HYDROLOGIC TEST WELLS
HRES-19, HRES-20, QV-5
COMPLETION REPORT

RESOLUTION COPPER MINING PROJECT
SUPERIOR, ARIZONA

Prepared For

Resolution Copper Mining, LLC

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF PLATES

1.0 EXECUTIVE SUMMARY

Clear Creek Associates (Clear Creek) was retained by Resolution Copper Mining, LLC (RCM) under RCM Contract No. CW199525 to oversee the drilling, installation, and testing of two hydrologic test wells for the Resolution Copper Project, and one replacement non-exempt supply well for the Queen Valley Domestic Water Improvement District (QVDWID) near Superior, Arizona. The wells are designated HRES-19, HRES-20, and QV-5, respectively. At HRES-19 and HRES-20, the primary target drilling depth was the contact between the Tertiary Apache Leap Tuff and the underlying White Tail Conglomerate. During drilling operations, data was collected to better characterize the hydrogeologic conditions within the Apache Leap Tuff. The target depth was reached at HRES-19, although the depth to the White Tail Conglomerate was shallower than expected. The White Tail Conglomerate was not reached at HRES-20 due to technical issues encountered while drilling. The hydrologic test wells will eventually be used to further evaluate regional aquifer characteristics through long-term pumping tests and water quality sampling. At QV-5, the main objective was to install and test a well that would provide a reliable supply of fresh water while collecting pertinent lithologic and hydrogeologic data from the site. All well drilling, installation, and development operations were performed between October 21, 2012 and December 14, 2012 by Boart Longyear Drilling Company (Boart). Working under the direction of RCM, Clear Creek provided technical and logistical support for the various phases of the project.

RCM prefers that units of length be reported in meters. All drilling equipment and tooling used by Boart for this project are configured in standard English units; depth measurements were converted to meters with a conversion factor of 3.28 feet/meter. Diameter measurements of drill bits, borehole, pipe, etc. are presented in inches.

1.1 HRES-19

Hydrologic test well HRES-19 was drilled, constructed, and tested between October 21 and November 8, 2012. The well borehole for HRES-19 was drilled to a depth of 291.5 meters below land surface (bls), into the White Tail Conglomerate. A suite of borehole geophysical logs was conducted, including: caliper, natural gamma, an electric suite (e-log), sonic, optical borehole imaging, acoustic borehole imaging, and magnetic deviation. HRES-19 was completed and installed to a depth of 276.8 meters bls. HRES-19 casing includes two screened intervals from 103.6 to 218.8 meters and from 231.6 to 268.2 meters bls with 8-inch J-55 LT&C R-1 casing, with machine-cut perforations. A bentonite seal was installed in the well annulus between the screen intervals. This seal will allow each respective screened interval to be isolated for aquifer testing purposes. Swab and airlift development was conducted at the well during formation stabilizer installation. No water production data was collected during drilling or development. Well construction and development was completed on November 8, 2012.

1.2 HRES-20

Hydrologic test well HRES-20 (HRES-20) was drilled, constructed, and tested between November 21 and December 8, 2012. The well borehole for HRES-20 was drilled to a depth of 322.2 meters bls. The target drilling depth was not reached due to drilling complications explained later in this report. A suite of borehole geophysical logs was conducted, including: caliper, natural gamma, an electric log suite (e-log), sonic, optical borehole imaging, acoustic borehole imaging, and magnetic deviation. HRES-20 was completed and installed to a depth of 322.2 meters bls. HRES-20 is screened from 182.1 to 315.7 meters bls with 8-inch J-55 LT&C R-1 casing, with machine-cut perforations. Airlift development was conducted at the well. During well development airlifting discharge rates ranged from 24 to 75 gallons per minute (gpm). Well construction and development was completed on December 8, 2012.

1.3 QV-5

Hydrologic test well QV-5 (QV-5) was drilled, constructed, and tested between December 5 and December 14, 2012. The well borehole for QV-5 was drilled to a depth of 173.2 meters bls. A suite of borehole geophysical logs was conducted, including: caliper, natural gamma, an electric log suite (e-log), sonic, optical borehole imaging, acoustic borehole imaging, and magnetic deviation. QV-5 was completed and installed to a depth of 172.3 meters bls. QV-5 is screened from 45 to 172.3 meters bls with 8-inch J-55 LT&C R-1 casing, with machine-cut perforations. No gravel pack was included in the well, however a cement well seal was installed to a depth of 32 meters. Airlift development was conducted at the well. During well development the airlifting discharge rates ranged from 40 to 250 gpm. Well construction and development was completed on December 14, 2012.

2.0 INTRODUCTION

Clear Creek was retained by RCM to oversee the drilling, installation, and testing of two hydrologic test wells for the Resolution Copper Project, and one replacement non-exempt supply well for the QVDWID near Superior, Arizona. The two hydrologic test wells, HRES-19 and HRES-20 were installed in order to characterize hydrogeologic conditions within the Tertiary Apache Leap Tuff unit (Tal) east of Superior, AZ (Figure 1). The non-exempt well, QV-5 was installed in order to characterize hydrogeologic conditions within a Tertiary dacite tuff, and to replace an existing water supply well (well #55-628139) near the community of Queen Valley, Arizona (Figure 2). Field work for this project was conducted between October 21, 2012 and December 14, 2012. This report summarizes the work completed during that period. Details of the locations of the respective well sites and well construction for HRES-19, HRES-20, and QV-5 are presented in Table 1, below.

Table 1. Well Site Location and Well Construction Details

Well Name	ADWR 55#	Cadastral Location	UTM Coordinates	Borehole Depth	Casing Depth	Screen Interval(s)
HRES-19	55-914789	D(2-13)8aaa	496726.0 3681837.0	291.4 m	276.8 m	103.6-218.8 m 231.6-268.2 m
HRES-20	55-914790	D(1-13)27cbd	497607.0 3685700.0	322.2 m	322.2 m	182.1-315.7 m
QV-5	55-221850	D(1-10)34cdd	0470845.0 3683975.0	173.2 m	172.3 m	45-172.3 m

Note: UTM coordinates were provided by RCM

2.1 SITE SETTING

Wells HRES-19 and HRES-20 are located in the vicinity of the Resolution Copper Mining project, approximately 4 miles east of Superior, Arizona (Figure 1). The HRES-19 site is located on land owned by the Arizona State Land Department. The HRES-20 site is located on land owned by the United States Forest Service. Mining operations for the project are currently in the prefeasibility phase.

Well QV-5 is located on land owned by the Queen Valley Domestic Water Improvement District (QVDWID), approximately 12 miles west of Superior, Arizona (Figure 2).

2.2 PERMITTING

The drilling company, Boart Longyear (Boart), submitted *Notice of Intent to Drill a Monitor Well* documents to the Arizona Department of Water Resources (ADWR) for HRES-19 and HRES-20; permits were issued by ADWR on October 10, 2012. ADWR assigned well registration numbers of 55-914789 and 55-914790 respectively.

QVDWID submitted *Notice of Intent to Construct a Replacement Non-Exempt Well* documents to ADWR for QV-5. A permit was issued by ADWR on November 26, 2012. ADWR assigned a well registration number of 55-221850. Permitting documentation for HRES-19, HRES-20, and QV-5 is presented in Appendix A.

2.3 SCOPE OF WORK

The wells were drilled, installed, and developed by Boart. Clear Creek's scope of work consisted of documenting and overseeing Boart's activities while in the field to ensure adherence to the technical specifications developed by RCM. Clear Creek also provided technical and logistical support to the project at the direction of RCM.

3.0 HRES-19 WELL DRILLING, LOGGING, AND CONSTRUCTION

HRES-19 was drilled, constructed, and developed by Boart using a Drill-Tech D80 rotary drill rig. The primary target drilling depth was the contact between the Tertiary Apache Leap Tuff and the underlying White Tail Conglomerate. The borehole was drilled with a nominal 15-inch diameter, to a total depth (TD) of 291.4 meters bls. Drilling of the HRES-19 borehole began on October 21, 2012 and was completed on November 3, 2012. On November 4, 2012, Southwest Exploration Services, LLC (Southwest) performed a suite of borehole geophysical logs. An As-Built well diagram is presented on Figure 3. Figure 4 presents the results of the geophysical logs, along with general lithology, drilling penetration rate data, and a schematic well diagram. Photographs taken during the well drilling and construction of HRES-19 are presented in Appendix B.

A number of logistical and technical challenges were encountered during operations at HRES-19. The site is in a remote location with high topographic relief. Site access is only via rough, unimproved dirt roads. Due to space constraints, materials for well drilling and construction were transported to the well site as needed from a storage facility in Superior. Fresh water for drilling operations was conveyed to the drilling site via tanker truck, and/or supplemented from a nearby well (HRES-7). The drill pad was small in size due topographic constraints, and operations at the site were conducted carefully and deliberately, to ensure safety.

3.1 SURFACE CASING

On October 21, 2012, Boart commenced drilling a 20-inch diameter borehole for the surface casing. Shortly after starting to drill the surface casing borehole, the D80 drill rig experienced a hydraulic systems malfunction and had to be shut down for repair. The broken portion of the hydraulic system (the Funk Box) was replaced and drilling resumed on October 24, 2012 and the surface borehole was completed to a depth of 11.9 meters bls on the same day. On October 24, 2012 Boart installed the surface casing to a depth of 11.9 meters bls and sealed the casing into place with neat-cement grout. The surface casing is mild steel, has a nominal 16-inch outside diameter, and a wall thickness of approximately 0.25 inches. The cement grout for the HRES-19 surface seal was mixed by Boart onsite and consisted of dry Portland cement, fresh water, and a calcium chloride accelerant to speed the cement curing process. The cement grout for the surface seal had a weight of approximately 16.4 lbs/gal.

3.2 DRILLING OPERATIONS

3.2.1 BOREHOLE DRILLING

On October 24, 2012 Boart began drilling the borehole for HRES-19 to a nominal diameter of 15 inches using an air-actuated hammer drill bit. Boart initially utilized the direct rotary method with compressed air to facilitate cuttings return. Fresh water was injected into the borehole to assist in lifting cuttings from

the borehole and to control dust. The fresh water for drilling operations was supplied to the site initially by tanker truck; several loads of water were required on a daily basis to maintain an adequate supply. Significant time and effort was required to deliver water to the site by tanker. After several days of drilling, RCM equipped nearby well HRES-07 with a generator and submersible pump allowing fresh water from the well to supply drilling operations. Water generated during drilling operations was diverted into an onsite storage tank, and then removed from the site by tanker truck. Drill cuttings from the Apache Leap Tuff unit were spread in a thin layer at the site. Drill cuttings from the White Tail Conglomerate unit were removed from the site to a designated disposal area.

The borehole was drilled with the hammer bit to a depth of approximately 151.5 meters on October 27, 2012. At this point, the drill rate slowed significantly and Boart could no longer return cuttings effectively utilizing direct air and the pneumatic hammer. In an effort to increase the volume of airflow into the borehole and improve cuttings return and drill rate, Boart switched to a tri-cone drill bit with tungsten-carbide buttons and continued drilling with direct air on October 27, 2012. By October 28, 2012 the borehole was drilled to a depth of 152.4 meters. Boart continued to experience difficulty in removing cuttings from the borehole and maintained a drill rate of less than 2 ft/hr. Boart and RCM made the decision to switch drilling methods to dual wall flooded reverse, using fresh water as drill fluid to facilitate the return of drilled cuttings. On October 28, 2012 drilling resumed with the flooded reverse method.

The preliminary well design for HRES-19 developed by RCM had specified that the borehole was to be drilled to a depth of approximately 321 meters. This target depth was based on the assumption that lithology at HRES-19 would be similar to what was encountered during drilling of nearby well HRES-07. However, the vitrophyre and White Tail Conglomerate units were encountered at a shallower depth than had been anticipated probably due to one or more intervening faults. Due to this unexpected change in borehole lithology, RCM modified the well design for HRES-19. The borehole was drilled to a total depth of approximately 291.4 meters bls on November 3, 2012.

3.2.2 PLUMBNESS AND ALIGNMENT

During drilling of the borehole, deviation surveys were conducted every 200 feet using a TOTCO inclinometer. Deviation survey results during drilling ranged from 0-1.5° (See HRES-19 lithologic log, Appendix C). A magnetic deviation survey was also conducted as part of the geophysical survey of the borehole. The magnetic survey indicated that the borehole drifted approximately 17.9 feet to the northeast, and is generally straight (Plate 1). Further discussion of the magnetic survey is contained in section 3.4.7 of this report.

3.3 LITHOLOGIC LOGGING

Clear Creek personnel prepared a lithologic log of the cuttings from the HRES-19 borehole in 10 foot intervals throughout the 291.4 meters of borehole. Because the aquifer penetrated by HRES-19 is a fractured rock aquifer, special care was given to identifying hydrothermal alteration within the cuttings, e.g., iron oxide neo-mineralization or euhedral calcite. Potential water producing fracture zones are discussed later in this report. The lithologic log for the HRES-19 boring is presented in Appendix C; a generalized stratigraphic column for the borehole is presented on Figure 4, and is summarized below. Pictures of drill cuttings for each major unit are included in Appendix B.

3.3.1 LITHOLOGY SUMMARY OF HRES-19 BOREHOLE

- **0-94.5 meters** – **(Talg) Apache Leap Gray Unit** reddish brown, well-indurated, phaneritic to porphyritic tuff with a cryptocrystalline groundmass and phenocrysts up to 5mm. Phenocrysts include feldspar (sanidine), quartz, and biotite, with trace magnetite. Pumice fragments within the unit are moderately flattened with a high aspect ratio. The unit contains lithic inclusions of underlying country rock. Secondary features include limonite on biotite phenocrysts and minor iron-oxide staining in the groundmass.

- **94.5-280.5 meters** – **(Talb) Apache Leap Brown Unit** reddish brown, well-indurated, phaneritic to porphyritic tuff with a cryptocrystalline groundmass and phenocrysts up to 5mm. Phenocrysts include feldspar (sanidine), quartz, and biotite, with trace magnetite. The unit contains laminations due to highly flattened pumice fragments. The unit contains lithic inclusions of underlying country rock. Secondary features include limonite on biotite phenocrysts, minor iron-oxide staining in the groundmass, local euhedral calcite fragments, and localized flow banding.

- **280.5-286.6 meters** – **(Talbt & Talv) Apache Leap Basal Tuff and Vitrophyre** pinkish-orange porphyritic-phaneritic poorly to moderately indurated tuff, with amorphous black glassy groundmass.

- **286.6-289.6 meters** – **(Talbt) Apache Leap Basal Tuff** Well indurated porphyritic-phaneritic tuff with crystalline groundmass. Phenocrysts include feldspar (sandine), quartz, and biotite. Unit contains fragments of vitrophyre and pinkish-orange tuff as previously described.

- **289.6-292.7 meters** – **(Tw, Talbt & Talv) White Tail Conglomerate, Apache Leap Basal Tuff and Vitrophere** pinkish-orange porphyritic-phaneritic poorly to moderately indurated tuff, and vitrophyre as previously described. Phenocrysts include feldspar, quartz, and biotite.

3.4 GEOPHYSICAL LOGGING

Geophysical logging was conducted in the HRES-19 borehole on November 4, 2012, to the total depth of 291.4 meters. Geophysical logs help to characterize subsurface hydrogeologic conditions that cannot be readily determined from drilled cuttings. Southwest Exploration Services LLC (Southwest) conducted a geophysical logging suite including: caliper log, natural gamma ray log, an electric log suite, spontaneous potential log, sonic log, optical televiewer, and acoustic televiewer. The geophysical logs for the HRES-19 borehole are presented in digital format in Plate 1 and summarized with the general geology on Figure 4.

3.4.1 CALIPER LOG

The caliper log provides a measurement of the borehole diameter. Changes in the borehole diameter commonly occur from formation washouts, voids or fracture sets, or swelling of natural clays in the formation. The caliper log is used in conjunction with other logs to differentiate borehole diameter effects from actual lithologic changes.

The caliper log for HRES-19 showed a fairly consistent diameter from the top of the borehole to approximately 125 meters, with borehole diameter averaging approximately 15 inches. A washout zone occurs in this interval from 30 to 85 meters with diameter in the washout ranging from 15 to 22.5 inches. From approximately 125 to 215 meters bls, a large washout zone occurs, with borehole diameter ranging from 16 inches to greater than 28 inches. This is likely due to a fractured zone in the dacite. From 215 meters to TD, borehole diameter is fairly consistent averaging approximately 16 inches. A small washout was indicated within this interval at approximately 280 meters.

3.4.2 NATURAL GAMMA RAY LOG

The gamma-ray log measures the naturally occurring gamma emissions from the decay of unstable elements in the formation surrounding the borehole. One of the most significant and the most abundant radioactive elements is potassium-40. As potassium-40 decays, it emits electromagnetic radiation, which the gamma-ray probe detects and records. The greater the count rate, the higher the amount of potassium-40 in the formation. Potassium-bearing minerals such as feldspar, biotite, and several clay minerals contain potassium-40. Consequently, an increase in clay content in the strata typically results in an elevated gamma-ray response.

In the HRES-19 borehole, the natural gamma ray log shows an average American Petroleum Institute (api) unit count of approximately 160 api units from the bottom of the surface casing to the water table at approximately 119 meters bls. At 119 meters, a notable decrease occurs and the log shows an average api unit count of approximately 80 api units from 119 meters to TD. This decrease is likely due to the

dampening effect that water has on gamma radiation and therefore reflects the depth of the water table rather than a geologic change.

3.4.3 ELECTRIC LOGS

The electric log suite included a spontaneous potential (SP) log, short-normal (16-inch) resistivity log, long-normal (64-inch) resistivity log, and single point resistance (SPR) log which are recorded simultaneously. The SP log measures naturally occurring electrical signals and is used mainly for lithologic correlations or for differentiating non-permeable strata in a clay-sand sequence.

The SP values for HRES-19 fluctuate between -130 and 465 mV from the water table to approximately 140 meters bls. From 140 meters to TD values have a fairly consistent range of 290-360 mV.

The short-normal and long-normal resistivity logs measure the electrical resistance of formation materials. Of interest to hydrogeologic investigations, resistivity can be at least partially controlled by formation porosity. Because groundwater is an electrical conductor, its presence in the interconnected pores reduces the overall formation resistivity. Typically, silt and clay units have lower resistivity values in comparison to sand and gravel units because of their higher porosity and water content. The short-normal resistivity log measures the resistivity of the formation near the borehole, while the long-normal resistivity log measures the resistivity at a greater distance from the borehole.

The short-normal, long-normal, and single point resistivity logs for HRES-19 show a gradual decrease from the water table to approximately 183 meters bls, followed by a gradual increase from 183 to 214 meters bls. From 214 meters to TD, values of single point resistance fluctuate.

3.4.4 SONIC LOG

The sonic log measures the average velocity of a sound wave passing through the formation. The velocity of the sound wave changes as it passes through water and through varying formation materials. Higher sonic velocity indicates an increase in density, which usually correlates with harder, less fractured rock. Conversely, lower velocity indicates lower density, which may correlate with fracture zones.

The sonic velocity values for HRES-19 range from 50-µSec to 250-µSec from the water table to approximately 200 meters. From 200 meters to borehole TD values range from 50-µSec to 100-µSec.

3.4.5 OPTICAL BOREHOLE IMAGING LOG

The Optical Borehole Imaging log (OBI) provides a continuous and orientated 360° view of the borehole wall from which the character, relation, and orientation of lithologic and structural planer features can be defined for studies of fractured rock aquifers. The optical images of the OBI allow for direct viewing of

the lithology and fractured zones within the borehole. The OBI log was run from the surface to the fluid level in the borehole (119 meters bls) and was used to locate fractured zones above the fluid level.

3.4.6 ACOUSTIC BOREHOLE IMAGING LOG

The Acoustic Borehole Imaging Log (ABI) provides a continuous orientated 360° view of the borehole wall from which the character, relation, and orientation of lithologic and structural planer features can be defined for studies of fractured rock aquifers. The ABI returns a reflected acoustic signal as a photographic-like borehole image. This allows for the direct viewing of fractured zones and caverns even when the boring is filled with drilling mud.

The ABI at HRES-19 was run from the fluid level (119 meters bls) to a total depth of 291.4 meters bls. The ABI data were used in concert with the lithologic log to determine the location and extent of water producing fractured zones discussed later in this report.

3.4.7 MAGNETIC DEVIATION SURVEY

In conjunction with the OBI and ABI logs, a magnetic deviation survey was conducted in the HRES-19 borehole on November 4, 2012 by Southwest (See Plate 1). There was a total drift distance of 5.5 meters from land surface to borehole TD. The borehole was generally straight, and trends to the northeast.

3.5 FRACTURED AND FAULTED ZONES

HRES-19 is located in a fractured dacite aquifer system. Because of the nature of fractured rock aquifer systems, locating the fractured and faulted zones within the borehole was vital in the productivity of HRES-19. Fractured and faulted zones were identified by corroborating information from drill cuttings, drill rates, rig chatter, and geophysical logs. Fractured zones are presented with the general geology on Figure 4.

Based on our interpretation of all of the data obtained from the drilling at HRES-19, there are at least 11 fractured zones in the well. The largest fractured zone occurs between 200 and 155 meters bls (Figure 4).

3.6 WELL CONSTRUCTION MATERALS

3.6.1 WELL CASING

The blank well casing installed in well HRES-19 is J-55 LT&C R-1 pipe. The threaded and coupled well casing has an inside diameter of 8.0 inches and an outside diameter of 8.625 inches with a wall thickness of 0.304 inches. The couplers have an outside diameter of 9.625 inches. The blank casing was factory-assembled in nominal 21-foot sections.

3.6.2 WELL SCREEN

The screen installed in well HRES-19 is J-55 LT&C R-1 pipe with machine cut perforations. The thread and coupled well screen has an inside diameter of 8.0 inches and an outside diameter of 8.625 inches with a wall thickness of 0.304 inches. The perforations are factory-installed 0.030-inch vertical slots approximately 3 inches in length, spaced approximately 3 inches apart, with 4 perforations per round providing 8 openings per linear foot. The casing couplers have an outside diameter of 9.625 inches. The screen was factory-assembled in nominal 21-foot sections.

3.6.3 FORMATION STABILIZER

The formation stabilizer installed in HRES-19 is Tacna $^{3}/_{8}$" x ¼" gravel.

3.6.4 BENTONITE SEALS

The bentonite seals installed in HRES-19 are comprised of 3/8-inch coated bentonite pellets ("Pel-Plug") and ¾-inch chips (Baroid "Hole-Plug"). Layers of 10x20 mesh silica choke sand were installed adjacent to the seals to prevent the incursion of the bentonite into the filter pack.

3.6.5 CEMENT SEAL

The cement-grout seal installed in HRES-19 was mixed by Boart onsite in a mixing tank. Each batch of cement consisted of a 2000-lb super sack of dry cement, 25-lbs of powdered bentonite, approximately 120 gal of fresh water, and 50 lbs of calcium chloride to accelerate the curing process.

3.7 CASING, SCREEN, AND ANNULAR MATERIALS INSALLATION

3.7.1 JOINTS IN THE WELL CASING

The sections of casing and screen were assembled with factory installed threads and couplers. Hydraulic tongs were used to tighten the sections into place. Casing centralizers were installed at periodic intervals to ensure the casing and screen remained centered in the borehole during the installation of annular materials. A threaded bottom cap was installed at the bottom of the sump. The field pipe talley for well construction is presented in Appendix D.

3.7.2 FORMATION STABILIZER INSTALLATION

The formation stabilizer was installed by use of a tremie pipe. The formation stabilizer was gravity fed using fresh water through the tremie pipe. Formation stabilizer was installed from 272.5 to 228.9 meters bls, and from 221.9 to 91.4 meters bls. In order to avoid bridging during gravel installation, and to develop the borehole, formation stabilizer material was settled by swab and airlift. Formation stabilizer

installation took place from November 5-8, 2012. Field forms documenting Clear Creek's oversight of formation stabilizer installation are presented in Appendix D.

3.7.3 BENTONITE SEAL INSTALLATION

The bentonite seals (and choke sand where applicable) were installed by use of a tremie pipe. The bentonite was gravity fed using fresh water through the tremie. Bentonite seals were installed in the borehole from 291.4 to 285.6 meters bls, 280.4 to 272.5 meters bls, 227.4 to 224.3 meters bls, and 89.9 to 88.4 meters bls.

3.8 SWAB AND AIRLIFT DEVELOPMENT

No additional swab and airlift development was performed at HRES-19 subsequent to formation stabilizer installation.

4.0 HRES-20 WELL DRILLING, LOGGING, AND CONSTRUCTION

HRES-20 was drilled, constructed, and developed by Boart using a Drill-Tech D80 rotary drill rig. The primary target drilling depth was the contact between the Tertiary Apache Leap Tuff and the underlying White Tail Conglomerate. The borehole was drilled with a nominal 15-inch diameter, to a total depth of 322.2 meters bls. Drilling of the HRES-20 borehole began on November 20, 2012 and was completed on December 2, 2012. On December 3, 2012, Southwest Exploration Services, LLC performed a suite of borehole geophysical logs. An As-Built well diagram is presented on Figure 5. Figure 6 presents the results of the geophysical logs, along with general lithology, drilling penetration rate data, and a schematic well diagram. Photographs taken during the well drilling and construction of HRES-20 are presented in Appendix B.

A number of logistical and technical challenges were encountered during operations at HRES-20. The site is in a remote location with high topographic relief. Access is limited via rough, unimproved dirt roads. Due to space constraints, materials for well drilling and construction were transported to the well site as needed from a storage facility in Superior. Fresh water for drilling operations was pumped to the site from the adjacent well HRES-15, and supplemented by tanker truck. Operations at the site were conducted carefully and deliberately, to ensure safety.

4.1 SURFACE CASING

On November 20, 2012, Boart drilled a 20-inch diameter borehole for the surface casing to a depth of 11.9 meters bls. Boart installed the surface casing to a depth of 11.9 meters bls and sealed the casing into place with neat-cement grout. The surface casing is mild steel, has a nominal 16-inch outside diameter, and a wall thickness of approximately 0.25 inches. The cement grout for the HRES-20 surface seal was mixed by Boart onsite and consisted of dry Portland cement, fresh water, and a calcium chloride accelerant to speed the cement curing process.

4.2 DRILLING OPERATIONS

4.2.1 BOREHOLE DRILLING

On November 21, 2012 Boart began drilling the borehole for HRES-20 to a nominal diameter of 15 inches using an air-actuated hammer drill bit. Boart initially utilized the direct rotary method with compressed air as a drilling fluid. Fresh water was injected into the borehole to assist in lifting cuttings from the borehole and to control dust. The fresh water for drilling operations was supplied to the site initially by pumping from nearby well HRES-15. When drilling mud products were utilized in the HRES-20 borehole, the pump at HRES-15 was shut down to avoid drawing drilling fluids into the well and fresh water was delivered to the site via tanker truck. Water generated during drilling operations was diverted

into an onsite storage tank, and then removed from the site by tanker truck. Drill cuttings were spread in a thin layer at the site.

The borehole was drilled with the hammer bit to a depth of approximately 172 meters on November 24, 2012. Boart was unable to return cuttings effectively from 152.4 to 172 meters due to lost fluid circulation. Boart and RCM made the decision to switch drilling methods to dual wall flooded reverse with a tri-cone drill bit, using fresh water drilling fluid to facilitate the return of drill cuttings. On November 24, 2012 drilling resumed with the flooded reverse method and fresh water fluid. Boart drilled to 186 meters bls but was still unable to stabilize or effectively clean the borehole. On November 25, 2012 RCM gave approval for Boart to drill direct mud rotary with bentonite mud drilling fluid until the borehole was stabilized and free of drilled cuttings.

Drilling with the direct mud method Boart successfully stabilized and cleaned the borehole, and drilled to a depth of approximately 213.65 meters bls on November 27, 2012. Drilling continued from 213.65 meters bls to 322.2 meters bls with the flooded reverse method and fresh water fluid. In order to investigate a slowing drill rate, on December 2, 2012, Boart removed the drill bit from the hole and discovered that part of the bottom hole assembly (a tungsten-carbide button roller from one of the rolling reamers) had become dislodged and had fallen to the bottom of the borehole, damaging the drill bit. The preliminary well design for HRES-20 proposed by RCM had specified that the borehole was to be drilled to a depth of approximately 598 meters. Boart was unsuccessful in removing the lost roller; therefore, RCM made the decision to cease drilling the borehole at 322.2 meters.

4.2.2 PLUMBNESS AND ALIGNMENT

During drilling of the borehole, deviation surveys were conducted every 200 feet using a TOTCO inclinometer. Deviation survey results during drilling ranged from 0-0.75° (See HRES-20 lithologic log, Appendix C). A magnetic deviation survey was also conducted as part of the geophysical survey of the borehole. The magnetic survey indicated that the borehole drifted approximately 2 meters to the west. The borehole is moderately aligned with minor doglegging throughout. There is an artificial dogleg at 152 meters bls that resulted from the way in which the survey was compiled. The nature of this artificial dogleg is disused further in section 4.4.7 of this report.

4.3 LITHOLOGIC LOGGING

Clear Creek personnel prepared a lithologic log of the cuttings from the HRES-20 borehole in 10 foot intervals throughout the 322.2 meters of borehole. Because the aquifer penetrated by HRES-20 is a fractured rock aquifer, special care was given to identifying hydrothermal alteration within the cuttings, e.g., iron oxide neo-mineralization or euhedral calcite. Potential water producing fracture zones are discussed later in this report. The lithologic log for the HRES-20 boring is presented in Appendix C; a generalized stratigraphic column for the borehole is presented in Figure 6, and is summarized below.

Photographs of cuttings representing each lithologic unit are provided in Appendix B Results of the lithologic log from nearby well HRES-15 (provided by RCM) were referenced in determining subunit contacts.

4.3.1 LITHOLOGY SUMMARY OF HRES-20 BOREHOLE

- **0-118.9 meters** – **(Talw) Apache Leap White Unit** reddish brown, well-indurated, phaneritic tuff with aphanitic crystalline groundmass. Phenocrysts include plagioclase, quartz, and biotite. The unit contains fragments of pinkish-gray to white pumice and lithic inclusions of red-brown siltstone. Pumice inclusions are slightly flattened maintaining a low aspect ratio.

- **118.9-256 meters** – **(Talg) Apache Leap Gray Unit** reddish brown, well -indurated, porphyritic to phaneritic tuff with an aphanitic groundmass. Phenocrysts include plagioclase feldspar, quartz, and biotite. The unit contains fragments of pinkish gray to white pumice that are moderately to highly flattened with a high aspect ratio. Unit contains lithic inclusions of underlying country rock. Secondary features include limonite on biotite phenocrysts, and minor iron-oxide staining in the groundmass.

- **256-322.2 meters** – **(Talb) Apache Leap Brown Unit Unit** reddish brown, well-indurated, phaneritic to porphyritic tuff with a cryptocrystalline groundmass and phenocrysts up to 5mm. Phenocrysts include feldspar (sanidine), quartz, and biotite, with trace magnetite. The unit contains laminations due to highly flattened pumice fragments. The unit contains lithic inclusions of underlying country rock. Secondary features include limonite on biotite phenocrysts, minor iron-oxide staining in the groundmass, local euhedral calcite fragments, and localized flow banding.

4.4 GEOPHYSICAL LOGGING

Geophysical logging was conducted in the HRES-20 borehole on December 3, 2012, to the total depth of 321.4 meters. Geophysical logs help to characterize subsurface hydrogeologic conditions that cannot be readily determined from drilled cuttings. Southwest conducted a geophysical logging suite including: caliper log, natural gamma ray log, electric logs, spontaneous potential log, sonic log, optical televiewer, and acoustic televiewer. The geophysical logs for the HRES-20 borehole are presented in digital format in Plate 2 and summarized with the general geology in Figure 6. A detailed description of each geophysical log is presented in section 3.4 of this report. This section only contains unique results for HRES-19.

4.4.1 CALIPER LOG

The caliper log for HRES-20 shows a fairly consistent borehole diameter from land surface to approximately 102 meters bls with diameter averaging approximately 15.5 inches. A large washout with

diameters ranging from 15 to 28 inches occurs from 102 to 141 meters. The diameter is fairly consistent from 141 to 200 meters, averaging 15.5 inches. From 200 meters to TD, significant washouts occur with borehole diameter ranging from 15 to 25.5 inches.

4.4.2 NATURAL GAMMA RAY LOG

In the HRES-20 borehole, natural gamma ray log shows an average American Petroleum Institute (api) unit count of approximately 160 api units from the bottom of the surface casing to the water table at approximately 195 meters bls. At 195 meters a notable decrease occurs and the log shows an average api unit count of approximately 80 api units from 195 meters to TD. This decrease is likely due to the dampening effect that water has on gamma radiation and therefore reflects the water table rather than a geologic change.

4.4.3 ELECTRIC LOGS

The SP values for HRES-20 fluctuate between -290 and 225 mV from the water table to approximately 217 meters bls. From 217 meters bls to TD values have a fairly consistent range of 260-390 mV. The short-normal, long-normal, and single point resistivity logs for HRES-20 show decreasing resistivity from the water table to 265 meters bls, and fairly consistent values from 262 meters bls to TD.

4.4.4 SONIC LOG

The sonic velocity values for HRES-20 range from -50-µSec to 160-µSec from the water table at approximately 195 meters, to borehole TD.

4.4.5 OPTICAL BOREHOLE IMAGING LOG

The Optical Borehole Imaging log (OBI) provides a continuous and orientated 360° view of the borehole wall from which the character, relation, and orientation of lithologic and structural planer features can be defined for studies of fractured rock aquifers. The optical images of the OBI allow for direct viewing of the lithology and fractured zones within the borehole. The OBI log was run from the surface to the fluid level in the borehole (195.5 meters bls) and was used to locate fractured zones above the fluid level.

4.4.6 ACOUSTIC BOREHOLE IMAGING LOG

The Acoustic Borehole Imaging Log (ABI) provides a continuous orientated 360° view of the borehole wall from which the character, relation, and orientation of lithologic and structural planer features can be defined for studies of fractured rock aquifers. The ABI returns a reflected acoustic signal as a photographic-like borehole image. This allows for the direct viewing of fractured zones and caverns. The ABI was run from the fluid level (195.5 meters bls) to a total depth of 321.4 meters. The ABI data were

used in concert with the lithologic log to determine the location and extent of water producing fractured zones discussed later in this report.

4.4.7 MAGNETIC DEVIATION SURVEY

In conjunction with the OBI and ABI logs, a magnetic deviation survey was conducted in the HRES-20 borehole on December 3, 2012 by Southwest (See Plate 2). The magnetic survey indicated that the borehole drifted approximately 2 meters to the west from land surface to TD. The magnetic deviation survey is constructed by combining the OBI and ABI orientation data. The OBI log is run from the surface to the static water level, and the ABI log is run from the static water level to the total depth of the borehole. The geophysical logger from Southwest indicated that the stitching process between the two sets of data generated an artificialyl significant dogleg at 152 meters bls. Borehole alignment initially trends slightly northwest do a depth of approximately 152 meters, and then doglegs to the west, but at a less extreme angle than indicated by the survey.

4.5 FRACTURED AND FAULTED ZONES

HRES-20 is located in a fractured dacite aquifer system. Because of the nature of fractured rock aquifer systems, locating the fractured and faulted zones within the borehole was vital in the productivity of HRES-20. Fractured and faulted zones were identified by corroborating information from drill cuttings, drill rates, rig chatter, and geophysical logs. Fractured zones are presented with the general geology in Figure 6.

Based on our interpretation of all of the data obtained from the drilling at HRES-20, there are numerous fractured zones in the well. The largest fractured zone occurs between approximately 316.3 and 261.2 meters bls (See Figure 6).

4.6 WELL CONSTRUCTION MATERALS

4.6.1 WELL CASING

The blank well casing installed in well HRES-20 is J-55 LT&C R-1 pipe. The threaded and coupled well casing has an inside diameter of 8.0 inches and an outside diameter of 8.625 inches with a wall thickness of 0.304 inches. The couplers have an outside diameter of 9.625 inches. The blank casing was factory-assembled in nominal 21-foot sections.

4.6.2 WELL SCREEN

The screen installed in well HRES-20 is J-55 LT&C R-1 pipe with machine cut perforations. The thread and coupled well screen has an inside diameter of 8.0 inches and an outside diameter of 8.625 inches with a wall thickness of 0.304 inches. The perforations are factory-installed 0.030-inch vertical slots

approximately 3 inches in length, spaced approximately 3 inches apart, with 4 perforations per round providing 8 openings per linear foot. The casing couplers have an outside diameter of 9.625 inches. The screen was factory-assembled in nominal 21-foot sections.

4.6.3 FORMATION STABILIZER

The formation stabilizer installed in HRES-20 is Tacna $^{3}/_{8}$" x ¼" gravel.

4.6.4 BENTONITE SEAL

The bentonite seal installed in HRES-20 is comprised of ¾-inch chips (Baroid "Hole-Plug"). A layer of 10x20 mesh silica choke sand was installed below the bentonite seal to prevent the incursion of the bentonite into the filter pack.

4.6.5 CEMENT SEAL

The cement-grout seal installed in HRES-20 was mixed by Boart onsite in a mixing tank. Each batch of cement consisted of a 2000-lb super sack of dry cement, 25-lbs of powdered bentonite, approximately 120 gal of fresh water, and 50 lbs of calcium chloride to accelerate the curing process.

4.7 CASING, SCREEN, AND ANNULAR MATERIALS INSALLATION

4.7.1 JOINTS IN THE WELL CASING

The sections of casing and screen were assembled with factory installed threads and couplers. Hydraulic tongs were used to tighten the sections into place. Casing centralizers were installed at periodic intervals to ensure the casing and screen remained centered in the borehole during the installation of annular materials. A threaded bottom cap was installed at the bottom of the sump. A field pipe tally documenting the installation of the well casing is presented in Appendix D.

4.7.2 FORMATION STABILIZER INSTALLATION

At the direction of RCM, Clear Creek did not oversee the installation of formation stabilizer in HRES-20 and relied on reports from Boart for the details of this section. The formation stabilizer was installed by use of a tremie pipe. The gravel pack was gravity fed using fresh water through the tremie pipe. The formation stabilizer was installed from 322.2 to 177.2 meters bls.

4.7.3 BENTONITE SEAL INSTALLATION

The bentonite seal (and choke sand) was installed by use of a tremie pipe. The bentonite was gravity fed using fresh water through the tremie. A bentonite seal was installed in the borehole from 175.9 to 174.9 meters bls.

4.8 SWAB AND AIRLIFT DEVELOPMENT

Swab and airlift development began on December 7, 2012 and was completed on December 8, 2012. Utilizing a double-cup swab tool, Boart swabbed and airlifted in 40-foot intervals throughout the entire screen interval to remove excess suspended drilling mud, silt, and sand. The rate of airlifting discharge ranged from 24 to 75 gpm throughout the development period. Clear Creek Associates monitored field parameters and clarity of the discharge water from each 40-foot interval until parameters were stable and the water was of acceptable clarity prior to moving to the next interval. Field forms documenting the swab and airlift development process are presented in Appendix E.

5.0 QV-5 WELL DRILLING, LOGGING, AND CONSTRUCTION

QV-5 was drilled, constructed, and developed by Boart using a Drill-Tech DH40 rotary drill rig. Drilling operations commenced with the objective of drilling to a depth of 183 meters, or until a significant change in lithology was encountered i.e., contact with basement rock. The borehole was drilled with a nominal 15-inch diameter, to a depth of 173.2 meters bls. Drilling of the QV-5 borehole began on December 6, 2012 and was completed on December 13, 2012. On December 13, 2012, Southwest Exploration Services, LLC performed a suite of borehole geophysical logs. An As-Built well diagram is presented on Figure 7. Figure 8 presents the results of the geophysical logs, along with general lithology, drilling penetration rate data, and a schematic well diagram. Photographs taken during the well drilling and construction of QV-5 are presented in Appendix B.

The QV-5 site is located within a QVDWID facilities maintenance yard, and access was through the community of Queen Valley, AZ. Boart was able to stage all materials for well drilling and construction in a lay-down area adjacent to the site. Operations at the site were conducted carefully and deliberately, to ensure safety.

5.1 SURFACE CASING

On December 6, 2012, Boart drilled a 20-inch diameter borehole for the surface casing to a depth of 17.9 meters bls on the same day. On October 24, 2012 Boart installed the surface casing to a depth of 17.9 meters bls and sealed the casing into place with neat-cement grout. The surface casing is mild steel, has a nominal 16-inch outside diameter, and a wall thickness of approximately 0.25 inches. The cement grout was mixed by Boart onsite and consisted of dry Portland cement, fresh water, and a calcium chloride accelerant to speed the cement curing process. The cement grout for the QV-5 surface seal had a weight of approximately 15.6 lbs/gal.

5.2 DRILLING OPERATIONS

5.2.1 BOREHOLE DRILLING

On December 7, 2012 Boart began drilling the borehole for QV-5 to a nominal diameter of 15 inches using an air-actuated hammer drill bit. Boart initially utilized the direct rotary method with compressed air as a drilling fluid. Fresh water was injected into the borehole to assist in lifting cuttings from the borehole and to control dust. Fresh water for the drilling operations was supplied by nearby hydrant belonging to QVDWID. Water generated during drilling operations was discharged to a retention basin owned by QVDWID, adjacent to the well site. Drill cuttings from the QV-5 borehole were conveyed to a disposal site designated by QVDWID. The borehole was drilled with the hammer bit to a depth of approximately 118.3 meters on December 10, 2012. From 81.7 to 118.3 meters bls Clear Creek monitored

airlifting discharge from the borehole at 20-foot intervals, using a 9-gallon container placed beneath the cyclone. Details of the discharge monitoring are presented in Table 2, below.

Table 2. Airlifting Discharge Rates While Drilling

Date	Drilling Depth (meters)	Discharge Rate (gallons per minute)
12/8/12	81.7	2.5
12/8/12	87.8	4.5
12/8/12	93.9	18
12/9/12	100	60
12/9/12	106.1	70
12/9/12	112.2	108
12/10/12	118.3	108

At 118.3 meters the borehole was producing too much water for the hammer bit to continue drilling effectively. On December 10, 2012 Boart switched to a tri-cone drill bit with tungsten-carbide buttons and continued drilling flooded reverse with fresh water. At approximately 160 meters, the drilling rate slowed and the formation became much harder than previously encountered, although no significant change was noted in the appearance of drill cuttings. After drilling for approximately 13 meters in the harder formation with no evidence of additional water production or fracturing, RCM made the decision to call borehole TD at a depth of 173.2 meters On December 13, 2012.

5.2.2 PLUMBNESS AND ALIGNMENT

During drilling of the borehole, deviation surveys were conducted every 200 feet using a TOTCO inclinometer. Deviation survey results during drilling ranged from 0-2° (See QV-5 lithologic log, Appendix C). A magnetic deviation survey was also conducted as part of the geophysical survey of the borehole. The magnetic survey indicated that the borehole drifted approximately 2 meters to the southwest, and is generally straight. Further discussion of the magnetic survey is contained in section 5.4.7 of this report.

5.3 LITHOLOGIC LOGGING

Clear Creek personnel prepared a lithologic log of the cuttings from the QV-5 borehole in 10 foot intervals throughout the 173.2 meters of borehole. Because the aquifer penetrated by QV-5 is a fractured rock aquifer, special care was given to identifying hydrothermal alteration within the cuttings, e.g., iron oxide neo-mineralization or euhedral calcite. Potential water producing fracture zones are discussed later in this report. The lithologic log for the QV-5 boring is presented in Appendix C; a generalized stratigraphic column for the borehole is presented in Figure 8, and is summarized below.

5.3.1 LITHOLOGY SUMMARY OF QV-5 BOREHOLE

- **0-6.1 meters** – **(Qal) Alluvium** unconsolidated, poorly sorted gravel and sand with trace fines. Clasts are angular to sub-angular, polylithic, and predominantly of felsic composition. Clasts include milky quartz, and fragments of sandstone, silt stone, mixed volcanics, and schist.

- **6.1-173.2 meters** – **(Tal) Apache Leap Tuff** dark pink/red/brown moderately to well-indurated, crystal-rich porphyritic tuff with an aphanitic groundmass. Phenocrysts include feldspar (sanidine), quartz, biotite, and trace magnetite. Secondary features include limonite on biotite phenocrysts and occasional iron-oxide staining on groundmass. Also includes fragments of white to gray pumice and trace lithic inclusions.

5.4 GEOPHYSICAL LOGGING

Geophysical logging was conducted in the QV-5 borehole on December 13, 2012, to the total depth of 173.2 meters. Geophysical logs help to characterize subsurface hydrogeologic conditions that cannot be readily determined from drilled cuttings. Southwest conducted a geophysical logging suite including: caliper log, natural gamma ray log, electric logs, spontaneous potential log, sonic log, optical televiewer, acoustic televiewer, and magnetic deviation. The geophysical logs for the QV-5 borehole are presented in digital format in Plate 3 and summarized with the general geology in Figure 8. A detailed description of each geophysical log is presented in section 3.4 of this report. This section only contains unique results for QV-5.

5.4.1 CALIPER LOG

The caliper log for QV-5 showed a fairly consistent borehole diameter from land surface to 61 meters bls, with borehole diameter averaging approximately 15 inches. A large washout zone occurs from 61 to 113 meters bls, with borehole diameter ranging from 15 to 27 inches. The borehole diameter averages 16 inches from 113 to 163 meters bls, with a moderate washout up to 27 inches occurring from 142 to 158 meters bls. From 163 meters to TD borehole diameter is a consistent 14.75 inches.

5.4.2 NATURAL GAMMA RAY LOG

In the QV-5 borehole, the natural gamma ray log shows an average American Petroleum Institute (api) unit count of approximately 160 api units from the bottom of the surface casing to approximately 45 meters. At 45 meters a notable decrease occurs and the log shows an average api unit count of approximately 80 api units from 45 meters bls to TD. This decrease is likely due to the dampening effect that water has on gamma radiation.

5.4.3 ELECTRIC LOGS

The SP values for QV-5 fluctuates between -160 and 325 mV from the water table to approximately 65 meters bls. From 65 to 97 meters bls, values gradually increased from 325 mV to 475 mV. SP values from 97 meters bls to TD have a fairly consistent range of approximately 438 to 513 mV. The short-normal, long-normal, and single point resistivity logs for QV-5 show fluctuating values from the water table at 45 meters bls and 148 meters bls, and decreasing resistivity values from 148 meters bls to TD.

5.4.4 SONIC LOG

The sonic log measures the average velocity of a sound wave passing through the formation. The velocity of the sound wave changes as it passes through water and through varying formation materials. Higher sonic velocity indicates an increase in density, which correlates with harder, less fractured rock. Conversely, lower velocity indicates lower density, which may correlate with fracture zones. The sonic velocity values for QV-5 range from 60-µSec to 160-µSec from the water table to 113 meters bls. From 113 meters bls to TD values are fairly consistent ranging from 60-µSec to 100-µSec.

5.4.5 OPTICAL BOREHOLE IMAGING LOG

The Optical Borehole Imaging log (OBI) provides a continuous and orientated 360° view of the borehole wall from which the character, relation, and orientation of lithologic and structural planer features can be defined for studies of fractured rock aquifers. The optical images of the OBI allow for direct viewing of the lithology and fractured zones within the borehole. The OBI log was run from the surface to the fluid level in the borehole (45 meters bls) and was used to locate fractured zones above the fluid level.

5.4.6 ACOUSTIC BOREHOLE IMAGING LOG

The Acoustic Borehole Imaging Log (ABI) provides a continuous orientated 360° view of the borehole wall from which the character, relation, and orientation of lithologic and structural planer features can be defined for studies of fractured rock aquifers. The ABI returns a reflected acoustic signal as a photographic-like borehole image. This allows for the direct viewing of fractured zones and caverns. The ABI was run from the fluid level (45 meters bls) to a total depth of 173.2 meters bls. The ABI data were

used in concert with the lithologic log to determine the location and extent of water producing fractured zones discussed later in this report.

5.4.7 MAGNETIC DEVIATION SURVEY

In conjunction with the OBI and ABI logs, a magnetic deviation survey was also conducted as part of the geophysical survey of the borehole. The magnetic survey indicated that the borehole drifted approximately 2 meters to the southwest, and is generally highly aligned.

5.5 FRACTURED AND FAULTED ZONES

QV-5 is located in a fractured dacite tuff aquifer system. Because of the nature of fractured rock aquifer systems, locating the fractured and faulted zones within the borehole was vital in the productivity of QV-5. Fractured and faulted zones were identified by corroborating information from drill cuttings, drill rates, rig chatter, and geophysical logs. Fractured zones are presented with the general geology in Figure 8.

Based on our interpretation of all of the data obtained from the drilling at QV-5, there are at least 6 fractured zones in the well. The two largest fractured zones occur between 61.1-88.5 and 95.7-113.4 meters bls (Figure 8).

5.6 WELL CONSTRUCTION MATERALS

5.6.1 WELL CASING

The blank well casing installed in well QV-5 is J-55 LT&C R-1 pipe. The threaded and coupled well casing has an inside diameter of 8.0 inches and an outside diameter of 8.625 inches with a wall thickness of 0.304 inches. The couplers have an outside diameter of 9.625 inches. The blank casing was factory-assembled in nominal 21-foot sections.

5.6.2 WELL SCREEN

The screen installed in well QV-5 is J-55 LT&C R-1 pipe with machine cut perforations. The threaded and coupled well screen has an inside diameter of 8.0 inches and an outside diameter of 8.625 inches with a wall thickness of 0.304 inches. The perforations are factory-installed 0.030-inch vertical slots approximately 3 inches in length, spaced approximately 3 inches apart, with 4 perforations per round providing 8 openings per linear foot. The casing couplers have an outside diameter of 9.625 inches. The screen was factory-assembled in nominal 21-foot sections.

5.6.3 CEMENT BASKET

The cement basket installed in well QV-5 is factory assembled, constructed of spring steel, and has a nominal outside diameter of 15 inches.

5.6.4 FORMATION STABILIZER

No formation stabilizer was installed in QV-5 in order to maximize water production of the well.

5.6.5 CEMENT SEAL

The cement-grout seal installed in QV-5 was mixed by Boart onsite in a mixing tank. Each batch of cement consisted of a 2000-lb super sack of dry cement, 25-lbs of powdered bentonite, approximately 120 gal of fresh water, and 50 lbs of calcium chloride to accelerate the curing process.

5.7 CASING, SCREEN, AND ANNULAR MATERIALS INSTALLATION

5.7.1 JOINTS IN THE WELL CASING

The sections of casing and screen were assembled with factory installed threads and couplers. Hydraulic tongs were used to tighten the sections into place. Casing centralizers were installed at periodic intervals to ensure the casing and screen remained centered in the borehole during the installation of annular materials. No sump or bottom cap was installed.

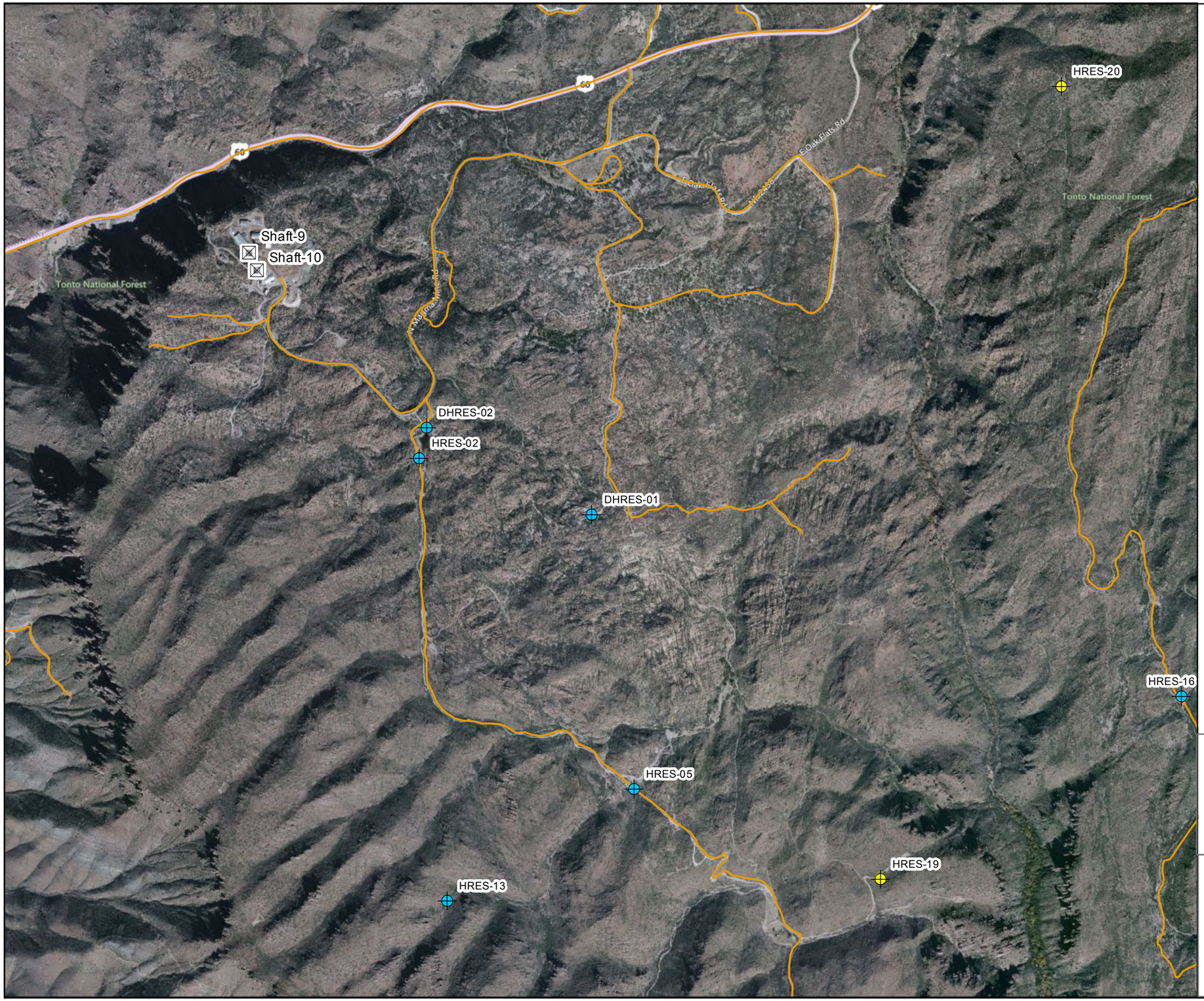
5.7.2 CEMENT BASKET

The cement basket was installed on the blank casing at a depth of approximately 32 meters bls. The basket was supported from below by a casing coupler, and was held in place by a stop collar.

5.8 AIRLIFT DEVELOPMENT

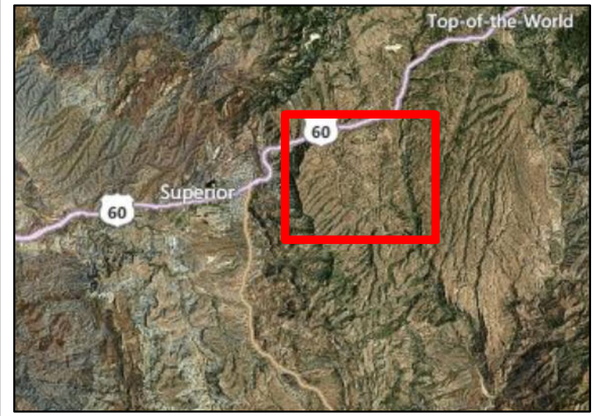
Airlift development was conducted on December 14, 2012. Boart airlifted in stages throughout the entire screen interval to remove excess suspended fine sediment, and sand. The rate of airlifting discharge ranged from 40 to 250 gpm throughout the development period. Clear Creek Associates monitored field parameters and clarity of the discharge until parameters were stable and the water was of acceptable clarity. Field forms documenting the swab and airlift development process are presented in Appendix E.

FIGURES



Legend

- Hydologic Wells
- New Hydrologic Wells
- Mine Shaft
- Access Road



0 0.25 0.5 0.75 1 Kilometers

CLEAR CREEK ASSOCIATES

Figure 1
Location Map East Plant
Resolution Copper Company
Superior, AZ

Legend

- New Hydrologic Wells
- Hydologic Wells
- Mine Shaft
- Access Road

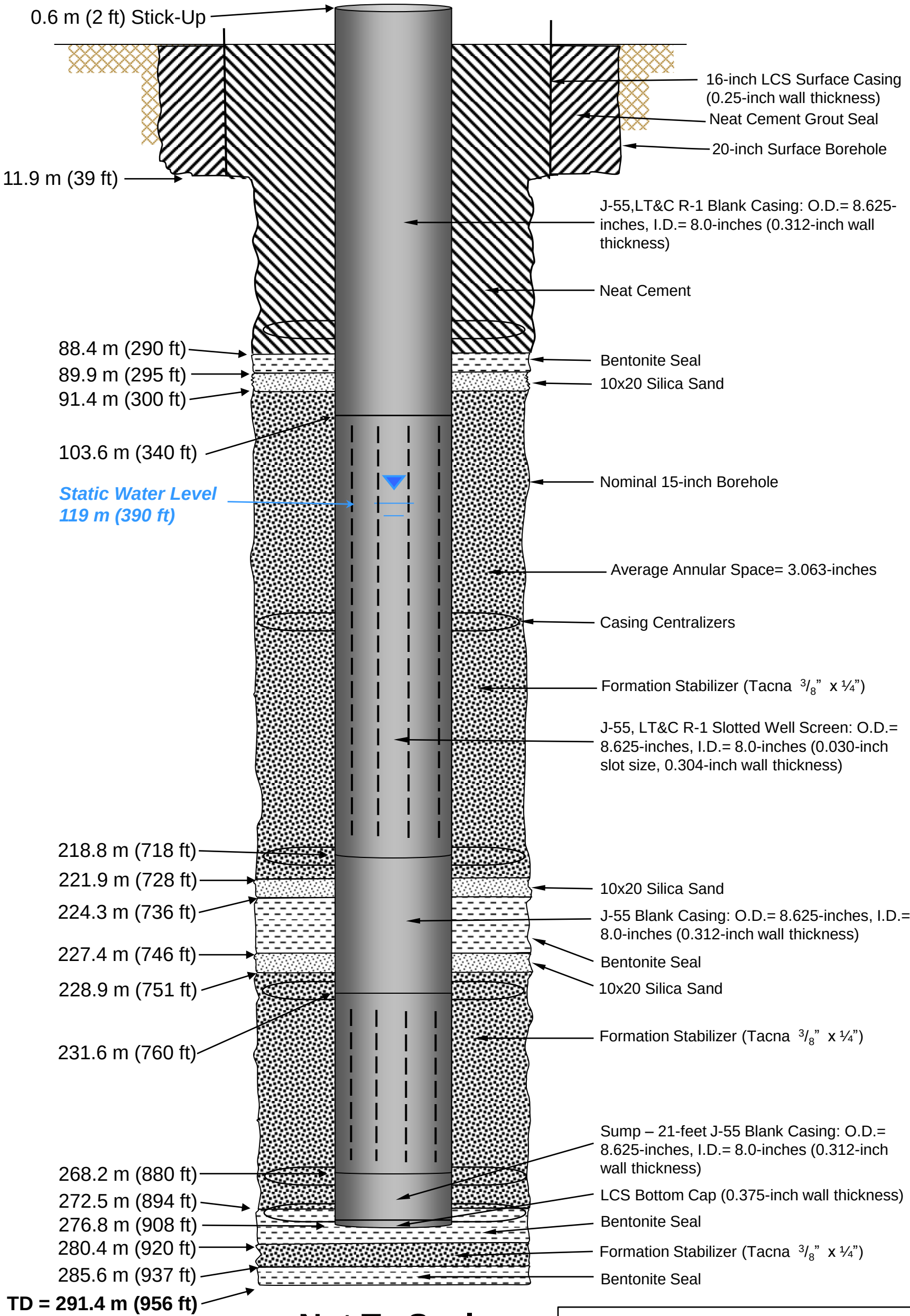
0 0.2 0.4 0.6 0.8 Kilometers

CLEAR CREEK ASSOCIATES

Figure 2
Location Map
Resolution Copper Company
Queen Valley, AZ

HRES-19

ADWR No. 55-914789

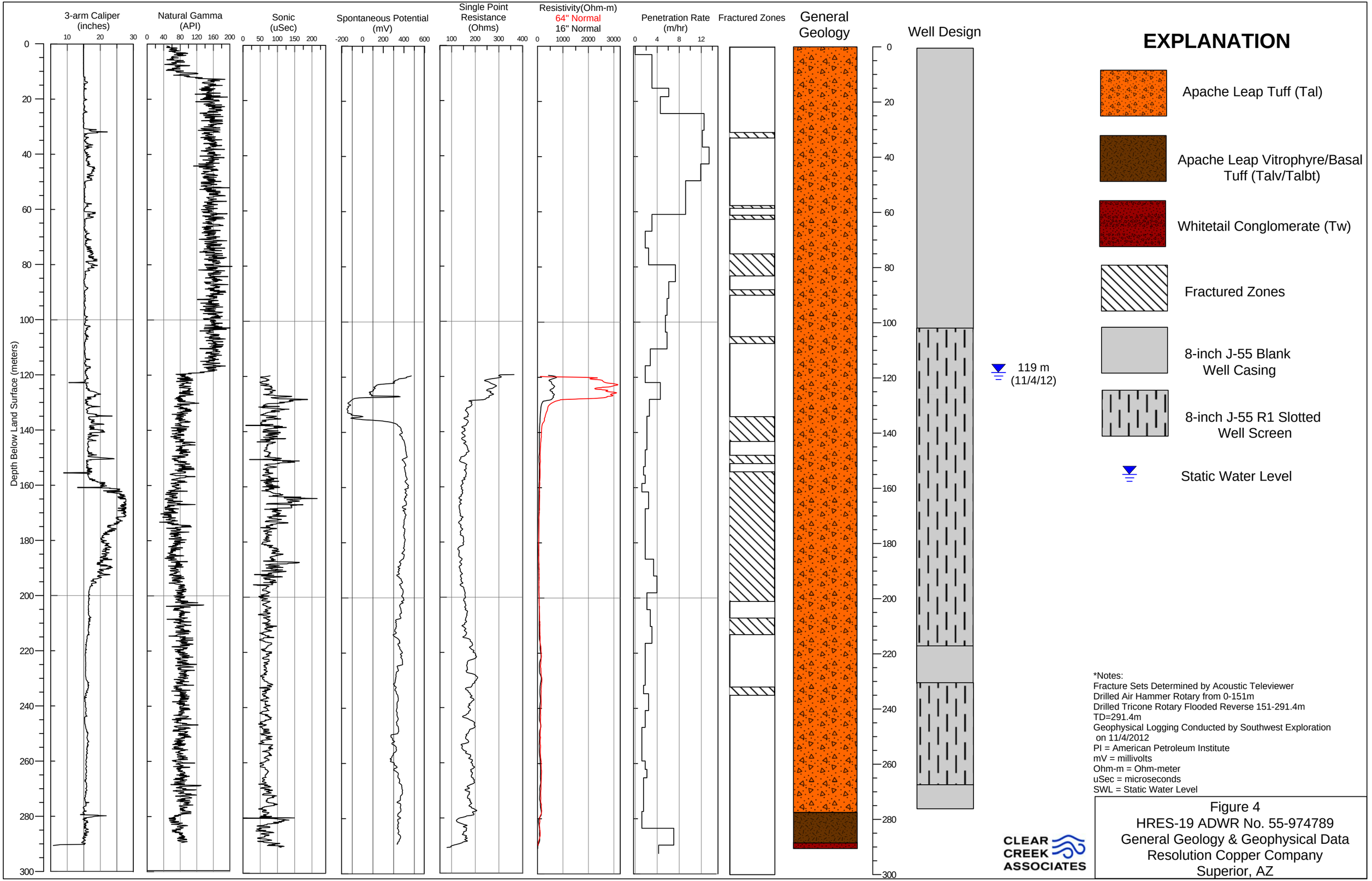


Not To Scale

Notes: LCS = Low Carbon Steel
O.D.= Outside Diameter
I.D. = Inside Diameter

CLEAR CREEK ASSOCIATES

Figure 3
HRES-19 Well
As-Built Diagram
ADWR No. 55-914789
Completion Date
11/8/2012
Job No. 313001



EXPLANATION

- Apache Leap Tuff (Tal)
- Apache Leap Vitrophyre/Basal Tuff (Talv/Talbt)
- Whitetail Conglomerate (Tw)
- Fractured Zones
- 8-inch J-55 Blank Well Casing
- 8-inch J-55 R1 Slotted Well Screen
- Static Water Level

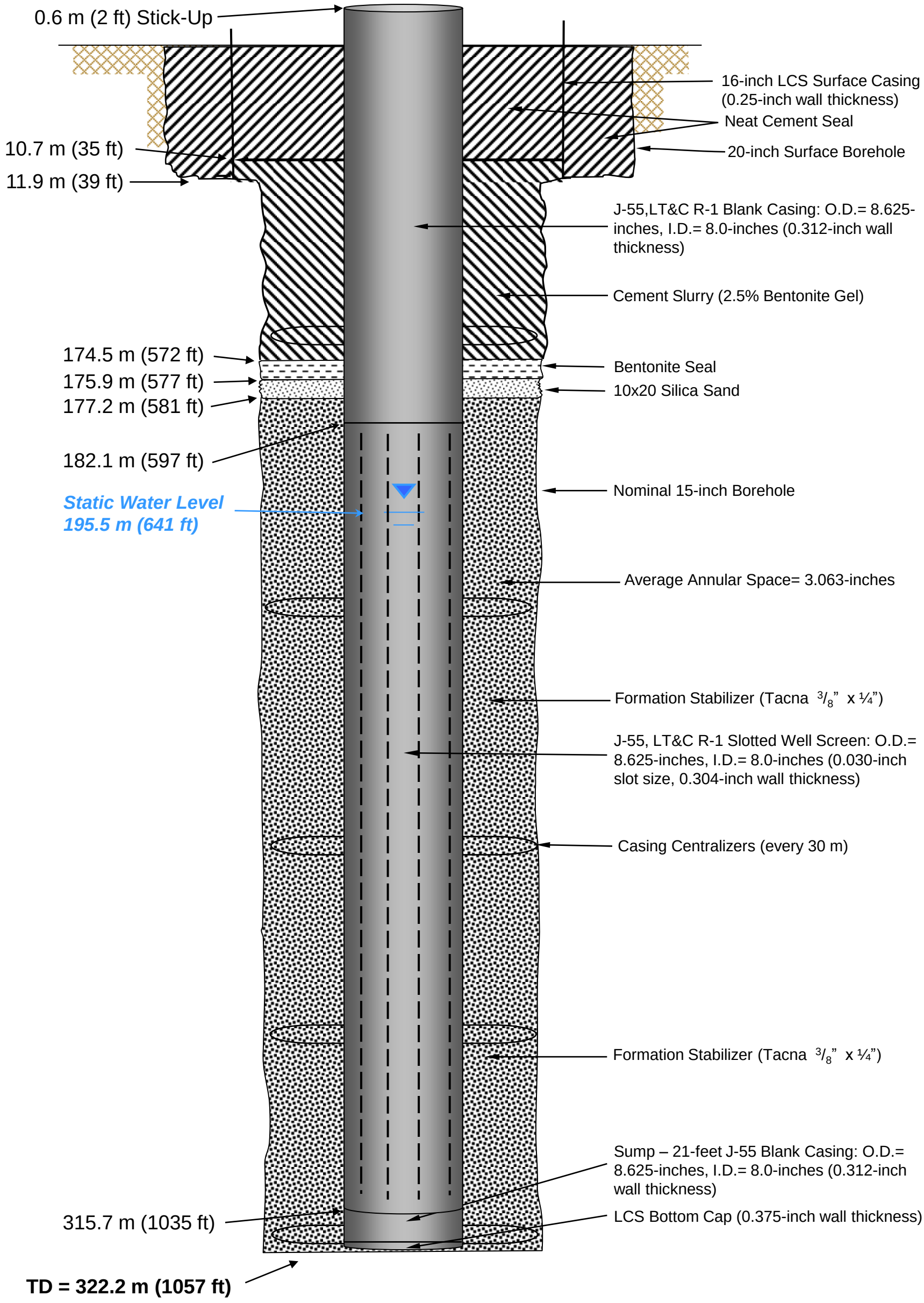
*Notes:
Fracture Sets Determined by Acoustic Televiewer
Drilled Air Hammer Rotary from 0-151m
Drilled Tricone Rotary Flooded Reverse 151-291.4m
TD=291.4m
Geophysical Logging Conducted by Southwest Exploration on 11/4/2012
PI = American Petroleum Institute
mV = millivolts
Ohm-m = Ohm-meter
uSec = microseconds
SWL = Static Water Level

CLEAR CREEK ASSOCIATES

Figure 4
HRES-19 ADWR No. 55-974789
General Geology & Geophysical Data
Resolution Copper Company
Superior, AZ

HRES-20

ADWR No. 55-914790

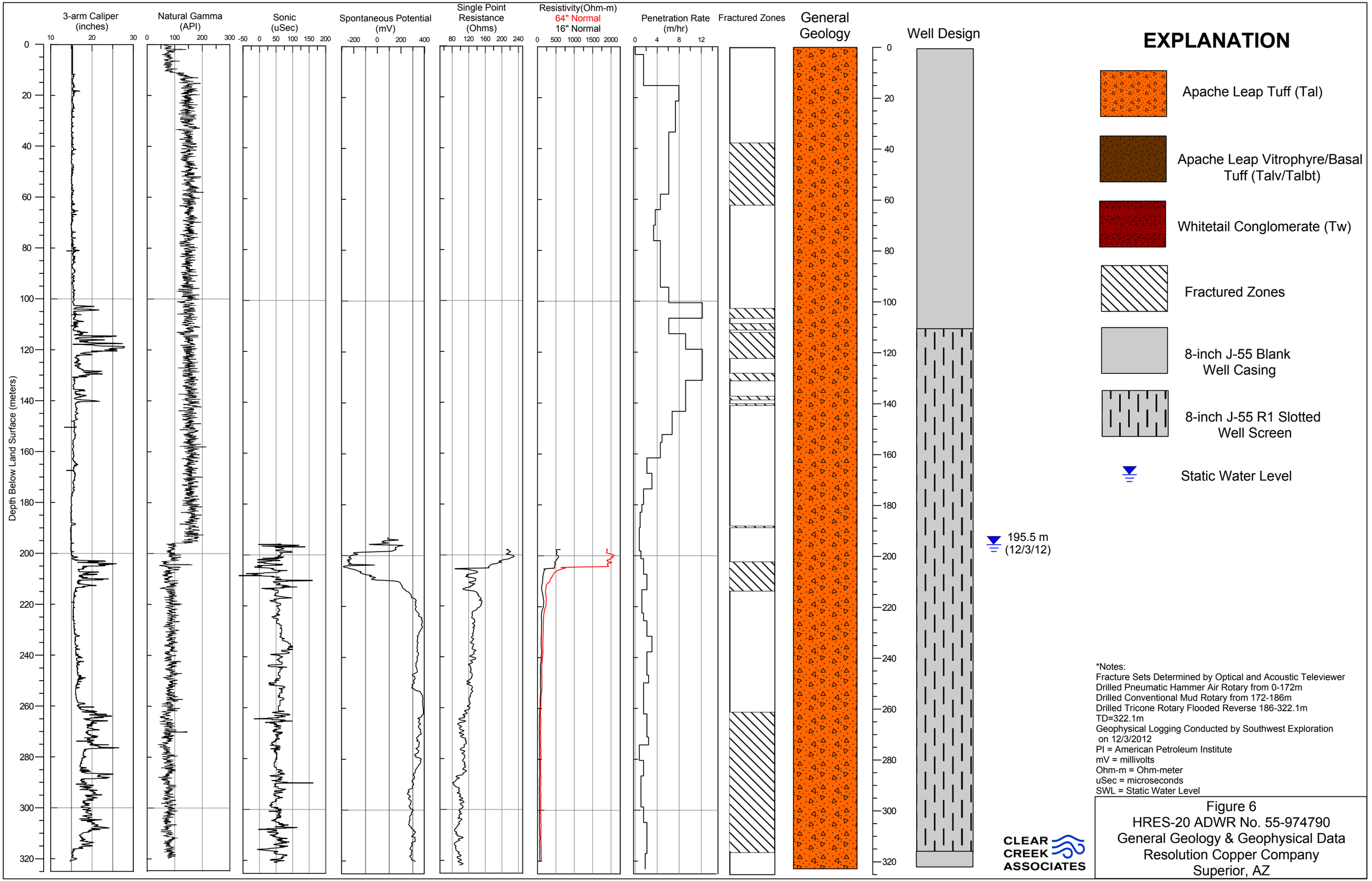


Not To Scale

Notes: LCS = Low Carbon Steel
O.D.= Outside Diameter
I.D. = Inside Diameter

CLEAR CREEK ASSOCIATES

Figure 5
HRES-20 Well
As-Built Diagram
ADWR No. 55-914789
Completion Date
12/7/2012
Job No. 313001



EXPLANATION

- Apache Leap Tuff (Tal)
- Apache Leap Vitrophyre/Basal Tuff (Talv/Talbt)
- Whitetail Conglomerate (Tw)
- Fractured Zones
- 8-inch J-55 Blank Well Casing
- 8-inch J-55 R1 Slotted Well Screen
- Static Water Level

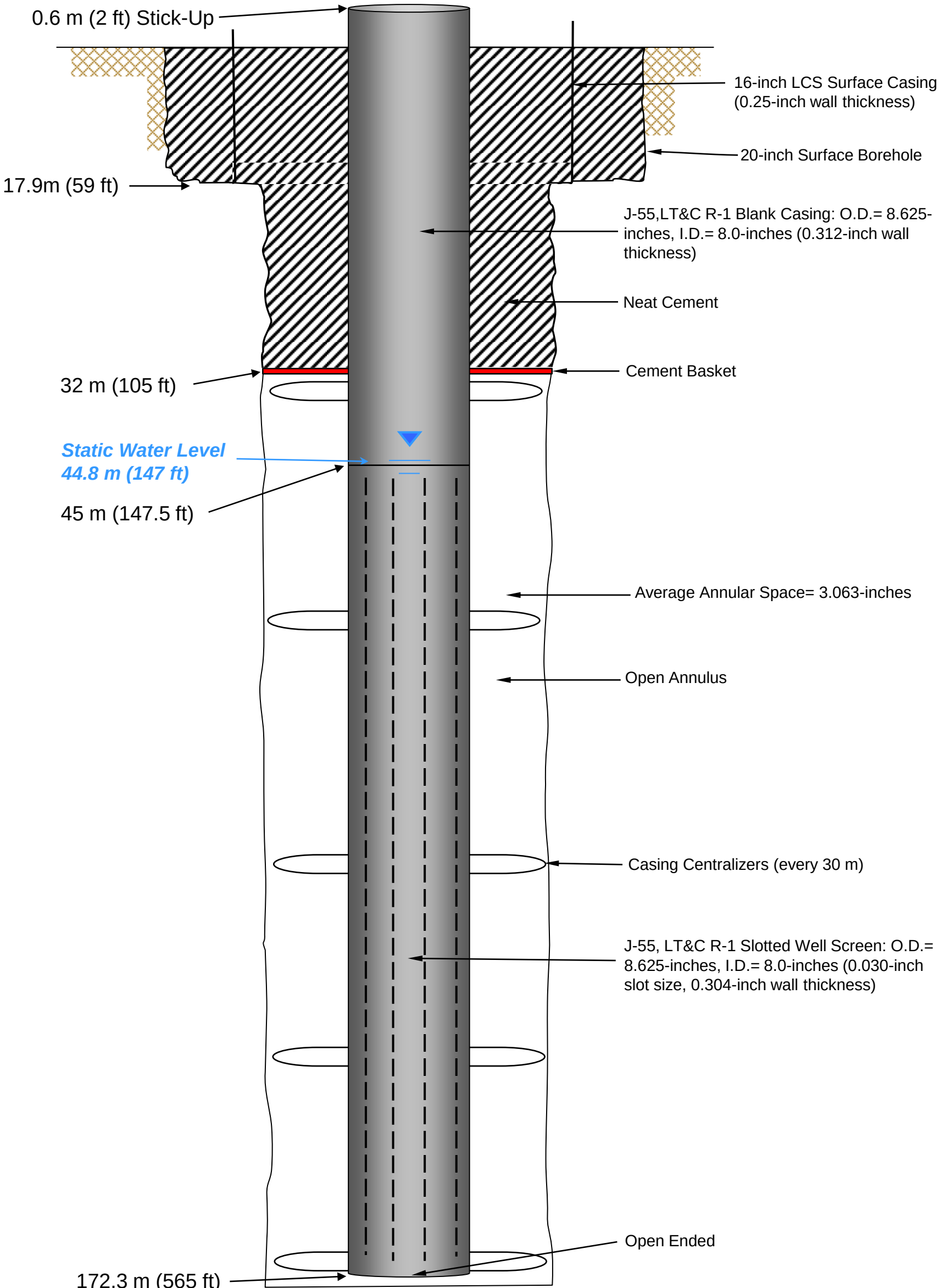
*Notes:
Fracture Sets Determined by Optical and Acoustic Televiewer
Drilled Pneumatic Hammer Air Rotary from 0-172m
Drilled Conventional Mud Rotary from 172-186m
Drilled Tricone Rotary Flooded Reverse 186-322.1m
TD=322.1m
Geophysical Logging Conducted by Southwest Exploration on 12/3/2012
PI = American Petroleum Institute
mV = millivolts
Ohm-m = Ohm-meter
uSec = microseconds
SWL = Static Water Level

CLEAR CREEK ASSOCIATES

Figure 6
HRES-20 ADWR No. 55-974790
General Geology & Geophysical Data
Resolution Copper Company
Superior, AZ

QV-5

ADWR No. 55-221850

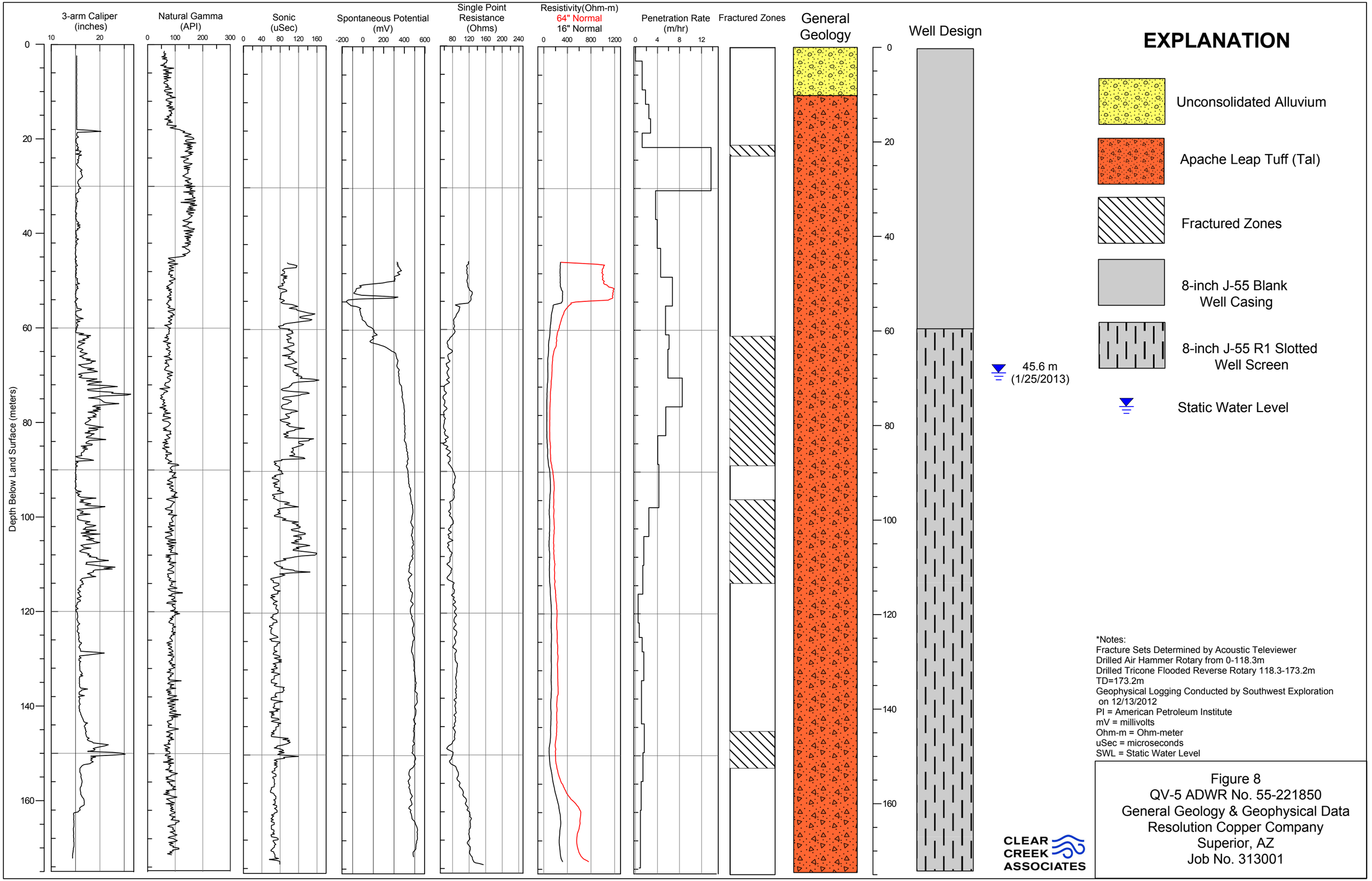


Not To Scale

Notes: LCS = Low Carbon Steel
O.D.= Outside Diameter
I.D. = Inside Diameter

CLEAR CREEK ASSOCIATES

Figure 7
QV-5 Well
As-Built Diagram
ADWR No. 55-221850
Completion Date
12/14/2012
Job No. 313001



*Notes:
Fracture Sets Determined by Acoustic Televiewer
Drilled Air Hammer Rotary from 0-118.3m
Drilled Tricone Flooded Reverse Rotary 118.3-173.2m
TD=173.2m
Geophysical Logging Conducted by Southwest Exploration on 12/13/2012
PI = American Petroleum Institute
mV = millivolts
Ohm-m = Ohm-meter
uSec = microseconds
SWL = Static Water Level

CLEAR CREEK ASSOCIATES

Figure 8
QV-5 ADWR No. 55-221850
General Geology & Geophysical Data
Resolution Copper Company
Superior, AZ
Job No. 313001

APPENDIX A

PERMIT DOCUMENTS

ARIZONA DEPARTMENT OF WATER RESOURCES

Electronic Filing - NOI Report

3550 N. Central Avenue Suite 200
Phoenix, Arizona 85012

NOI Type: Notice of Intent to Drill, Deepen, Modify a Monitor/Piezometer/Environmental Well
Well Type: MONITOR
Date Received at ADWR Website: 10/10/2012 8:26:44 AM

Fee Paid: $150.00 Order Number: VPFE7AF6F73E

Well Registration Number: 55 - 914789
Number of Wells/Holes: 1 Drilling Authority Expires On: 10/9/2013

Driller's ADWR License Number: 468

Authorized Driller: LANG EXPLORATORY DRILLING DBA BOART LONGYEAR
ROC License Number Entered By Driller: 073446
Qualifying Party License Categories: A-4

Well Owner Name: Resolution Copper Mining
Well Owner Address: P.O. Box 1944
Well Owner City, State - Zip: Resolution, AZ - 85173
Well Owner Phone: 520 689-9374

Book: Map: Parcel:

Is the Land Owner the same as the Well Owner?: No

Land Owner Name: Arizona State Land Department
Land Owner Address: 1616 W. Adams St.
Land Owner City, State - Zip: Phoenix, AZ - 85007
Land Owner Phone: 602 542-4621

Well Location: **NE** 1/4 of the **NE** 1/4 of the **NE** 1/4 Section **8** Township **2 S** Range **13 E**

AMA: NOT WITHIN ANY AMA OR INA
County: PINAL
Contamination Site: NOT IN ANY WQARF SITE

Primary Water Use: TEST
Secondary Water Use(s): N/A

Is any portion of the land, on which the well is to be located, within 100 feet of a designated municipal provider's operating water distribution system as shown on the municipal provider's most recent digitized service area map filed by the municipal provider with the director of ADWR. N/A

Proximity to a designated municipal provider's operating water distribution system exemption type:
N/A

Will you be installing a dedicated pump ?: N/A

Will the installed pump have a pumping capacity of greater than 35 GPM, or will the well will be used to withdraw greater than 10 Acre Feet per year?: N/A

Is this NOI an application to replace, deepen, or modify an existing well? No

Variance(s) Granted To Driller: **None**

Certification(s) Made By Driller:

- ☑ By checking this box, I certify that I have all necessary Registrar of Contractor (ROC) licenses in all necessary license categories for this drilling or abandonment project and that those licenses are current.
- ☑ If the landowner and the well owner are not the same, by checking this box, I certify that I have obtained written approval from the landowner in order to conduct this drilling or abandonment project. A copy of the written approval shall be submitted to ADWR with the Well Driller Report and Well Log or Well Abandonment Completion Report within 30 days of completion of drilling or abandonment.
- ☑ By checking this box, I certify that this NOI application is not an application to replace, deepen, or modify an existing well.
- ☑ By checking this box, I certify that I have been authorized by the above-named well owner to submit this Notice of Intent on the well owner's behalf.
- ☑ By checking this box, I certify that the information above is complete and correct, and that the well shall be drilled or abandoned in compliance with all pertinent statutes and rules, including any special standards that may be required to protect the aquifer or other water sources.

