT DATA			
Rmf @ Meas Temp	2 36 @ 58 F	@	Run No	Tool Type & No	Pad Type	Tool Pos / Other
Rmc @ Meas Temp	3 13 @ 58 F	@	ONE	HRIDE AB180	N/A	1 5 SO / N/A
Source Rmf | Rmc	CALC | CALC	|				
Rm @ BHT	0 87 @ 216 F	@				
Rmf @ BHT	0 69 @ 216 F	@				
Rmc @ BHT	0 91 @ 216 F	@				

EQUIPMENT DATA

GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No	ONE	Run No		Run No	ONE	Run No	ONE
Serial No	A143	Serial No		Serial No	I709P066	Serial No	108734
Model No	NGRT-A	Model No		Model No	SDL_DC	Model No	DSN_II
Diameter	3 625	No of Cent		Diameter	4 5	Diameter	3 625
Detector Model No	102A	Spacing		Log Type	GAM-GAM	Log Type	THERMAL
Type	SCINT			Source Type	CS137	Source Type	AM241BE
Length	4	LSA [Y / N]	NO	Serial No	2189 GW	Serial No	DSN-80
Distance to Source	10	FWDA [Y / N]	NO	Strength	1 5 CI	Strength	18 5 CI

LOGGING DATA

GENERAL	GAMMA	ACOUSTIC	DENSITY	NEUTRON

Run	Depth		Speed	Scale		Scale			Scale			Scale		
No	From	To	Ft / Min	L	R	L	R	Matrix	L	R	Matrix	L	R	Matrix
ONE	T D	SURF	REC	0	200				30%	-10%	2 68	30%	-10%	SAND
											GM/CC			GM/CC

RULISON FIELD TYPE LOG 045-10518

DIRECTIONAL INFORMATION

Maximum Deviation | deg @ | KOP

Remarks

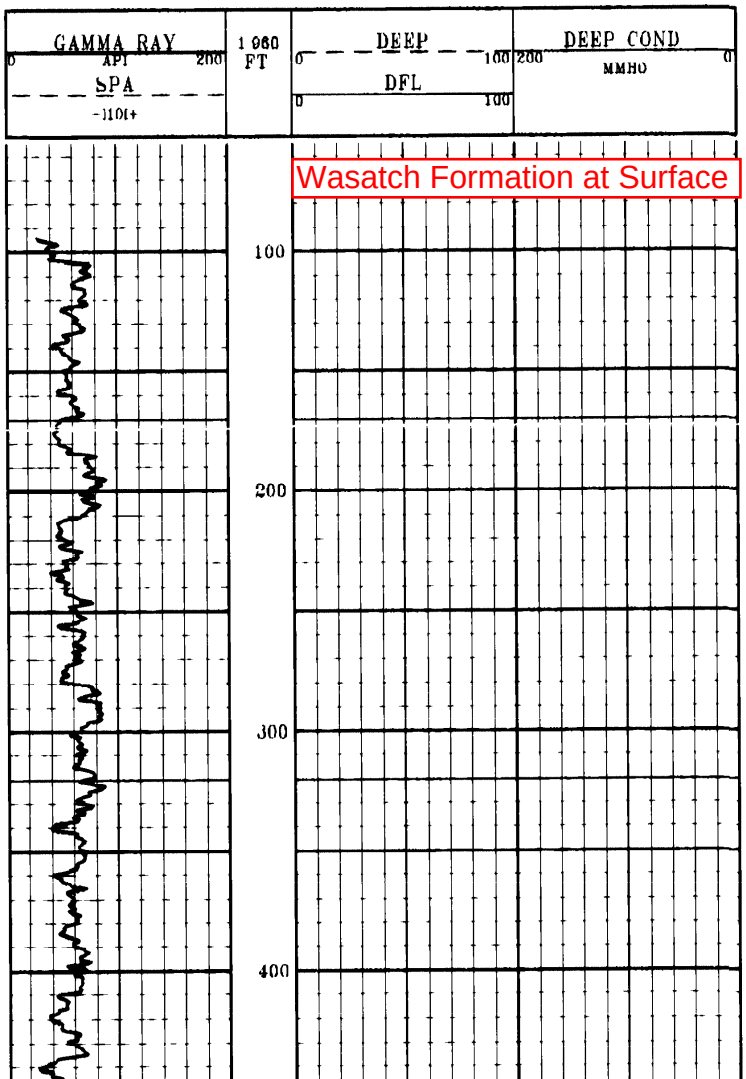
GR-DSN-SDL-MSFL-HRIDE WERE RUN IN COMBINATION
HOLE RUGOSITY AND TENSION PULLS MAY AFFECT LOG QUALITY
CHLORIDES REPORTED AT 400 mg/l
A H V CALCULATED FOR 4 5" CASING
DEPTH CORRECTED TO SCHLUMBERGER FMI DATED 6-8-05

LATITUDE 39 34 N // LONGITUDE 107 49 W
YOUR CREW TODAY IS J ZLOMKE, J BROWNLEE, D CORBY RIG NABORS 723
THANK YOU FOR USING HALLIBURTON ENERGY SERVICES G J , CO 970 523-3600

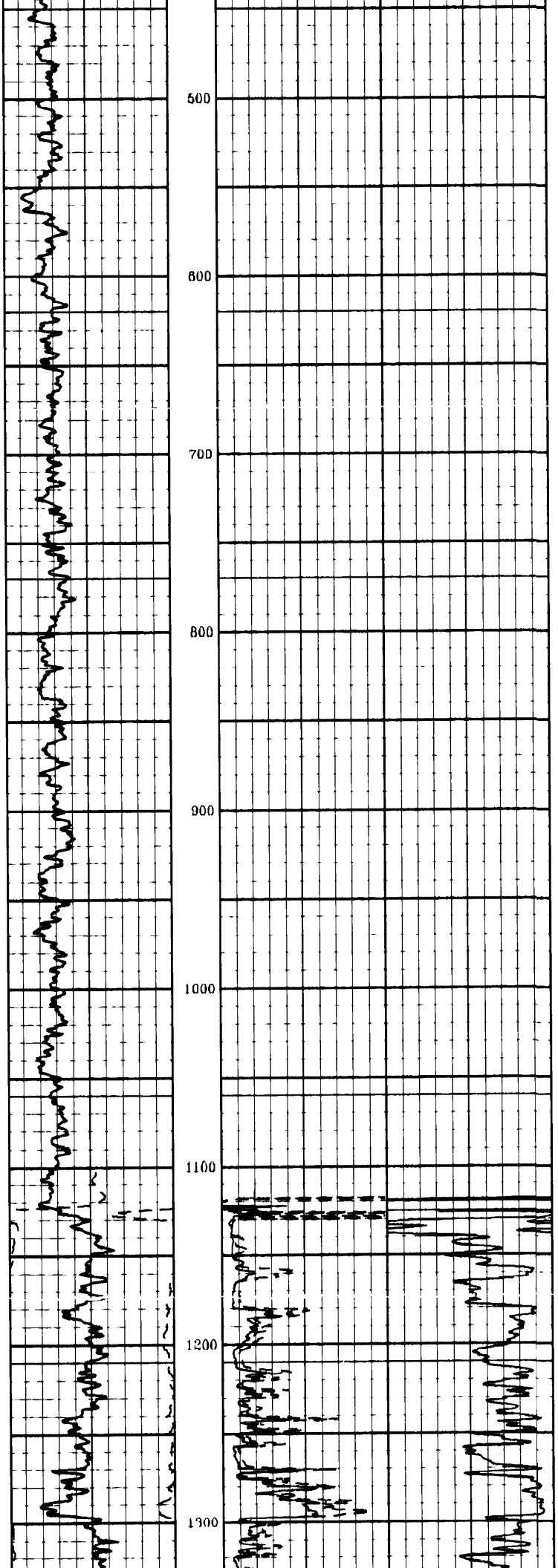
HALLIBURTON DOES NOT GUARANTEE THE ACCURACY OF ANY INTERPRETATION OF THE LOG DATA CONVERSION OF LOG DATA TO PHYSICAL ROCK PARAMETERS OR RECOMMENDATIONS WHICH MAY BE GIVEN BY HALLIBURTON PERSONNEL OR WHICH APPEAR ON THE LOG OR IN ANY OTHER FORM ANY USER OF SUCH DATA INTERPRETATIONS CONVERSIONS OR RECOMMENDATIONS AGREES THAT HALLIBURTON IS NOT RESPONSIBLE EXCEPT WHERE DUE TO GROSS NEGLIGENCE OR WILLFUL MISCONDUCT FOR ANY LOSS DAMAGES OR EXPENSES RESULTING FROM THE USE THEREOF

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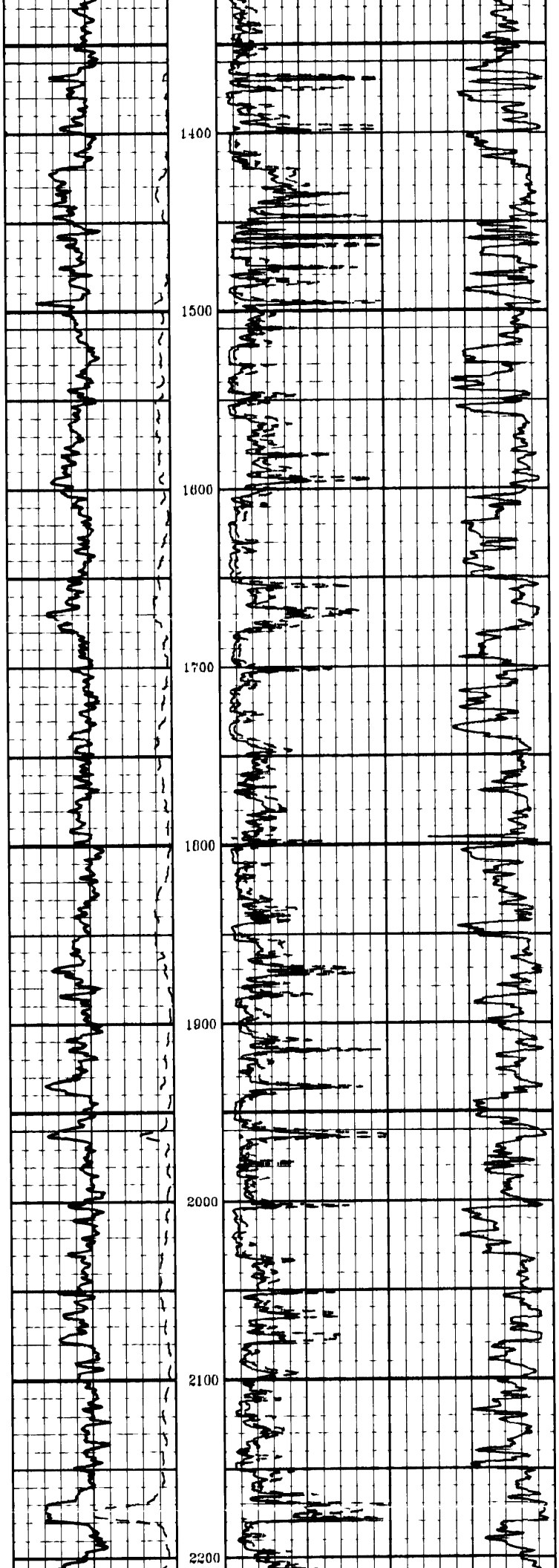
MAIN PASS 1"=100'



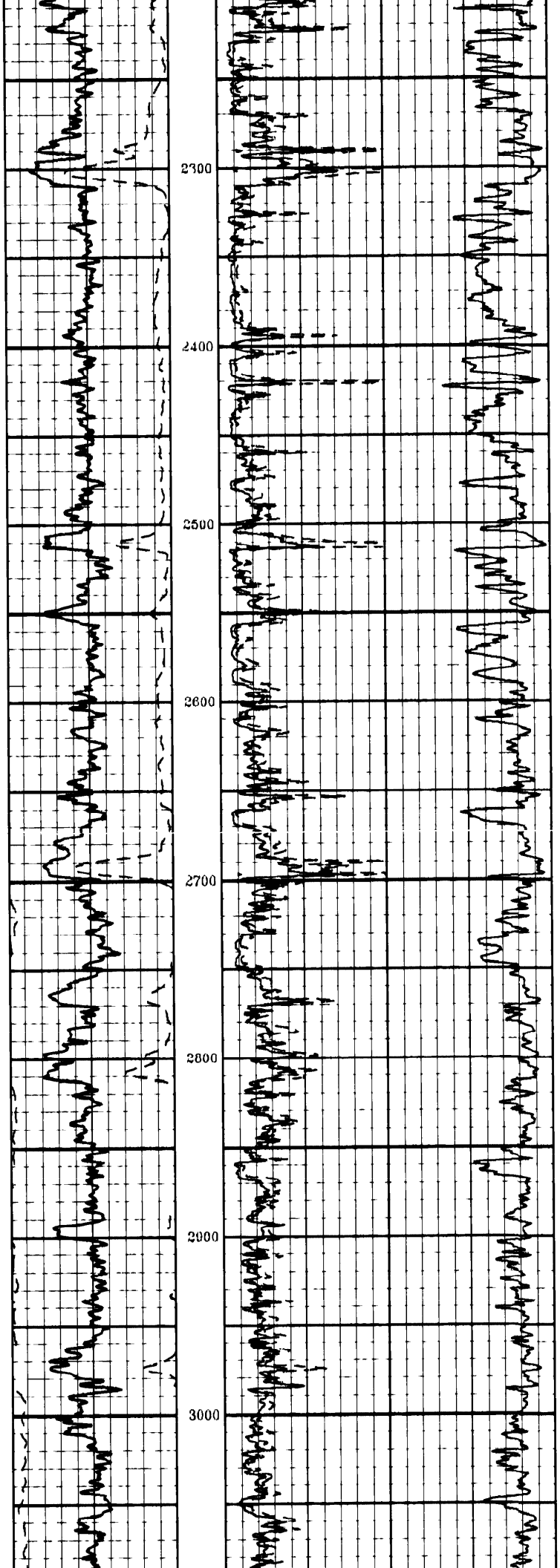
RULISON FIELD TYPE LOG 045-10518

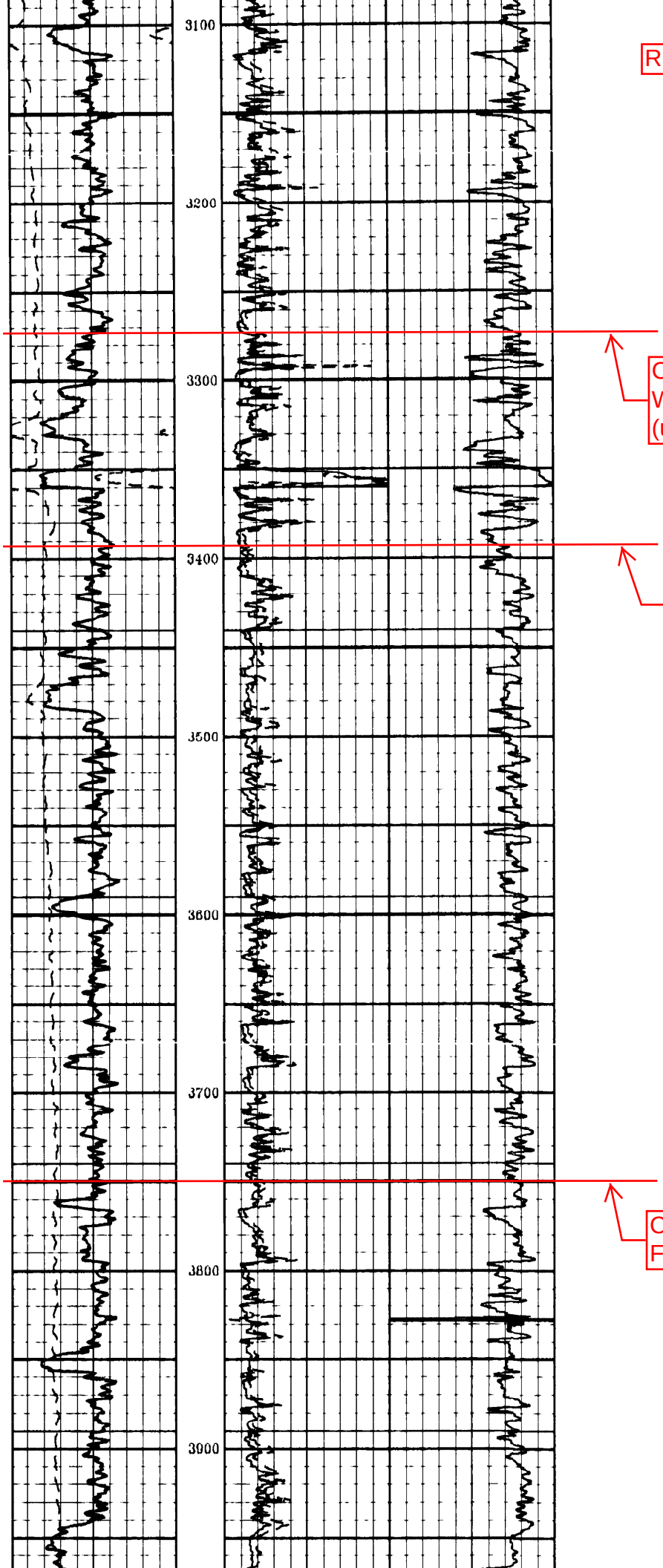


RULISON FIELD TYPE LOG 045-10518



RULISON FIELD TYPE LOG 045-10518





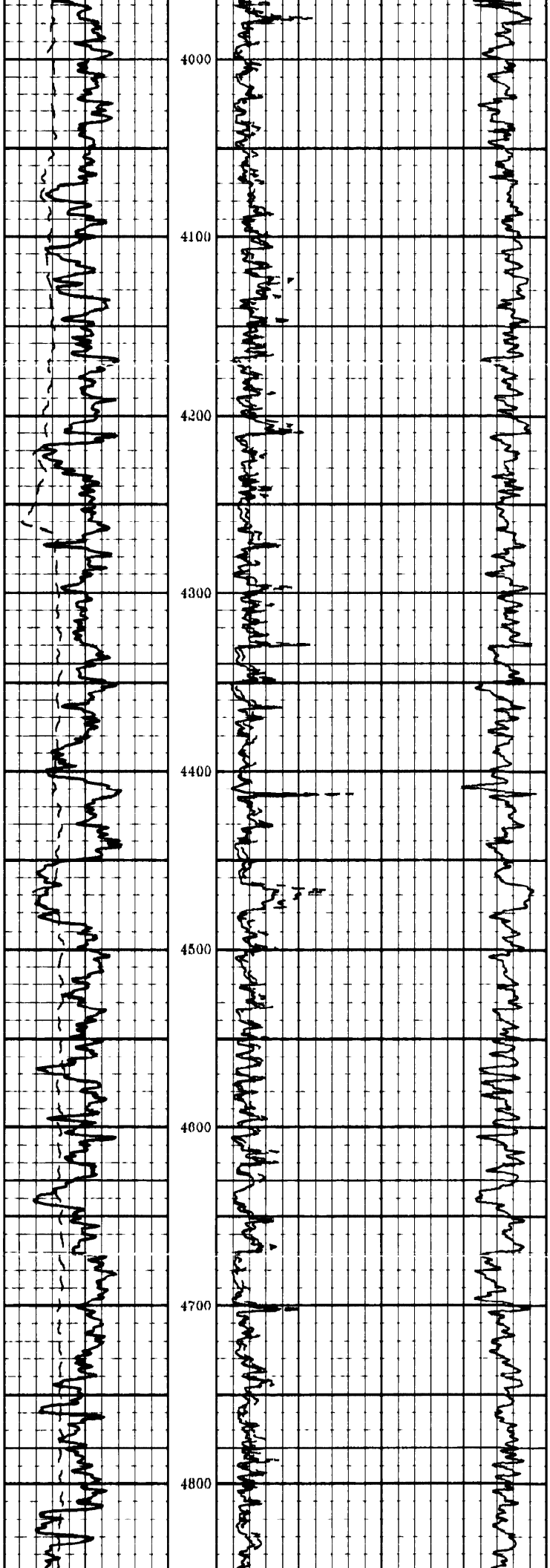
RULISON FIELD TYPE LOG 045-10518

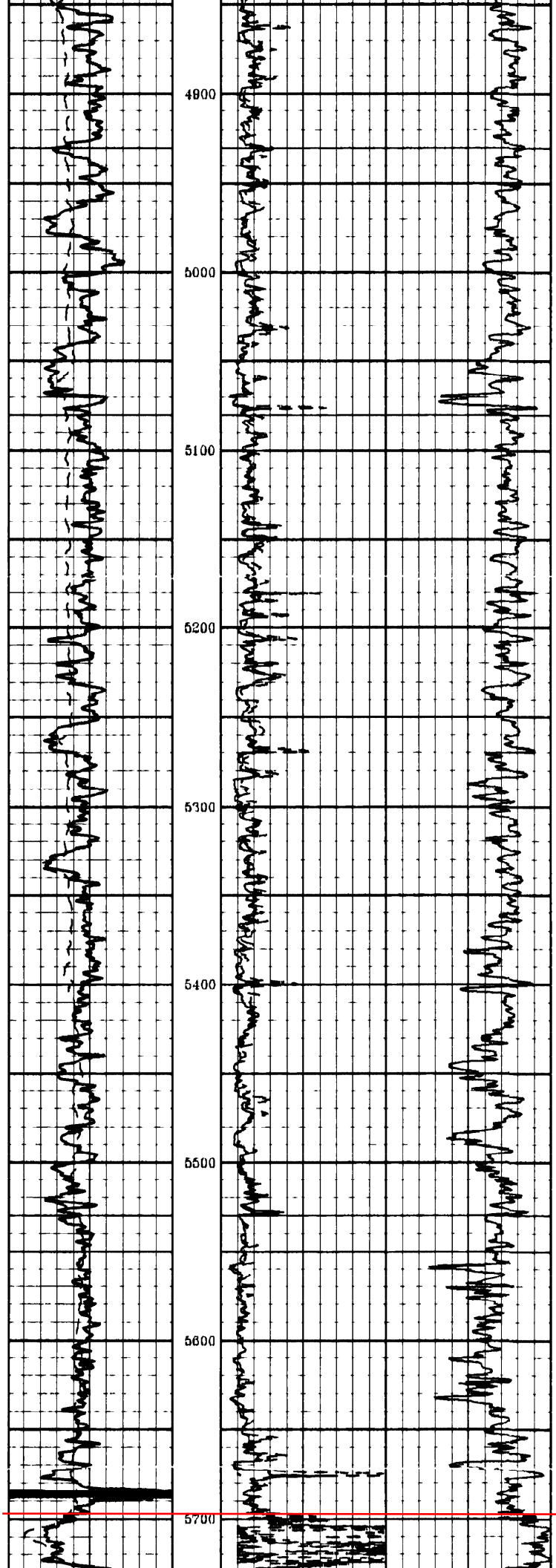
COGCC pick for Wasatch G Sand top (upper interval)

COGCC pick for Wasatch G Sand top (lower interval)

COGCC pick for Fort Union top

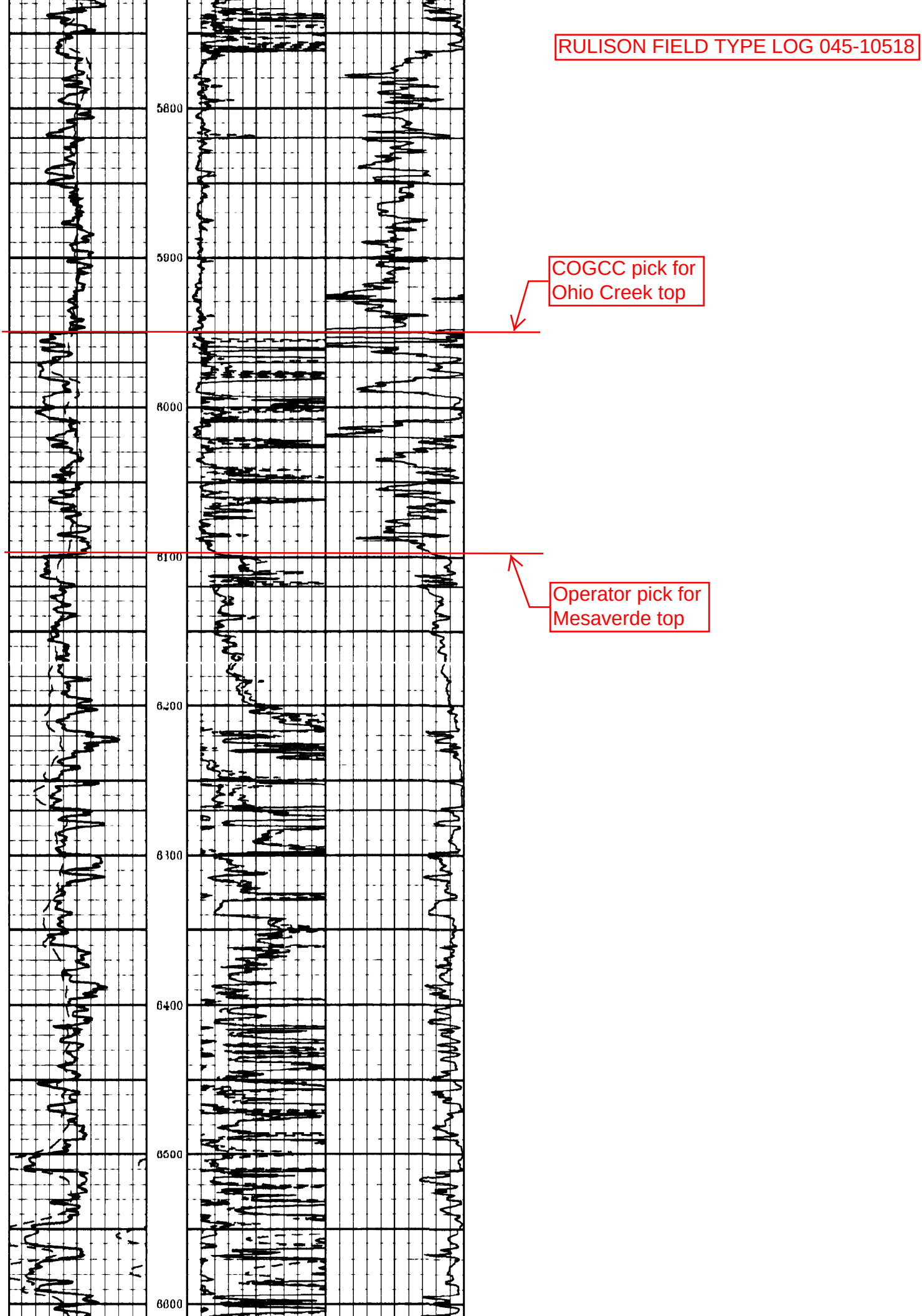
RULISON FIELD TYPE LOG 045-10518



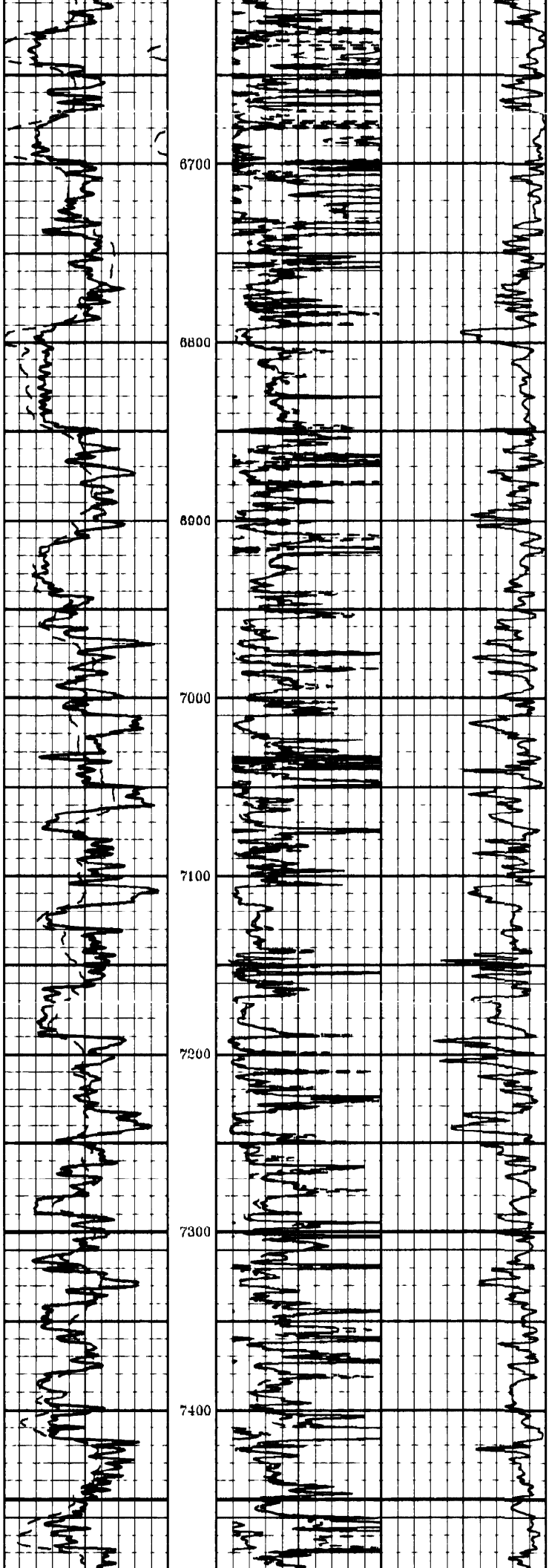


RULISON FIELD TYPE LOG 045-10518

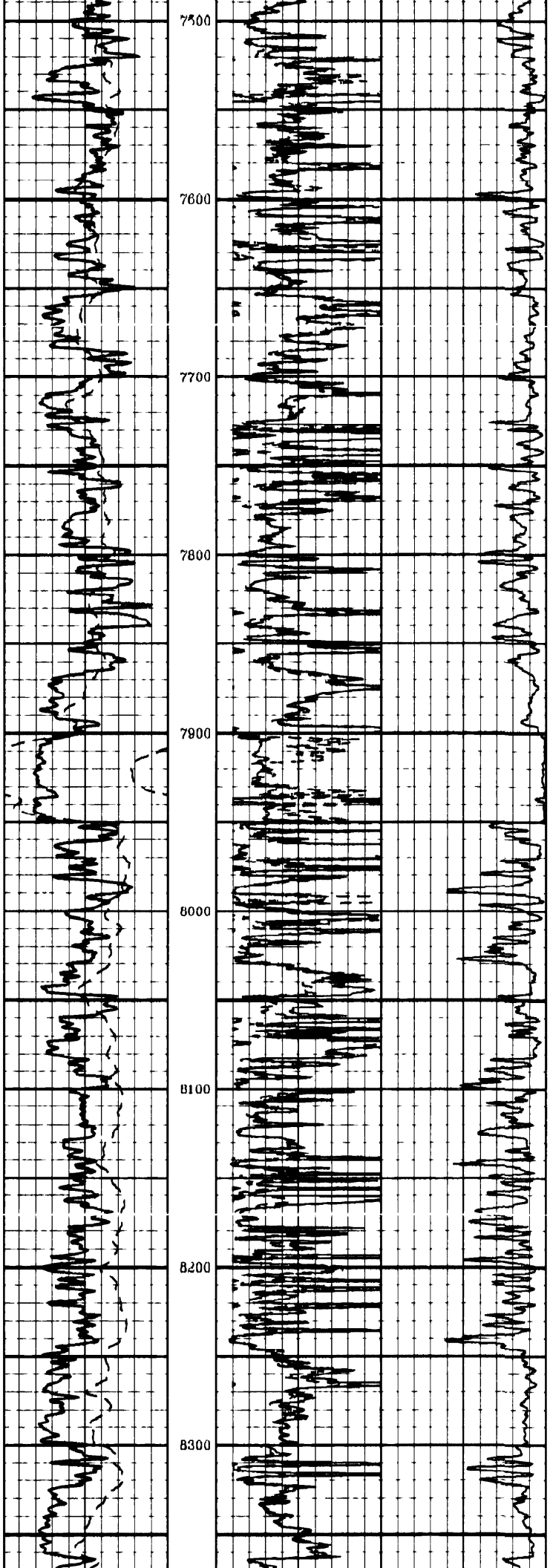
COGCC pick for Lower Wasatch top (cement required 200'/500' above this point, effective 04-18-2016)