ARIZONA DEPARTMENT OF WATER RESOURCES
3550 N. Central Avenue Suite 200, Phoenix, Arizona 85012
Telephone (602) 771-8500
Fax (602) 771-8691

Wednesday, October 10, 2012

Janice K. Brewer
Governor

Sandra A. Fabritz-Whitney
Director

Resolution Copper Mining
P.O. Box 1944
Resolution, AZ 85173

Registration No. 55- 914789
File No. D(2-13)8 AAA

Dear Applicant:

Enclosed is a copy of the Notice of Intent to Drill a Monitor/Piezometer/Environmental Well ("NOI") which you recently filed with this Department pursuant to A.R.S. § 45-596. This is to inform you that the Department has approved the NOI and has mailed (or otherwise provided) a drilling card authorizing the drilling of the well to the well driller identified in the NOI. The driller may not begin drilling until he has received the drilling card which he must keep in his posssession at the well site during drilling. Well drilling activities must be completed within one year after the date the NOI was filed with the Department. If drilling is not completed within one year, you must file a new NOI before proceeding with further drilling.

If it is necessary to change the location of the proposed well, you may not proceed with drilling until you file a new NOI with the Department and the Department issues an amended drilling card to the driller. If you change drillers, you must notify the Department of the new driller's identity. A new driller may not begin drilling until he receives a new drilling card from the Department. If in the course of drilling the well, it is determined that the well cannot be successfully completed as initially intended (dry hole, cave in, lost tools, etc.), the well must be properly abandoned and a Well Abandonment Completion Report filed as required by A.A.C. R12-15-816(F).

A.R.S. § 45-600 requires the driller to file a complete and accurate Well Drillers Report and Well Log (DWR Form 55-55) with the Department within 30 days after completion of drilling. That form was mailed to your driller with the drilling card.

Please be advised that A.R.S. § 45-593(C) requires the person to whom a well is registered to notify the Department of a change in ownership of the well and/or information pertaining to the physical characteristics of the well in order to keep this well registration file current and accurate. Any change in well information or a request to change well driller must be filed on a Request to Change Well Information form (DWR form 55-71A) that may be downloaded from the ADWR Internet website at
http://www.azwater.gov/dwr/Content/Find_by_Category/Permits_Forms_Applications/default.htm.

ARIZONA DEPARTMENT OF WATER RESOURCES

Electronic Filing - NOI Report

3550 N. Central Avenue Suite 200
Phoenix, Arizona 85012

NOI Type: Notice of Intent to Drill, Deepen, Modify a Monitor/Piezometer/Environmental Well
Well Type: MONITOR
Date Received at ADWR Website: 10/10/2012 8:45:31 AM

Fee Paid: $150.00 Order Number: VREE7B4214BA

Well Registration Number: 55 - 914790
Number of Wells/Holes: 1 Drilling Authority Expires On: 10/9/2013

Driller's ADWR License Number: 468

Authorized Driller: LANG EXPLORATORY DRILLING DBA BOART LONGYEAR
ROC License Number Entered By Driller: 073446
Qualifying Party License Categories: A-4

Well Owner Name: Resolution Copper Mining
Well Owner Address: P.O. Box 1944
Well Owner City, State - Zip: Resolution, AZ - 85173
Well Owner Phone: 520 689-9374

Book: Map: Parcel:

Is the Land Owner the same as the Well Owner?: No

Land Owner Name: U.S. Forest Service
Land Owner Address: 333 Broadway SE
Land Owner City, State - Zip: Albuquerque, NM - 87102
Land Owner Phone: 505 842-3292

Well Location: **SE** 1/4 of the **NW** 1/4 of the **SW** 1/4 Section **27** Township **1 S** Range **13 E**

AMA: NOT WITHIN ANY AMA OR INA
County: PINAL
Contamination Site: NOT IN ANY WQARF SITE

Primary Water Use: TEST
Secondary Water Use(s): N/A

Is any portion of the land, on which the well is to be located, within 100 feet of a designated municipal provider's operating water distribution system as shown on the municipal provider's most recent digitized service area map filed by the municipal provider with the director of ADWR. N/A

Proximity to a designated municipal provider's operating water distribution system exemption type:
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Will you be installing a dedicated pump ?: N/A

Will the installed pump have a pumping capacity of greater than 35 GPM, or will the well will be used to withdraw greater than 10 Acre Feet per year?: N/A

Is this NOI an application to replace, deepen, or modify an existing well? No

Variance(s) Granted To Driller: **None**

Certification(s) Made By Driller:

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- ☑ By checking this box, I certify that the information above is complete and correct, and that the well shall be drilled or abandoned in compliance with all pertinent statutes and rules, including any special standards that may be required to protect the aquifer or other water sources.

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3550 N. Central Avenue Suite 200, Phoenix, Arizona 85012
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Wednesday, October 10, 2012

Janice K. Brewer
Governor

Sandra A. Fabritz-Whitney
Director

Resolution Copper Mining
P.O. Box 1944
Resolution, AZ 85173

Registration No. 55- 914790
File No. D(1-13)27 CBD

Dear Applicant:

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If it is necessary to change the location of the proposed well, you may not proceed with drilling until you file a new NOI with the Department and the Department issues an amended drilling card to the driller. If you change drillers, you must notify the Department of the new driller's identity. A new driller may not begin drilling until he receives a new drilling card from the Department. If in the course of drilling the well, it is determined that the well cannot be successfully completed as initially intended (dry hole, cave in, lost tools, etc.), the well must be properly abandoned and a Well Abandonment Completion Report filed as required by A.A.C. R12-15-816(F).

A.R.S. § 45-600 requires the driller to file a complete and accurate Well Drillers Report and Well Log (DWR Form 55-55) with the Department within 30 days after completion of drilling. That form was mailed to your driller with the drilling card.

Please be advised that A.R.S. § 45-593(C) requires the person to whom a well is registered to notify the Department of a change in ownership of the well and/or information pertaining to the physical characteristics of the well in order to keep this well registration file current and accurate. Any change in well information or a request to change well driller must be filed on a Request to Change Well Information form (DWR form 55-71A) that may be downloaded from the ADWR Internet website at
http://www.azwater.gov/dwr/Content/Find_by_Category/Permits_Forms_Applications/default.htm.

JANICE K. BREWER
Governor

SANDRA A. FABRITZ-WHITNEY
Director

ARIZONA DEPARTMENT OF WATER RESOURCES

3550 North Central Avenue, Second Floor
PHOENIX, ARIZONA 85012-2105

(602) 771-8500

November 26, 2012

Queen Valley Domestic Water Improvement District
Attention: Mr. Steve Wene
1552 East Queen Valley Drive
Queen Valley, AZ 85218

SUBJECT: Notice of Intention to Construct a Replacement Non-Exempt Well at Approximately the Same Location
Registration No. 55-221850 (Replacing Well No. 55-628139)
File No. D (1-10) 34CDD

Dear Mr. Wene:

The above-referenced Notice of Intention to Construct an Existing Non-Exempt Well in Approximately the Same Location within the Phoenix Active Management Area has been approved. An annotated copy of the Notice is enclosed for your records. As the well owner you are required to submit the enclosed Completion Report within thirty (30) days of installation of pump equipment.

Pursuant to the provisions of A.R.S. § 45-604, any person withdrawing groundwater from a well is required to use a water measuring device to record rates of withdrawal in order to provide or allow the computation of an annual volume of groundwater withdrawn from the well. The total volume of withdrawals from the well which is being replaced and the completed new well shall be reported on your Annual Water Withdrawal and Use Report for calendar year 2012. Subsequent annual reporting periods shall be from January 1 through December 31.

The Department has issued the authorization to drill this well pursuant to A.R.S. §§ 45-596 and 45-597 of the Groundwater Code. The legal nature of the water withdrawn from the well may be the subject of court action in the future as part of a determination of surface water rights in your area. If there are court proceedings that could affect your well, you will be notified and be given the opportunity to participate.

Please be aware that the withdrawals from the proposed well cannot exceed the maximum annual capacity of the original well you wish to replace. The maximum annual capacity of the original

well is 177 acre-feet per year. In addition, if the original well will be used in conjunction with the proposed replacement well, the withdrawals from both wells cannot exceed the maximum annual capacity of the original well.

If the maximum annual capacity is exceeded in any calendar year, the well will no longer qualify as a replacement well in approximately the same location, and will instead fall into the category of "new well." This means that you will not be able to pump the well again until you first submit an application for a non-exempt well permit, and obtain a determination from the Department that the well will not cause unreasonably increasing damage to other land and water users.

Under A.R.S. § 45-593, the person to whom a well is registered must notify the Department of a change in ownership, physical characteristics or any other data about the well in order to keep the well registration records current and accurate. A *Request to Change Well Information* form may be obtained online at http://www.azwater.gov.

Your permit has been issued by this Department without a hearing. As such, it is an appealable agency action. You are entitled to appeal and your rights are described in the enclosed notice of right to appeal.

If you have any questions about the terms and conditions of the permit or require any administrative corrections to this permit, please contact the Groundwater Permitting and Wells Section at 602-771-8527.

Sincerely,

Stella Murillo

Stella Murillo, Manager
Groundwater Permitting and Wells Section

Enclosures

cc: File

ARIZONA DEPARTMENT OF WATER RESOURCES
WATER MANAGEMENT DIVISION
3550 N. Central Avenue, Phoenix Arizona 85012

THIS AUTHORIZATION SHALL BE IN THE POSSESSION OF THE DRILLER DURING ALL DRILL OPERATIONS

WELL REGISTRATION NO: 55-221850 **REPLACING:** 55-628139 **PERMIT NO.:** S-221850

AUTHORIZED DRILLER: BOART LONGYEAR **LICENSE NO.:** 468

A PERMIT TO DRILL A REPLACEMENT NON-EXEMPT WELL INSIDE THE PHOENIX ACTIVE MANAGEMENT AREA HAS BEEN GRANTED TO:

WELL OWNER: QUEEN VALLEY DOMESTIC WATER IMPROVEMENT DISTRICT

The well(s) is/are to be located in the:

SE ¼ of the SE ¼ of the SW ¼ of Section 34 Township 1 South, Range 10 East

No. of well(s) in this project: 1

THIS AUTHORIZATION EXPIRES AT MIDNIGHT ON THE 18TH DAY OF NOVEMBER 2013

Stella Murillo
ENGINEERING AND PERMITS DIVISION

THE DRILLER MUST FILE A WELL DRILLER REPORT AND WELL LOG WITHIN 30 DAYS OF COMPLETION OF DRILLING.

ARIZONA DEPARTMENT OF WATER RESOURCES

NON-EXEMPT WELL PERMIT

PURSUANT TO A.R.S. §§ 45-598 AND 45-599

PERMIT NO. S-221850

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

This is to certify that Application No. S-221850 meets the requirements of A.R.S. §§ 45-598 and 45-599 for a replacement well in approximately the same location. The Director hereby grants authority to the Permittee to construct and operate a non-exempt well, subject to the following limitations and conditions:

Permit Limitations

Permittee:	Queen Valley Domestic Water Improvement District 1552 East Queen Valley Drive Queen Valley, AZ 85218
Well Registration Number:	55-221850 File No. D(1-10)34CDD
Active Management Area:	Phoenix
Subbasin:	East Salt River Valley
Well Location:	THE SE ¼ OF THE SE ¼ OF THE SW ¼ OF SECTION 34, TOWNSHIP 1 SOUTH, RANGE 10 EAST of the GSRB&M
Depth:	600 feet
Casing Material:	Steel
Casing Diameter:	Eight (8) inches
Maximum Pumping Capacity:	150 gallons per minute

PERMIT NO. S-221850

Maximum Annual Volume:	177 acre-feet per annum
Authorized Place of Use for Groundwater Withdrawn:	As Authorized by Water Provider Right No. 56-002221
Authorized Use of Groundwater:	As Authorized by Water Provider Right No. 56-002221
Latest Date for Completing Well:	November 18, 2013

Permit Conditions

1. If the permitted well is not completed on or before November 18, 2013, the Permittee will be required to file a new application, and secure a new permit before proceeding with construction.

2. This permit is issued pursuant to A.R.S. § 45-599 and authorizes the permittee to construct a a replacement well in approximately the same location for the purpose of withdrawing groundwater for the use or uses set forth in the permit. This permit does not authorize the permittee to withdraw surface water from the well. If the permittee withdraws surface water from the well in any year, the permittee shall do so only pursuant to a decreed or appropriative surface water right and shall separately report in the annual report filed pursuant to A.R.S. § 45-632 the amount of groundwater and surface water withdrawn from the well.

3. The permittee shall monitor withdrawals of groundwater and shall report the total amount of groundwater withdrawn on an Annual Water Withdrawal and Use Report. The first annual reporting period shall be from the date of issuance of this permit through December 31, 2012. Subsequent annual reporting periods shall be from January 1 through December 31.

4. The proposed well shall be constructed in accordance with the minimum well construction standards, pursuant to A.A.C. R12-15-811.

5. The issuance of the permit does not waive any federal, state, county or local government ordinances, regulations or permits for which the facility may have to comply.

WITNESS my hand and seal of office this 26th day of November, 2012.

Michael J. Johnson, Assistant Director

APPENDIX B

PHOTOGRAPHIC LOG

Appendix B

HRES-19

View of D80 drill rig at HRES-19

22 inch Tri-cone button bit and 7 inch drill collars

15- inch Hammer bit

CLEAR CREEK ASSOCIATES

Appendix B

HRES-19

Roll reamers

Gravel install during well construction

View of 0.030-inch mill slot casing

Tacna gravel (3/8” x 1/4”) on well screen

CLEAR CREEK ASSOCIATES

Appendix B

HRES-20

D80 Drill Rig

Threaded and Coupled Well Casing

Well Casing Couplers

CLEAR CREEK ASSOCIATES

Appendix B

HRES-20

View of damaged tri-cone bit

Southwest Exploration Services, LLC conducting geophysical logging

Roll Reamer with missing roller

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Appendix B

HRES-20

Magnetic fishing tool used to retrieve roller reamer fragments

Steel band centralizers

Discharge water during airlift development

CLEAR CREEK ASSOCIATES

Appendix B

QV-5

D40 Drill Rig

Tri-cone button bit

Hammer bit

CLEAR CREEK ASSOCIATES

Appendix B

QV-5

Well casing

Well casing

Tungsten carbide button roller

CLEAR CREEK ASSOCIATES

Appendix B

QV-5

View of drill cuttings

Southwest Exploration Services, LLC conducting geophysical logging

Cement basket

CLEAR CREEK ASSOCIATES

Appendix B

Lithology

Apache Leap Tuff- White Unit

Apache Leap Tuff- Gray Unit

Apache Leap Tuff- Brown Unit

Apache Leap Tuff- Vitrophyre and Basal Tuff

CLEAR CREEK ASSOCIATES

Appendix B

Lithology

White Tail Conglomerate and Apache Leap Basal Tuff

Apache Leap Tuff at QV-5

Bronzy Biotite- Limonite on Boitite

Iron-oxide in Groundmass

CLEAR CREEK ASSOCIATES

APPENDIX C

LITHOLOGIC LOGS

Project No.: 313001
Project Name: RCC Hydro Wells
55-914789
Cadastral: T25, R13E, Sec 8 (D-2-13) 08 AAA
NAD 83:
Drill Company: Boart Longyear
Driller(s): Chris Perry, Mike , Hunter Skalls
Logged By: RM/ BWH/ GJM

Well/Boring Name: HRES-19
Date/Time Started: 10/21/2012
Date/Time Completed: 11/03/2012
Drilling Equipment: Drill Tech
Drilling Method(s): Direct Air, flooded reverse
Bit Size(s)/Type(s): 15" Hammer Bit, 14.75" Tri-Cone
Conductor Casing (type; diameter; depth): 16" Steel to 39'bls
Total Well/Borehole Depth: 956' bls

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
0-10	0-3	10	None	2.5 YR 5/4 Reddish Brown	Apache Leap Tuff - Gray Unit (Talg). Well indurated, phaneritic to porphoritic textured tuff, 50-60% plagioclase (sanidine), quart, biotite, cryptocrystalline ground mass, red in color.	Surficial weathering iron oxide on biotite and ground mass	Air rotary for surface casing.
20	6.1	10	None	2.5 YR 5/4 Reddish Brown	Talg	Limonite on biotite	
30	9.1	10	None	2.5 YR 5/4 Reddish Brown	Talg	Limonite on biotite	
40	12.2	10	None	2.5 YR 4/4 Reddish Brown	Talg	Limonite on biotite	Cuttings are sand-sized: No large chips
50	15.2	20	None	2.5 YR 4/3 Reddish Brown	Talg	Limonite on biotite. Surface weathering on larger chips	Surface casing set to 39' bls $14^{3/4}$. Air hammer bit cuttings or predominantly sand-sized, no large chips. Down to 120 ft
60	18.3	15	None	2.5 YR 4/3 Reddish Brown	Talg		200-mesh on the mud shaker explains abundance of finds.
70	21.3	15	None	2.5 YR 4/3 Reddish Brown	Talg		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

CLEAR CREEK ASSOCIATES

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
70-80	21.3-24.4	41	None	2.5 YR 4/3 Reddish Brown	Apache Leap Tuff-Gray Unit (Talg). Well indurated, phaneritic to porphoritic textured tuff. Phenocryst up to 4mm, plagioclase (sanidine), quartz, biotite. ~40% Cryptocrystalline ground mass.	Limonite on biotite.	Cuttings are sand-sized: No large chips. Down to 120 ft.
90	27.4	41	None	2.5 YR 4/3 Reddish Brown	Talg		
100	30.5	40	None	2.5 YR 4/3 Reddish Brown	Talg		
110	33.5	40	None	2.5 YR 4/3 Reddish Brown	Talg		Per-Driller log: Fracutre Set 100-130' bls
120	36.6	44	None	2.5 YR 4/4 Reddish Brown	Talg		
130	39.6	44	None	2.5 YR 4/4 Reddish Brown	Talg	Evidence of weathering on chip faces	Increase in chip size up to 3cm
140	42.7	39	None	2.5 YR 4/4 Reddish Brown	Talg		
150	45.7	39	None	2.5 YR 4/4 Reddish Brown	Talg		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
150-160	45.7-48.8	30	None	2.5 YR 4/4 Reddish Brown	Apache Leap Tuff-Gray Unit (Talg). Well indurated, phaneritic to porphoritic textured tuff. Phenocryst up to 4mm, plagioclase (sanidine), quartz, biotite. ~40% Cryptocrystalline ground mass.	Limonite on biotite. Fe-Oxide stains on ground mass.	Chips mostly sed size (~50% up to 5cm)
170	51.8	30	None	2.5 YR 4/4 Reddish Brown	Talg		
180	54.9	30	None	2.5 YR 4/4 Reddish Brown	Talg		
190	57.9	30	None	2.5 YR 4/4 Reddish Brown	Talg		
200	61	10	None	2.5 YR 4/4 Reddish Brown	Talg		
210	64	10	None	2.5 YR 4/4 Reddish Brown	Talg		
220	67.1	6	None	2.5 YR 4/3 Reddish Brown	Talg		Sand Produced by hammer bit are effecting the pneumatic, driller slowed down to accomidate
230	70.1	6	None	2.5 YR 4/4 Reddish Brown	Talg		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
230-240	70.1-73.2	8	None	2.5 YR 4/4 Reddish Brown	Apache Leap Tuff-Gray Unit (Talg). Well indurated, phaneritic to porphoritic textured tuff. Phenocryst up to 4mm, plagioclase (sanidine), quartz, biotite. ~40% Cryptocrystalline ground mass.		
250	76.2	8	None	2.5 YR 4/4 Reddish Brown	Talg		Increase in drill rate
260	79.3	24	None	2.5 YR 4/4 Reddish Brown	Talg		
270	82.3	24	None	2.5 YR 4/4 Reddish Brown	Talg		
280	85.4	20	None	2.5 YR 4/4 Reddish Brown	Talg		
290	88.4	20	None	2.5 YR 4/4 Reddish Brown	Talg		
300	91.5	19	None	2.5 YR 4/4 Reddish Brown	Talg		
310	94.5	19	None	2.5 YR 4/4 Reddish Brown	Talg		Deviation survey taken =1.0º

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
310-320	94.5-97.6	18	None	2.5 YR 4/4 Reddish Brown	Apache Leap Tuft-brown Unit (Talb). Well indurated, phaneritic to porphoritic textured tuff. Phenocryst up to ~5mm, Predominantly 1-2mm. Some flow banding. Plagioclase (sanidine), quartz, biotite. Lineations could suggest brown unit.	Limonite on biotite.	Cuttings are mostly sand-grain in size, very few gravel-sized framents.
330	100.6	18	None	2.5 YR 4/4 Reddish Brown	Talb		
340	103.7	19	None	2.5 YR 4/4 Reddish Brown	Talb		
350	106.7	19	None	2.5 YR 4/4 Reddish Brown	Talb		
360	109.8	9	None	2.5 YR 4/4 Reddish Brown	Talb		
370	112.8	9	None	2.5 YR 4/4 Reddish Brown	Talb		Slow down in rate. Driller reports formation is actually soft and broken up- causing slow progress with hammer bit.
380	115.9	6	None	2.5 YR 4/4 Reddish Brown	Ground mass predominetly brown in color.		
390	118.9	6	None	2.5 YR 4/4 Reddish Brown	Talb		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
390-400	118.9-122.0	15	None	2.5 YR 4/4 Reddish Brown	Apache Leap Tuff-Brown Unit (Talb). Well indurated, phaneritic to porphoritic tuff, ~30% Phenocrysts of anhedral plagioclase (sanidine), quartz, biotite (subhedral), Lithic inclusions of brown siltstone.	Limonite on biotite. Fe-Oxide mixed in matrix	Chips are mostly sand sized.
410	125	15	None	2.5 YR 4/4 Reddish Brown	Talb		
420	128.1	8.5	None	2.5 YR 4/4 Dark Reddish Brown	Apache Leap Tuff-Brown Unit (Talb). Well indurated, phaneritic to porphoritic tuff, 30-40% Phenocrysts of anhedral plagioclase (sanidine), quartz, biotite (subhedral), Lithic inclusions of brown siltstone.	Limonite on biotite. Fe-Oxide stains on ground mass.	Groundmass logging sand sized cuttings
430	131.1	8.5	None	2.5 YR 4/4 Dark Reddish Brown	Talb		
440	134.2	7	None	2.5 YR 4/4 Dark Reddish Brown	Talb		
450	137.2	7	None	2.5 YR 4/4 Dark Reddish Brown	Talb		
460	140.3	7	None	2.5 YR 4/4 Dark Reddish Brown	Talb		
470	143.3	7	None	2.5 YR 4/4 Dark Reddish Brown	Talb		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
470-480	143.3-146.4	6	None	5 YR 3/3 Dark Reddish Brown	Apache Leap Tuff-Brown Unit (Talb). Well indurated, phaneritic to porphoritic tuff, 30-40% Phenocrysts of anhedral plagioclase (sanidine), quartz, biotite (subhedral), Lithic inclusions of brown siltstone.	Limonite on biotite. Fe-Oxide stains on ground mass.	Sand sized cuttings
490	149.4	6	None	5 YR 3/3 Dark Reddish Brown	Talb		
500	152.5	5	None	5 YR 3/3 Dark Reddish Brown	Talb		(Deveation survey = 1.5º) Switch to flooded reverse drilling
510	155.5	6	None	5 YR 3/3 Dark Reddish Brown	Talb		
520	158.5	4	None	5 YR 3/3 Dark Reddish Brown	Talb		
530	161.6	8	None	5 YR 3/3 Dark Reddish Brown	Talb		
540	164.7	8	None	5 YR 3/3 Dark Reddish Brown	Talb		
550	167.7	6	None	5 YR 3/3 Dark Reddish Brown	Talb		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
550-560	167.7-170.8	6	None	5 YR 3/3 Dark Reddish Brown	Apache Leap Tuff-Brown Unit (Talb). Well indurated, phaneritic to porphoritic tuff, 50% Phenocrysts of anhedral plagioclase (sanidine), quartz, biotite magnetite, lithic inclusions of brown siltstone. Ground mass is cryptocrystalline Si-rich.	Fe-oxide in ground mass. Weathered plagioclase halo.	Cuttings returned are mostly sand sized
570	173.8	6	None	5 YR 3/3 Dark Reddish Brown	Talb		
580	176.9	6	None	5 YR 3/3 Dark Reddish Brown	Talb		
590	17.9	6	None	5 YR 3/3 Dark Reddish Brown	Talb		Driller reports unstable borehole @~587 ft, Collapsing onto drill string- Fractures?
600	183	6	None	5 YR 3/3 Dark Reddish Brown	Talb		
610	186	11	None	5 YR 3/3 Dark Reddish Brown	Talb		
620	189.1	11	None	5 YR 3/3 Dark Reddish Brown	Talb		
630	192.1	13	None	5 YR 3/3 Dark Reddish Brown	Talb		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
630-640	192.1-195.1	13	None	5 YR 3/3 Dark Reddish Brown	Apache Leap Tuff-Brown Unit (Talb). Well indurated, phaneritic to porphoritic tuff, 50% Phenocrysts of anhedral plagioclase (sanidine), quartz, biotite magnetite, lithic inclusions of brown siltstone. Ground mass is cryptocrystalline Si-rich.	Limonite on biotite. Fe-oxide in ground mass. Weathered plagioclase holes.	Cuttings returned mostly sand sized.
650	198.2	7	None	5 YR 3/3 Dark Reddish Brown	Talb		
660	201.2	7	None	5 YR 3/3 Dark Reddish Brown	Talb		
670	204.3	9	None	5 YR 3/3 Dark Reddish Brown	Talb		
680	207.3	9	None	5 YR 3/3 Dark Reddish Brown	Talb	Chips with slicken sides on them.	Surge of large cuttings up to ~5cm.
690	210.4	10	None	5 YR 3/3 Dark Reddish Brown	Talb		Driller reports unstable borehole. Difficulty cleaning.
700	213.4	10	None	5 YR 3/3 Dark Reddish Brown	Talb		Deviation For 700' bls = 1^{o}
710	216.5	6	None	5 YR 3/3 Dark Reddish Brown	Talb		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
710-720	216.5-219.6	6	None	5 YR 3/3 Dark Reddish Brown	Apache Leap Tuff-Brown Unit (Talb). Well indurated, phaneritic to porphoritic tuff, 50-60% Phenocrysts of anhedral plagioclase (sanidine), quartz, biotite magnetite, lithic inclusions of brown siltstone. Ground mass is cryptocrystalline Si-rich.	Limonite on biotite. Fe-oxide in ground mass. Weathered plagioclase holes.	Cuttings returned are mostly sand sized. 718' (Per driller) Fracture zone contains large chips up to 10cm.
730	222.6	6	None	5 YR 3/3 Dark Reddish Brown	Increase in lithic inclusions siltstone Quartzite, possibly baked limestone.		Weight on bit = 23K lbs
740	225.7	6	None	5 YR 3/3 Dark Reddish Brown	Talb		
750	228.7	6	None	5 YR 3/3 Dark Reddish Brown	Talb		
760	231.8	5	None	5 YR 3/3 Dark Reddish Brown	Talb		Decrease in drill rate
770	234.8	8	None	5 YR 3/3 Dark Reddish Brown	Talb		Increase in drill rate
780	237.9	8	None	5 YR 3/3 Dark Reddish Brown	Talb		large fragments in cuttings, up to ~5cm
790	240.9	6	None	5 YR 3/3 Dark Reddish Brown	Talb		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
790-800	240.9-243.9	6	None	5 YR 3/3 Dark Reddish Brown	Apache Leap Tuff-Brown Unit (Talb). Well indurated, phaneritic to porphoritic tuff. Dacite Composition with up to 60% Phenocrysts of euhedral plagioclase (sandine), subhedral quartz, biotite. Ground mass is cryptocrystalline Si-rich.	Limonite in ground mass and biotite. Local calcite. Fe-oxide stain, red to brown on the groundmass.	Chips are mostly sand sized with tones of large chips up to 10cm.
810	247	4	None (Strong on calcite)	5 YR 3/3 Dark Reddish Brown	Talb	Subhedral $CaCo_3$	
820	250	4	None (Strong on calcite)	5 YR 3/3 Dark Reddish Brown	Talb		
830	253	4	None (Strong on calcite)	5 YR 3/3 Dark Reddish Brown	Talb		
840	256.1	4	None (Strong on calcite)	5 YR 3/3 Dark Reddish Brown	Talb		
850	259.1	6	None (Strong on calcite)	5 YR 3/3 Dark Reddish Brown	Talb	Euhedral Calcite	
860	262.2	7	None (Strong on calcite)	5 YR 3/3 Dark Reddish Brown	Talb	Euhedral Calcite	Borehole taking fluid rapidly @ ~853ft.
870	265.2	5	None (Strong on calcite)	5 YR 3/3 Dark Reddish Brown	Talb- few fragments of light green-yellow claystone	Ehuhedral Calcite	

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
870-880	265.2-268.3	5	On calcite frags only	5 YR 3/3 Dark Reddish Brown	Apache Leap Tuff-Brown Unit (Talb). Well indurated, phaneritic to porphoritic tuff, dacitic composition, plagioclase (sandine), quartz, biotite, magnetite. Dark reddish brown crystalline ground mass, few fragments or calcite crystals.	Calcite, green-yellow clay (Fault scour?)	To 956.4ft (291.6m)
890	271.3	5	On calcite frags only	5 YR 3/3 Dark Reddish Brown	Talb	Calcite, green-yellow clay (Fault scour?)	
900	274.4	5	On calcite frags only	5 YR 3/3 Dark Reddish Brown	Talb	Traces of rust-orange clay	
910	277.4	4	On calcite frags only	5 YR 3/3 Dark Reddish Brown	Talb		Transition into Vitrophyre
920	280.5	4	On calcite frags only	5YR 6/8 reddish yellow GLEY 13/13	Basal Tuff (Talbt)/Vitrophyre(Talv)- fragments of black glass, dark gray porphyritic-phaneritic tuff. Pinkish orange porphyritic-phaneritic poorly to moderately indurated tuff.		
930	283.5	23	None	5YR 6/8 reddish yellow GLEY 13/14	Talbt (30%)/Talv (70%)		
940	286.6	23	None	5YR 6/8 reddish yellow GLEY 13/15	Talbt (30%) /Talv (70%)		
950	289.6	14	None	7.5 YR 5/2 Brown 5YR 6/8 Reddish Yellow	Basal Tuff (Talbt)- Well indurated porphyritic-phaneritic tuff. Sandine, quartz, biotite. Also fragments of vitrophyle and pinckish orange tuff previously described. Crystalline ground mass.	Talv fragments contain Fe-oxide statining	
950-960	289.6-292.7	14	None		White Tail Conglomerate (Tw)/ Basal Tuff (Talbt)/ Vitrophyre (Talv)- Tw is locally expressed as consolidated dark sand and white tuffaceous sand. Tw cuttings returned appear to have been weakly altered from contact metamorphism, giving a crsyalline texture.	Fe-oxide staining around biotite and magnitite.	Hole TD ~956FT Talbt and Talv are likely mixed in sample due to drilling method.

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Project No.: 313001	**Well/Boring Name: HRES-20**
Project Name: Resolution Copper Well Install	**Date/Time Started: 11/20/2012**
55-914790	**Date/Time Completed: 12/02/2012**
Cadastral: T1S, R13E, Sec 27 D(1-13)27 CBD	**Drilling Equipment: Drill Tech D 80**
NAD 83:	**Drilling Method(s): Direct Air, flooded reverse**
Drill Company: Boart Longyear	**Bit Size(s)/Type(s): 15" Hammer Bit, 14.75" Tri-Cone**
Driller(s): Chris, Mike , Josh	**Conductor Casing (type; diameter; depth): 16" Steel to 39'bls**
Logged By: RM/ RT	**Total Well/Borehole Depth: 1057' bls**

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
0-10	0-3	5	None	5 YR 5/3 Reddish Brown	Apache Leap Tuff- White unit (Talw), Well indurated, phaneritic to porphoritic textured tuff, ~40% phenocrysts of plagioclase (sanidine), quart, and biotite. Traces of lithic fragments	Fe-Oxide on biotite and groundamss.	Munsell color determined from wet cuttings. 20-inch tri cone drill bit used to set 16-inch surace casing to 40 feet.
20	6.1	5	None	5 YR 5/3 Reddish Brown	Talw		Mostly sand sized cutings.
30	9.1	5	None	5 YR 5/3 Reddish Brown	Talw		
40	12.2	5	None	5 YR 5/3 Reddish Brown	Talw		Begin drilling with hammer bit. (14 7/8 ")
50	15.2	26	None	5 YR 5/3 Reddish Brown	Talw		
60	18.3	26	None	5 YR 5/3 Reddish Brown	Talw		
70	21.3	24	None	5 YR 5/3 Reddish Brown	Talw		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
70-80	21.3-24.4	24	None	5 YR 5/3 Reddish Brown	Apache Leap Tuff- White unit (Talw). Well indurated, phaneritic textured tuff, with 60% cryptocrystallin/aphanitic groundmass. ~40% phenocrysts of euhedral biotite, anhedral quartz and plagioclase. Lithic inclusions of red-brown siltstone.	Limonite on biotite.	Increase in chip size, up to 1 cm.
90	27.4	24	None	5 YR 5/3 Reddish Brown	Talw		
100	30.5	24	None	5 YR 5/3 Reddish Brown	Talw		
110	33.5	20	None	5 YR 5/3 Reddish Brown	Talw		
120	36.6	20	None	5 YR 5/3 Reddish Brown	Talw		
130	39.6	20	None	5 YR 5/3 Reddish Brown	Talw	Fe-Oxide in groundmass.	
140	42.7	20	None	5 YR 5/3 Reddish Brown	Talw		
150	45.7	20	None	5 YR 5/3 Reddish Brown	Talw		Increase in chip size, up to 2 cm.

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
150-160	45.7-48.8	20	None	5 YR 5/3 Reddish Brown	Apache Leap Tuff- White unit (Talw). Well indurated, phaneritic textured tuff, with ~65% Pinkish gray to white pumice, and cryptocrystallin/aphanitic groundmass. ~35% phenocrysts of euhedral biotite, anhedral quartz and plagioclase. Lithic inclusions of red-brown siltstone.	Limonite on biotite. Fe-Oxide stains on ground mass.	Chips mostly sand sized with chips up to 1.5 cm.
170	51.8	20	None	5 YR 5/3 Reddish Brown	Talw		
180	54.9	20	None	5 YR 5/3 Reddish Brown	Talw		
190	57.9	15	None	5 YR 5/3 Reddish Brown	Talw		
200	61	15	None	5 YR 5/3 Reddish Brown	Talw		Deviation survey taken =0.75^{0}
210	64	12	None	5 YR 5/3 Reddish Brown	Talw		
220	67.1	12	None	5 YR 5/3 Reddish Brown	Talw		
230	70.1	11	None	5 YR 5/3 Reddish Brown	Talw		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

CLEAR CREEK ASSOCIATES

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
230-240	70.1-73.2	11	None	5 YR 5/3 Reddish Brown	Apache Leap Tuff- White unit (Talw). Well indurated, phaneritic textured tuff, with ~65% Pinkish gray to white pumice, and aphanitic groundmass. ~35% phenocrysts of euhedral biotite, anhedral quartz and plagioclase. Lithic inclusions of red-brown siltstone.	Limonite on biotite. Fe-Oxide stains on ground mass.	Chips mostly sand sized with chips up to 2 cm.
250	76.2	15	None	5 YR 5/3 Reddish Brown	Talw		
260	79.3	15	None	5 YR 5/3 Reddish Brown	Talw		
270	82.3	15	None	5 YR 5/3 Reddish Brown	Talw		
280	85.3	15	None	5 YR 5/3 Reddish Brown	Talw		RT logging.
290	88.4	15	None	5 YR 5/3 Reddish Brown	Talw		Decrease in chip size to less than 1 cm.
300	91.4	15	None	5 YR 5/3 Reddish Brown	Talw		
310	94.5	20	None	5 YR 5/3 Reddish Brown	Talw		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

CLEAR CREEK ASSOCIATES

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
310-320	94.5-97.5	20	None	5 YR 5/2	Apache Leap Tuff- White unit (Talw). Well indurated, phaneritic textured tuff, with ~60% Pinkish gray to white pumice, and aphanitic groundmass. ~40% phenocrysts of euhedral to subhedral bronze biotite, anhedral quartz and plagioclase. Lithic inclusions of red-brown siltstone.	Hematite and Limonite.	Cuttings are dominately coarse-medium grained sand. Minor subangular chips to 1 cm in diameter.
330	100.6	40	None	5 YR 5/2	Talw		
340	103.6	40	None	5 YR 5/2	Talw		Increase in size and number of large chips (up to 2cm)
350	106.7	20	None	5 YR 5/2	Talw		
360	109.7	20	None	5 YR 5/2	Talw- Trace of dark gray-brown (5yr 3/2) fragments of pumice up to 3mm.		Return to less than 1 cm chip size
370	112.8	30	None	5 YR 5/2	Talw		
380	115.8	30	None	5 YR 5/2	Talw		
390	118.9	40	None	2.5 YR 4/3	Apache Leap Tuff- Gray unit (Talg). Well indurated, phaneritic textured tuff, with ~70% dark red-gray aphanitic groundmass. ~30% phenocrysts of subhedral biotite, anhedral quartz and plagioclase. Traces of yellow-brown lithic fragments. Pumice is partally flattened.	Traces of hematite in groundmass. Biotite is nearly altered to limonite.	Cuttings dominately coarse sand sized chips up to 1 cm.

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
390-400	118.9-121.9	40	None	2.5 YR 4/3	Apache Leap Tuff- Gray unit (Talg). Well indurated, phaneritic textured tuff, with ~75% dark red-gray aphanitic groundmass. ~25% phenocrysts of subhedral biotite, anhedral quartz and plagioclase. Traces of yellow-brown lithic fragments. Pumice is partally flattened, slight foliation.	Hematite and Limonite.	Cuttings are coarse sand sized up to .5 cm.
410	125	40	None	2.5 YR 4/3	Talg		Deviation survey taken =0.75^{0}
420	128	40	None	2.5 YR 4/3	Talg		
430	131.1	30	None	2.5 YR 4/3	Talg - Traces of red-brown siltstone lithic fragments		Increase in chip size to more than 2.2 cm.
440	134.1	30	None	2.5 YR 4/3	Talg		Return to less than 1 cm chip size.
450	137.2	30	None	2.5 YR 4/3	Talg		
460	140.2	30	None	2.5 YR 4/3	Talg		
470	143.3	22	None	2.5 YR 4/3	Talg		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
470-480	143.3-146.3	22	None	2.5 YR 4/3 Reddish Brown	Apache Leap Tuff- Gray unit (Talg). Well indurated, phaneritic textured tuff, with ~75% dark red-gray aphanitic groundmass. ~25% phenocrysts of subhedral biotite, anhedral quartz and plagioclase. Traces of lithic fragments of siltstone and quartzite.	Limonite on biotite. Fe-Oxide stains on ground mass.	RM logging- Cuttings are mostly sand sized, some larger chips up to ~ 2 cm
490	149.4	22	None	2.5 YR 4/3 Reddish Brown	Talg		
500	152.4	16	None	2.5 YR 4/3 Reddish Brown	Talg		(Deveation survey = 1.5º) Switch to flooded reverse drilling
510	155.4	15	None	2.5 YR 4/3 Reddish Brown	Talg		
520	158.5	15			Lost Circulation. No cuttings returned.		Switch from hammer bit to tricone.
530	161.5	7					
540	164.6	7					
550	167.6	10					

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
550-560	167.6-170.7	10			Lost Circulation. No cuttings returned.		
570	173.3	5					
580	176.8	5					
590	178.8	4					
600	182.9	3					
610	185.9	3					
620	189	2.5					
630	192	2.5					

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
630-640	192-195.1	2.5			Lost Circulation. No cuttings returned.	Limonite on biotite. Fe-oxide in groundmass. Weathered plagioclase holes.	Cuttings returned mostly sand sized.
650	198.1	3.5					
660	201.2	5					
670	204.2	5					
680	207.3	7					
690	210.3	7					
700	213.4	4					
710	216.4	4					Circulation returned.

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
710-720	216.4-219.5	4	None	2.5 YR 3/4 Reddish Brown	Apache Leap Tuff- Gray unit (Talg). Well indurated, porphyritic to phaneritic textured tuff, with ~70% pink/gray/brown groundmass. ~30% phenocrysts of subhedral to euhedral biotite, anhedral to subhedral quartz and plagioclase. Traces of lithic fragments of red brown siltstone.	Limonite on biotite. Fe-oxide in groundmass.	Cuttings returned are mostly sand sized with chips up to 2 cm.
730	222.5	5	None	2.5 YR 3/4 Reddish Brown	Talg		Drilling flooded reverse with 14 3/4" tricone.
740	225.6	7	None	2.5 YR 3/4 Reddish Brown	Talg		
750	228.6	7	None	2.5 YR 3/4 Reddish Brown	Talg		
760	231.6	10	None	2.5 YR 3/4 Reddish Brown	Talg		
770	234.7	10	None	2.5 YR 3/4 Reddish Brown	Talg		
780	237.7	7	None	2.5 YR 3/4 Reddish Brown	Talg		
790	240.8	7	None	2.5 YR 3/4 Reddish Brown	Talg		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
790-800	240.8-243	7	None	2.5 YR 4/4 Reddish Brown	Apache Leap Tuff- Gray unit (Talg). Well indurated, porphyritic to phaneritic textured tuff, with ~70% pink/gray/brown groundmass. ~30% phenocrysts of subhedral to euhedral biotite, anhedral to subhedral quartz and plagioclase. Traces of lithic fragments of red brown siltstone.	Limonite on biotite. Fe-oxide in groundmass.	Some of the sand sized cuttings are up to 2.5 cm.
810	246.9	8	None	2.5 YR 4/4 Reddish Brown	Talg		
820	249.9	5	None	2.5 YR 4/4 Reddish Brown	Talg		Dramatic decrease in cuttings size to med-fine .
830	253	5	None	5 YR 4/4 Reddish Brown	Talg		
840	256	5	None	10 R 3/2 Dusky Red	Apache Leap Tuff- Browm unit (Talb). Well indurated, porphyritic textured tuff, with ~60% pink/brown groundmass. ~40% phenocrysts of biotite, quartz, plagioclase, and magnetite. Traces of lithic imclusions.	Limonite on biotite. Fe-oxide in groundmass.	Conact with brown unit.
850	259.1	5	None	10 R 3/2 Dusky Red	Talb		
860	262.1	7	None	10 R 3/2 Dusky Red	Talb		
870	265.2	7	None	10 R 3/2 Dusky Red	Talb		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
870-880	265.2-268.2	7	None	10 R 3/2 Dusky Red	Apache Leap Tuff- Browm unit (Talb). Well indurated, porphyritic textured tuff, with ~70% pink/brown groundmass. ~30% phenocrysts of biotite, quartz, plagioclase, and magnetite. Traces of lithic imclusions.	Limonite on biotite. Fe-oxide in groundmass.	Cuttings returned are fine sand sized.
890	271.3	8	None	10 R 3/2 Dusky Red	Talb		
900	274.3	2.5	None	10 R 3/2 Dusky Red	Talb		
910	277.4	2.5	None	10 R 3/2 Dusky Red	Talb		
920	280.4	5	None	10 R 3/2 Dusky Red	Talb		
930	283.5	5	None	10 R 3/2 Dusky Red	Talb		
940	286.5	3.5	None	10 R 3/2 Dusky Red	Talb		
950	289.6	3.5	None	10 R 3/2 Dusky Red	Talb		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
950-960	289.6-292.6	3.5	None	10 R 3/2 Dusky Red	Apache Leap Tuff- Browm unit (Talb). Well indurated, porphyritic textured tuff, with ~65% pink/gray/brown groundmass. ~35% phenocrysts of biotite, quartz, plagioclase, and magnetite. Traces of lithic imclusions.	Limonite on biotite. Fe-oxide in groundmass.	Cuttings returned are fine sand sized.
970	295.7	3.5	None	10 R 3/2 Dusky Red	Talb		
980	298.7	5	None	10 R 3/2 Dusky Red	Talb		
990	301.8	5	None	10 R 3/2 Dusky Red	Talb		
1000	304.8	7	None	10 R 3/2 Dusky Red	Talb		
1010	307.8	7	None	10 R 3/2 Dusky Red	Talb		
1020	310.9	7	None	10 R 3/2 Dusky Red	Talb		
1030	313.9	7	None	10 R 3/2 Dusky Red	Talb		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
1030-1040	313.9-317	6	None	10 R 3/2 Dusky Red	Apache Leap Tuff- Browm unit (Talb). Well indurated, porphyritic textured tuff, with ~65% pink/red/brown groundmass. ~35% phenocrysts of biotite, quartz, and plagioclase. Traces of lithic imclusions.	Limonite on biotite. Fe-oxide in groundmass.	Cuttings returned are fine sand sized.
1050	320	6	None	10 R 3/2 Dusky Red	Talb		Dramatic increase in chip size up to 5cm.
1060	323.1	6	None	10 R 3/2 Dusky Red	Talb		Total depth 1057 (12/2/12)

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

CLEAR CREEK ASSOCIATES

Project No.: 313001/313002	**Well/Boring Name: QV-5**
Project Name: Resolution Copper Well Install	**Date/Time Started: 12/06/2012**
55-221850	**Date/Time Completed: 12/13/2012**
Cadastral: D(1-10) 34 cdd	**Drilling Equipment: Drill Tech D 40**
NAD 83: 33.294458 111.313117	**Drilling Method(s): Rotary**
Drill Company: Boart Longyear	**Bit Size(s)/Type(s): 15" Hammer, 14 3/4" Tri-Cone**
Driller(s): Jesee, Ben	**Conductor Casing (type; diameter; depth): 16" Steel to 60'bls**
Logged By: BWH, JCJ	**Total Well/Borehole Depth: 568' bls**

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
0-10	0-3	4	Mod. in fines	5 YR 4/3	Poorly sorted gravel and sand, traces of silt. Gravel to ~2cm. Angular to subangular , felsic dominated- quartz, tuff, feldspar, sandstone, siltstone, schist fragments.		Stream channel sediments drilled wth 22" surface casing reamer- tricone bit
20	6.1	4	Mod. in fines	5 YR 4/3	Sample description is same as above.		Cuttings logged wet.
30	9.1	6	None	2.5 YR 4/3	Apache Leap Tuff (Tal), crystal-rich, moderately lithified, pink aphanitic groundmass, approximately 40% phenocryst content including quartz, feldspar (sanadine), biotite, white pumice, trace magnetite, trace lithics.	Fe-Oxide stains on Biotite (limonite)	Very similar to Tal unit moderate flattening of pumice.
40	12.2	8	None	10 R 4/3	Sample description is same as above with a more reddish groundmass and slightly smaller biotite grains.		Formation gets harder 30-33ft
50	15.2	9	None	2.5 YR 4/3	Tal		
60	18.3	4	None	2.5 YR 4/3	Tal		
70	21.3	45	None	2.5 YR 4/3	Tal		Drilled with 15" hammer bit. Direct air.

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

CLEAR CREEK ASSOCIATES

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
70-80	21.3-24.4	45	None	2.5 YR 4/4	Apache Leap Tuff, crystal-rich, moderately to well lithified, dark pink/red/brown aphanitic groundmass, approximately 40% phenocryst content including quartz, feldspar (sanadine), biotite, white pumice, trace magnetite, trace lithics.	Fe-Oxide stains on Biotite (limonite)	
90	27.4	45	None	10 R 3/3	Tal		
100	30.5	12	None	10 R 3/3	Tal		Reverse circulation. Fresh water assist 15" hammer.
110	33.5	12	None	10 R 3/3	Tal		
120	36.6	13	None	10 R 3/3	Tal		
130	39.6	13	None	10 R 3/3	Tal		
140	42.7	15	None	10 R 3/3	Tal		
150	45.7	15	None	10 R 3/3	Tal		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
150-160	45.7-18.8	22	None	10 R 3/3	Apache Leap Tuff, crystal-rich, moderately to well lithified, dark pink/red/brown aphanitic groundmass, approximately 40% phenocryst content including quartz, feldspar (sanadine), biotite, white pumice, trace magnetite, trace lithics.	Fe-Oxide stains on Biotite (limonite)	
170	51.8	22	None	10 R 3/3	Tal		Deviation survey @162 ft = 2°
180	54.9	17.9	None	10 R 3/3	Tal		
190	57.9	17.9	None	10 R 3/3	Tal		Driller notes fracture @ ~183 ft
200	61	20	None	2.5 YR 3/4	Tal		
210	64	19.3	None	10 R 3/3	Tal		30 ft/hr drill rate.
220	67.1	19.3	None	10 R 3/3	Tal		Deviation survey @200 ft = 1°
230	70.1	27.9	None	10 R 3/3	Tal		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
230-240	70.1-73.2	27.9	None	10 R 3/3	Apache Leap Tuff, crystal-rich, moderately to well lithified, dark pink/red/brown aphanitic groundmass, approximately 40% phenocryst content including quartz, feldspar (sanadine), biotite, white pumice, trace magnetite, trace lithics.	Fe-Oxide stains on Biotite (limonite)	Drillers reports fracture @~233 ft
250	76.2	18.1	None	10 R 3/3	Tal		
260	79.3	18.1	None	10 R 3/3	Tal		
270	82.3	13.3	None	10 R 3/3	Tal		
280	85.4	13.3	None	10 R 3/3	Tal		
290	88.4	14	None	10 R 3/3	Tal		
300	91.5	14	None	10 R 3/3	Tal		
310	94.5	14	None	10 R 3/3	Tal		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
310-320	94.5-97.6	8	None	10 R 3/3	Apache Leap Tuff, crystal-rich, moderately to well lithified, dark pink/red/brown aphanitic groundmass, approximately 40% phenocryst content including quartz, feldspar (sanadine), biotite, white pumice, trace magnetite, trace lithics.	Fe-Oxide stains on Biotite (limonite)	Deviation survey @ 312 ft = 1°
330	100.6	8	None	10 R 3/3	Tal		
340	103.7	5	None	10 R 3/3	Tal		
350	106.7	5	None	10 R 3/3	Tal		Driller notes fracture @ ~340 ft
360	109.8	4.4	None	10 R 3/3	Tal		
370	112.8	4.4	None	10 R 3/3	Tal		
380	115.9	1.6	None	10 R 3/3	Tal		
390	118.9	1.6	None	10 R 3/3	Tal		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
390-400	118.9-1222	2.3	None	10 R 3/3	Apache Leap Tuff, crystal-rich, moderately to well lithified, dark pink/red/brown aphanitic groundmass, approximately 40% phenocryst content including quartz, feldspar (sanadine), biotite, white pumice, trace magnetite, trace lithics.	Fe-Oxide stains on Biotite (limonite)	At 388 ft - start drilling with tricone rotary 14 3/4", Reverse flooded.
410	125	4	None	10 R 3/3	Tal		
420	128	5	None	10 R 3/3	Tal		
430	131.1	5	None	10 R 3/3	Tal		
440	134.1	3.6	None	10 R 3/3	Tal		Driller reports fracture @ ~440ft
450	137.2	3.6	None	5 YR 3/4	Tal		
460	140.2	3.6	None	10 R 3/3	Tal		
470	143.3	5.3	None	10 R 3/3	Tal		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
470-480	143.3-146.3	5.3	None	10 R 3/3	Apache Leap Tuff, crystal-rich, moderately to well lithified, dark pink/red/brown aphanitic groundmass, approximately 40% phenocryst content including quartz, feldspar (sanadine), biotite, white pumice, trace magnetite, trace lithics.	Limonite on biotite. Calcite crystals, trace cream-white material, soft, crumbly.	
490	149.4	4.5	None	10 R 3/3	Tal	No calcite observed.	
500	152.4	4.5	None	10 R 3/3	Tal		
510	155.5	3.4	None	10 R 3/3	Tal		Harder formation? Drilling rate slows. Deviation survey @500 ft 1.5º
520	158.5	3.4	None	10 R 3/3	Tal		
530	161.6	3	None	2.5 YR 3/3	Tal		Moderate rig chatter
540	164.6	3	None	2.5 YR 4/4	Tal		
550	167.7	3	None	2.5 YR 4/4	Tal		

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

Depth (feet)	Depth (meters)	Drill Rate (ft/hr)	HCl Rxn	Munsell Color	Sample Description	Secondary Features	Remarks
550-560	167.7-170.7	3	None	2.5 YR 4/4	Apache Leap Tuff, crystal-rich, moderately to well lithified, dark pink/red/brown aphanitic groundmass, approximately 40% phenocryst content including quartz, feldspar (sanadine), biotite, white pumice, trace magnetite, trace lithics.	Limonite on biotite. Calcite crystals, trace cream-white material, soft, crumbly.	
570	173.8	2.2	None	2.5 YR 4/4	Tal	Limonite on biotite. Calcite crystals, trace cream-white material, soft, crumbly.	Borehole TD ~568 ft bls.

Notes:
HCL Rxn = Hydrochloric acid reaction (strong, moderate, mild, none);

APPENDIX D

WELL CONSTRUCTION FORMS

CLEAR CREEK ASSOCIATES

PIPE TALLY

Project Name.: Resolution Copper	Project No.: 313001
Well No.: HRES-19	Date: 11/4/12
Location:	Pipe Talley for: Well Casing (Blank & Screen)
Total Depth: 966 ft. bs	Geologist: RT

Type of Connections: ☐ Welded ☒ T+C ☐ Flush Thread ☐ Other

Type of Welding: ☐ ARC (Stick) ☐ Flux Core Wire ☐ Other Stick Code or Wire Type: _____

Pipe	✓	Length (ft)	Length Σ (ft)	Pipe Type	Pipe	✓	Length (ft)	Length Σ (ft)	Pipe Type
C* 1	✓	0.84		End Cap	36	✓	21.04	78.36	Blank
C* 2	✓	21.01	21.85	8" Blank	37	✓	21.04	734.90	Blank
3	✓	21.02	42.87	8" Screen	38	✓	20.54	755.44	Blank
4	✓	21.07	63.94	" Screen	39	✓	21.15	776.59	Blank
5	✓	21.08	85.02	Screen	40	✓	21.07	797.66	Blank
6	✓	21.10	106.12	Screen	41	✓	21.03	818.69	Blank
7	✓	21.10	127.22	Screen	42	✓	21.02	839.71	Blank
C* 8	✓	21.04	148.26	Screen	43	✓	21.03		Blank
9	✓	21.59	169.85	Blank	44	✓	21.06		Blank
C* 10	✓	21.12	190.97	Blank	45	✓	21.17	924.01	Blank
11	✓	21.05	212.02	Screen					
12	✓	21.06	233.08	Screen					
13	✓	21.09	254.17	Screen					
14	✓	20.50	274.67	Screen					
15	✓	21.10	295.77	Screen					
16	✓	21.01	316.78	Screen					
17	✓	21.11	337.89	Screen					
18	✓	21.05	358.94	Screen					
C* 19	✓	20.95	379.89	Screen					
20	✓	21.10	400.99	Screen					
21	✓	21.08	422.07	Screen					
22	✓	20.55	442.62	Screen					
23	✓	21.05	463.67	Screen					
24	✓	21.06	484.73	Screen					
25	✓	20.56	505.29	Screen					
26	✓	20.55	525.84	Screen					
27	✓	21.05	546.89	Screen					
28	✓	20.97	567.86	Screen					
29	✓	21.09	588.95	Blank					
30	✓	20.54	609.49	Blank					
C* 31	✓	21.05	630.54	Blank					
32	✓	20.61	651.15	Blank					
33	✓	21.10	672.25	Blank					
34	✓	20.51	692.82	Blank					
35	✓	21.02	713.86	Blank					

860.73
881.76
902.84
924.01

SUMMARY OF TALLY

Total length of casing/screen tallied (ft):	924.01
Length of casing cut off after landing (ft.):	16
Bottom of Casing (feet below land surface):	908
Screened Interval(s) (ft.bls):	
Total feet of blank casing in hole (ft.):	

Notes: C* = centralizer installed 8" ID. ~~8.75" OD~~ 8.625" OD
O.D. of coupling = 9.625"

ESTIMATED ANNULAR MATERIAL RECORD

Project Name: Resolution Copper
Project No.: 313001 Date: 11/5/12
Well No.: HRES-19 Geologist: BWH, RM

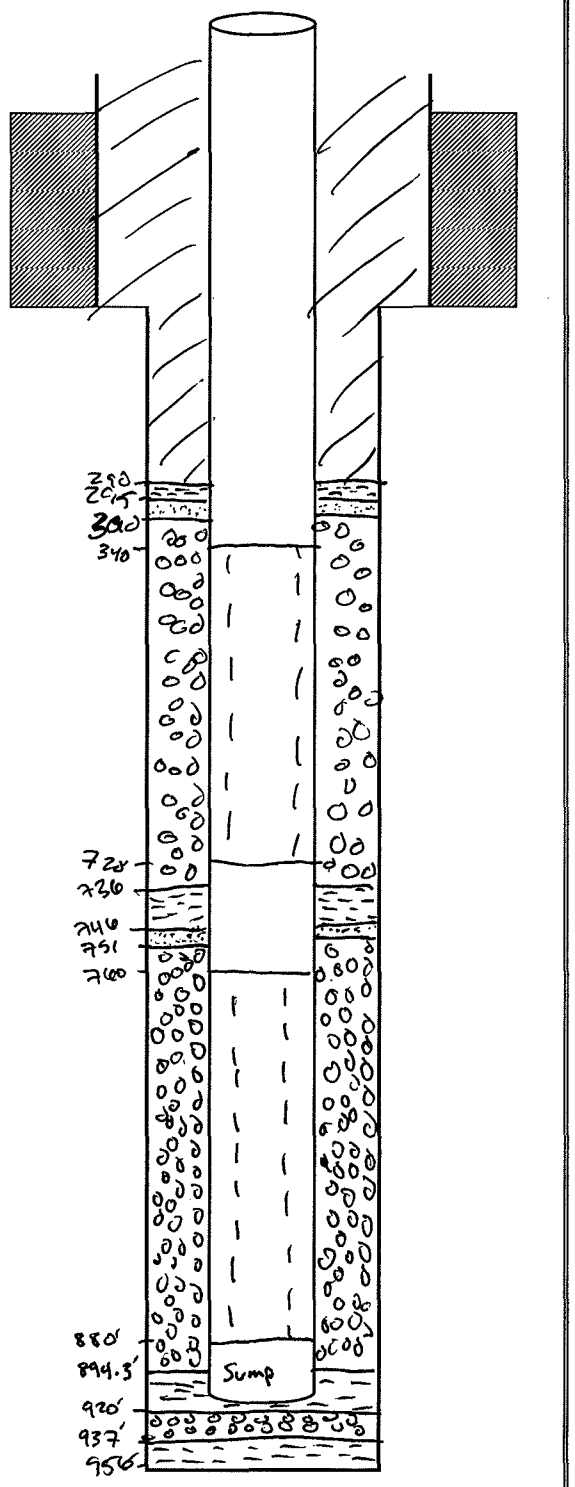
ANNULAR VOLUME CALCULATIONS

Total Depth of Borehole (ft) [T]: 956 ft
Length of Interval to be filled (ft) [L]: 956
Borehole Diameter (in.) [D]: 14.75
Total Cased Depth (ft): 908
Casing Diameter (in.) [d]: ~~8.750 O.D.~~ 8.625 O.D.
Rat Hole Volume (ft^3) [R]: 60
Annular Volume [A]: (D^2-d^2) 0.005454 = 0.78 Ft³/Lin. Ft
Expected Calculated Volume = (AxL)+R= ~~758~~ 769 Ft³

NOTES:

CLEAR CREEK ASSOCIATES

As-Built



ESTIMATED ANNULAR MATERIAL RECORD (Continued)

Project Name: Resolution Copper | Project Number: 313001

Well Number: HRES-19 | Date: 11/5/12 | Geologist: BWH, RM

EQUATIONS

2,700 lbs. Silica Sand=1 cubic yard=27 cubic ft | Pea gravel: 1yd^3 = ~2700 lbs. | Bentonite bag = .69ft^3/bag (hydrated)

[1] Volume of bag (Ft^3) = bag weight/100 | [2] Calculated depth=previous calculated depth - (v/A)

No.	✓	Weight installed (lbs.)	Volume installed (v)[1] (ft^3)	Total Vol. installed (ft^3)	Calculated Depth[2] (ft bls)	Tagged Depth (ft bls)	Type of Annular Material	Type/Size of Container	Measurement Method	Comments
3b1	✓		19.2	19.2	940	937	Bentonite Pellets	5-gal bucket	wire line	32 buckets
2	✓	2,000	20.0	39.2	920.1	920	Pea Gravel	S.S.	wire line	2/3 S.S.
3	✓		13.2	52.4	908.8	913	Bentonite Pellets	5 gal bucket	wire line	22 buckets
4	✓	600	6.0	58.4	908.1	901	3/8" Bentonite Chips	50lbs bag	wire line	12 bags
5	✓	350	3.5	61.9	896.5	894.35	" "	"	"	7 bags
6	✓	7,000	70	141.9	804.6	799	Pea Gravel	S.S.	wire line	2 1/3 S.S.
7	✓	3,000	30	171.9	760	~~780~~ (787)	Pea Gravel	S.S.	wireline/tremie	1 S.S. (only 12ft?)
8	✓	3000	30	201.9		754.63	Pea Gravel	S.S.	Tremie	1 SS.
9	✓	~500	5	206.9		750	Pea Gravel	5-gal buck	Tremie	85-gal buckets
—	-	~	—	206.9	—	755.9	—	—	wireline/tremie	Swab Cycle
10	✓		4.68	211.5	750	751	Pea Gravel	5-gal. buckets	tremie	7x 5 gal. Buckets
11	✓		4.68	216.18	745	746	Silica Sand	5-gal buckets	tremie	7x5 gal. Buckets
12	✓		8.69	224.8	735	737	Hole plug	Hole Plug	wireline	13x5 gal. Buckets
13	✓		2.0	226.8	734.5	736	" "	5-gal bucket	wireline	3x5 gal. Buckets
14	✓		4.68	231.48	731.0	733	Silica Sand	5-gal. bucket	wireline	7x5 gal. Buckets
15	✓		2.67	234.15	730	727	" "	"	wireline/tremie	4x5 gal. Buckets
-	-	-	—	234.15	—	726	—	—	—	Tag after S+A Development
16	✓	27000	270	504.15	~380 (voids)	538	Pea Gravel	S.S.	wireline	9x3,000 lb S.S.
								-		CCA offsite

Notes: 1 bucket of bentonite pellets is ~ 0.6 ft^3 (buckets are full to ~4 gal mark) Dehydrated

SS. = Super Sack

CLEAR CREEK ASSOCIATES

PIPE TALLY

Project Name.: Resolution Copper	Project No.: 31300 1
Well No.: HPOS-20 (55-914790)	Date: 12/3/12 - 12/4/12
Location: RC Superior, AZ	Pipe Talley for: Well Casing
Total Depth:	Geologist: BM

Type of Connections: ☐ Welded ☑ T+C ☐ Flush Thread ☐ Other

Type of Welding: ☐ ARC (Stick) ☐ Flux Core Wire ☐ Other Stick Code or Wire Type: _____

Pipe	✓	Length (ft)	Length Σ (ft)	Pipe Type
1	✓	0.83	0.83	Bull Nose
2	✓	21.01	21.84	Blank 8 5/8"
3	✓	20.56	42.40	Screen 8 5/8"
4	✓	21.05	63.45	
5	✓	20.50	83.95	
6	✓	21.04	104.99	
7	✓	20.51	125.50	
8	✓	21.14	146.64	
9	✓	21.02	167.66	
10	✓	21.03	188.69	
11	✓	21.06	209.75	
12	✓	21.14	230.89	
13	✓	21.12	252.01	
14	✓	20.70	272.71	
15	✓	20.98	293.69	
16	✓	21.02	314.71	
17	✓	20.54	335.25	
18	✓	21.03	356.28	
19	✓	20.59	376.87	
20	✓	21.02	397.89	
21	✓	21.06	418.95	
22	✓	20.53	439.48	
23	✓	20.59	460.07	
24	✓	21.10	481.17	Blank 8 5/8"
25	✓	21.02	502.19	
26	✓	21.05	523.24	
27	✓	21.03	544.27	
28	✓	21.00	565.27	
29	✓	21.03	586.30	
30	✓	21.00	607.30	
31	✓	21.09	628.39	
32	✓	20.75	649.14	
33	✓	20.99	670.13	
34	✓	21.02	691.15	
35	✓	21.09	712.24	
36	✓	21.14	733.38	Blank
37	✓	21.09	754.47	
38	✓	20.77	775.24	
39	✓	20.74	795.98	
40	✓	20.48	816.46	
41	✓	21.02	837.48	
42	✓	21.07	858.55	
43	✓	21.06	879.61	
44	✓	21.04	900.65	
45	✓	20.54	921.19	
46	✓	20.56	941.75	
47	✓	20.81	962.56	
48	✓	20.50	983.06	
49		20.80	1003.86	
50		21.03	1024.89	
51		21.03	1045.92	
52		21.00	(1066.92)	

SUMMARY OF TALLY

Total length of casing/screen tallied (ft.): _____

Length of casing cut off after landing (ft.): _____

Bottom of Casing (feet below land surface): _____

Screened Interval(s) (ft.bls): _____

Total feet of blank casing in hole (ft.): _____

Notes:

8 5/8" casing (O.D.)

C = Centralizer.

T.D. = 1057' bls

CLEAR CREEK ASSOCIATES

PIPE TALLY

Project Name.: Resolution Copper	Project No.: 313001
Well No.: 55-221850 (QU-5)	Date: 12/13/12
Location: Queen Valley, AZ	Pipe Talley for: well casing
Total Depth: 568'	Geologist: fm

Type of Connections: ☐ Welded ☒ T+C ☐ Flush Thread ☐ Other

Type of Welding: ☐ ARC (Stick) ☐ Flux Core Wire ☐ Other Stick Code or Wire Type: _____

Pipe	✓	Length (ft)	Length Σ (ft)	Pipe Type	Pipe	✓	Length (ft)	Length Σ (ft)	Pipe Type
1	✓	21.00	21.00	Screen					
2	✓	21.03	42.03						
3	✓	20.99	63.02						
4	✓	21.10	84.12						
5	✓	20.06	104.18						
6	✓	21.04	125.22						
7	✓	21.03	146.25						
8	✓	20.56	166.81						
9	✓	20.55	187.36						
10	✓	21.10	208.46						
11	✓	21.16	229.62						
12	✓	20.99	250.61						
13	✓	20.55	271.16						
14	✓	21.05	292.21						
15	✓	21.04	313.25						
16	✓	21.06	334.31						
17	✓	20.58	354.89						
18	✓	21.07	375.95						
19	✓	20.58	396.49						
20	✓	21.05	417.52						
21	✓	21.10	438.62	Blank					
22	✓	20.92	459.54						
23	✓	20.57	480.11						
24	✓	21.12	501.23						
25	✓	21.06	522.29						
26	✓	20.75	543.04						
27	✓	21.04	564.08						
28	✓	21.03	585.11						

SUMMARY OF TALLY

Total length of casing/screen tallied (ft.): _____

Length of casing cut off after landing (ft.): _____

Bottom of Casing (feet below land surface): _____

Screened Interval(s) (ft.bls): _____

Total feet of blank casing in hole (ft.): _____

Notes:

8" Std. T&C casing. Screen is 0.030" vertical slot 4x round
8.625" O.D. (8.5")
C = centralizer
# C = basket

APPENDIX E

WELL DEVELOPMENT FORMS

CLEAR CREEK ASSOCIATES

AIR-LIFT DEVELOPMENT FIELD DATA LOG

Project Name: Resolution Copper	Project No.: 313001
Well No.: HRES-20	Date: 12/7/12 - 12/8/12
Location: Superior / RCM	Geologist: VNH + CTM
Total Depth of Well (ft bls): 1057'	Measuring Point (M. P.): Casing + Pipe
Screen Interval (ft bls): 1037'-582'	Distance from ground level to M. P.: 4.35'
	SWL = 647.32' bmp / SWL = 642.97' bls

Time	Depth Interval (ft)	Color	Odor	Sand Content (ml)	pH	Sp. Cond. (µs/cm)	Temp. (°F)	Comments
0726	Bottom (~1040)	—	—	—	—	—	—	Compressor On, ~75gpm
0728		Muddy Brown	Dirty (Dirt)	6	—	—	—	Too dirty for parameters
0758		" "	" "	.75	—	—	—	" "
0815		Slightly translucent muddy brown	" "	.30	8.39	605.3	23.1	
0830		Slightly translucent light muddy brown	NA	.25	8.39	569.5	22.6	~72gpm
0845		" "	NA	.1	8.36	536.4	22.5	
0900		" "	"	TR	8.32	518.5	23.3	
0920		Same as above, getting lighter	"	TR	8.27	492.6	23.6	
0940		Translucent light yellow	"	TR	8.26	472.5	24.0	
1000		Cloudy; slight yellow tint	NA	TR	8.26	461.7	24.0	~56
1020		" "	NA	"	8.22	448.4	23.7	
1040		" "	"	"	8.25	437.4	23.4	
1100		Cloudy	"	"	8.25	426.1	24.1	
1120		Slightly Cloudy	"	None	8.22	420.0	24.1	
1140		" "	"	"	8.25	419.1	23.8	
1200		" "	"	"	8.24	411.2	23.9	
	VNH off site	post-site/crew change for phone call						
1300		Clear	NA	None	8.24	398.6	24.0	
1320	Bottom (~1040)	"	"	"	8.24	394.3	23.9	
1325		—	—	—	—	—	—	OFF for recharge
	Recharge, check rig oil, and adjust Kelly hose							
1355	Bottom (~1040)	—	—	—	—	—	—	ON, ~
1358		Cloudy light yellow	NA	Co	8.13	389.6	25.1	
1401		opaque brown muddy water	NA	4.5	—	—	—	Too dirty for parameters
1410		" "	NA	2.5	—	—	—	" "
1420		Light Brown translucent water	"	.4	8.27	409.5	24.2	~60gpm
1430		Same + More clear	"	.3	8.28	401.1	24.3	
1445		Same + more clear	"	.2	8.21	397.1	24.0	

Additional Comments: Field Parameters stable when: pH w/in Ø.2 s.u. } in 3 or more
Ec w/in 200 µS/cm } consecutive readings
T w/in 2°C

CLEAR CREEK ASSOCIATES

AIR-LIFT DEVELOPMENT FIELD DATA LOG

Project Name: Resolution Copper	Project No.: 313001
Well No.: HRES-20	Date: 12/7/12 -
Location: Superior / RCM	Geologist: VNH +
Total Depth of Well (ft bls): 1057'	Measuring Point (M. P.): Casing + Pipe
Screen Interval (ft bls): 1037'-582'	Distance from ground level to M. P.: 4.35'
	SWL: 647

Time	Depth Interval (ft)	Color	Odor	Sand Content (ml)	pH	Sp. Cond. (µs/cm)	Temp. ~~(°F)~~ °C	Comments
1500	Bottom (~1040')	Translucent light yellow	NA	.1	8.24	387.0	24.0	Q ~ 60 gpm
1520		Cloudy	"	TR	8.24	388.2	23.7	
1540		" "	"	TR	8.22	384.5	23.9	
1600		Slightly Cloudy	"	"	8.23	381.1	23.9	
1620		Clear	"	None	8.24	376.9	24.0	
1640		Slightly Cloudy	"	TR	8.23	377.0	23.2	
1643		—	—	—	—	—	—	OFF Trip out 40'
~~	Trip Out	40' and	wait	for	recharge	~~~	~~~	~~~
1700	Bottom (~1000')	—	—	—	—	—	—	ON
1708	Bottom (~1000')	Transluscent Light Brown	NA	TR	8.28	381.5	23.3	Q ~ 60 gpm
1720		Faintly yellow cloudy	"	None	8.30	371.6	23.8	
1740		Faintly Cloudy	"	"	8.25	376.9	23.4	
1800		Clear	"	"	8.27	375.7	23.7	
1820		"	"	"	8.30	373.9	23.1	
1823		—	—	—	—	—	—	OFF
~~	Trip out	40' and	wait	for	recharge	~~~	~~~	~~~
1840	Bottom (~960')	—	—	—	—	—	—	ON
1845	Bottom (~960')	Cloudy	NA	TR	8.23	374.2	23.6	
1849		Translucent cloudy Mud Brown	NA	2	8.28	382.8	23.6	Q ~ 50 gpm
1900		Translucent cloudy light brn	NA	.5	8.25	383.3	23.1	
1945	920-960	nearly clear	None	trace	8.40	0.40	69.6	New equipment (Hanna)
2000	920-960	"	"	Trace	8.39	0.36	66.4	used for monitoring purposes
2025	" "	nearly clear	None	None	8.42	0.37	65.8	T=F / cond = mS
2100	920-960	nearly clear	None	None	8.42	0.38	66.2	Q ~ 50 gpm
2125	920-960	clear	None	None	8.42	0.38	68.1	Q ~ 50 gpm
2130	Trip out	40' &	wait	for	recharge.			
2152	880-920	—	—	—	—	—	—	ON
2156	" "	LT brown	None	0.2	8.44	0.39	67.2	Q ~ 50 gpm

Additional Comments: Field Parameters stable when: pH w/in 0.2 s.u. } in 3 or more
EC w/in 200 µS/cm } consecutive readings
T w/in 2° C }

CLEAR CREEK ASSOCIATES

SWAB AND AIR-LIFT DEVELOPMENT FIELD DATA LOG

Project Name: Resolution Copper	Project No.: 31300
Well No.: HRES-20	Date: 12/7-12/8
Location: Superior/RCM	Geologist: GTM
Total Depth of Well (ft bls): 1037'	Measuring Point (M. P.): Casing/Pipe Arrows- Baffle
Screen Interval (ft bls): 562-1037'	Distance from ground level to M. P.: 4.35
	SWL-647'

Time	Depth Interval (ft)	Color	Odor	Sand Content (ml/l)	pH	Sp. Cond. ~~(us/cm)~~ mS	Temp. (°F)	Comments
~~2234~~	880-920	LT brown/cloudy	None	Trace	8.42	0.39	69.1	Q~43gpm
2212	"	LT brown	None	Trace	8.44	0.36	69.1	
2230	880-920	cloudy-LT brown	None	0.2	8.46	0.35	67.5	
2245	"	slightly cloudy	None	0.2	8.45	0.37	67.2	Q~45gpm
2300	880-920	"	None	Trace	8.46	0.34	67.8	
2315	"	slightly cloudy	None	Trace	8.45	0.39	68.6	Q~50gpm
2330	880-920	clear	None	None	8.49	0.35	67.6	
2345	"	clear	None	None	8.49	0.35	68.5	
2350	Trip out	2 joints	E	allow	recharge			840-880 OFF
0010	840-880	—	—	—	—	—	—	ON
0020	840-880	LT brown	None	0.7	8.52	0.35	69.2	Q~50gpm
0030	" "	nearly clear	None	Trace	8.49	0.35	68.5	
0045	840-880	slightly cloudy	None	Trace	8.49	0.35	68.6	47 gpm
0100	840-880	clear	None	None	8.50	0.34	68.6	Q~50gpm
0115	" "	clear	None	None	8.50	0.34	67.9	
0128	" "	clear	None	None	8.49	0.34	68.4	Q~41gpm
0130	Trip out	2 joints	E	allow	recharge			800-840 OFF
0140	~~800~~-840	—	—	—	—	—	—	ON
0145	800-840	LT brown	None	0.3	8.50	0.34	66.8	~33gpm
0200	" "	LT brown	None	0.2	8.50	0.34	66.7	
0215	800-840	cloudy	None	Trace	8.49	0.35	66.7	gpm
0230	" "	nearly clear	None	Trace	8.49	0.32	66.5	~33gpm
0245	800-840	clear	None	Trace	8.49	0.33	66.5	
0315	800-840	nearly clear	None	None	8.51	0.33	65.8	33 gpm
0325	Trip out	2 joints	E	allow	recharge			OFF 760-800
0340	—	—	—	—	—	—	—	Resume airlift
0345	760-800	LT brown	None	0.4	8.54	0.34	64.2	30gpm est
0400	" "	LT brown	None	0.2	8.53	0.34	65.3	24gpm

Additional Comments:

CLEAR CREEK ASSOCIATES

SWAB AND AIR-LIFT DEVELOPMENT FIELD DATA LOG

Project Name: Resolution Copper	Project No.: 31300/
Well No.: HRES-20	Date: 12/8/12
Location: Superior/RCM	Geologist: GSM
Total Depth of Well (ft bls): 1037'	Measuring Point (M. P.): Casing/Pipe, Parameters - Baffle
Screen Interval (ft bls): 582-1037'	Distance from ground level to M. P.: 4.35'
	SWL-647'

Time	Depth Interval (ft)	Color	Odor	Sand Content (ml/l)	pH	Sp. Cond. ~~(µs/cm)~~ mS	Temp. (°F)	Comments
0415	760-800	Clear	None	Trace	8.52	0.33	65.3	
0430	760-800	nearly clear	None	none	8.53	0.33	65.4	
0445	" "	Clear	None	none	8.53	0.33	65.3	
0500	TRP out 2 joints & allow recharge							off. 720-760
0520	720-760	LT brown	None	0.2	8.64	0.34	59.4	* Minimal discharge
0540	720-760	nearly clear	None	None	8.65	0.34	59.7	Q-trace
0600	720-760	nearly clear	None	Trace	8.53	0.33	59.3	
0608	TRP IN	40'	—	—	—	—	—	OFF
0615	760-800	—	—	—	—	—	—	Resume Airlift
0620								

Additional Comments:

* Minimal discharge noted during airlifting of 720-760. Swab to halfway for 3 long towers (740-760')

CLEAR CREEK ASSOCIATES

WELL DEVELOPMENT FIELD DATA LOG

Project Name: Resolution Copper Well install	Project No.: 313001
Well No.: 55-721850 (QV-5)	Date: 12/14/12
Location: Queen Valley AZ	Measuring Point:
Total Depth of Well (ft bls): 565 open end	Screen Interval (ft bls): 145-565
Pump Type/Setting (ft bls): Dual wall drill pipe, multiple set	Development Type: Airlift
How Q Measured: Estimate	Geologist: RM

Time	Discharge (gpm)	Pumping Water Level (ft)	Specific Capacity (gpm/ft)	Sand Content (ml)	pH	Sp. Cond. (µs/cm) ~~mS/cm~~	Temp. °F °C	Comments
1430								Airlifting at 180, hole evacuated settling lower.
1500	~40			0	7.89	~~0.936~~ ~~0.888~~	18.71	Intake set at 200' cloudy, slight tan
1515	~40			0	8.07	741	19.70	
1530	~40			0	8.07	747	19.88	colorless, cloudy (Air)
1545	~100			0	8.06	740	19.79	Set at 380' 6/s
1600	~100			0	8.08	744	20.15	cloudy, colorless
1615	~100			0	8.08	752	20.17	" "
1630	~125			0	8.06	736	19.83	Intake set at 400' 6/s.
1645	~125			0	8.07	741	19.88	
1700	~180			0	8.06	731	19.34	Intake at ~500' 6/s
1715	~180			0	8.07	735	19.81	
1730	~180			0	8.06	733	19.22	
1745	~210			0	8.05	732	19.27	Intake set at 555' 6/s.
1800	~210			0	8.06	732	19.28	
1815	~210			0	8.06	735	19.34	
1830	~210			0	8.04	740	19.58	Colorless, cloudy
1845	~210			0	8.05	737	19.39	

Additional Comments:

PLATE 1

HRES-19 GEOPHYSICAL LOGS

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-19 (ADWR 55-914789)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: CALIPER-GAMMA RAY
MORE: FLUID TEMP/RESIS

LOCATION
D(2-13)8AAA

SEC 8 TWP 2S RGE 13E

OTHER SERVICES
OBI
ABI
E-LOGS
SONIC

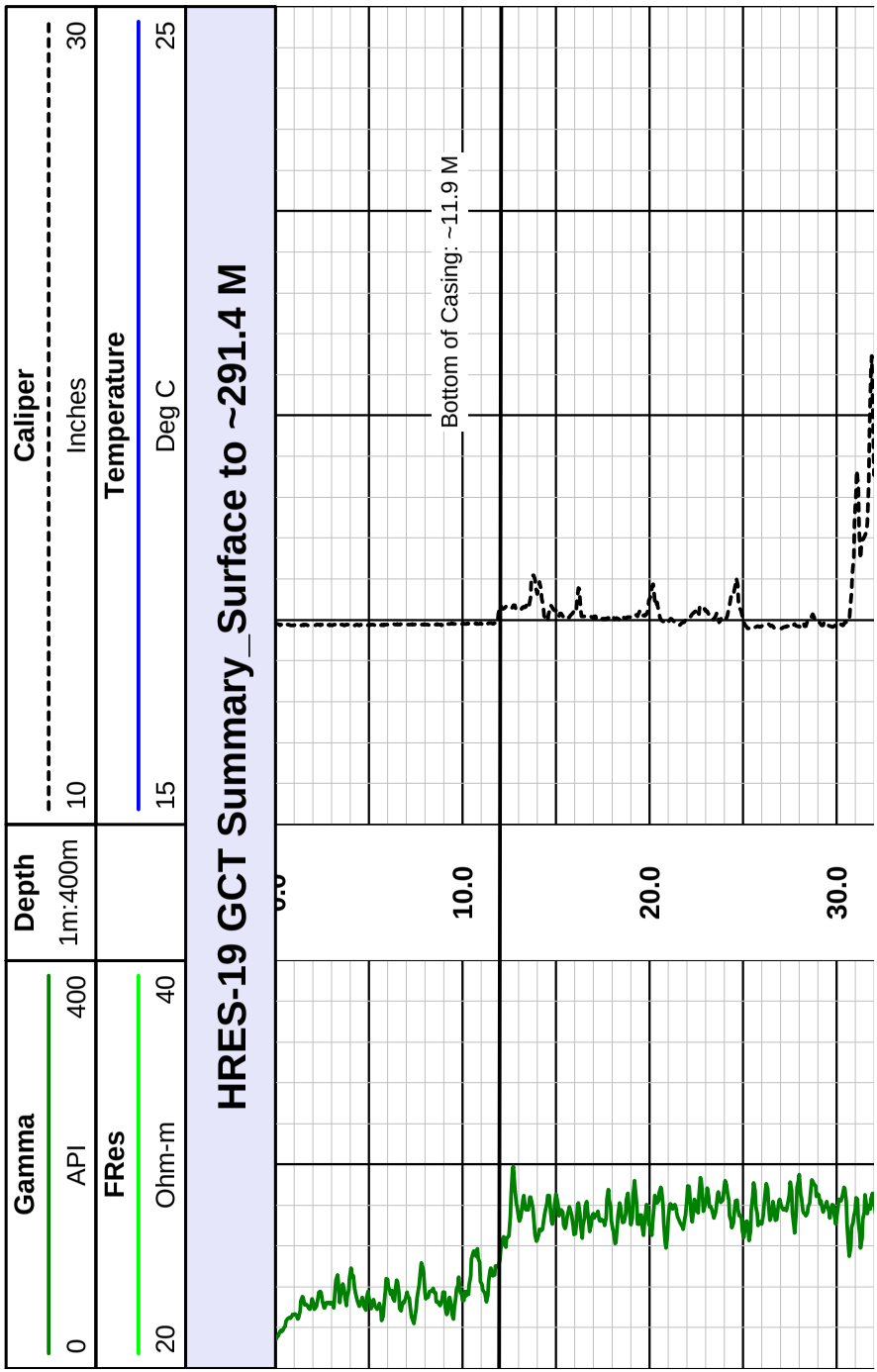
PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

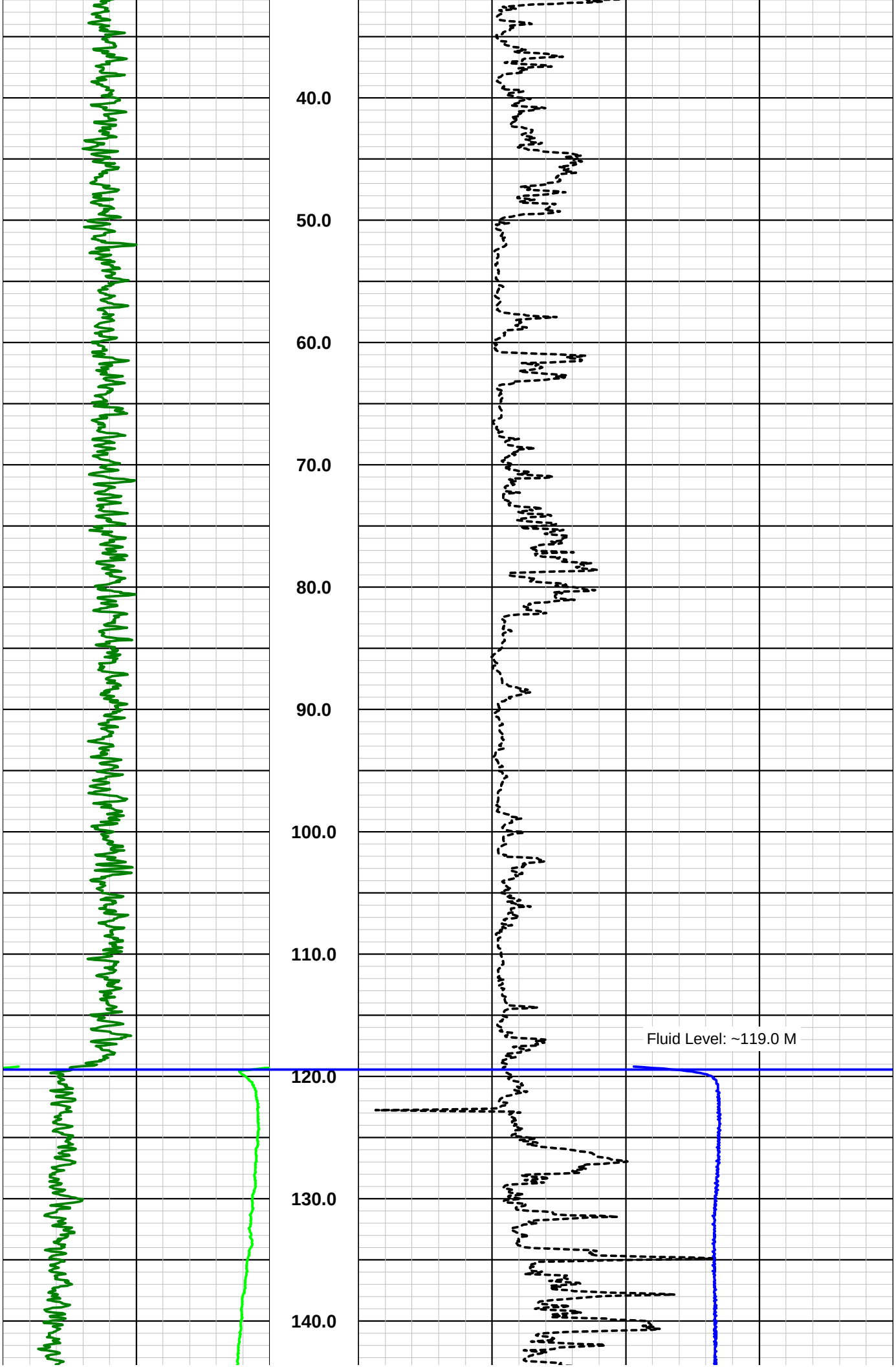
DATE	11-4-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	GAMMA-CALIPER-TEMP	DENSITY	N/A
DEPTH-DRILLER	291.5 M	LEVEL	119.2 M
DEPTH-LOGGER	291.5 M	MAX. REC. TEMP.	23.5 DEG C
BTM LOGGED INTERVAL	291.5 M	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	SURFACE	SAMPLE INTERVAL	.2 FT
DRILLER / RIG#	BOART LONGYEAR	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	MSI 2PCA-PGA-F SN4953
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	7:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	20"	SURFACE	11.9 M	15 3/4"	HWT	SURFACE	11.9 M
2	14 3/4"	11.9 M	TD				
3							

COMMENTS:

.

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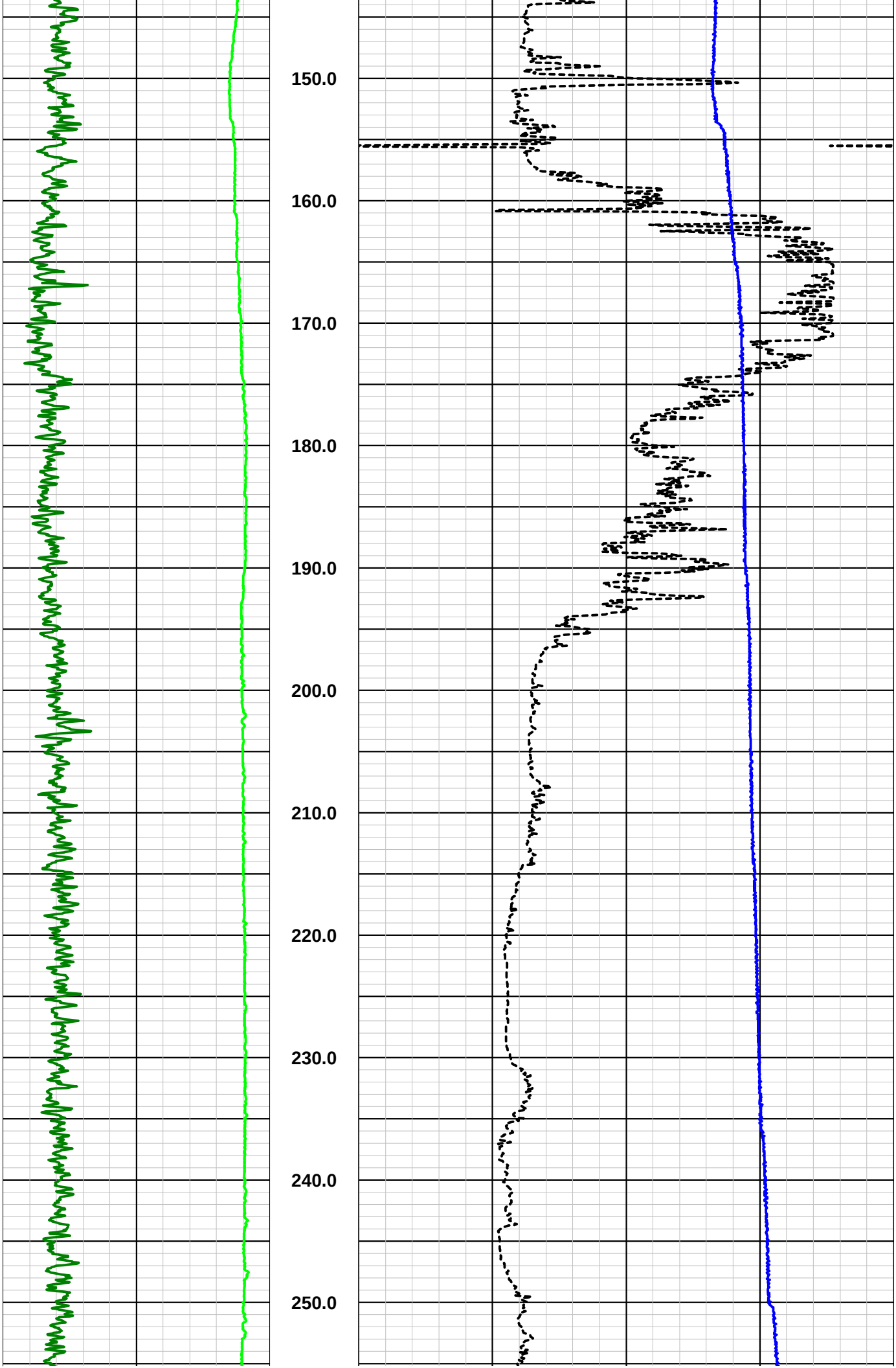
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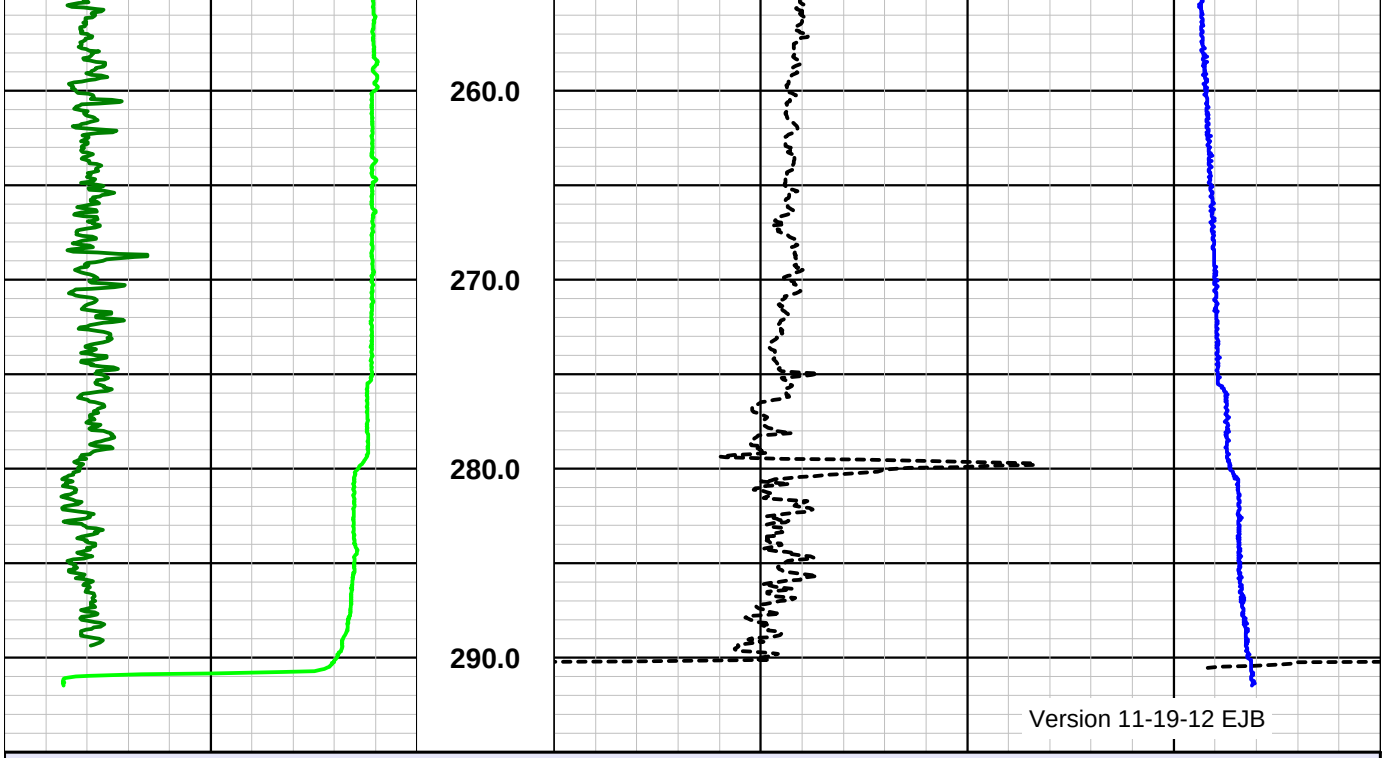

HRES-19 GCT Summary_Surface to ~291.4 M

FRes		Temperature
20 Ohm-m 40		15 Deg C 25
Gamma	**Depth**	**Caliper**
0 API 400	1m:400m	10 Inches 30

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-19 (ADWR 55-914789)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: E-LOGS

MORE:

LOCATION
D(2-13)8AAA

SEC 8 TWP 2S RGE 13E

OTHER SERVICES
CALIPER
TEMP/FLUID RES
OBI
ABI
SONIC

PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

DATE	11-4-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	ELOGS	DENSITY	N/A
DEPTH-DRILLER	291.5 M	LEVEL	119.2 M
DEPTH-LOGGER	291.5 M	MAX. REC. TEMP.	23.5 DEG C
BTM LOGGED INTERVAL	291.5 M	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	119.2 M	SAMPLE INTERVAL	.2 FT
DRILLER / RIG#	BOART LONGYEAR	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	40 GRP SN 5019
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	7:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	20"	SURFACE	11.9 M	15 3/4"	HWT	SURFACE	11.9 M
2	14 3/4"	11.9 M	TD				
3							

COMMENTS:

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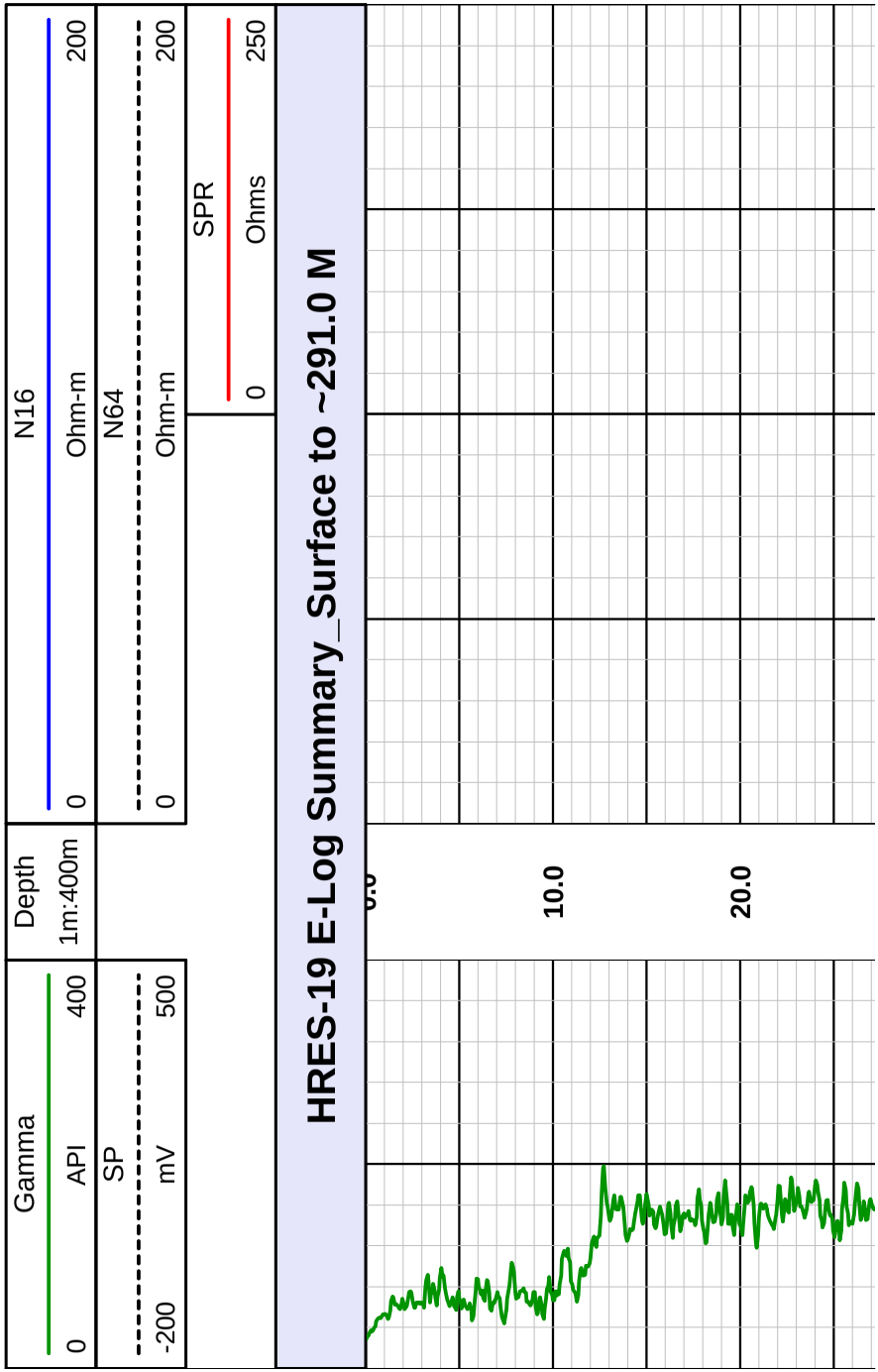

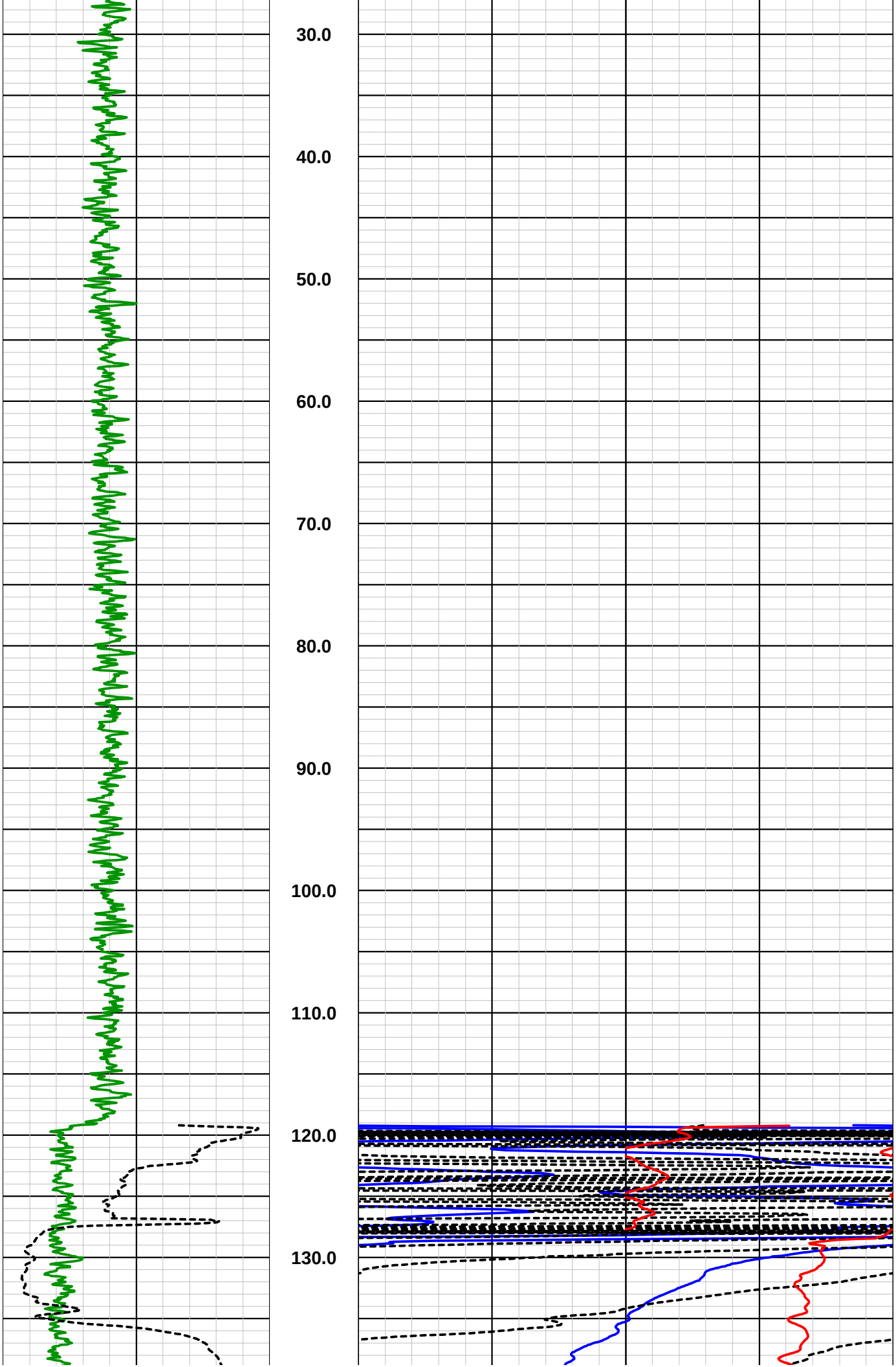
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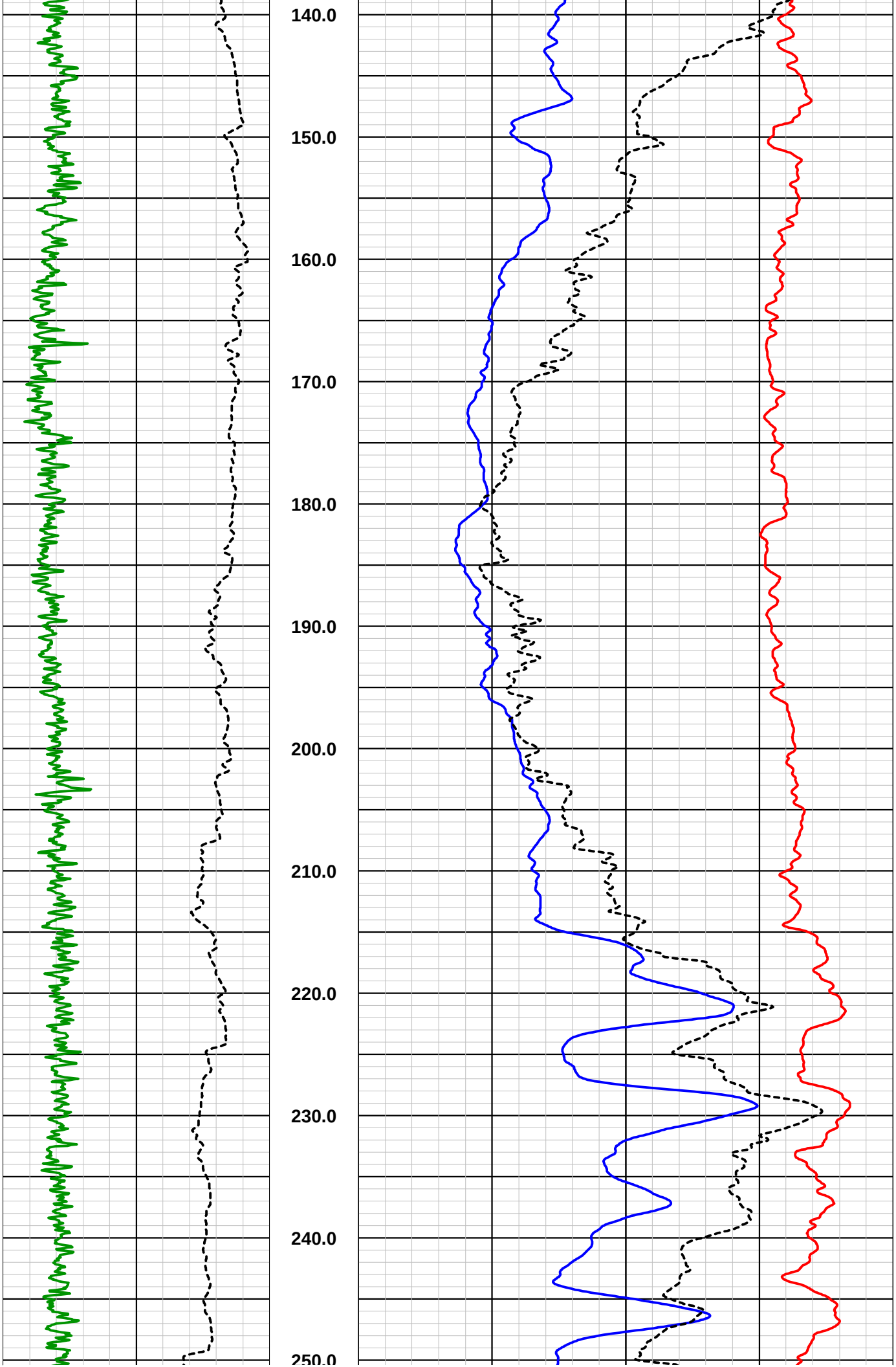
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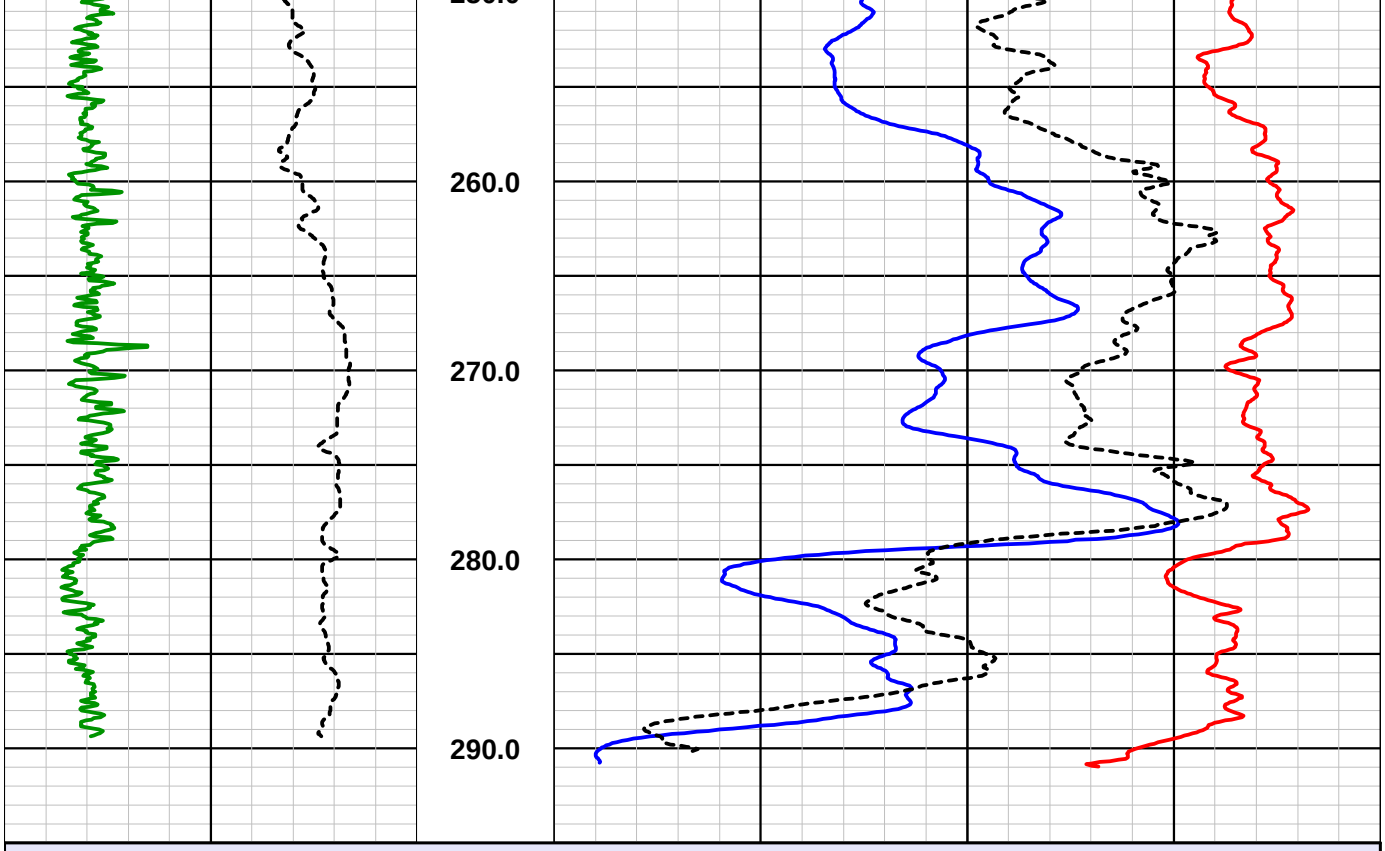

HRES-19 E-Log Summary_Surface to ~291.0 M

		SPR 0 Ohms 250
SP -200 mV 500		N64 0 Ohm-m 200
Gamma 0 API 400	Depth 1m:400m	N16 0 Ohm-m 200

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-19 (ADWR 55-914789)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: SONIC 4 RX
MORE: GAMMA-CALIPER

LOCATION
D(2-13)8AAA

SEC 8 TWP 2S RGE 13E

OTHER SERVICES
TEMP/FLUID RES
OBI
ABI
E-LOGS

PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

DATE	11-4-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	SONIC 4RX-GAMMA-CALIPER	DENSITY	N/A
DEPTH-DRILLER	291.5 M	LEVEL	119.2 M
DEPTH-LOGGER	291.5	MAX. REC. TEMP.	23.5 DEG C
BTM LOGGED INTERVAL	291.5	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	119.2 M	SAMPLE INTERVAL	.25 FT
DRILLER / RIG#	BOART LONGYEAR	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	ALT SONIC 4RX SN 4572
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	7:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	20"	SURFACE	11.9 M	15 3/4"	HWT	SURFACE	11.9 M
2	14 3/4"	11.9 M	TD				
3							

COMMENTS:

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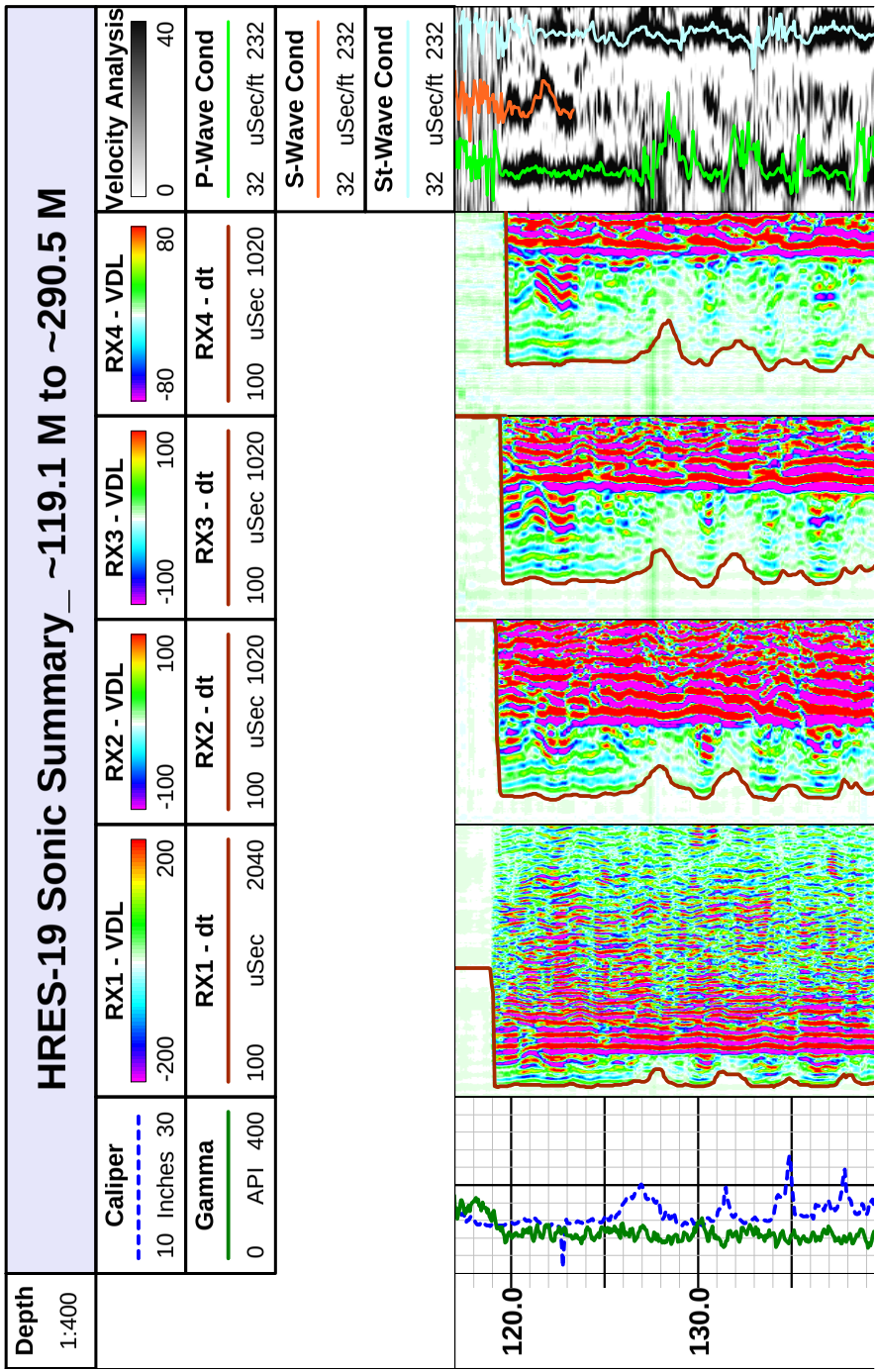

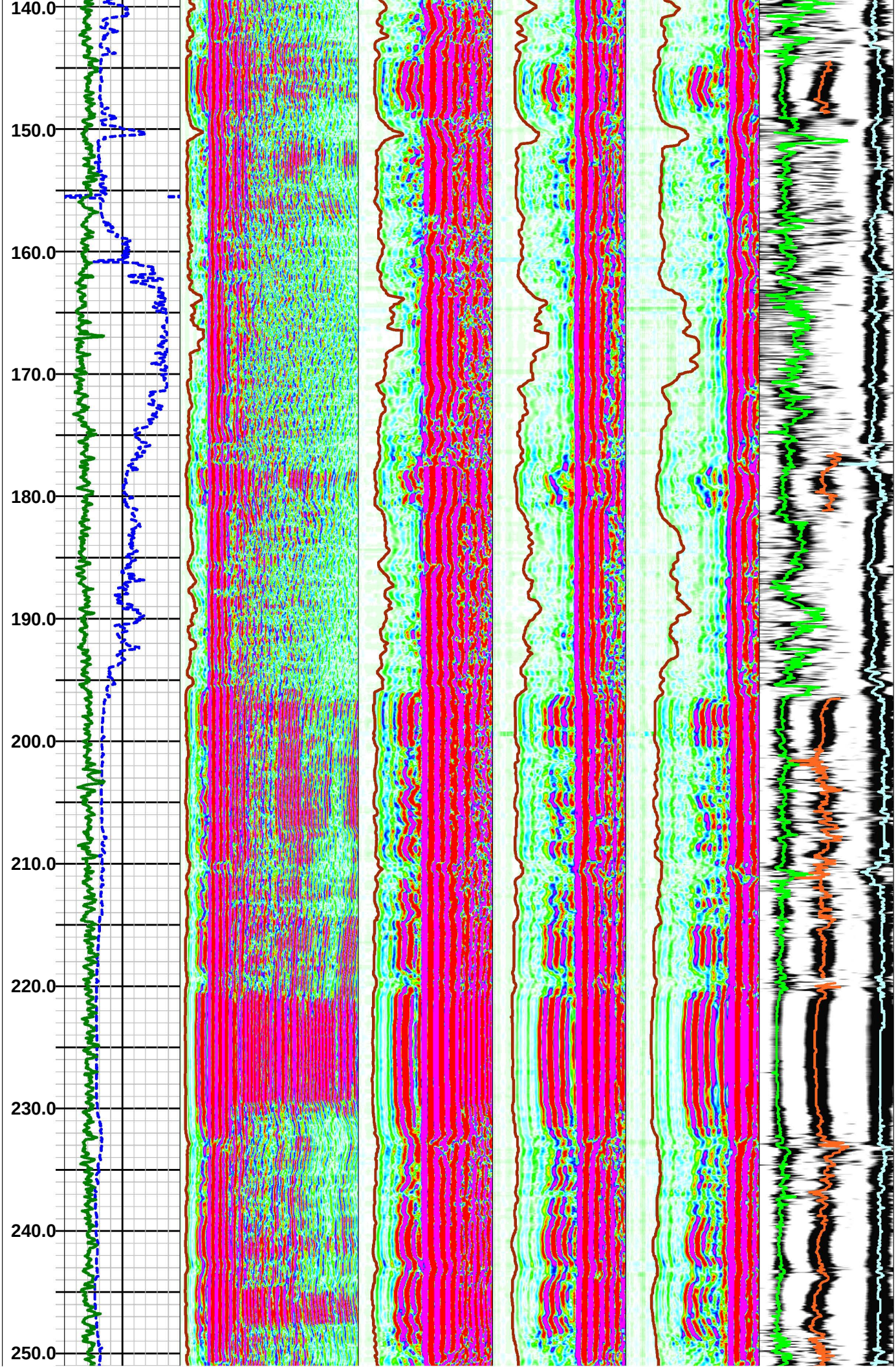
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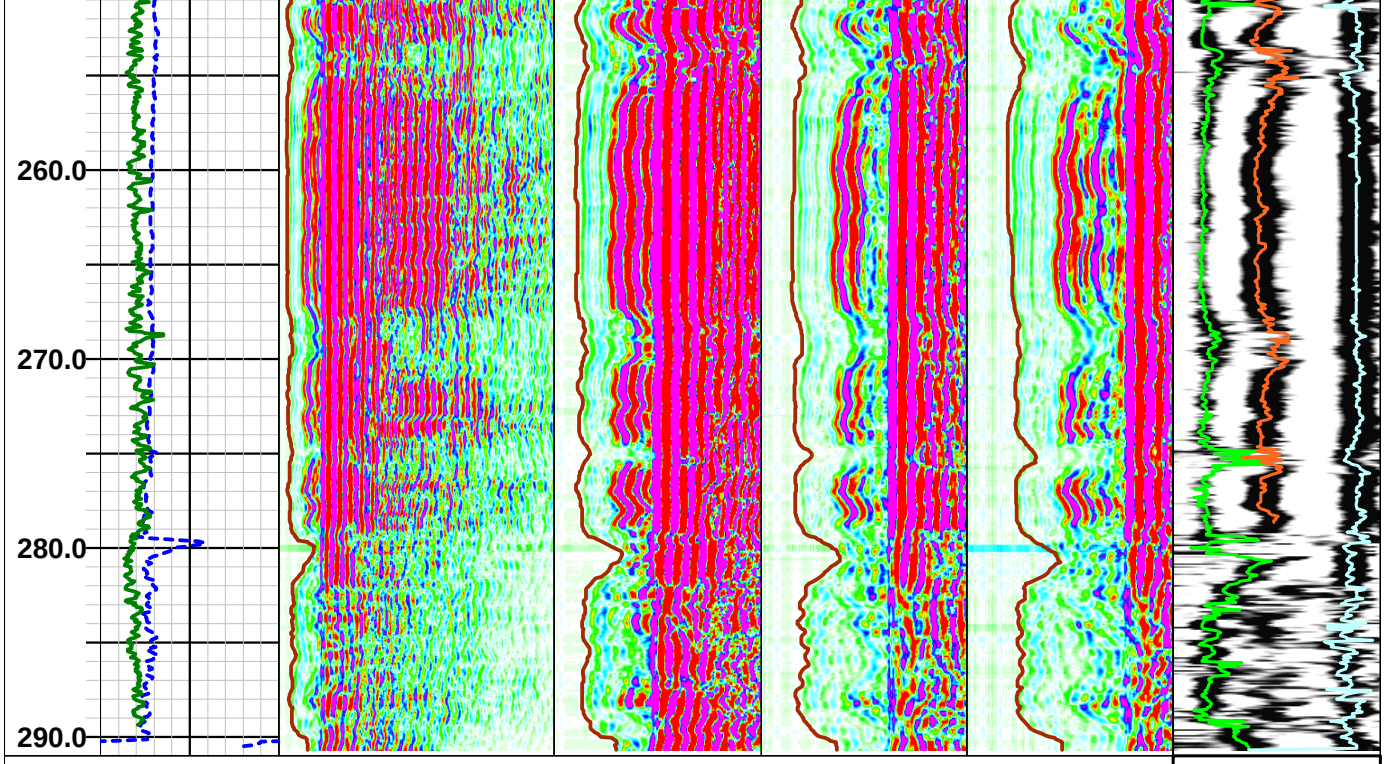

						St-Wave Cond 32 uSec/ft 232
						S-Wave Cond 32 uSec/ft 232
	Gamma 0 API 400	RX1 - dt 100 uSec 2040	RX2 - dt 100 uSec 1020	RX3 - dt 100 uSec 1020	RX4 - dt 100 uSec 1020	P-Wave Cond 32 uSec/ft 232
	Caliper 10 Inches 30	RX1 - VDL -200 200	RX2 - VDL -100 100	RX3 - VDL -100 100	RX4 - VDL -80 80	Velocity Analysis 0 40
Depth 1:400	HRES-19 Sonic Summary_ ~119.1 M to ~290.5 M					

Full Waveform Sonic Summary Legend

Mnemonics and Comments

Gamma = Natural gamma ray log plotted from 0 to 400 API units (green line).

Caliper = 3-arm mechanical caliper of hole diameter plotted from 10-30 inches (blue line).

RX1 - VDL = Color variable density display of 0.6m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 2040 uSec.

RX1 - dt = P-wave travel time pick. Plotted 100 to 2040 uSec (brown line).

RX2 - VDL = Color variable density display of 0.8m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 1020 uSec.

RX2 - dt = P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).

RX3 - VDL = Color variable density display of 1.0m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 1020 uSec.

RX3 - dt = P-wave travel time pick - if determined. Plotted 100 to 1020 uSec (brown line).

RX4 - VDL = Color variable density display of 1.2m Rx waveform; stacked over 5 waveforms, and

plotted from 100 to 1020 uSec.

RX4 - dt = P-wave travel time pick - if determined. Plotted 100 to 1020 uSec (brown line).

Velocity Analysis = Gray scale variable density display of velocity semblence waveform of the stacked waveforms; plotted from 32 to 232 uSec/ft.

P-Wave-Cond = Apparent P-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft (green line).

S-Wave-Cond = Apparent S-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft - with conditional testing to remove invalid values (orange line).

St-Wave-Cond = Apparent Stoneley-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. - with conditional testing to remove invalid values (light blue line).

Prepared by Erika J Beam

Version 11-19-12

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-19 (ADWR 55-914789)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: OBI MK 4
MORE: 3- ARM CALIPER

LOCATION
D(2-13)8AAA

SEC 8 TWP 2S RGE 13E

OTHER SERVICES
GAMMA
TEMP/FLUID RES.
ABI
E-LOGS
SONIC

PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

DATE	11-4-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	OBI-40 - CALIPER	DENSITY	N/A
DEPTH-DRILLER	291.5 M	LEVEL	119.2 M
DEPTH-LOGGER	291.5 M	MAX. REC. TEMP.	23.5 DEG C
BTM LOGGED INTERVAL	141 M	IMAGE ORIENTED TO:	MAG NORTH
TOP LOGGED INTERVAL	11 M	SAMPLE INTERVAL	.0096 FT
DRILLER / RIG#	BOART LONGYEAR	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	ALT OBI40 MK 4 080903
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	7:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	20"	SURFACE	11.9 M	15 3/4"	HWT	SURFACE	11.9 M
2	14 3/4"	11.9 M	TD				
3							

COMMENTS:

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Major Lithology

- Apache Leap Tuff - Gray Unit
- Apache Leap Tuff - Brown Unit
- Basal Tuff - Vitrophyre
- Basal Tuff
- Transition Zone

Optical Image Features Legend

- Bedding / Banding / Foliation / Veins
- Filled Fracture / Joint
- Btm of Casing

Partially Open Joint / Fracture

Minor Open Joint / Fracture

OJ/Fx terminates at Fx intersection

Unclassified

Sulfide Vein

Breakouts

Major Open Joint / Fracture

Fluid Level

Bx & NVJts Legend

Breccia or Conglomerate

Large Vugs/Vesicles (> 6")

Medium Vugs/Vesicles (2-6")

Small Vugs/Vesicles (< 2")