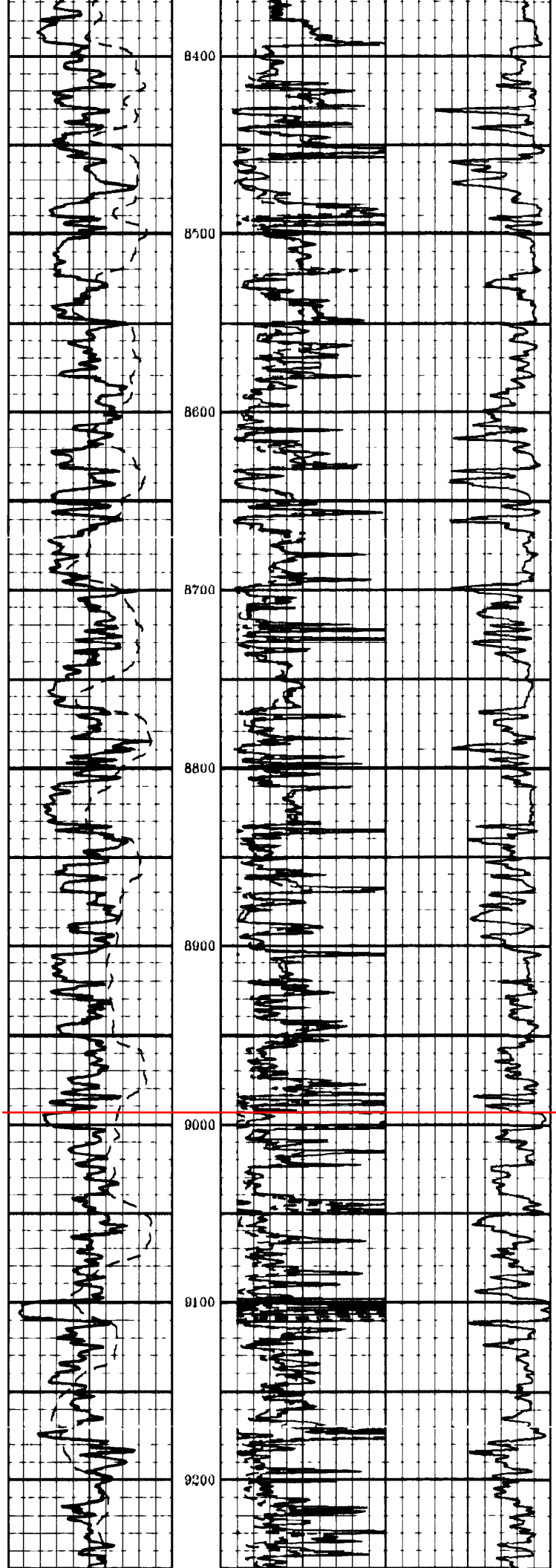

RULISON FIELD TYPE LOG 045-10518
5800
5900
6000
6100
6200
6300
6400
6500
6600
COGCC pick for
Ohio Creek top
Operator pick for
Mesaverde top

RULISON FIELD TYPE LOG 045-10518



RULISON FIELD TYPE LOG 045-10518

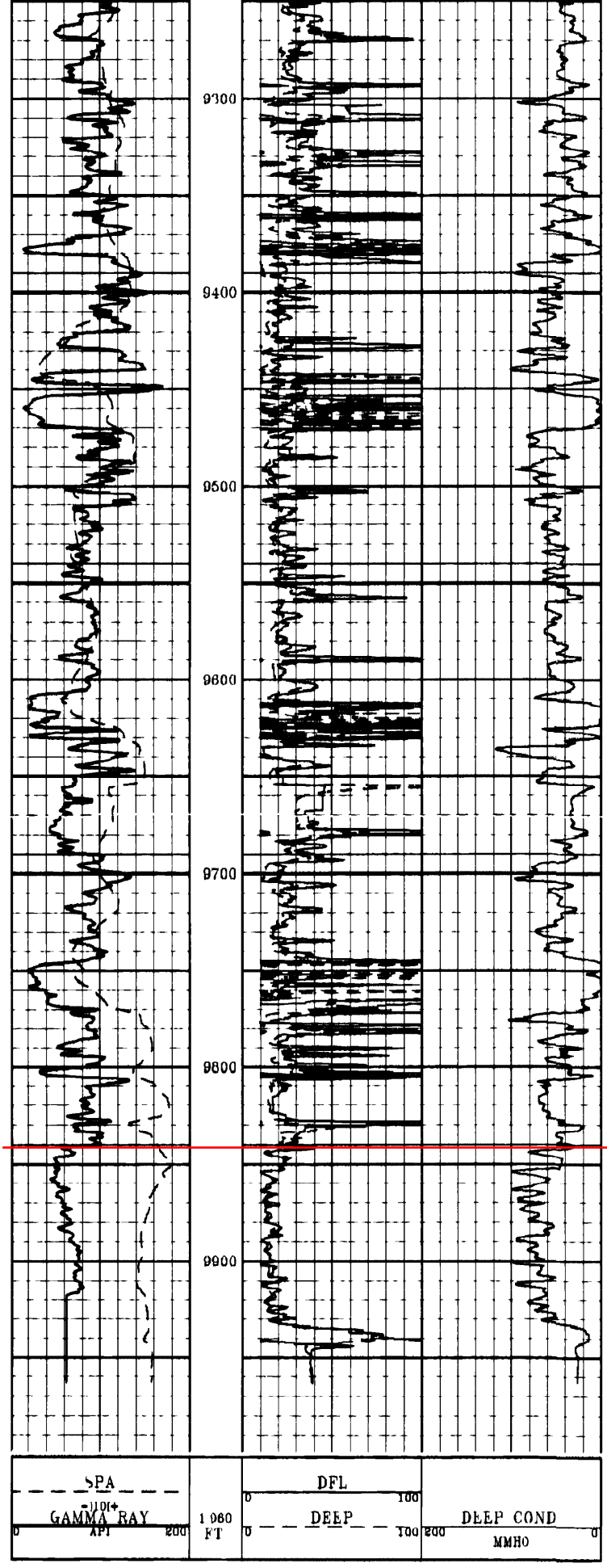




RULISON FIELD TYPE LOG 045-10518

Operator pick
for Cameo top

RULISON FIELD TYPE LOG 045-10518



Operator pick for Rollins top

COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056119

FIELD NAME	**SHEEP CREEK**
FIELD NUMBER	**77200**

LOCATION

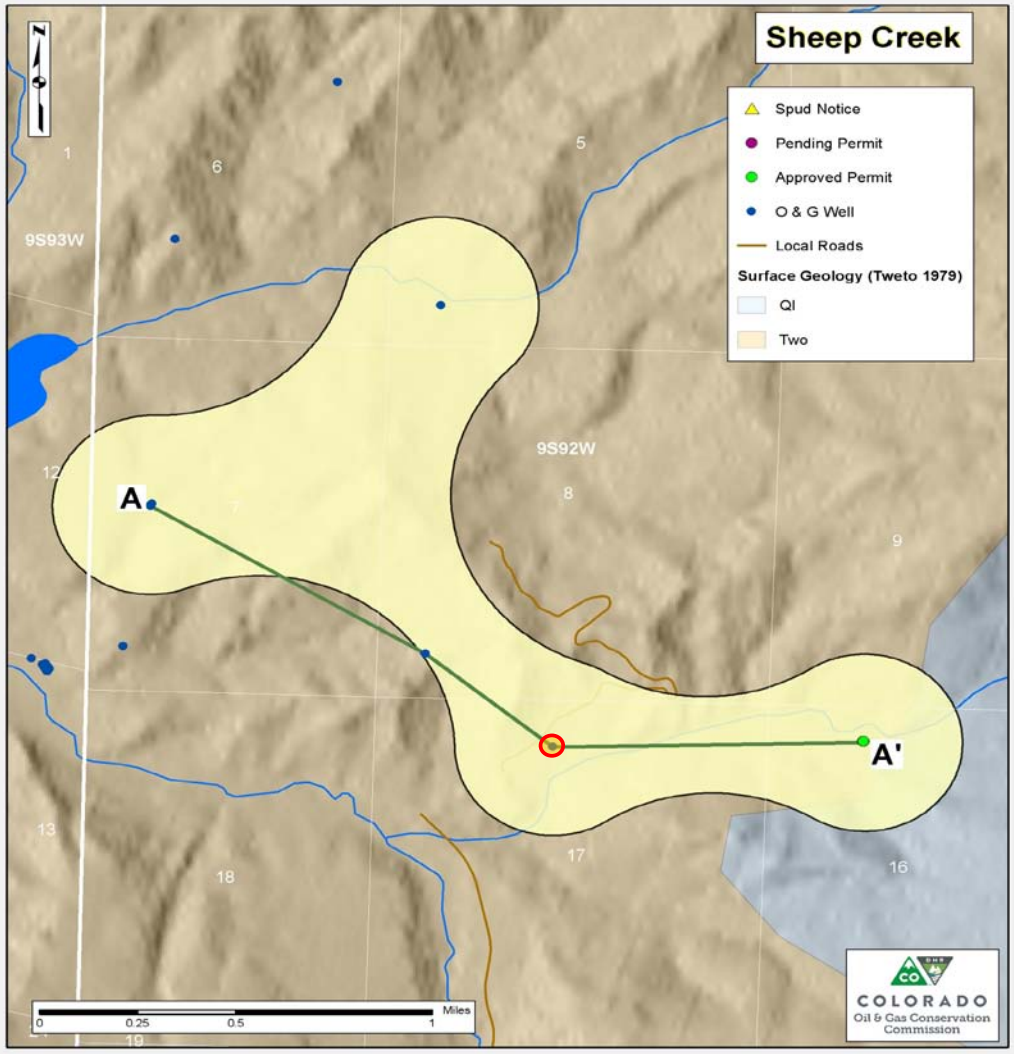
Basin	Piceance
Township(s)	9S
Range(s)	92W

SURFACE GEOLOGY

Surface Geology consists of alluvium at the northwest end of the field and landslide deposits at the southeast end of the field, underlain by the Wasatch Formation. The Wasatch Formation outcrops at surface throughout most of

GEOLOGIC STRUCTURE

None present within this field or nearby on COGCC's 250K GIS Geology layer.



Type Log Well

COGCC OIL AND GAS FIELD SCOUT CARD
SHEEP CREEK #7720

				A - Northwest			A' - Southeast
STRATIGRAPHY			**API Number =>**	**077-08569**	**077-05097**	**077-08500**	**077-08435**
			Surface Elevation =>	**7,602**	**7,652**	**7,620**	**7,838**
All depths are measured depths			**Well Type =>**	**Vertical**	**Vertical**	**Vertical**	**Vertical**
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water	0			
	Landslide deposits		Water				
	Wasatch	Upper	Shallow Water		0	0	0
	Wasatch	G-Sand*	None	2,598/2,780*		2,438/2,614*	2,352/2,510*
	Wasatch	Fort Union*	None	3,044*		2,934*	2,806*
	Wasatch	Middle	None				
	Wasatch	Lower*	Water	4,090*		3,885*	3,780*
Mesaverde	Williams Fork	Ohio Creek	Water	4,360*		4,215*	4,290*
Mesaverde	Williams Fork	U. Mesaverde	Water	4,900*		4,698	4,775*
Mesaverde	Williams Fork	Top of Gas	Gas				
Mesaverde	Williams Fork	Cameo	Gas				
Mesaverde	Iles	Rollins	Gas	7,919	7,802*	7,690*	7,800
Mesaverde	Iles	Cozzette	Gas	8,443	8,393	8,252	8,330
Mesaverde	Iles	Corcoran	Gas	8,627	8,562*	8,412	8,490
	Mancos		Possible Gas				
	Niobrara		Possible Gas				

Annotated Type Log for 077-08500: COGCC Document Number 2056077

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval. "Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

WATER RESOURCE ISOLATION

Alluvium, Landslide Deposits, Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde
The deepest water well within the vicinity of the field is 310' (likely Wasatch)

PRODUCING ZONE ISOLATION

Primary Objectives: Mesaverde Group (Williams Fork, Cameo, Rollins, Cozzette, and Corcoran)

UNDERGROUND INJECTION CONTROL

None in this field.

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

1-107 (9/20/2004)	Establishes a Bradenhead Monitoring Area, including the Sheep Creek Field.
386-1 (6/21/1982)	Mesaverde: Recognizes Cozzette and Corcoran as a **Common Source** of supply. Establishes 640-acre drilling and spacing units, 600' from unit line.
386-2 (11/27/2006)	Mesaverde: Amends Order 386-1 to allow 4 wells per quarter-quarter (10-acre spacing), with wells 100 feet from unit lines and one pad per quarter-quarter.
Various	Mesaverde: Amends Order 386-1 to allow 10-acre density in the Williams Fork, Rollins, Cozzette, and Corcoran, with wells 100 feet / 200 feet from unit lines and one pad per quarter-quarter.

COGCC OIL AND GAS FIELD SCOUT CARD
SHEEP CREEK #7720

HISTORIC WELL CONSTRUCTION

Surface casing setting depths generally range from 400' to 1,000'. Production casing generally terminates in the Iles or underlying Mancos formations. Production casing cement may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 5% TVD required for well control in Mesa County (10% TVD recommended) and to cover water resources in the upper interval of the Wasatch Formation. Recommend setting depth of 1,000' or greater, based on potential water resources apparent on induction logs with shallow-set surface casing. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. New Standards require cementing intermediate (if used) or production casing at least 200' above Lower Wasatch sands, as shown on the annotated type log for this field.

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug above Ohio Creek and across Lower Wasatch (squeeze to 200' above Lower Wasatch if no annular cement coverage); stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000' intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug. Larger surface casing shoe plugs should be considered for wells with less than 1,000' of surface casing.

NOTES

This field is located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.

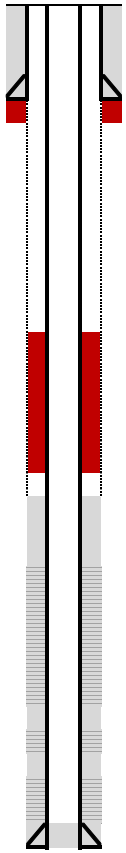
ISOLATION REQUIREMENTS FOR TYPICAL WELLS

Date 04/18/2016 **COGCC Document No.** 2056120

FIELD NAME **SHEEP CREEK**
FIELD NUMBER **77200**

LOCATION
Basin Piceance
Township(s) 9S
Range(s) 92W

Depth	Formation/Member
0	Alluvium/ Landslide Deposits/ U. Wasatch
1,000	
2,000	
	Wasatch G
3,000	
	L. Wasatch
4,000	
	Ohio Creek
	U. Mesaverde
5,000	
6,000	Top of Gas
7,000	
	Rollins
8,000	
	Cozzette
	Corcoran



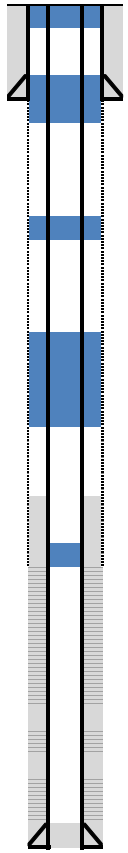
Casing and Cement Coverage

New Surface Casing Standard
Minimum 5% TVD (10% recommended) or cover all apparent water resources in the U. Wasatch, whichever is more stringent. Recommend 1,000 ft or greater based on potential water resources apparent on induction logs.

New Cement Standard
Cement must provide coverage across Ohio Creek and 200 ft above L. Wasatch, in addition to productive interval coverage.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of U. Mesaverde, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	Alluvium/ Landslide Deposits/ U. Wasatch
1,000	
2,000	
	Wasatch G
3,000	
	L. Wasatch
4,000	
	Ohio Creek
	U. Mesaverde
5,000	
6,000	Top of Gas
7,000	
	Rollins
8,000	
	Cozzette
	Corcoran



Plug Placement

Surface plug

Surface casing shoe plug
Set deeper shoe plug if casing depth < 1,000 ft

Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 feet)

Squeeze plug across Ohio Creek and across L. Wasatch (top of plug 200 ft above L. Wasatch)

Plug above Mesaverde Group Completions

FORM 925317

SHEEP CREEK FIELD TYPE LOG 077-08500
COGCC Document Number 2056077
04-18-2016
00987609

Dresser Atlas

DRESSER

Dual Induction Focused Log

FILE NO.

API NO.

COMPANY COORS ENERGY 077-08500

WELL USA 1-17 SC

FIELD SHEEP CREEK

COUNTY MESA STATE COLORADO

SEC 2 LOCATION:

COLO. OIL & GAS CONS. COMM.

SEC 17 TWP 9S RGE 92W

Other Services

CDL/CNLOG
BHC

Permanent Datum G.L. Elev. 7620

Log Measured from K.B. 12 Ft. Above Permanent Datum

Drilling Measured from K.B.

Elev.
KB 7632
DF
GL 7620

Date	7-9-82			
Run No.	ONE			
Service Order	51756			
Depth — Driller	8575			
Depth — Logger	8580			
Bottom Logged Interval	8578			
Top Logged Interval	710			
Casing — Driller	8 5/8 @ 710	@	@	@
Casing — Logger	710			
Bit Size	7 7/8			
Type Fluid in Hole	GEL			
Density and Viscosity	9.3 55			
pH and Fluid Loss	8.0 8.0 cc	cc	cc	cc
Source of Sample	FLOWLINE			
Rm @ Meas. Temp.	2.81 @ 88 °F	@ °F	@ °F	@ °F
Rmf @ Meas. Temp.	2.01 @ 78 °F	@ °F	@ °F	@ °F
Rmc @ Meas. Temp.	3.98 @ 78 °F	@ °F	@ °F	@ °F
Source of Rmf and Rmc	M M			
Rm @ BHT	1.06 @ 238 °F	@ °F	@ °F	@ °F
Time Since Circ.	16 HRS			
Max. Rec. Temp. Deg. F.	236 °F	°F	°F	°F
Equip. No. and Location	5351 [illegible]			
Recorded By	TOPPER/VAN-MILLER			
Witnessed By	[illegible]			

FOLD HERE

Remarks:

EQUIPMENT DATA

	RUN NO. 1 DIFL	RUN NO. 1 G/R	RUN NO. 1 CALIPER	RUN NO. 2 DIFL	RUN NO. 2 G/R	RUN NO. 2 CALIPER	RUN NO. 3 DIFL	RUN NO. 3 G/R	RUN NO. 3 CALIPER
Tool Series No.	1503	1309							
Serial No.	57595	55349							
Diameter	3 3/8"	3 5/8"							
Tool Position	1.55 C								
Detec. Model No.		0764							
Type		SCINT.							
Panel Series No.	3761	3751							
Serial No.	45355	45355							

LOGGING DATA

LOGGING SCALES

Run No.	Depths From	Depths To	Speed Ft/Min.	Resistivity Scale (Ohm m²/m)	Conductivity Scale (mmhos/m)	Acoustic Scale (μ sec./ft.)	GR Scale (API Units)	Caliper Scale (Inches)	Rwa Scale Ohm m	Δt ma Value μ sec./ft.	Δt Shale Value μ sec./ft.	S.P. Scale (Millivolts)
ONE	8578	710	REC.	2,20000,200		--	0,150	6,16	--	--	--	0,100

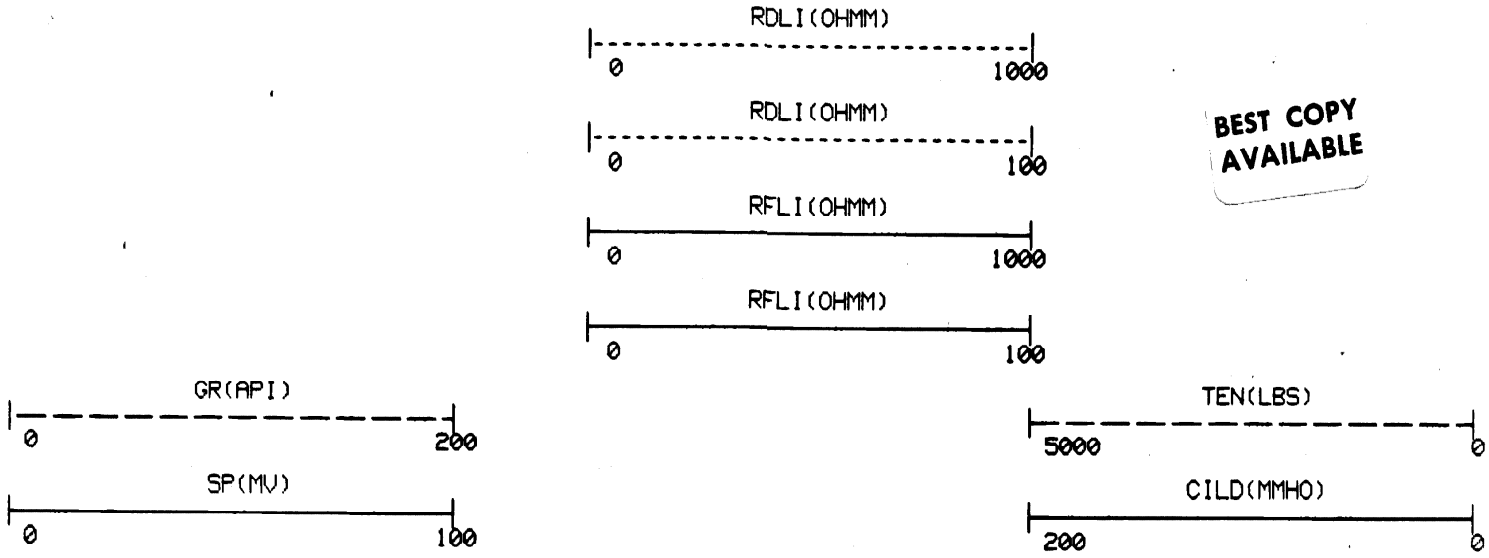
SHEEP CREEK FIELD TYPE LOG 077-08500

COMPANY: COORS ENERGY

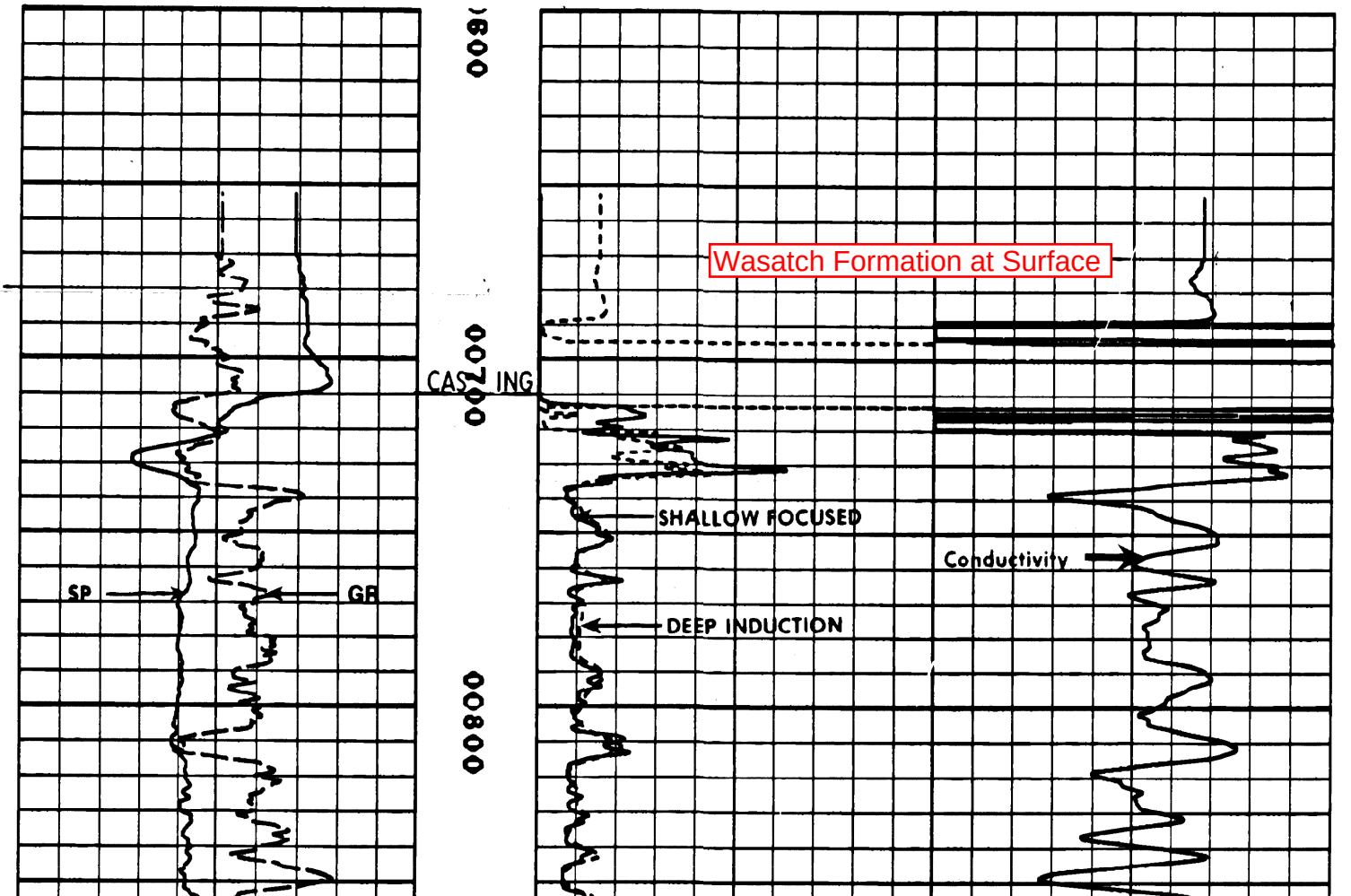
WELL NAME: USA 1-17SC FIELD: SHEEP CREEK IN MESA COUNTY, COLORADO

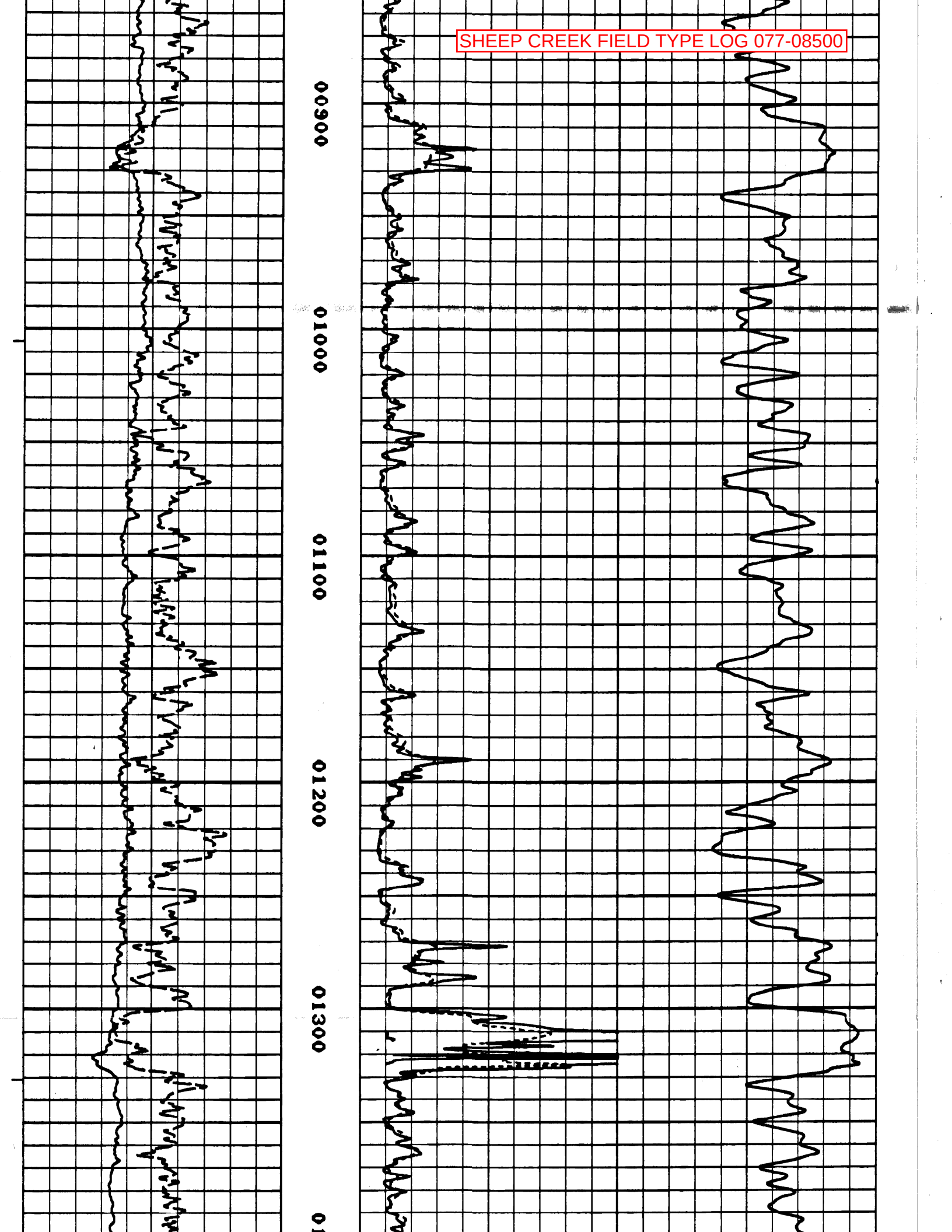
SERVICE: K 212L FILE: 3 DATE: 7/ 9/82 TIME: 10: 2:15

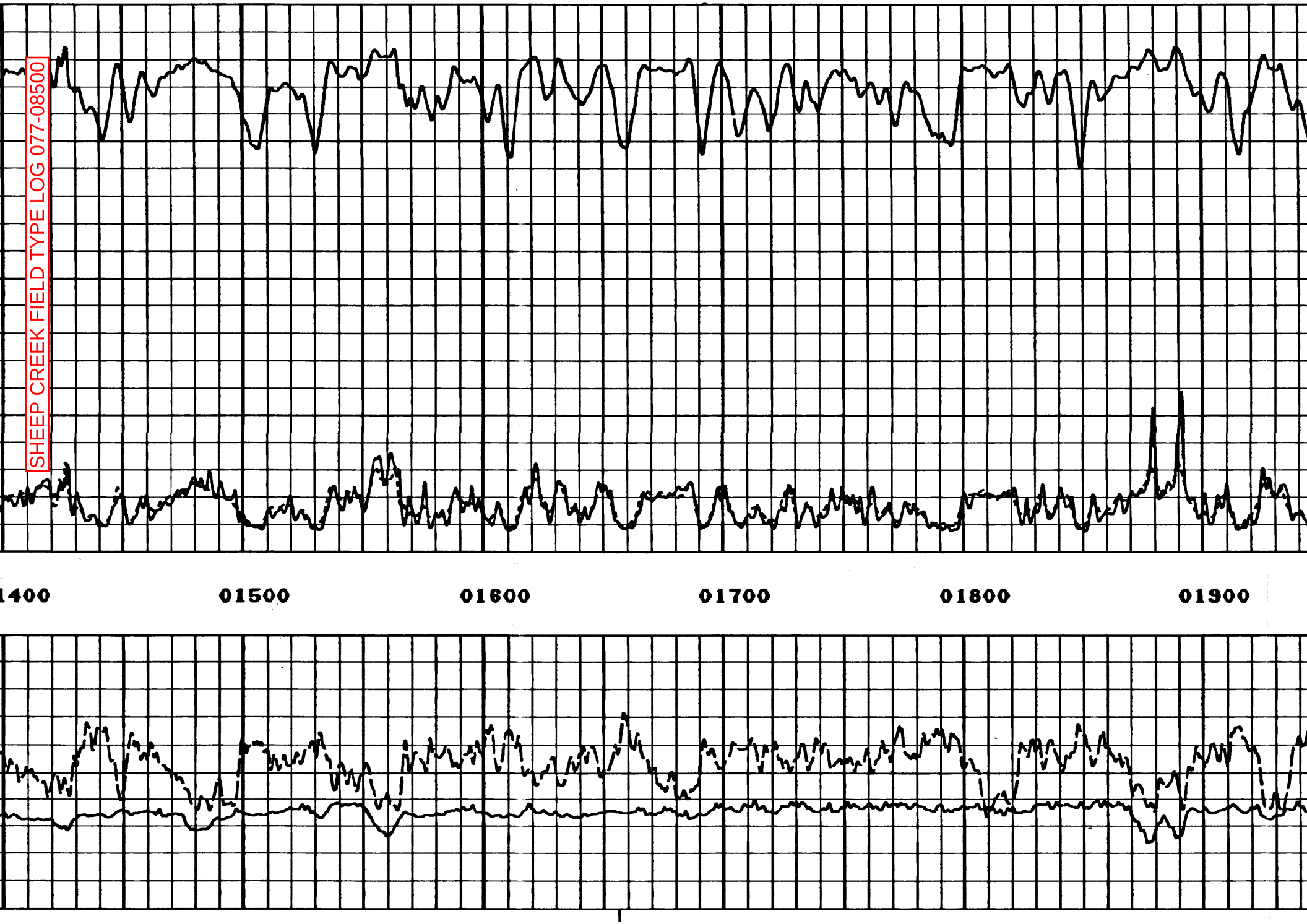
REVISION: REV D005 MODE: PLAYBACK

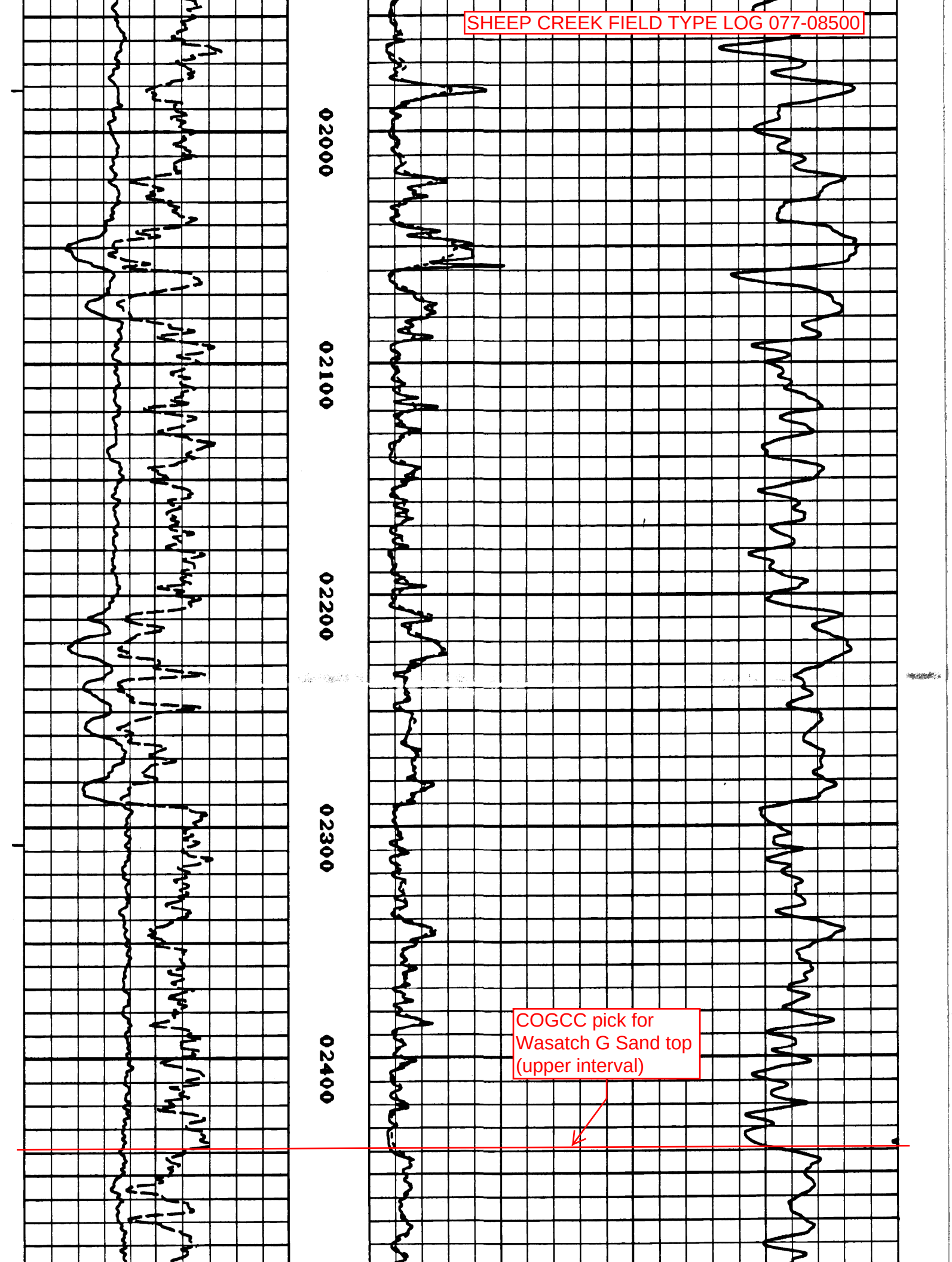


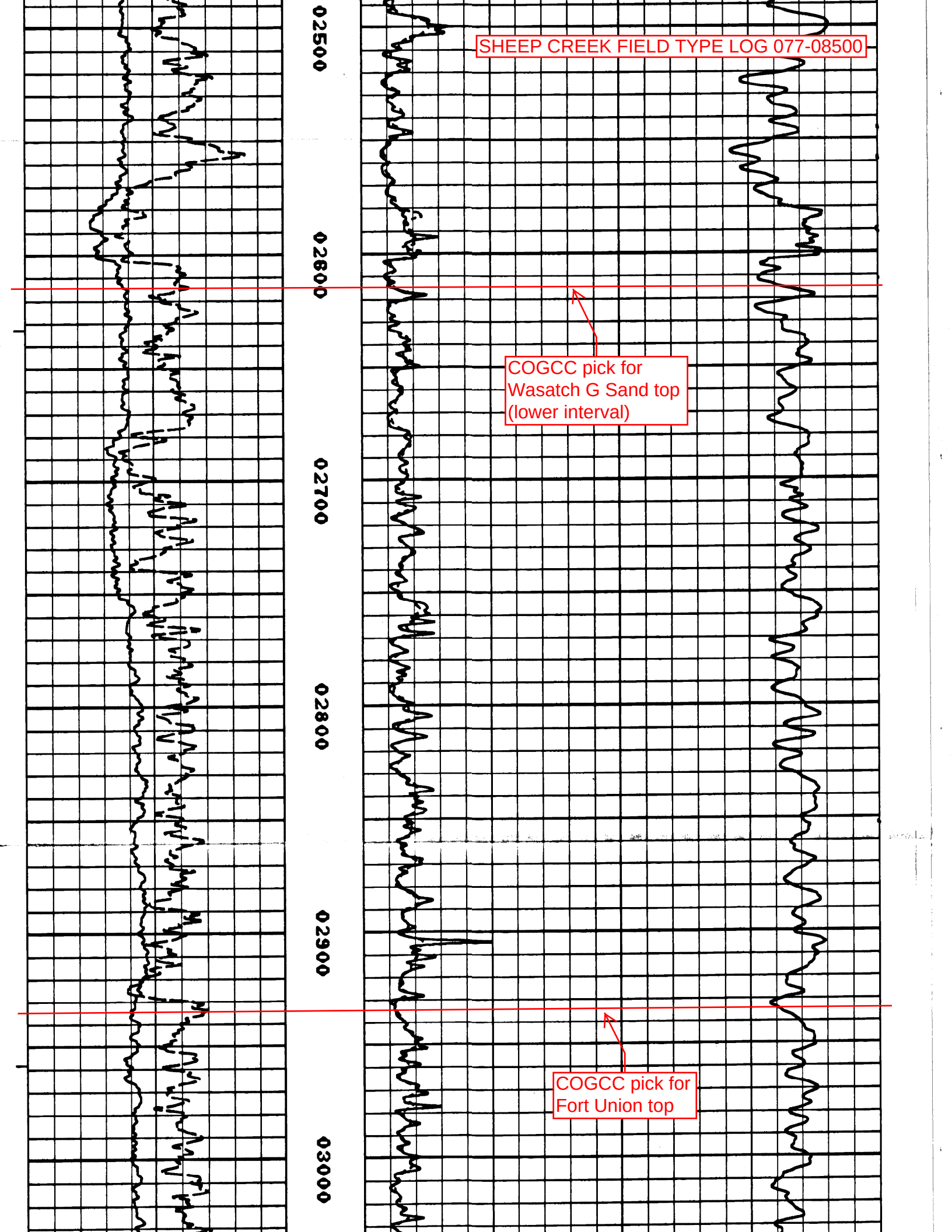
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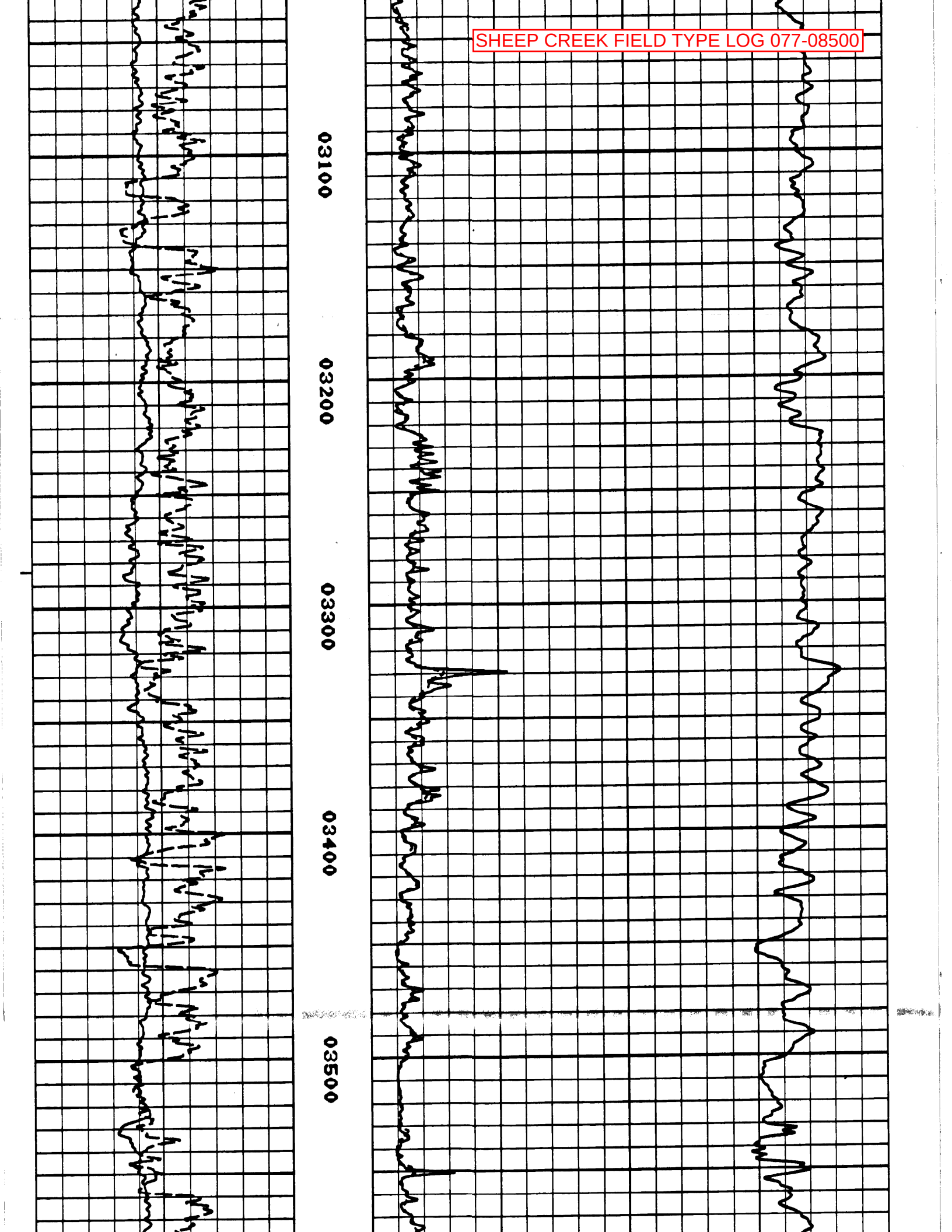


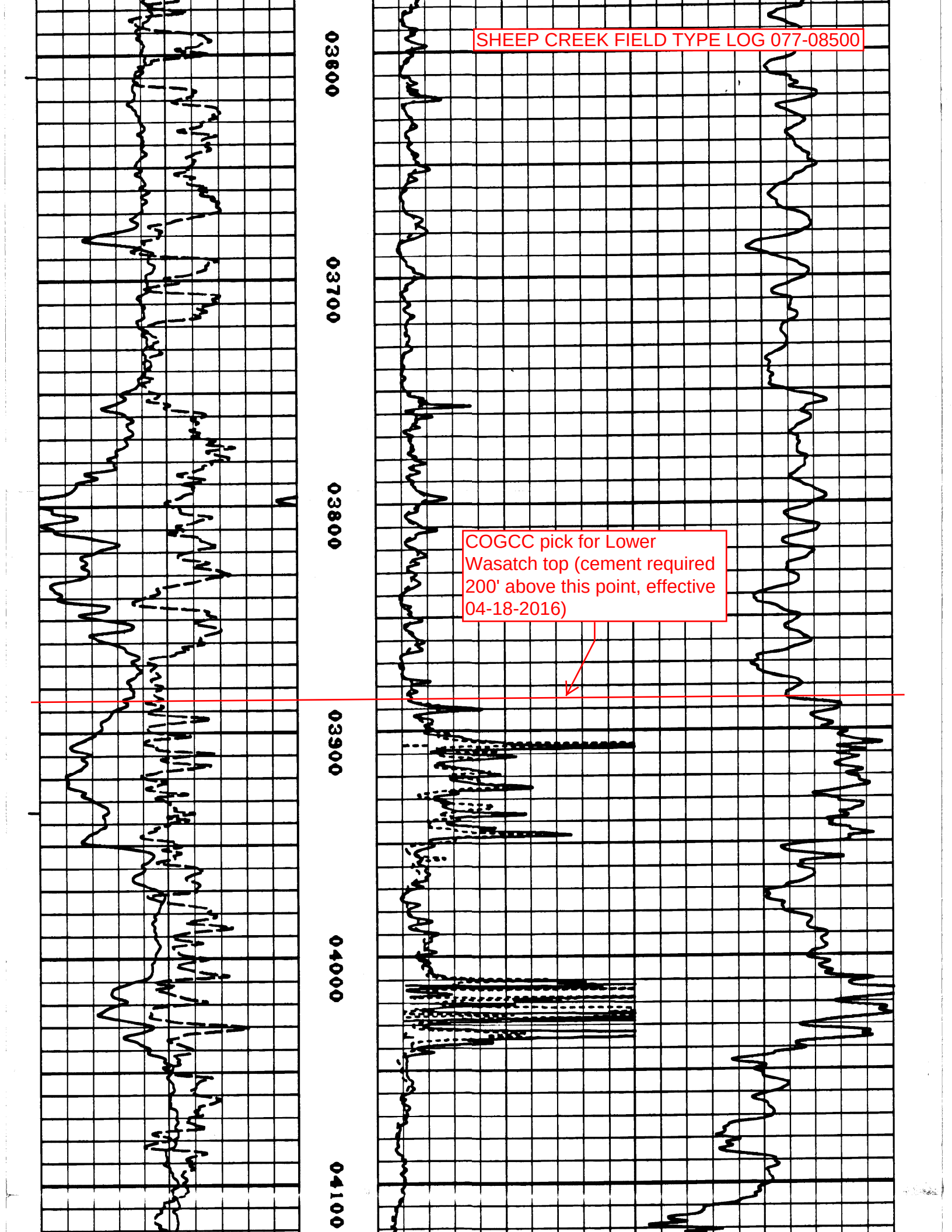

SHEEP CREEK FIELD TYPE LOG 077-08500
00900
01000
01100
01200
01300

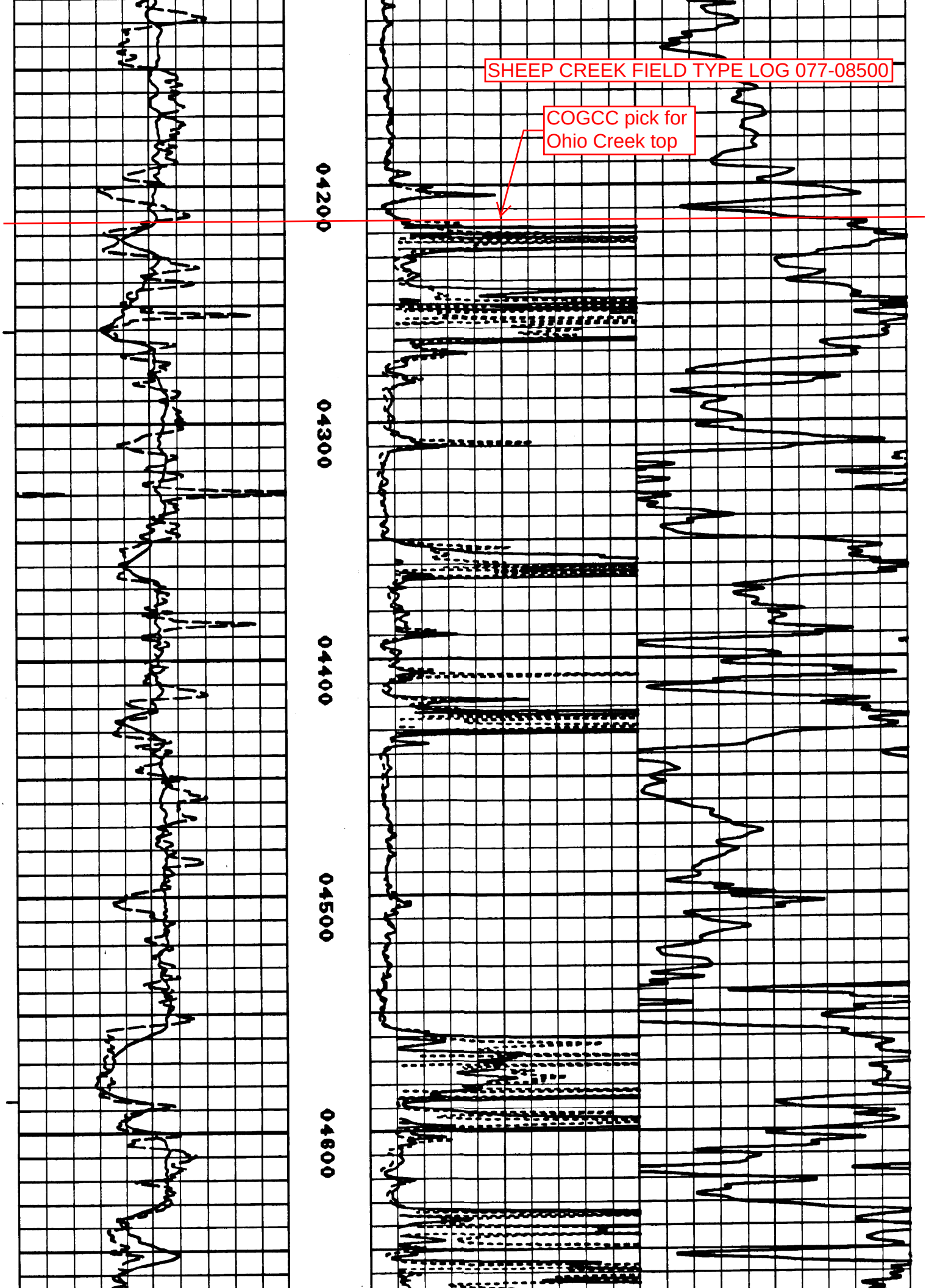

SHEEP CREEK FIELD TYPE LOG 077-08500
1400
01500
01600
01700
01800
01900

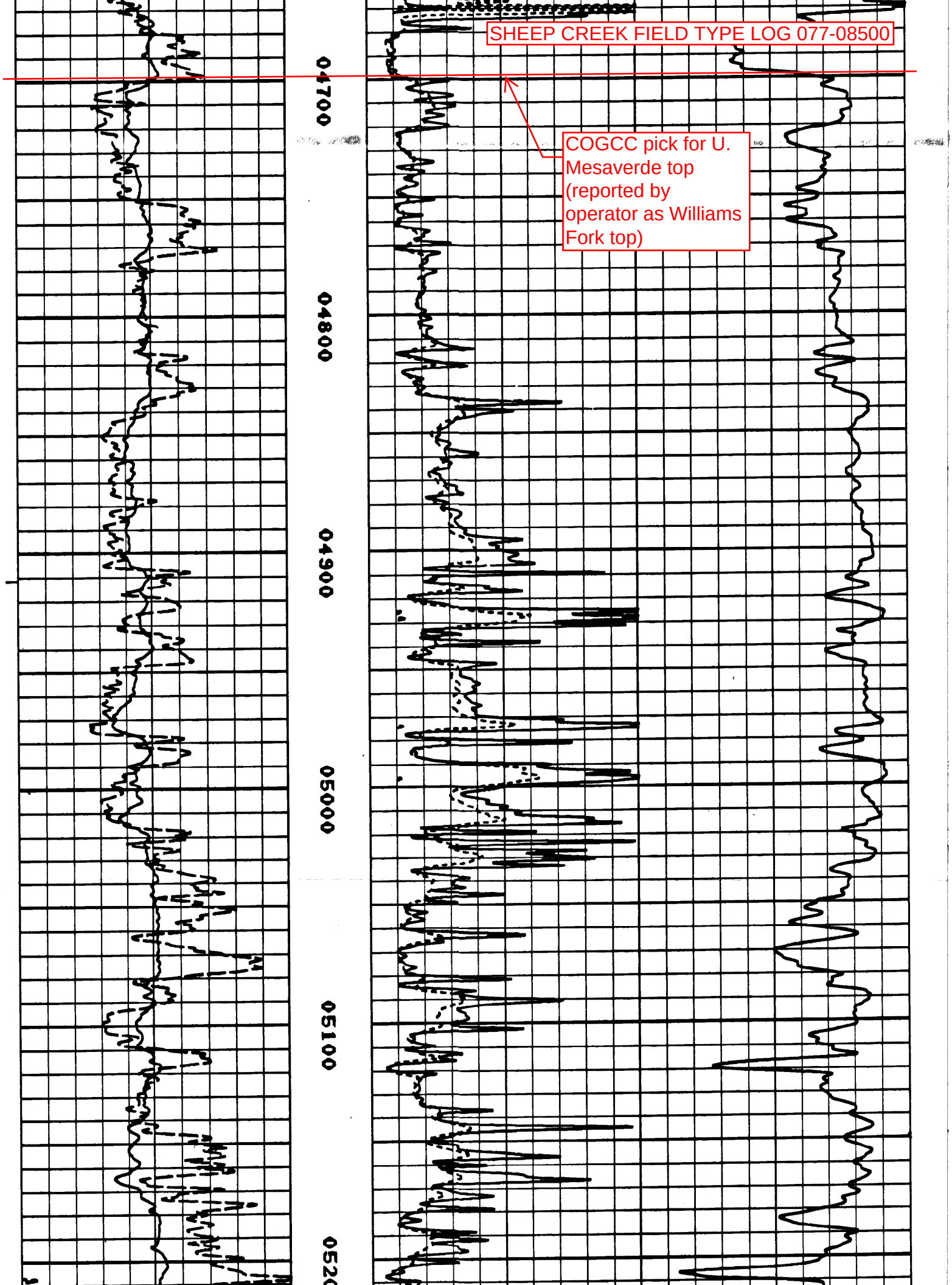

SHEEP CREEK FIELD TYPE LOG 077-08500
02000
02100
02200
02300
02400
COGCC pick for
Wasatch G Sand top
(upper interval)

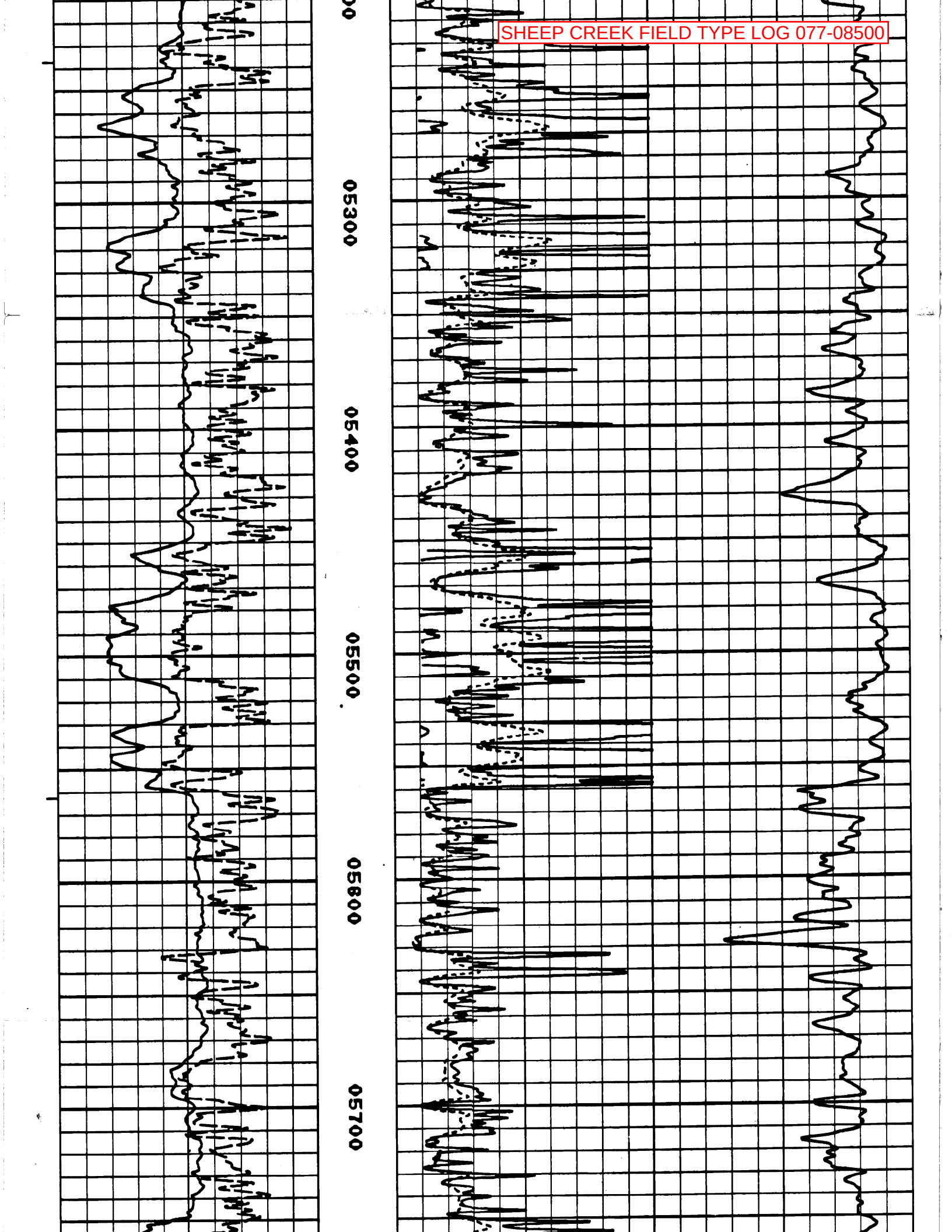

SHEEP CREEK FIELD TYPE LOG 077-08500
02500
02600
02700
02800
02900
03000
COGCC pick for
Wasatch G Sand top
(lower interval)
COGCC pick for
Fort Union top

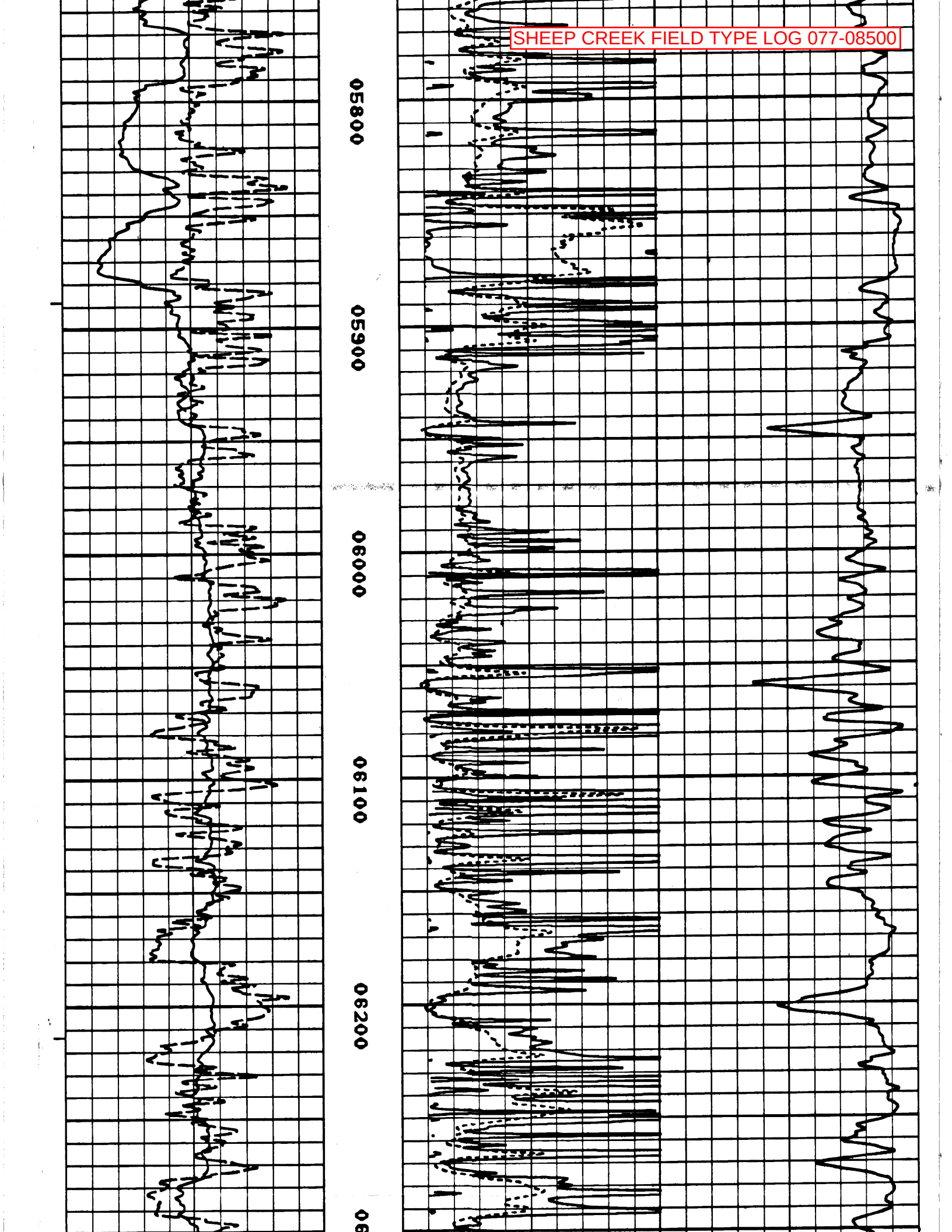

SHEEP CREEK FIELD TYPE LOG 077-08500
03100
03200
03300
03400
03500


SHEEP CREEK FIELD TYPE LOG 077-08500
03600
03700
03800
03900
04000
04100
COGCC pick for Lower Wasatch top (cement required 200' above this point, effective 04-18-2016)