Conglomerate - sand matrix supported

Conglomerate - mud matrix supported

Conglomerate - clast supported

Broken Zone / Undifferentiated

Major Breakout

Minor Breakout

Tensile Fracture

Filled Near Vertical Joint/Fx

Near Vertical Joint/Fx

HRES-19 OBI-40 Summary_ ~11.9 M to ~119.8 M

Depth 1m:20m

Caliper 10 30

Gamma 0 400

Image-NM Oriented Mag North 0° 90° 180° 270° 0°

Image_11 M - 20 M Rot'd by 23.0 deg 0° 90° 180° 270° 0°

OBI DIPA

NVJt

Bx

3D 0°

Tadpole DIPT 0 100

Mag Field 40 uT 60

Gravity 0.8 G 1.2

Tilt 0 Deg 10

Azi-Edited 0 360

Roll 0 360

MRoll 0 360

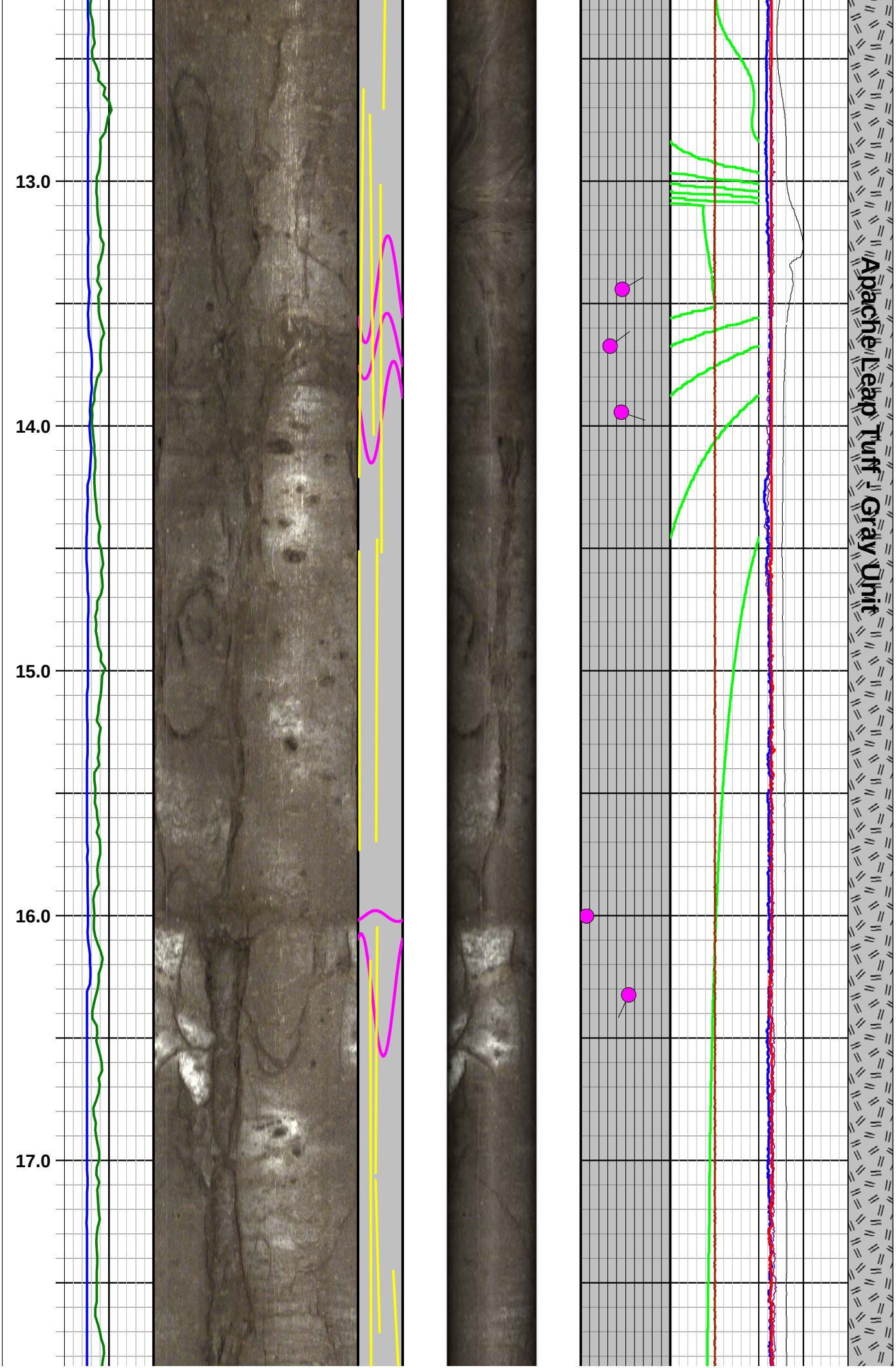
Lith

Desc

11.0

12.0

Bottom of Casing: 11.9 M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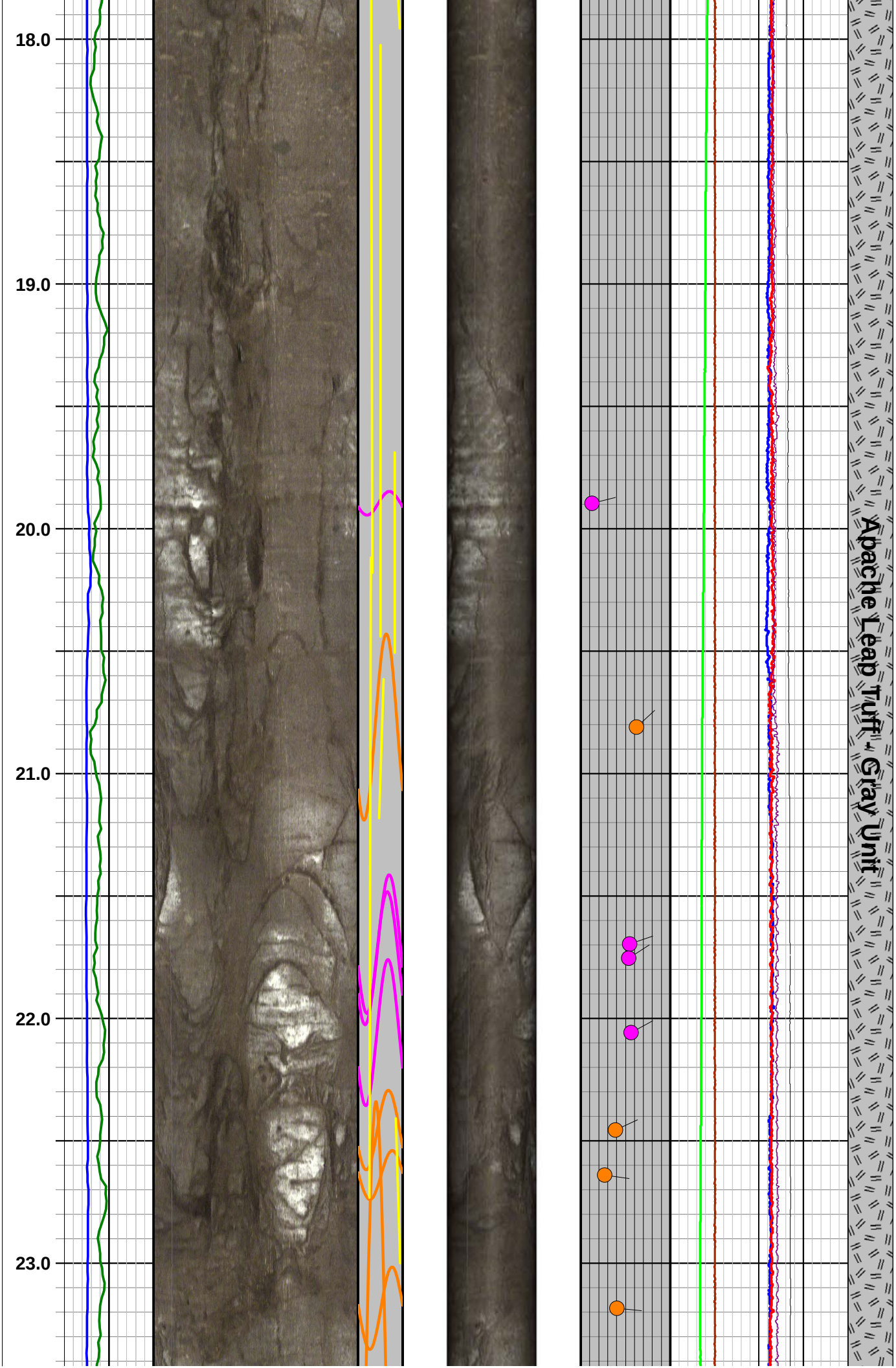
Apache Leap Tuff - Gray Unit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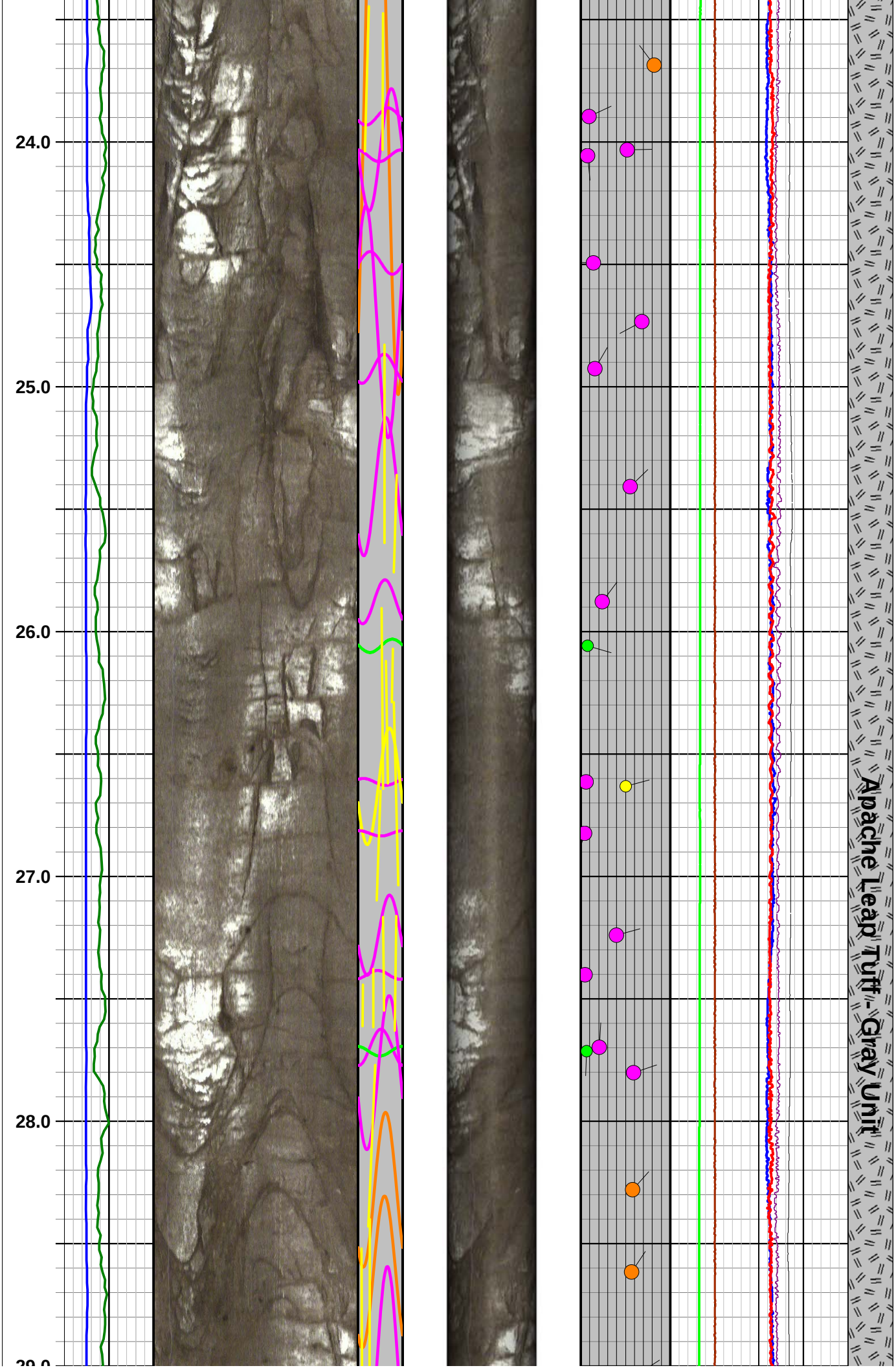
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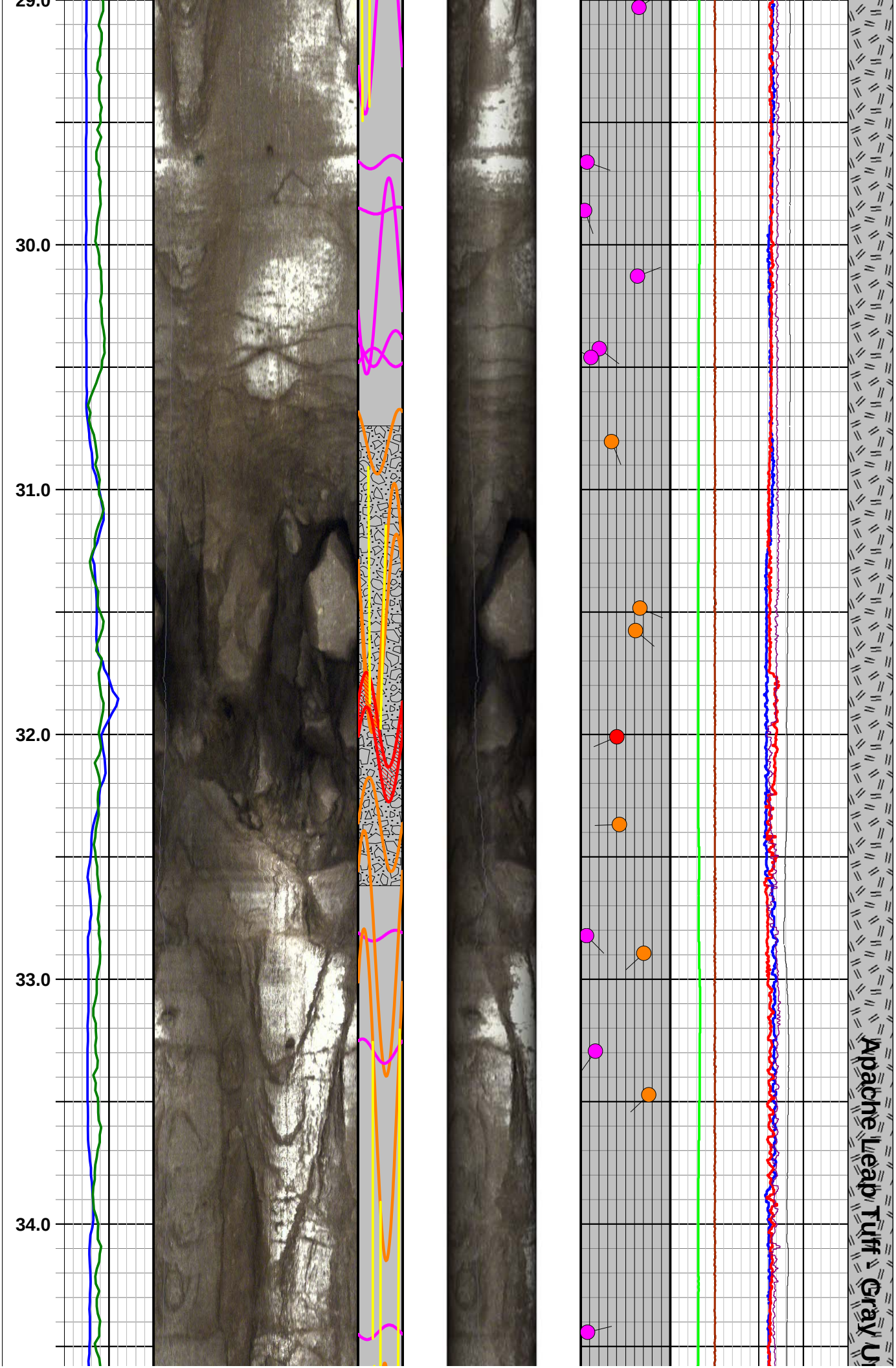
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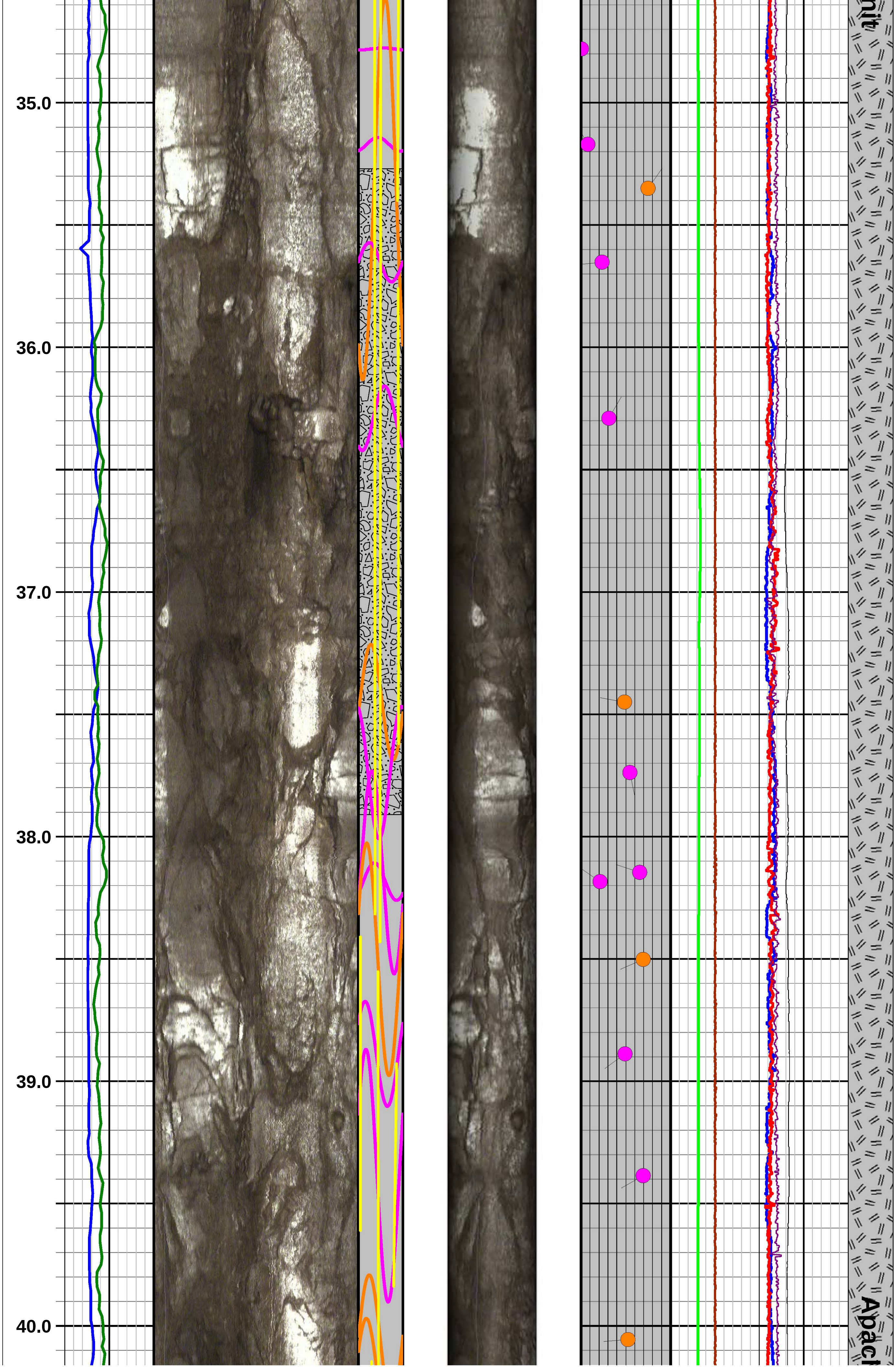
Apache Leap Tuff - Gray U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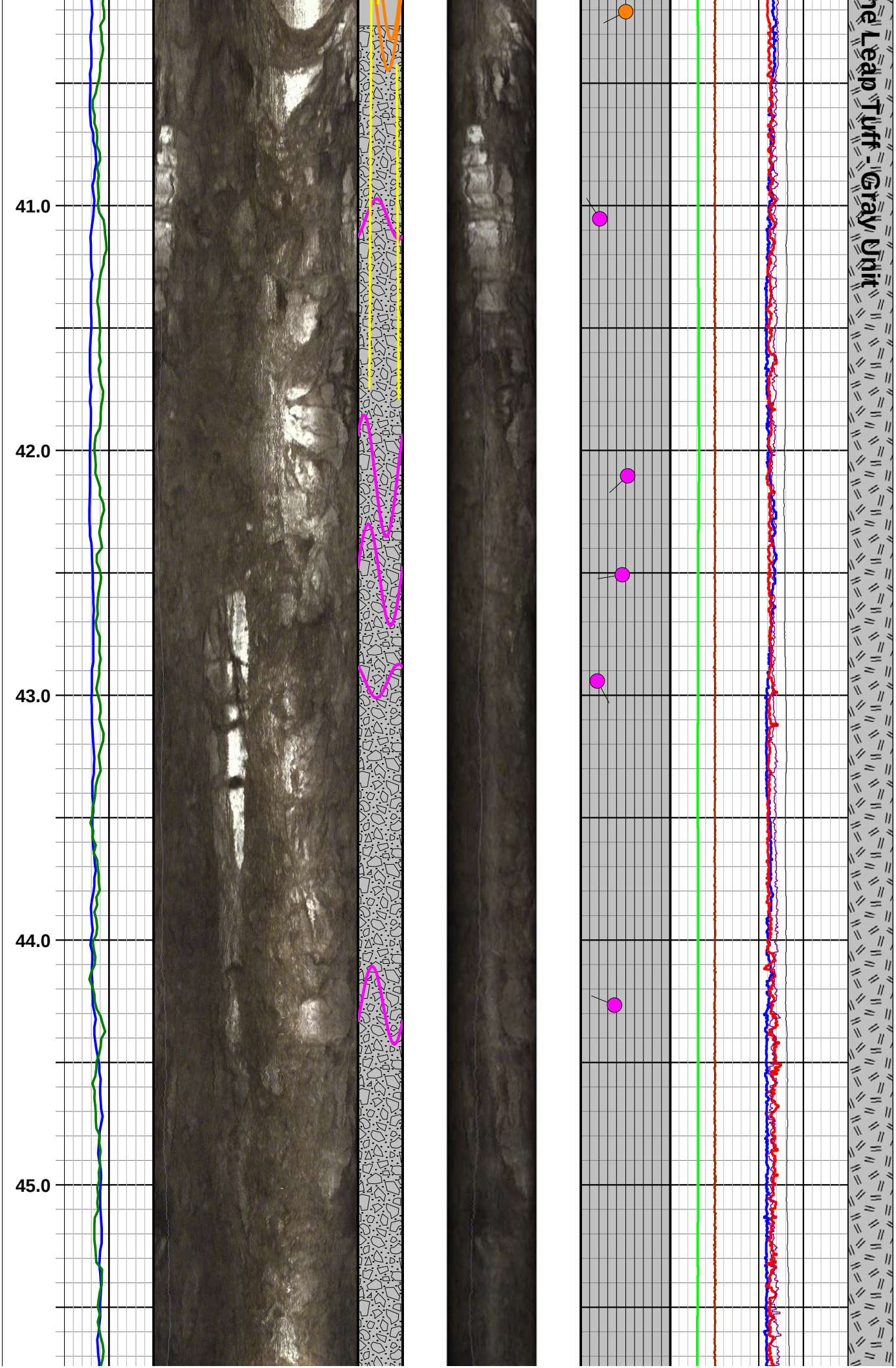
nit
Apach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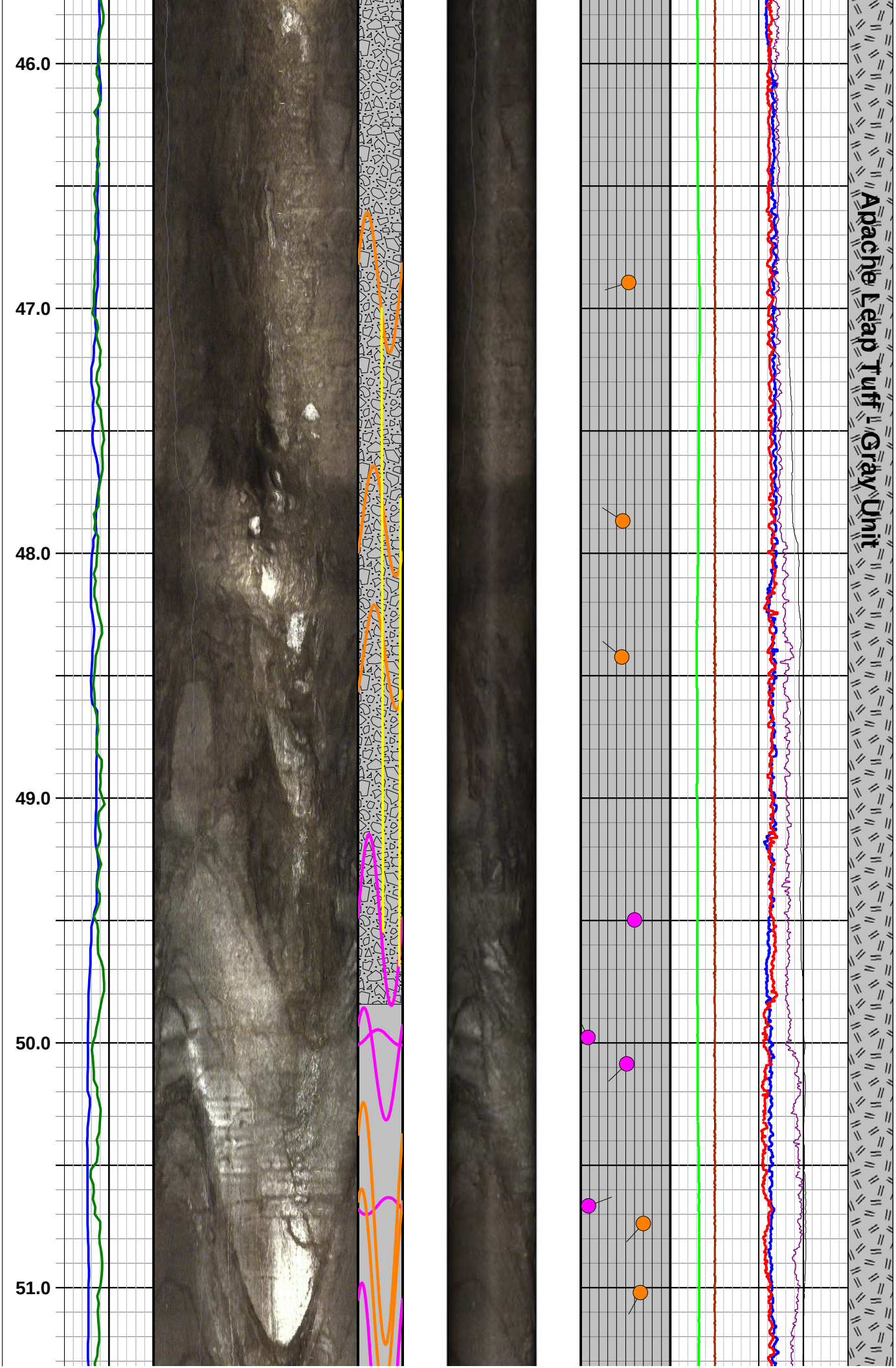
Leap Tuff - Gray Unit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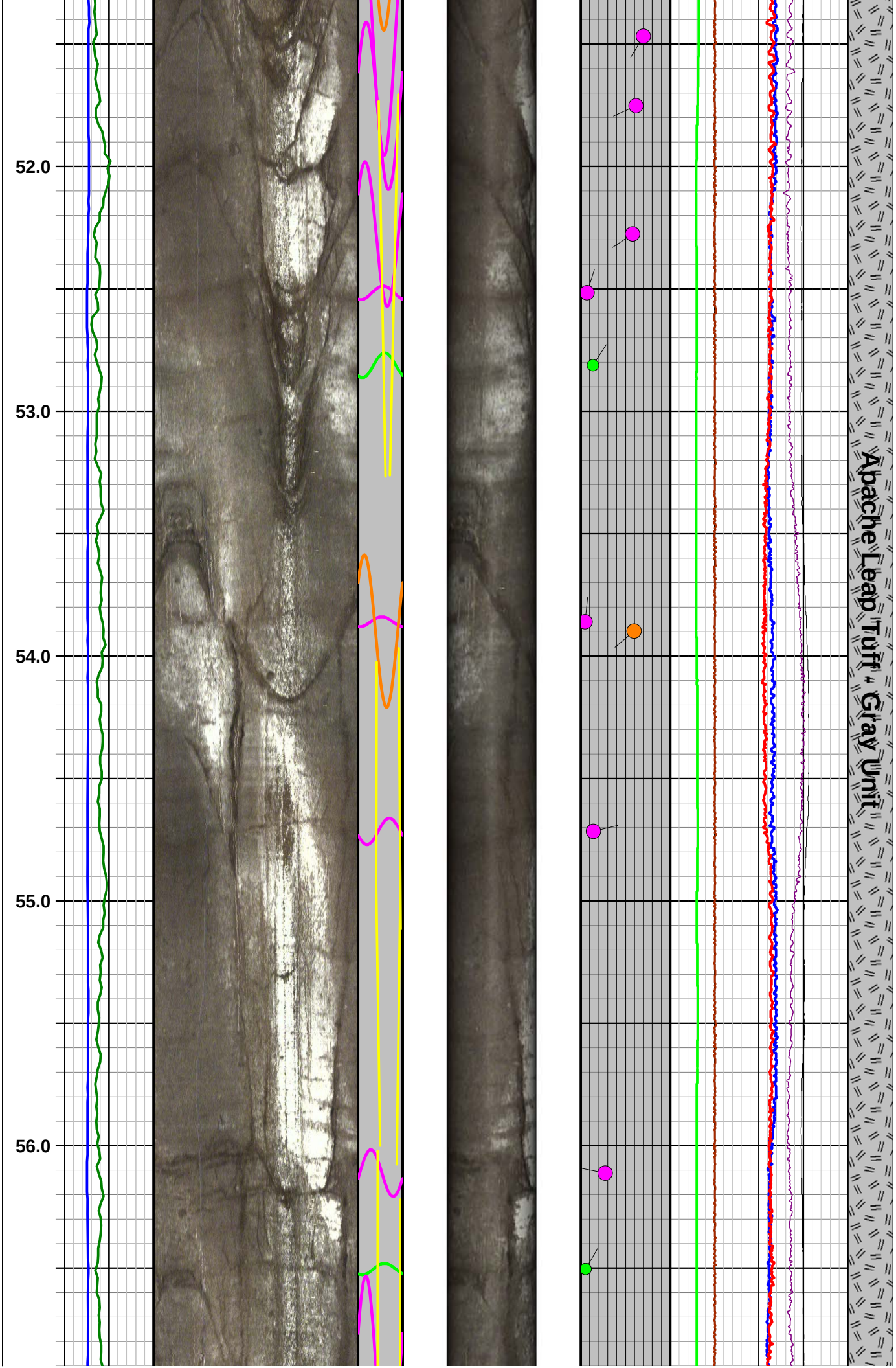
Apache Leap Tuff - Gray Unit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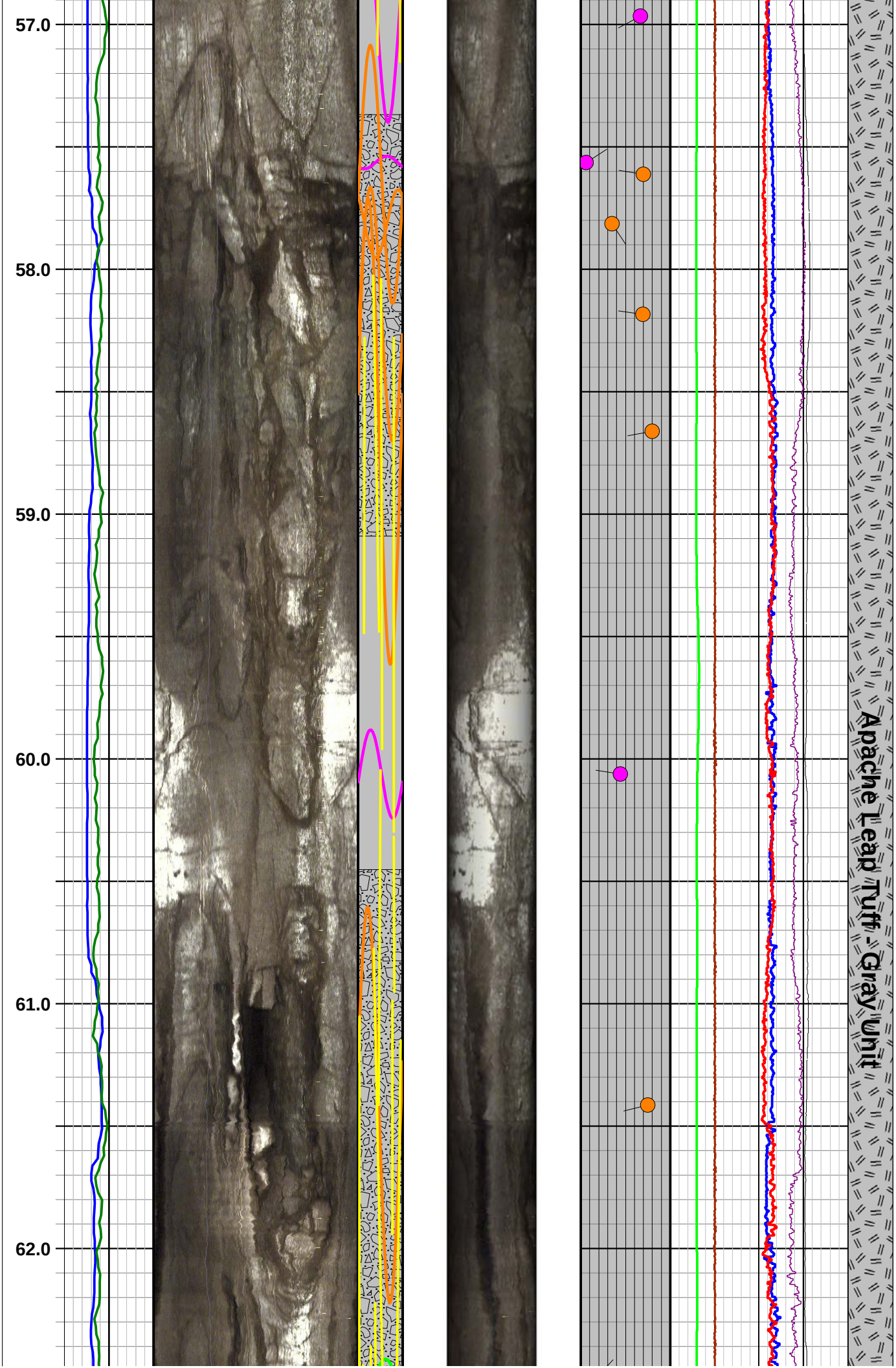
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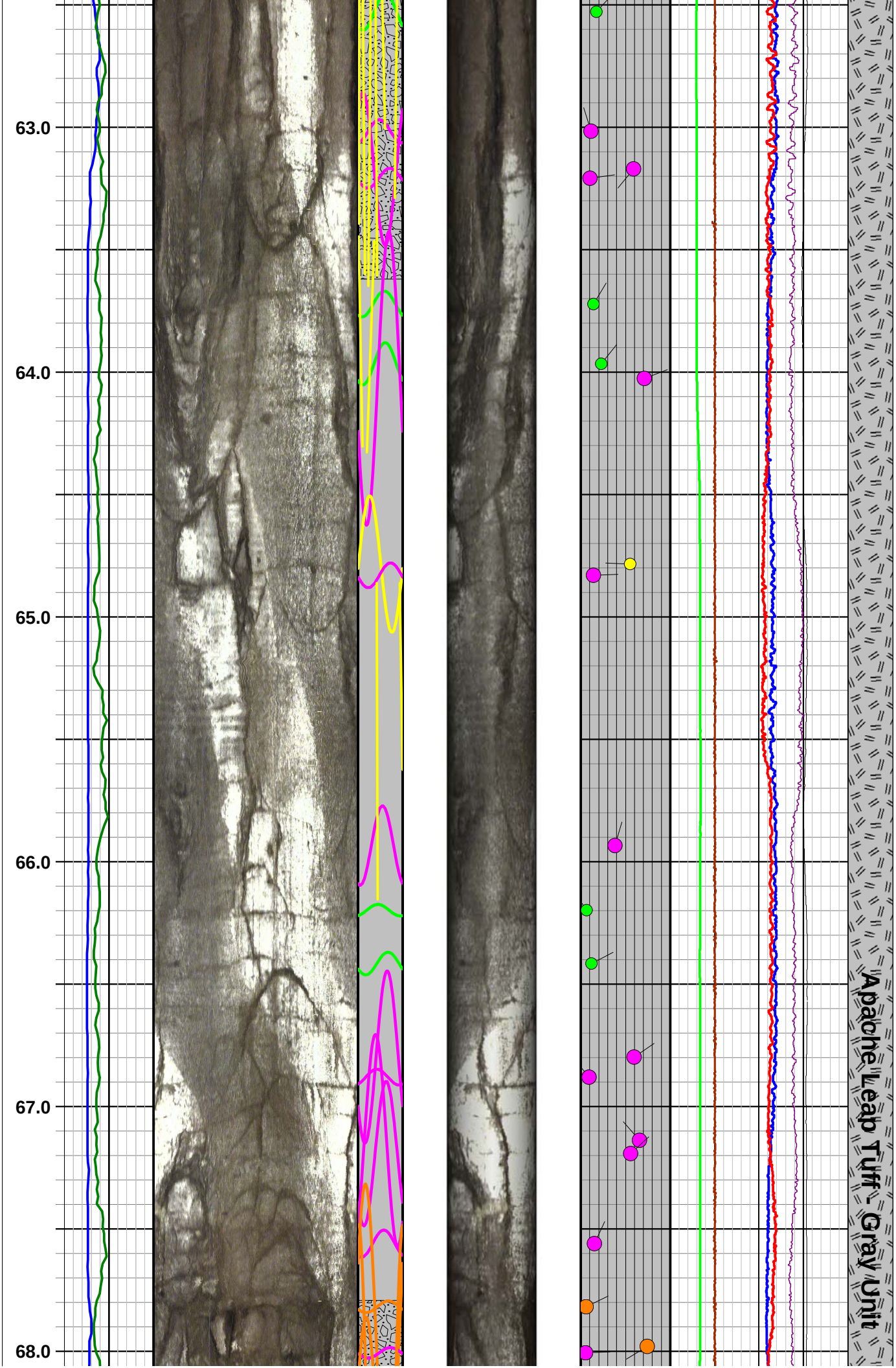
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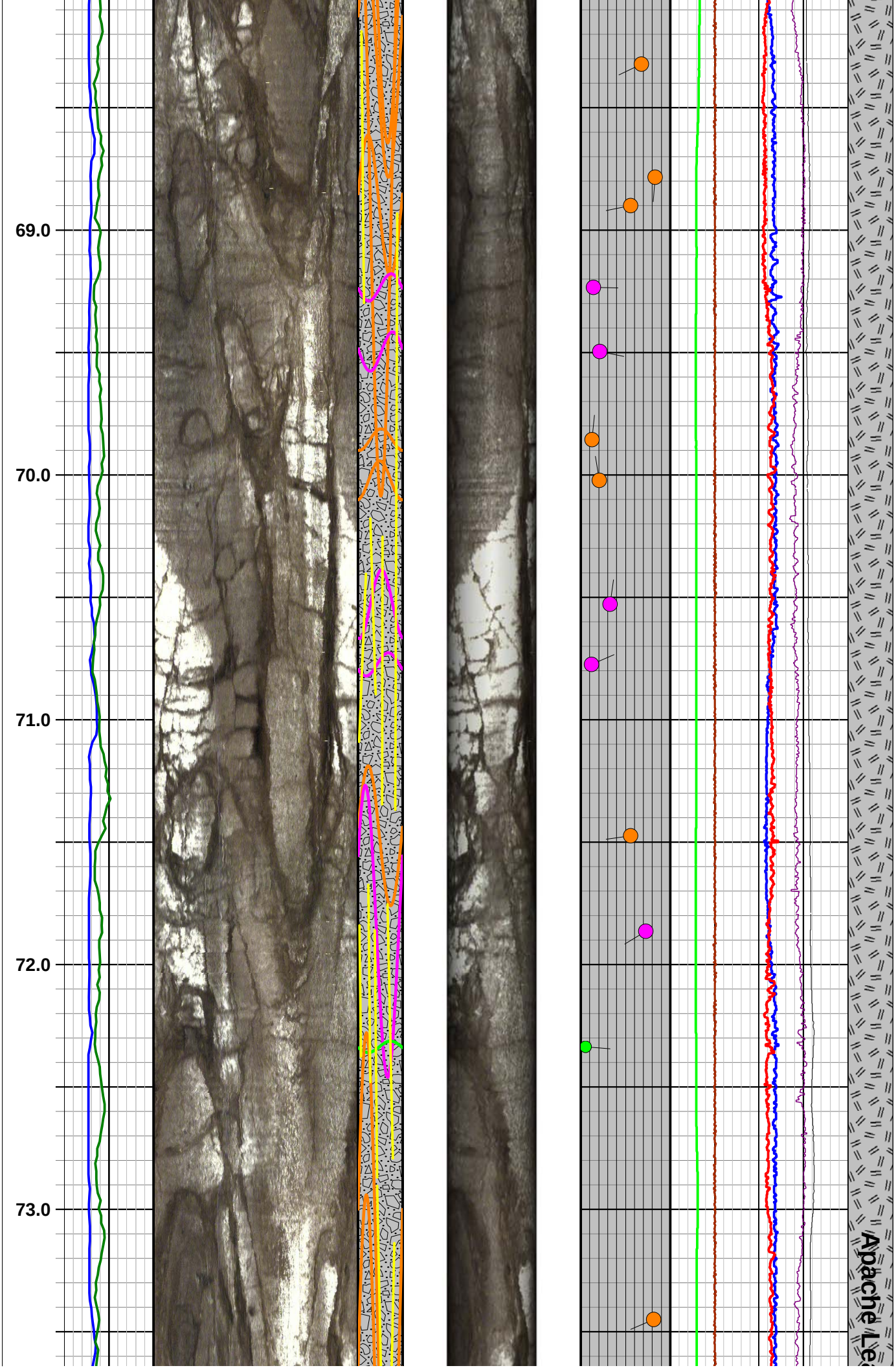
Apache Leap Tuff - Gray Unit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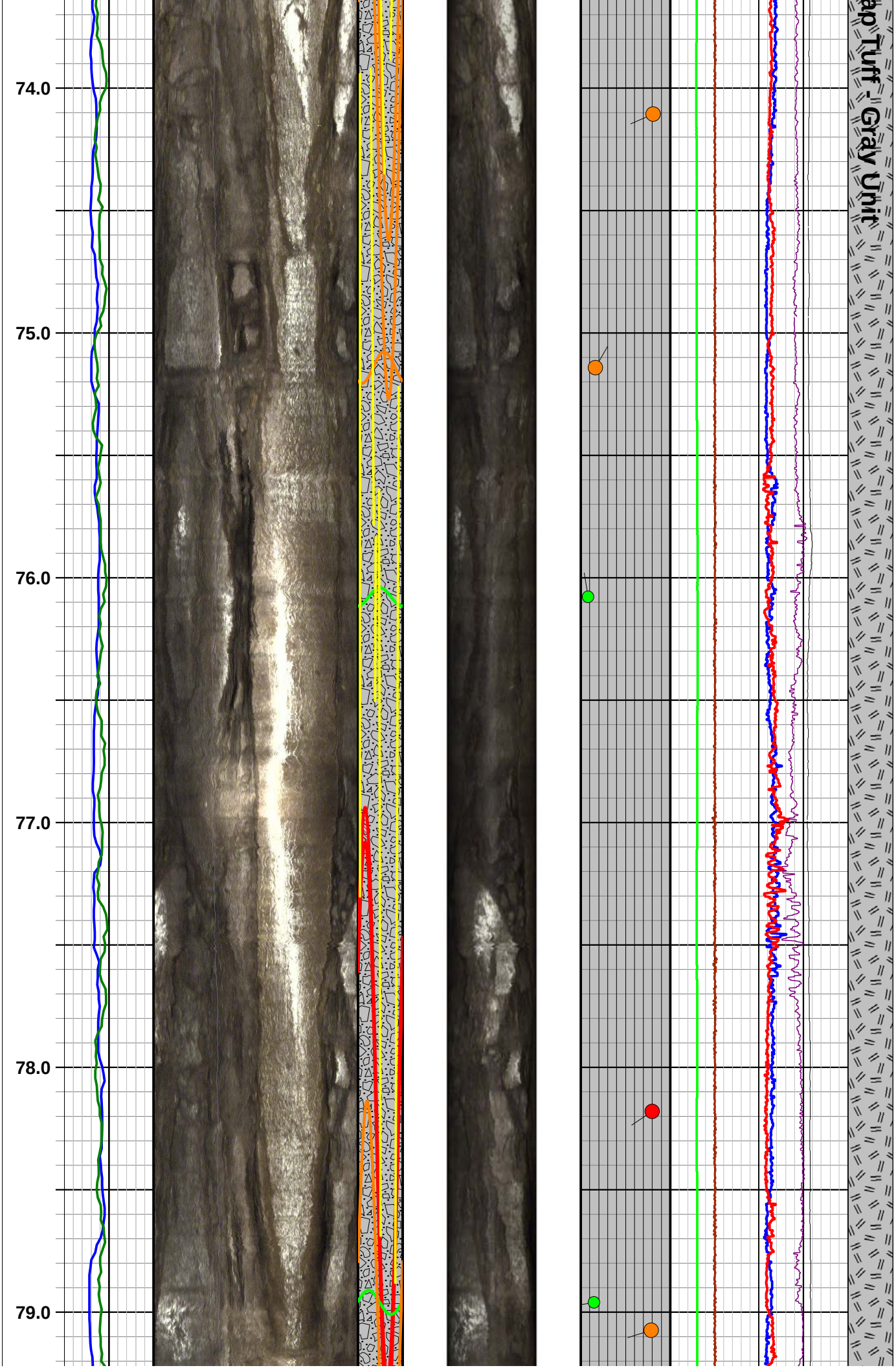
Apache Lea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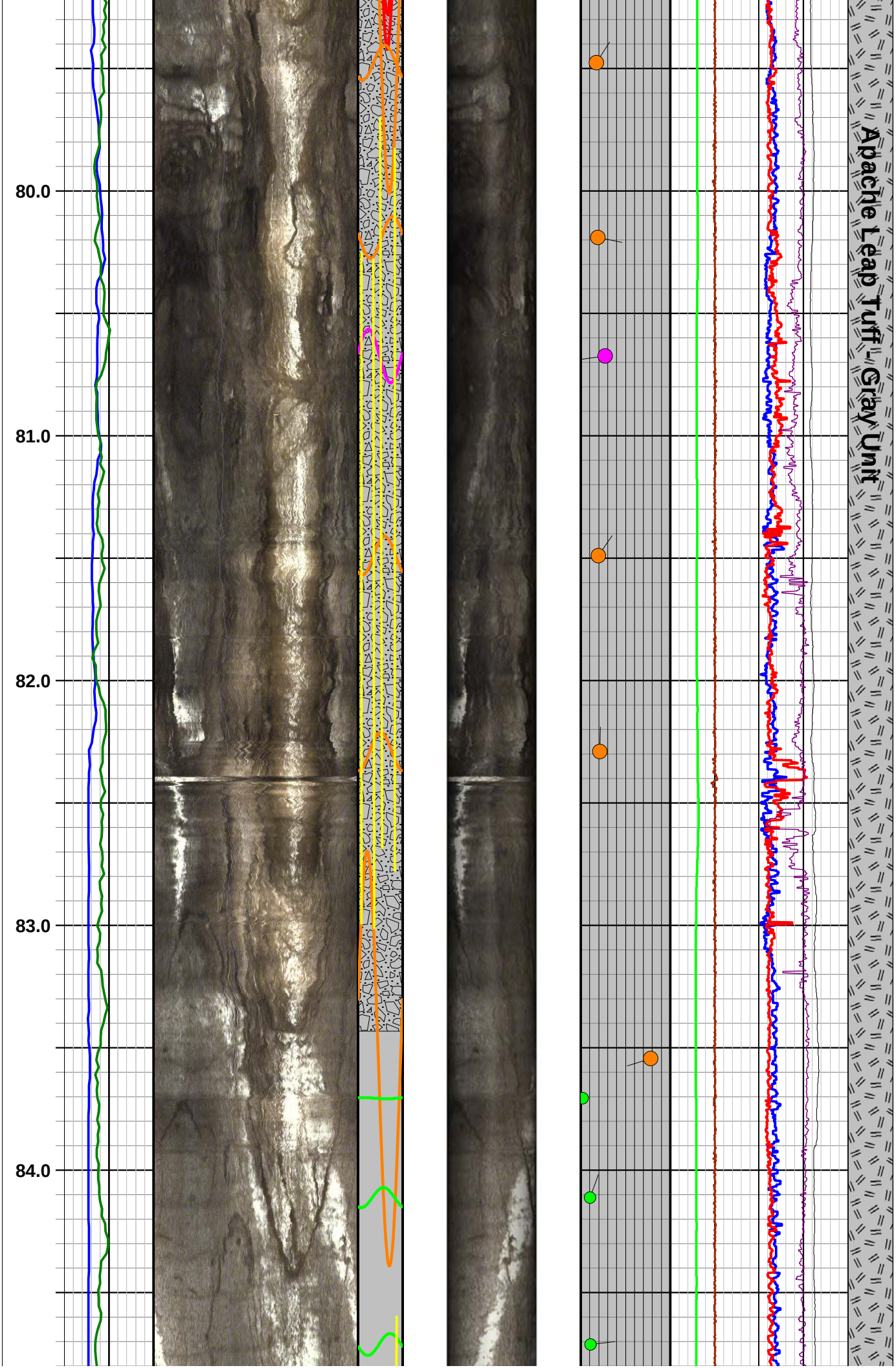
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83.0
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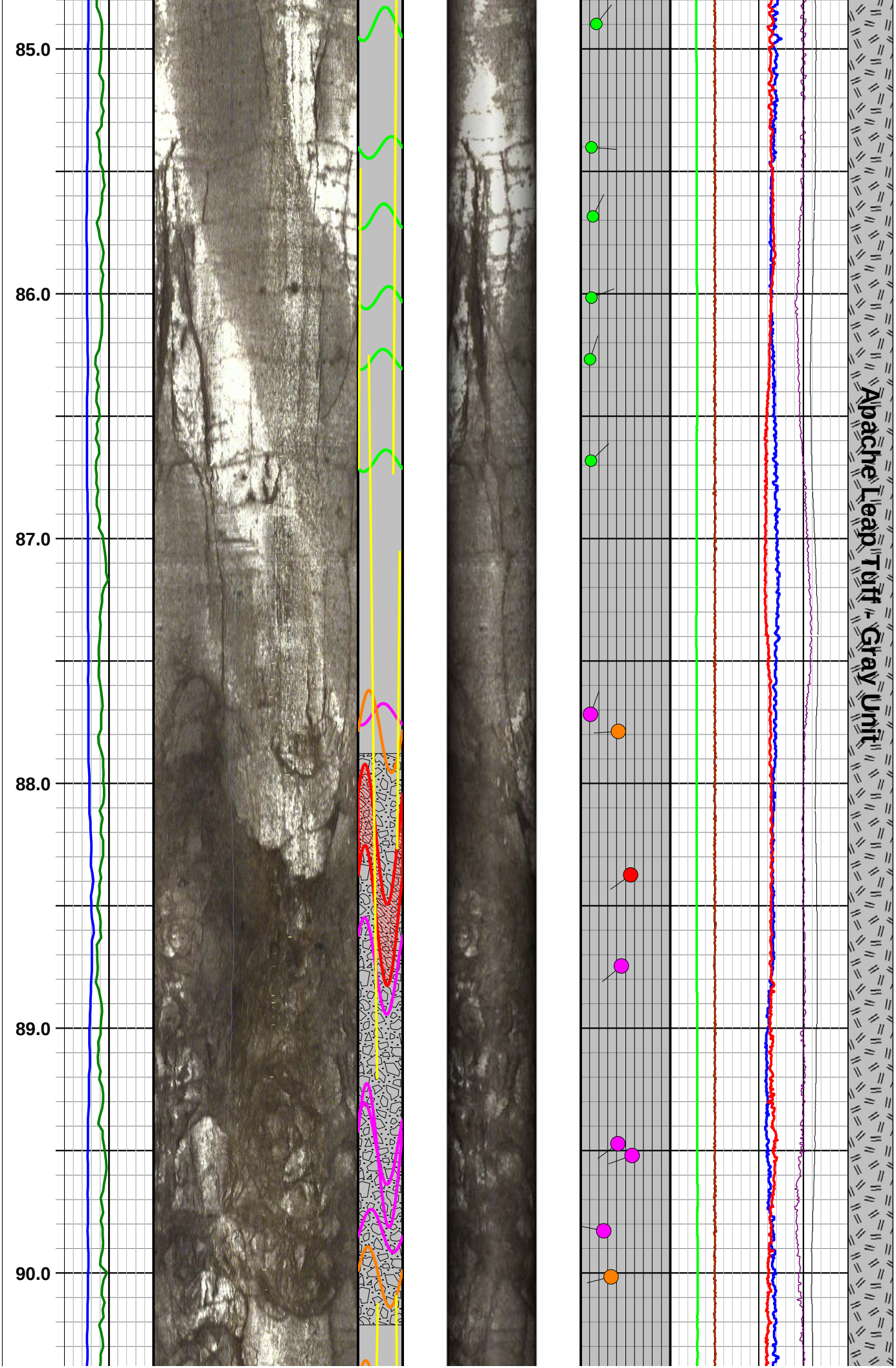
Apache Leap Tuff / Gray Unit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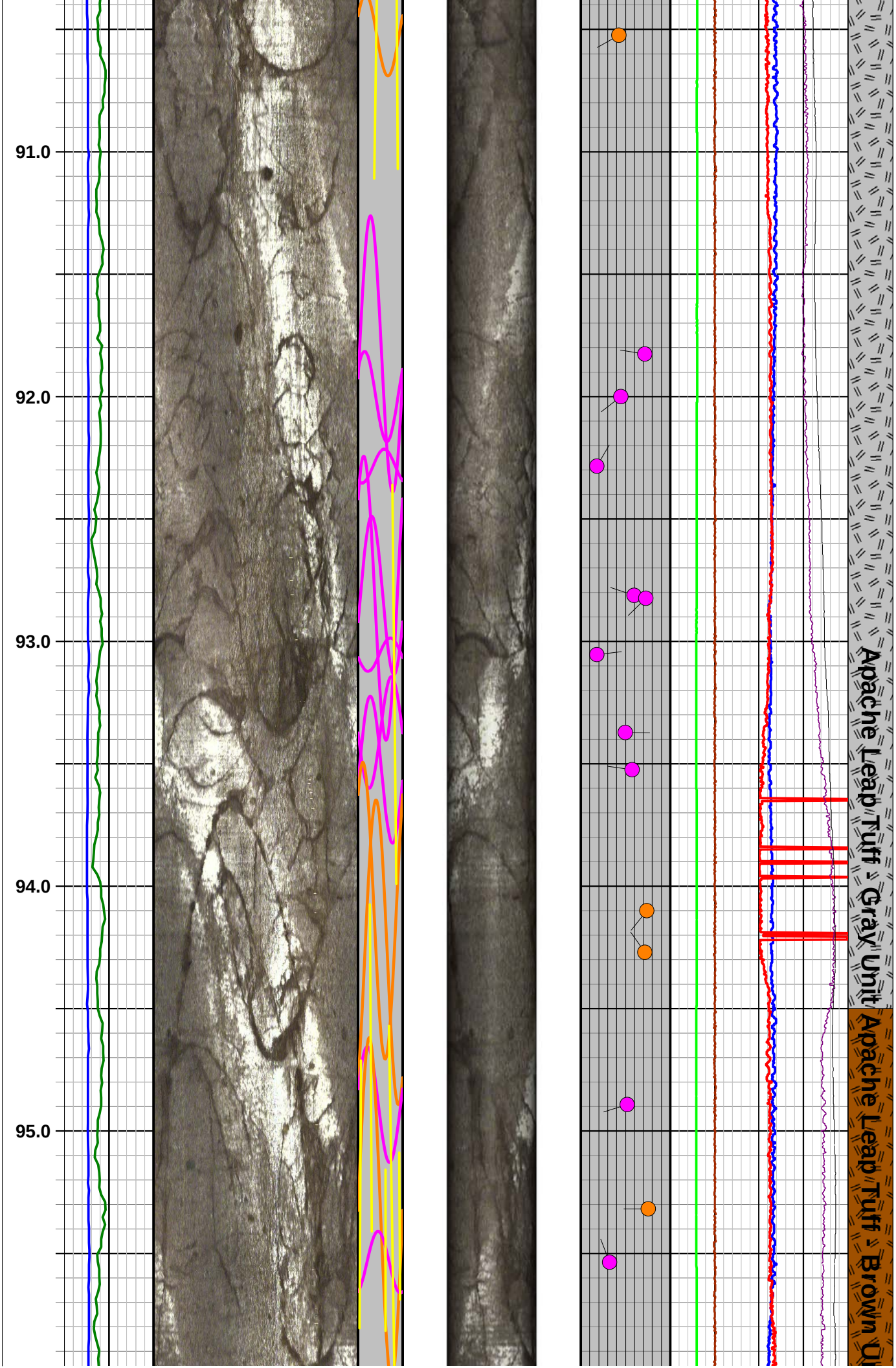
Apache Leap Tuff - Gray Unit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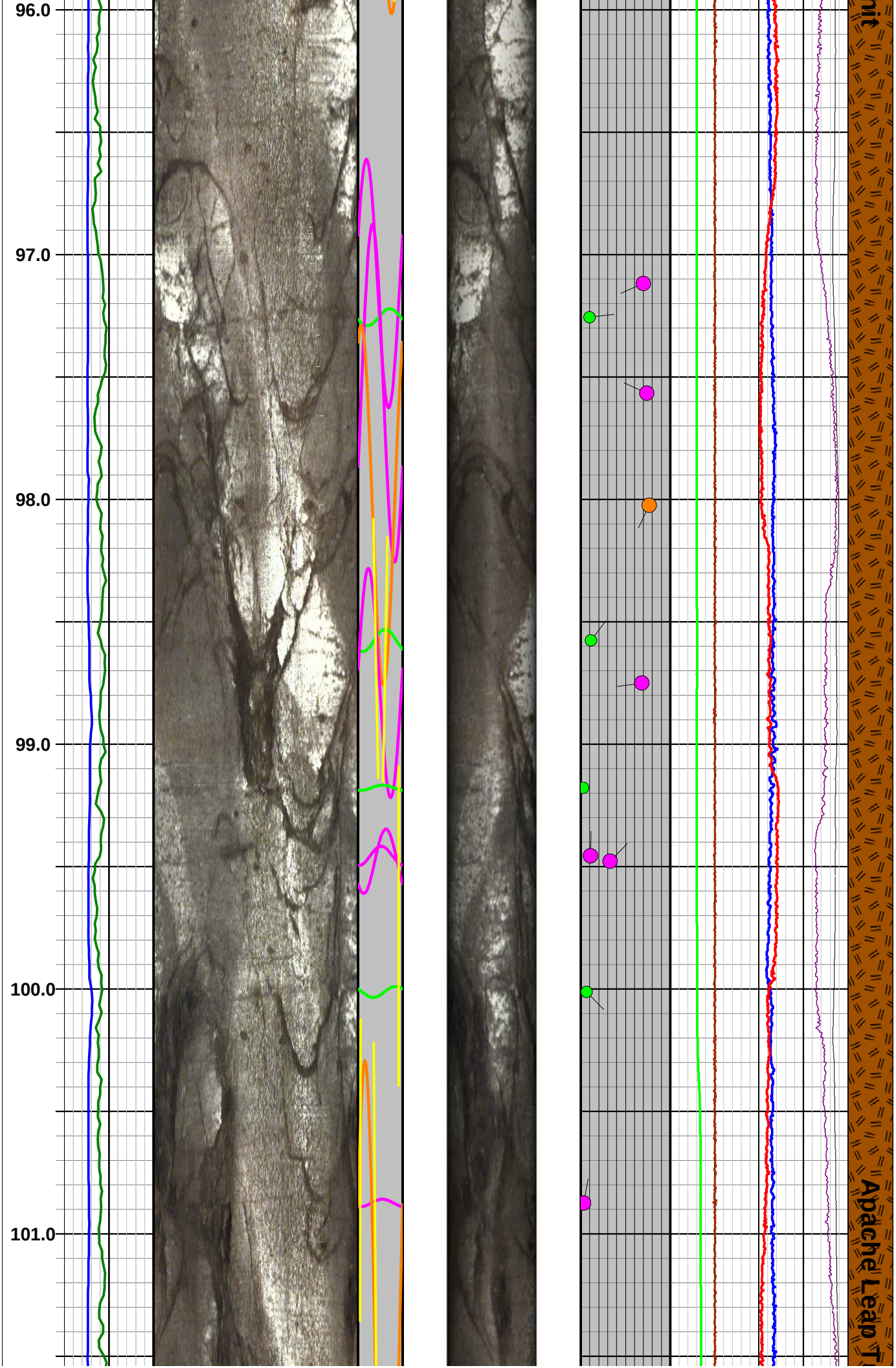
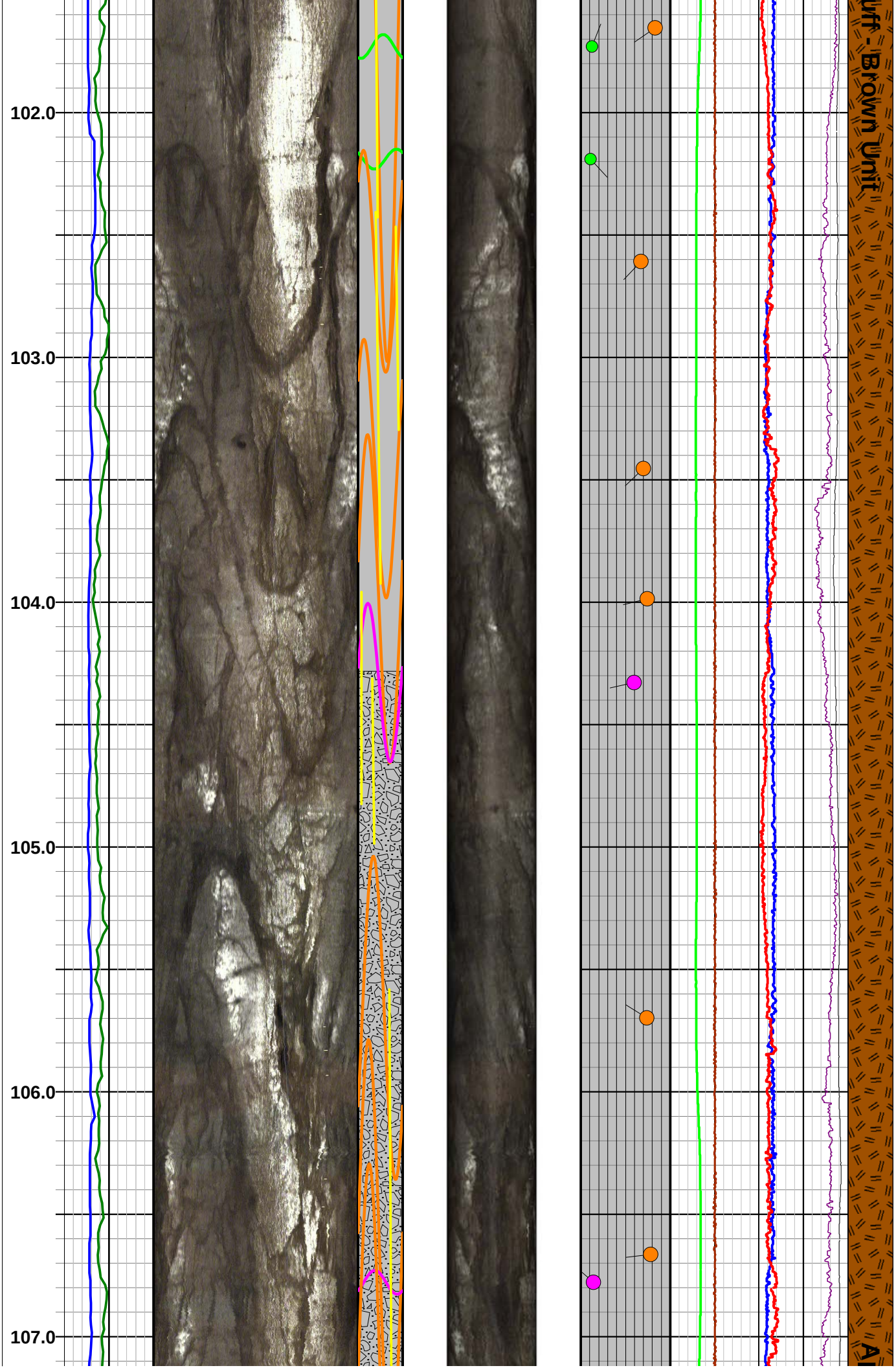
Apache Leap Tuff - Gray Unit
Apache Leap Tuff - Brown Un


96.0
97.0
98.0
99.0
100.0
101.0
Apache Leap T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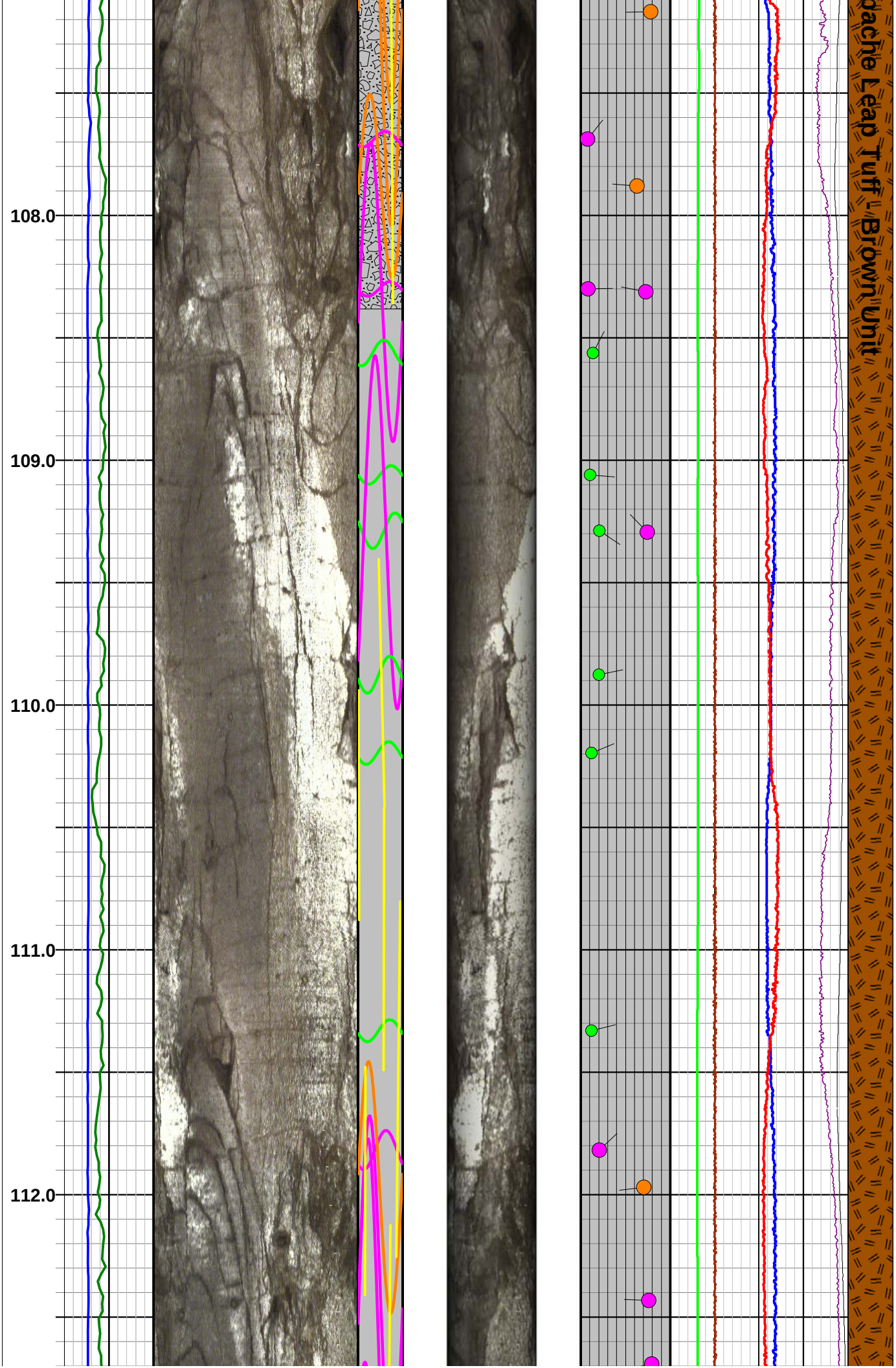
Buff - Brown Unit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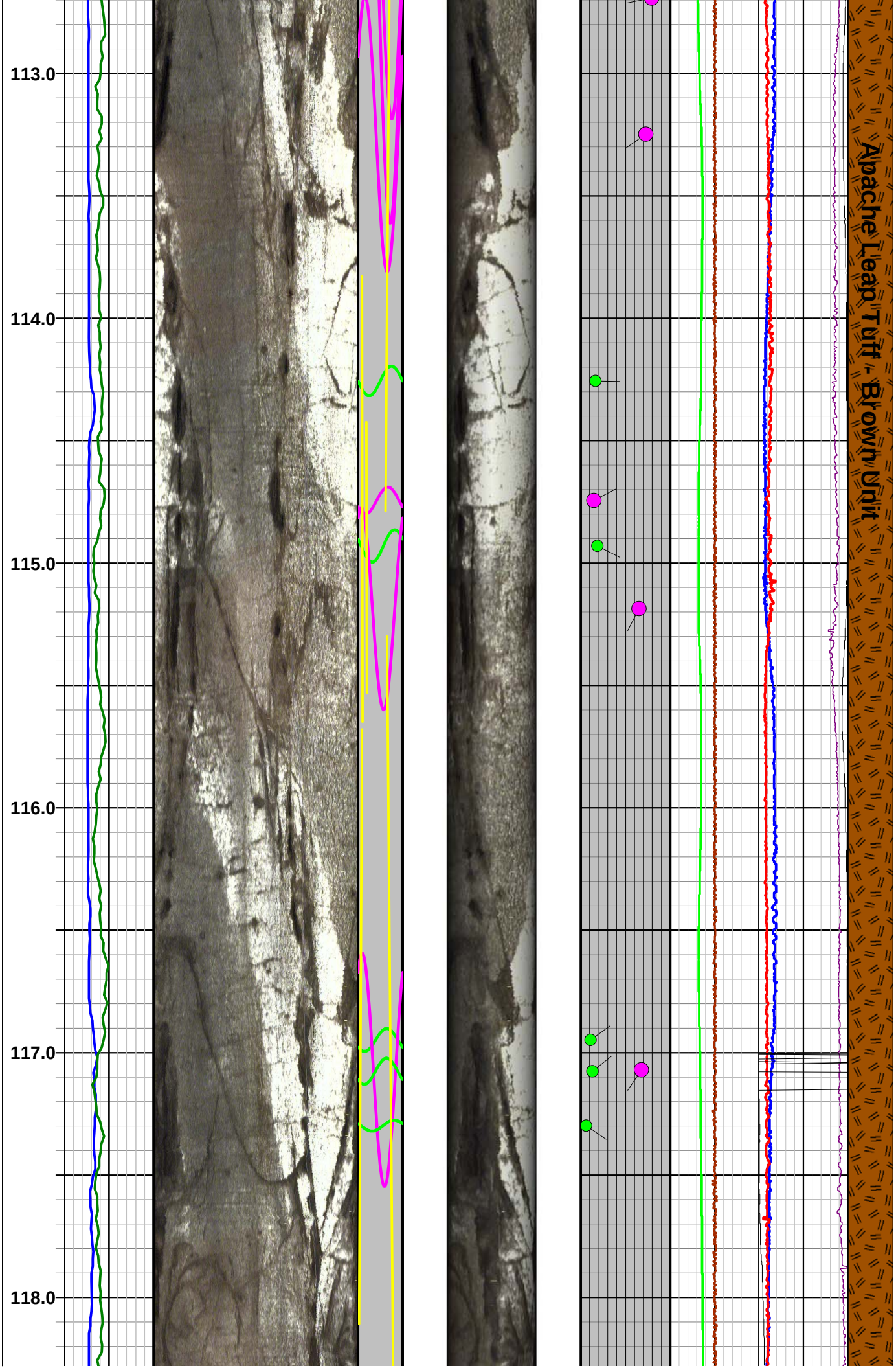
Apache Leap Tuff-Brown Unit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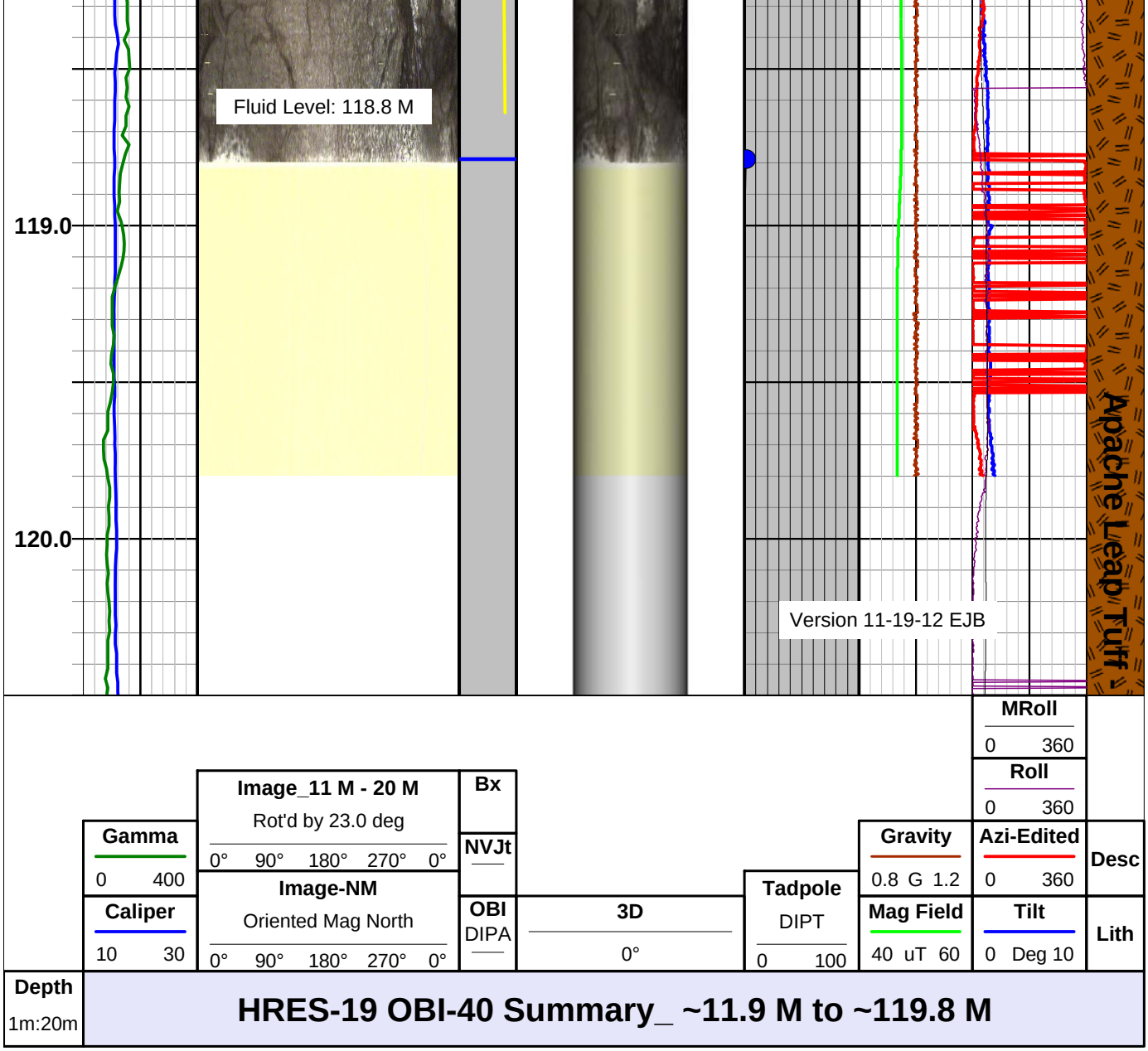
Apache Leap Tuff - Brown Unit



Depth 1m:20m	Gamma 0 400	Caliper 10 30	Image_11 M - 20 M Rot'd by 23.0 deg 0° 90° 180° 270° 0°	Image-NM Oriented Mag North 0° 90° 180° 270° 0°	Bx	NVJt	OBI DIPA	3D 0°	Tadpole DIPT 0 100	Gravity 0.8 G 1.2	Mag Field 40 uT 60	MRoll 0 360	Roll 0 360	Azi-Edited 0 360	Tilt 0 Deg 10	Desc	Lith

HRES-19 OBI-40 Summary_ ~11.9 M to ~119.8 M

Optical Image Summary Legend

Mnemonics and Comments

Caliper = 3-arm mechanical caliper of hole diameter plotted from 10-30 inches (blue line).

Gamma = Natural gamma ray log plotted from 0 to 400 API units (green line).

Image-NM = 2D plot of optical image oriented to magnetic north. Plotted from left to right N-E-S-W-N.

Image_11.0M - 20.0M = 2D plot of optical image non-oriented and rotated by 99.5 deg to correct for magnetic affect in proximity of steel casing. Plotted from left to Right N-E-S-W-N.

OBI = Planar features picked on optical borehole image shown as colored sinusoid (color designation shown on header). DIPA = dip apparent hole axis.

Bx = Apparent Breccia or Congomerate zones and Vugs/Vesicles/Cavities.

NVJt = Near Vertical (near parallel to hole axis) joint/fracture features picked on acoustic borehole image shown as colored sinusoid (color designation shown on header).

3D = 3D cylindrical projection of OBI image viewed from north.

Tadpole = Tadpole plot of the image feature picks (fractures and bedding planes); plotted from 0 to 90 dip - see legend above. DIPT = True orientation; features corrected for hole deviation.

Mag Field = Total magnetic field strength as measured by fluxgate magnetometer in OBI deviation sensor

- plotted 40-60 uT (green line).

Gravity = Tool accelleration or gravity as measured by 3-axis accellerometers in OBI deviation sensor - plotted 0.8 - 1.2 G (brown line).

Azi-Edited = Direction of tool tilt plotted 0 to 360 deg; edited for anomalous magnetic influence - represents borehole deviation direction (red line).

Roll = Roll or gravity tool face angle is plotted 0 to 360 degrees. Roll is 90 degree if the y-axis of the probe (reference mark on the housing) points to the high side of the borehole. (purple line)

MRoll = MRoll or Magnetic Roll angle is plotted 0 to 360 degrees. MRoll is used when Tool Tilt is < 1 deg from vertical and two components of accelerometer are close to zero. At vertical, MRoll is 90 degree if the projection of the y-axis of the probe (reference mark on the housing) into a horizontal plane points to Magnetic North. (black line)

Tilt = Tool tilt (vertical = 0 and horizontal = 90) plotted 0 to 10 deg; represents borehole deviation tilt from vertical (blue line).

Lith = Major/principal lithology based on field geologic descriptions provided by Clear Creek staff.

Desc = Major/principal field geologic descriptions provided by Clear Creek staff.