SHEEP CREEK FIELD TYPE LOG 077-08500
COGCC pick for
Ohio Creek top
04200
04300
04400
04500
04600


SHEEP CREEK FIELD TYPE LOG 077-08500
COGCC pick for U. Mesaverde top (reported by operator as Williams Fork top)
04700
04800
04900
05000
05100


SHEEP CREEK FIELD TYPE LOG 077-08500
05300
05400
05500
05600
05700


SHEEP CREEK FIELD TYPE LOG 077-08500
05800
05900
06000
06100
06200

SHEEP CREEK FIELD TYPE LOG 077-08500

06300

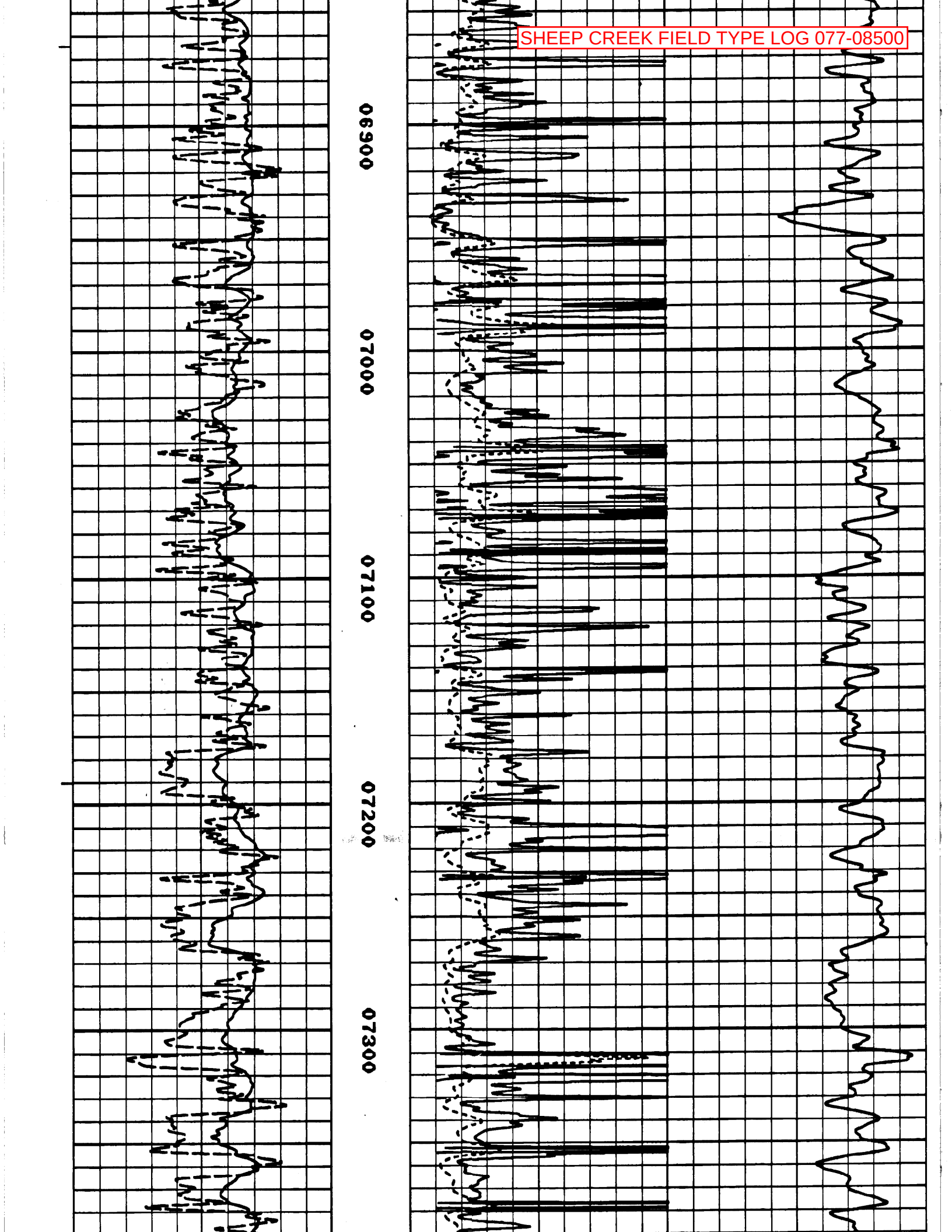
06400

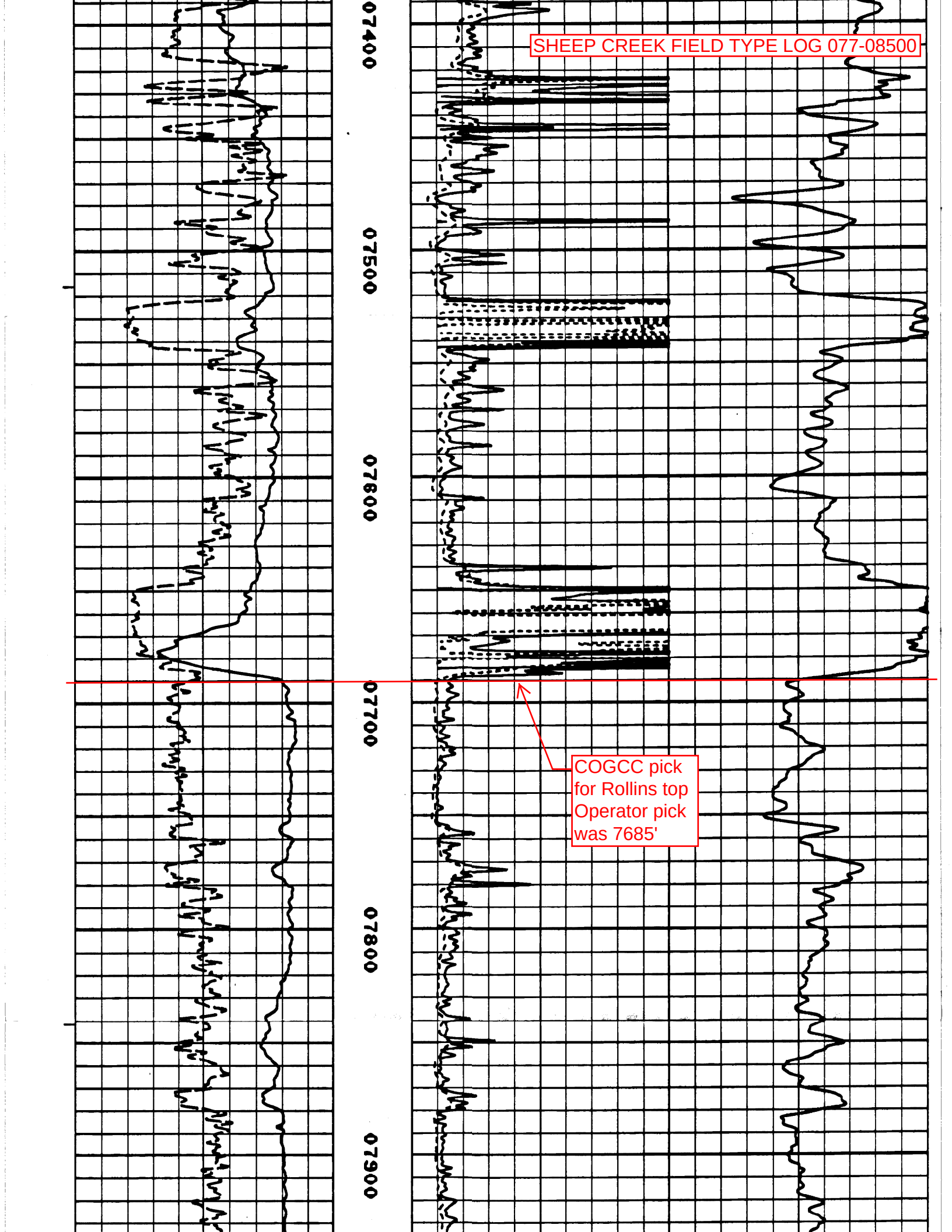
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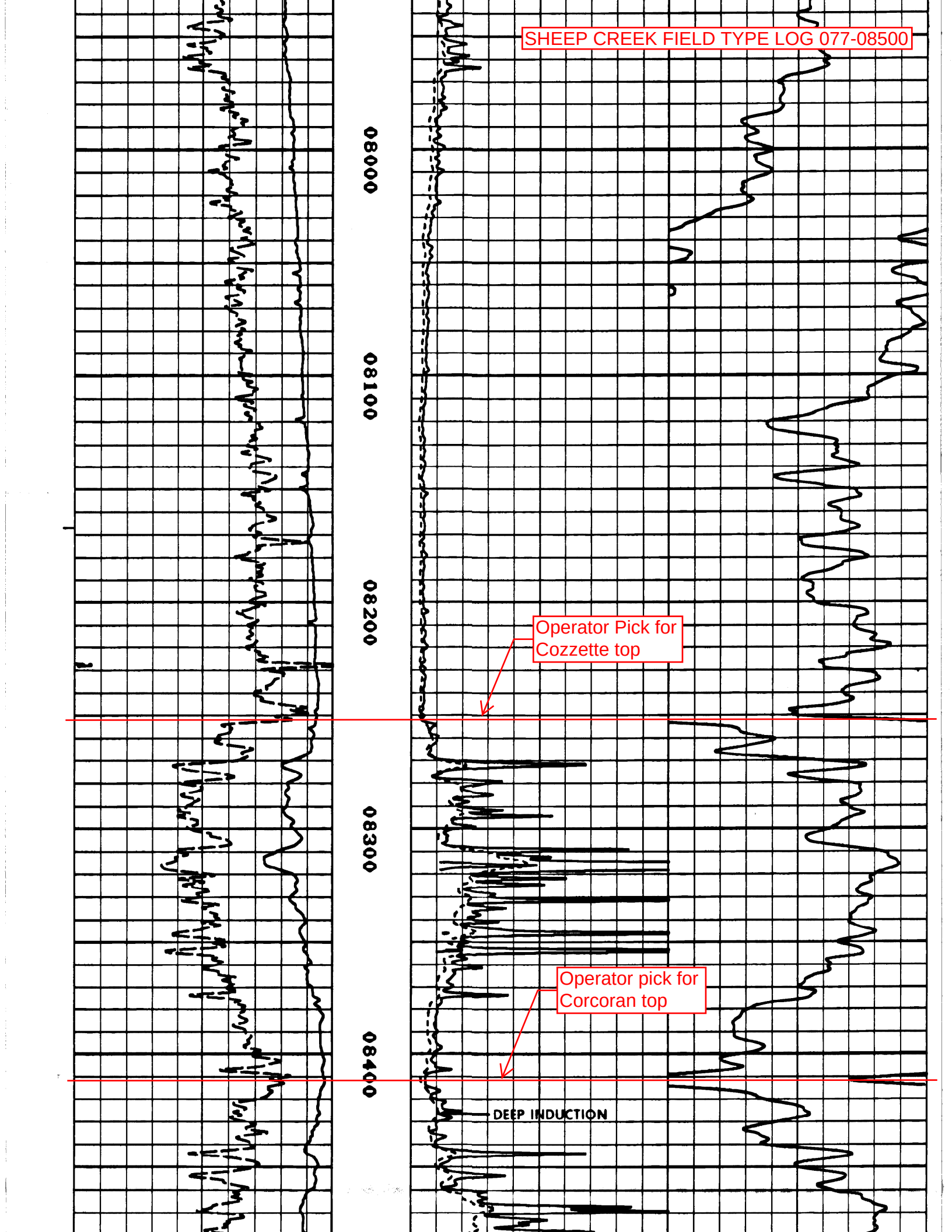
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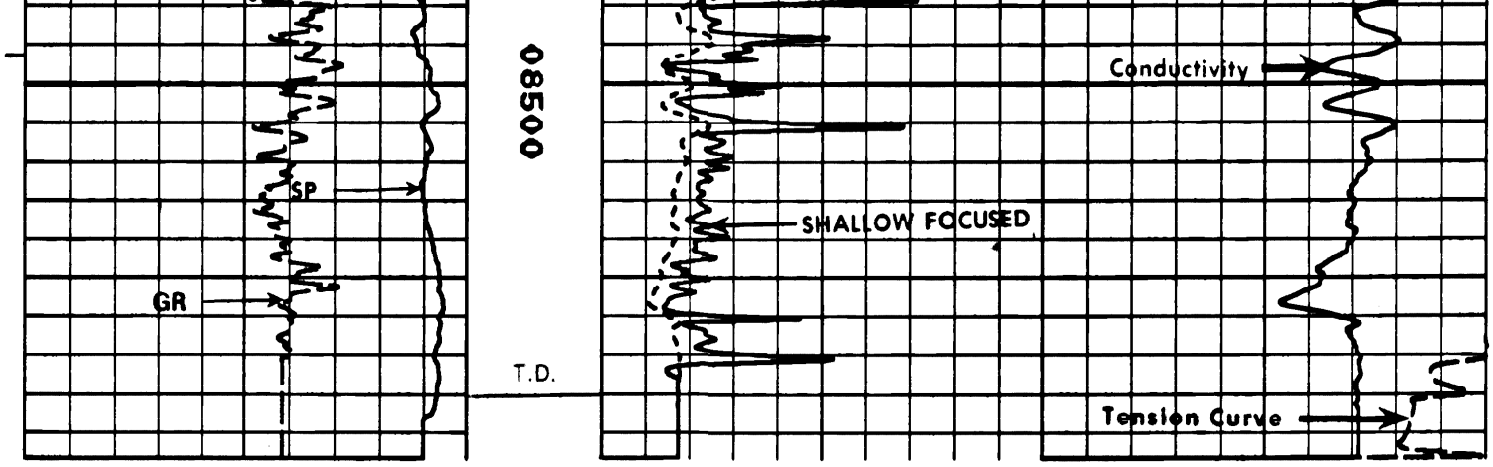
06700

06800

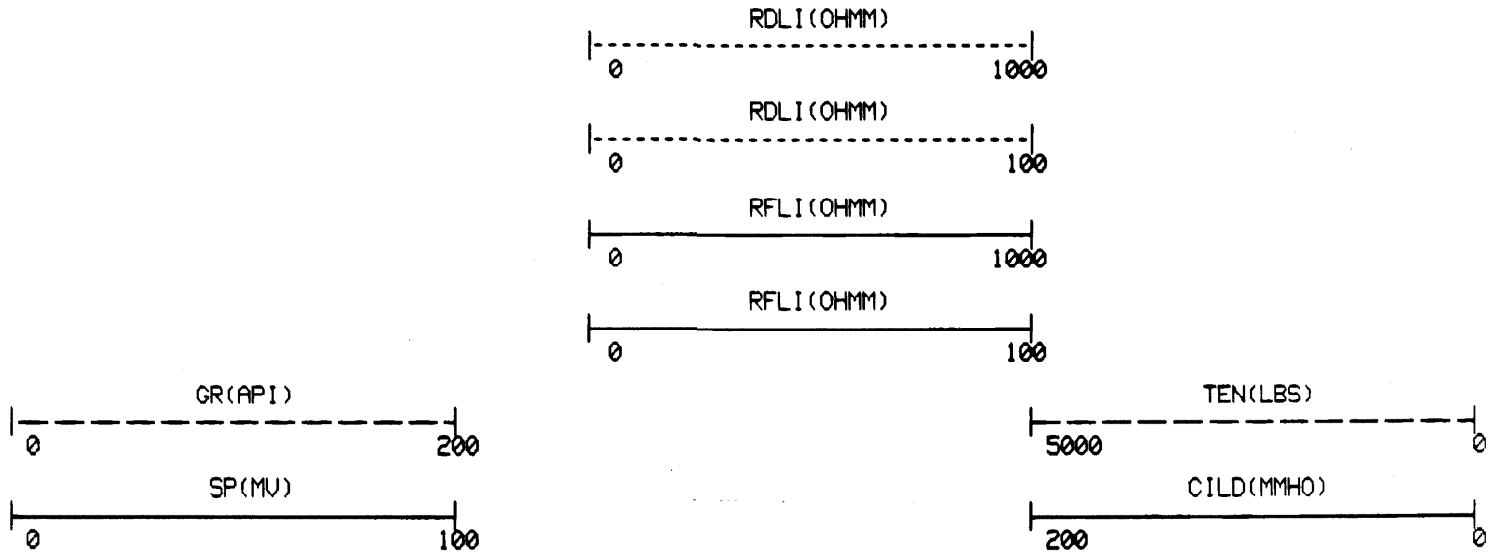

SHEEP CREEK FIELD TYPE LOG 077-08500
06900
07000
07100
07200
07300


SHEEP CREEK FIELD TYPE LOG 077-08500
07400
07500
07600
07700
07800
07900
COGCC pick
for Rollins top
Operator pick
was 7685'


SHEEP CREEK FIELD TYPE LOG 077-08500
08000
08100
08200
08300
08400
Operator Pick for Cozzette top
Operator pick for Corcoran top
DEEP INDUCTION



SHEEP CREEK FIELD TYPE LOG 077-08500



Company	COORS ENERGY	Drillers T.D.	8575
Well	USA 1-17 SC	Log F.R.	8578
Field	SHEEP CREEK	Log T.D.	8580
County	MESA	Elevations:	
State	COLORADO	K.B. 7632 D.F.	G.L. 7620

COGCC OIL AND GAS FIELD SCOUT CARD

Revised	04/18/2016
Document No.	2056123

FIELD NAME	**VEGA**
FIELD NUMBER	**85930**

LOCATION

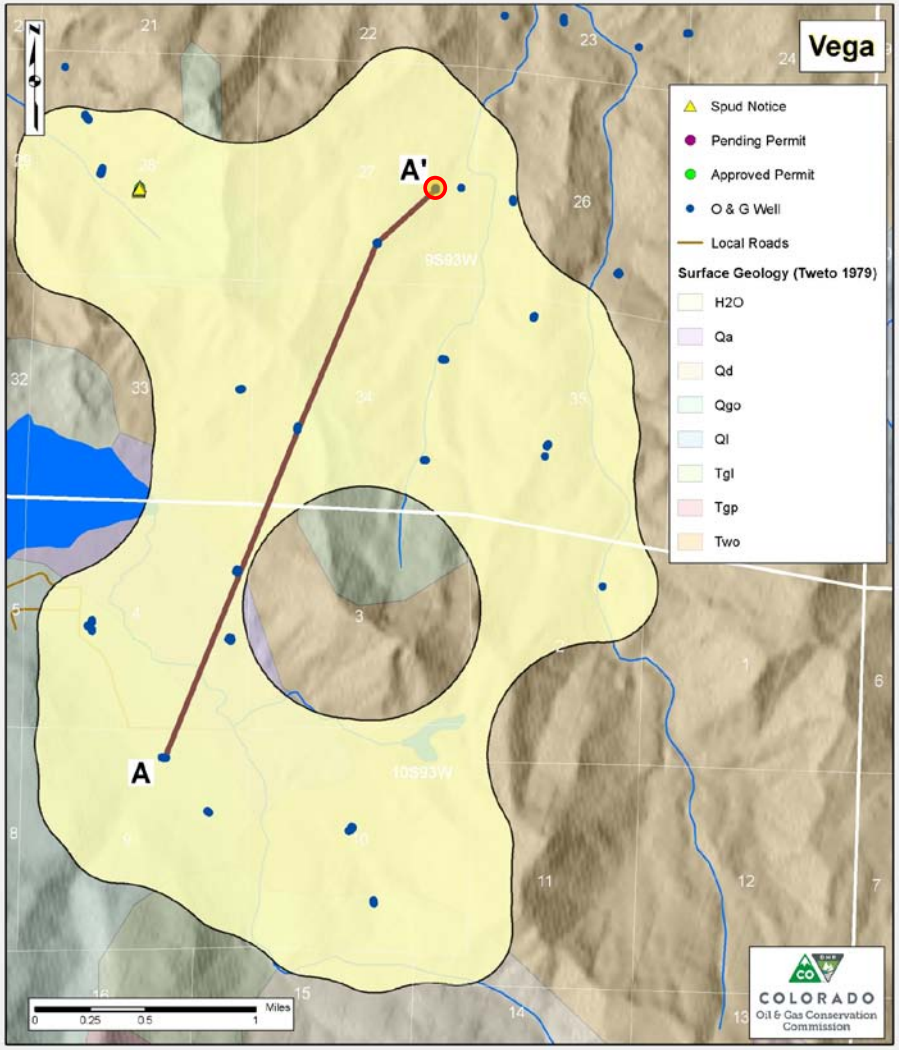
Basin	Piceance
Township(s)	9S to 10S
Range(s)	93W

SURFACE GEOLOGY

Surface Geology generally consists of alluvium in the southwestern portion of the field, underlain by the Wasatch Formation. The Green River Formation outcrops, overlying the Wasatch Formation, in the north-central and northwestern portions of the field. Glacial drift overlies the Wasatch Formation in the extreme southern portion of the field.

GEOLOGIC STRUCTURE

None present within this field or nearby on COGCC's 250K GIS Geology layer.



Type Log Well

COGCC OIL AND GAS FIELD SCOUT CARD
VEGA #85930

				A - Southwest			A' - Northeast
STRATIGRAPHY			**API Number =>**	**077-08096**	**077-08132**	**077-09289**	**077-09288**
			Surface Elevation =>	**8,150**	**8,140**	**7,896**	**7,720**
All depths are measured depths			**Well Type =>**	**Vertical**	**Vertical**	**Vertical**	**Directional**
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water	0			
	Glacial Drift		Water				
	Green River		Water				
	Wasatch	Upper	Shallow Water		0	0	0
	Wasatch	G-Sand*	None	2,652/2,860*	3,036/3200*		2,845/2,976*
	Wasatch	Fort Union*	None	3,123*	3,540*		3,340*
	Wasatch	Middle	None				
	Wasatch	Lower*	Water	4,050*	4,410*		4,163*
Mesaverde	Williams Fork	Ohio Creek	Water / UIC	4,221*	4,615*		4,501*
Mesaverde	Williams Fork	U. Mesaverde	Water / UIC	4,630*	5,034*		4,930*
Mesaverde	Williams Fork	Top of Gas	Gas			6,442	6,160
Mesaverde	Williams Fork	Cameo	Gas			7,747	7,535
Mesaverde	Iles	Rollins	Gas	7,550*	8,060*	8,052	7,911
Mesaverde	Iles	Cozzette	Gas	8,090	8,585	8,637	8,521
Mesaverde	Iles	Corcoran	Gas	8,290	8,766	8,824	8,707
	Mancos		Possible Gas				
	Niobrara		Possible Gas				

Annotated Type Log for 077-09288: COGCC Document Number 2056082

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval.
"Middle Wasatch" is an interval that may include multiple formation members, and therefore, log tops are not presented for the Middle Wasatch.

** COGCC log picks (Wasatch G-Sand [top of upper and lower intervals] and Fort Union are not commonly recognized by operators in this field; however, Wasatch G is completed in a shallow well in the adjacent Buzzard Creek Field to the north, 077-08637, NWNE 14-9S-93W; "Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

WATER RESOURCE ISOLATION

Alluvium, glacial drift, Green River, Upper Wasatch (weathered portion in which water supply wells are screened), Lower Wasatch, Ohio Creek, and Upper Mesaverde. The deepest water well within the vicinity of the field is 590' (likely Wasatch)

PRODUCING ZONE ISOLATION

Primary Objectives: Mesaverde Group (Williams Fork, Cameo, Rollins, Cozzette, and Corcoran)

COGCC OIL AND GAS FIELD SCOUT CARD
VEGA #85930

UNDERGROUND INJECTION CONTROL

API Number	Well Name and Number	Type	Zone	Sample Top	Sample Bottom	TDS	Source
077-09042	Vega Unit #34-13D	Disposal	Ohio Creek[1]	4,724	5,023	13,300	SWAB - 7/17/2009[2]
077-09042	Vega Unit #34-13D	Disposal	Ohio Creek[1]	4,724	5,023	15,200	SWAB - 7/18/2009[2]
077-08132	Vega Unit #2	Disposal	Ohio Creek[1,3]	4,925	5,062	16,900	SWAB - 12/5/2008
077-09042	Vega Unit #34-13D	Disposal	Williams Fork[4]	5,039	5,039	6,999	FB avg - 11/7/2006
077-08132	Vega Unit #2	Disposal	Williams Fork[3,4]	5,184	5,450	21,567	SWAB - 5/16/2011
077-08132	Vega Unit #2	Disposal	Williams Fork[3,4]	5,184	5,450	23,341	SWAB - 5/19/2011
077-08132	Vega Unit #2	Disposal	Williams Fork[3,4]	5,184	5,450	21,799	SWAB - 5/20/2011
077-08934	Vega #10-23	Source	Williams Fork	6,230	7,606	22,794	SEP - 8/18/2008
077-08920	Vega #34-14	Source	Williams Fork	6,400	7,976	25,409	SEP - 8/18/2008
077-08933	Vega Unit #10-33	Source	Williams Fork	6,741	7,533	22,220	WH - 11/29/2007
077-09093	Vega Unit #10-131	Source	Williams Fork - Rollins	6,000	7,965	17,965	SEP - 8/18/2008
077-09465	Vega #4-234	Source	Williams Fork - Rollins	6,118	7,743	20,265	SEP - 8/18/2008
077-09238	Vega Unit #4-241	Source	Williams Fork - Rollins	6,226	7,700	21,925	SEP - 8/18/2008
077-09461	Vega #4-331	Source	Williams Fork - Rollins	6,266	7,945	17,190	SEP - 8/18/2008
077-09003	Vega Unit #34-124	Source	Williams Fork - Rollins	6,342	8,286	16,945	WH - 11/29/2007
077-09117	Vega Unit #34-431	Source	Williams Fork - Rollins	6,644	8,137	27,494	SEP - 8/18/2008
077-09242	Vega Unit #10-124	Source	Williams Fork - Rollins	6,689	7,982	24,827	WH - 11/29/2007
077-09452	Vega Fed #34-224	Source	Williams Fork - Rollins	6,789	8,336	27,245	SEP - 8/18/2008
077-09190	Vega Unit #9-321	Source	Williams Fork - Rollins	6,856	7,775	18,273	WH - 11/29/2007
077-08928	Vega Unit #4-34	Source	Williams Fork - Rollins	6,999	7,876	19,188	WH - 11/29/2007
077-09193	Vega Unit #9-224	Source	Williams Fork - Rollins	7,073	7,984	17,856	WH - 11/29/2007
077-09194	Vega Unit #4-244	Source	Williams Fork - Rollins	7,091	7,965	17,089	WH - 11/29/2007
077-09192	Vega Unit #9-221	Source	Williams Fork - Rollins	7,106	7,960	17,713	WH - 11/29/2007
077-09191	Vega Unit #4-341	Source	Williams Fork - Rollins	7,178	8,052	21,650	WH - 11/29/2007
077-09123	Vega Unit #9-421	Source	Williams Fork - Iles	5,862	8,253	20,735	WH - 11/29/2007
077-09134	Vega Unit #34-421	Source	Williams Fork - Iles	6,668	8,652	29,400	SEP - 8/18/2008
077-08929	Vega Unit #9-31	Source	Williams Fork - Iles	6,774	8,406	21,550	WH - 11/29/2007
077-09001	Vega Unit #33-42	Source	Williams Fork - Iles	6,888	8,853	26,398	SEP - 8/18/2008
077-08927	Vega Unit #10-22	Source	Williams Fork - Iles	6,938	8,416	26,458	WH - 11/29/2007

Aquifer Exemption: Ohio Creek 1/4-mile radius around Vega Unit 34-13D (077-09042).

Data in this table is listed first by zone from shallowest to deepest, then by Sample Top depth.

(1) Designated the Wasatch Formation by the operator, but in 2015 COGCC staff contends that this interval is primarily Ohio Creek with some U. Mesaverde.

(2) Injectivity tests reported on production records prior to this 2009 sample but after the 2006 sample. This timing may have created higher TDS artificially.

(3) Vega Unit #2 (077-08132) perforations added on 6/15/2011, but no pre-injection water sample in the file for the new interval from 4,410' to 4,914' (Lower Wasatch & Ohio Creek).

(4) Designated the Ohio Creek Formation by the operator, but in 2015 COGCC staff contends that this interval is entirely below the Ohio Creek Formation in the interval commonly designated Williams Fork or Upper Mesaverde by most operators.

COGCC OIL AND GAS FIELD SCOUT CARD
VEGA #85930

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

399-1 (5/10/1983)	Mesaverde Group: Recognizes all Mesaverde Group formations as a **Common Source** of supply. Establishes 320-acre drilling and spacing units, 600' from unit line.
1-107 (9/20/2004)	Establishes a Bradenhead Monitoring Area, including the Vega Field.
Various	Mesaverde Group: Amends prior orders to allow 20-acre spacing in certain parts of the field, 200' from unit line, 400' well-to-well spacing and one pad per quarter-quarter.
Various	Mesaverde Group: Amends prior orders to allow 10-acre spacing in certain parts of the field, 100' / 200' from unit lines and one pad per quarter-quarter.
399-8 (9/19/2011)	Mesaverde Group and Deeper Formations: Establishes 160-acre drilling and spacing units for vertical and directional wells targeting the Mesaverde Group and Deeper formation objectives (Mancos, Morapos, Niobrara, and Frontier): establishes 10-acre spacing, 600' from unit line, 100' well-to-well spacing and one pad per quarter-quarter.

HISTORIC WELL CONSTRUCTION

Other than one older well with a surface casing set at 1049', surface casing setting depths generally range from 1,800' to 2,300'. Production casing generally terminates in the Iles or underlying Mancos formations. Production casing cement may be limited to coverage of the producing intervals, and coverage may be lacking across parts of the Mesaverde Group and Wasatch Formation.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Minimum surface casing of 5% TVD required for well control in Mesa County (10% TVD recommended) and to cover water resources in the upper interval of the Wasatch Formation. Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. Active UIC wells are also completed in the L. Wasatch and Ohio Creek Formations in this field. New Standards require cementing intermediate (if used) or production casing at least 200' above Lower Wasatch sands, as shown on the annotated type log for this field.

PLUGGING OBJECTIVES

Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Mesaverde Group completions; plug across Ohio Creek and across Lower Wasatch (squeeze to 200' above Lower Wasatch if no annular cement coverage); stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000-foot intervals if plugs are not already planned in those intervals as described above (may be a concern with shallow-set surface casing < 2,000 feet); surface casing shoe plug and surface plug.

NOTES

This field is located within the Bradenhead Monitoring Area. Special requirements and Form 2 Conditions of Approval apply.

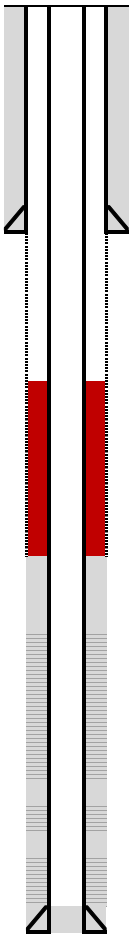
ISOLATION REQUIREMENTS FOR TYPICAL WELLS

Date 04/18/2016 **COGCC Document No.** 2056124

FIELD NAME **VEGA**
FIELD NUMBER **85930**

LOCATION
Basin Piceance
Township(s) 9S to 10S
Range(s) 93W

Depth	Formation/Member
0	Alluvium/ Glacial Drift/ Green River/ U. Wasatch
1,000	
2,000	
3,000	Wasatch G
4,000	L. Wasatch
	Ohio Creek U. Mesaverde
5,000	
6,000	
	Top of Gas
7,000	
	Cameo
8,000	Rollins
	Cozzette Corcoran
9,000	



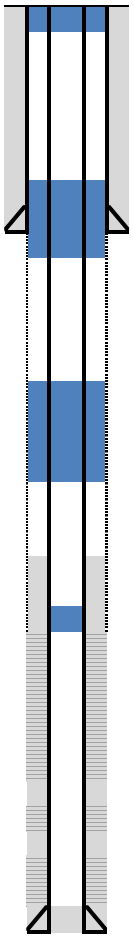
Casing and Cement Coverage

New Surface Casing Standard
Minimum 5% TVD (10% recommended) or cover all apparent water resources in the U. Wasatch, whichever is more stringent. Recommend 1,000 ft or greater based on limited log data and past practices in the field. Setting depth of around 2000 ft is common for newer wells in this field.

New Cement Standard
Cement must provide coverage across Ohio Creek and 200 ft above L. Wasatch, in addition to productive interval coverage.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of U. Mesaverde, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	Alluvium/ Glacial Drift/ Green River/ U. Wasatch
1,000	
2,000	
3,000	Wasatch G
4,000	L. Wasatch
	Ohio Creek U. Mesaverde
5,000	
6,000	
	Top of Gas
7,000	
	Cameo
8,000	Rollins
	Cozzette Corcoran
9,000	



Plug Placement

Surface plug

Surface casing shoe plug

Squeeze plug across Ohio Creek and across L. Wasatch (top of plug 200 ft above L. Wasatch)

Plug above Mesaverde Group Completions

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HIGH RESOLUTION INDUCTION LOG

VEGA FIELD TYPE LOG 077-09288

COGCC Document Number 2056082

04-18-2016

077-09288

COMPANY	DELTA PETROLEUM CORPORATION
WELL	NORTH VEGA 27-431
FIELD	VEGA
COUNTY	MESA
STATE	CO

COMPANY DELTA PETROLEUM CORPORATION
WELL NORTH VEGA 27-431
FIELD VEGA
COUNTY MESA
STATE CO
API No. 05077092800
Location SURFACE: 2344' FSL, 1008' FEL
BOTTOM: 2344' FSL, 1000' FEL
Sect. 27 Twp. 09S Rge. 93W
SDL/DSN

RECEIVED
MAR 28 2008
COGCC

Permanent Datum	GROUND LEVEL	Elev. 7720.0 ft	Elev.: K.B. 7737.5 ft
Log measured from	KELLY BUSHING	17.5 ft above perm. Datum	D.F. 7736.5 ft
Drilling measured from	KELLY BUSHING		G.L. 7720.0 ft

Date	Run No.	Depth - Driller	Depth - Logger	Bottom - Logged Interval	Top - Logged Interval	Casing - Driller	Casing - Logger	Bit Size	Type Fluid in Hole	Density	Viscosity	PH	Fluid Loss	Source of Sample	Rm @ Meas. Temperature	Rmf @ Meas. Temperature	Rmc @ Meas. Temperature	Source Rmf	Rmc	Rm @ BHT	Time Since Circulation	Time on Bottom	Max. Rec. Temperature	Equipment	Location	Recorded By	Witnessed By
03-Aug-07 14:42:23	ONE	8960.0 ft	8973.0 ft	8963.0 ft	CASING	8.625 in @ 2043.0 ft	2044.0 ft	7.875 in	LSND	9.4 ppg	46.00 s/qt	9.00 pH	6 cptm	FLOWLINE	1.77 ohmm @ 78.00 degF	1.87 ohmm @ 73.00 degF	2.03 ohmm @ 73.00 degF	MEAS	MEAS	0.68 ohmm @ 213.0 degF	6.8 hr	04-Aug-07 18:15:51	213.0 degF @ 8973.0 ft	10549596	FMTN.	L. SMITH	R. BOYLE

Fold here

Service Ticket No.: 5276259		API Serial No.: 05077092800			PGM Version: WL INSITE R1.8 (Build 6)		
CHANGE IN MUD TYPE OR ADDITIONAL SAMPLE					RESISTIVITY SCALE CHANGES		
Date	Sample No.				Type Log	Depth	Scale Up Hole	Scale Down Hole
Depth-Driller								
Type Fluid in Hole								
Density	Viscosity							
Ph	Fluid Loss							
Source of Sample					RESISTIVITY EQUIPMENT DATA			
Rm @ Meas. Temp		@	@		Run No.	Tool Type & No.	Pad Type	Tool Pos.	Other
Rmf @ Meas. Temp.		@	@		ONE	HRI-I133S008	N/A	1.5" S.O.	N/A
Rmc @ Meas. Temp.		@	@						
Source Rmf	Rmc								
Rm @ BHT		@	@						
Rmf @ BHT		@	@						
Rmc @ BHT		@	@						

EQUIPMENT DATA

GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No.	ONE	Run No.		Run No.	ONE	Run No.	ONE
Serial No.	A070	Serial No.		Serial No.	I380P049	Serial No.	108721
Model No.	NGRT	Model No.		Model No.	SDL_DC	Model No.	DSN_II
Diameter	3.625"	No. of Cent.		Diameter	4.0"	Diameter	3.625"
Detector Model No.	102-A	Spacing		Log Type	GAM-GAM	Log Type	NEU-NEU
Type	SCINT.			Source Type	Cs137	Source Type	Am241Be
Length	4"	LSA [Y/N]		Serial No.	2647 GW	Serial No.	DSN_34
Distance to Source	10'	FWDA [Y/N]		Strength	1.5 Ci	Strength	18.5 Ci

LOGGING DATA

GENERAL				GAMMA		ACOUSTIC			DENSITY			NEUTRON		
Run	Depth		Speed	Scale		Scale		Matrix	Scale		Matrix	Scale		Matrix
No.	From	To	ft/min	L	R	L	R		L	R		L	R	
ONE	T.D.	CSG.	REC.	0	200				30%	-10%	2.68 g/cc	30%	-10%	SAND.

VEGA FIELD TYPE LOG 077-09288

DIRECTIONAL INFORMATION

Maximum Deviation @ KOP @

Remarks: HRI-SDL-DSN-GR RAN IN COMBINATION.

ANNULAR HOLE VOLUME CALCULATED FOR 4.5" CASING.

ANNULAR HOLE VOLUME = 2790 FT3.

CHLORIDES REPORTED AT 700 mg/L.

BOREHOLE RUGOSITY, TENSION PULLS AND WASHOUTS MAY AFFECT TOOL RESPONSE.

INDCTION ANOMALIES AT 7535', 7670', 7720', AND 7740' REPEATED ON DOWNLOG.

LATITUDE: 39° 14' N // LONGITUDE: 107° 44' N.

TODAY'S CREW: R. RUSSELL & W. KENNEDY. RIG: DHS #6.

THANK YOU FOR CHOOSING HALLIBURTON ENERGY SERVICES, FARMINGTON, NM.

HALLIBURTON DOES NOT GUARANTEE THE ACCURACY OF ANY INTERPRETATION OF THE LOG DATA, CONVERSION OF LOG DATA TO PHYSICAL ROCK PARAMETERS OR RECOMMENDATIONS WHICH MAY BE GIVEN BY HALLIBURTON PERSONNEL OR WHICH APPEAR ON THE LOG OR IN ANY OTHER FORM. ANY USER OF SUCH DATA, INTERPRETATIONS, CONVERSIONS, OR RECOMMENDATIONS AGREES THAT HALLIBURTON IS NOT RESPONSIBLE EXCEPT WHERE DUE TO GROSS NEGLIGENCE OR WILLFUL MISCONDUCT, FOR ANY LOSS, DAMAGES, OR EXPENSES RESULTING FROM THE USE THEREOF.

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PARAMETERS REPORT

Depth (ft)	Tool Name	Mnemonic	Description	Value	Units
TOP					
	SHARED	BS	Bit Size	7.875	in
	SHARED	UBS	Use Bit Size instead of Caliper for all applications.	No	
	SHARED	MDWT	Borehole Fluid Weight	9.400	ppg
	SHARED	RMUD	Mud Resistivity	1.770	ohmm
	SHARED	TRM	Temperature of Mud	78.0	degF
	SHARED	OBM	Oil Based Mud System?	No	
	SHARED	ICOD	AHV Casing OD	4.500	in
	SHARED	CSD	Logging Interval is Cased?	No	
	SHARED	CSOD	Casing OD size	4.500	in
	SHARED	CSWT	Casing Weight	17.00	lbpf
	SHARED	ST	Surface Temperature	75.0	degF
	SHARED	TD	Total Well Depth	10000.00	ft
	SHARED	BHT	Bottom Hole Temperature	200.0	degF
	SHARED	CSOD	Outer Casing OD size	8.500	in
	SHARED	CSWT	Outer Casing Weight	17.00	lbpf
	Rwa / CrossPlot	XPOK	Process Crossplot?	Yes	
	Rwa / CrossPlot	FCHO	Select Source of F	Automatic	
	Rwa / CrossPlot	AFAC	Archie A factor	0.6200	
	Rwa / CrossPlot	MFAC	Archie M factor	2.1500	
	Rwa /	RMFR	Rmf Reference	0.10	ohmm

CrossPlot				
Rwa / CrossPlot	TMFR	Rmf Ref Temp	75.00	degF
NGRT	GROK	Process Gamma Ray?	Yes	
NGRT	GRSO	Gamma Tool Standoff	0.000	in
NGRT	GEOK	Process Gamma Ray EVR?	No	
DSN_II	DNOK	Process DSN?	Yes	
DSN_II	DEOK	Process DSN EVR?	No	
DSN_II	BHOL	Use DSN Bad Hole Correction?	No	
DSN_II	NLIT	Neutron Lithology	Sandstone	
DSN_II	DNSO	DSNTool Standoff	0.000	in
DSN_II	TMPC	Temperature Correction Type	None	
DSN_II	DPRS	DSN Pressure Correction Type	None	
SDL_DC	DNOK	Process Density?	Yes	
SDL_DC	DNOK	Process Density EVR?	No	
SDL_DC	AD	Is Hole Air Drilled?	No	
SDL_DC	CB	Use Calibration Blocks?	No	
SDL_DC	SPVT	SDLT Pad Temperature Valid?	Yes	
SDL_DC	MDTP	Weighted Mud Correction Type?	None	
SDL_DC	DMA	Formation Density Matrix	2.680	g/cc
SDL_DC	DFL	Formation Density Fluid	1.000	g/cc
SDL_DC	CLOK	Process Caliper Outputs?	Yes	
HRID-SP	HRE	Do HRI Induction Calculation?	Yes	
HRID-SP	DFLE	Do DFL Calculation?	Yes	
HRID-SP	PYRI	Pyrite Switch	Off	
HRID-SP	CSDP	Casing Depth	2010.0	ft
HRID-SP	HDSP	Spike Reduction Filter Type	DELTA	
HRID-SP	HRTC	Temperature Correction Source	None	
HRID-SP	MMRS	Hrimap Minimum Resistivity	0.20	
HRID-SP	MXRS	Hrimap Maximum Resistivity	200.00	

BOTTOM

Data: DELT_VEGA_27431\0002 D4TS-NGRT-DSN-SDL-HRI-TEMPSUB\004 04-Aug-07 18:16 Up @8980.8f

Date: 04-Aug-07 19:08:05

HALLIBURTON

Plot Time: 04-Aug-07 21:40:48
Plot Range: 2020 ft to 8980 ft
Data: {ActiveWell}-Well Based-DAQ-0002-MAIN-
Plot File: \\IND\DELTA_2IN_IND_COND

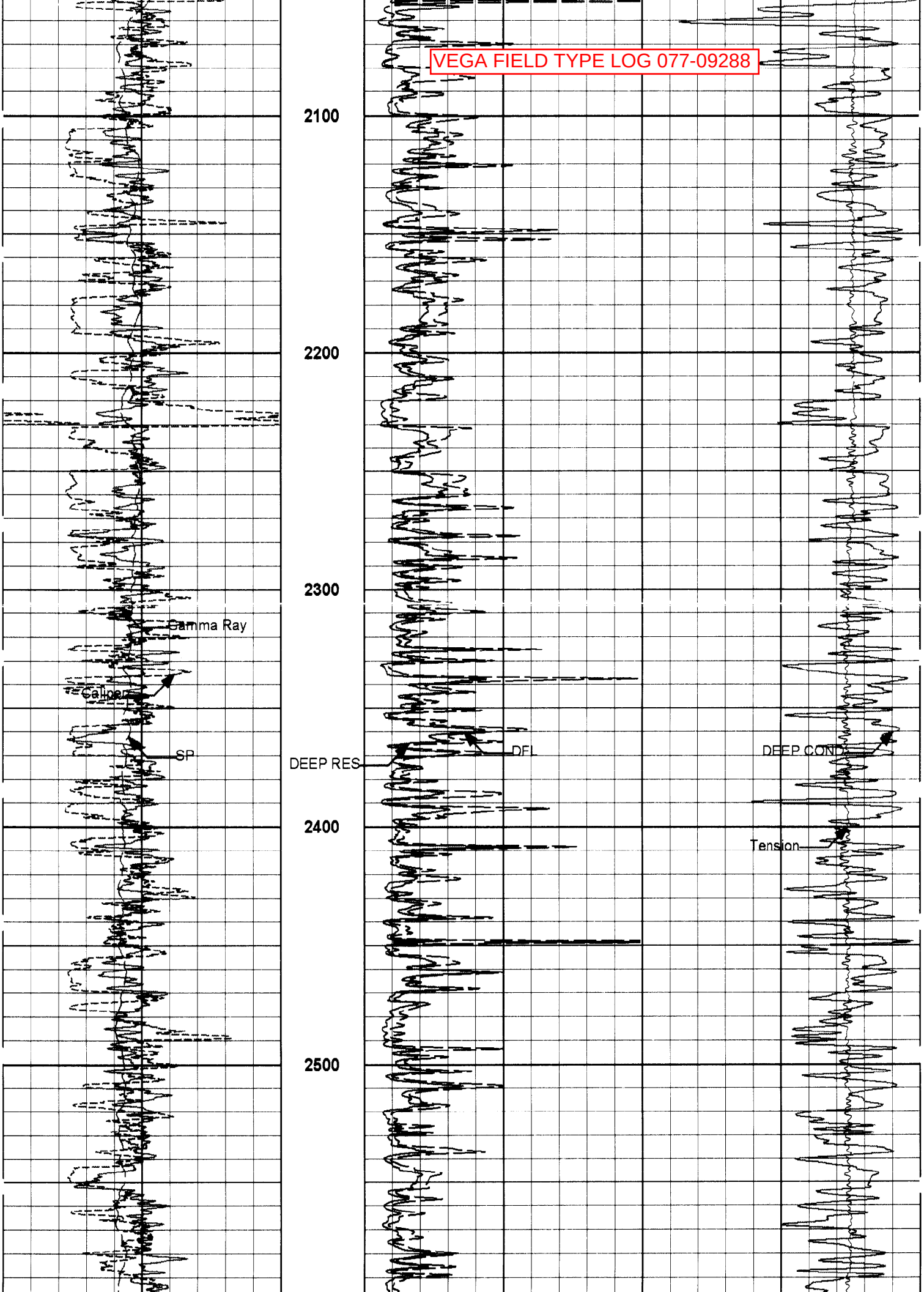
INDUCTION - CONDUCTIVITY PRESENTATION
MAIN LOG SECTION
2" = 100'

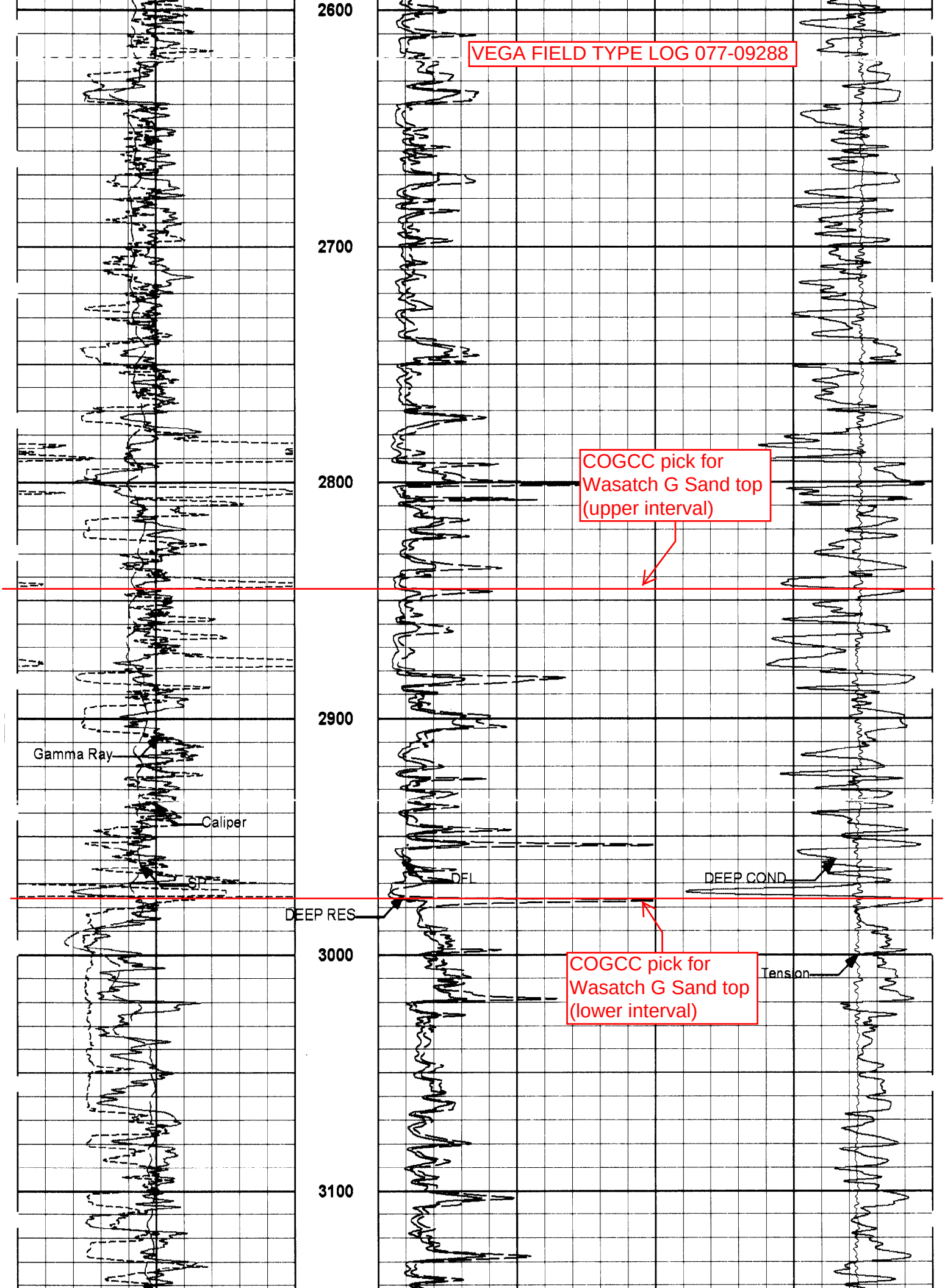
VEGA FIELD TYPE LOG 077-09288

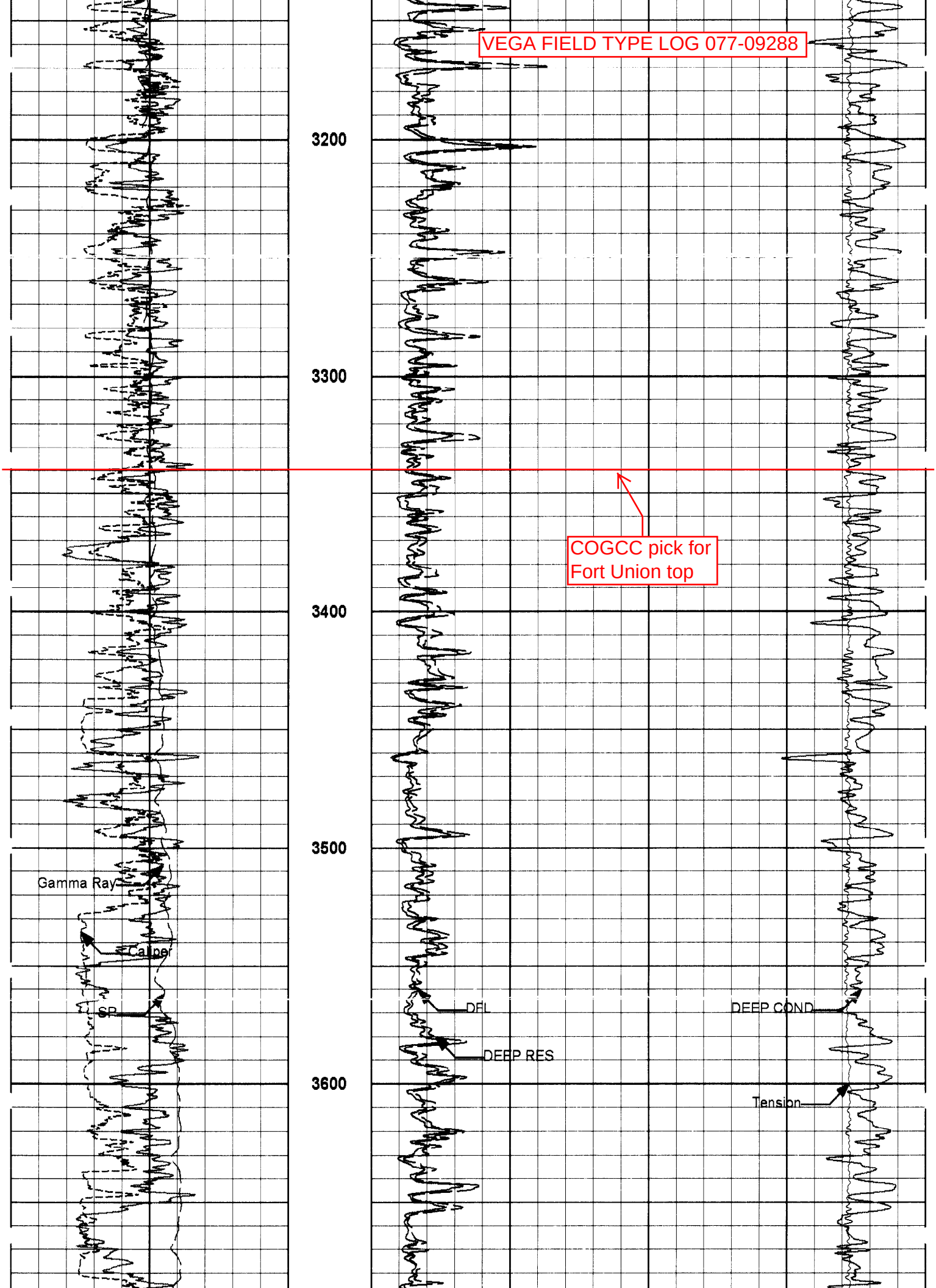
0 Gamma Ray 200		500 DEEP COND 0
api		mmo/m
6 Caliper 16		0 DFL 100 | 10000 Tension 0
inches		ohmm | lbs
SP	MD	0 DEEP RES 100
-]10mV[+	1 : 600 ft	ohmm

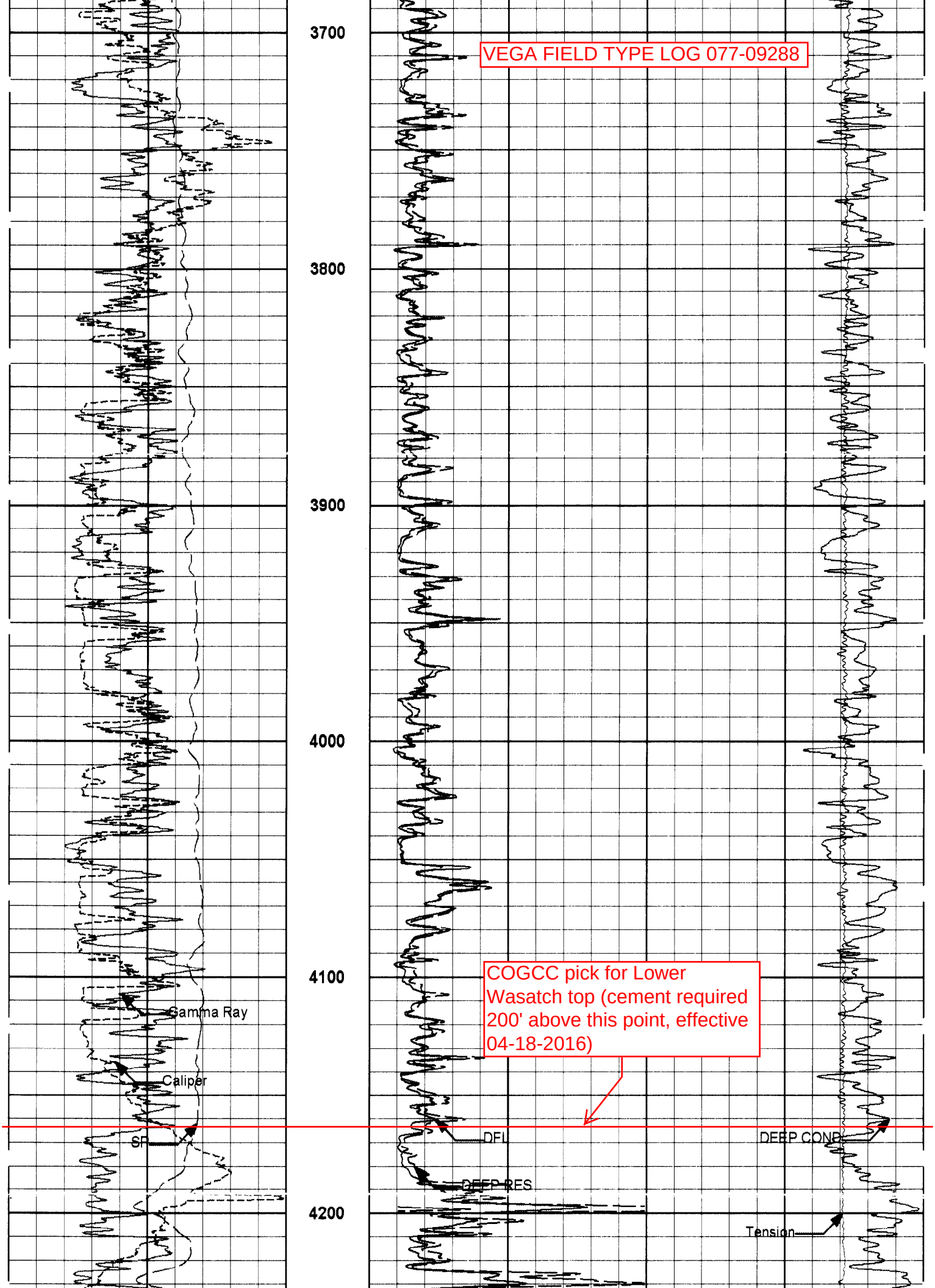
Wasatch Formation at Surface

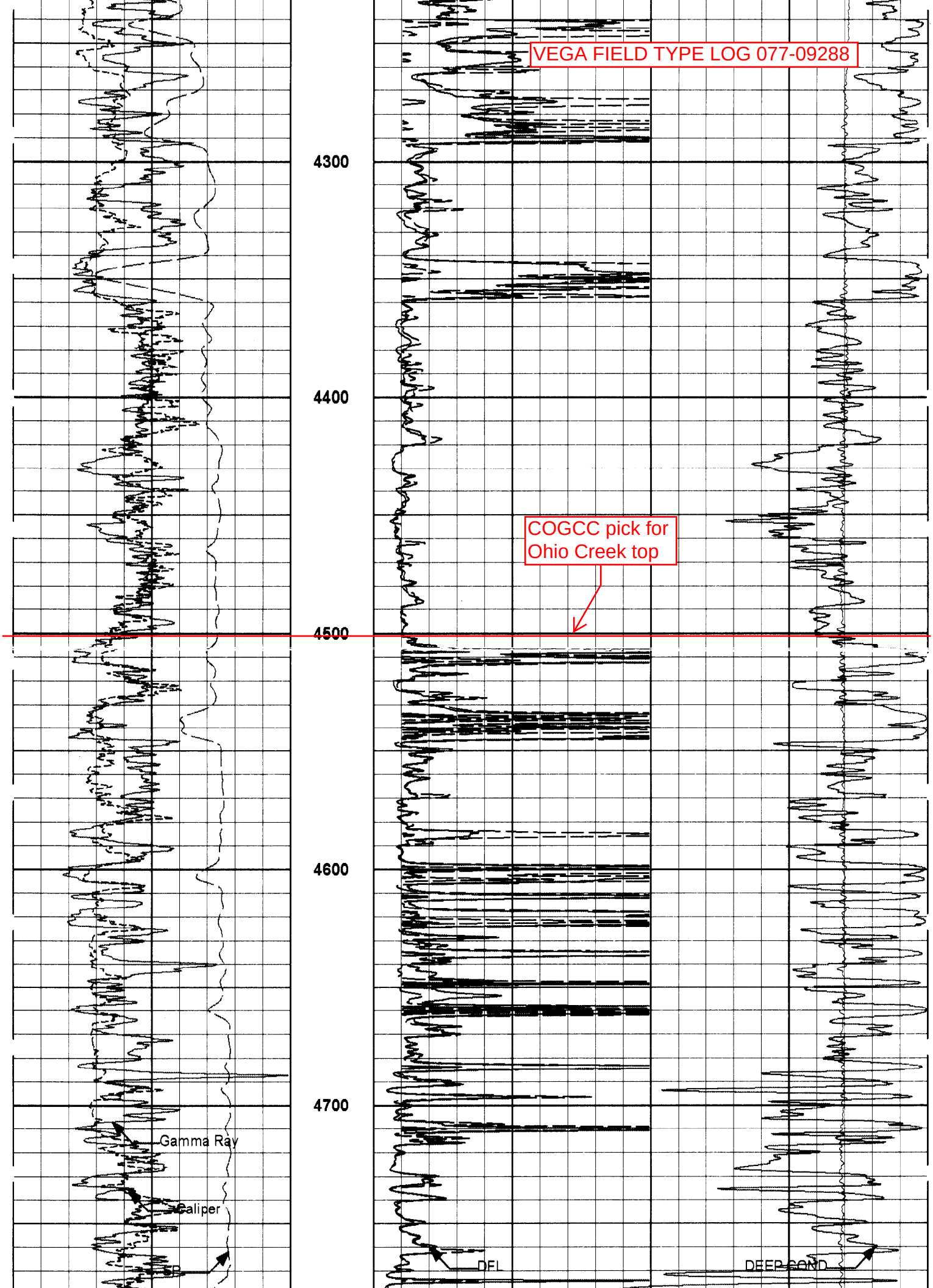
CSG

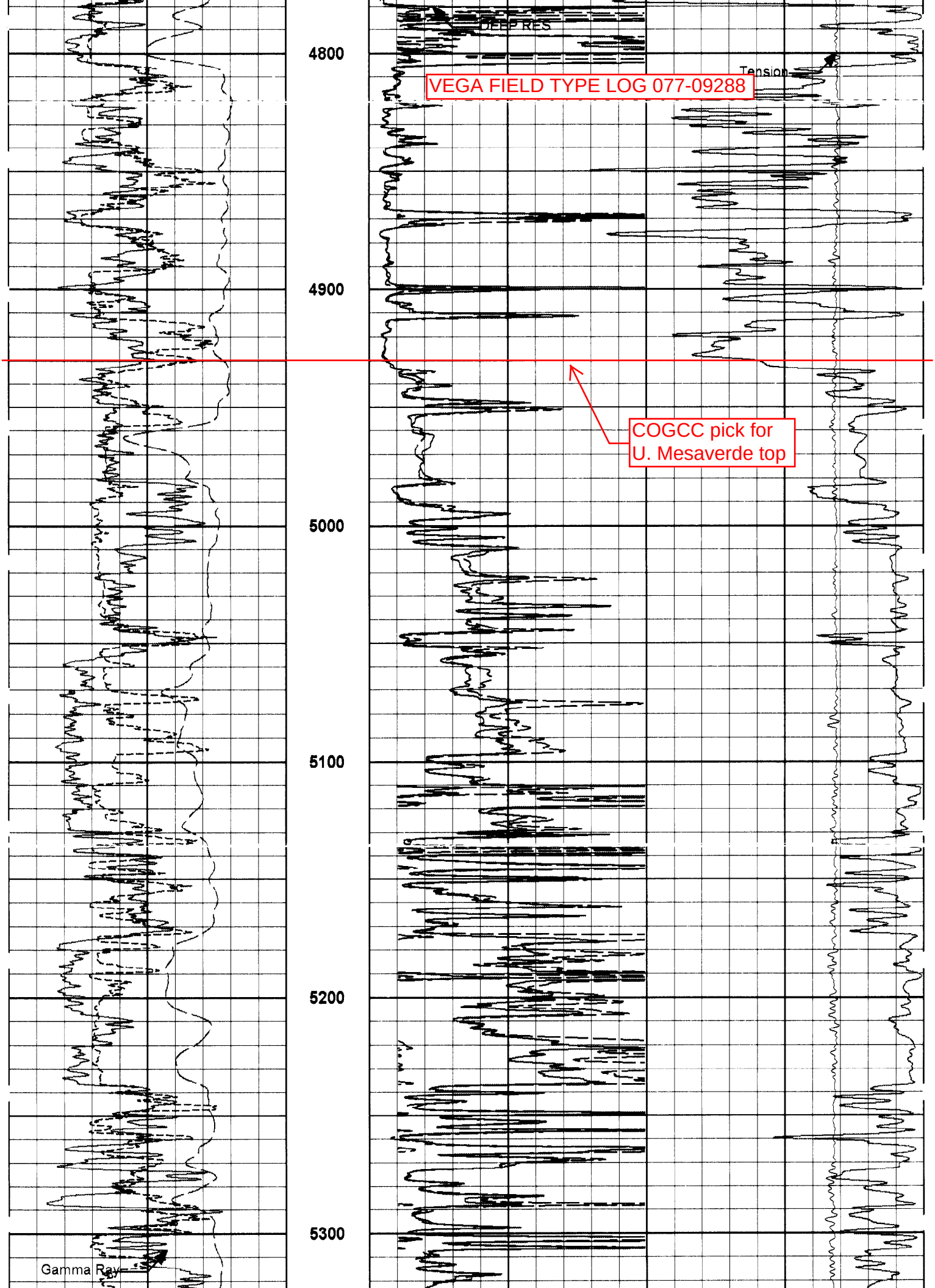

VEGA FIELD TYPE LOG 077-09288
2100
2200
2300
2400
2500
Gamma Ray
Caliper
SP
DEEP RES
DFL
DEEP COND
Tension