Prepared by Erika J. Beam

Version 11-20-12

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-19 (ADWR 55-914789)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: ABI-43
MORE: 3-ARM CALIPER

LOCATION
D(2-13)8AAA

SEC 8 TWP 2S RGE 13E

OTHER SERVICES
OBI
GAMMA-CALIPER-
FLUID TEMP-RES
E-LOGS
SONIC

PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

DATE	11-4-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	ABI-43 3 ARM CALIPER	DENSITY	N/A
DEPTH-DRILLER	291.5 M	LEVEL	119.2 M
DEPTH-LOGGER	291.5 M	MAX. REC. TEMP.	23.5 DEG C
BTM LOGGED INTERVAL	291.5 M	IMAGE ORIENTED TO:	MAG NORTH
TOP LOGGED INTERVAL	119.2 M	SAMPLE INTERVAL	0.0096FT
DRILLER / RIG#	BOART LONGYEAR	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	ALT ABI-43 SN-91601
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	7:30 AM 5:00 PM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	20"	SURFACE	11.9 M	15 3/4"	HWT	SURFACE	11.9 M
2	14 3/4"	11.9 M	TD				
3							

COMMENTS:

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Major Lithology

- Apache Leap Tuff - Gray Unit
- Apache Leap Tuff - Brown Unit
- Basal Tuff - Vitrophyre
- Basal Tuff
- Transition Zone

Acoustic Image Features Legend

- Bedding / Banding / Foliation / Veins
- Filled Fracture / Joint
- Btm of Casing

Partially Open Joint / Fracture

Minor Open Joint / Fracture

OJ/Fx terminates at Fx intersection

Unclassified

Sulfide Vein

Breakouts

Major Open Joint / Fracture

Fluid Level

Bx & NVJts Legend

Breccia or Conglomerate

Large Vugs/Vesicles (> 6")

Medium Vugs/Vesicles (2-6")

Small Vugs/Vesicles (< 2")

Conglomerate - sand matrix supported

Conglomerate - mud matrix supported

Conglomerate - clast supported

Broken Zone / Undifferentiated

Major Breakout

Minor Breakout

Tensile Fracture

Filled Near Vertical Joint/Fx

Near Vertical Joint/Fx

HRES-19 ABI-43 Summary_ ~119.0 M to ~289.6 M

Depth
1m:20m

Centralized TT
Oriented Mag North
0° 90° 180° 270° 0°

Caliper
10 Inches 30

Amplitude-NM
Oriented Mag North
0° 90° 180° 270° 0°

Amp-Static
Oriented Mag North
0° 90° 180° 270° 0°

Amp-High Pass
Oriented Mag North
0° 90° 180° 270° 0°

ARI
0 400

ABI
DIPA

NVJt

Bx

3D
0°

Tadpole
DIPT
0 100

Mag Field
40 uT 60

Gravity
0.8 g 1.2

Tilt
0 deg 10

Azimuth
0 360

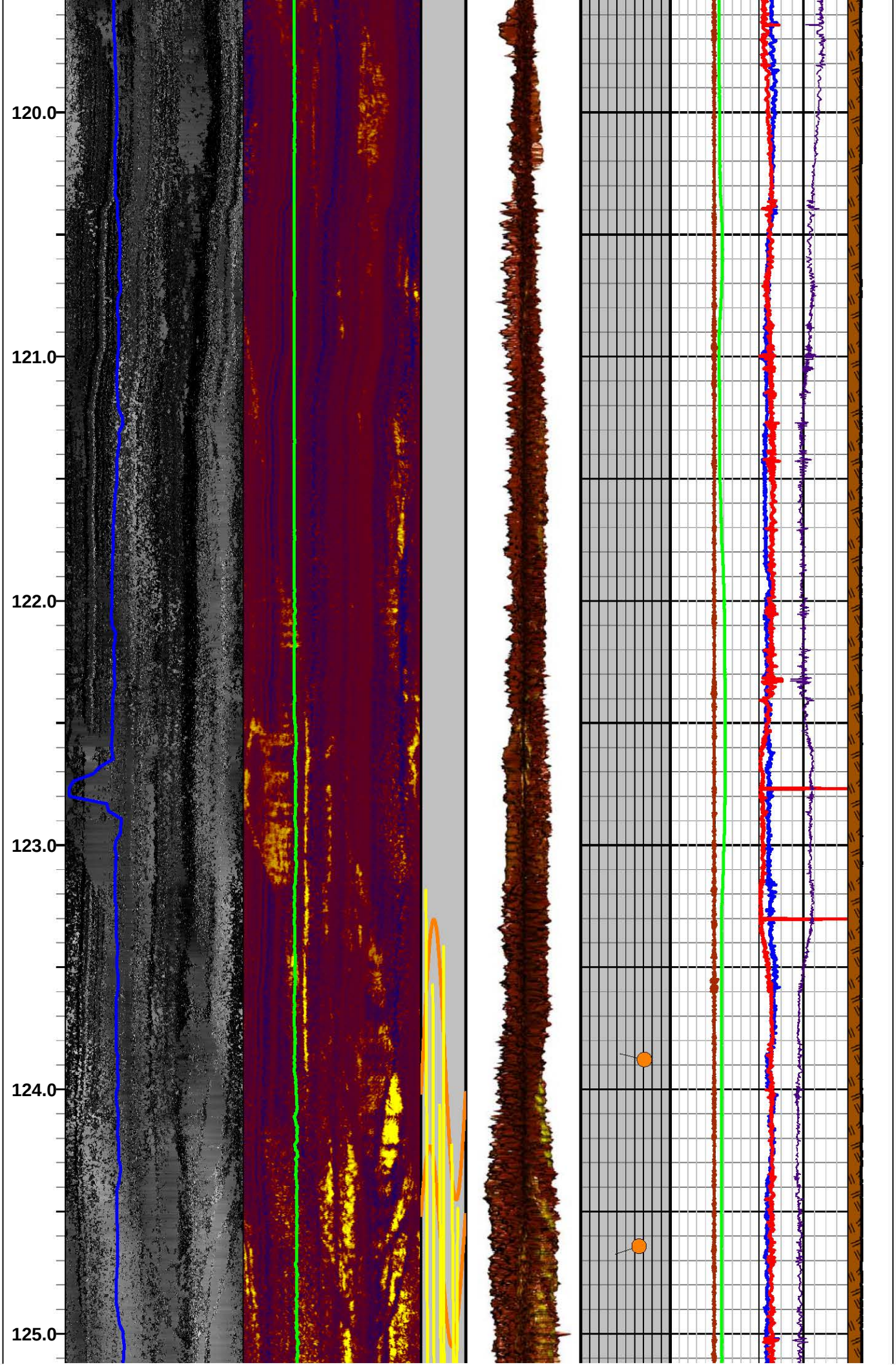
RBR
-90 270

Lith

Hard

Desc

119.0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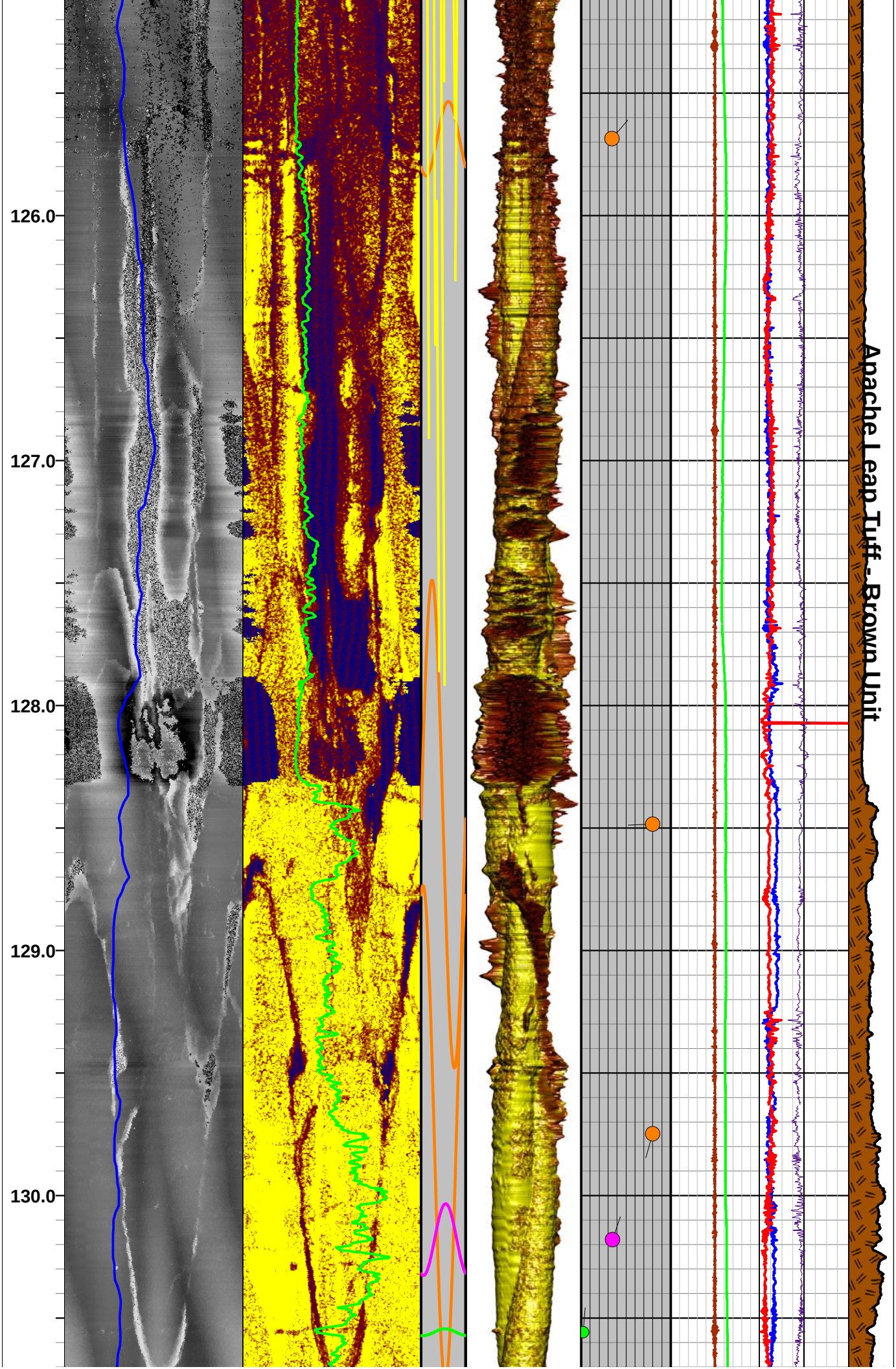
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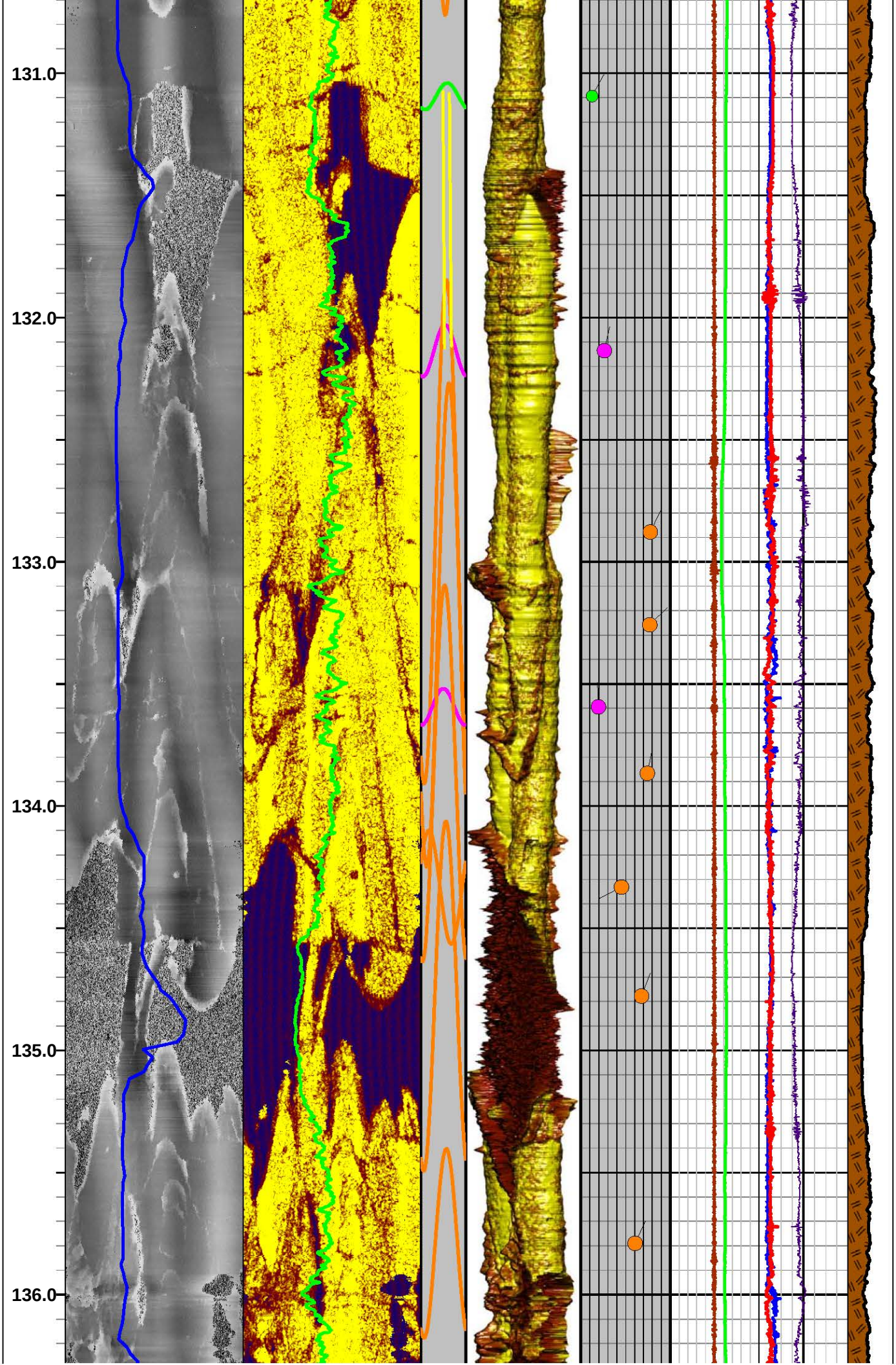
Apache Leap Tuff - Brown Unit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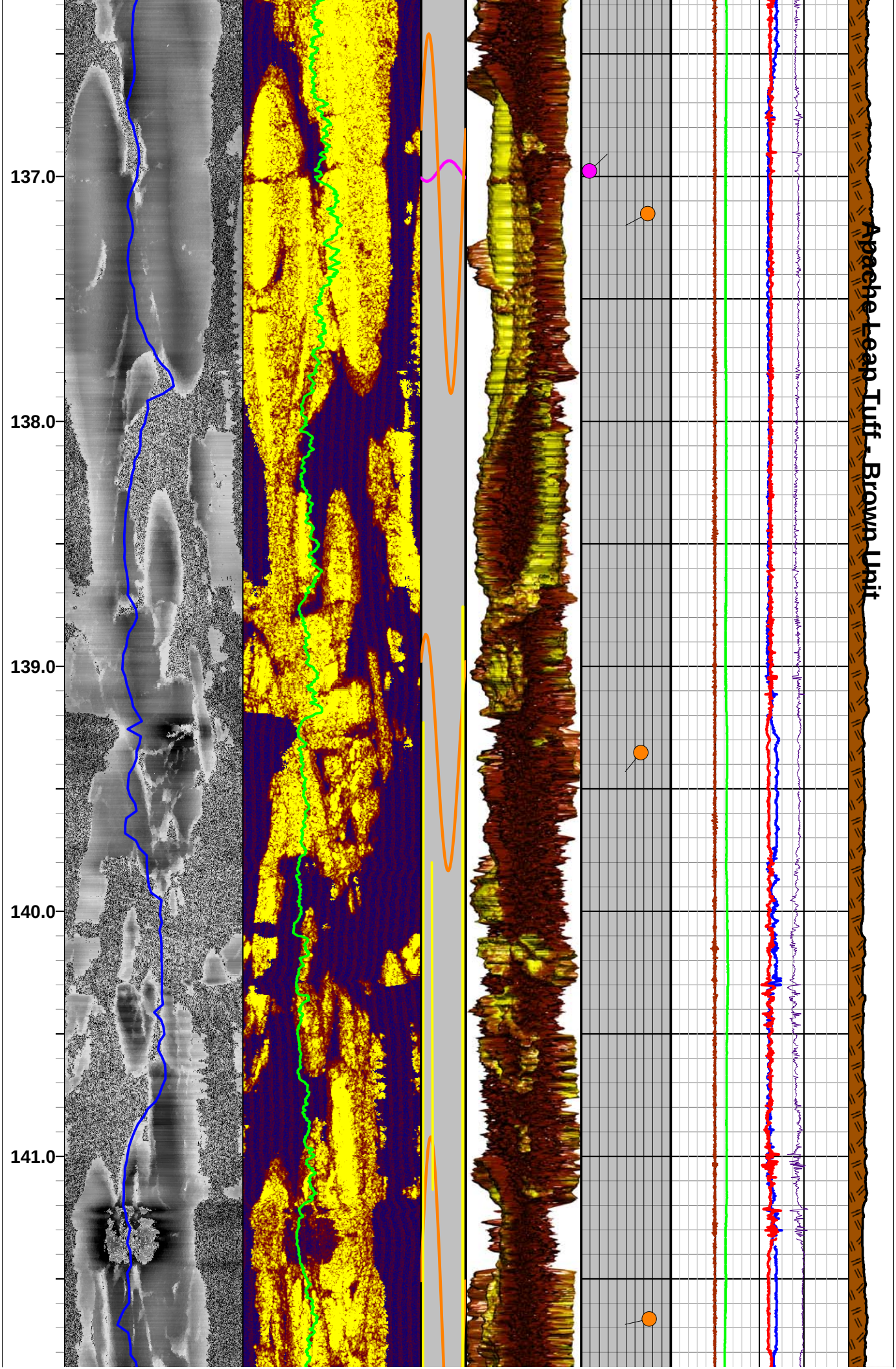
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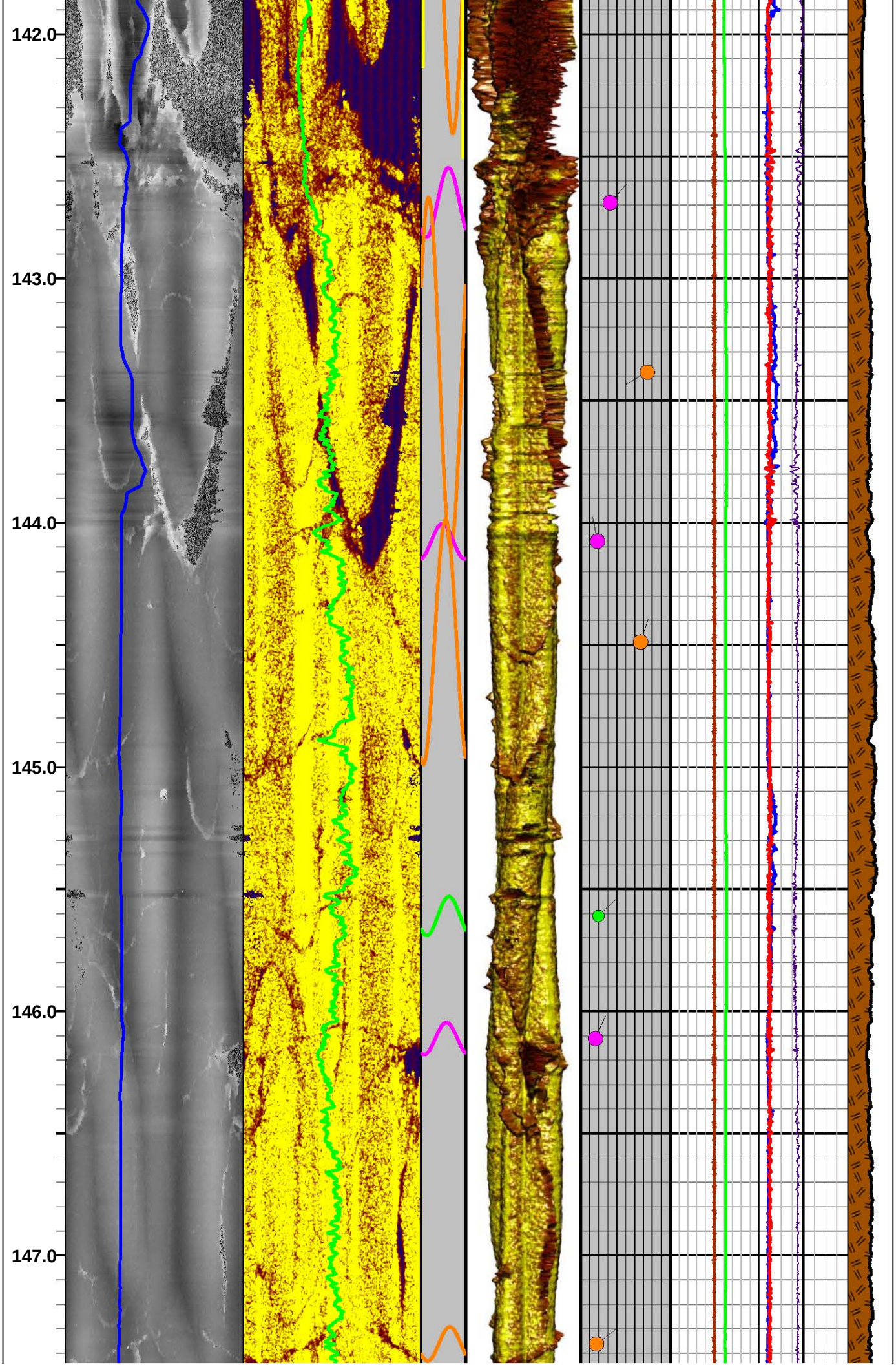
Apache Leap Tuff - Brown Unit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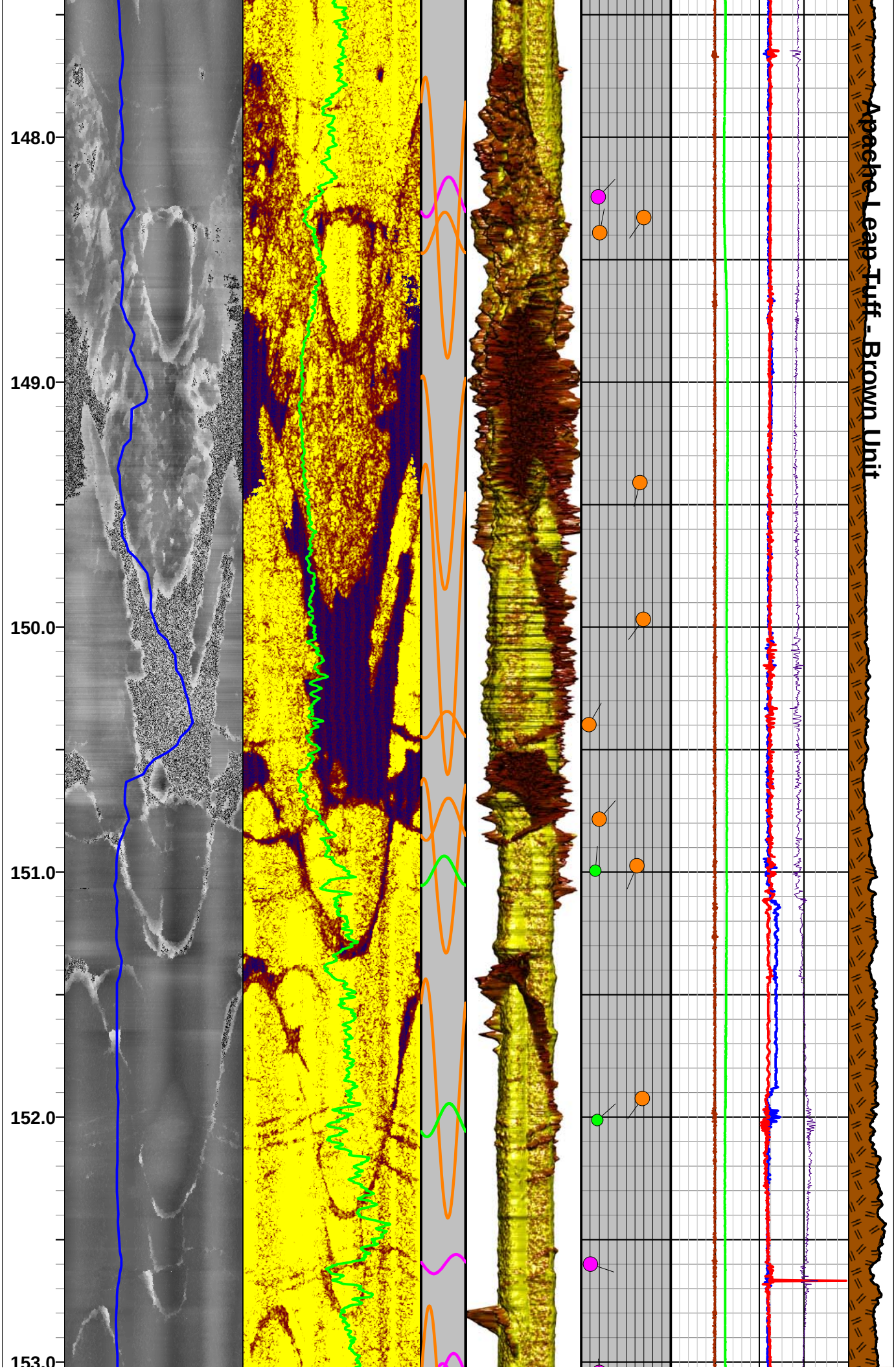
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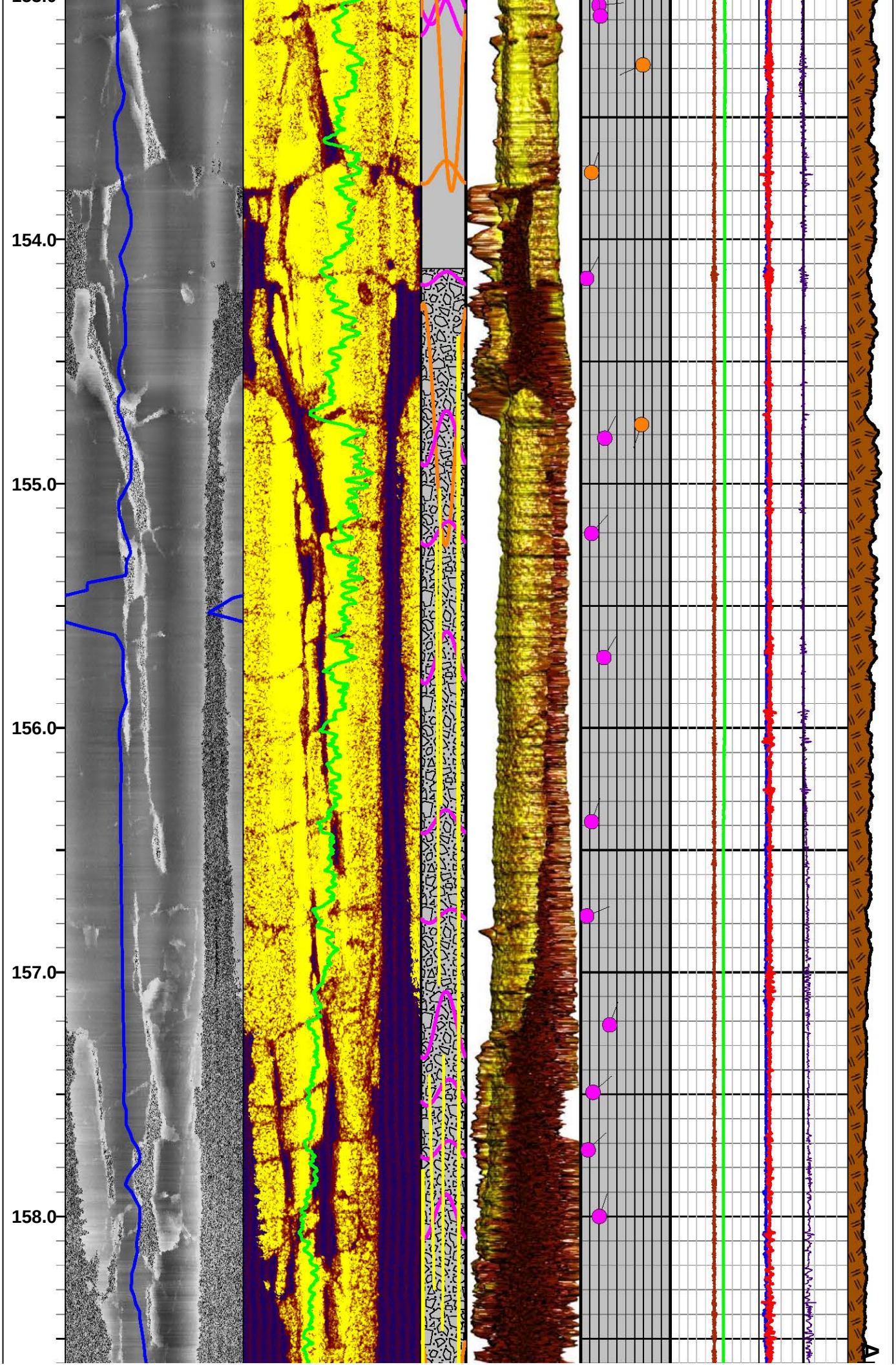
Apache Leap Tuff - Brown Unit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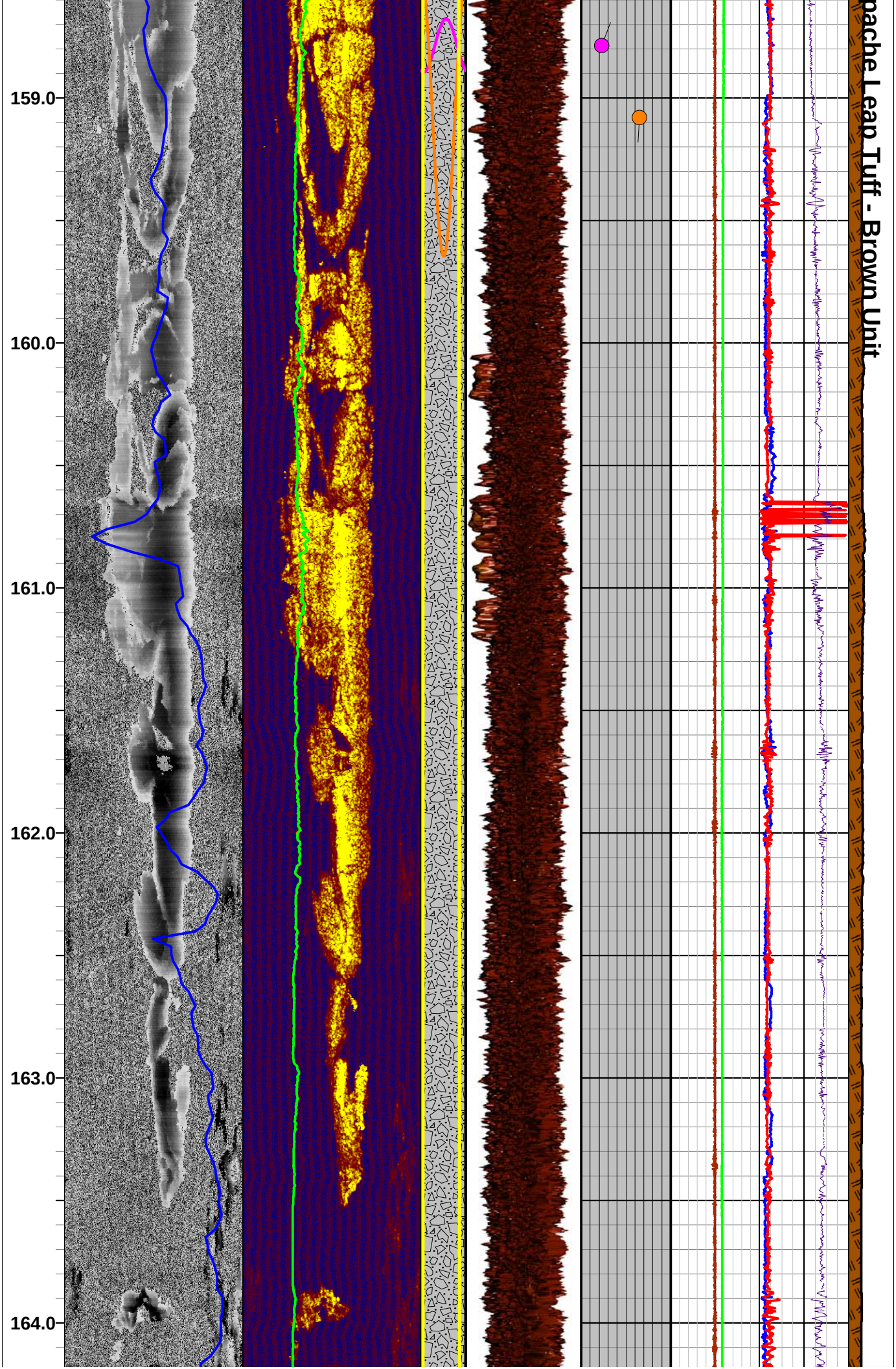
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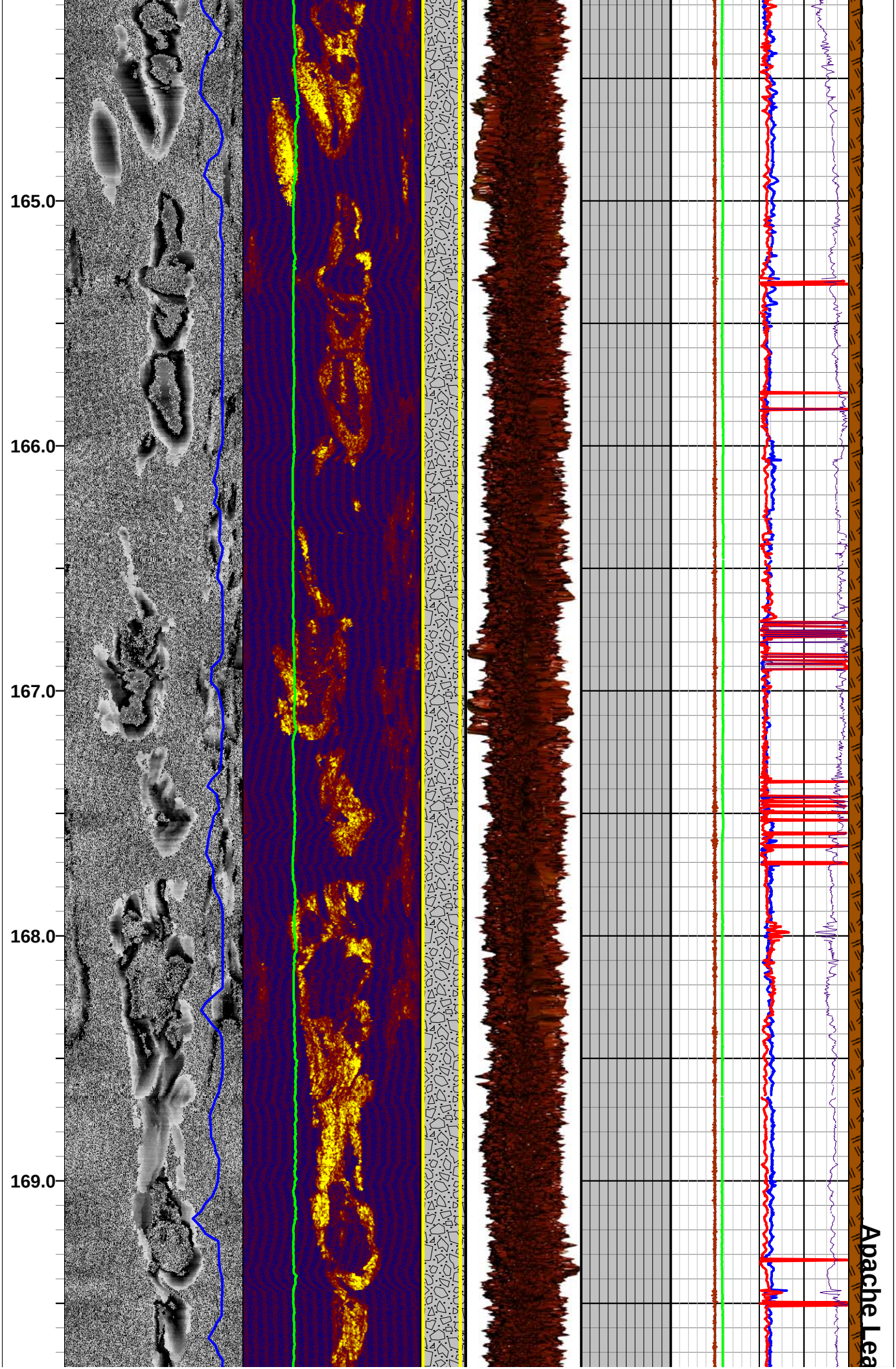
Apache Leap Tuff - Brown Unit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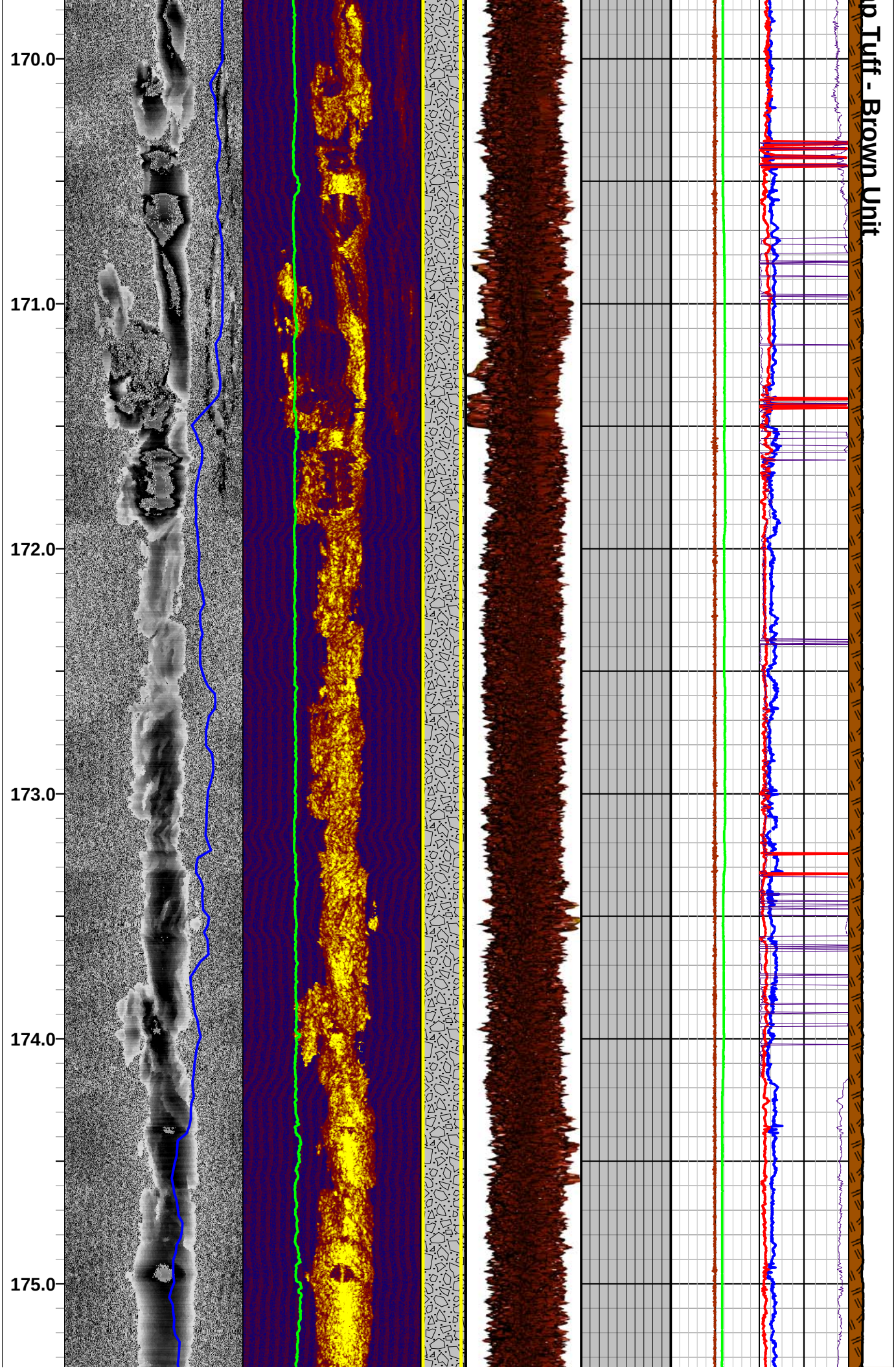
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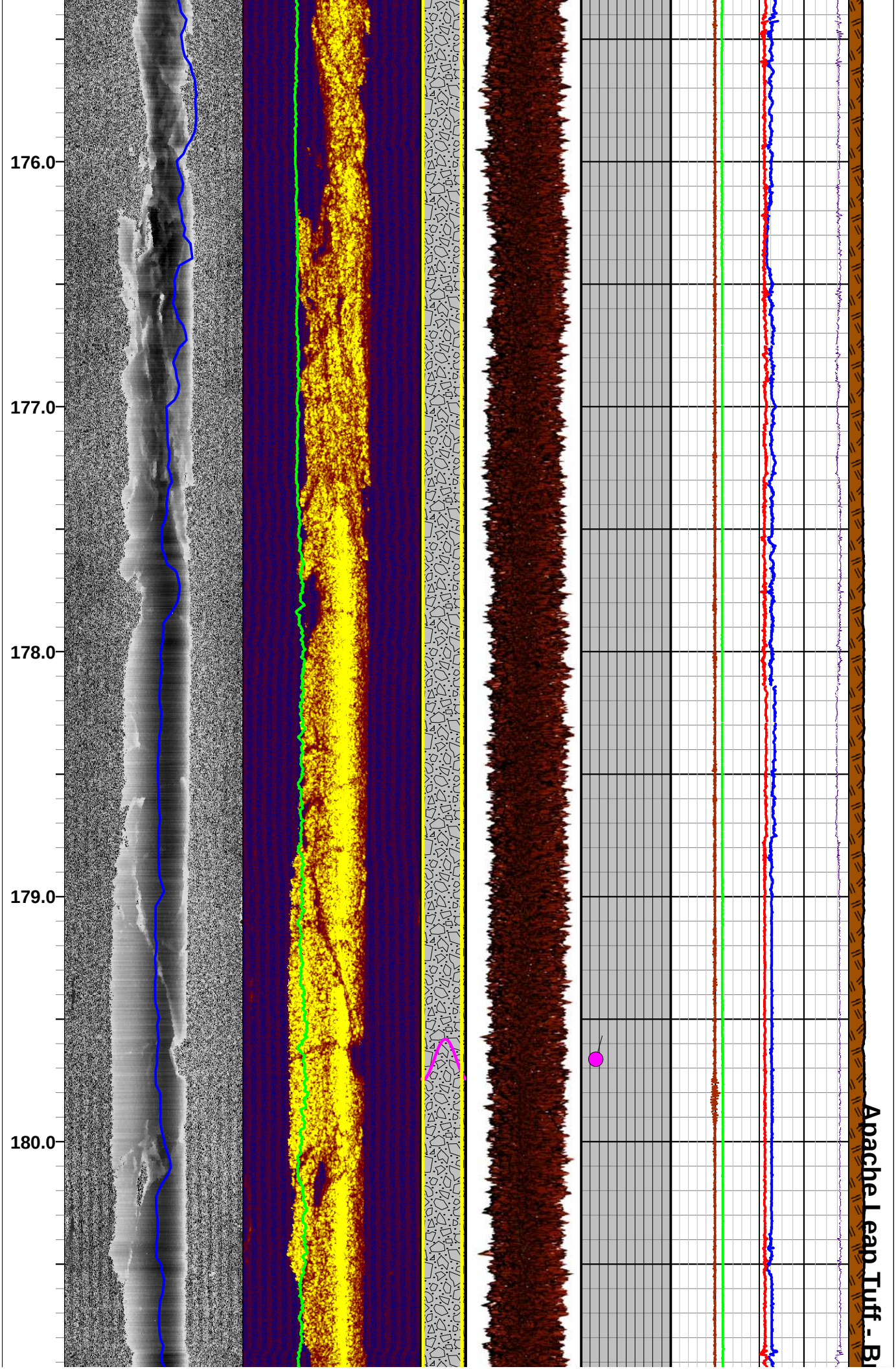
175.0
p Tuff - Brown Unit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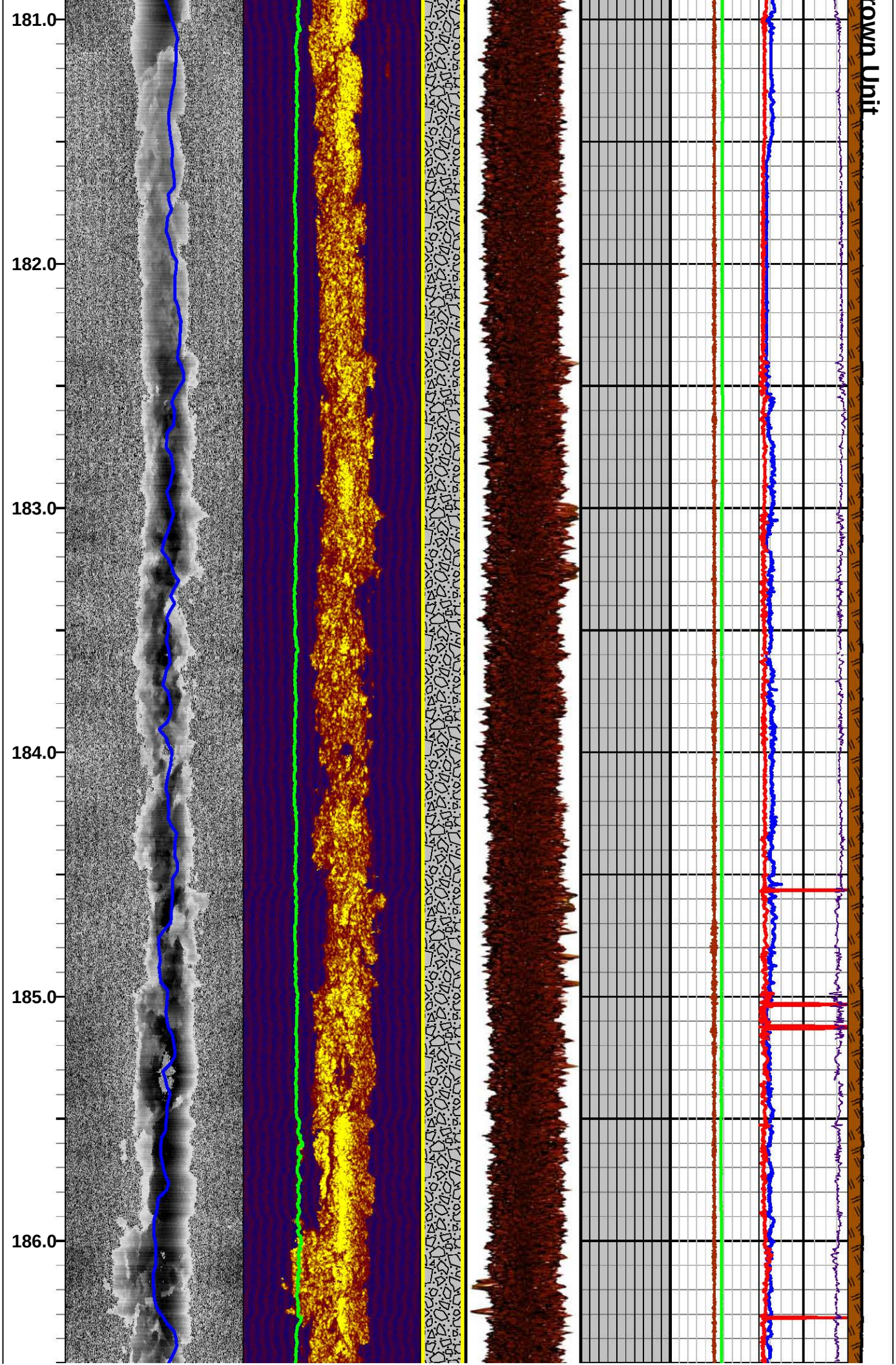
Apache Leap Tuff - Bu


181.0
182.0
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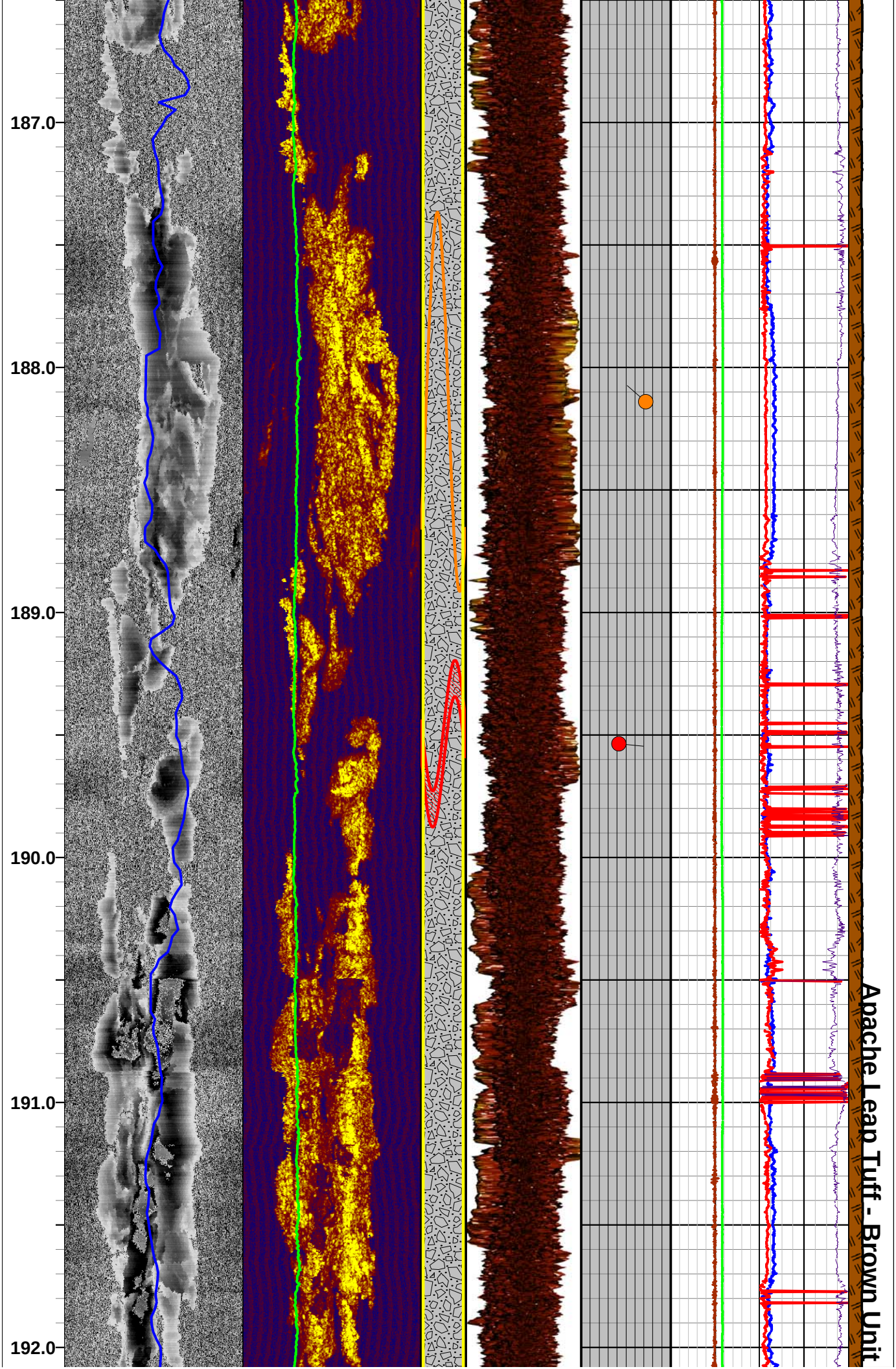
185.0
186.0
rown Unit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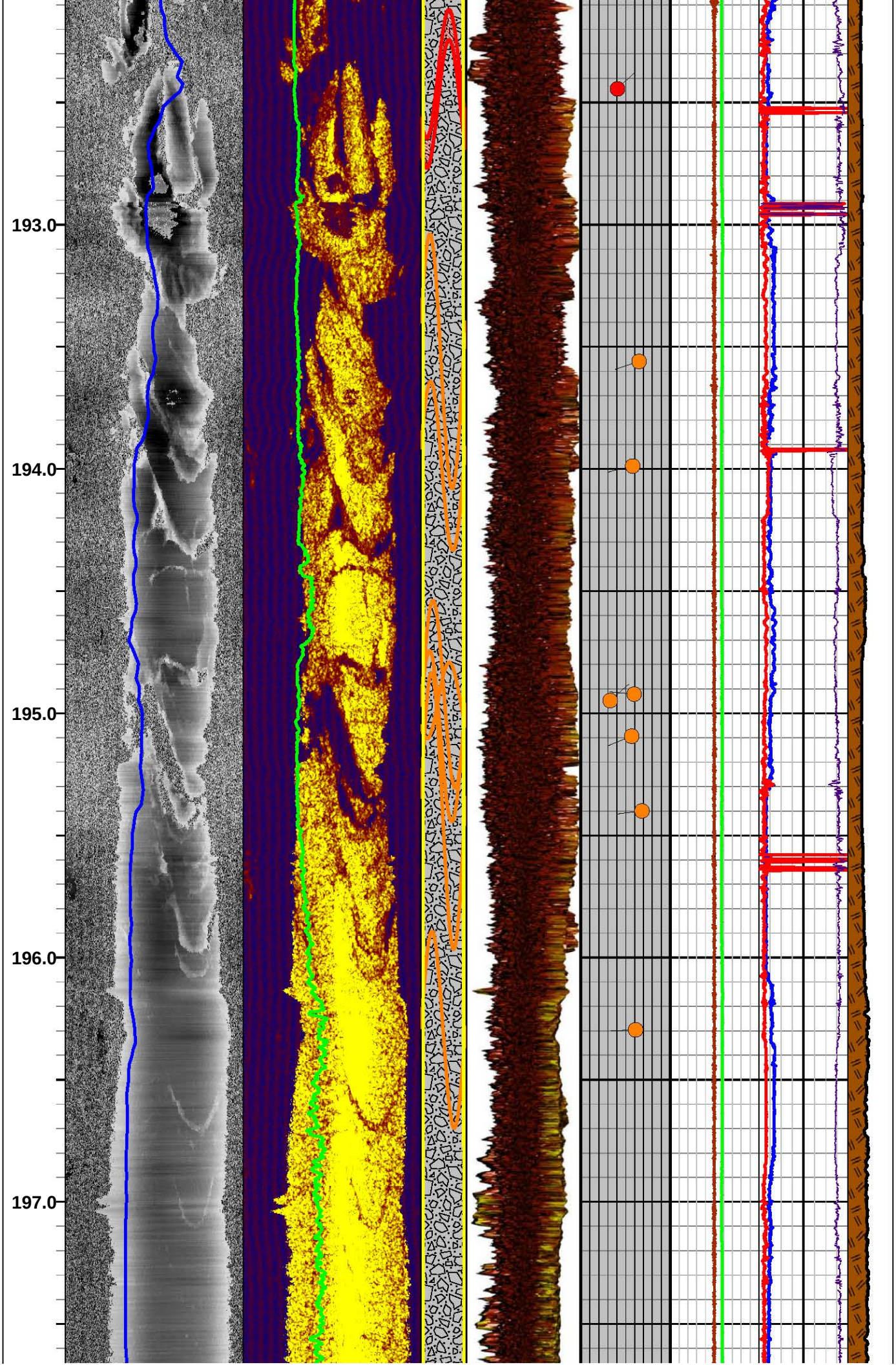
Apache Leap Tuff - Brown Unit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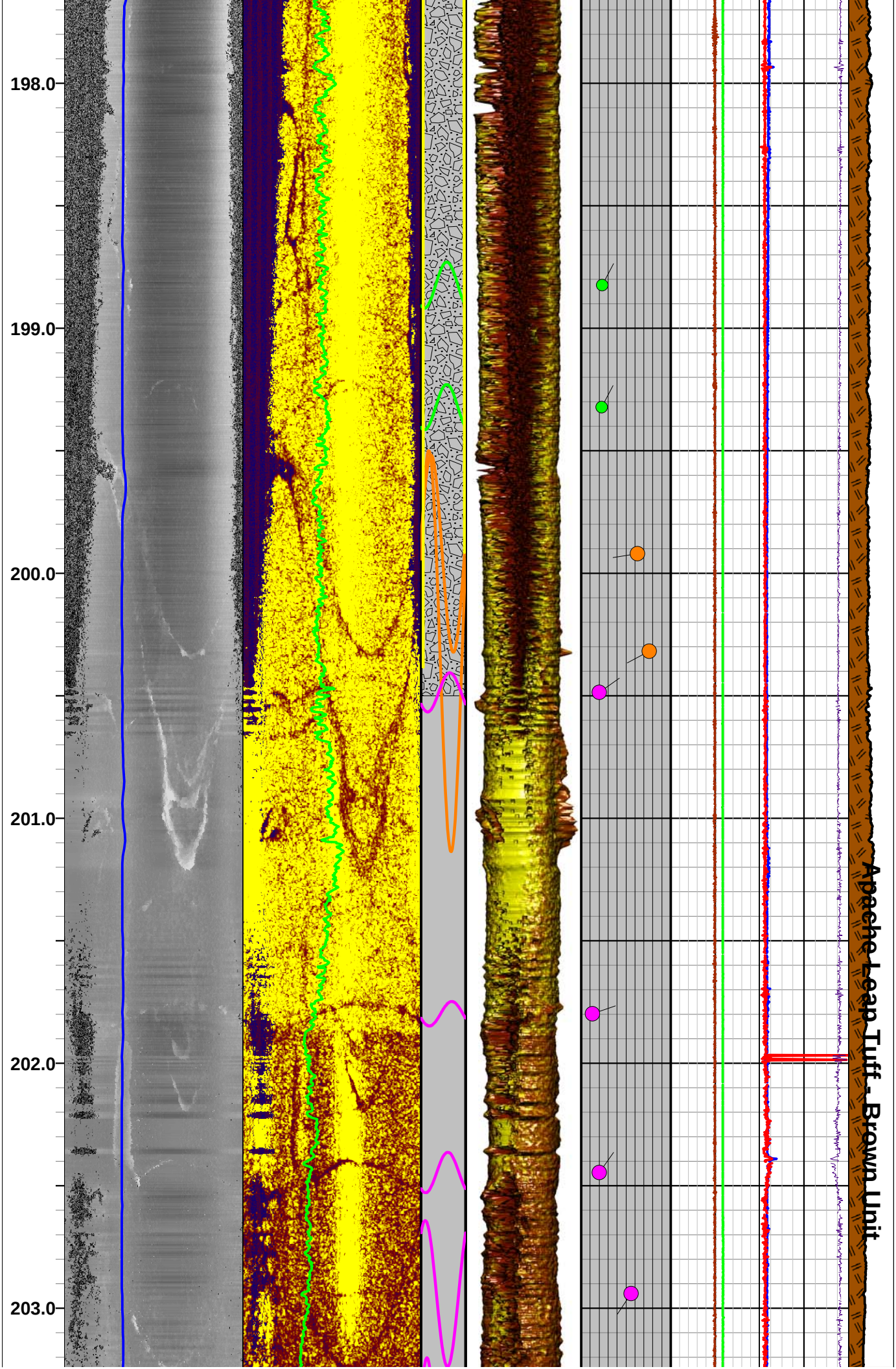
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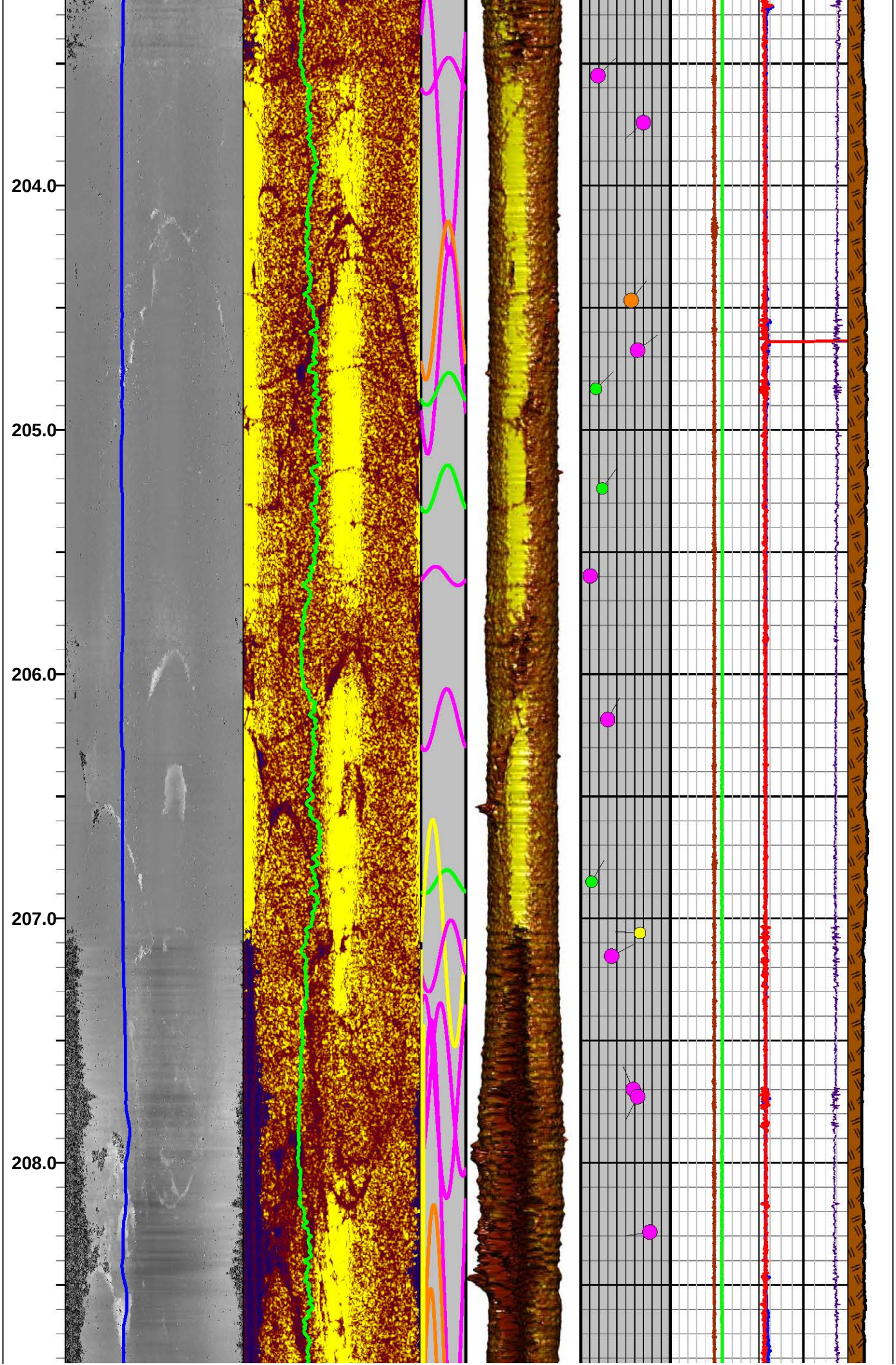
Apache Leap Tuff - Brown Unit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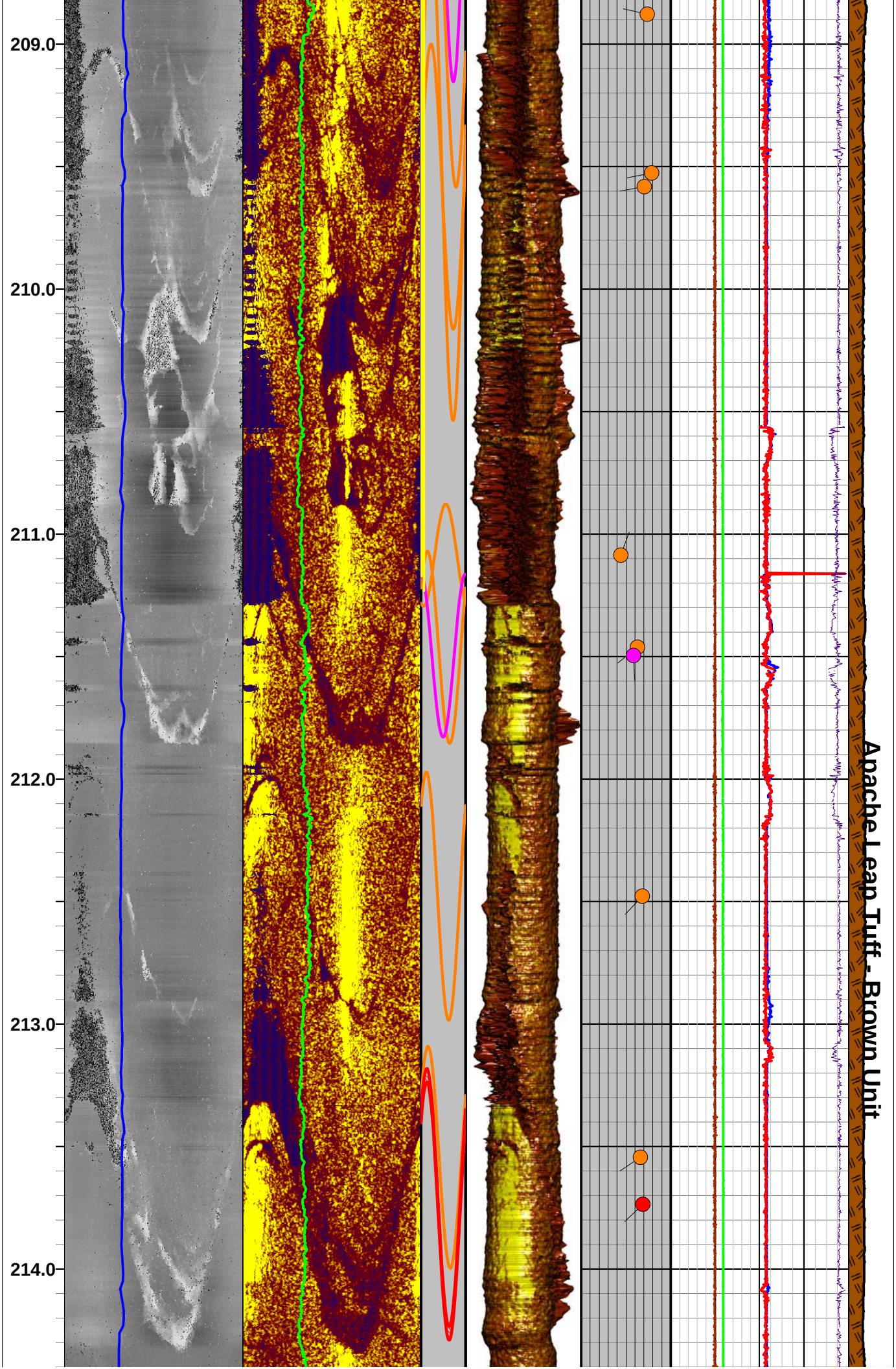
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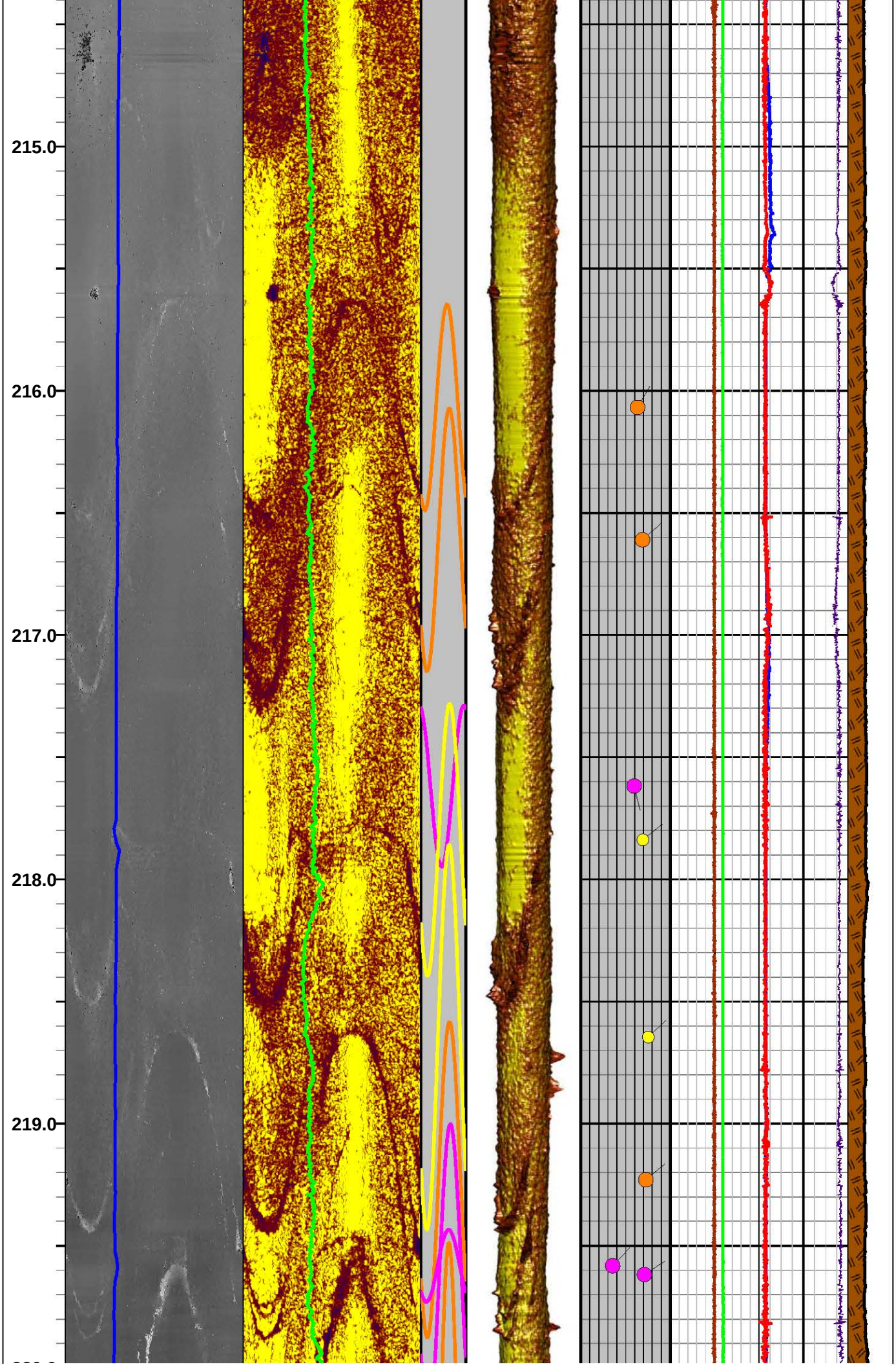
Apache Leap Tuff - Brown Unit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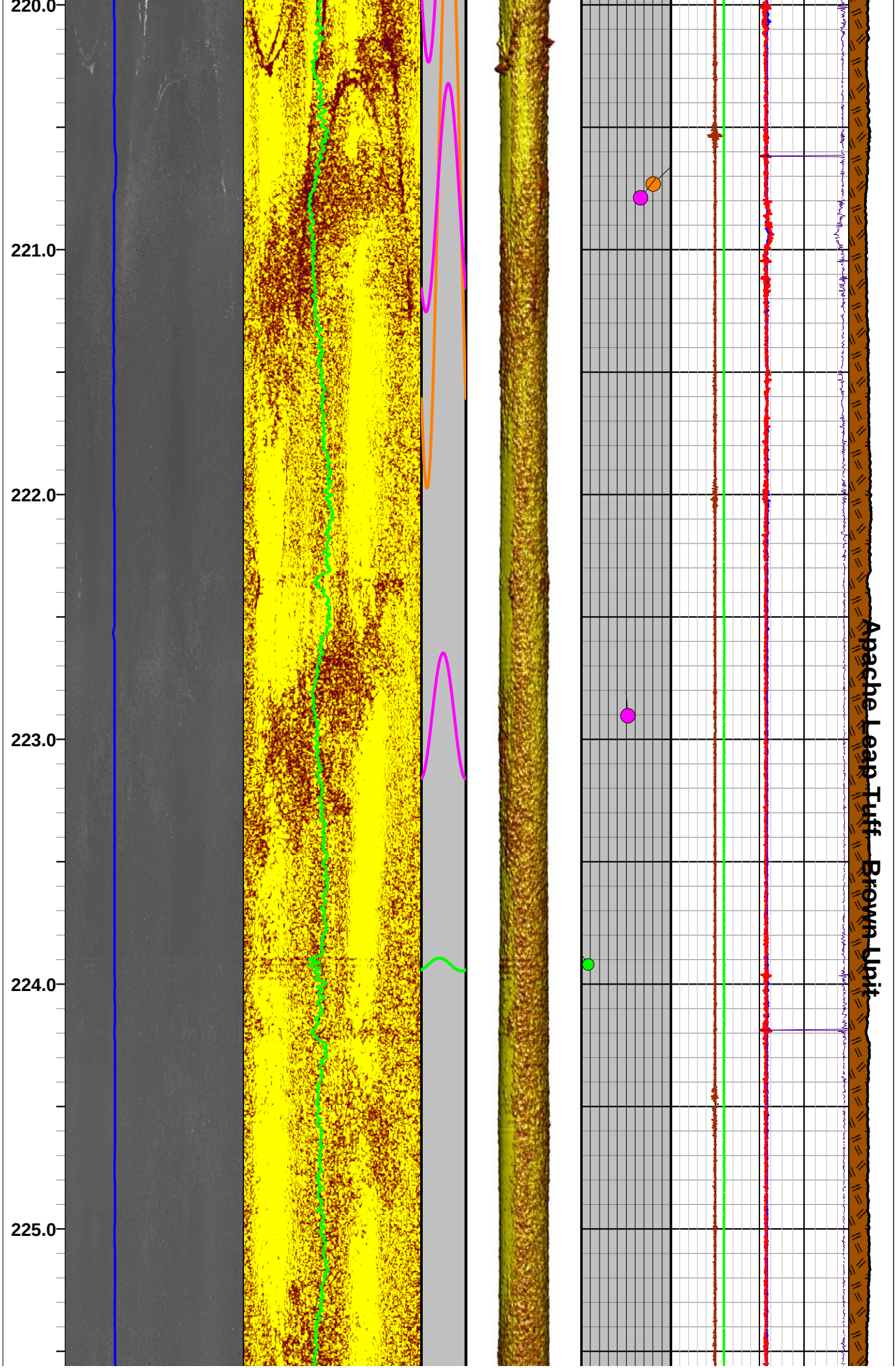
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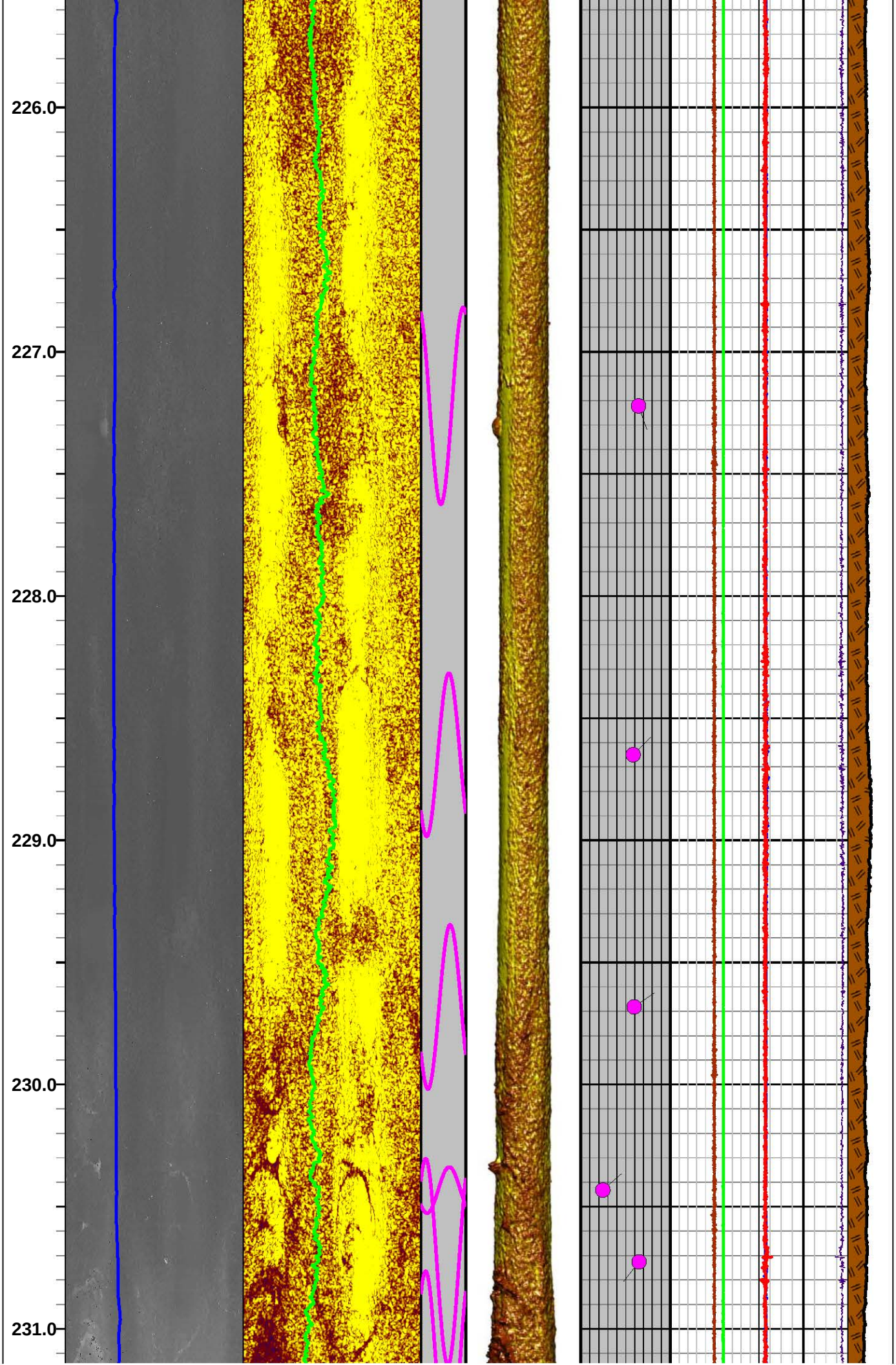
Apache Leap Tuff, Brown Unit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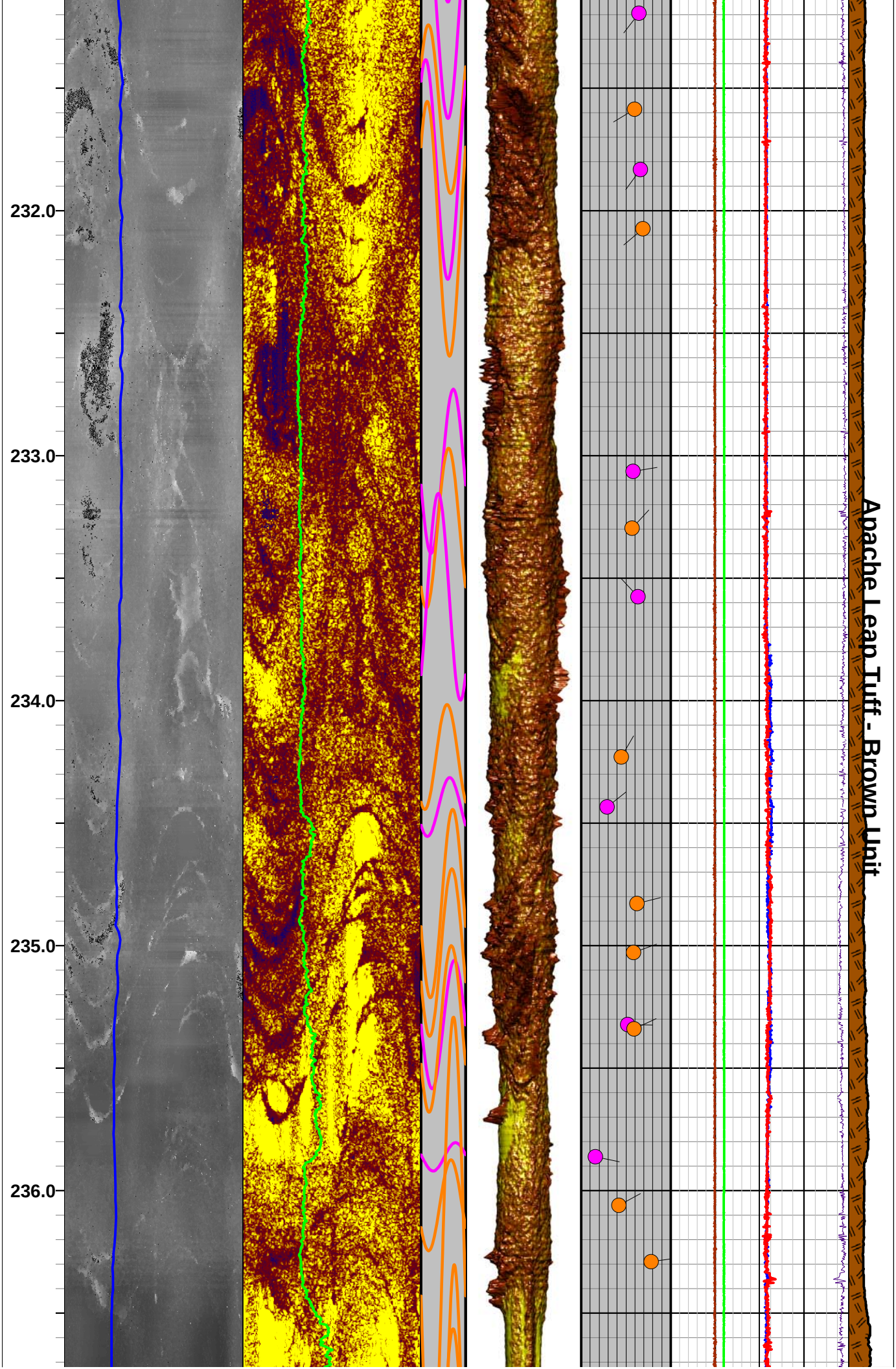
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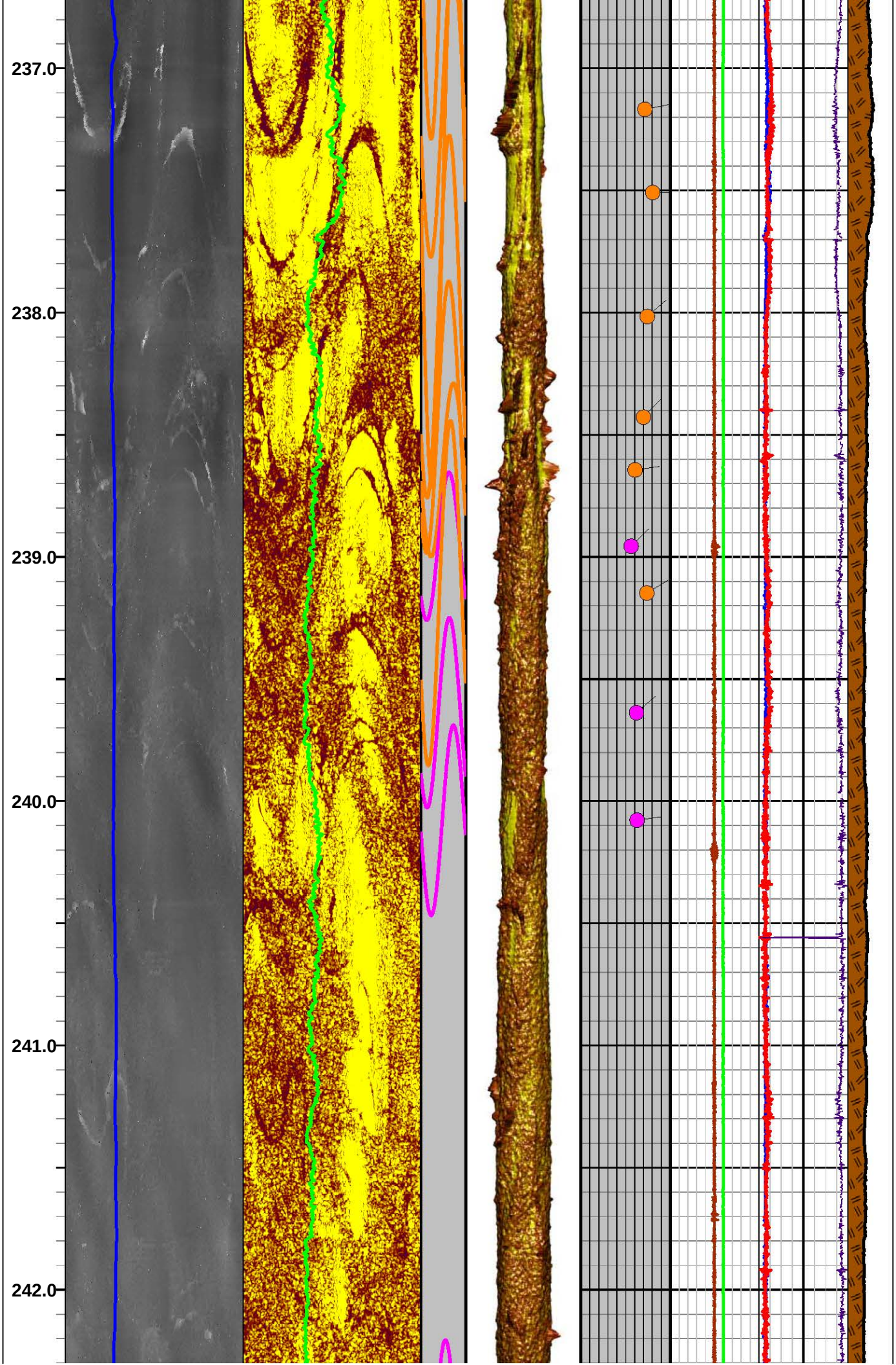
Apache Leap Tuff - Brown Unit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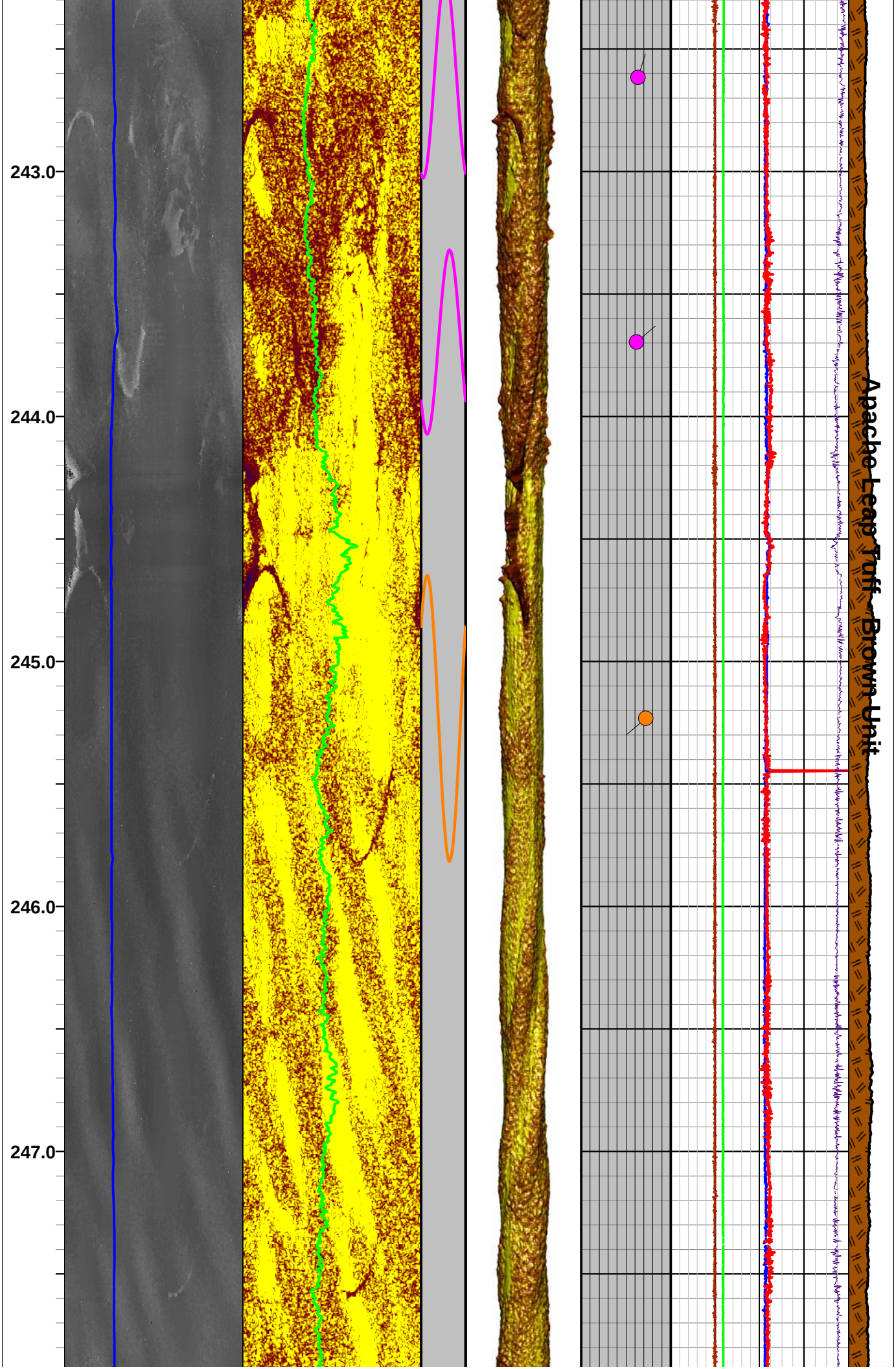
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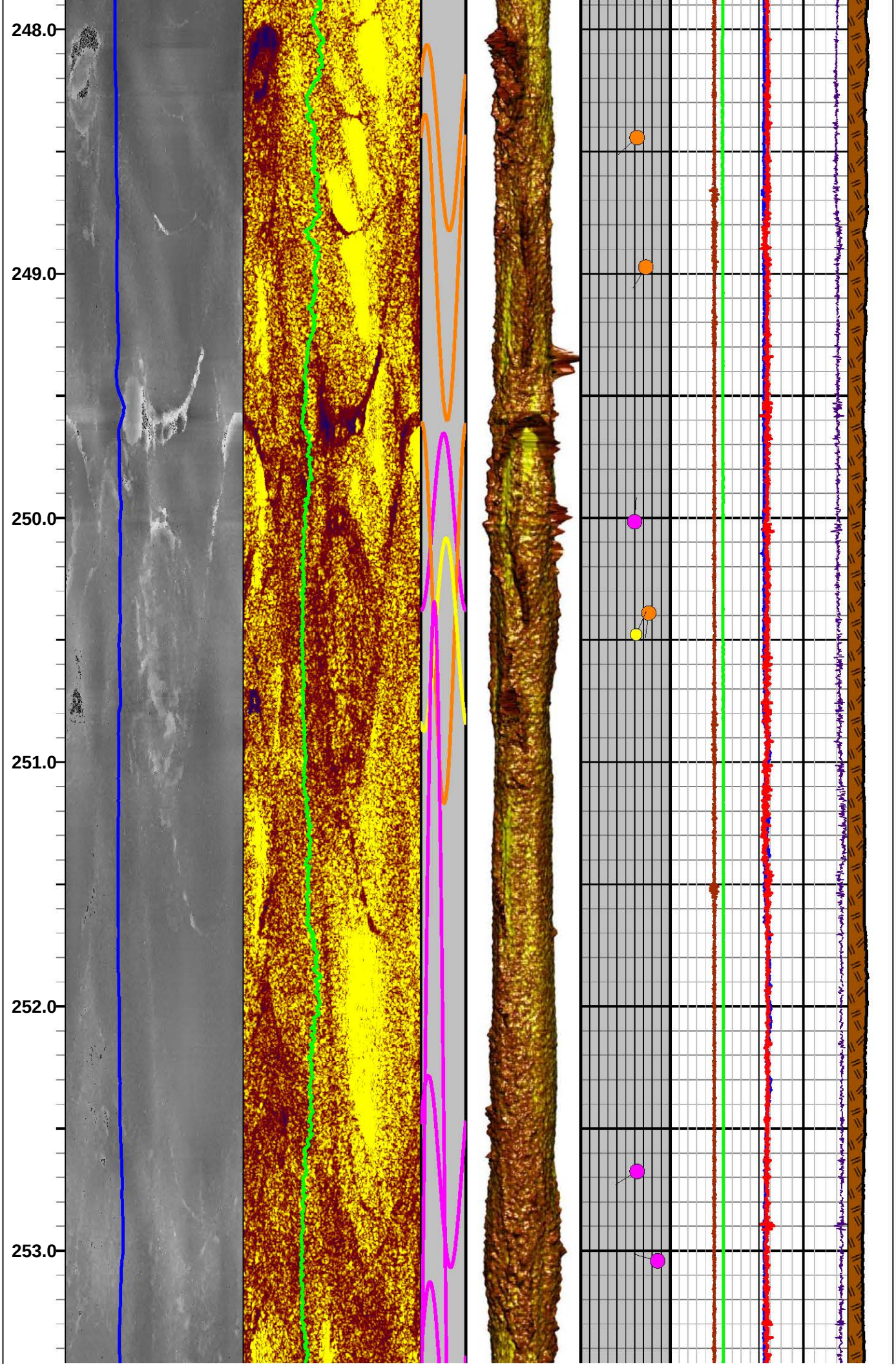
Apache Leap Tuff - Brown Unit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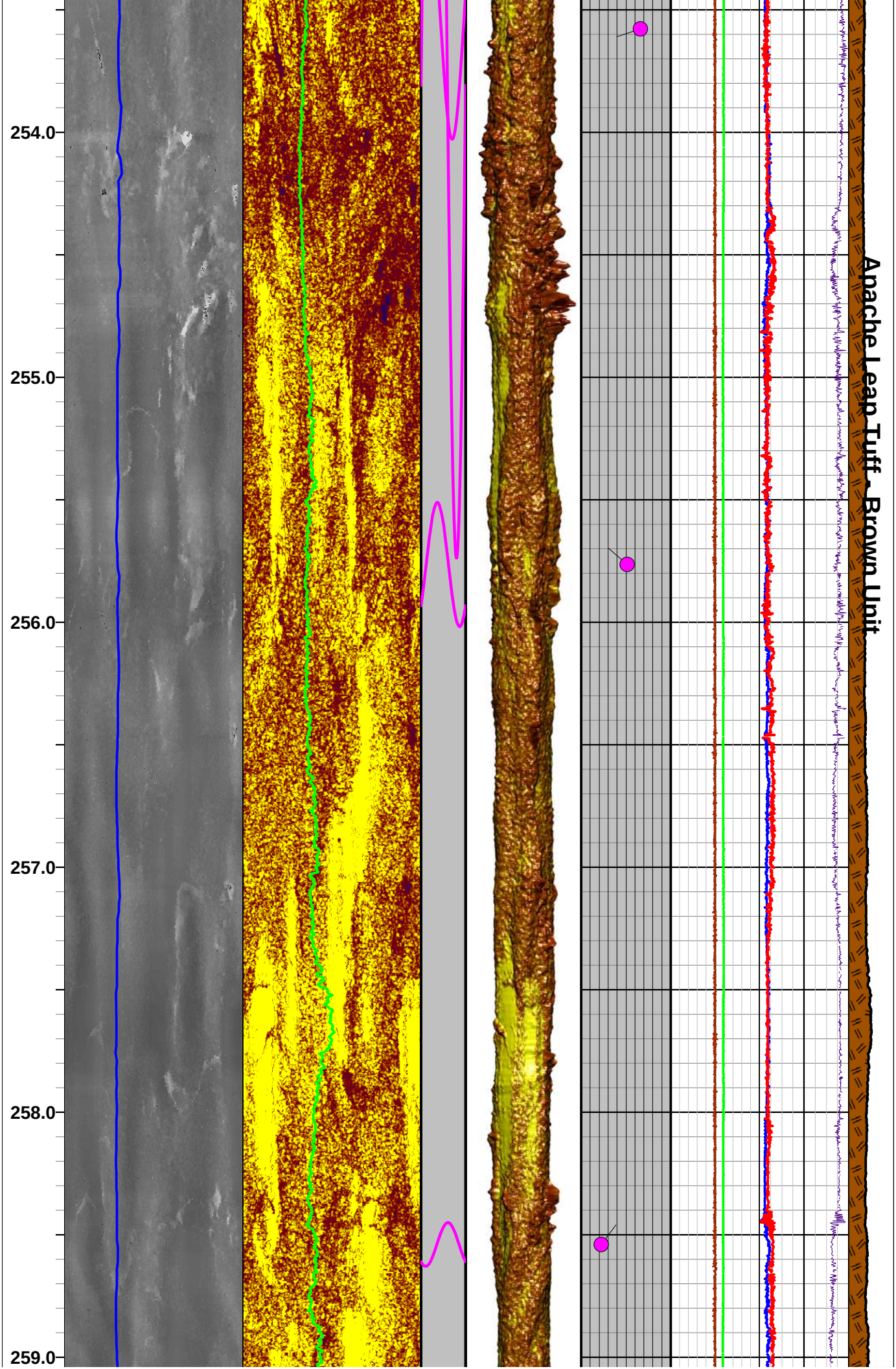
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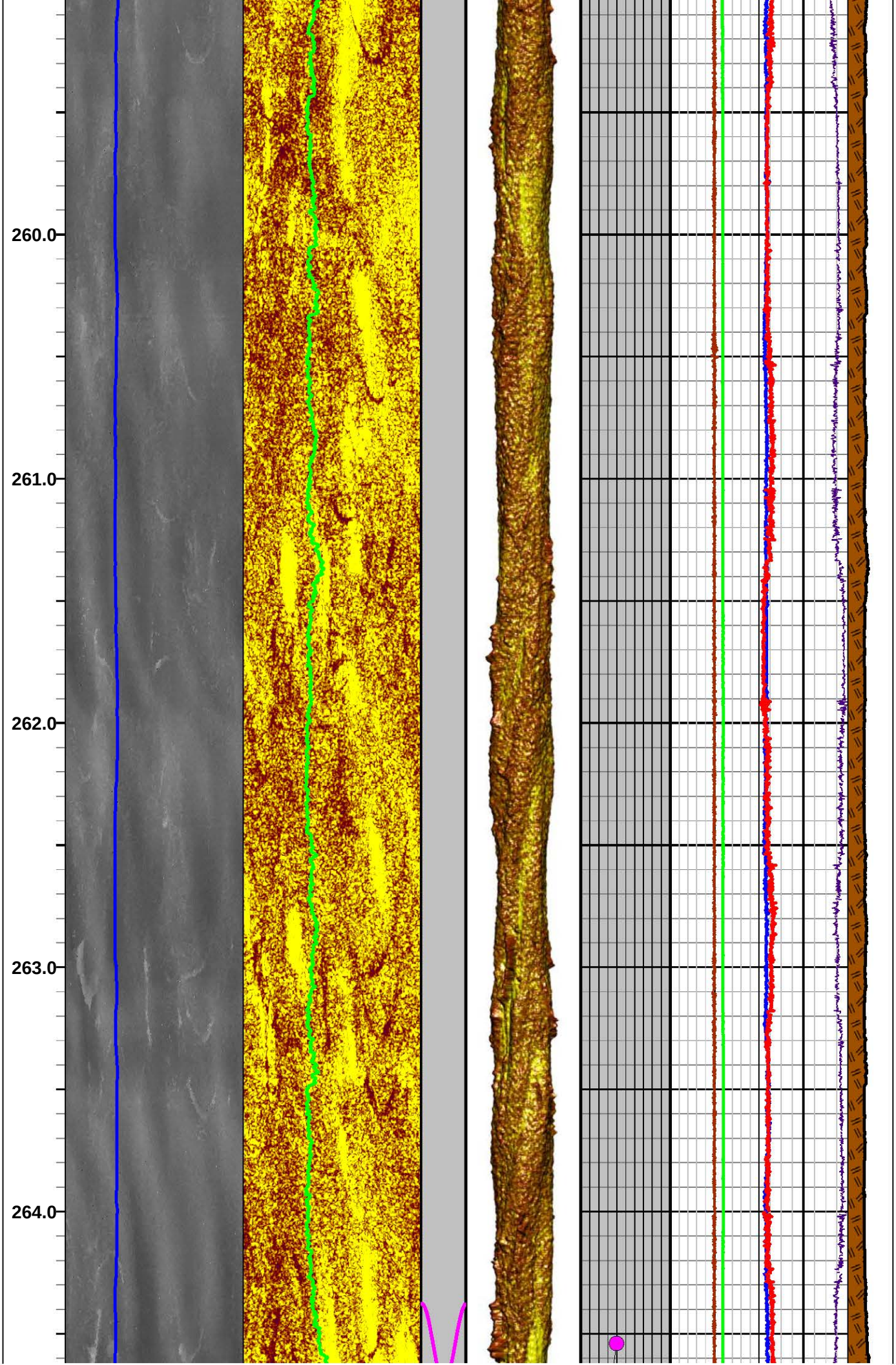
259.0
Apache Leap Tuff - Brown Unit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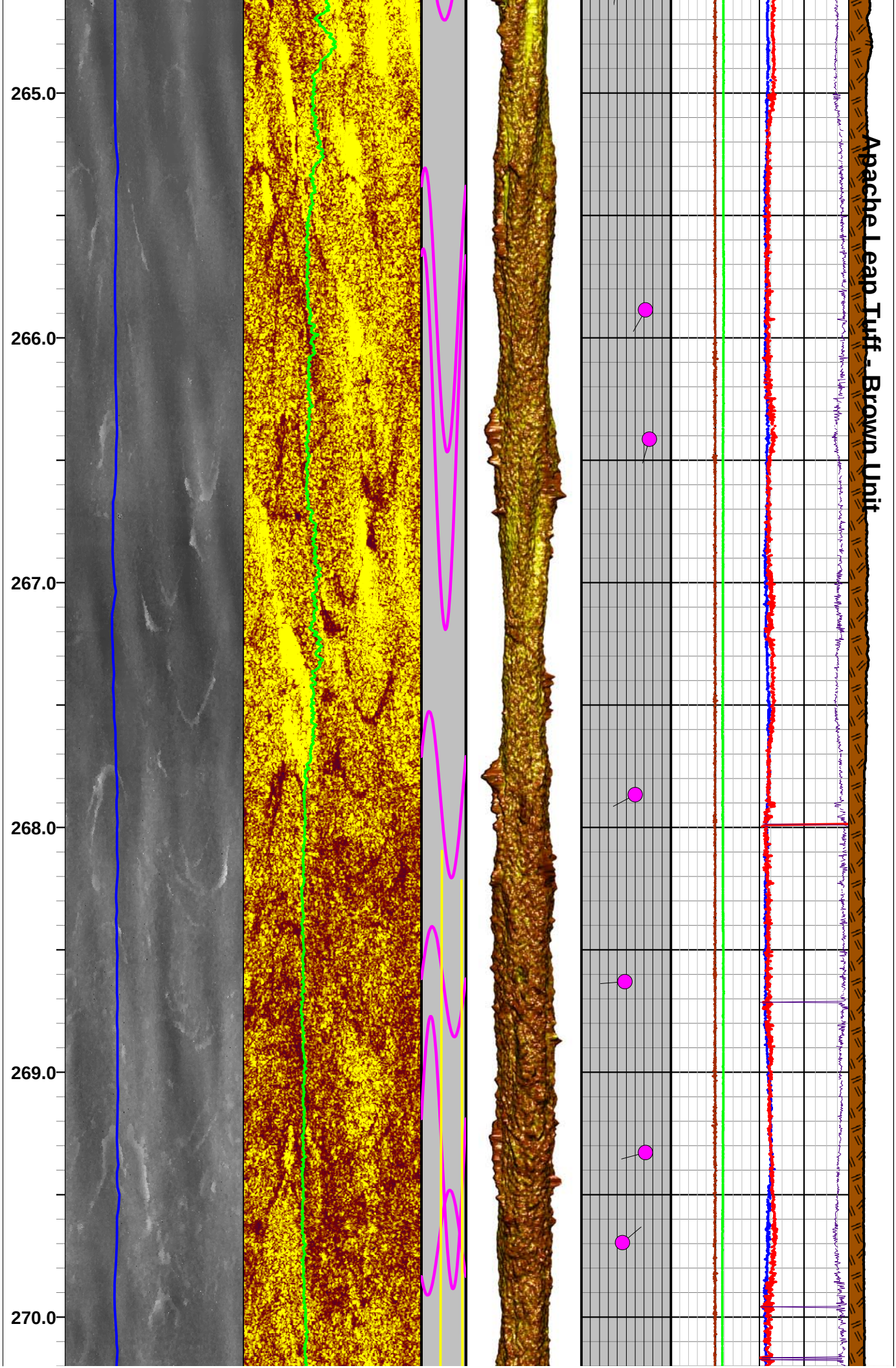
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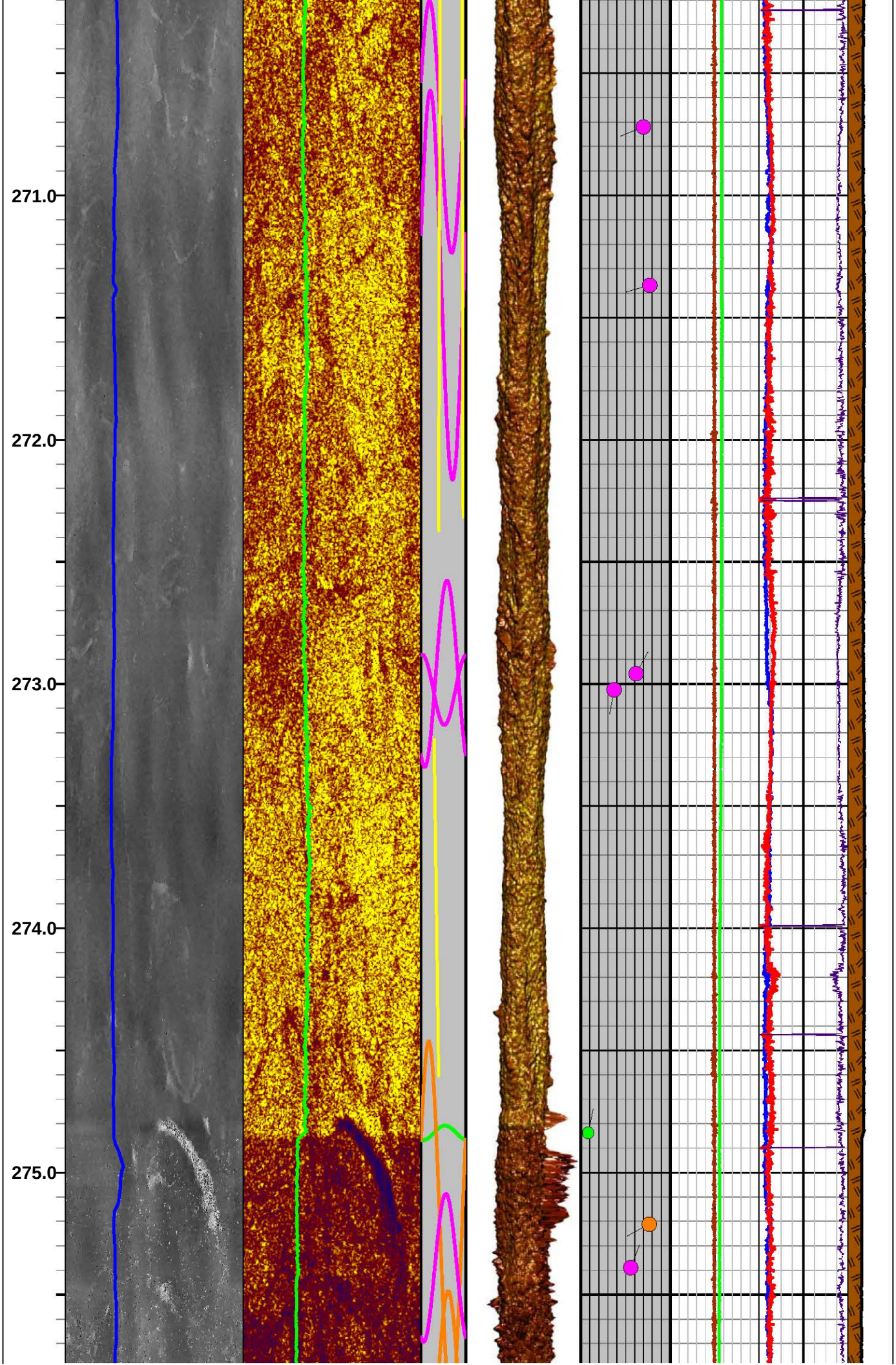
270.0
Apache Leap Tuff - Brown Unit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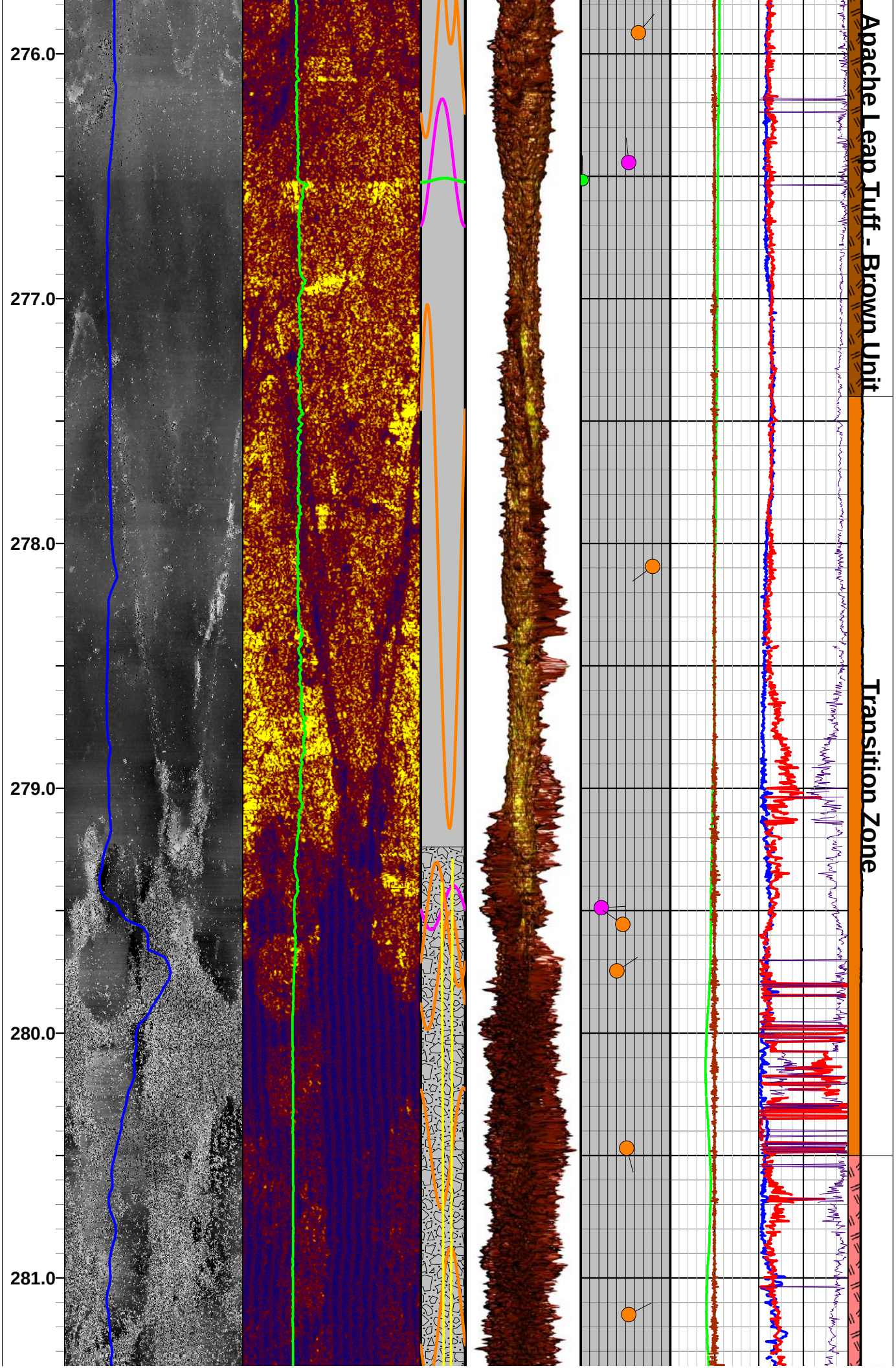
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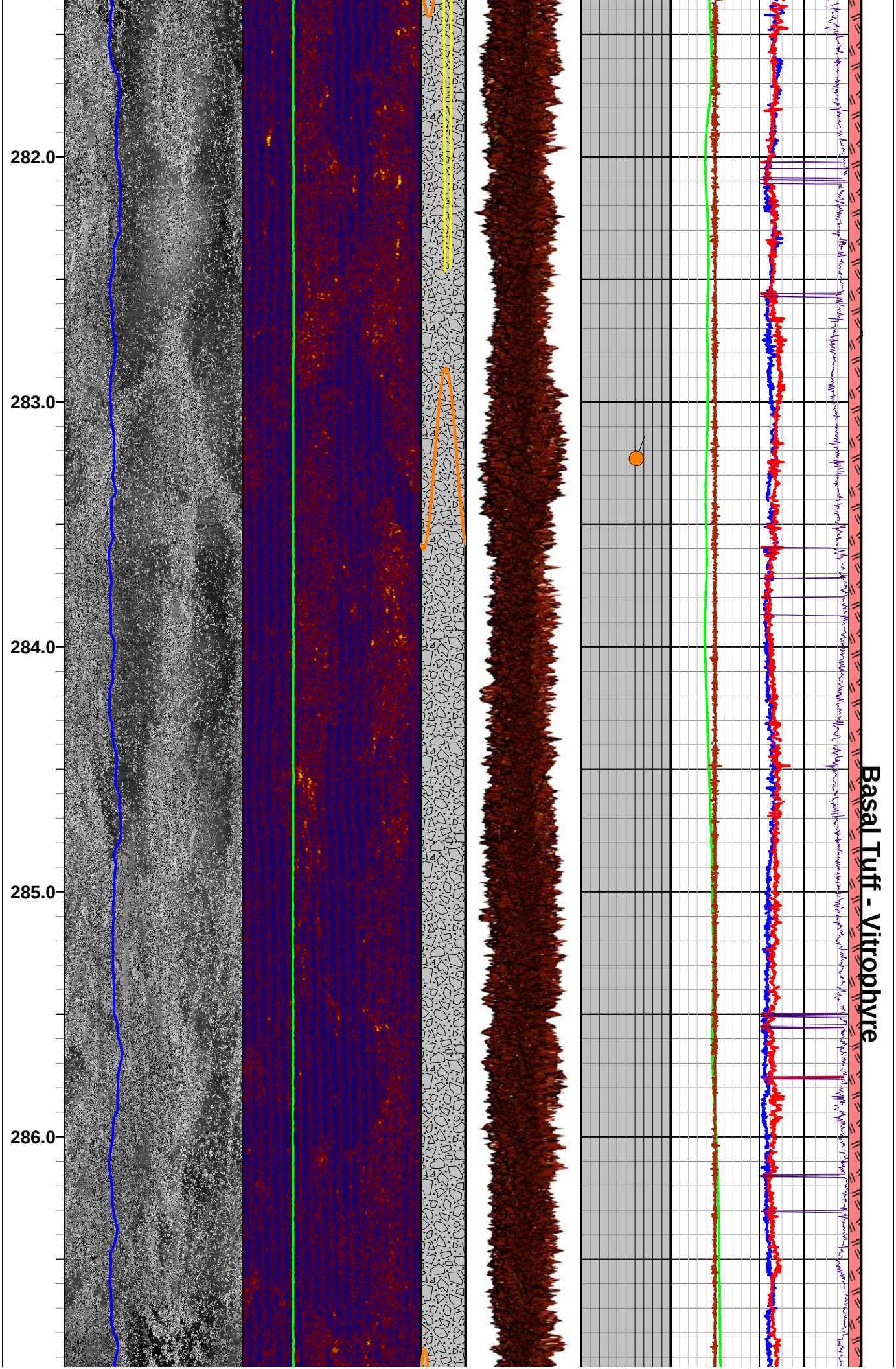
Apache Leap Tuff - Brown Unit
Transition Zone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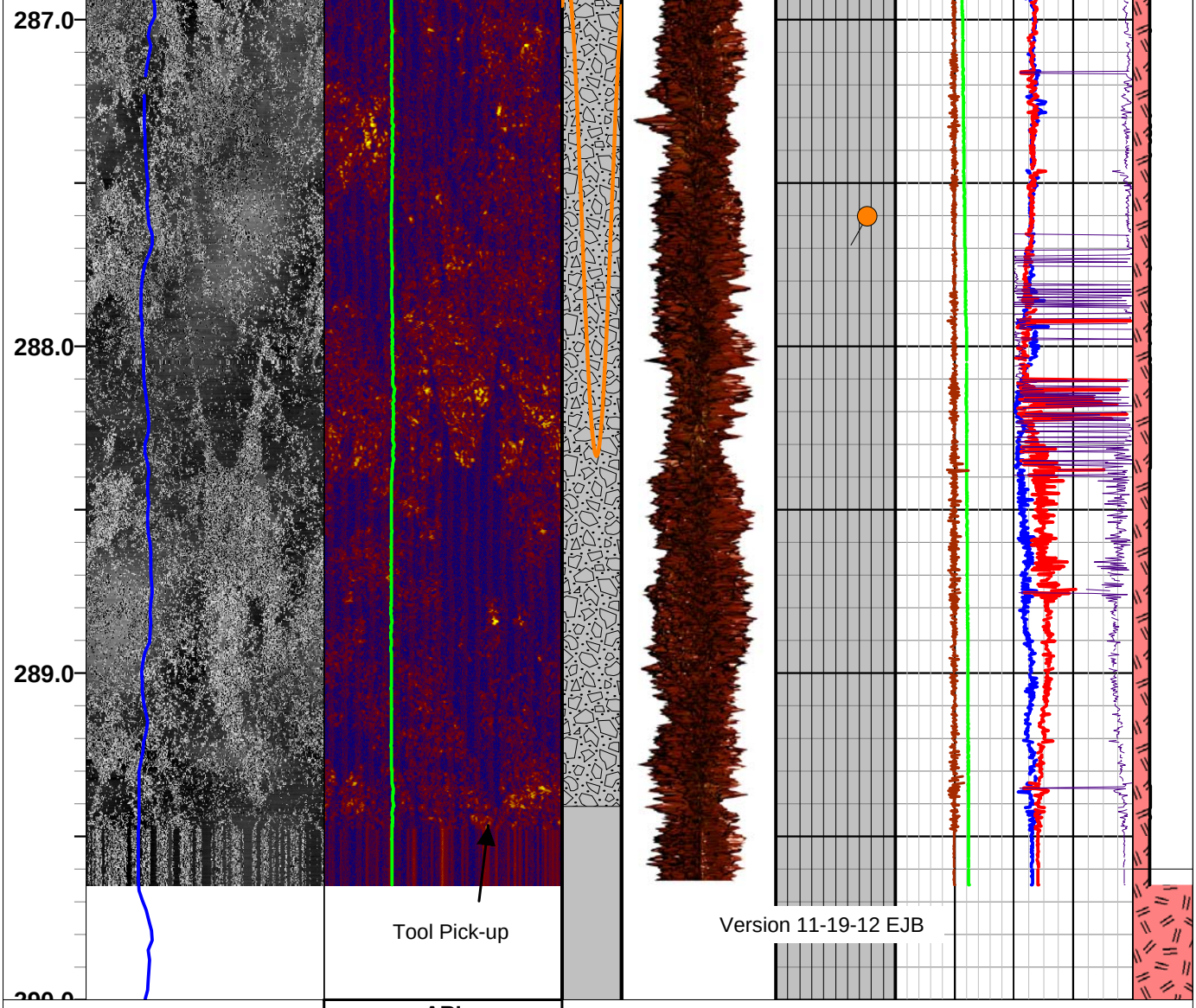
Basal Tuff - Vitrophyre