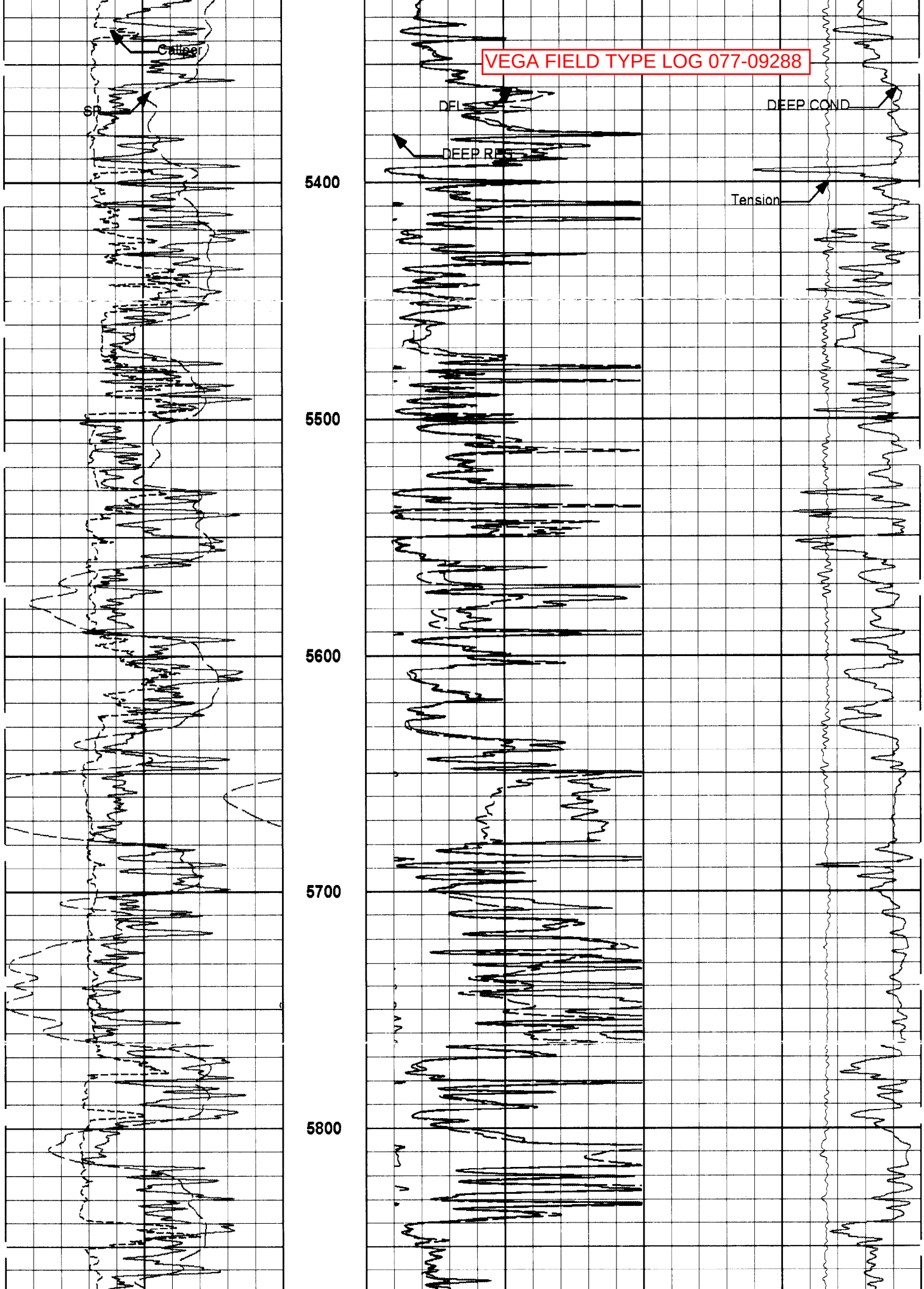

VEGA FIELD TYPE LOG 077-09288
2600
2700
2800
2900
3000
3100
COGCC pick for Wasatch G Sand top (upper interval)
COGCC pick for Wasatch G Sand top (lower interval)
Gamma Ray
Caliper
SP
DFL
DEEP RES
DEEP COND
Tension

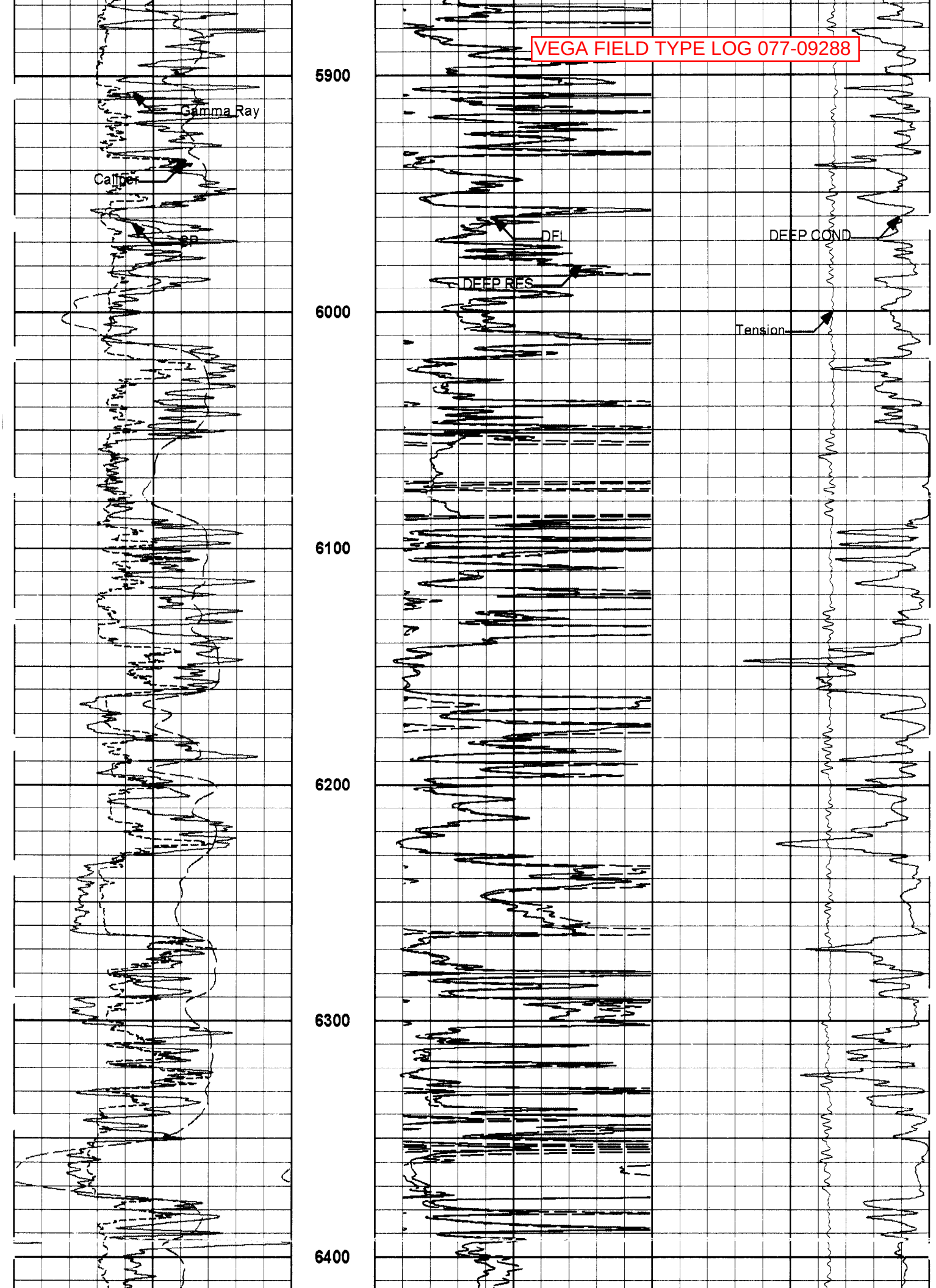

VEGA FIELD TYPE LOG 077-09288
3200
3300
3400
3500
3600
COGCC pick for
Fort Union top
Gamma Ray
Caliper
SP
DFL
DEEP RES
DEEP COND
Tension

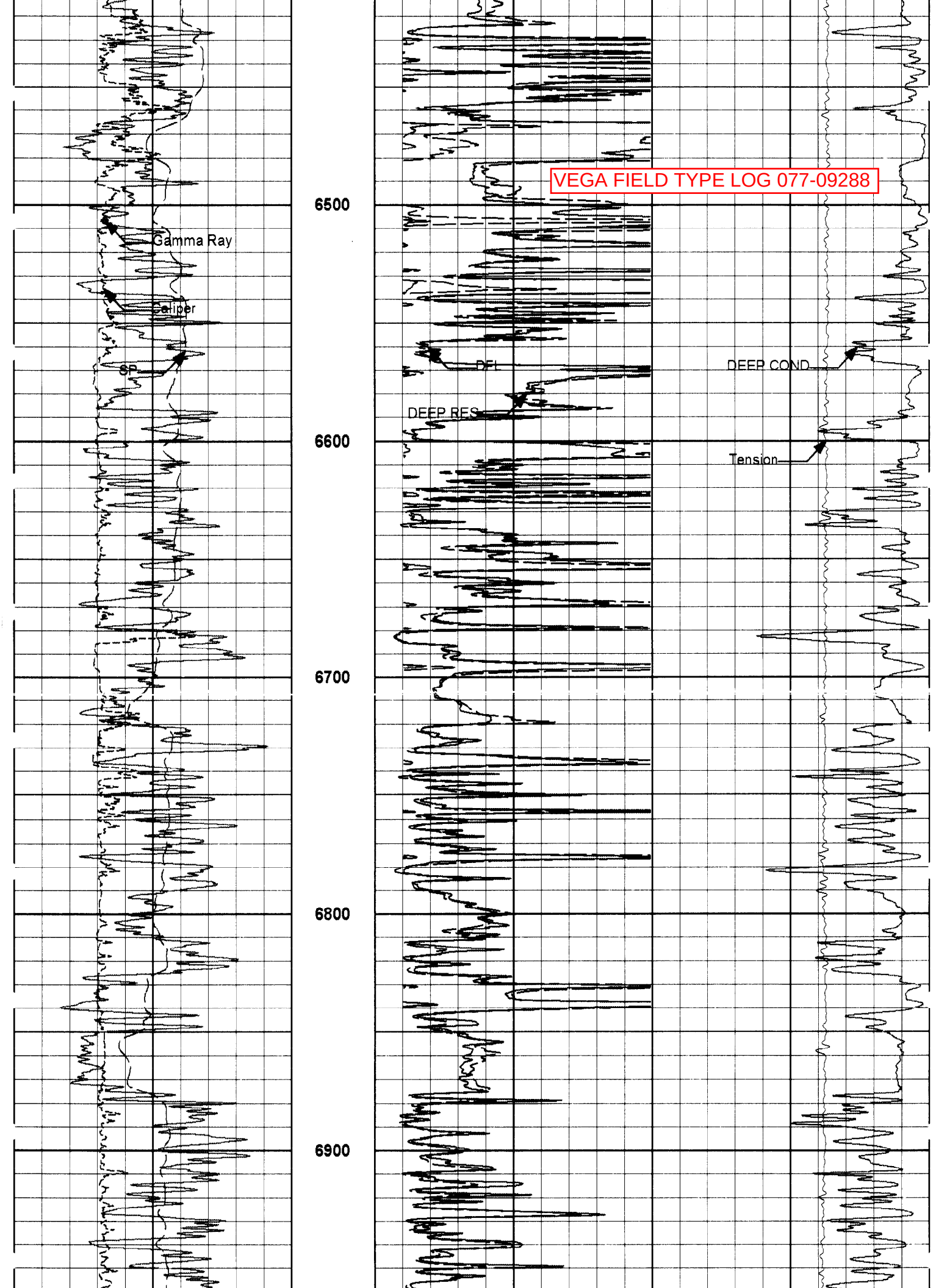

VEGA FIELD TYPE LOG 077-09288
3700
3800
3900
4000
4100
4200
Gamma Ray
Caliper
SP
COGCC pick for Lower Wasatch top (cement required 200' above this point, effective 04-18-2016)
DEEP RES
DEEP COND
Tension

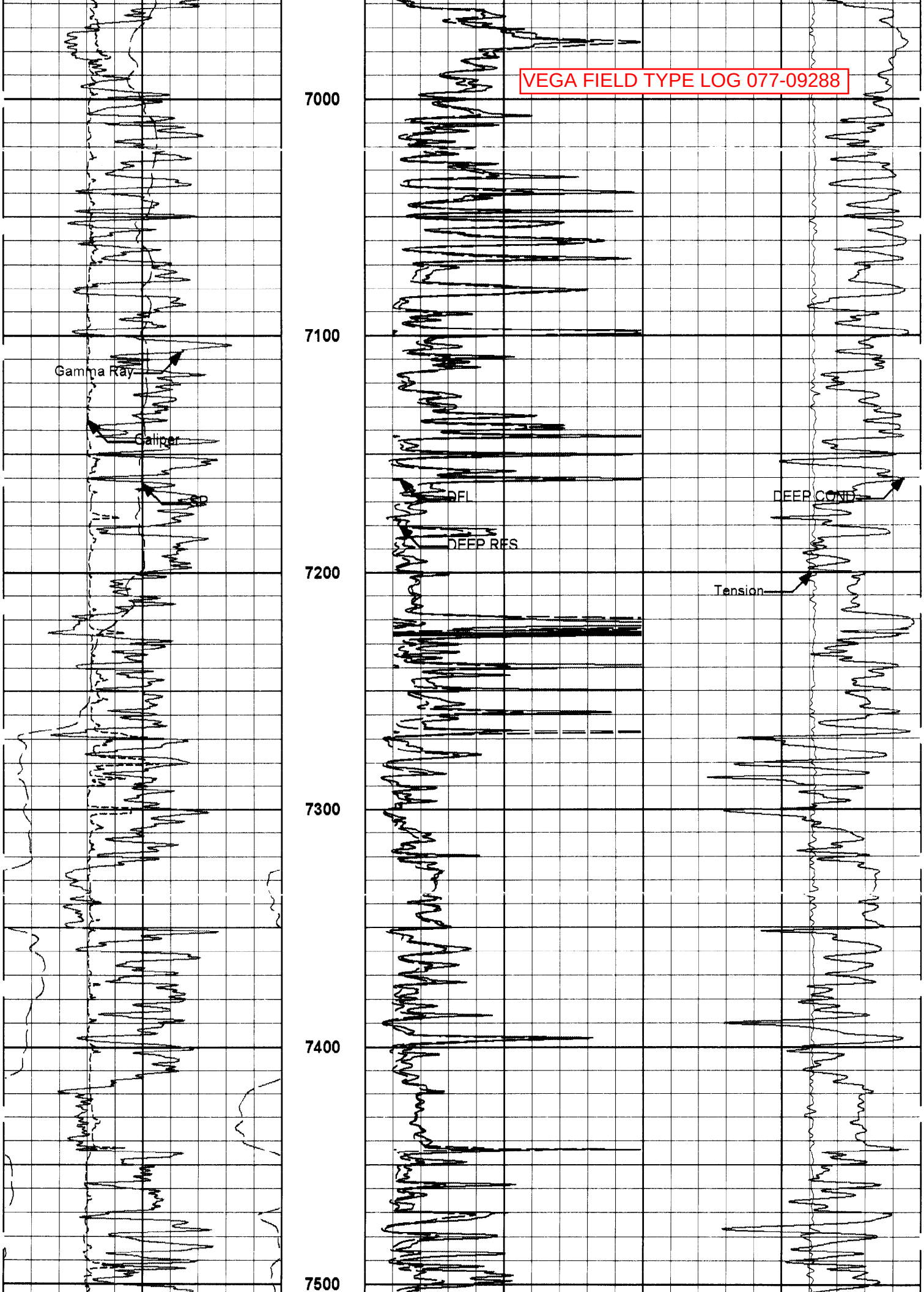

VEGA FIELD TYPE LOG 077-09288
4300
4400
COGCC pick for
Ohio Creek top
4500
4600
4700
Gamma Ray
Caliper
SP
DFL
DEEP COND

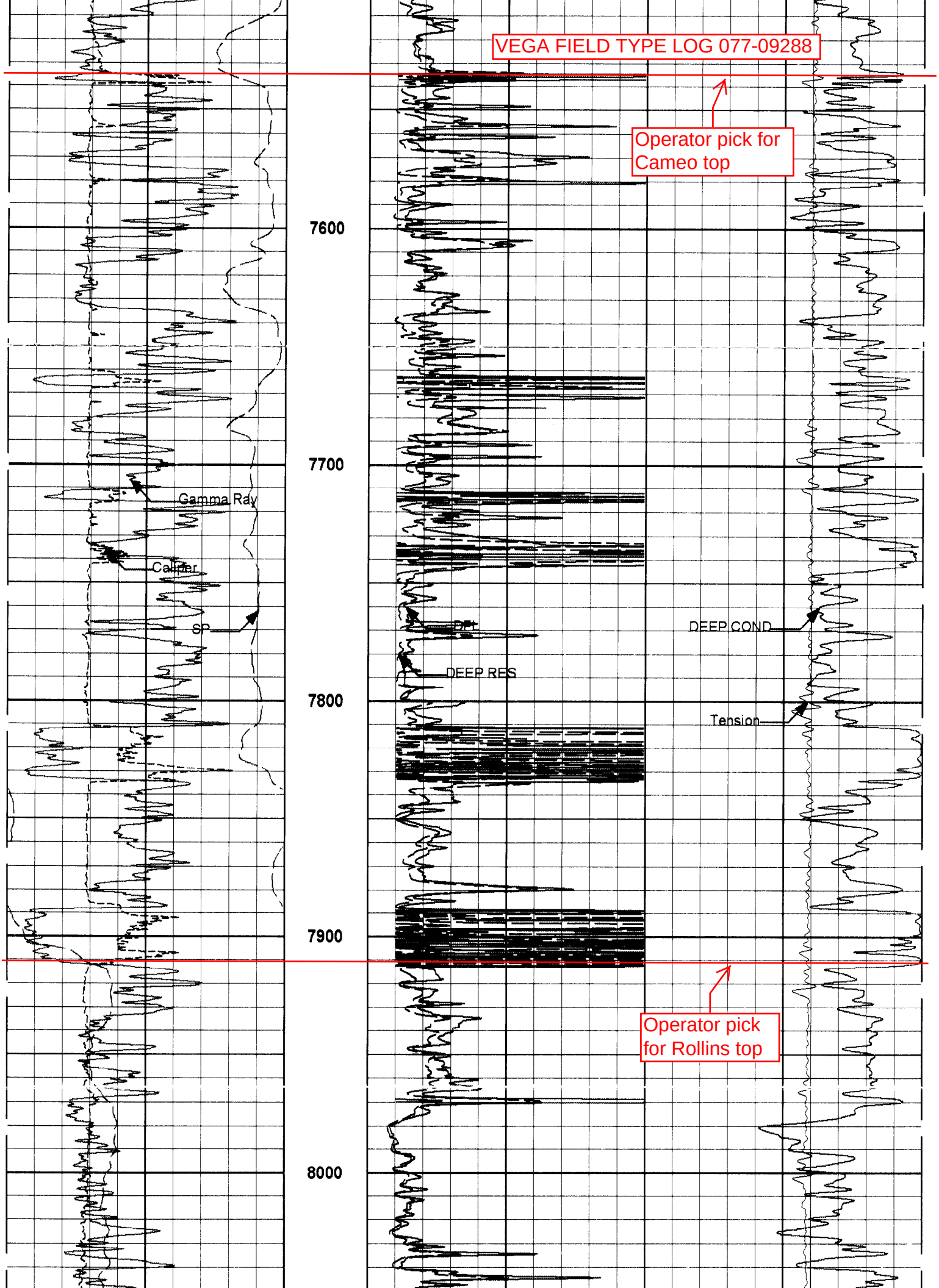

DEEP RES
Tension
VEGA FIELD TYPE LOG 077-09288
4800
4900
5000
5100
5200
5300
COGCC pick for
U. Mesaverde top
Gamma Ray

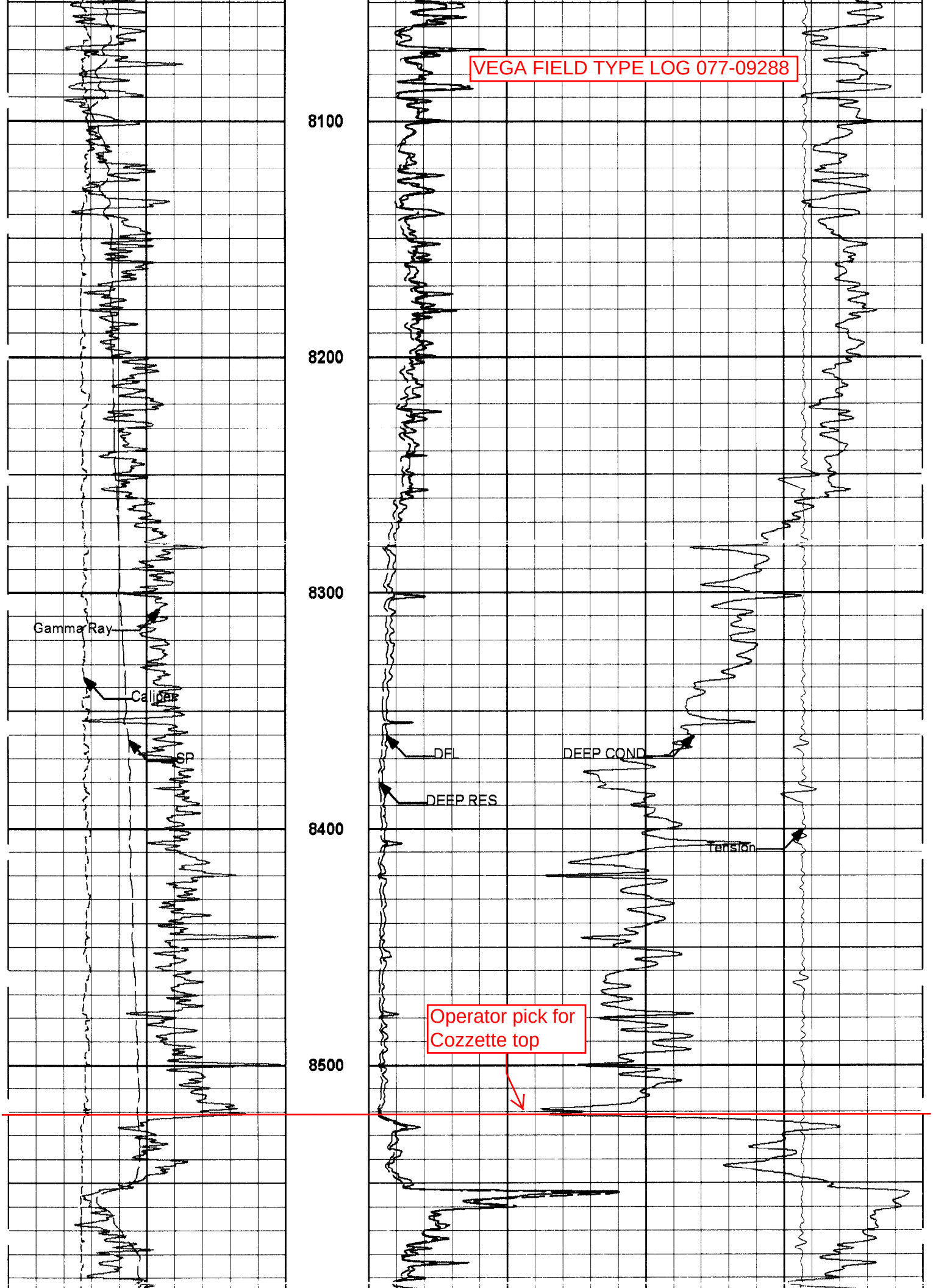

VEGA FIELD TYPE LOG 077-09288
Caliper
SP
DEEP COND
Tension
5400
5500
5600
5700
5800

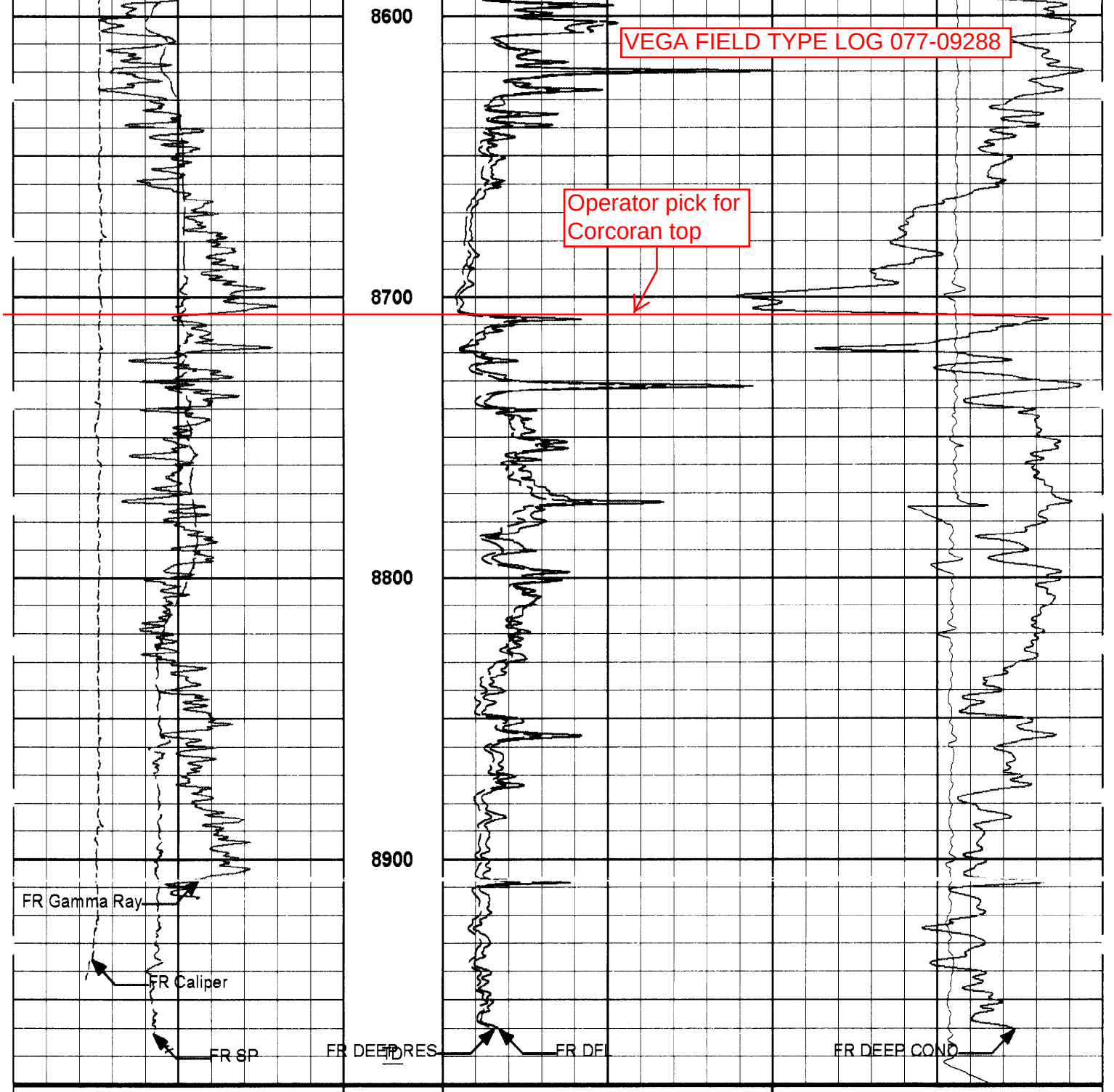

VEGA FIELD TYPE LOG 077-09288
5900
6000
6100
6200
6300
6400
Gamma Ray
Caliper
SP
DFL
DEEP RES
DEEP COND
Tension