Depth 1m:20m	Caliper 10 Inches 30	Centralized TT Oriented Mag North 0° 90° 180° 270° 0°	ARI 0 400	Amp-High Pass Oriented Mag North 0° 90° 180° 270° 0°	Amp-Static Oriented Mag North 0° 90° 180° 270° 0°	Amplitude-NM Oriented Mag North 0° 90° 180° 270° 0°	Bx	NVJt	ABI DIPA	3D 0°	Tadpole DIPT 0 100	Gravity 0.8 g 1.2	Mag Field 40 uT 60	RBR -90 270	Azimuth 0 360	Tilt 0 deg 10	Desc	Hard	Lith
1m:20m	HRES-19 ABI-43 Summary_ ~119.0 M to ~289.6 M																		

ABI Image Summary Legend

Mnemonics and Comments

Centralized TT = 2D plot of acoustic image travel time with probe position centralized. Oriented to magnetic north and plotted from left to right N-E-S-W-N

Caliper = 3-arm mechanical caliper of hole diameter plotted from 10 to 30 inches (blue line).

Max Acoustic Caliper = Maximum acoustic caliper of hole diameter calculated from Travel Time data

Max-Acoustic Caliper = Maximum acoustic caliper of hole diameter calculated from Travel Time data and plotted as orange line from 10 to 30 inches. Turned off due to elongation of hole diameter.

Ave-Acoustic Caliper = Average acoustic caliper of hole diameter calculated from Travel Time data and plotted as bright green line from 10 to 30 inches. Turned off due to elongation of hole diameter

Enlargements = Pink shaded zone between Avg-Acoustic Caliper and Max-Acoustic Caliper calculated from Travel Time data showing borehole enlargment. Turned off due to elongation of hole diameter.

Amplitude-NM = 2D plot of unfiltered acoustic image amplitude oriented to magnetic north. Plotted from left to right N-E-S-W-N. Image toggled off.

Amp-Static = 2D plot of acoustic image amplitude with Static normalization filter oriented to magnetic north. Plotted from left to Right N-E-S-W-N. Image toggled on.

Amp-High Pass = 2D plot of acoustic image amplitude with High Pass normalization filter oriented to magnetic north. Plotted from left to Right N-E-S-W-N. Image toggled on.

ARI = Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 400 (harder) as green line.

ABI = Planar strucutral features picked on acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis.

NVJt = Near Vertical (near parallel to hole axis) joint/fracture features picked on acoustic borehole image shown as colored sinusoid (color designation shown on header).

Bx = Apparent Breccia or Congomerate zones and Vugs/Vesicles/Cavities.

3-D = 3D cylindrical projection of ABI image using Centralized TT log for hole shape looking from North.

Tadpole = Tadpole plot of the ABI feature picks (fractures and bedding planes); plotted from 0 to 90 dip - see legend above. DIPT = True orientation; features corrected for hole deviation.

Mag Field = Total magnetic field strength as measured by fluxgate magnetometer in OBI or ABI deviation sensor - plotted 40-60 uT (green line).

Gravity = Total gravity (probe acceleration) as measured by 3-axis accelerometers in ABI deviation sensor - plotted 0.8-1.2 g (brown line).

Azimuth = Direction of tool tilt plotted 0 to 360 deg - represents borehole deviation direction (red line).

Tilt = Tool tilt (vertical = 0 and horizontal = 90) plotted 0 to 10 deg ; represents borehole deviation tilt from vertical (blue line).

RBR = Relative bearing - azimuth of the probe marker position to Magnetic North measured clockwise (thin purple line).

Lith = Major/principal lithology based on field geologic descriptions provided by Clear Creek staff.

Desc = Major/principal field geologic descriptions provided by Clear Creek staff.

Hard = Apparent rock harness from ARI used to silhouette lithology.

Prepared by Erika J. Beam

Rev 11-19-12

Southwest Exploration Services, LLC
borehole geophysics & video services

ABI-OBI Combined - Deviation Plot: Bulls-Eye View

Survey Calculation Method : Minimum Curvature

Reference : Mag. North
Mag Declination : 11.5 Deg

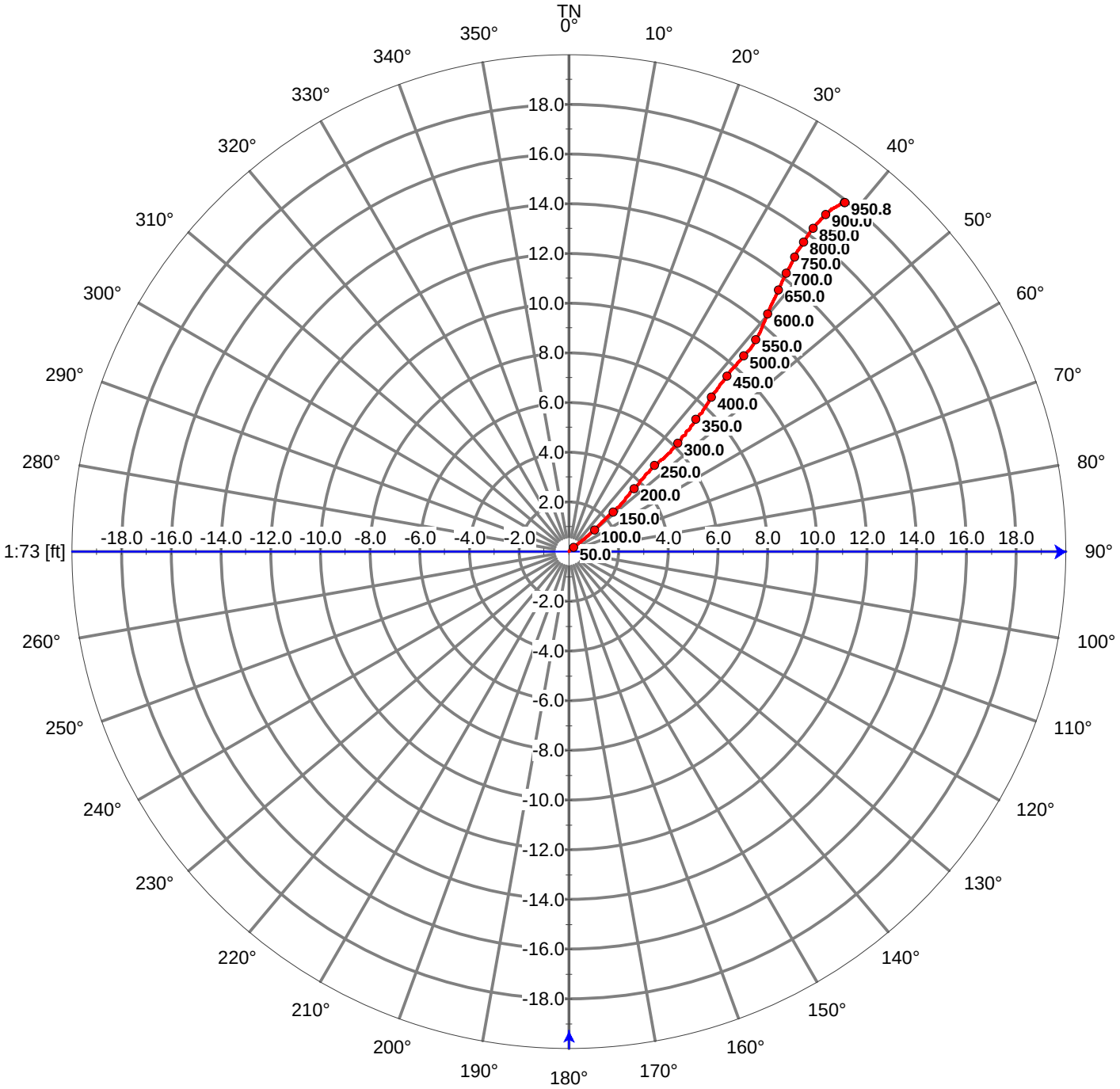
WELL #	HRES-19	DATE	11-4-12
CLIENT	RESOLUTION COPPER		
FIELD/SITE	OAK FLATS		
COUNTY	PINAL	STATE	AZ
OPERATOR	K. MITCHELL/E. BEAM	WITNESS	BARRY H. - CLEAR CREEK

FINAL LOCATION
CLOSURE DISTANCE 17.9 FT
CLOSURE ANGLE 50.3 DEG
TVD 950.6 FT

Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in context of measured interval only

Measured Interval SURF TO 291.4 M
Tool Zero Reference Ground Level
Tool used: OBI MK4/ABI-43

Centralized YES
Elevation:
Serial No:



Southwest Exploration Services, LLC
borehole geophysics & video services

ABI-OBI Combined - Deviation Plot: Vertical View

Survey Calculation Method : Minimum Curvature

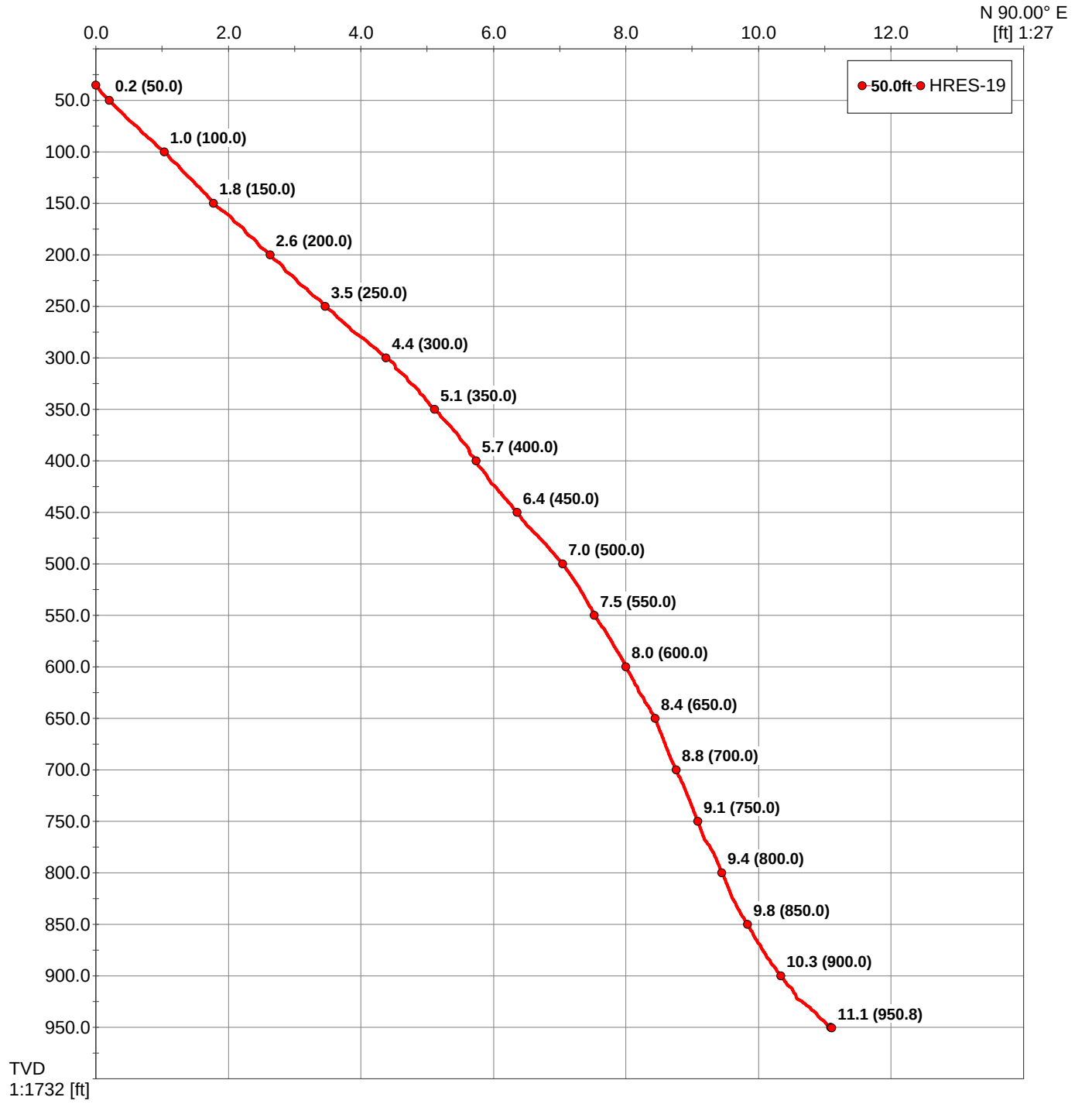
Reference : Mag. North
Mag Declination : 11.5 Deg

WELL #	HRES-19	DATE	11-4-12	FINAL LOCATION	
CLIENT	RESOLUTION COPPER			CLOSURE DISTANCE	17.9 FT
FIELD/SITE	OAK FLATS			CLOSURE ANGLE	50.3 DEG
COUNTY	PINAL	STATE	AZ	TVD	950.6 FT
OPERATOR	K. MITCHELL/E. BEAM	WITNESS	BARRY H. - CLEAR CREEK		

Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in contexted of measured interval only.

Measured Interval: SURF TO 291.4 M
Tool Zero Reference: Ground Level
Tool used: OBI MK4/ABI-43

Centralized: YES
Elevation:
Serial No:



Southwest Exploration Services, LLC
borehole geophysics & video services

ABI-OBI Combined - Deviation Plot: Closure View

Survey Calculation Method : Minimum Curvature

Reference : Mag. North
Mag Declination : 11.5 Deg

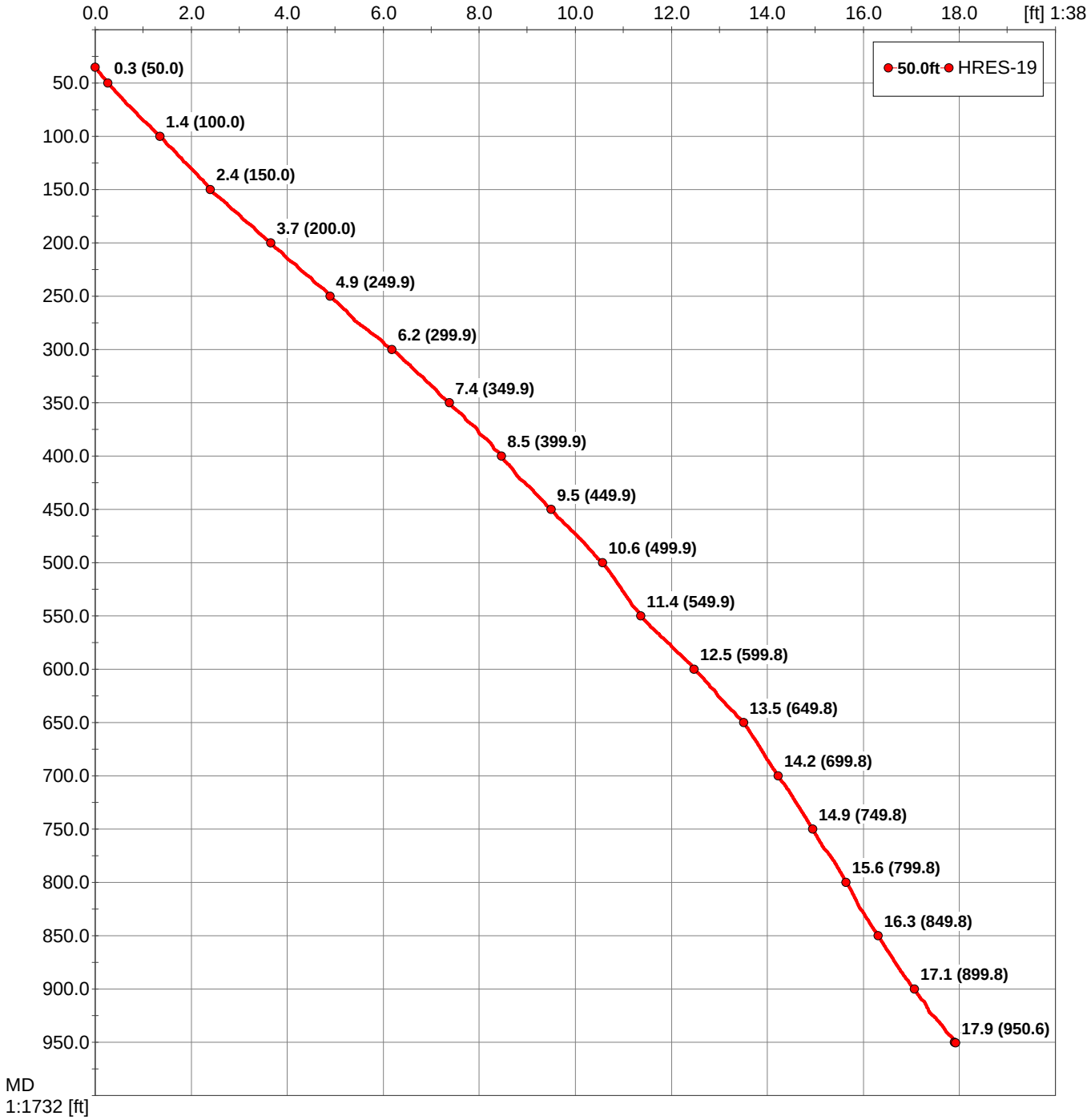
WELL #	HRES-19	DATE	11-4-12
CLIENT	RESOLUTION		
FIELD/SITE	OAK FLATS		
COUNTY	PINAL	STATE	AZ
OPERATOR	K. MITCHELL/E. BEAM	WITNESS	BARRY H - CLEAR CREEK

FINAL LOCATION
CLOSURE DISTANCE 17.9 FT
CLOSURE ANGLE 255.2 DEG
TVD 950.6 FT

Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in contexted of measured interval only.

Measured Interval SURF TO 291.4 M
Tool Zero Reference Ground Level
Tool used: OBI MK4/ABI-43

Centralized YES
Elevation:
Serial No:



MD
1:1732 [ft]

PLATE 2

HRES-20 GEOPHYSICAL LOGS

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-20 (ADWR 55-914790)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: CALIPER-GAMMA RAY
MORE: FLUID TEMP/RESIS

LOCATION
D(1-13)27CBD

SEC 27 TWP 1S RGE 13E

OTHER SERVICES
OBI
ABI
E-LOGS
SONIC

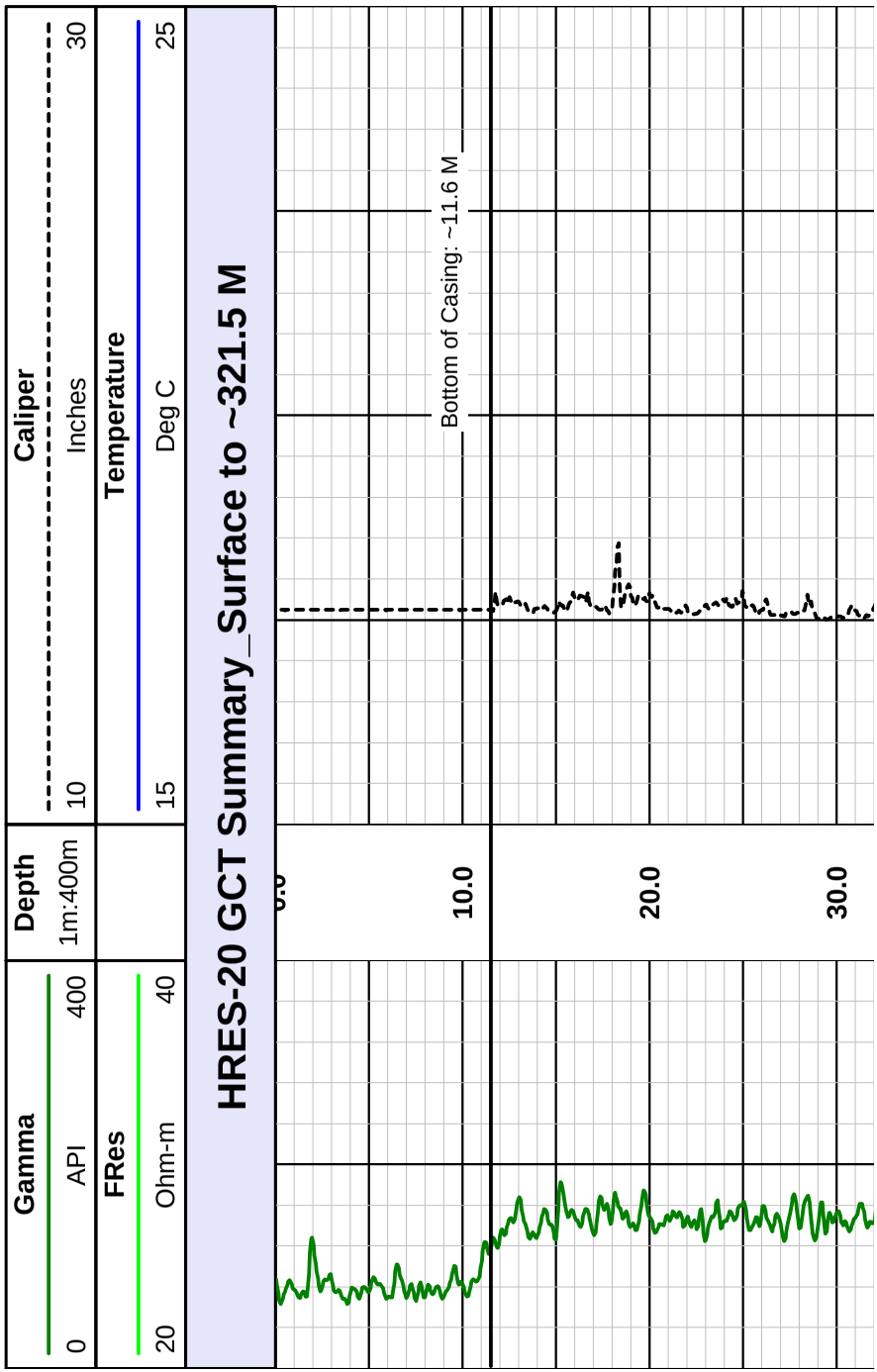
PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

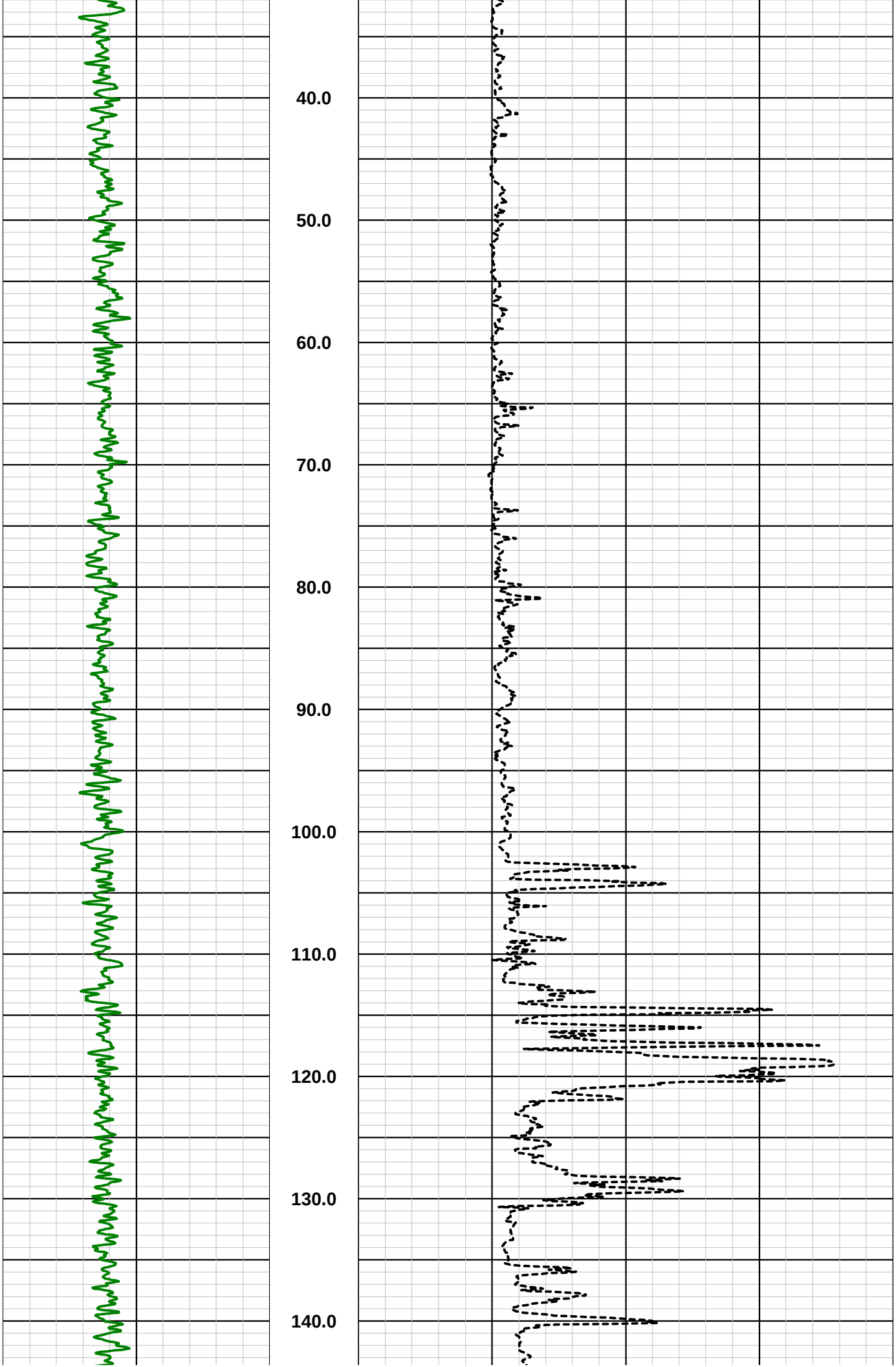
DATE	12-03-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	GAMMA-CALIPER-TEMP	DENSITY	N/A
DEPTH-DRILLER	321 M	LEVEL	196 M
DEPTH-LOGGER	321 M	MAX. REC. TEMP.	22.2 DEG C
BTM LOGGED INTERVAL	321 M	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	SURFACE	SAMPLE INTERVAL	.1 FT
DRILLER / RIG#	BOART LY	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/M.QUINONES	TOOL STRING/SN	MSI 2PCA-PGA-F SN4953
WITNESSED BY	CLEAR CREEK-R. MITCHELL	LOG TIME:ON SITE/OFF SITE	7:00 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	22"	SURFACE	39 FT	16"	HWT	SURFACE	39 FT
2	15"	39 FT	570 FT				
3	14 3/4"	570 FT	TD				

COMMENTS:

.

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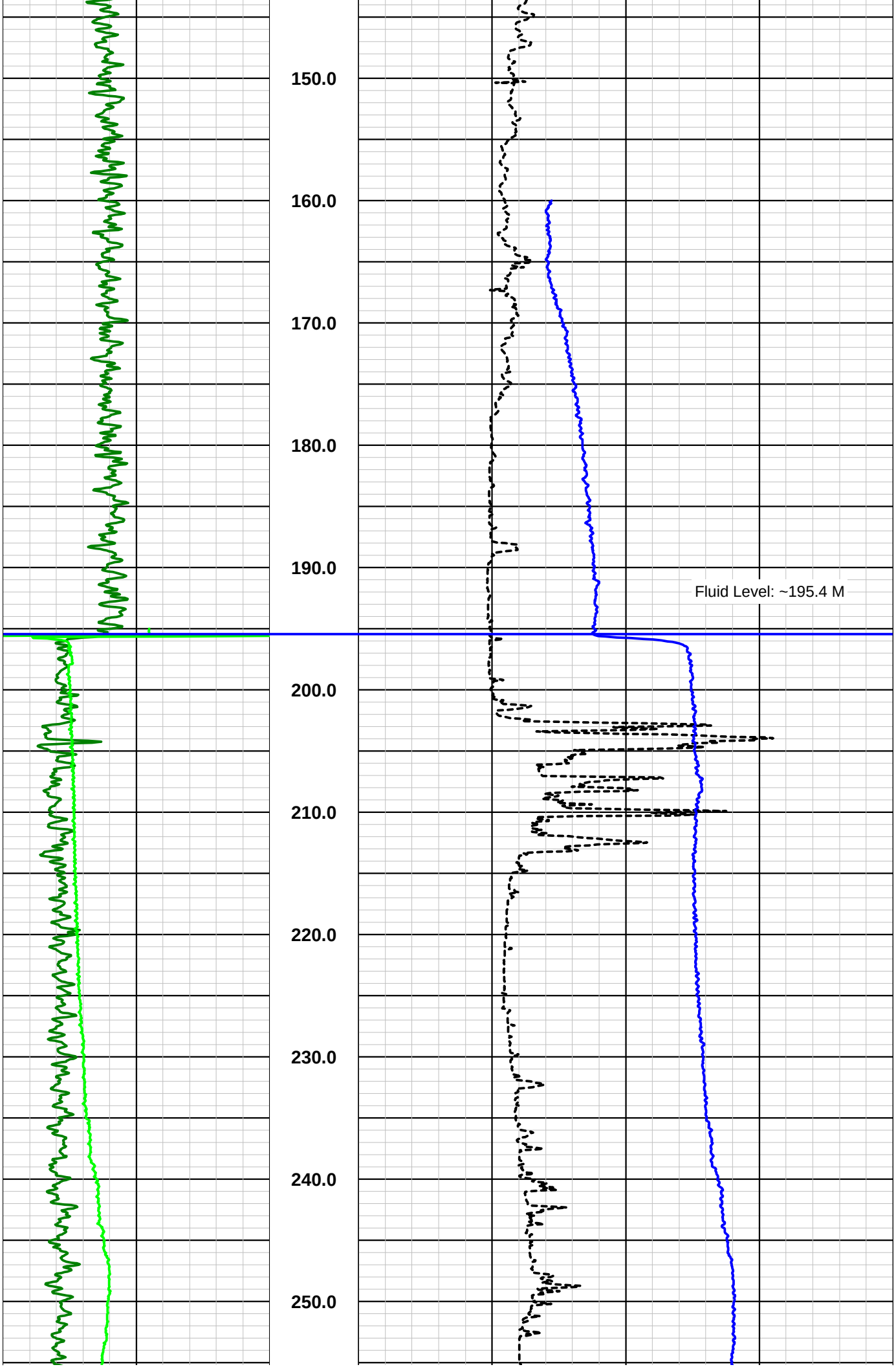
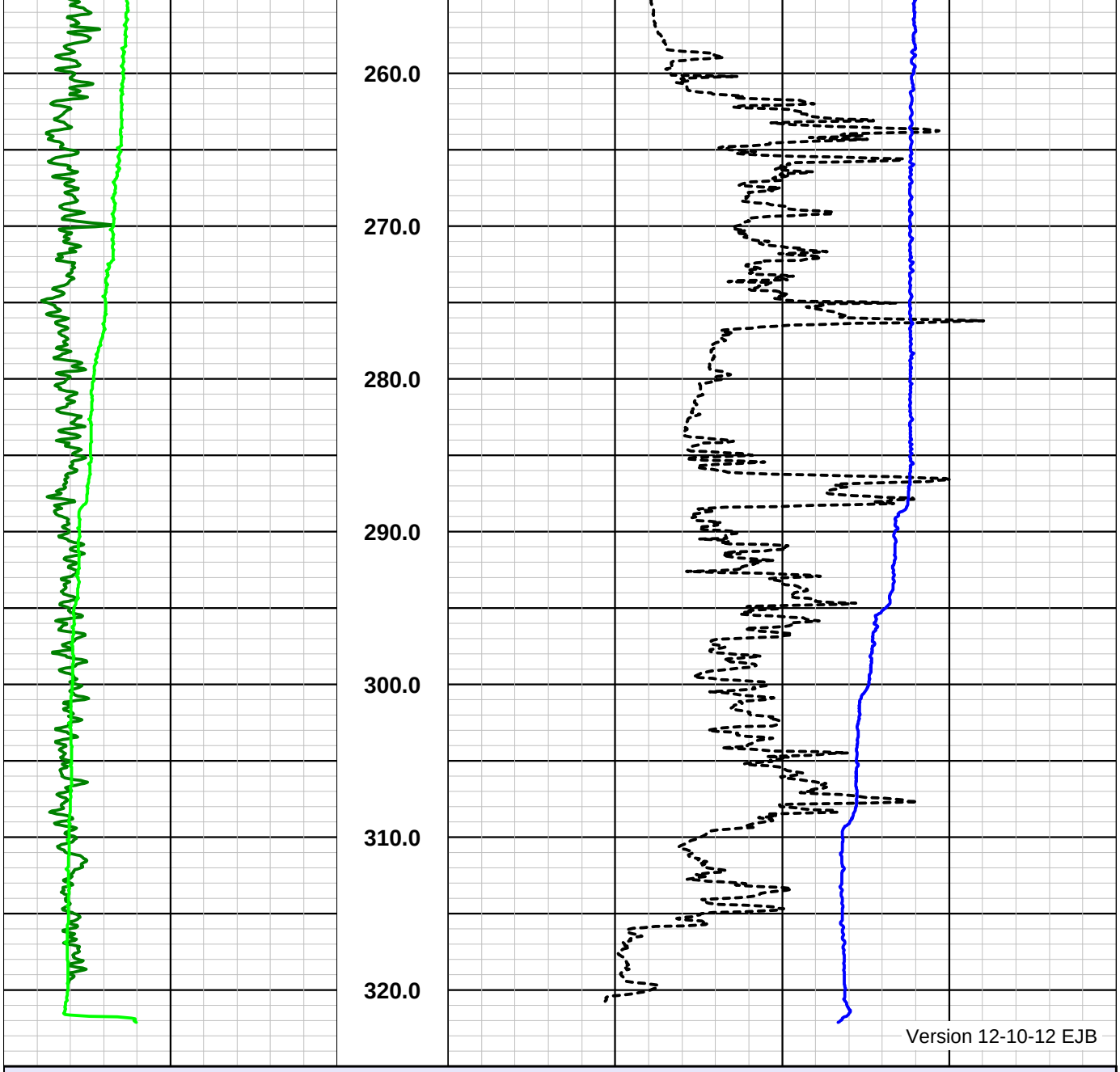
130.0
140.0


150.0
160.0
170.0
180.0
190.0
Fluid Level: ~195.4 M
200.0
210.0
220.0
230.0
240.0
250.0



HRES-20 GCT Summary_Surface to ~321.5 M

FRes		Temperature
20 Ohm-m 40		15 Deg C 25
Gamma	**Depth**	**Caliper**
0 API 400	1m:400m	10 Inches 30

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COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-19 (ADWR 55-914789)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: E-LOGS

MORE:

LOCATION
D(2-13)8AAA

SEC 8 TWP 2S RGE 13E

OTHER SERVICES
CALIPER
TEMP/FLUID RES
OBI
ABI
SONIC

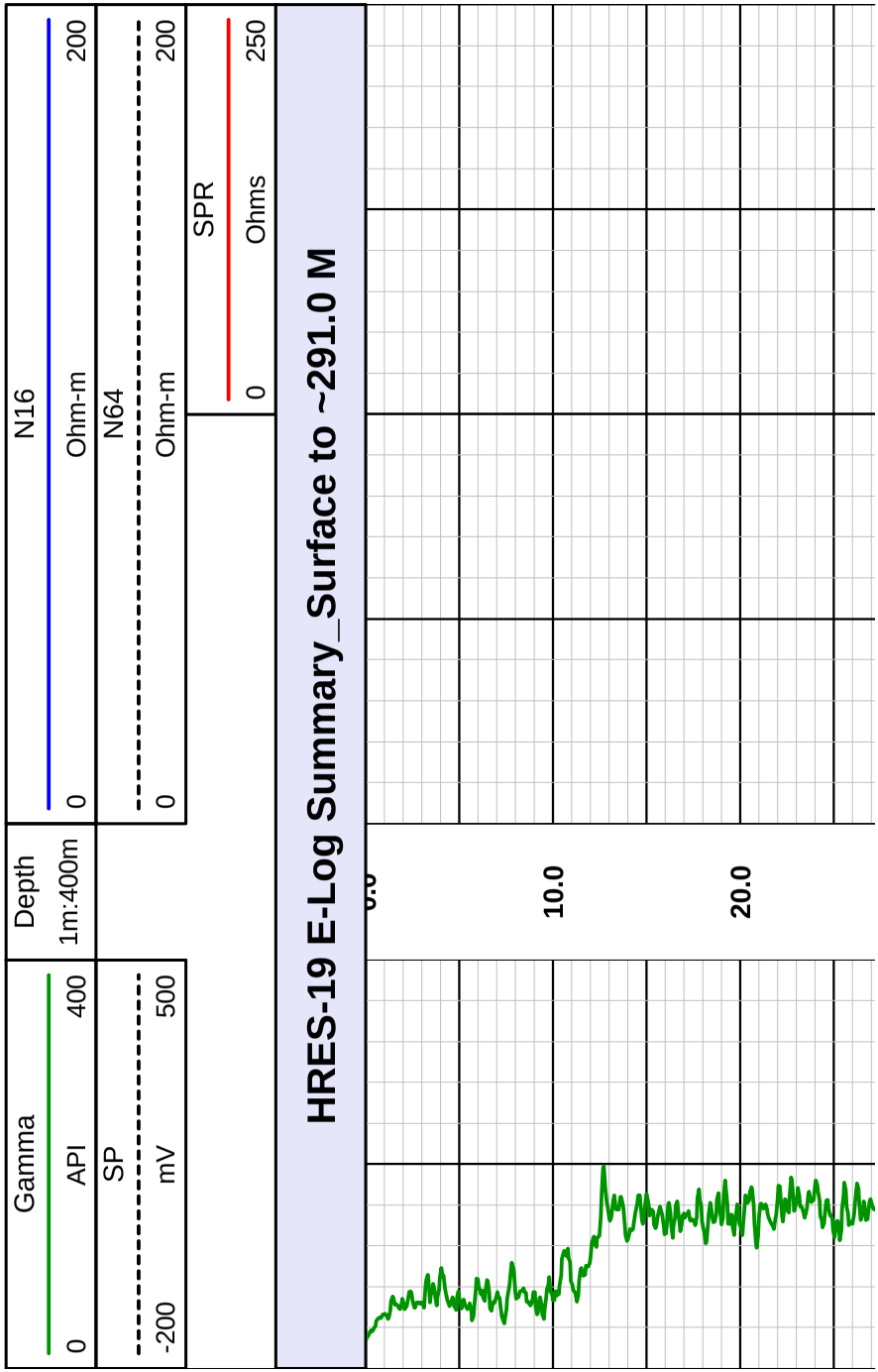
PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

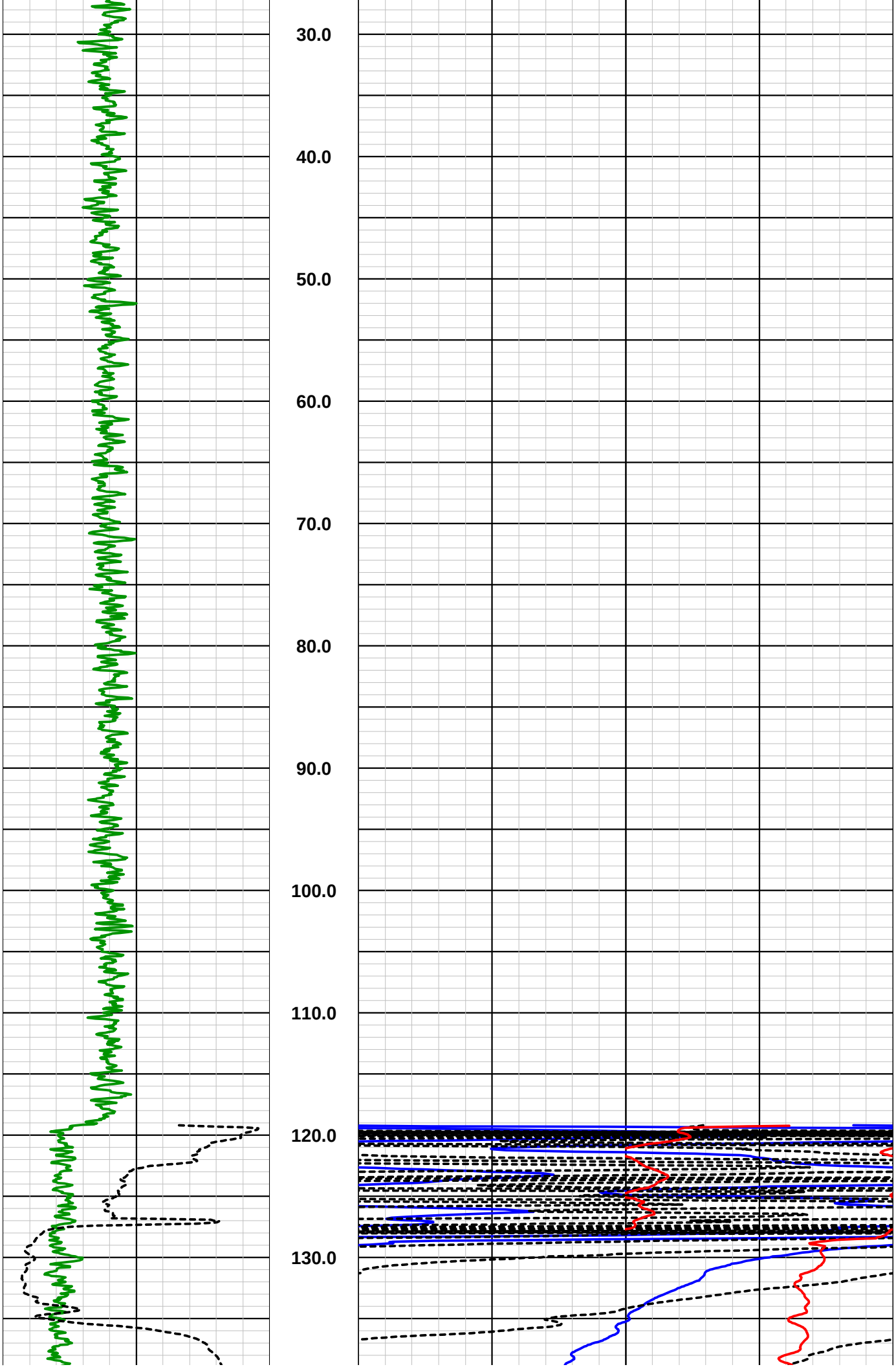
DATE	11-4-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	ELOGS	DENSITY	N/A
DEPTH-DRILLER	291.5 M	LEVEL	119.2 M
DEPTH-LOGGER	291.5 M	MAX. REC. TEMP.	23.5 DEG C
BTM LOGGED INTERVAL	291.5 M	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	119.2 M	SAMPLE INTERVAL	.2 FT
DRILLER / RIG#	BOART LONGYEAR	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	40 GRP SN 5019
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	7:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	20"	SURFACE	11.9 M	15 3/4"	HWT	SURFACE	11.9 M
2	14 3/4"	11.9 M	TD				
3							

COMMENTS:

.

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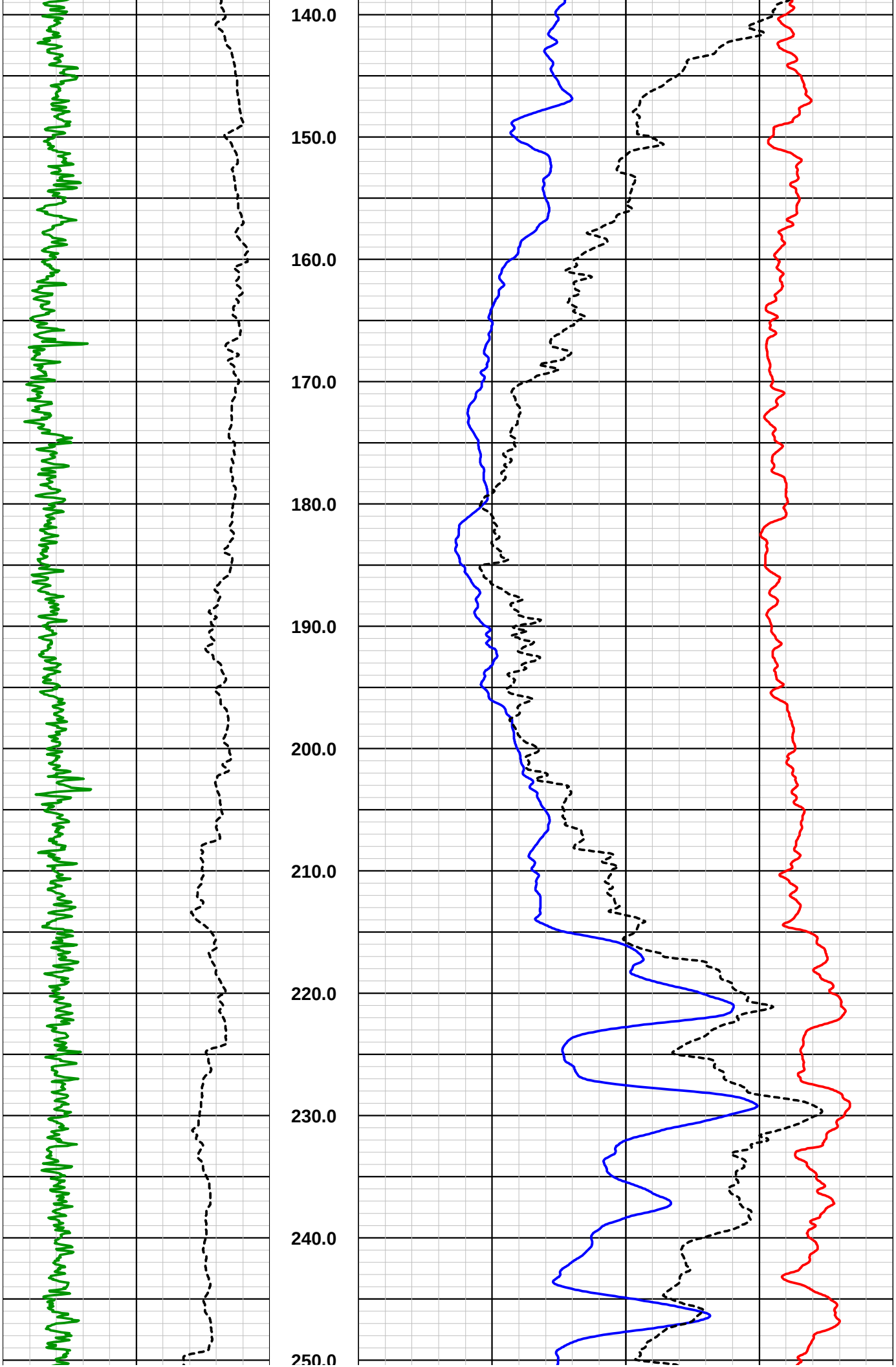
90.0
100.0
110.0
120.0
130.0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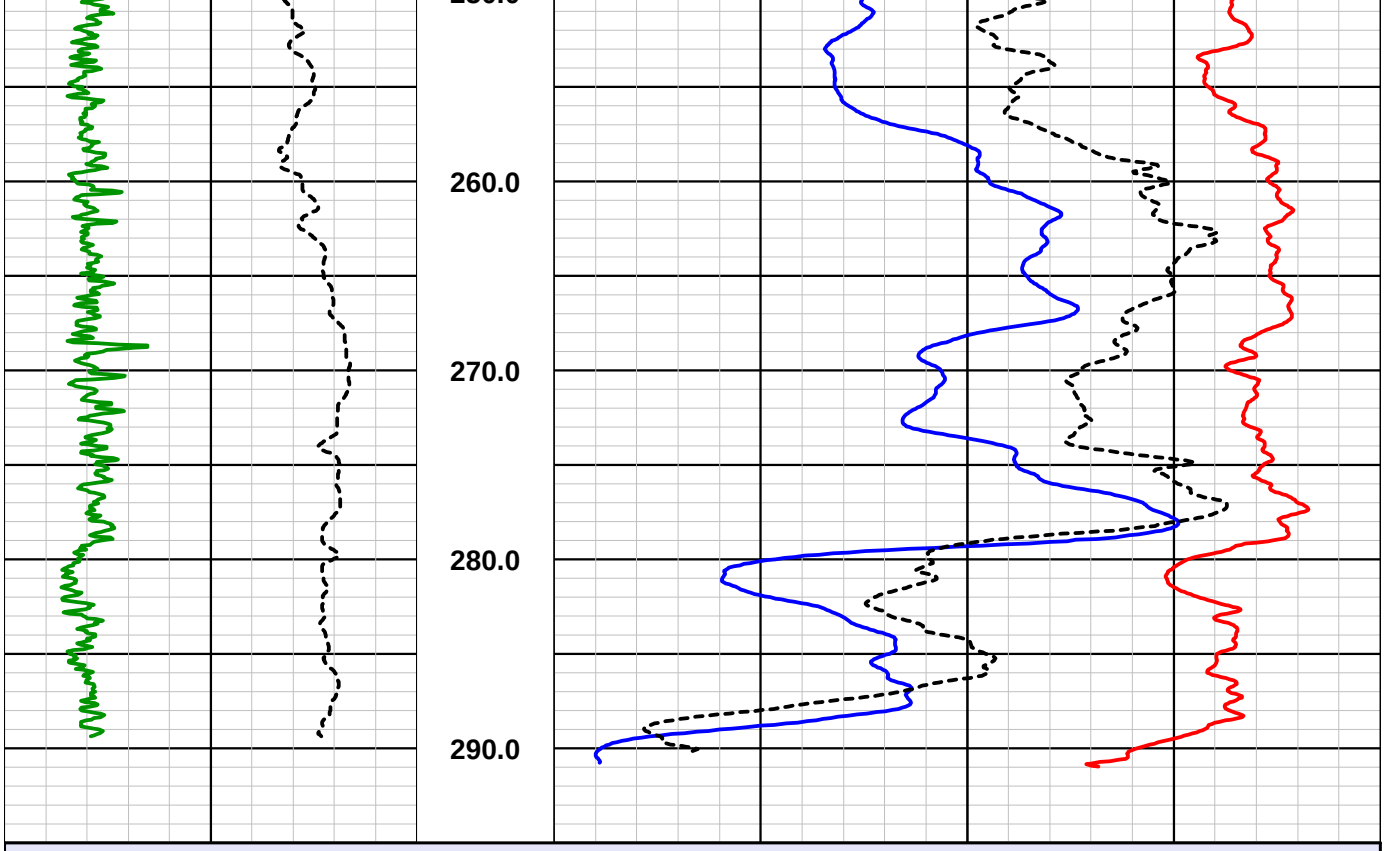
220.0
230.0
240.0
250.0



HRES-19 E-Log Summary_Surface to ~291.0 M

		SPR 0 Ohms 250
SP -200 mV 500		N64 0 Ohm-m 200
Gamma 0 API 400	Depth 1m:400m	N16 0 Ohm-m 200

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-19 (ADWR 55-914789)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: SONIC 4 RX
MORE: GAMMA-CALIPER

LOCATION
D(2-13)8AAA

SEC 8 TWP 2S RGE 13E

OTHER SERVICES
TEMP/FLUID RES
OBI
ABI
E-LOGS

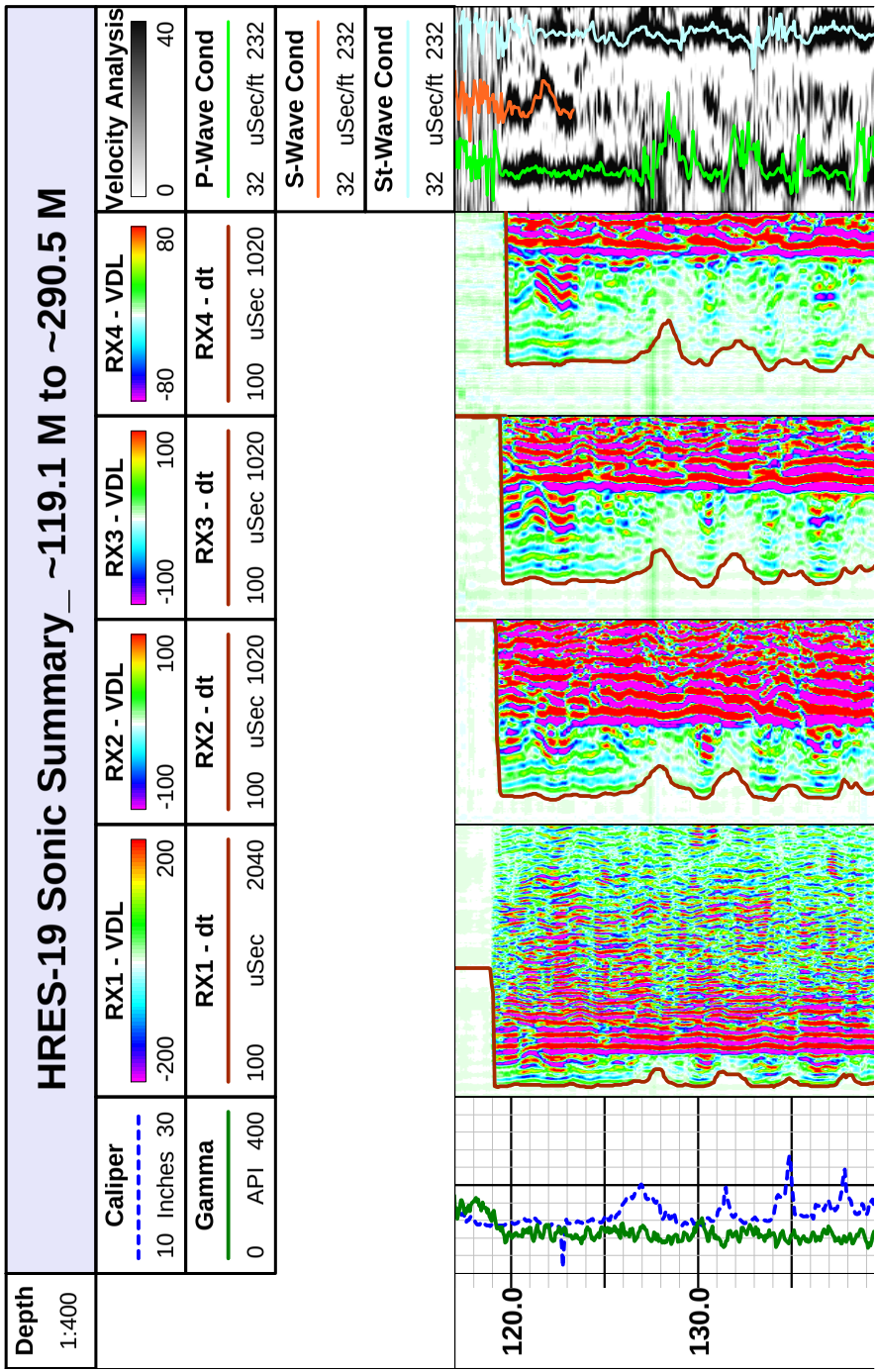
PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

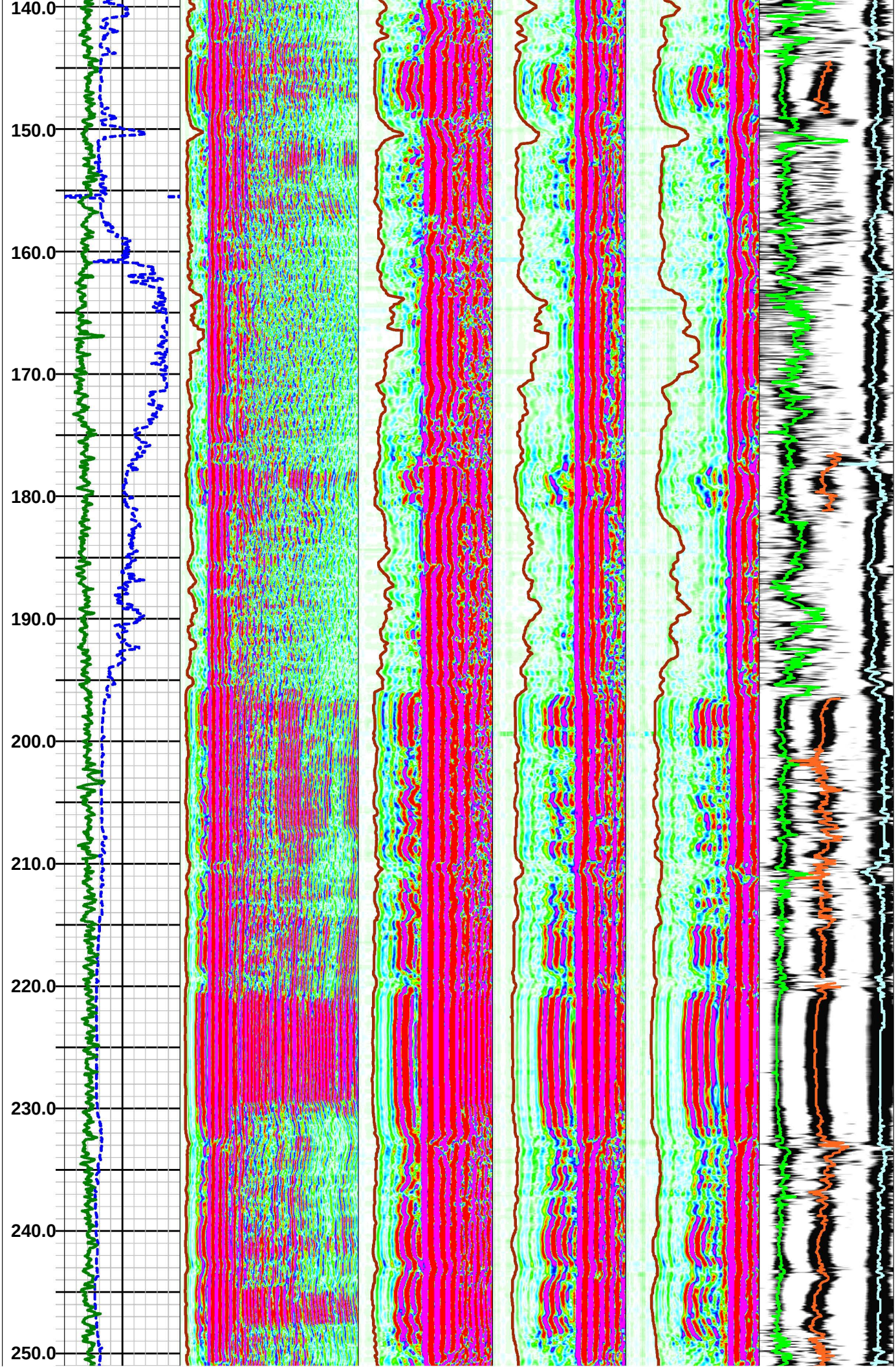
DATE	11-4-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	SONIC 4RX-GAMMA-CALIPER	DENSITY	N/A
DEPTH-DRILLER	291.5 M	LEVEL	119.2 M
DEPTH-LOGGER	291.5	MAX. REC. TEMP.	23.5 DEG C
BTM LOGGED INTERVAL	291.5	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	119.2 M	SAMPLE INTERVAL	.25 FT
DRILLER / RIG#	BOART LONGYEAR	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	ALT SONIC 4RX SN 4572
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	7:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	20"	SURFACE	11.9 M	15 3/4"	HWT	SURFACE	11.9 M
2	14 3/4"	11.9 M	TD				
3							

COMMENTS:

.

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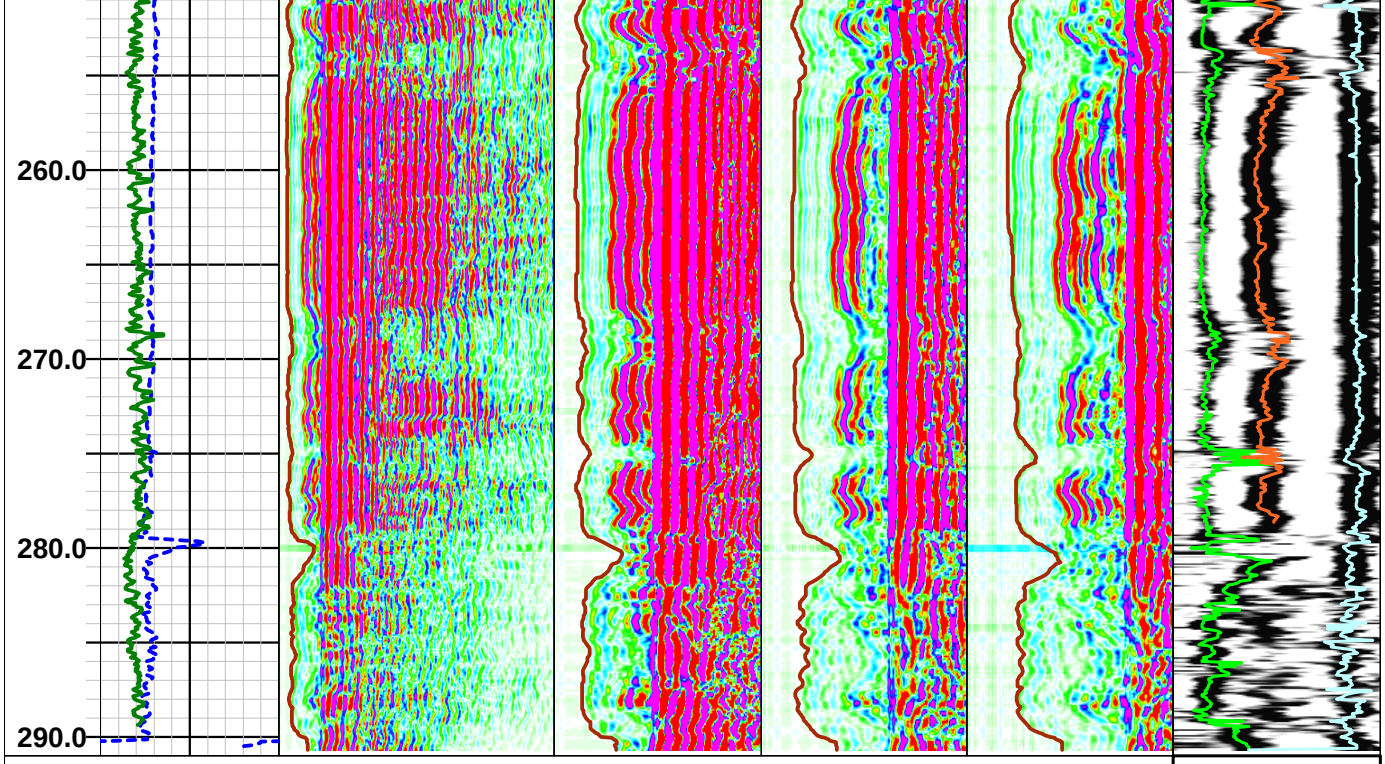

						St-Wave Cond 32 uSec/ft 232
						S-Wave Cond 32 uSec/ft 232
	Gamma 0 API 400	RX1 - dt 100 uSec 2040	RX2 - dt 100 uSec 1020	RX3 - dt 100 uSec 1020	RX4 - dt 100 uSec 1020	P-Wave Cond 32 uSec/ft 232
	Caliper 10 Inches 30	RX1 - VDL -200 200	RX2 - VDL -100 100	RX3 - VDL -100 100	RX4 - VDL -80 80	Velocity Analysis 0 40
Depth 1:400	HRES-19 Sonic Summary_ ~119.1 M to ~290.5 M					

Full Waveform Sonic Summary Legend

Mnemonics and Comments

Gamma = Natural gamma ray log plotted from 0 to 400 API units (green line).

Caliper = 3-arm mechanical caliper of hole diameter plotted from 10-30 inches (blue line).

RX1 - VDL = Color variable density display of 0.6m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 2040 uSec.

RX1 - dt = P-wave travel time pick. Plotted 100 to 2040 uSec (brown line).

RX2 - VDL = Color variable density display of 0.8m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 1020 uSec.

RX2 - dt = P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).

RX3 - VDL = Color variable density display of 1.0m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 1020 uSec.

RX3 - dt = P-wave travel time pick - if determined. Plotted 100 to 1020 uSec (brown line).

RX4 - VDL = Color variable density display of 1.2m Rx waveform; stacked over 5 waveforms, and

plotted from 100 to 1020 uSec.

RX4 - dt = P-wave travel time pick - if determined. Plotted 100 to 1020 uSec (brown line).

Velocity Analysis = Gray scale variable density display of velocity semblence waveform of the stacked waveforms; plotted from 32 to 232 uSec/ft.

P-Wave-Cond = Apparent P-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft (green line).

S-Wave-Cond = Apparent S-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft - with conditional testing to remove invalid values (orange line).

St-Wave-Cond = Apparent Stoneley-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. - with conditional testing to remove invalid values (light blue line).

Prepared by Erika J Beam

Version 11-19-12

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-19 (ADWR 55-914789)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: OBI MK 4
MORE: 3- ARM CALIPER

LOCATION
D(2-13)8AAA

SEC 8 TWP 2S RGE 13E

OTHER SERVICES
GAMMA
TEMP/FLUID RES.
ABI
E-LOGS
SONIC

PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

DATE	11-4-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	OBI-40 - CALIPER	DENSITY	N/A
DEPTH-DRILLER	291.5 M	LEVEL	119.2 M
DEPTH-LOGGER	291.5 M	MAX. REC. TEMP.	23.5 DEG C
BTM LOGGED INTERVAL	141 M	IMAGE ORIENTED TO:	MAG NORTH
TOP LOGGED INTERVAL	11 M	SAMPLE INTERVAL	.0096 FT
DRILLER / RIG#	BOART LONGYEAR	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	ALT OBI40 MK 4 080903
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	7:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	20"	SURFACE	11.9 M	15 3/4"	HWT	SURFACE	11.9 M
2	14 3/4"	11.9 M	TD				
3							

COMMENTS:

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Major Lithology

- Apache Leap Tuff - Gray Unit
- Apache Leap Tuff - Brown Unit
- Basal Tuff - Vitrophyre
- Basal Tuff
- Transition Zone

Optical Image Features Legend

- Bedding / Banding / Foliation / Veins
- Filled Fracture / Joint
- Btm of Casing

Partially Open Joint / Fracture

Minor Open Joint / Fracture

OJ/Fx terminates at Fx intersection

Unclassified

Sulfide Vein

Breakouts

Major Open Joint / Fracture

Fluid Level

Bx & NVJts Legend

Breccia or Conglomerate

Large Vugs/Vesicles (> 6")

Medium Vugs/Vesicles (2-6")

Small Vugs/Vesicles (< 2")

Conglomerate - sand matrix supported

Conglomerate - mud matrix supported

Conglomerate - clast supported

Broken Zone / Undifferentiated

Major Breakout

Minor Breakout

Tensile Fracture

Filled Near Vertical Joint/Fx

Near Vertical Joint/Fx

HRES-19 OBI-40 Summary_ ~11.9 M to ~119.8 M

Depth 1m:20m

Caliper 10 30

Gamma 0 400

Image-NM Oriented Mag North 0° 90° 180° 270° 0°

Image_11 M - 20 M Rot'd by 23.0 deg 0° 90° 180° 270° 0°

OBI DIPA

NVJt

Bx

3D 0°

Tadpole DIPT 0 100

Mag Field 40 uT 60

Gravity 0.8 G 1.2

Tilt 0 Deg 10

Azi-Edited 0 360

Roll 0 360

MRoll 0 360

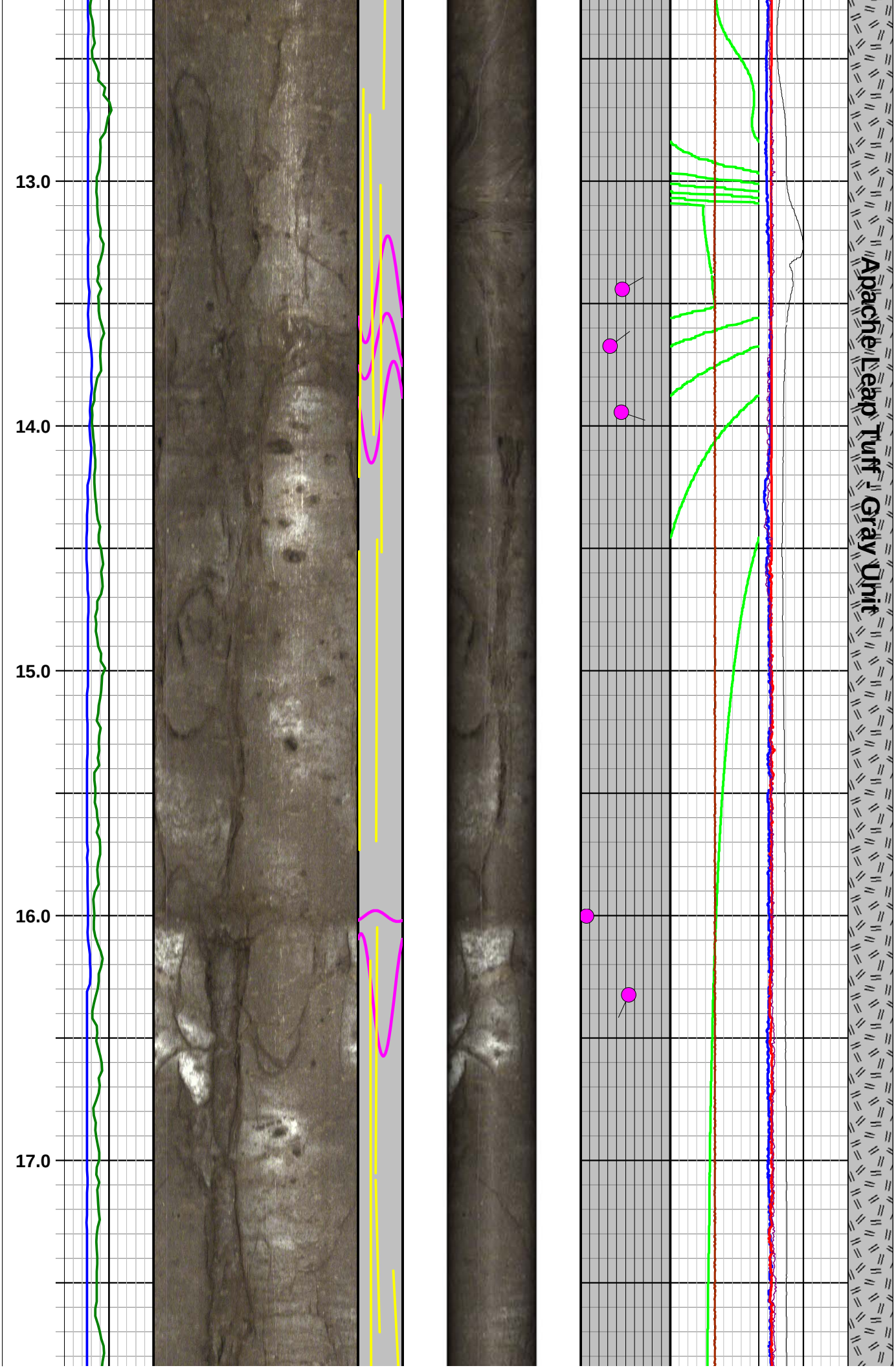
Lith

Desc

11.0

12.0

Bottom of Casing: 11.9 M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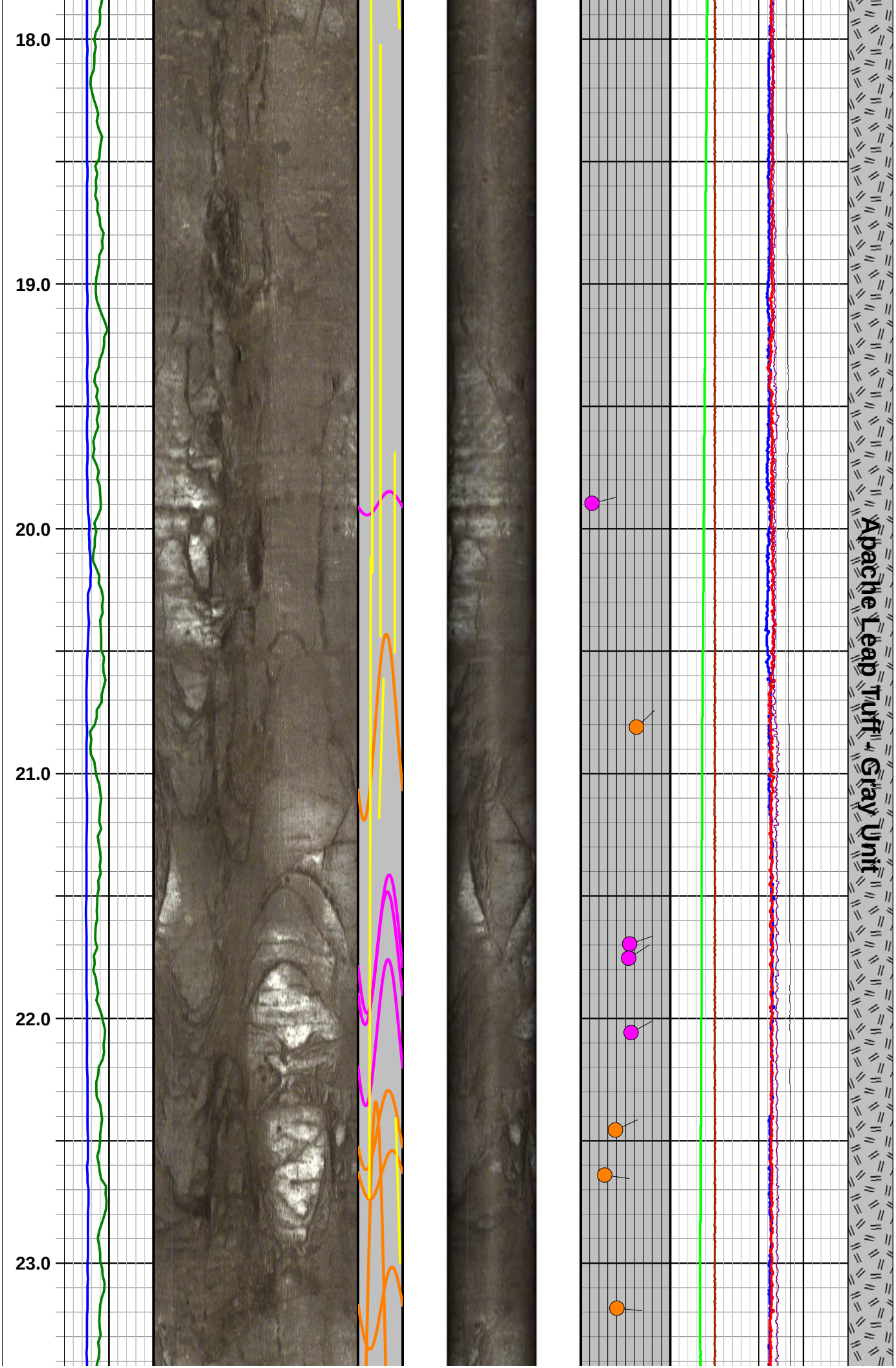
Apache Leap Tuff - Gray Unit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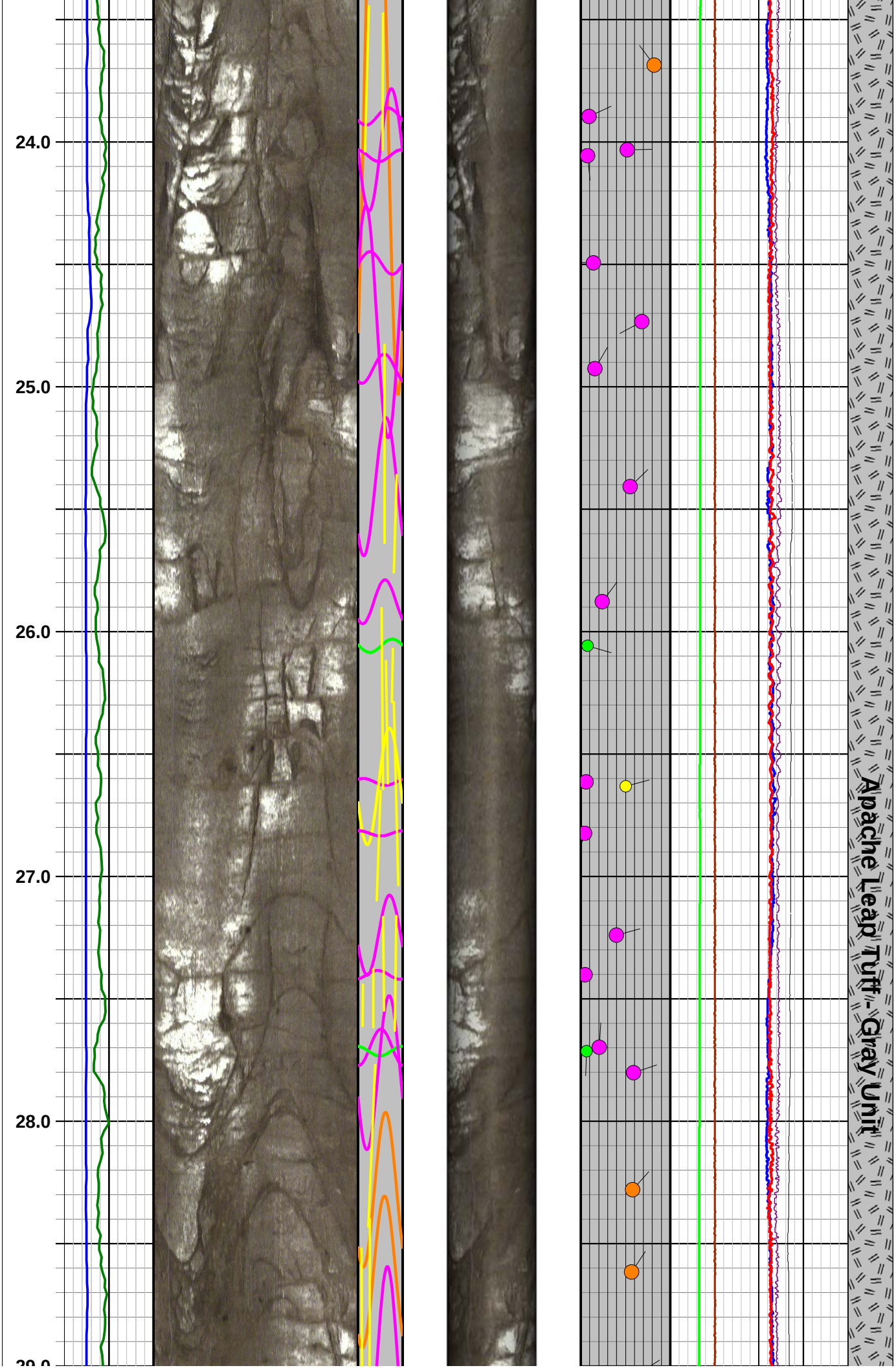
Apache Leap Tuff - Gray Unit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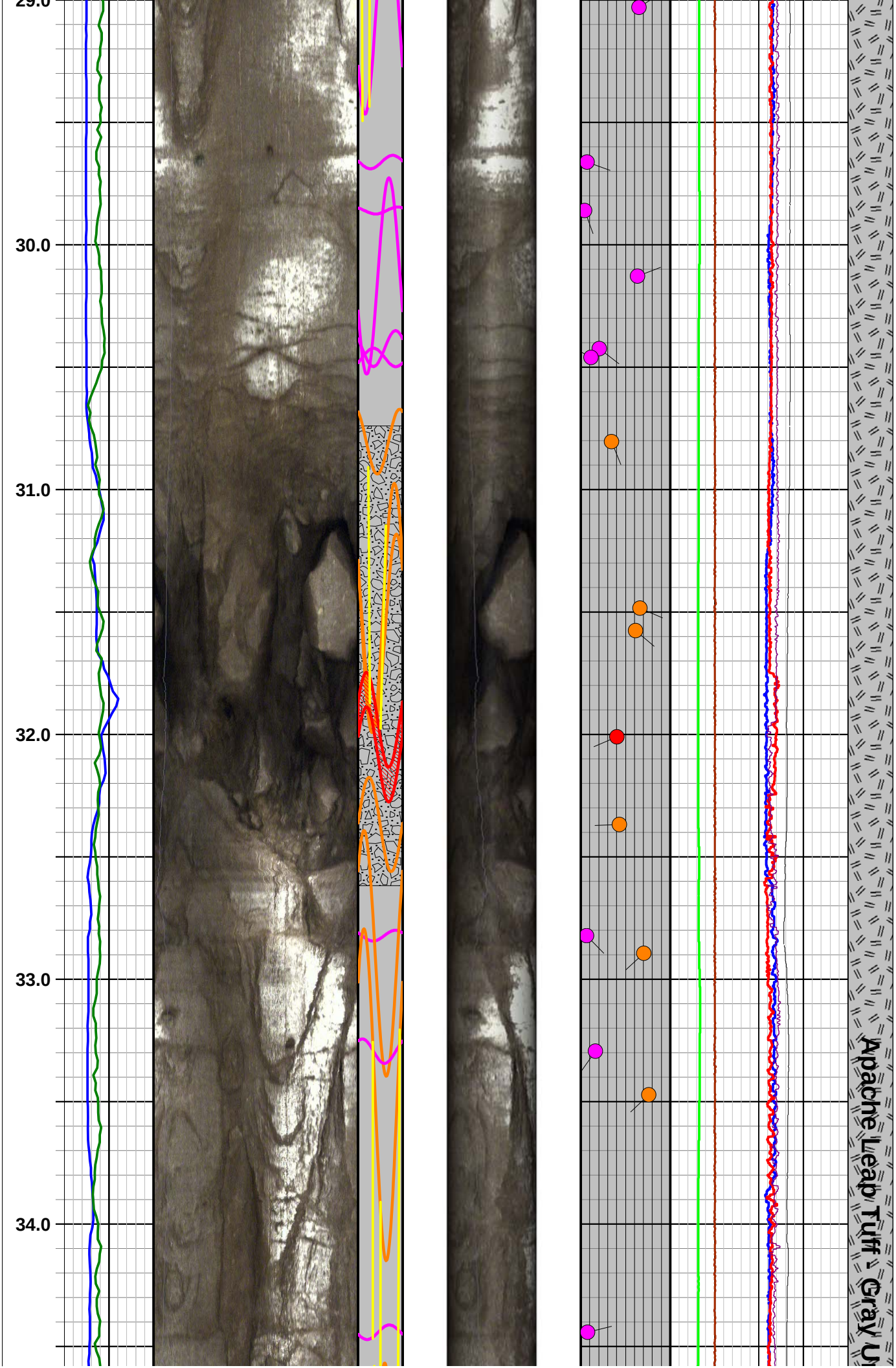
Apache Leap Tuff - Gray Unit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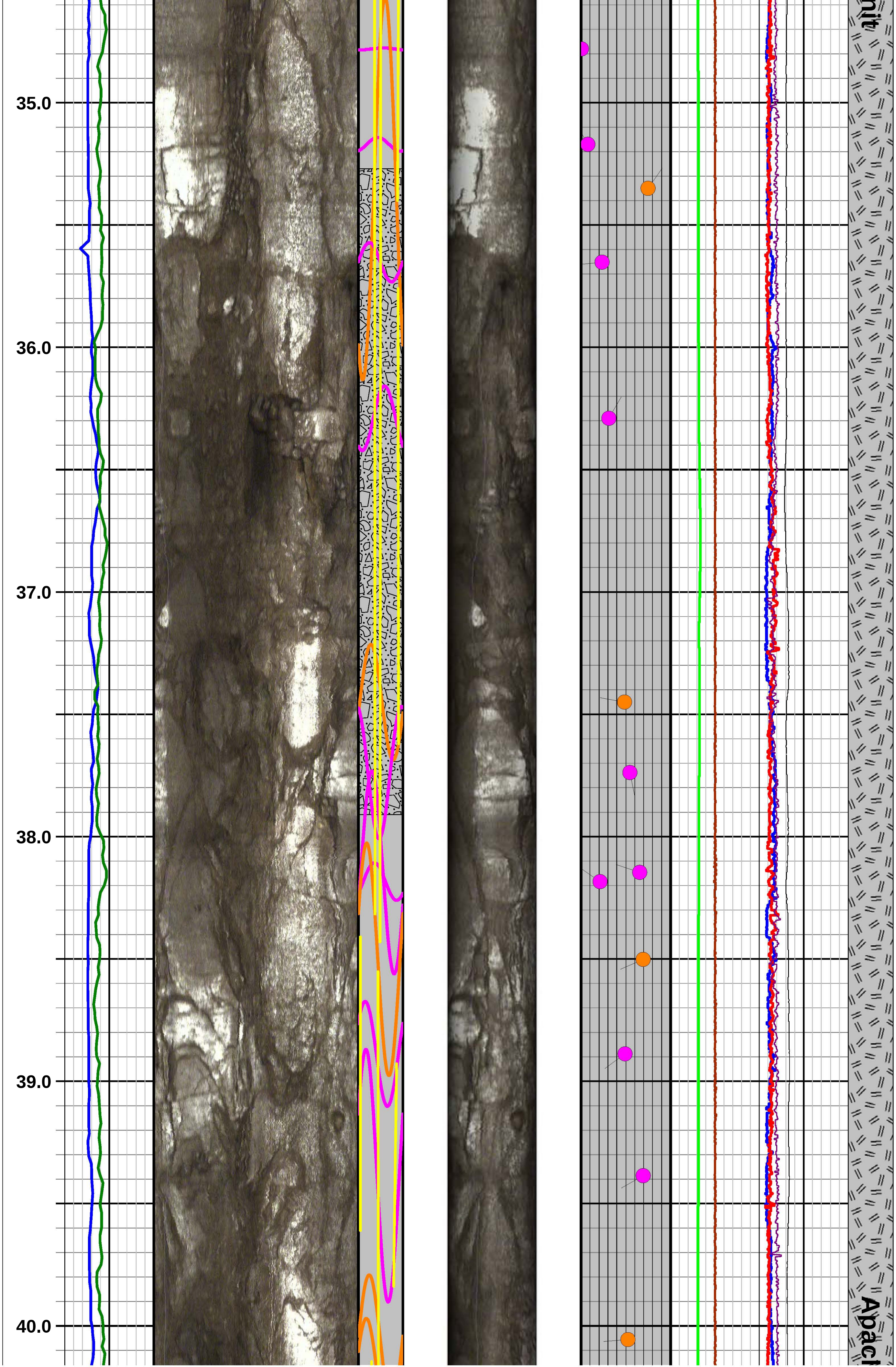
Apache Leap Tuff - Gray U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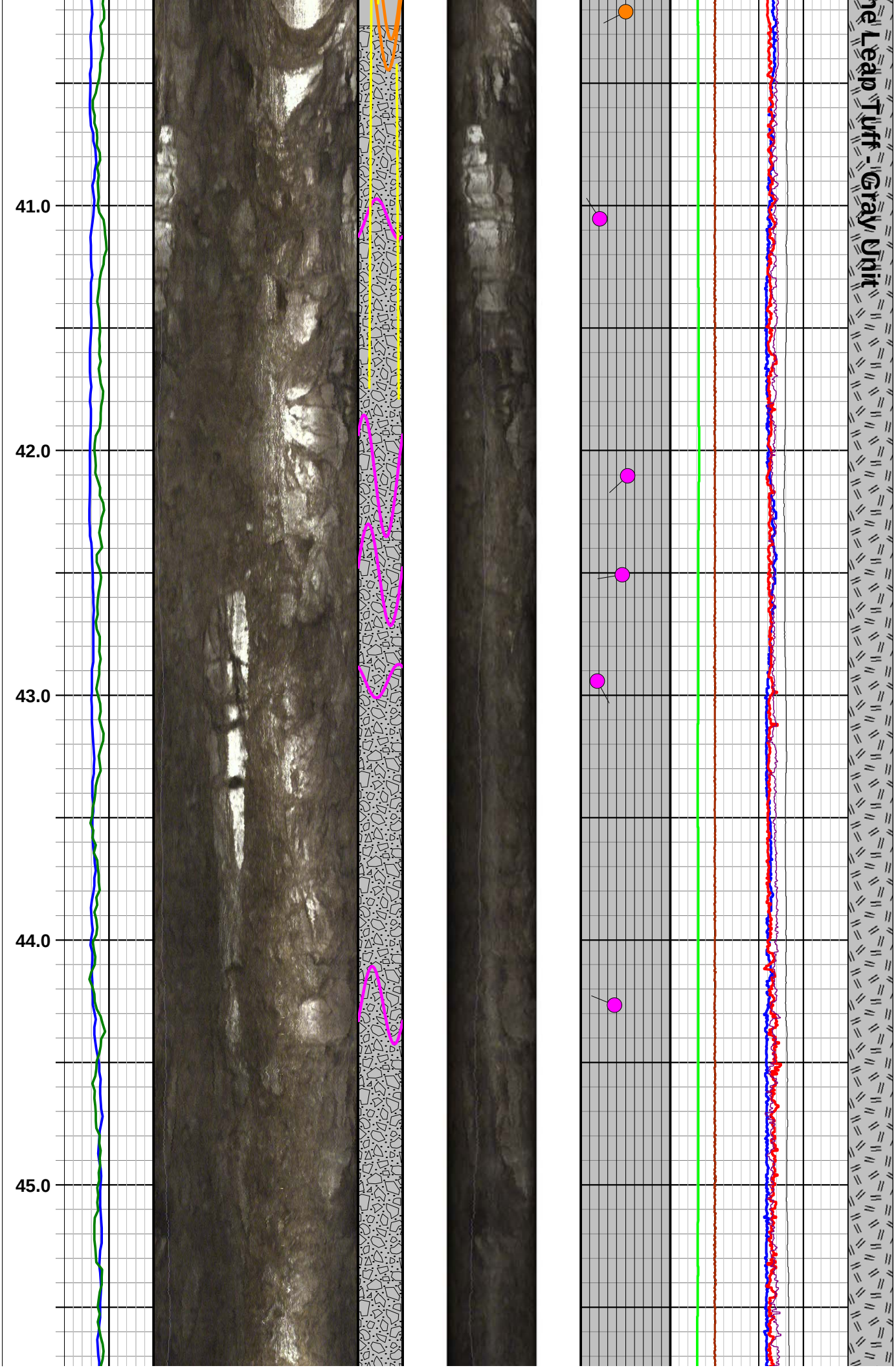
Apac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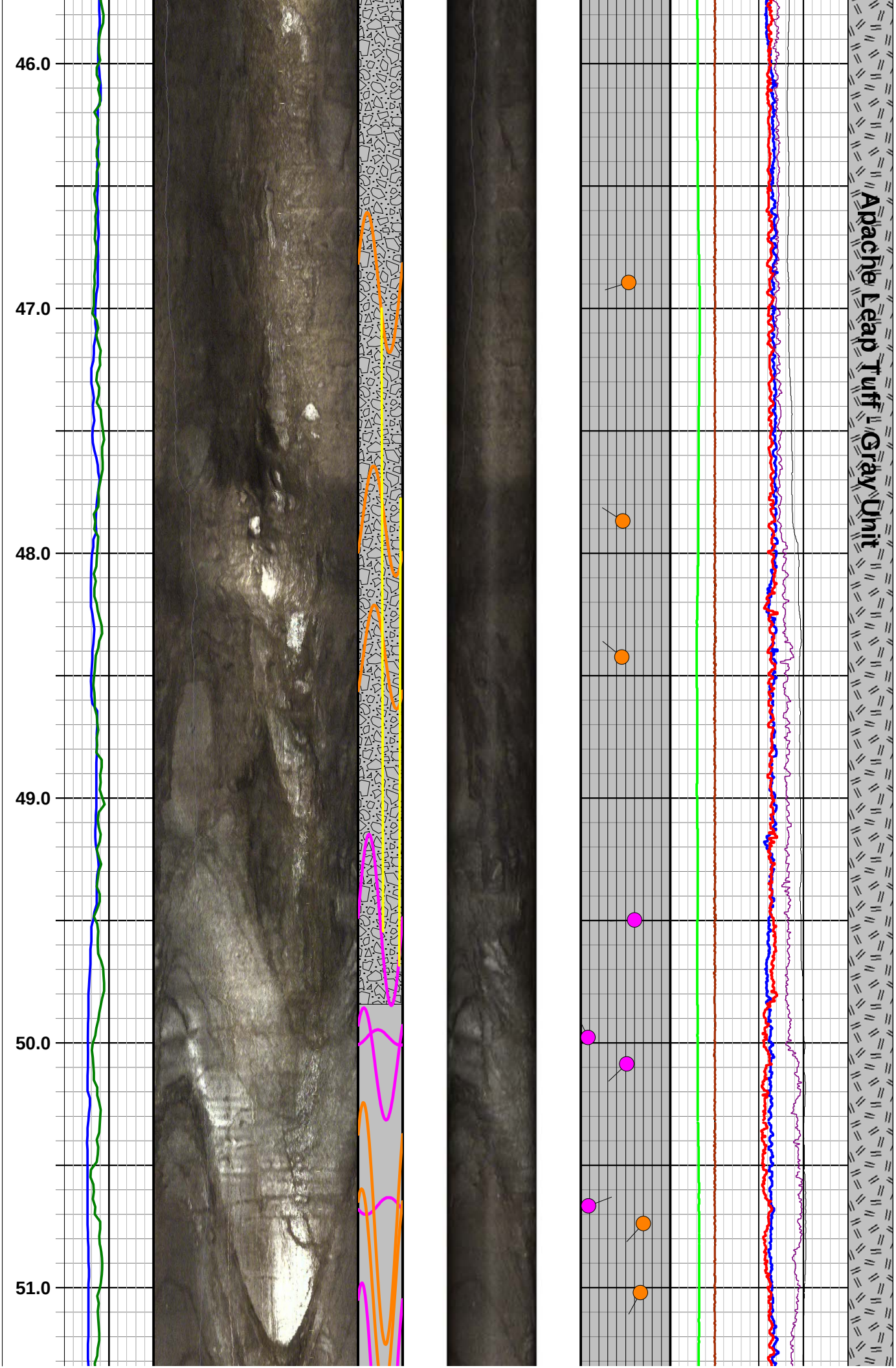
Leap Tuff - Gray Unit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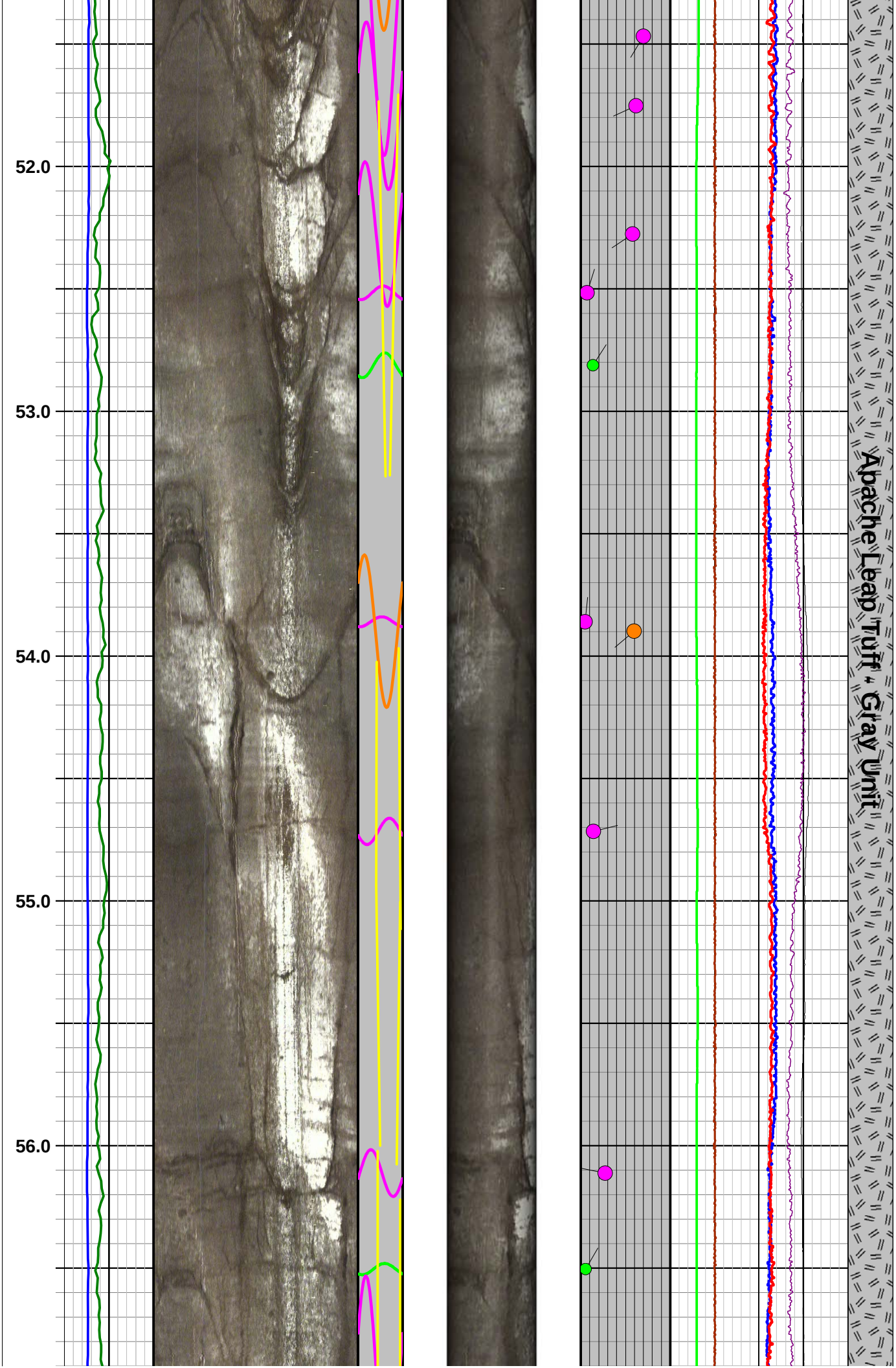
Apache Leap Tuff - Gray Unit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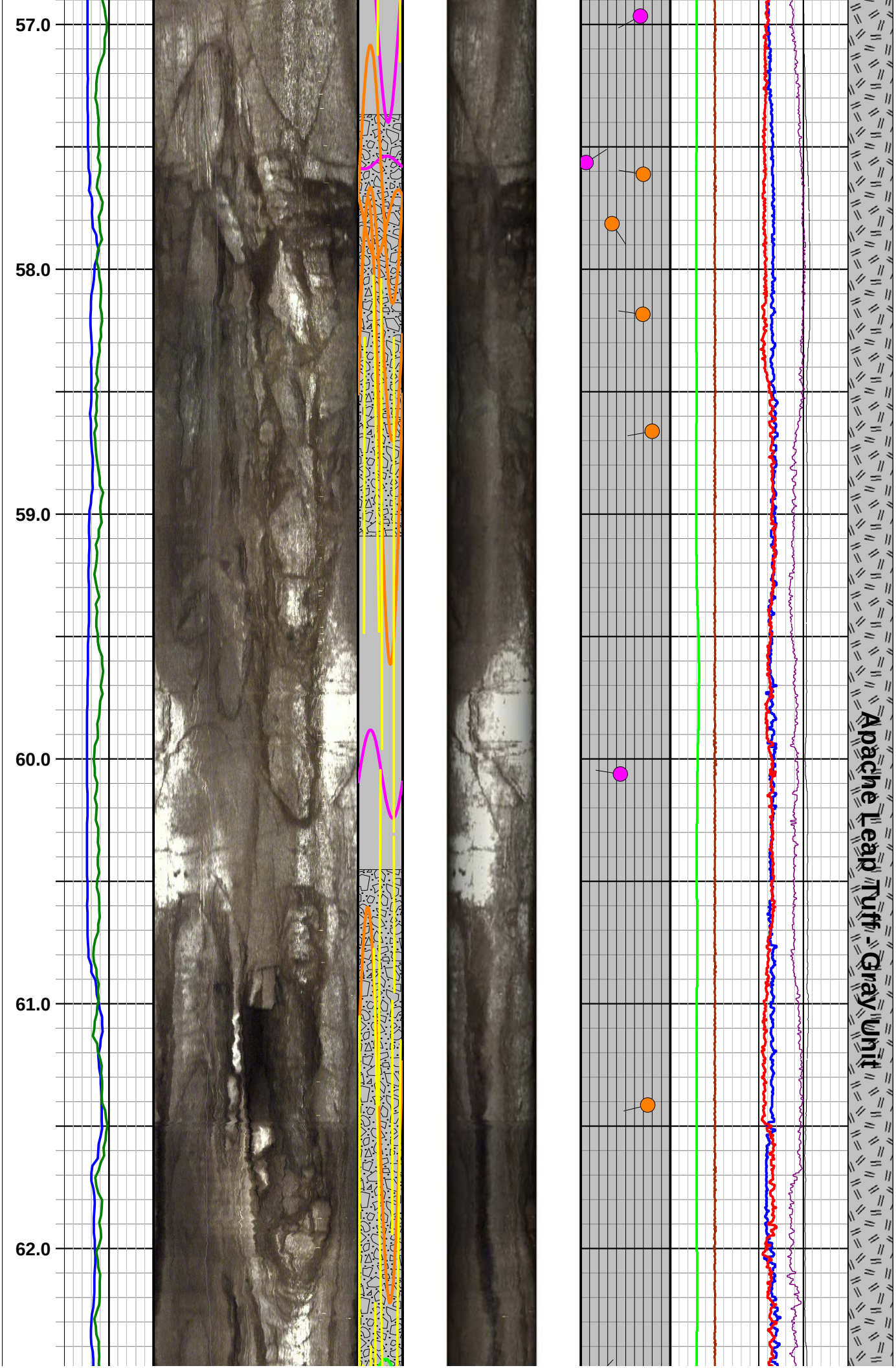
Apache Leap Tuff - Gray Unit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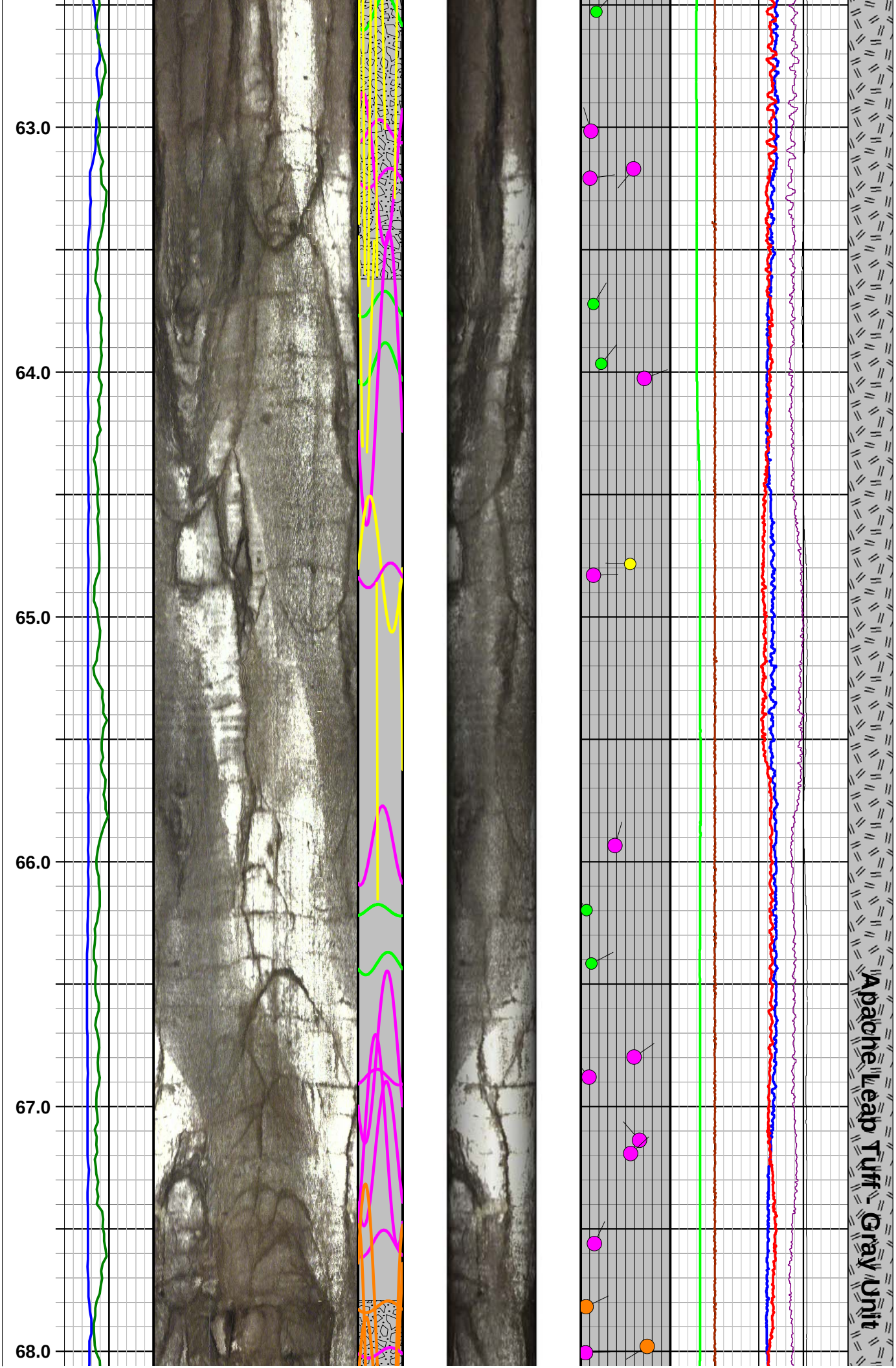
Apache Leap Tuff - Gray Unit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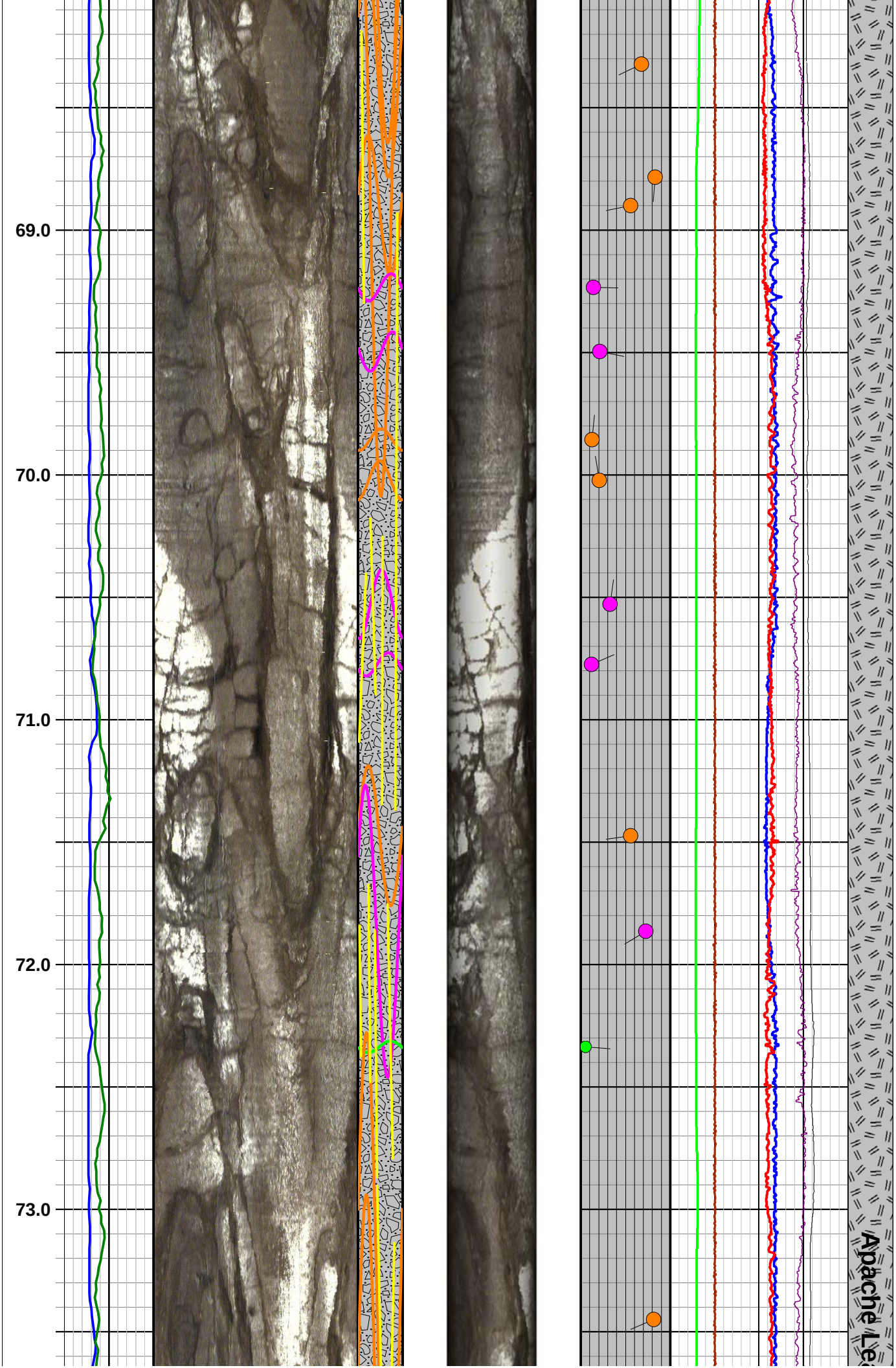
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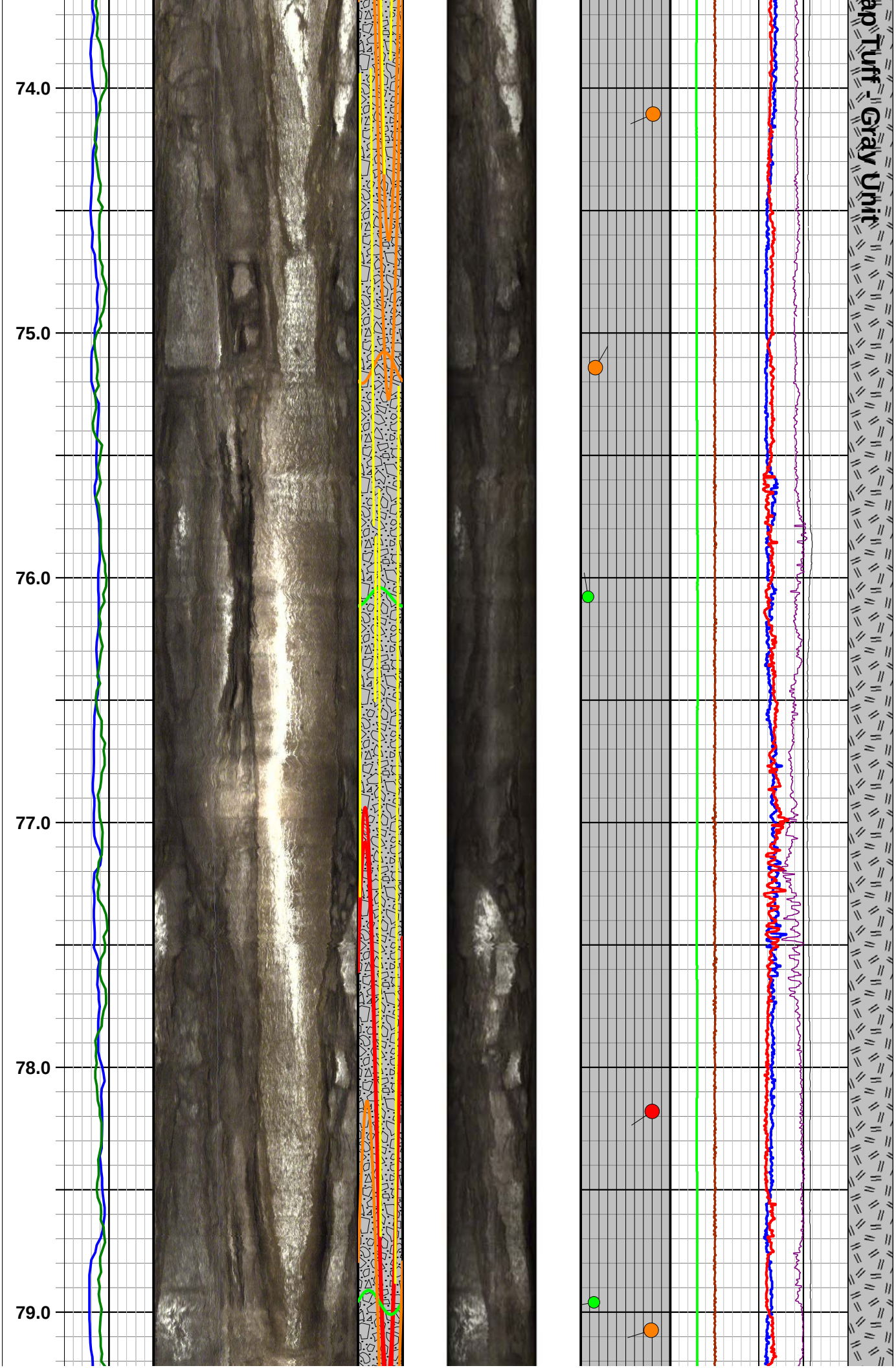
Apache Lea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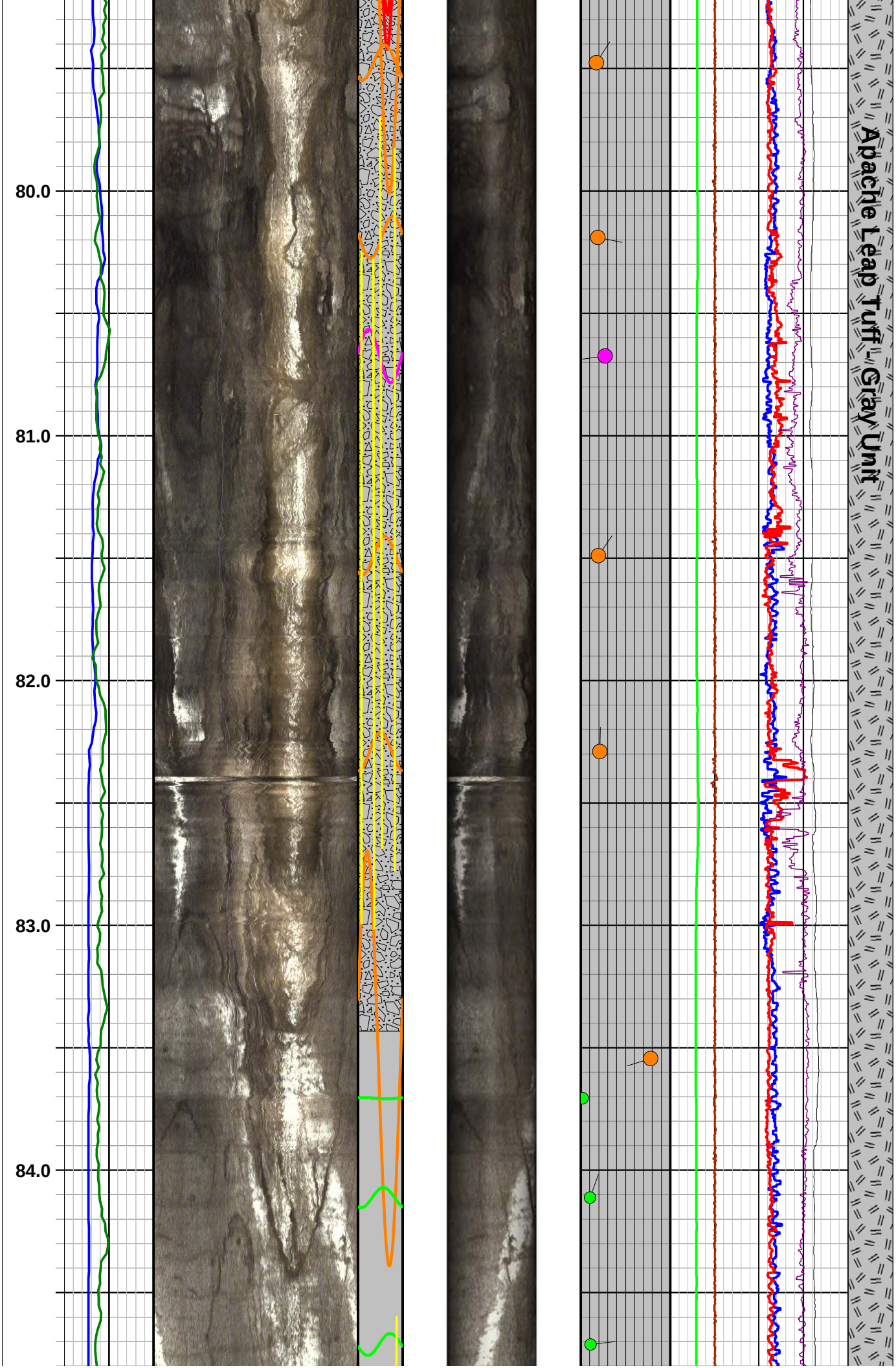
ap Tuff, Gray Unit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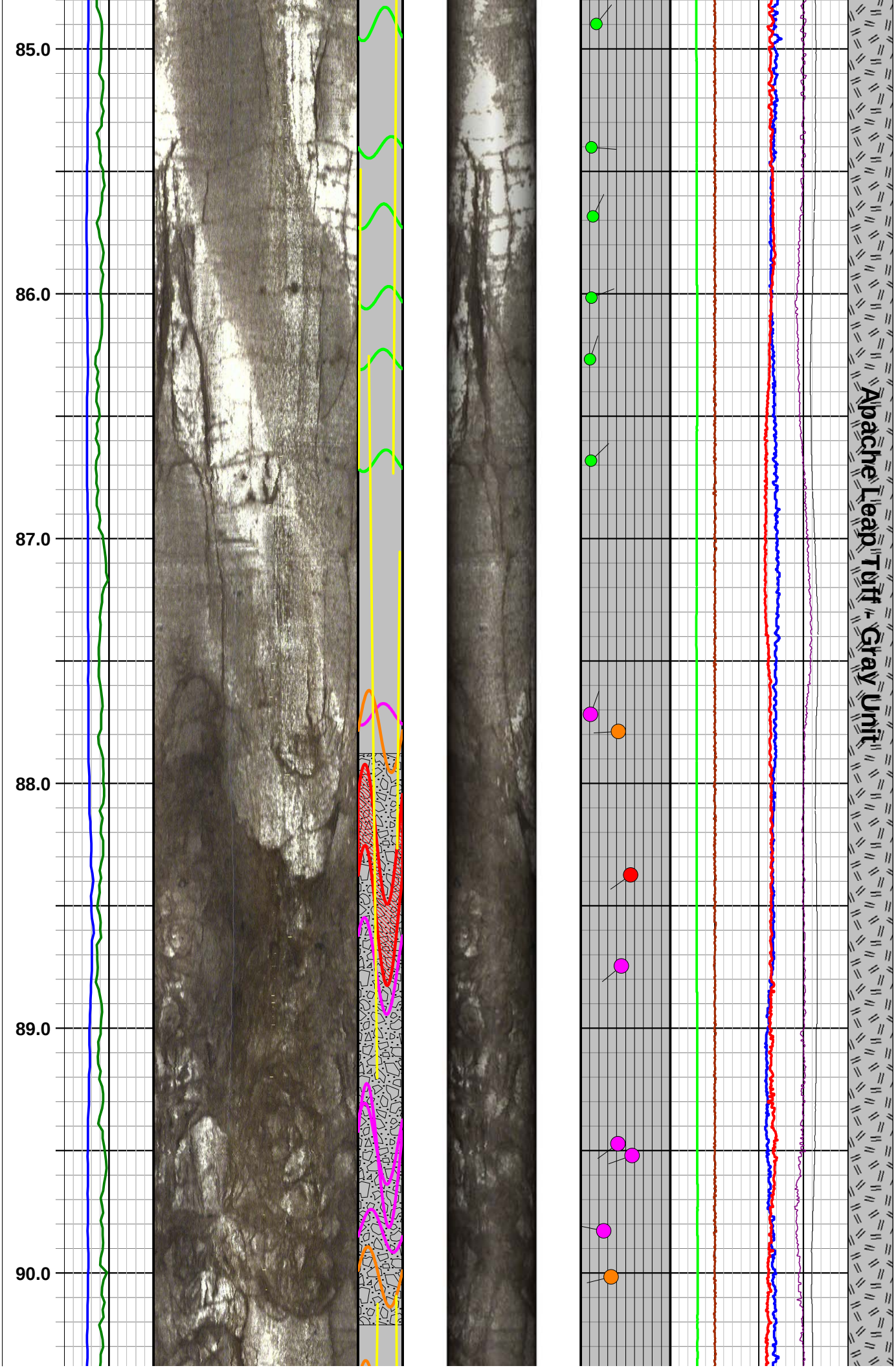
Apache Leap Tuff / Gray Unit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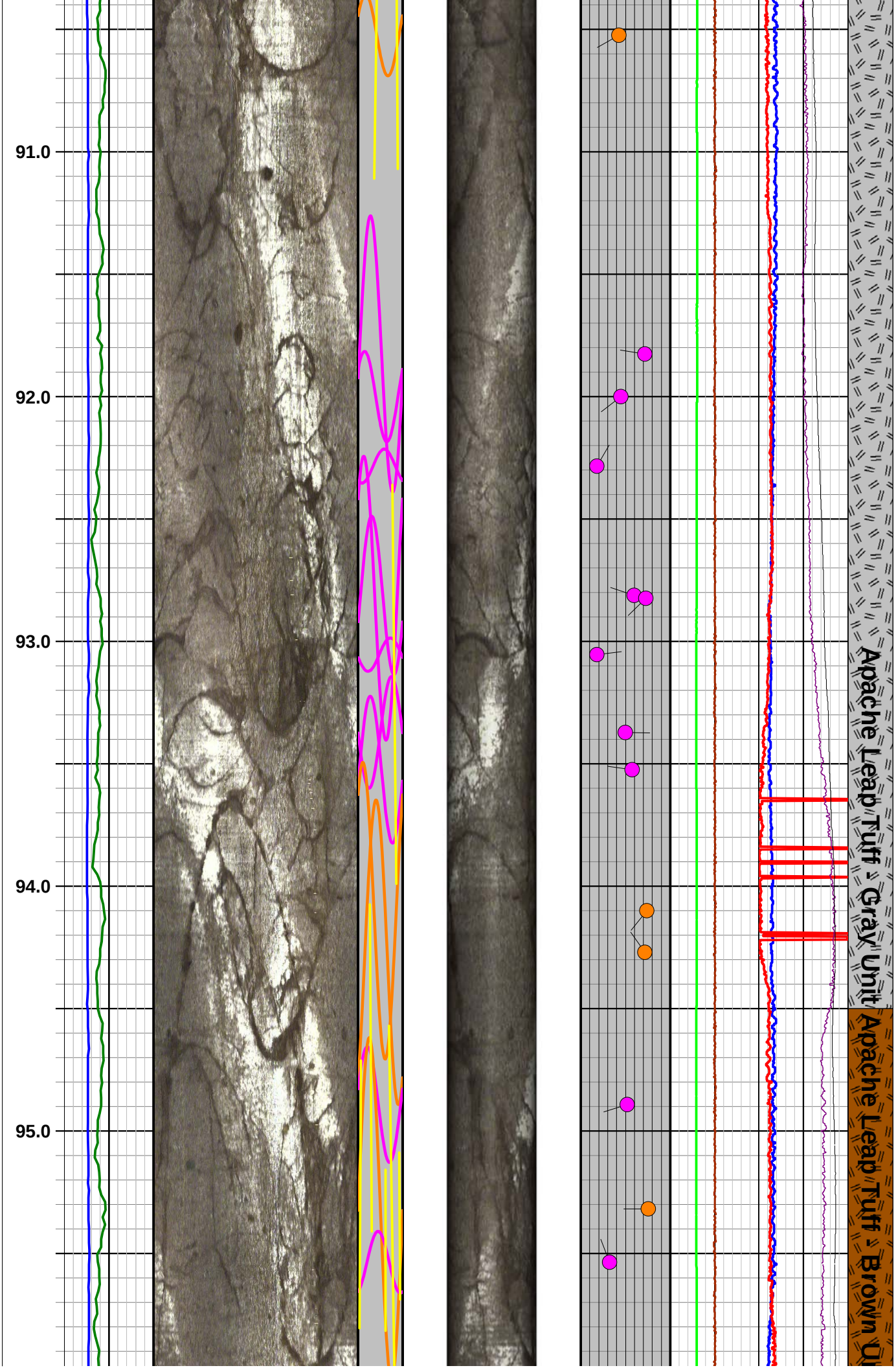
89.0
90.0
Apache Leap Tuff - Gray Unit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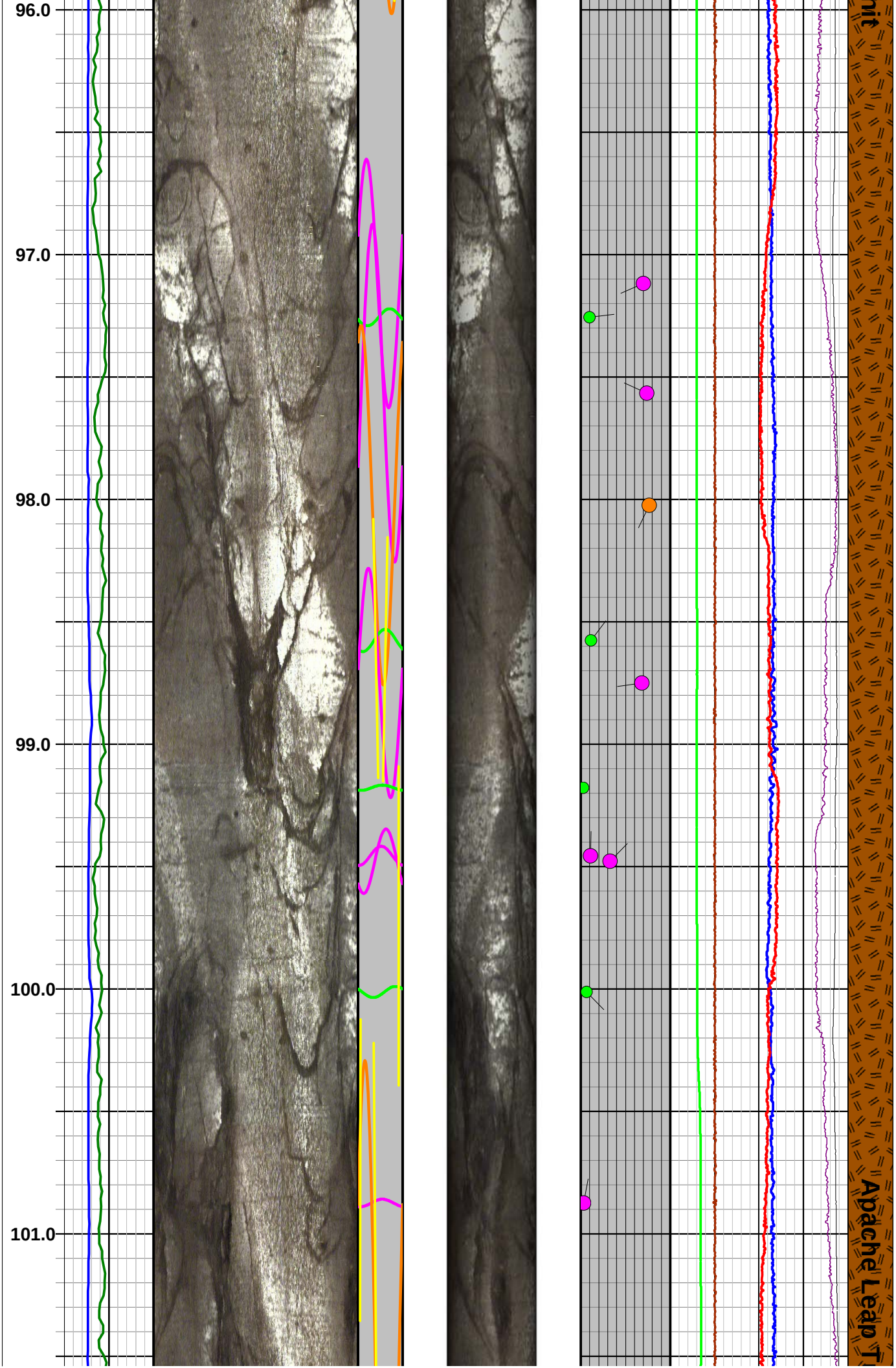
95.0
Apache Leap Tuff - Gray Unit
Apache Leap Tuff - Brown Un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98.0
99.0
100.0
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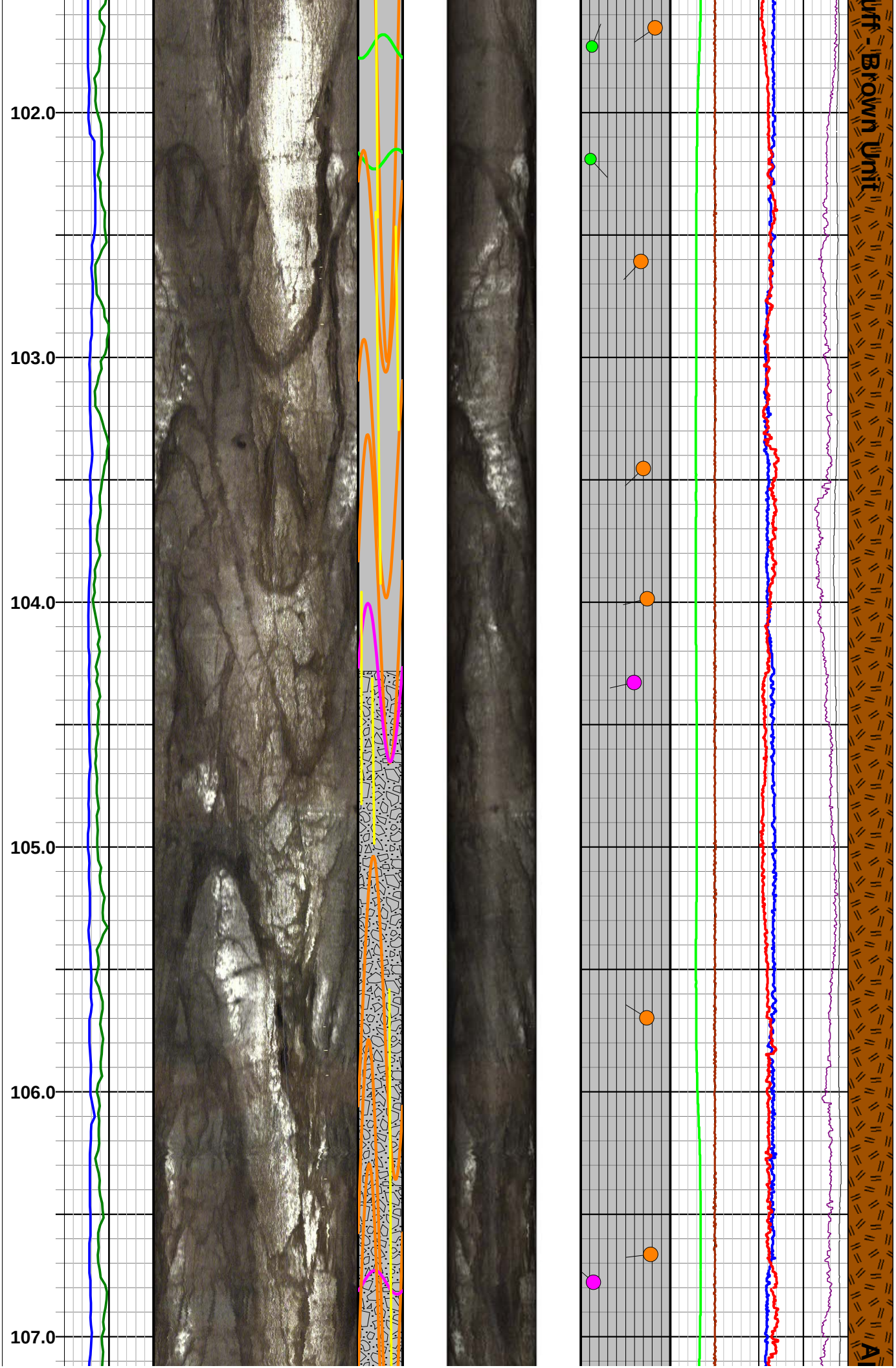
Apache Leap T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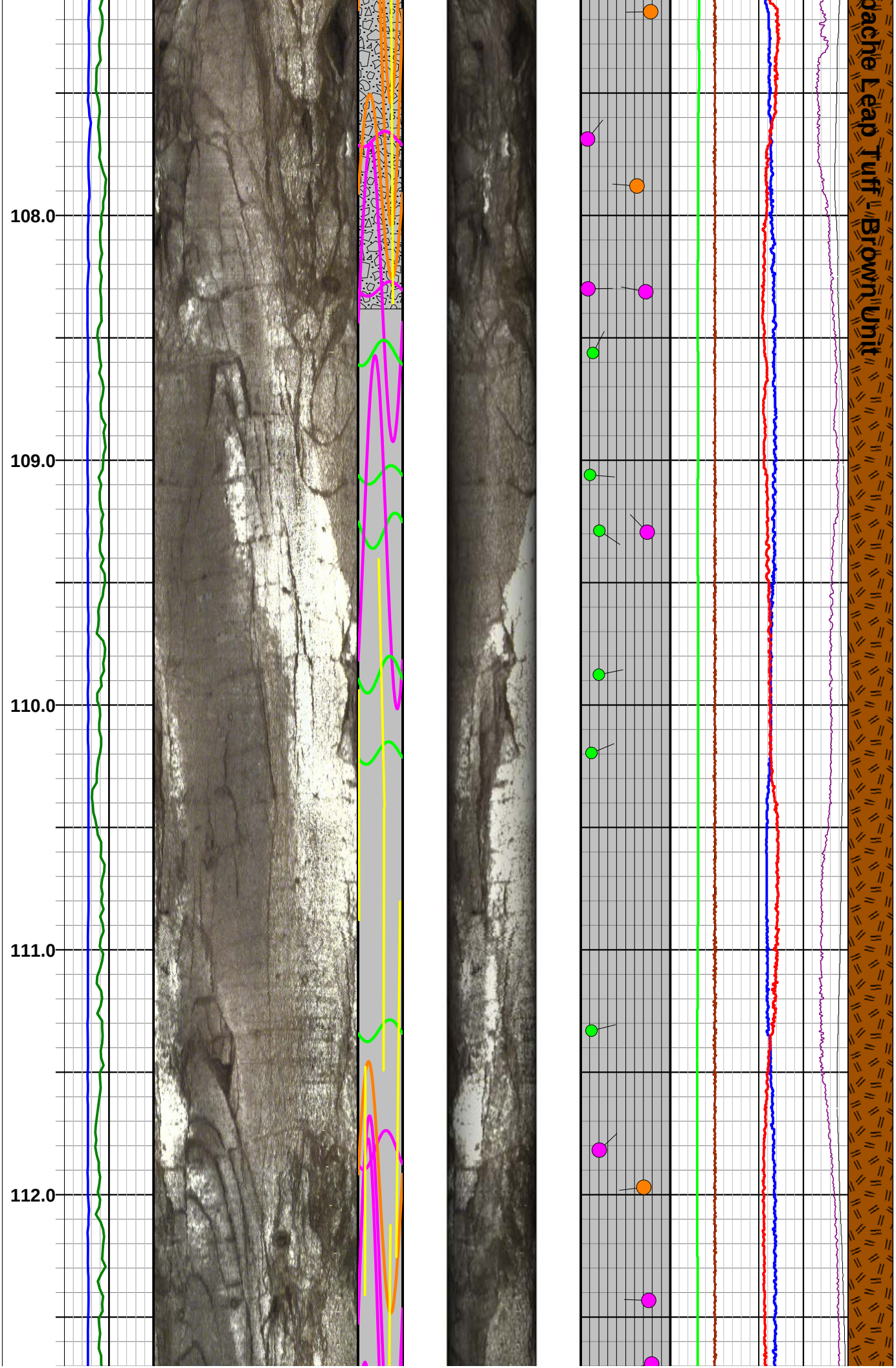
Buff - Brown Unit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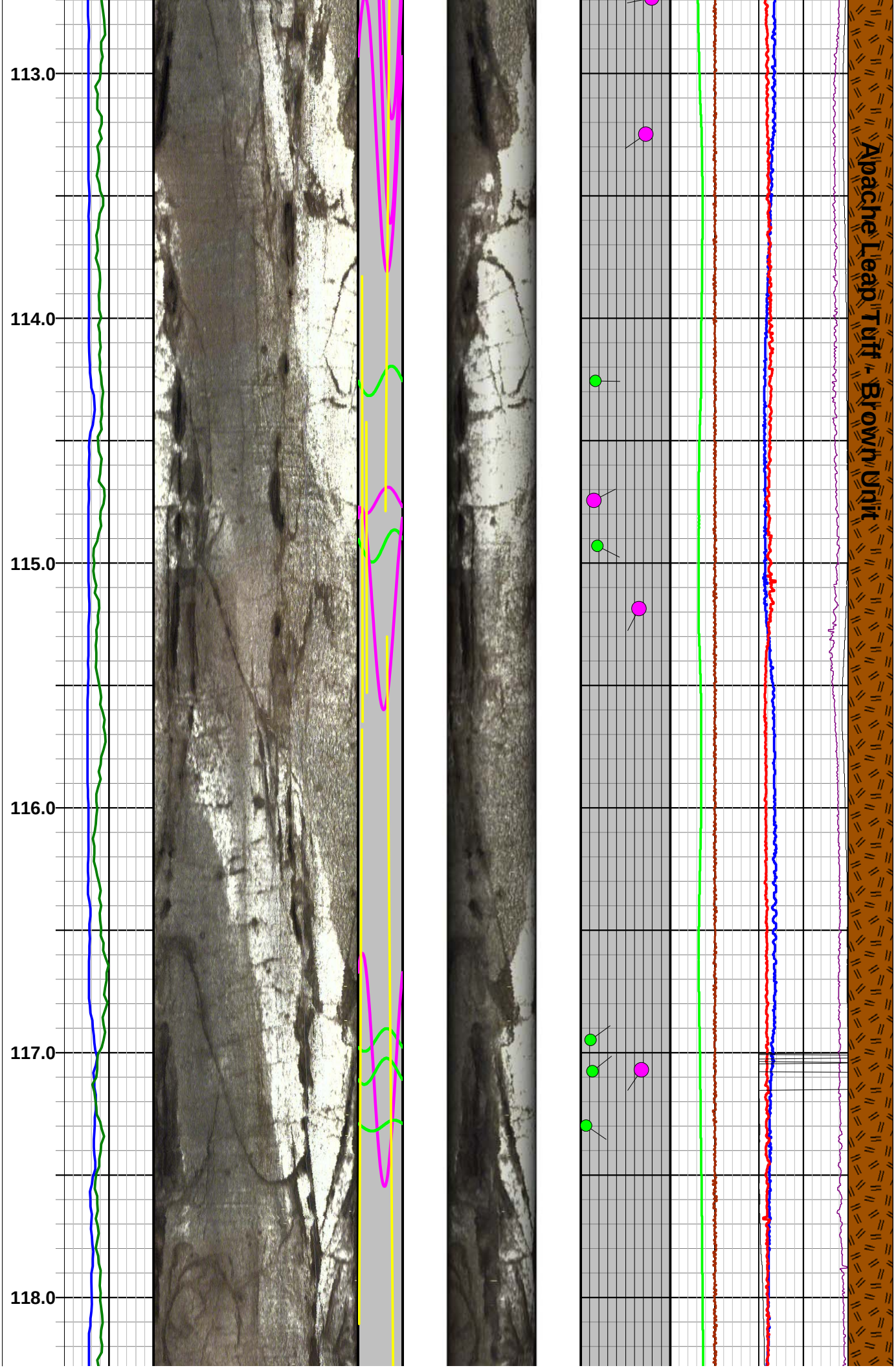
Apache Leap Tuff-Brown Unit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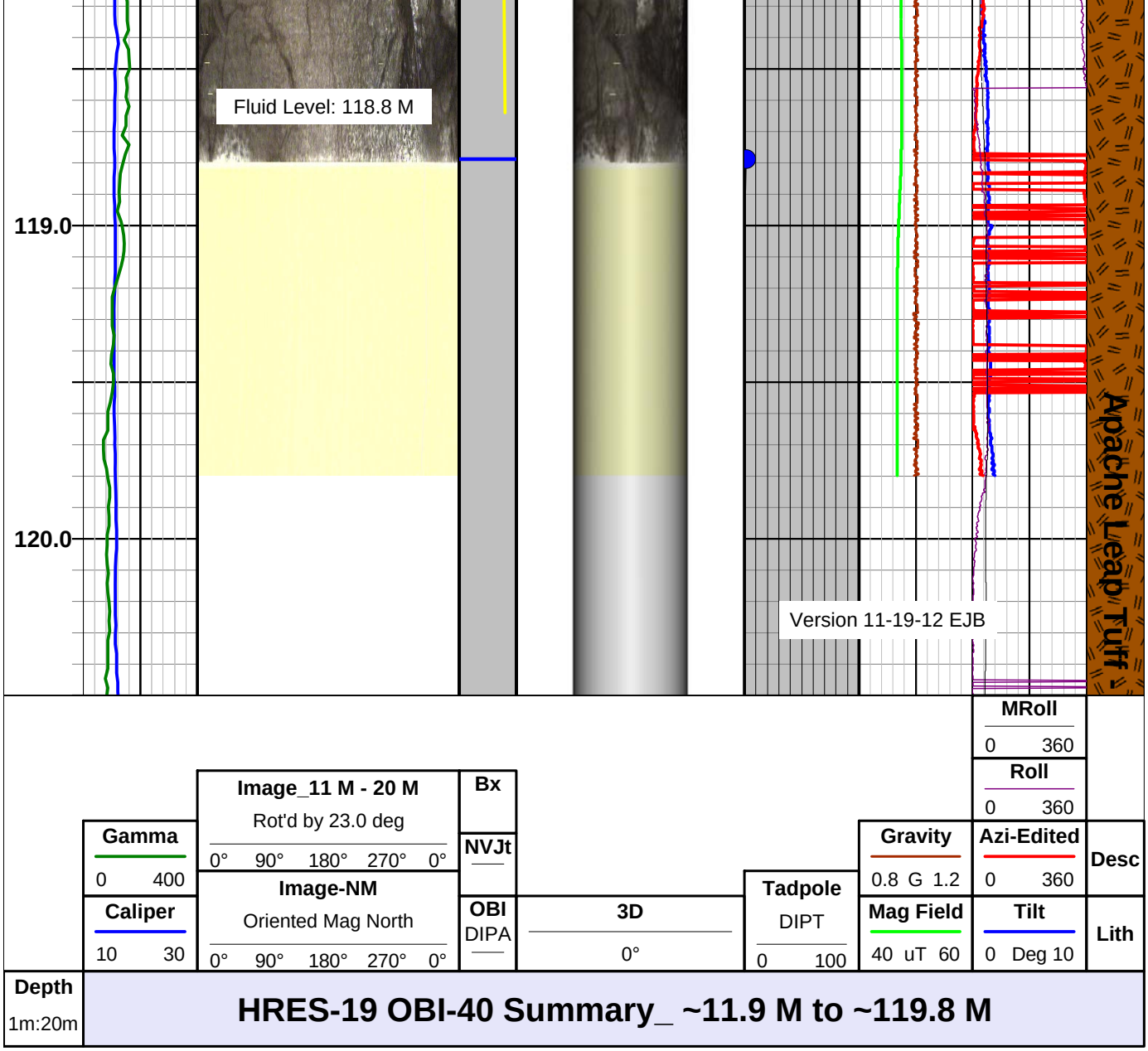
Apache Leap Tuff - Brown Unit