VEGA FIELD TYPE LOG 077-09288
6500
6600
6700
6800
6900
Gamma Ray
Caliper
SP
DFL
DEEP RES
DEEP COND
Tension


VEGA FIELD TYPE LOG 077-09288
7000
7100
7200
7300
7400
7500
Gamma Ray
Caliper
SP
DFL
DEEP RES
DEEP COND
Tension


VEGA FIELD TYPE LOG 077-09288
Operator pick for Cameo top
7600
7700
Gamma Ray
Caliper
SP
DPT
DEEP RES
DEEP COND
7800
Tension
7900
Operator pick for Rollins top
8000


VEGA FIELD TYPE LOG 077-09288
8100
8200
8300
8400
8500
Gamma Ray
Caliper
SP
DFL
DEEP RES
DEEP COND
Tension
Operator pick for
Cozzette top



SP	MD	DEEP RES	
-]10mV[+	1 : 600	0 — 100	
	ft	ohmm	
6 Caliper 16		0 DFL 100	10000 Tension 0
inches		ohmm	lbs
0 Gamma Ray 200		500 DEEP COND 0	
api		mmo/m	

HALLIBURTON

Plot Time: 04-Aug-07 21:41:01
Plot Range: 2020 ft to 8980 ft
Data: {ActiveWell}-Well Based-DAQ-0002-MAIN-
Plot File: \\IND\DELTA_2IN_IND_COND

INDUCTION - CONDUCTIVITY PRESENTATION
MAIN LOG SECTION
2" = 100'

COGCC OIL AND GAS FIELD SCOUT CARD

Date	04/18/2016
Document No.	2056188

FIELD NAME	**WOLF CREEK**
FIELD NUMBER	**94010**

LOCATION

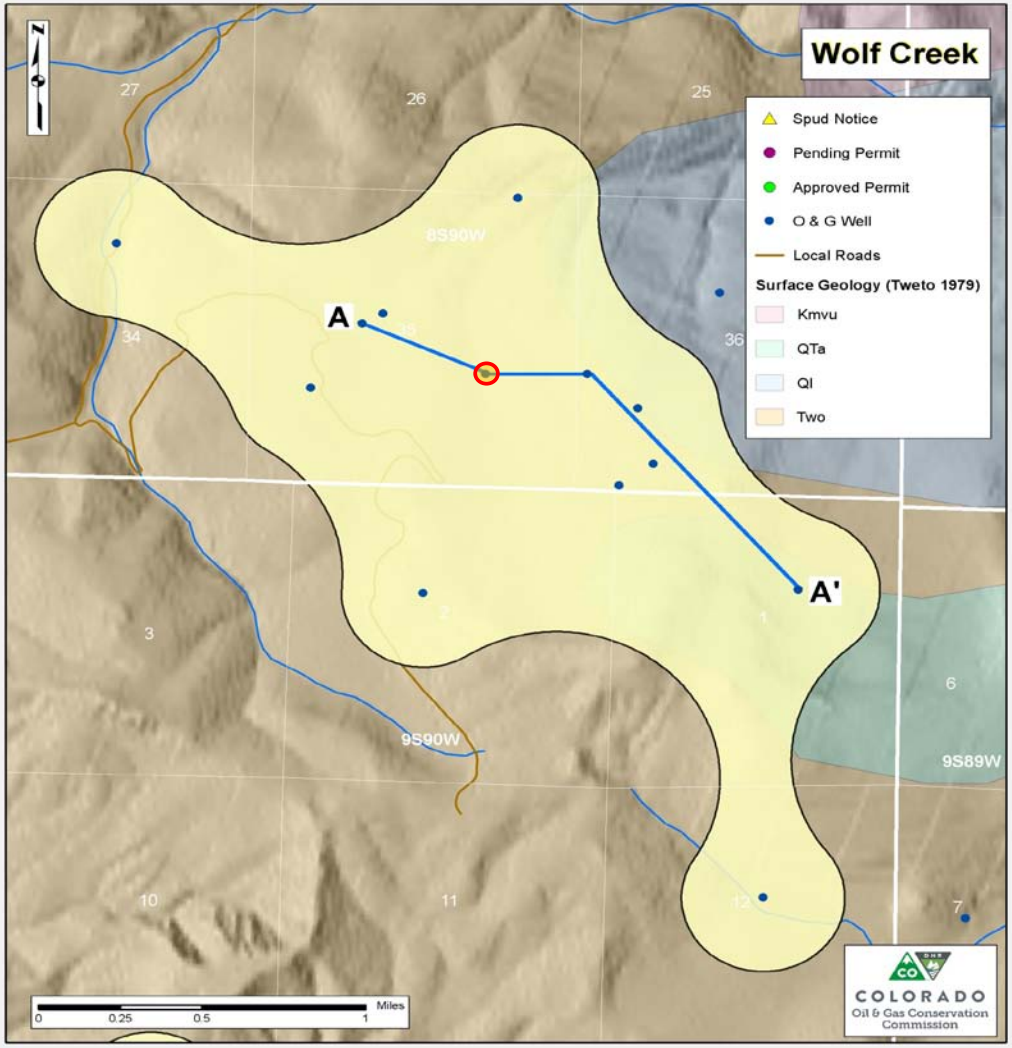
Basin	Piceance
Township(s)	8S to 9S
Range(s)	90W

SURFACE GEOLOGY

Surface Geology consists of alluvium and landslide deposits in the eastern portion of the field, underlain by the Wasatch Formation, which outcrops in the western portion of the field.

GEOLOGIC STRUCTURE

None within the field boundaries on COGCC's 250K GIS Geology layer; a northwest-southeast trending anticline is present several miles to the west, and a northwest-southeast trending syncline is present a few miles to the east.



Type Log Well

COGCC OIL AND GAS FIELD SCOUT CARD
WOLF CREEK #94010

STRATIGRAPHY

All depths are measured depths

				A - Northwest			A' - Southeast
			API Number =>	097-06005	097-06007	097-06008	097-05067
			Surface Elevation =>	9,805	9,898	10,109	10,283
			Well Type =>	Vertical	Vertical	Vertical	Vertical
Group	**Formation**	**Interval/Member**	**Isolation Concern**	**Log Top**	**Log Top**	**Log Top**	**Log Top**
	Alluvium		Water				0
	Landslide Deposit		Water			0	
	Wasatch	Lower*	Water	0	0		
Mesaverde	Williams Fork	Ohio Creek	Water				380*
Mesaverde	Williams Fork	U. Mesaverde	Water and Gas		473*	690*	876*
Mesaverde	Iles	Rollins	Gas		3,638	3,877	3,996*
Mesaverde	Williams Fork	Cameo	Gas		3,743	3,982	4,116
	Mancos Tongue		None		4,252	4,486	4,660*
Mesaverde	Iles	Cozzette	Gas Storage		4,657	4,819	5,002
Mesaverde	Iles	Corcoran	Possible Gas				5,246
	Mancos		Possible Gas	4,950			
	Niobrara		Possible Gas	8,435*			
	Frontier		Possible Gas	9,256			
Dakota	Dakota		Possible Gas	9,714			
	Morrison		Possible Gas	9,754			
San Rafael	Entrada		Possible Gas	10,268			
	Chinle		None	10,382			
	Weber		Possible Gas	10,406			

Annotated Type Log for 097-06007: COGCC Document Number 2056190

Stippled cells indicate that the respective log top was not apparent on logs or the top may be covered by a shallower casing string above the logged interval.

** COGCC log picks ("Lower" Wasatch, as shown herein for water isolation, is not recognized in geologic literature)*

WATER RESOURCE ISOLATION

Alluvium, landslide deposits, Lower Wasatch, Ohio Creek, and Upper Mesaverde

Shallow water wells are present within the field boundary (depth of 10' or less - likely groundwater monitoring wells). There are no nearby water supply wells at a similar ground surface elevation.

PRODUCING ZONE ISOLATION

Primary Objectives: Cozzette (gas storage field - federal jurisdiction)

UNDERGROUND INJECTION CONTROL

None in this field

COMMISSION ORDER SUMMARY (Significant Engineering and Spacing Issues)

None for this field

COGCC OIL AND GAS FIELD SCOUT CARD
WOLF CREEK #94010

HISTORIC WELL CONSTRUCTION

Surface casing setting depths generally range from 200' to 400', with production casing terminating in the Iles Formation. Production casing cement is normally limited to coverage of the storage interval, and coverage is likely lacking across parts of the Wasatch and and Mesaverde Group.

NEW WELL CONSTRUCTION (effective 04/18/2016)

Recommendations (gas storage is Federal jurisdiction): Minimum surface casing of 5% TVD required for well control in Mesa County (10% TVD recommended). Full cement coverage of the Mesaverde Group and Ohio Creek is required in the Piceance Basin through 2015. Based on review of induction log response across the Wasatch, Ohio Creek, and Mesaverde (possible water resources), new standards require cementing intermediate or production casing at least 200' into the surface casing for full coverage of these zones.

PLUGGING OBJECTIVES

Recommendations (gas storage is federal jurisdiction): Plug(s) above Mancos and other deeper formations (if penetrated) to address potential future horizontal wells; plug above Cozzette storage zone; plugs at base of Ohio Creek and base of Lower Wasatch (squeeze if no annular cement coverage, full coverage not required because of the increased thickness of these zones in this field compared to other fields to the northwest); stray gas isolation squeezes (if no annular cement) or in-casing stabilization plugs (if annular cement present) at 3,000' intervals if plugs are not already planned in those intervals as described above; surface casing shoe plug and surface plug.

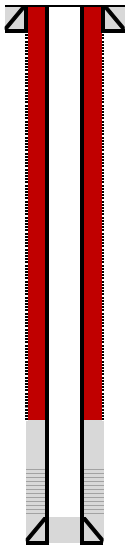
ISOLATION REQUIREMENTS FOR TYPICAL WELLS

Date 04/18/2016 **COGCC Document No.** 2056189

FIELD NAME **WOLF CREEK**
FIELD NUMBER **94010**

LOCATION
Basin Piceance
Township(s) 8S to 9S
Range(s) 90W

Depth	Formation/Member
0	L. Wasatch
	U. Mesaverde
1,000	
2,000	
3,000	
	Rollins
4,000	Cameo
	Mancos Tongue
	Cozzette
5,000	
	Corcoran



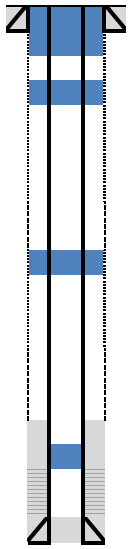
Casing and Cement Coverage

New Surface Casing Standard
Minimum 5% TVD (10% recommended) for well control

New Cement Standard
Full coverage required up into surface casing.

Typical Older Well Configuration
TOC covers productive intervals, but cement coverage of the Mesaverde Group, Ohio Creek and L. Wasatch may be lacking

Depth	Formation/Member
0	L. Wasatch
	U. Mesaverde
1,000	
2,000	
3,000	
	Rollins
4,000	Cameo
	Mancos Tongue
	Cozzette
5,000	
	Corcoran



Plug Placement

Surface plug
Surface casing shoe plug
Plug at U. Mesaverde top
Plug at base of Wasatch
Stabilization squeeze plug (use if separation between plugs above and below are > 3,000 feet)
Plug above Cozzette Storage Formation completions

WOLF CREEK FIELD TYPE LOG 097-06007

COGCC Document Number 2056190

04-18-2016

DUAL INDUCTION SFL

COMPANY GASCO, INC.

WELL #12 WOLF CREEK

FIELD WOLF CREEK

COUNTY PITKIN STATE COLORADO

API SERIAL NO. 05-097-06007

LOCATION SW/SE 3202 FNL 1671 FEL

SECT. 35 TWP. 8 S RANGE 90W

Other Services: FDC CNL

Permanent Datum GROUND LEVEL Elev. 9698.0 F

Log Measured From KB 14.5 F above Perm. Datum

Drilling Measured From KB

Elev.: K.B. 9712.5 F D.F. 9711.5 F G.L. 9698.0 F

Date	13-SEP-1999
Run No.	ONE
Depth Driller	4811.0 F
Depth Logger (Schl.)	4807.0 F
Btm. Log Interval	4804.0 F
Top Log Interval	280.0 F
Casing-Driller	8 5/8 @ 299.0 F
Casing-Logger	299.0 F
Bit Size	12 1/4" 7 7/8"
Type Fluid in Hole	CHEM-GEL
Dens.	9.20 LB/G
Visc.	69.0 S
pH	8.0
Fluid Loss	6.6 C3
Source of Sample	CIRC
Rm @ Meas. Temp.	4.910 OHMM @ 77.0 DEGF
Rmf @ Meas. Temp.	5.380 OHMM @ 77.0 DEGF
Rmc @ Meas. Temp.	4.730 OHMM @ 77.0 DEGF
Source: Rmf	MEAS
Rmc	CALC
Rm @ BHT	3.197 OHMM @ 122. DEGF
Time Circulation Ended	013 1200
Time Logger on Bottom	013 1800
Max. Rec. Temp.	122. DEGF
Equip. Location	6162 VERNAL
Recorded By	JEFF BOND
Witnessed By	STEEL, HELD

The well name, location and borehole reference data were furnished by the customer.

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretations made by any of our officers, agents or employees. These interpretations are also subject to Clause 4 of our General Terms and Conditions as set out in our current Price Schedule.

Run No.	ONE	
Service Order No.	520678	
Drilling Fluid Level	14.0 F	
Salinity	1500.0 PPM	
Rmf @ BHT	3.503 OHMM @ 122. DEGF	@
Rmc @ BHT	3.080 OHMM @ 122. DEGF	@
Logging Speed	1800.0 F/HR	
EQUIPMENT DATA		
Tool Number 1	DRSC 4738	
Tool Number 2	PDHL 3738	
Tool Number 3	GSRJ 6183	
Tool Number 4	NSCD 1782	
Tool Number 5	CNCHA 290	
Tool Number 6	NSRF 2649	
Tool Number 7	NSRGB 3221	
Tool Number 8	SGCSA 280	
Tool Number 9	CCCB 1883	
Tool Number 10		
Tool Number 11		
Tool Number 12		

REMARKS:

TOOL STRING: DITD-LDTC-CNTH-SGTE-CCCB.

SANDSTONE POROSITY, 2.68 GM/CC.

BOWSPRING USED ON CNL TOOL.

1.5-INCH STANDOFF ON DIL.

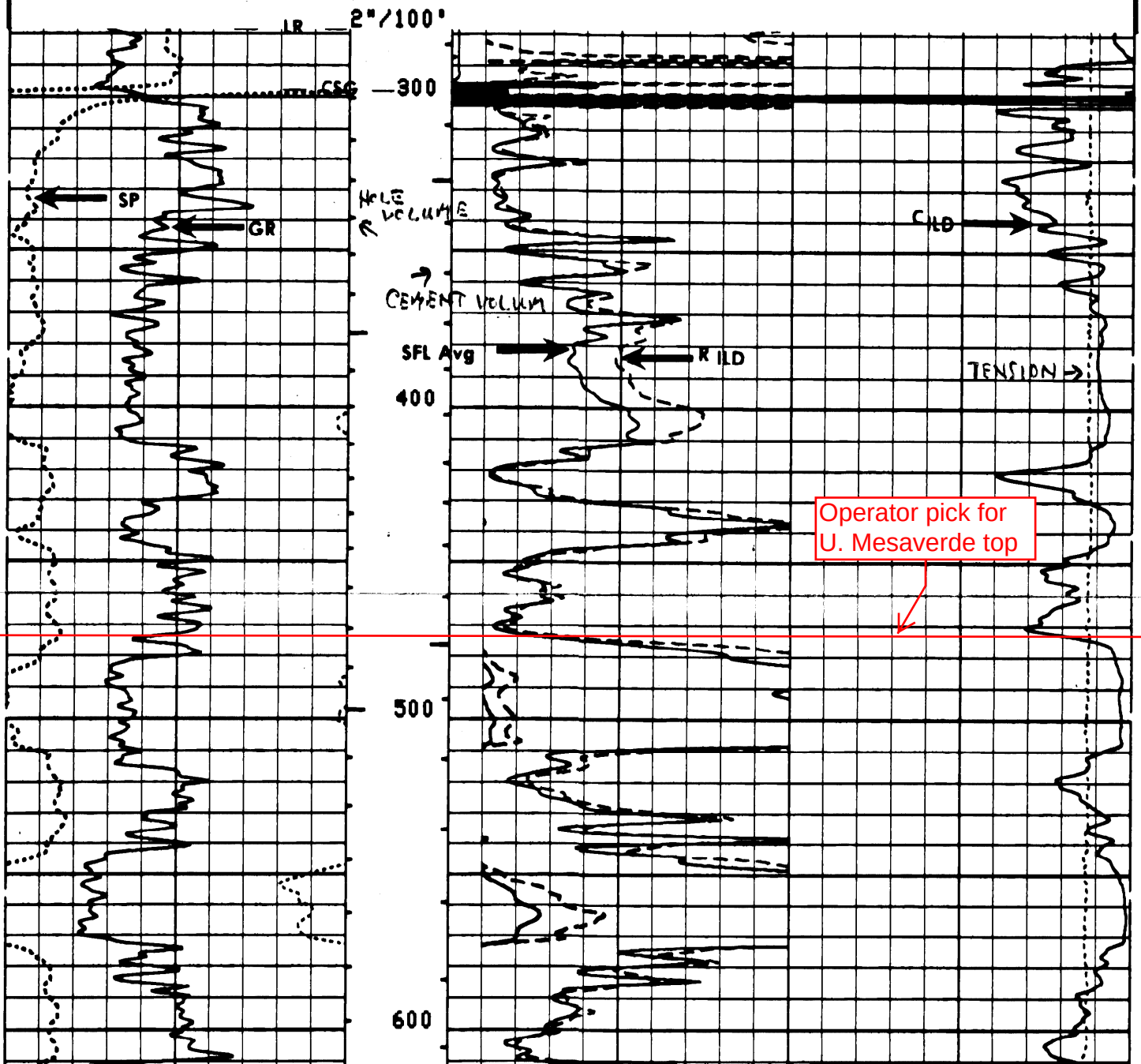
CEMENT VOLUME CALCULATED USING 5.5" OD PIPE

WOLF CREEK FIELD TYPE LOG 097-06007

GR(GAPI)		ILD(OHMM)		TENS(LBF)	
0.0	200.00	0.0	100.00	10000.	0.0
SP(MV)		SFLA(OHMM)		CILD(MMM/M)	
-80.00	20.000	0.0	100.00	400.00	0.0

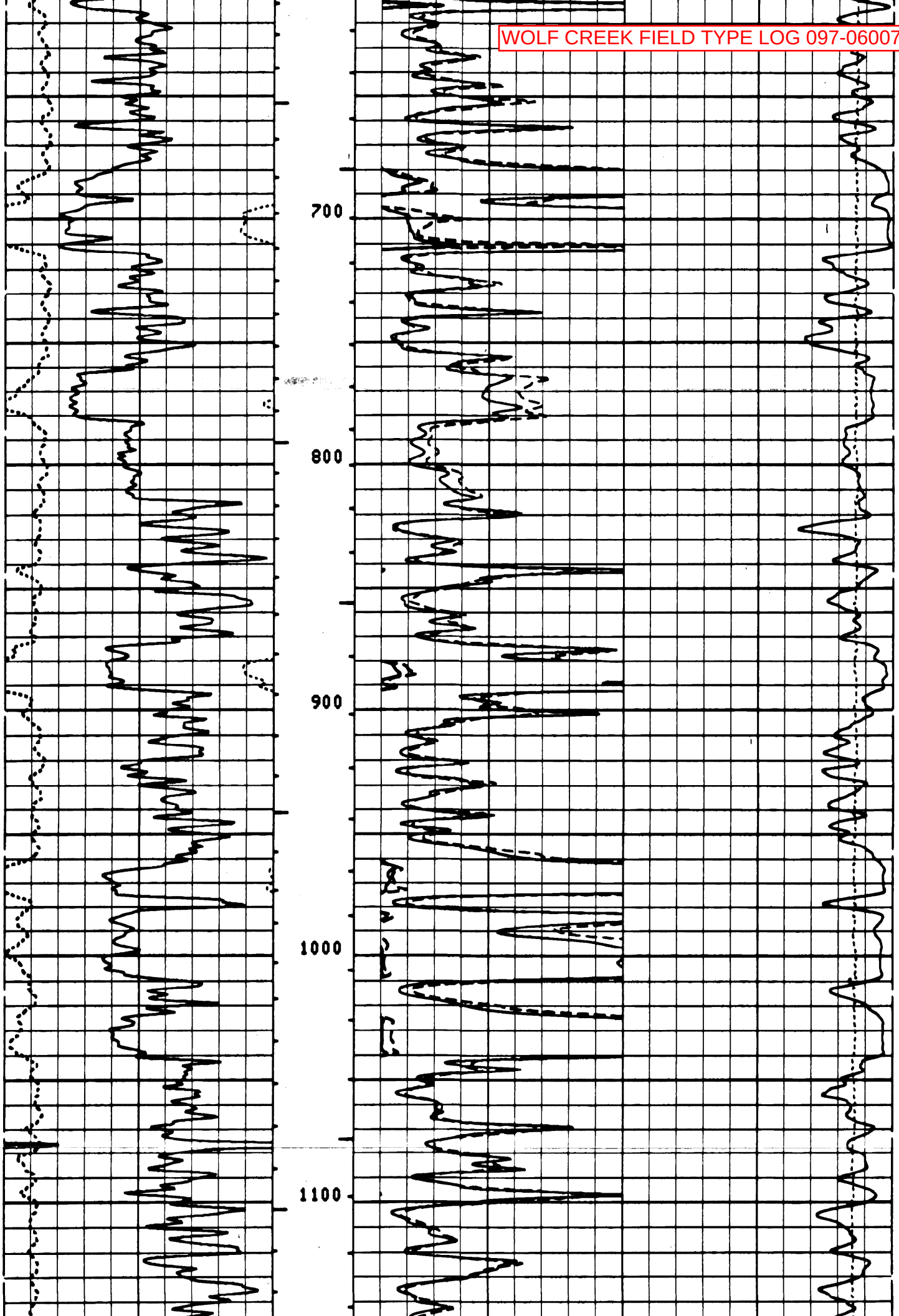
Wasatch Formation at Surface, overlying Ohio Creek (formation top behind surface casing in this well)

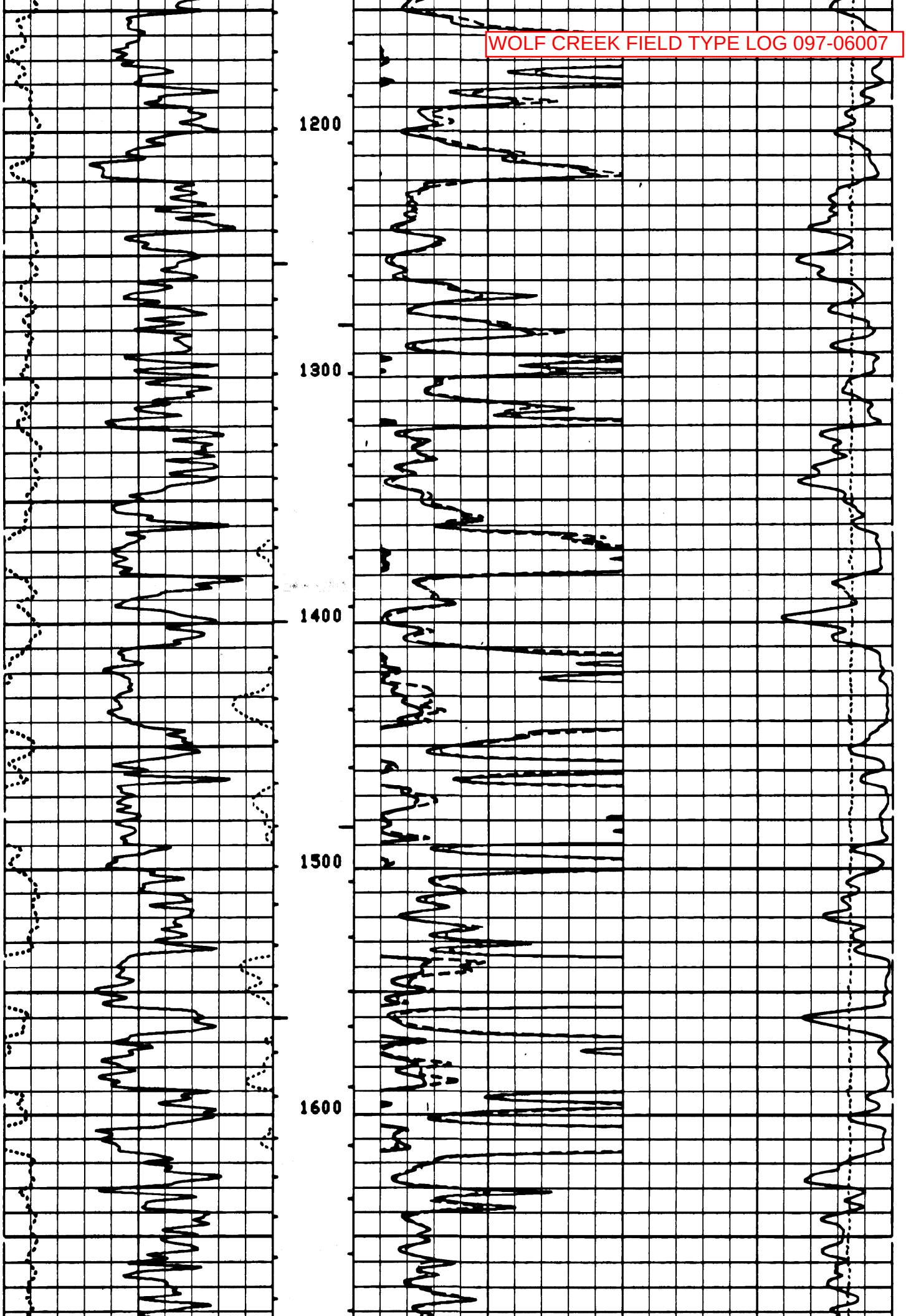
CP 32.2 FILE 5 19-SEP-1989

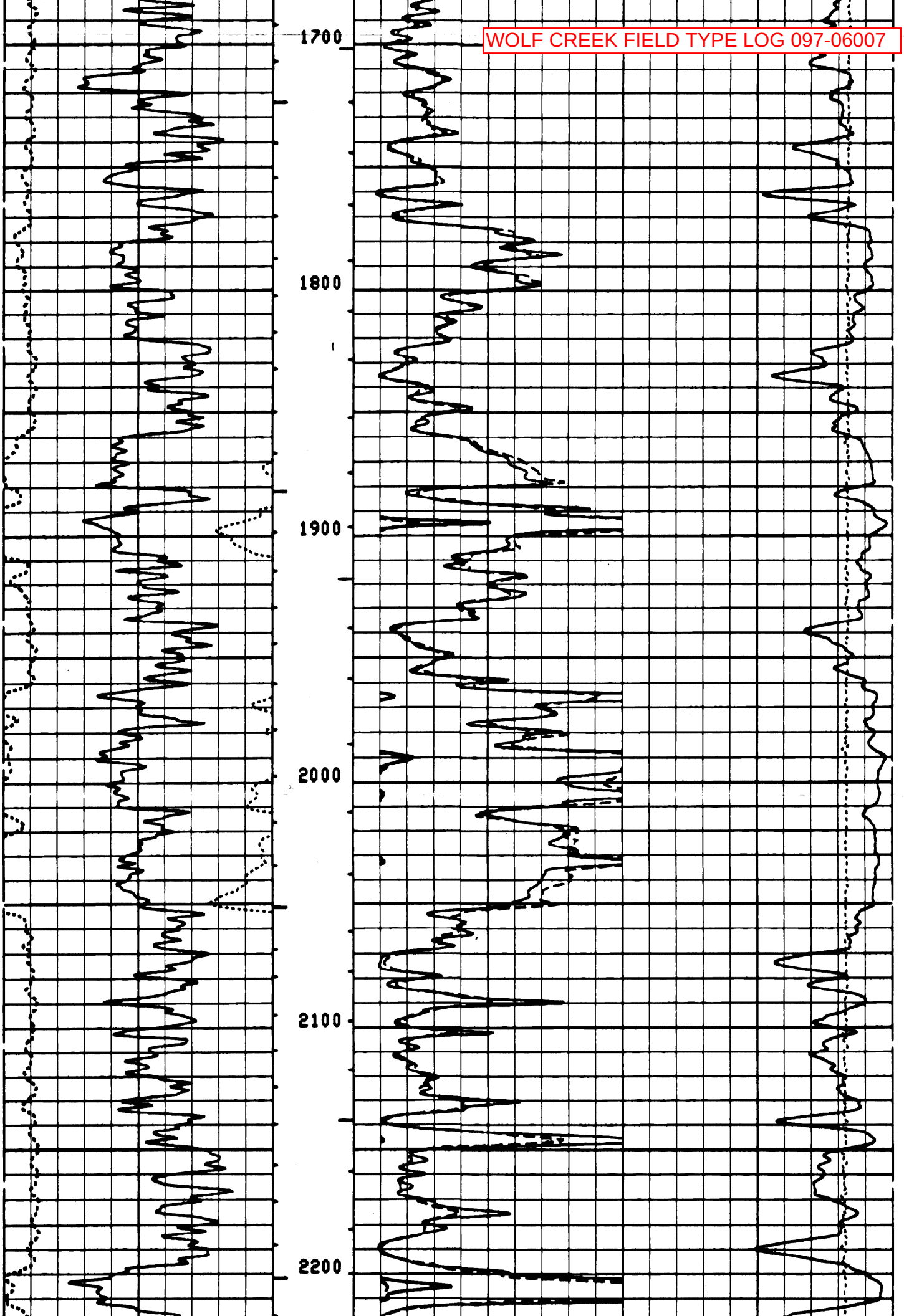


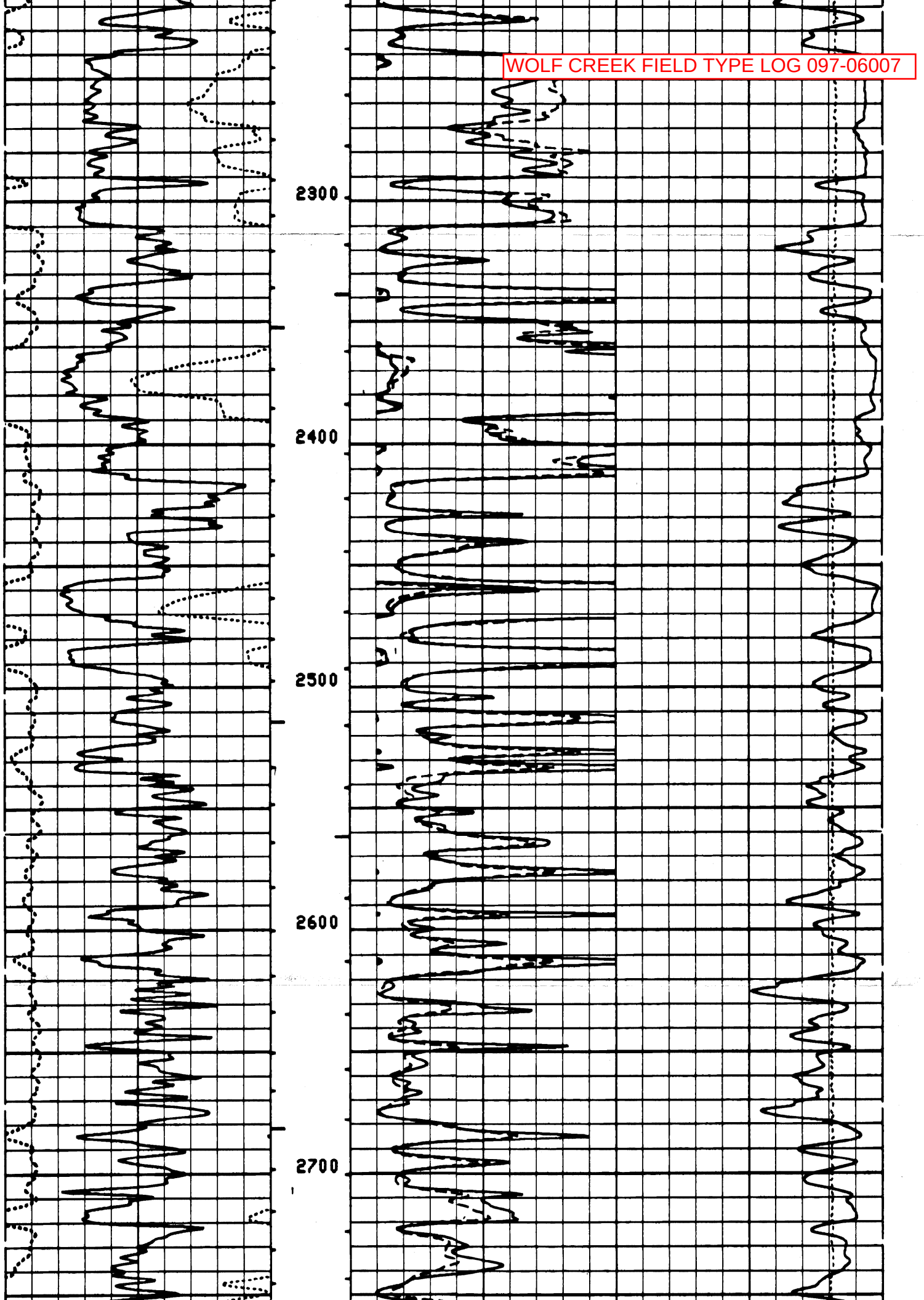
Operator pick for U. Mesaverde top

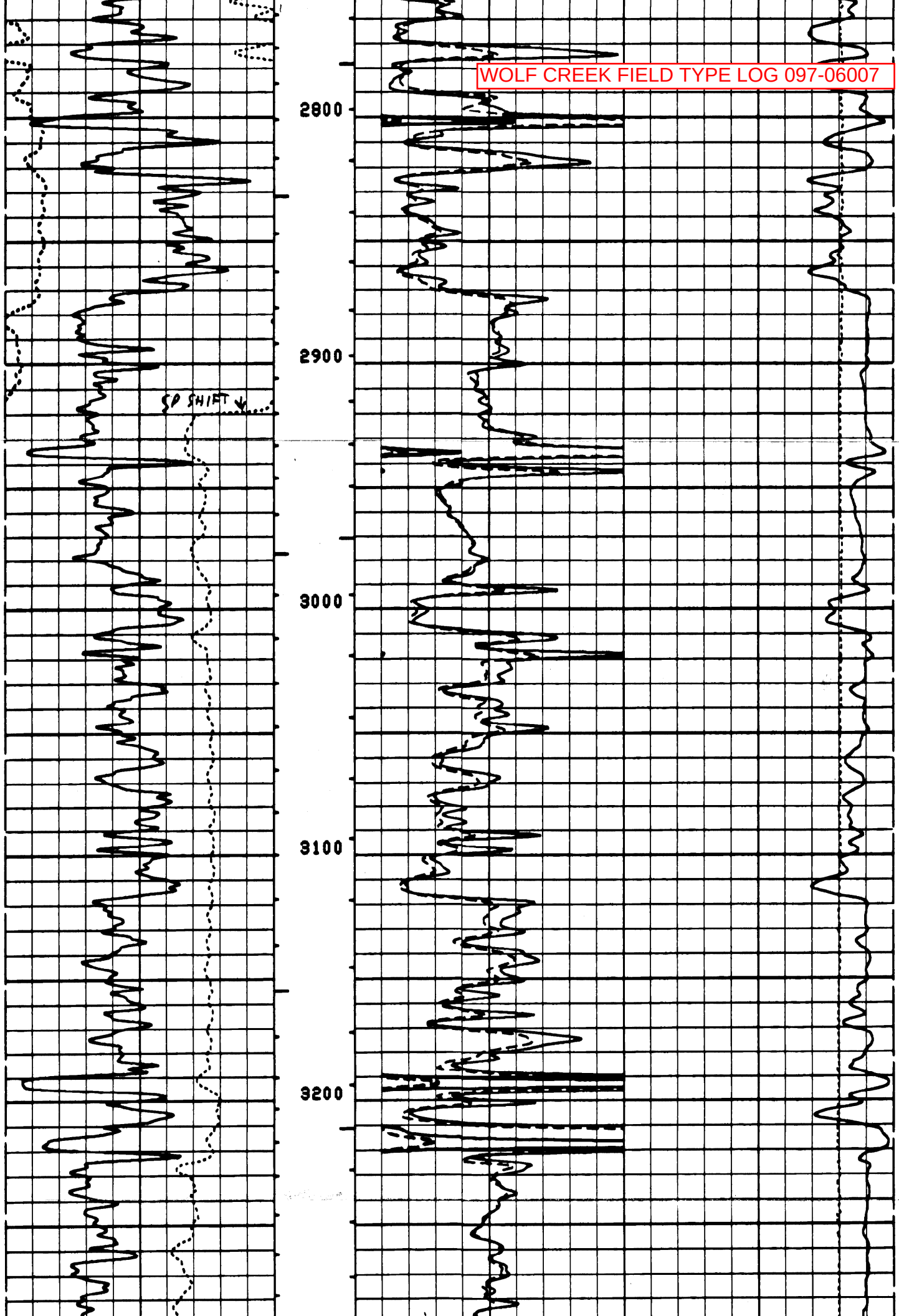
WOLF CREEK FIELD TYPE LOG 097-06007

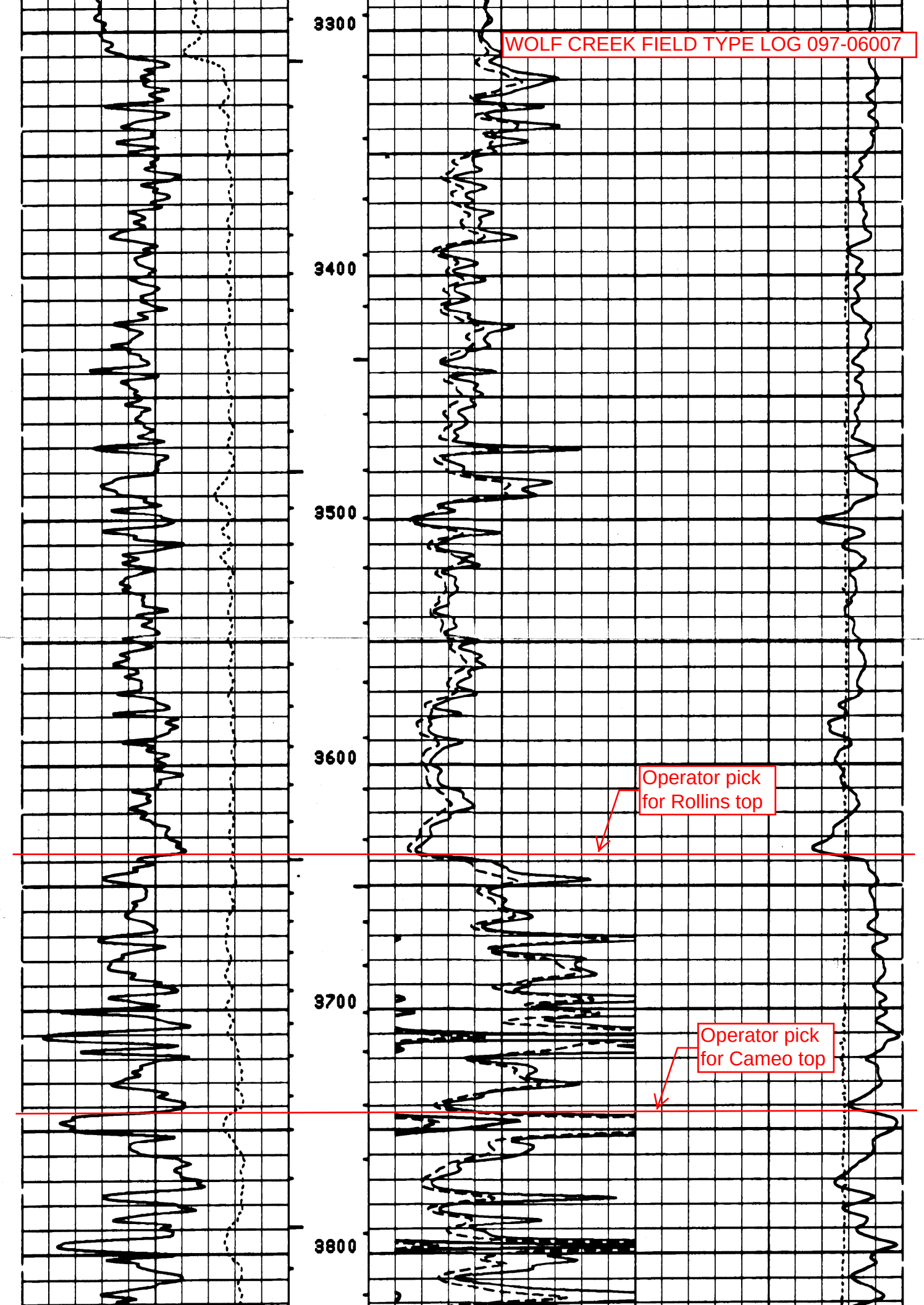


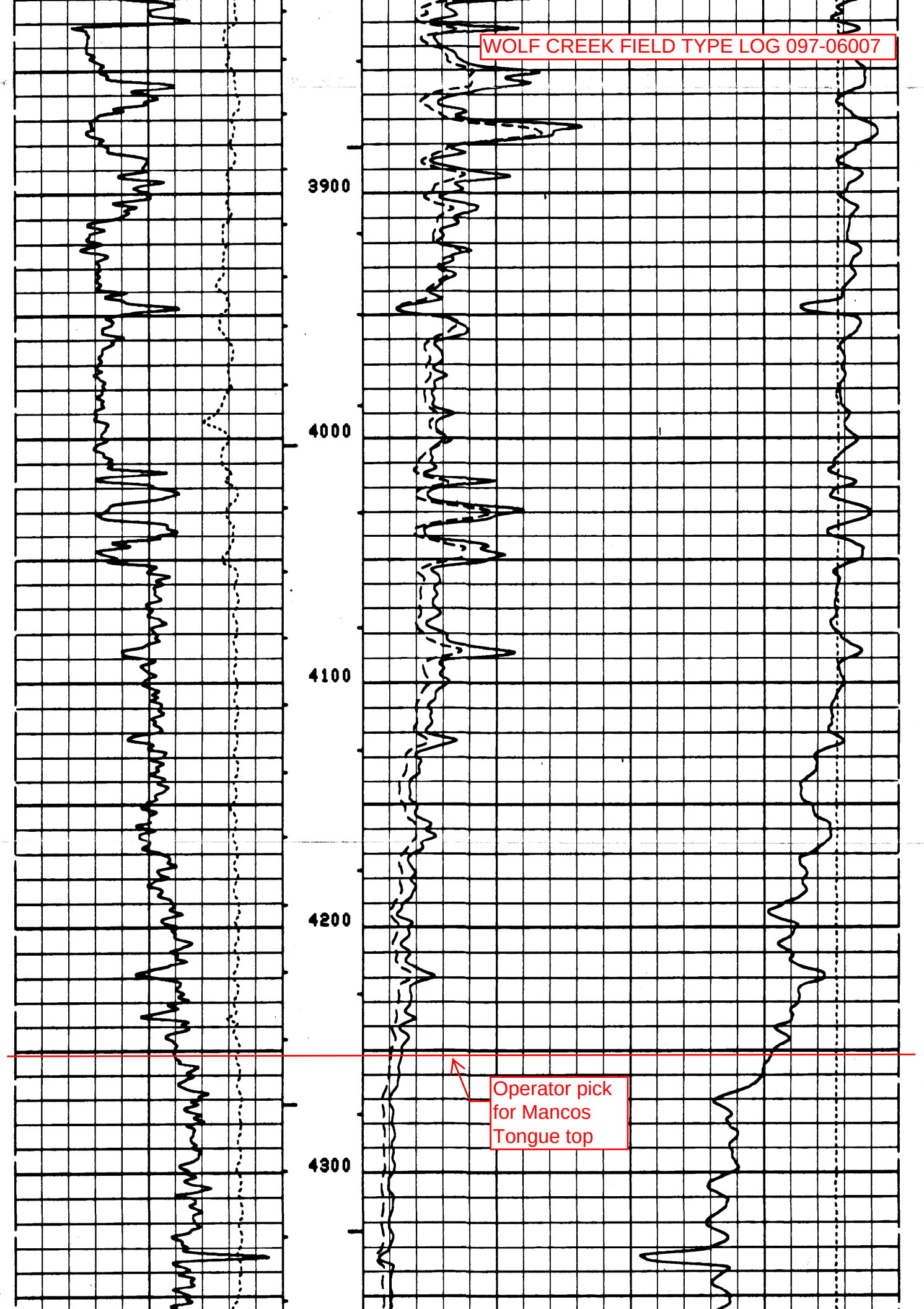

WOLF CREEK FIELD TYPE LOG 097-06007
1200
1300
1400
1500
1600

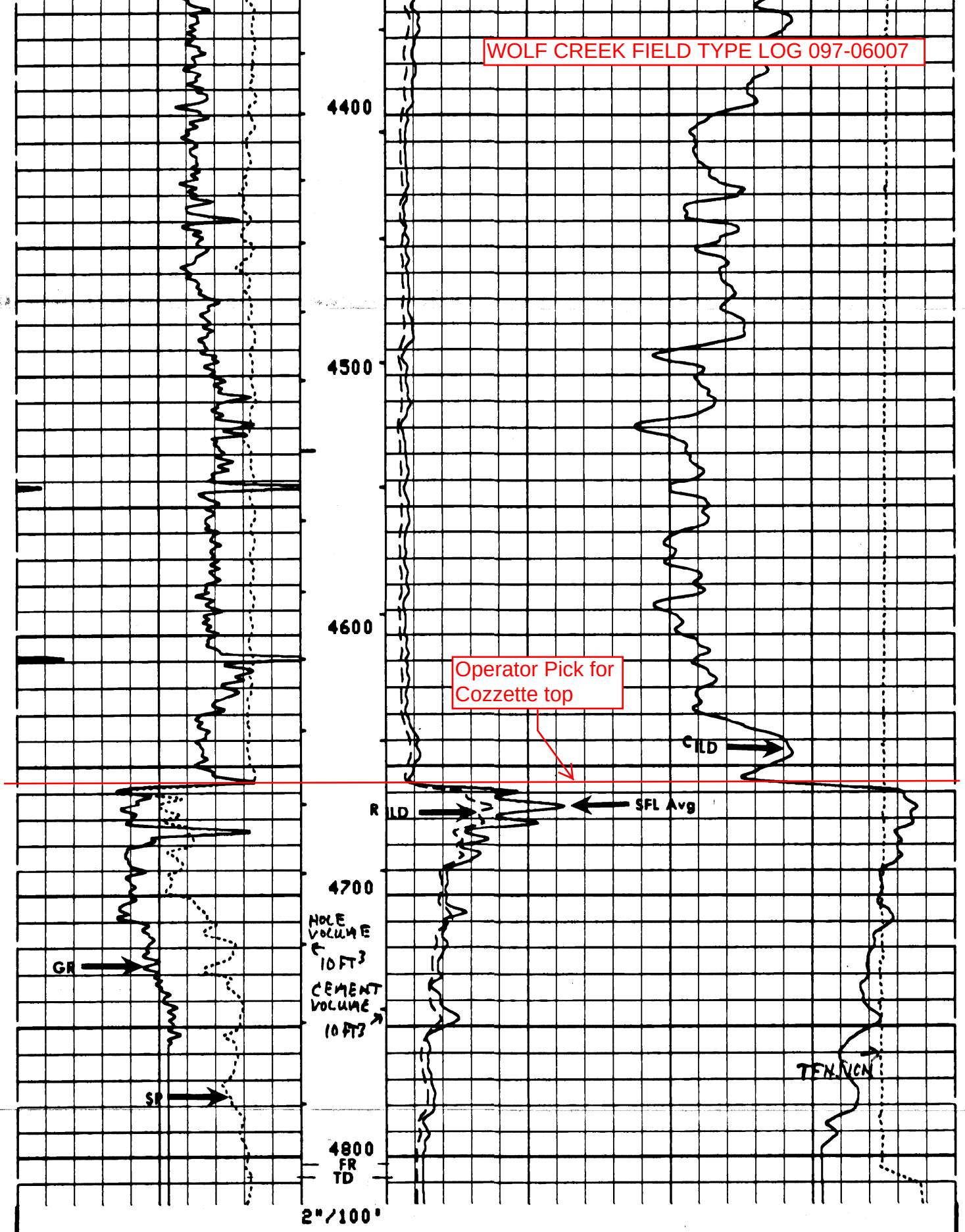

WOLF CREEK FIELD TYPE LOG 097-06007
1700
1800
1900
2000
2100
2200

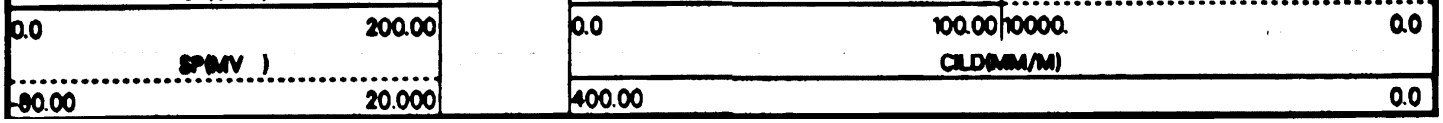

WOLF CREEK FIELD TYPE LOG 097-06007
2300
2400
2500
2600
2700


WOLF CREEK FIELD TYPE LOG 097-06007
2800
2900
SP SHIFT
3000
3100
3200


WOLF CREEK FIELD TYPE LOG 097-06007
3300
3400
3500
3600
3700
3800
Operator pick for Rollins top
Operator pick for Cameo top


WOLF CREEK FIELD TYPE LOG 097-06007
3900
4000
4100
4200
4300
Operator pick
for Mancos
Tongue top


WOLF CREEK FIELD TYPE LOG 097-06007
4400
4500
4600
Operator Pick for
Cozzette top
CILD
RILD
SFL Avg
4700
HOLE VOLUME
10 FT3
CEMENT VOLUME
10 FT3
GR
SP
TENSION
4800
FR
TD
2"/100'
CP 32.2
FILE 5
13-SEP-1989 18:16
GR(GAPI)
ILD(OHMM)
0.0
100.00
SFLA(OHMM)
TENS(LBF)



WOLF CREEK FIELD TYPE LOG 097-06007

APPENDIX B

Example Detailed Well File and Log Reviews

Bradenhead Pressure and Flow Evaluation

Date:	4/18/2016
Operator:	ENCANA OIL & GAS (USA) INC – 100185
Well Name/No.:	Aspen RM 10-6C (F10E)
API No.:	05-045-09123
Sec., Twp., Rng.:	10-7S-92W
Spud Date:	2/22/2003
Reported TOC:	surface
WSTCG/FTUN:	near surface (behind surface casing) or not present
Surface Casing:	1012’
LWSTC:	1623’ (cogcc)
OHCRK:	1900’ (cogcc)
TOG:	not reported
WMFK:	2736’ (operator); 2192’ (Upper MVRD, cogcc)
Top Perforation:	3771’ WMFK
RLNS:	5888’ (operator)
TMD:	6000’

Preliminary concerns that resulted in flagging the well:

- From 2010 through 2015, 7-day SI bradenhead pressures ranged from 104 psi to 135 psi, time to blow down was one minute or less with some water produced during the blowdown about half the time. Blew down in one second with no fluid on 9/22/2015.
- Moderate pressure gradient at surface casing shoe, 135 psi / 1012 ft = 0.13 psi/ft plus hydrostatic pressure gradient.

Current Status:

- Normal bradenhead valve status is SI. Not approved for venting. No indication of venting on 4/7/2015 Field Inspection Report #666800846.

Induction Log Review:

- Upper Wasatch, Wasatch G top(s), and Fort Union (if present) are covered by surface casing. The Middle Wasatch (below the Fort Union-equivalent interval), the Lower Wasatch, the Ohio Creek, and the Upper Mesaverde (non-productive interval of the Williams Fork Formation) are isolated with cement.

Neutron-Density Log Review:

- Top of log interval was 1012’. Crossover (>= 5’ thick) above top perforation: None

CBL Review:

- Casing size = 7”
- Theoretical Free Pipe Amplitude = 62 mV
- Estimated Continuous Interval Required @ 80% Bond for Effective Seal = 33’
- Observed free pipe amplitude = N/A (cemented to surface)
- Observed 100% bond amplitude = 1.8 mV @ 5842’
- Calculated 80% bond amplitude = 3.7 mV (uses Theoretical Free Pipe Amplitude)

- Analysis of CBL with no pressure: First amplitude lower than 21 mV @ 78’, equivalent to 30% bond (disregards extreme top of log). VDL scatter is variable throughout the log, but generally, it appears fair to good. Most amplitudes are less than 50 mV, but amplitudes approach or exceed 50 mV in intervals with poor bond. First 80% bond @ 4942’, good scatter on VDL. Top of first continuous 80% bond > 33’ @ NONE.
- A second CBL was run under pressure. A microannulus may be present.

Bradenhead Pressure and Flow Evaluation
Aspen RM 10-6C (F10E)

Conclusions:
Isolation was compliant with COGCC requirements at the time when this well was drilled and cemented. Surface casing setting depth exceeded 10% of TVD and TOC > 200' above shallowest producing horizon.

The production casing is cemented to surface, but fair to poor bond is evident in several intervals throughout the well. Bradenhead gas may originate from the Wasatch Formation, the Mesaverde Group or some combination of the two.

Mitigation/Remediation Recommendations:
Collect bradenhead and production gas samples for comparison in an effort to identify the source of the bradenhead gas. If sufficient water is present during bradenhead blowdown, also collect a water sample. Contact COGCC Environmental staff for analysis requirements.

The production casing is cemented to surface, preventing circulation of remedial cement, and the potential success of block squeezes to eliminate pressure is questionable. Squeezing would also risk compromising casing integrity with additional perforations. Continued annual monitoring is advised with no cement remediation recommendations.

Bradenhead Pressure and Flow Evaluation

Date:	4/18/2016
Operator:	VANGUARD OPERATING LLC – 10531
Well Name/No.:	Tharp 44D-14-692
API No.:	05-045-18599
Sec., Twp., Rng.:	23-6S-92W
Spud Date:	12/7/2009
Surface Casing:	943’
WSTCG:	1246’/1354’ (cogcc)
FTUN:	1653’ (cogcc)
LWSTC:	3245’ (cogcc)
OHCRK:	3603’ (cogcc)
WMFK:	3797’ (operator); 3797’ (Upper MVRD, cogcc)
Reported TOC:	5100’ (cogcc picked 5180’, but VDL scatter extends up to about 5090’)
TOG:	5650’
Top Perforation:	5984’ WMFK
RLNS:	7533’ (operator)
TMD:	8600’

Preliminary concerns that resulted in flagging the well:

- Zero bradenhead pressure reported on Form 4 Request to Complete #2577109.
- All operator annual reports from 2010 through 2015 show zero bradenhead pressure, and the bradenhead valve was reportedly left in a normally open state for that reporting period. This well was noted as “open to tank” on the 2012 with no pressure or flow reported.
- Operator submitted a new annual report for this well with bradenhead pressure monitoring commencing on 1/6/2016. For the 7-day test, the operator reported a 7-day bradenhead buildup pressure of 34 psig. The pressure blew down in one minute with no fluids.
- Low pressure gradient at surface casing shoe, 34 psig / 943 ft = 0.04 psi/ft plus hydrostatic pressure gradient.

Current Status:

- Approved for venting on Form 4 #2522268. The bradenhead valve was open on 10/22/2015, as indicated on Field Inspection Report #666801555.

Induction Log Review:

- The Wasatch G, the Middle Wasatch (including the Fort Union-equivalent interval), the Lower Wasatch, the Ohio Creek, and a portion of the Upper Mesaverde (non-productive interval of the Williams Fork Formation) is uncemented.

Neutron-Density Log Review:

- Top of log interval was 943’. Crossover (>= 5’ thick) above top perforation observed as follows: 5194’-99’ (Williams Fork).

Bradenhead Pressure and Flow Evaluation
Tharp 44D-14-692

Post-Cementing Temperature Log:

- Significant gradient change starts at approximately 5200', consistent with COGCC's TOC pick.

CBL Review:

- Casing size = 4.5"
- Theoretical Free Pipe Amplitude = 81 mV
- Estimated Continuous Interval Required @ 80% Bond for Effective Seal = 15'
- Observed free pipe amplitude = N/A (appears to be cemented above the top of log at 3592' possible lead cement or poor calibration)
- Observed 100% bond amplitude = 3.5 mV @ 8407'
- Calculated 80% bond amplitude = 6.6 mV (uses Theoretical Free Pipe Amplitude)

- First amplitude lower than 32 mV @ 4774', equivalent to 30% bond. VDL begins to improve noticeably and consistently at 5214', with amplitudes less than 20 mV. First 80% bond @ 5238', good scatter on VDL. Top of first continuous 80% bond > 15' @ 5304', excellent scatter on VDL. Qualitatively, good to excellent scatter is apparent on the VDL from 5240' to TD, and poor to fair scatter is apparent above 5240' to the top of the log at 3592'.

Conclusions:
Isolation was compliant with COGCC requirements at the time when this well was drilled and cemented. Surface casing setting depth exceeded 10% of TVD and TOC > 500' above TOG.

Adequate seal likely at and below top WMFK perforation, but bond becomes fair between top perforation and TOC. No significant bradenhead gas pressure or flow reported.

Mitigation/Remediation Recommendations:
Continued annual monitoring is advised with no cement remediation advised.

Bradenhead Pressure and Flow Evaluation

Date:	4/18/2016
Operator:	URSA OPERATING COMPANY LLC - 10447
Well Name/No.:	CSF #21B-07-07-91
API No.:	045-11122
Sec., Twp., Rng.:	7-7S-91W
Spud Date:	10/17/2005
WSTCG:	top above surface casing shoe (cogcc)
Surface Casing:	869’
FTUN:	1240’ (cogcc)
LWSTC:	2950’ (cogcc)
OHCRK:	3200’ (cogcc)
WMFK:	3546’ (operator); 3546’ (Upper MVRD, cogcc)
Reported TOC:	4050’
TOG:	5119’
Top Perforation:	5277’ WFCM
CMEO:	6954’ (operator)
RLNS:	7278’ (operator)
TMD:	7467’

Preliminary concerns that resulted in flagging the well:

- Highest bradenhead pressure reported on Form 4 Request to Complete #1526627 was 90 psi.
- Bradenhead pressures reported as zero 1/15/2011 and 120 psi 1/14/2012. Pressure blew down on 1/14/2012 in less than 10 minutes with no liquids.
- Operator reported 50 psi blown down to 40 psi with “black fluid at 40 psi”, on 8/29/2012, 10/1/2013, and 12/24/2014, and 10/1/2015 (operator notes for all four events were similar).
- Does not blow down completely, remaining pressure of 40 psi while producing black fluid
- Moderate pressure gradient at surface casing shoe, 120 psi / 869 ft = 0.14 psi/ft plus hydrostatic pressure gradient

Current Status:

- Bradenhead valve status is SI. Not approved for venting. Venting marked as “No” on 9/9/2015 COGCC Field Inspection Report #666801407.

Induction Log Review:

- Upper Wasatch and Wasatch G top(s) covered by surface casing. The lower portion of the Wasatch G, the Middle Wasatch (including the Fort Union-equivalent interval), the Lower Wasatch, the Ohio Creek, and a portion of the Upper Mesaverde (non-productive interval of the Williams Fork Formation) is uncemented.

Neutron-Density Log Review:

- Top of log interval was 869’. Crossover (>= 5’ thick) above top perforation observed as follows: 4489’-94’ and 5127’-40’ (Williams Fork).

Bradenhead Pressure and Flow Evaluation
CSF #21B-07-07-91

Post-Cementing Temperature Log:

- Significant gradient change starts at 4000', near the operator's reported TOC of 4050'.

CBL Review:

- Casing size = 4.5"
- Theoretical Free Pipe Amplitude = 81 mV
- Estimated Continuous Interval Required @ 80% Bond for Effective Seal = 15'
- Observed free pipe amplitude = 97 mV @ 3810'
- Observed 100% bond amplitude = 0.5 mV @ 7196'
- Calculated 80% bond amplitude = 1.4 mV

- First amplitude lower than 20.0 mV @ 4166', equivalent to 30% bond. VDL begins to improve noticeably at 4151', with amplitudes consistently less than 50 mV. First 80% bond @ 7091', excellent scatter on VDL. Top of first continuous 80% bond > 15': None. However, qualitatively, good to excellent scatter is apparent on the VDL from 5690' to TD. Bond is fair to good from 4050' to 5690'.

Conclusions:

Isolation was compliant with COGCC requirements at the time when this well was drilled and cemented. Surface casing setting depth exceeded 10% of TVD and TOC > 500' above TOG.

Quality of the cement bond appears to be good to fair in the upper portion of the WMFK perforated interval from the good cement top at 5690' to the top perforation at 5277'. Bradenhead gas has become negligible, as reported in recent annual reports, but flowing liquid is a concern when the bradenhead valve is open. The source of liquid may be from the Wasatch, Ohio Creek, Upper Mesaverde, or some combination of water-bearing zones in those intervals.

Mitigation/Remediation Recommendations:

Collect liquid samples from bradenhead valve and produced water from the well. Analyze to evaluate similarities or differences between the two samples in an effort to determine the source of the flow. Contact COGCC Environmental staff for analysis requirements.

Cement remediation advised with an initial goal of isolating the Lower Wasatch, Ohio Creek, and Upper Mesaverde interval from the existing TOC up to 2450' (500' above COGCC pick for top of "Lower Wasatch"). However, circulation and full coverage of this interval may not be possible. Targeted squeeze(s) will be considered.

This well has Federal minerals, and BLM has primary jurisdiction for the wellbore. BLM would need to take the lead on remediation requirements, if any.