Depth 1m:20m	Gamma 0 400	Caliper 10 30	Image_11 M - 20 M Rot'd by 23.0 deg 0° 90° 180° 270° 0°	Image-NM Oriented Mag North 0° 90° 180° 270° 0°	Bx	NVJt	OBI DIPA	3D 0°	Tadpole DIPT 0 100	Gravity 0.8 G 1.2	Mag Field 40 uT 60	MRoll 0 360	Roll 0 360	Azi-Edited 0 360	Tilt 0 Deg 10	Desc	Lith

HRES-19 OBI-40 Summary_ ~11.9 M to ~119.8 M

Optical Image Summary Legend

Mnemonics and Comments

Caliper = 3-arm mechanical caliper of hole diameter plotted from 10-30 inches (blue line).

Gamma = Natural gamma ray log plotted from 0 to 400 API units (green line).

Image-NM = 2D plot of optical image oriented to magnetic north. Plotted from left to right N-E-S-W-N.

Image_11.0M - 20.0M = 2D plot of optical image non-oriented and rotated by 99.5 deg to correct for magnetic affect in proximity of steel casing. Plotted from left to Right N-E-S-W-N.

OBI = Planar features picked on optical borehole image shown as colored sinusoid (color designation shown on header). DIPA = dip apparent hole axis.

Bx = Apparent Breccia or Congomerate zones and Vugs/Vesicles/Cavities.

NVJt = Near Vertical (near parallel to hole axis) joint/fracture features picked on acoustic borehole image shown as colored sinusoid (color designation shown on header).

3D = 3D cylindrical projection of OBI image viewed from north.

Tadpole = Tadpole plot of the image feature picks (fractures and bedding planes); plotted from 0 to 90 dip - see legend above. DIPT = True orientation; features corrected for hole deviation.

Mag Field = Total magnetic field strength as measured by fluxgate magnetometer in OBI deviation sensor

- plotted 40-60 uT (green line).

Gravity = Tool accelleration or gravity as measured by 3-axis accellerometers in OBI deviation sensor - plotted 0.8 - 1.2 G (brown line).

Azi-Edited = Direction of tool tilt plotted 0 to 360 deg; edited for anomalous magnetic influence - represents borehole deviation direction (red line).

Roll = Roll or gravity tool face angle is plotted 0 to 360 degrees. Roll is 90 degree if the y-axis of the probe (reference mark on the housing) points to the high side of the borehole. (purple line)

MRoll = MRoll or Magnetic Roll angle is plotted 0 to 360 degrees. MRoll is used when Tool Tilt is < 1 deg from vertical and two components of accelerometer are close to zero. At vertical, MRoll is 90 degree if the projection of the y-axis of the probe (reference mark on the housing) into a horizontal plane points to Magnetic North. (black line)

Tilt = Tool tilt (vertical = 0 and horizontal = 90) plotted 0 to 10 deg; represents borehole deviation tilt from vertical (blue line).

Lith = Major/principal lithology based on field geologic descriptions provided by Clear Creek staff.

Desc = Major/principal field geologic descriptions provided by Clear Creek staff.

Prepared by Erika J. Beam

Version 11-20-12

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	HRES-19 (ADWR 55-914789)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: ABI-43
MORE: 3-ARM CALIPER

LOCATION
D(2-13)8AAA

SEC 8 TWP 2S RGE 13E

OTHER SERVICES
OBI
GAMMA-CALIPER-
FLUID TEMP-RES
E-LOGS
SONIC

PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

DATE	11-4-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	ABI-43 3 ARM CALIPER	DENSITY	N/A
DEPTH-DRILLER	291.5 M	LEVEL	119.2 M
DEPTH-LOGGER	291.5 M	MAX. REC. TEMP.	23.5 DEG C
BTM LOGGED INTERVAL	291.5 M	IMAGE ORIENTED TO:	MAG NORTH
TOP LOGGED INTERVAL	119.2 M	SAMPLE INTERVAL	0.0096FT
DRILLER / RIG#	BOART LONGYEAR	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	ALT ABI-43 SN-91601
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	7:30 AM 5:00 PM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	20"	SURFACE	11.9 M	15 3/4"	HWT	SURFACE	11.9 M
2	14 3/4"	11.9 M	TD				
3							

COMMENTS:

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Major Lithology

- Apache Leap Tuff - Gray Unit
- Apache Leap Tuff - Brown Unit
- Basal Tuff - Vitrophyre
- Basal Tuff
- Transition Zone

Acoustic Image Features Legend

- Bedding / Banding / Foliation / Veins
- Filled Fracture / Joint
- Btm of Casing

Partially Open Joint / Fracture

Minor Open Joint / Fracture

OJ/Fx terminates at Fx intersection

Unclassified

Sulfide Vein

Breakouts

Major Open Joint / Fracture

Fluid Level

Bx & NVJts Legend

Breccia or Conglomerate

Large Vugs/Vesicles (> 6")

Medium Vugs/Vesicles (2-6")

Small Vugs/Vesicles (< 2")

Conglomerate - sand matrix supported

Conglomerate - mud matrix supported

Conglomerate - clast supported

Broken Zone / Undifferentiated

Major Breakout

Minor Breakout

Tensile Fracture

Filled Near Vertical Joint/Fx

Near Vertical Joint/Fx

HRES-19 ABI-43 Summary_ ~119.0 M to ~289.6 M

Depth
1m:20m

Centralized TT
Oriented Mag North
0° 90° 180° 270° 0°

Caliper
10 Inches 30

Amplitude-NM
Oriented Mag North
0° 90° 180° 270° 0°

Amp-Static
Oriented Mag North
0° 90° 180° 270° 0°

Amp-High Pass
Oriented Mag North
0° 90° 180° 270° 0°

ARI
0 400

ABI
DIPA

NVJt

Bx

3D
0°

Tadpole
DIPT
0 100

Mag Field
40 uT 60

Gravity
0.8 g 1.2

Tilt
0 deg 10

Azimuth
0 360

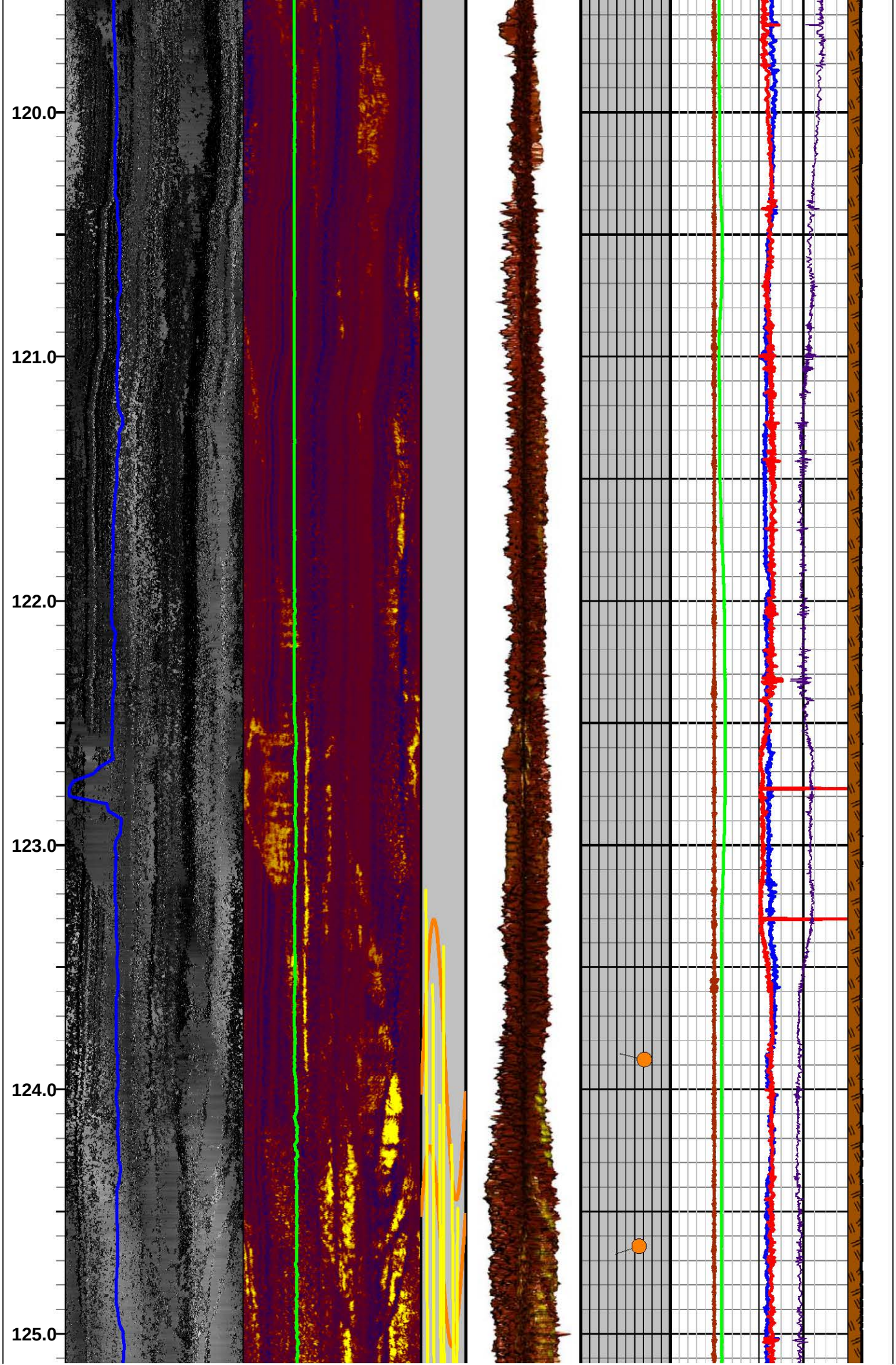
RBR
-90 270

Lith

Hard

Desc

119.0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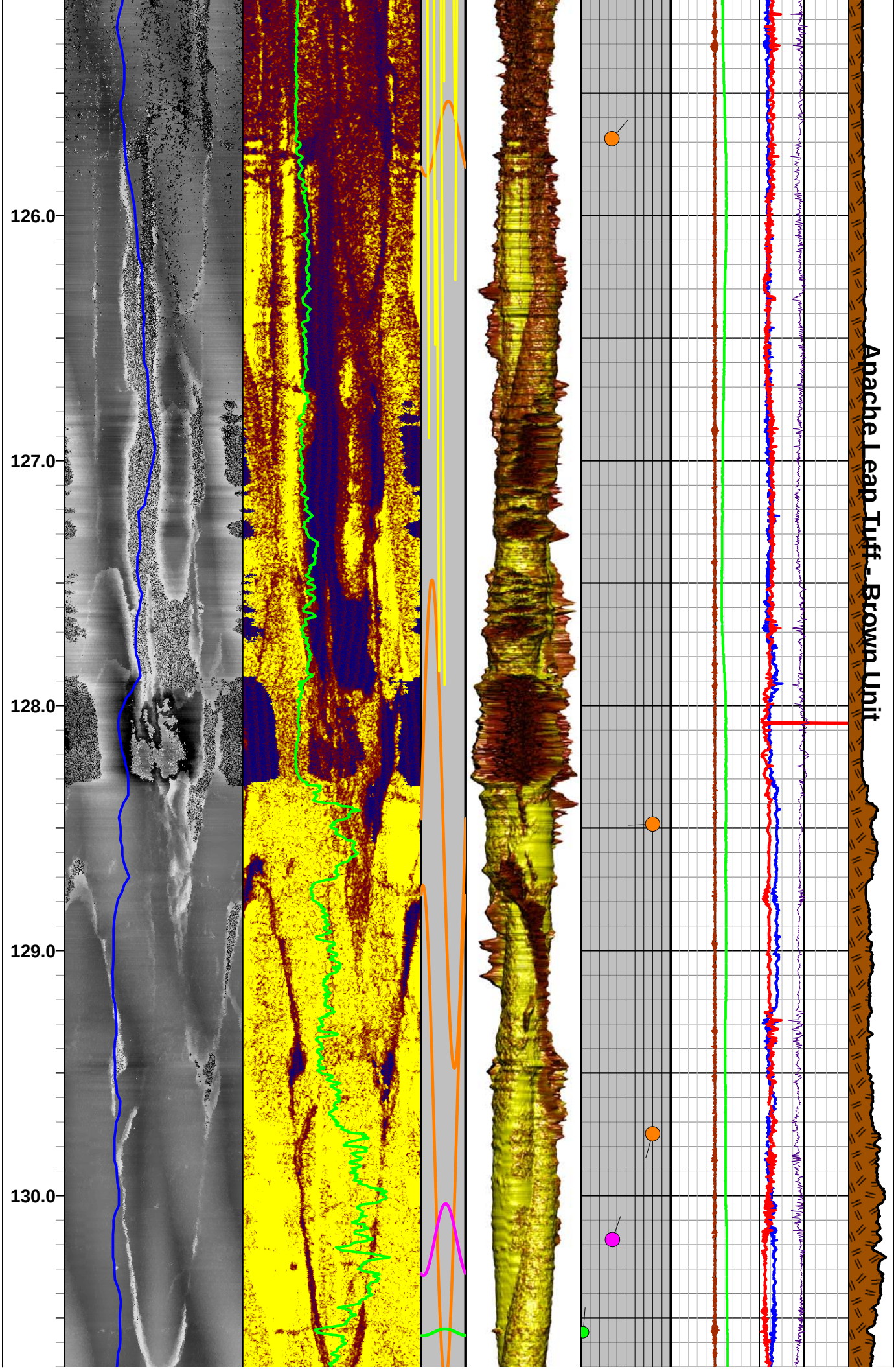
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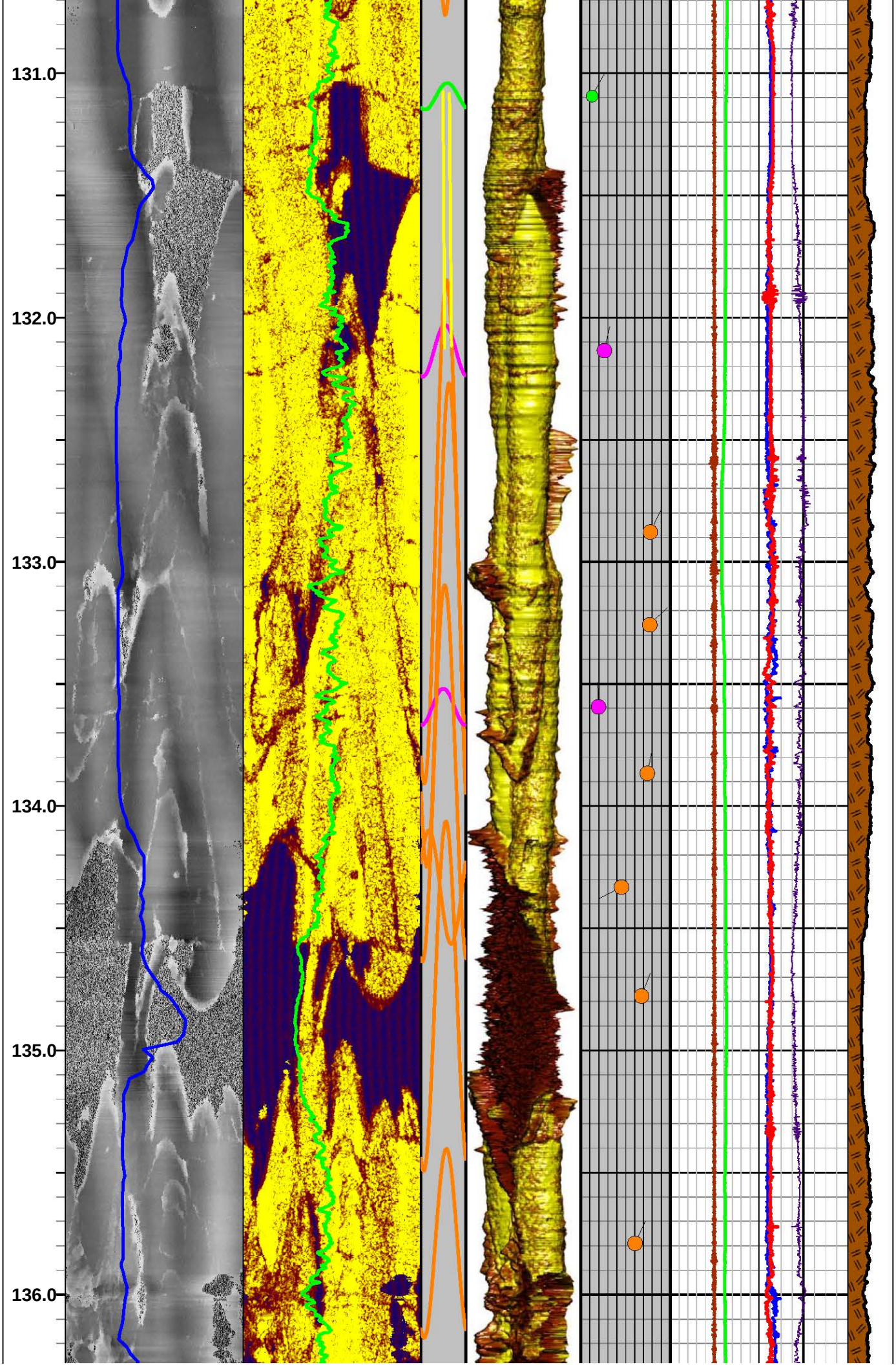
Apache Leap Tuff - Brown Unit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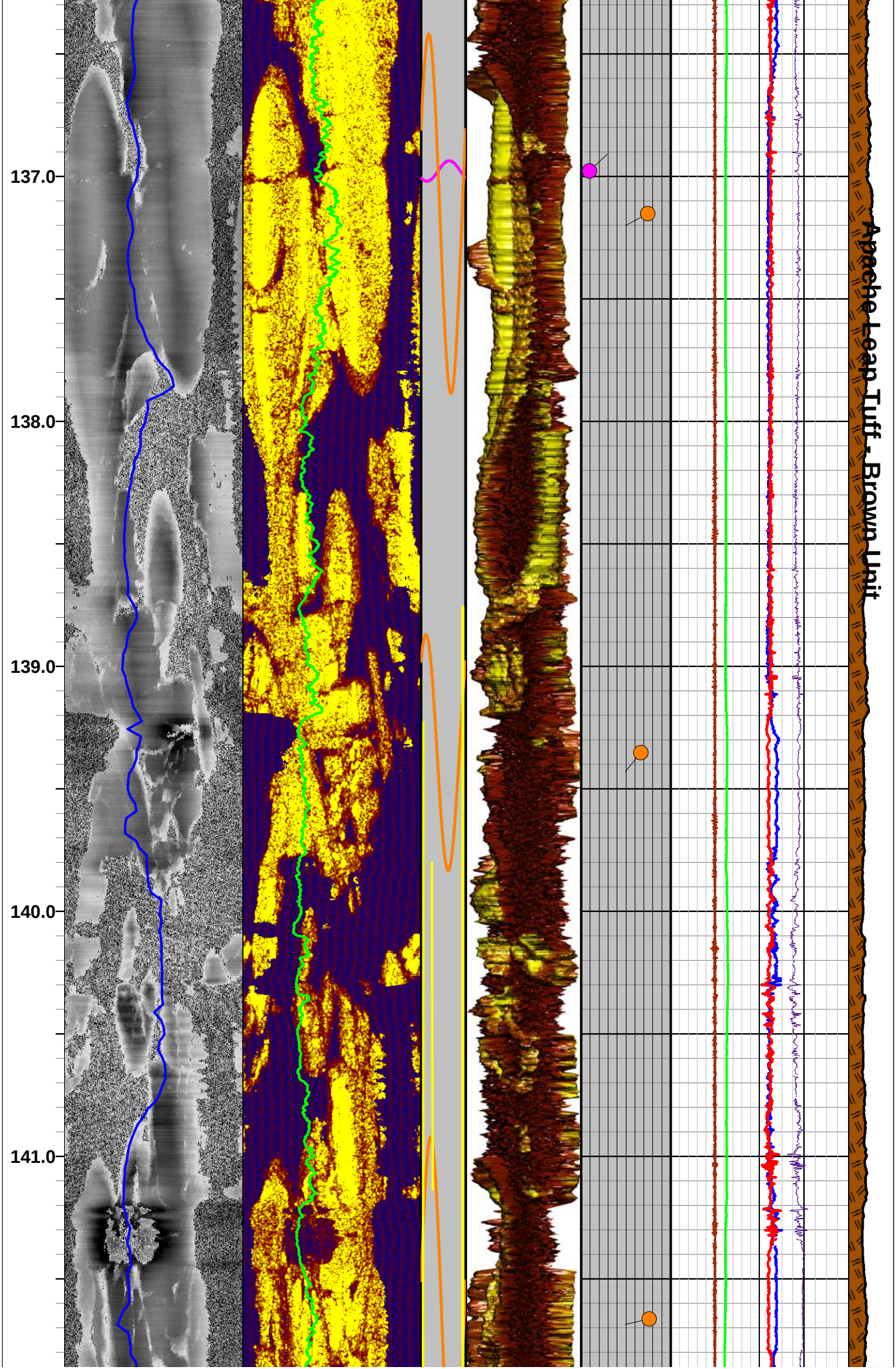
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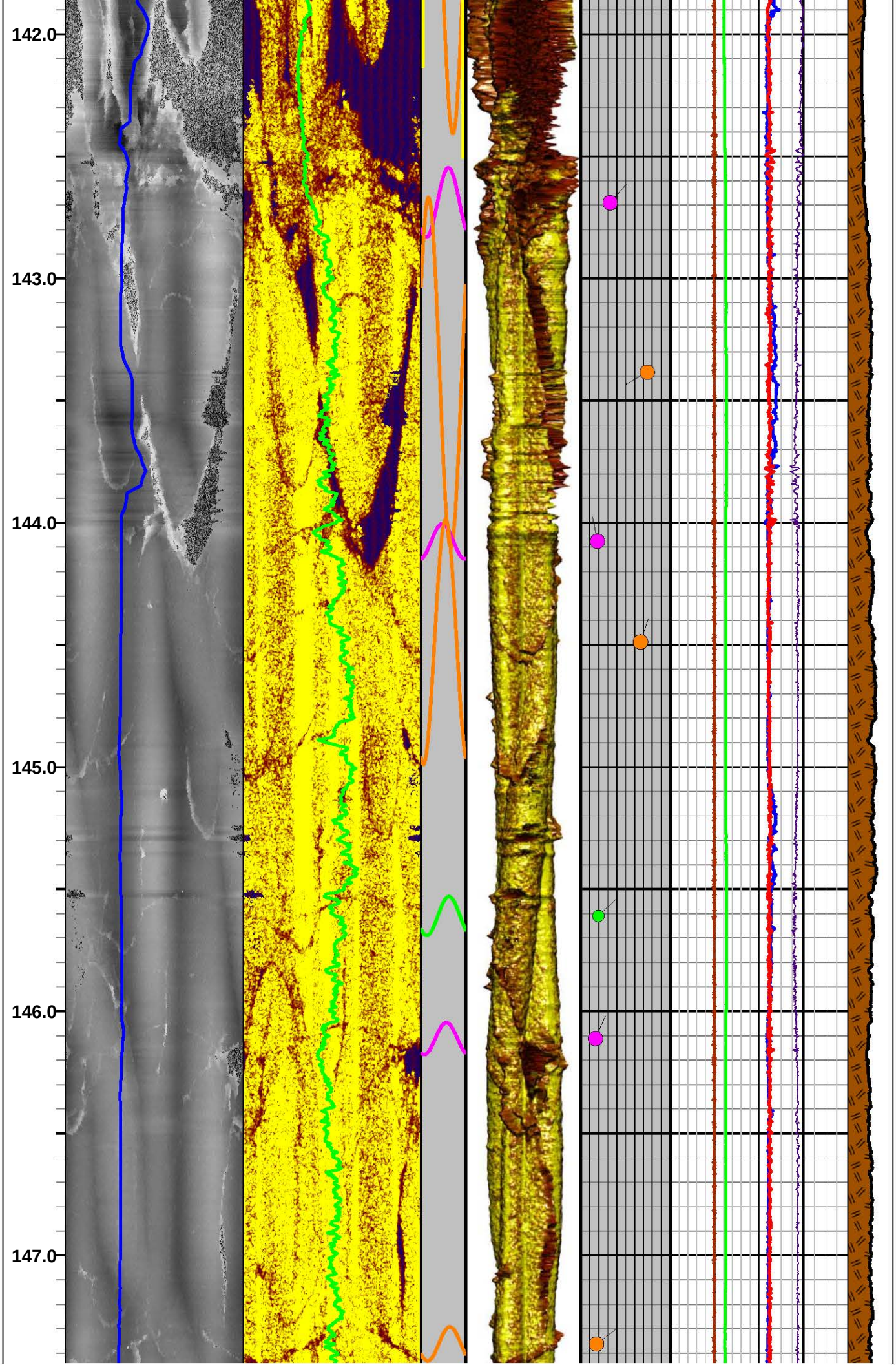
Apache Leap Tuff - Brown Unit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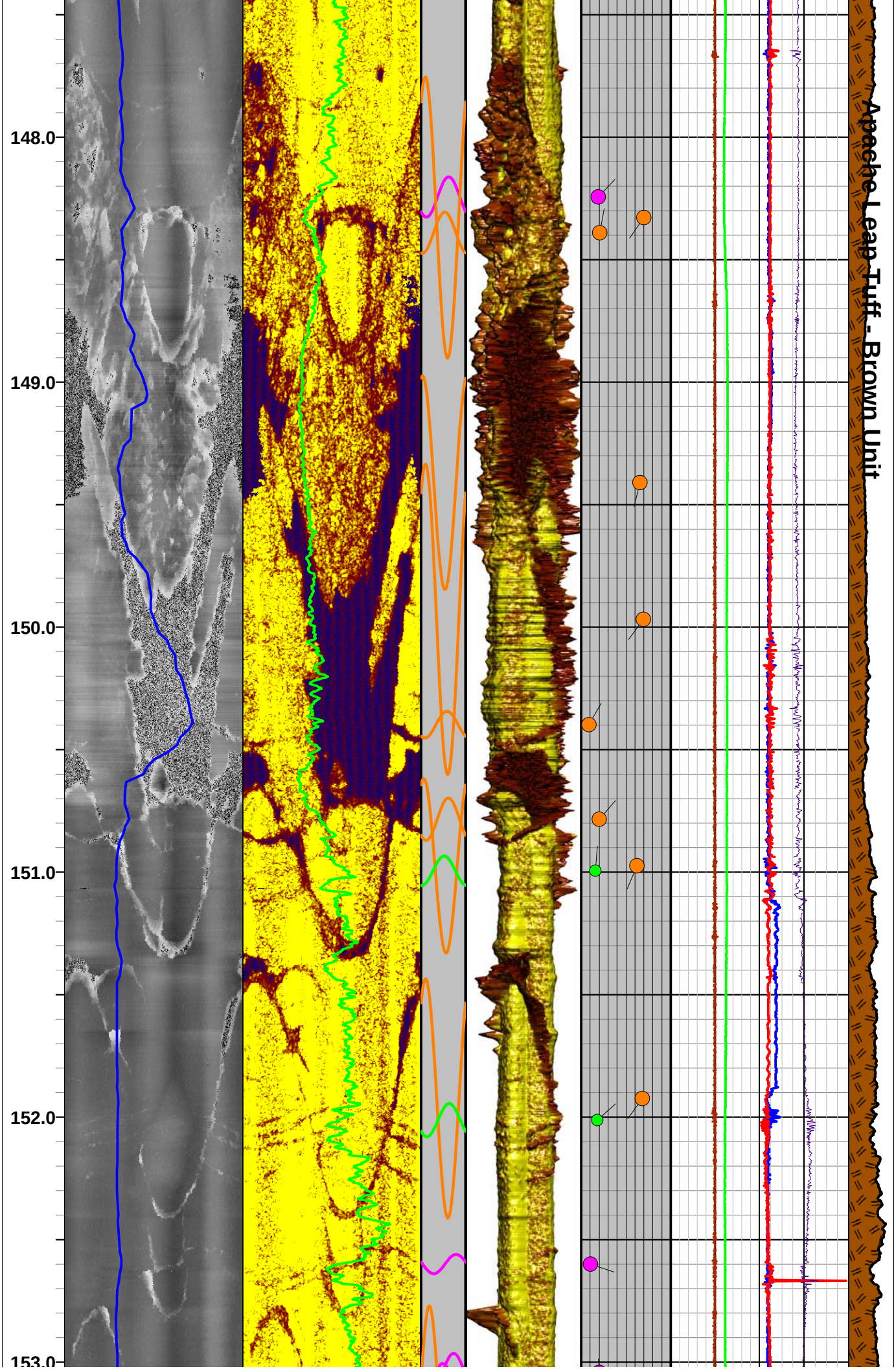
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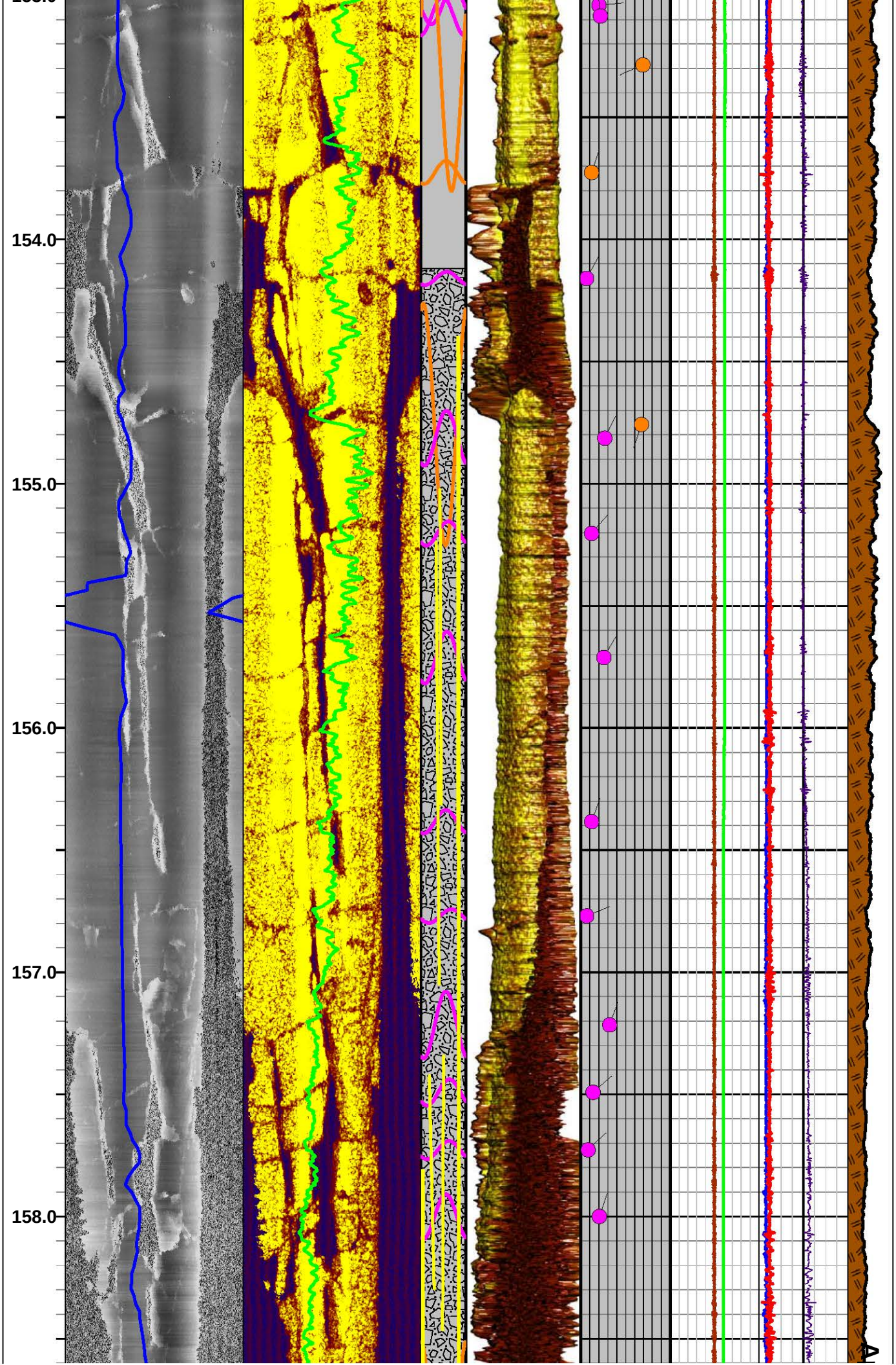
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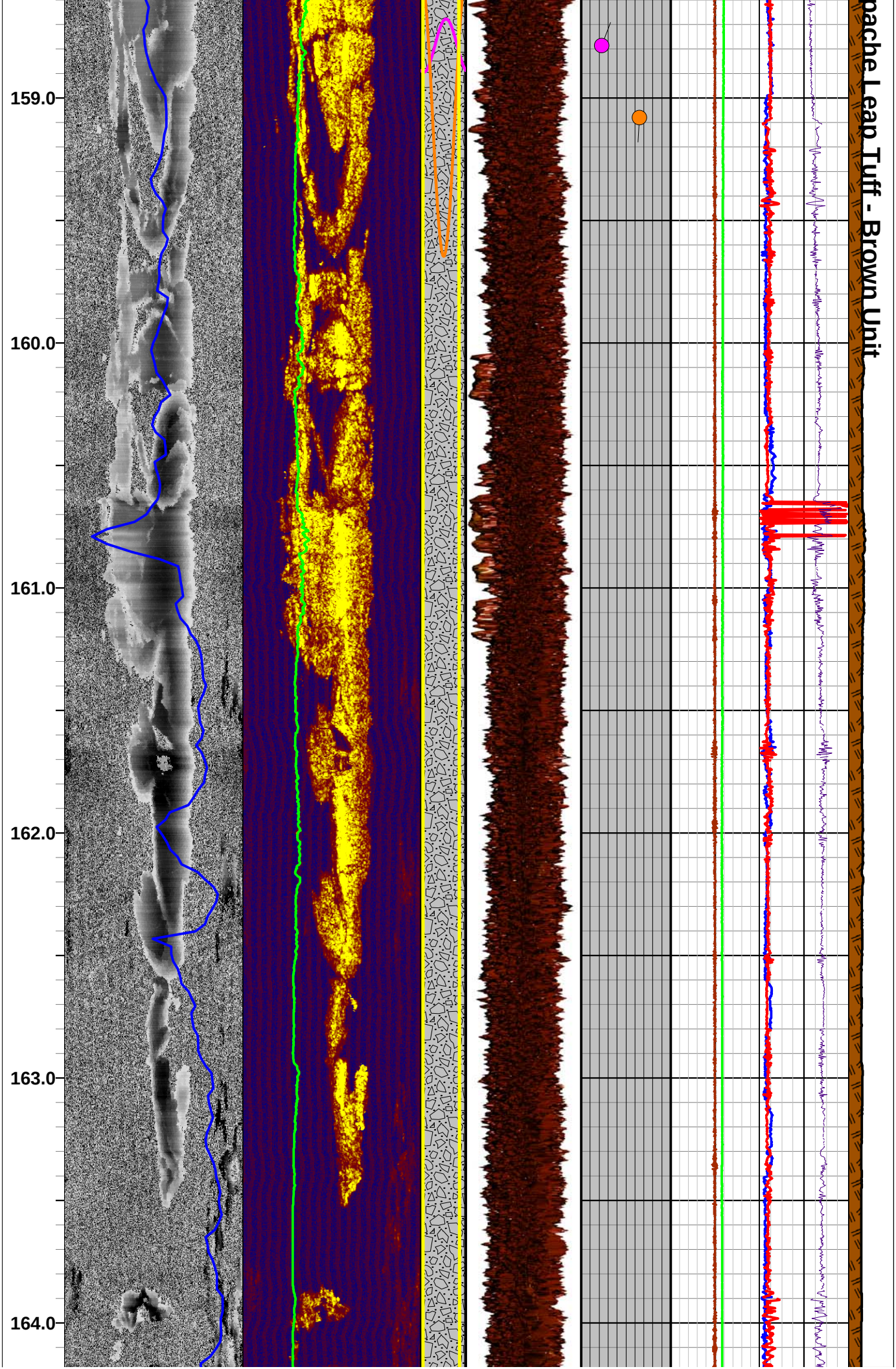
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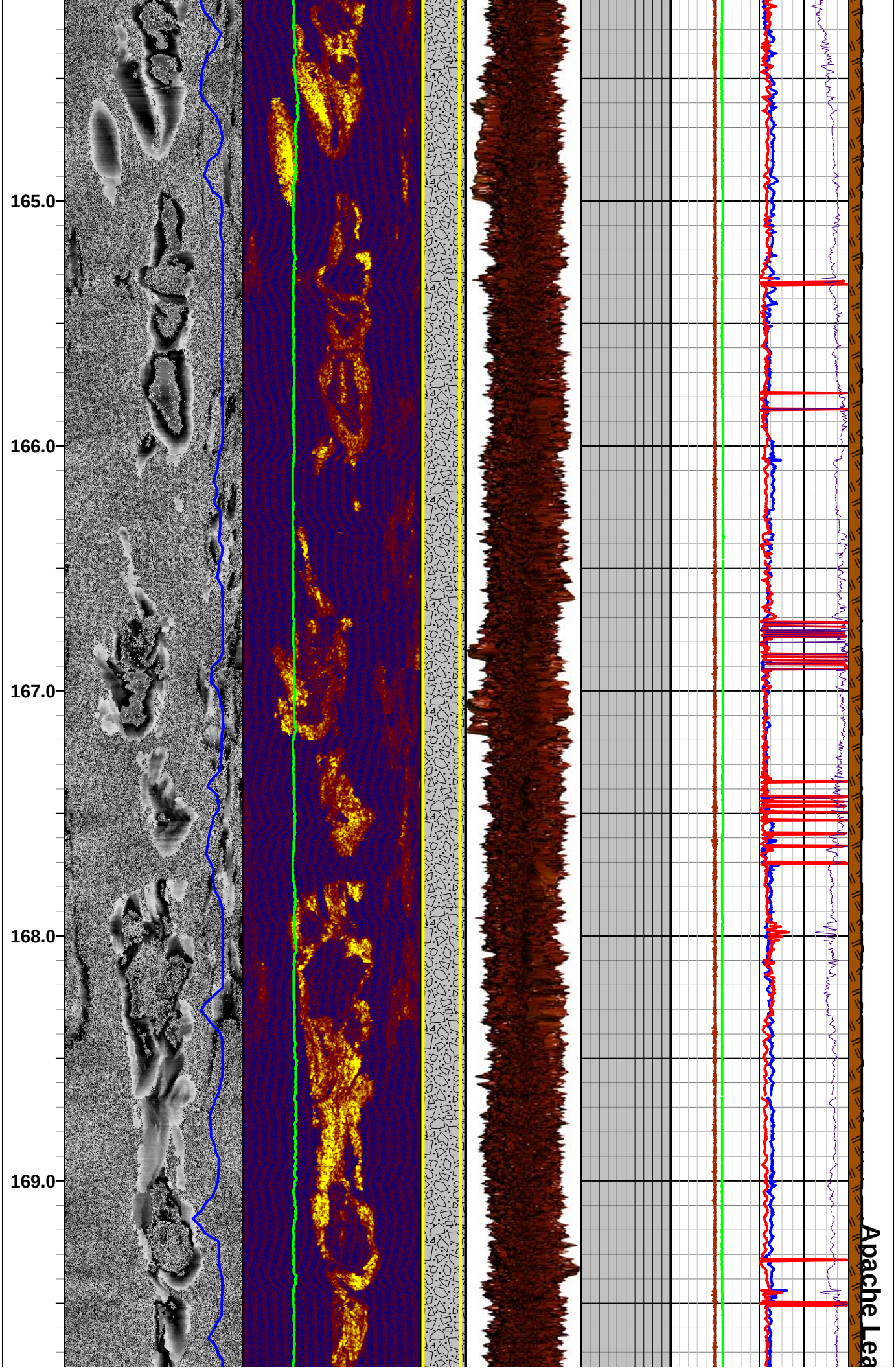
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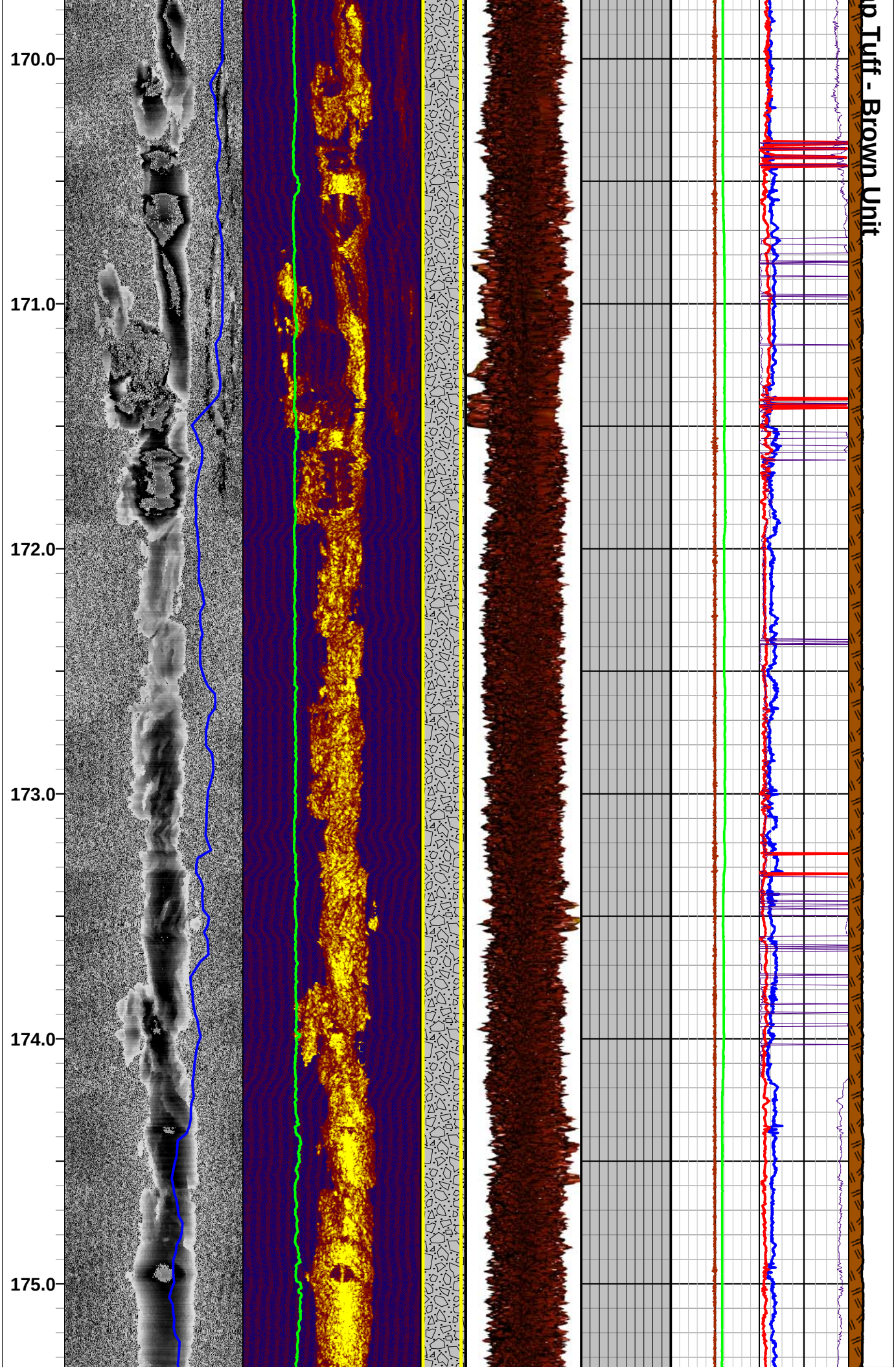
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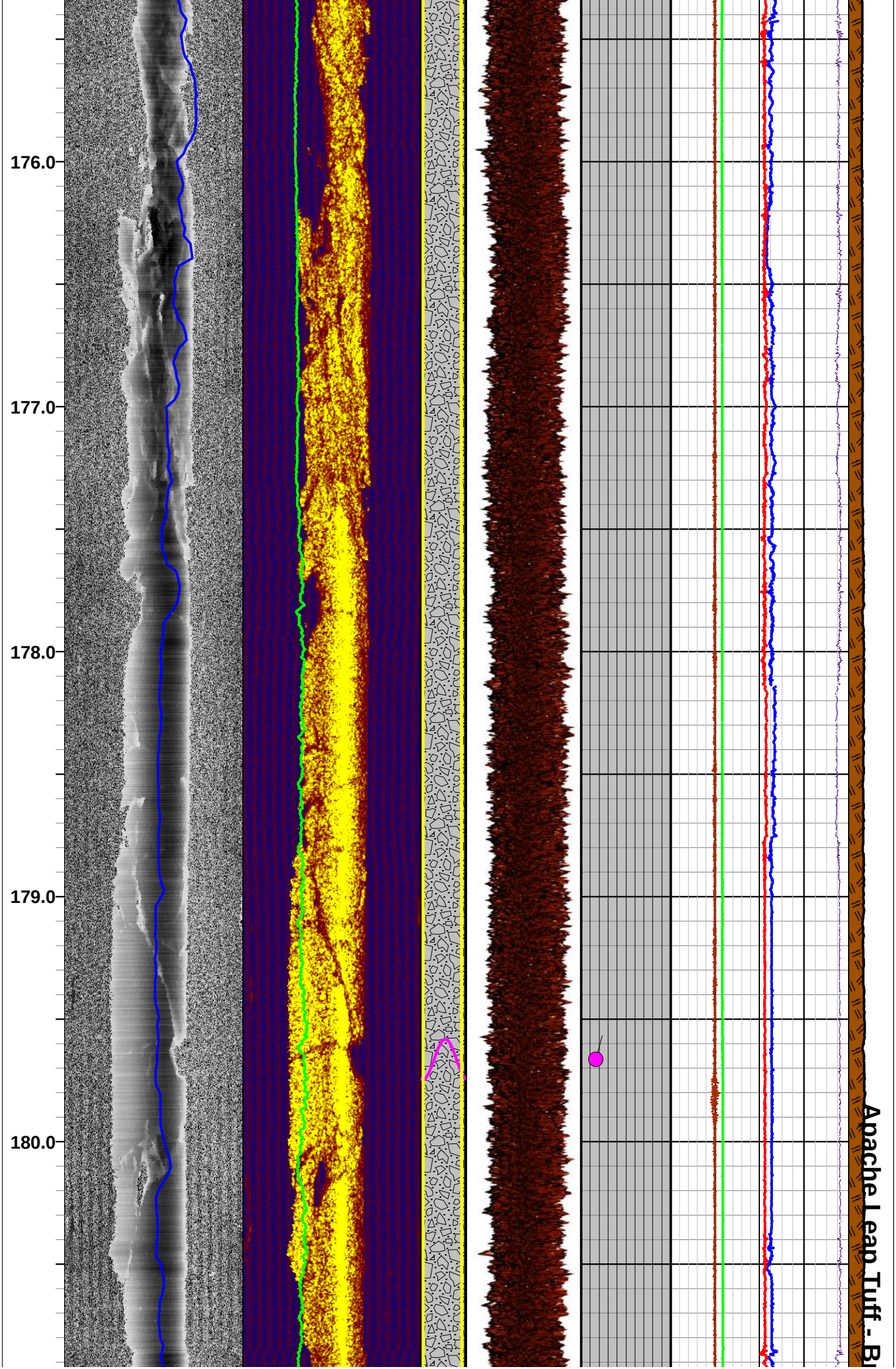
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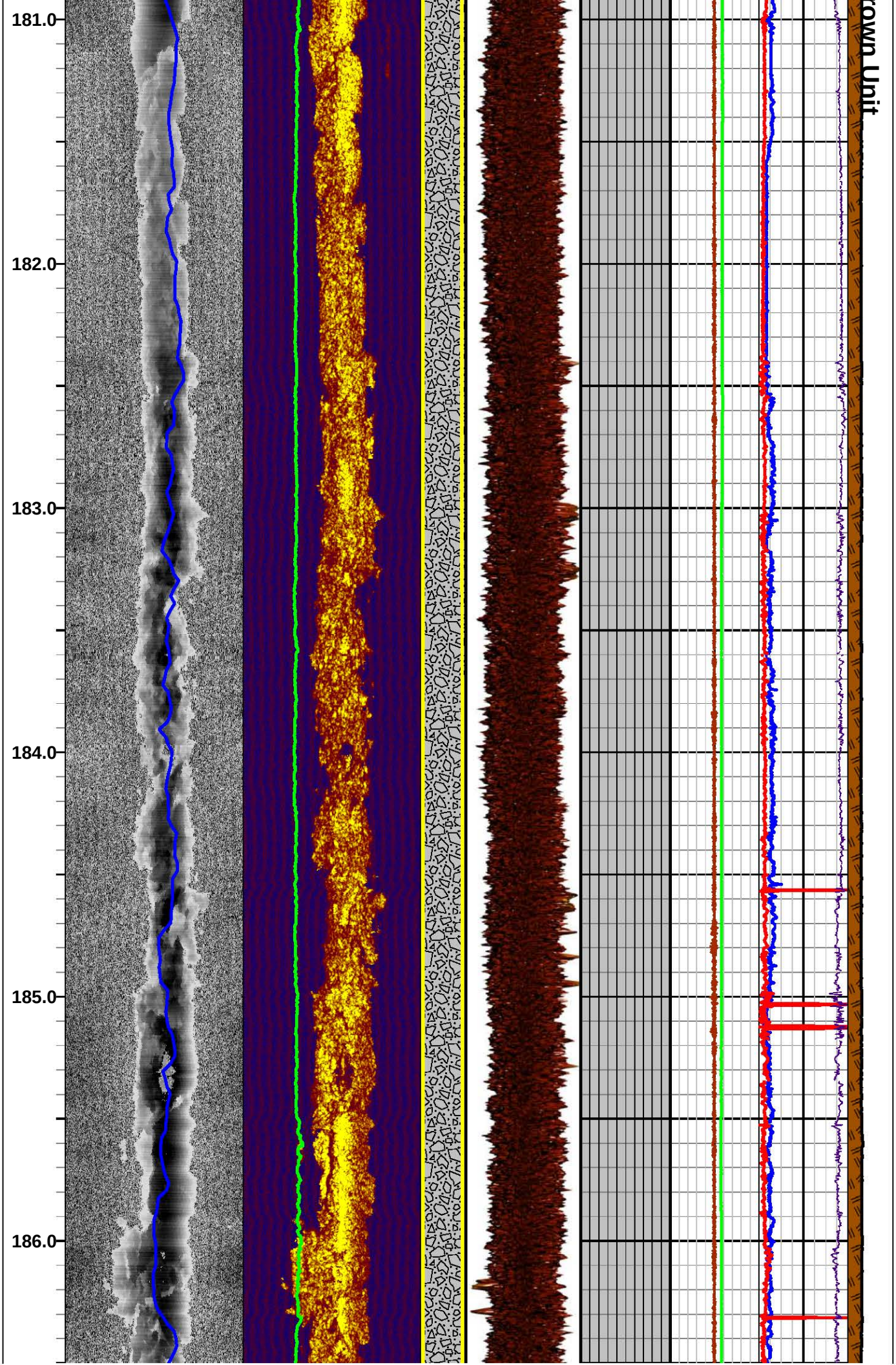
Apache Leap Tuff - Bu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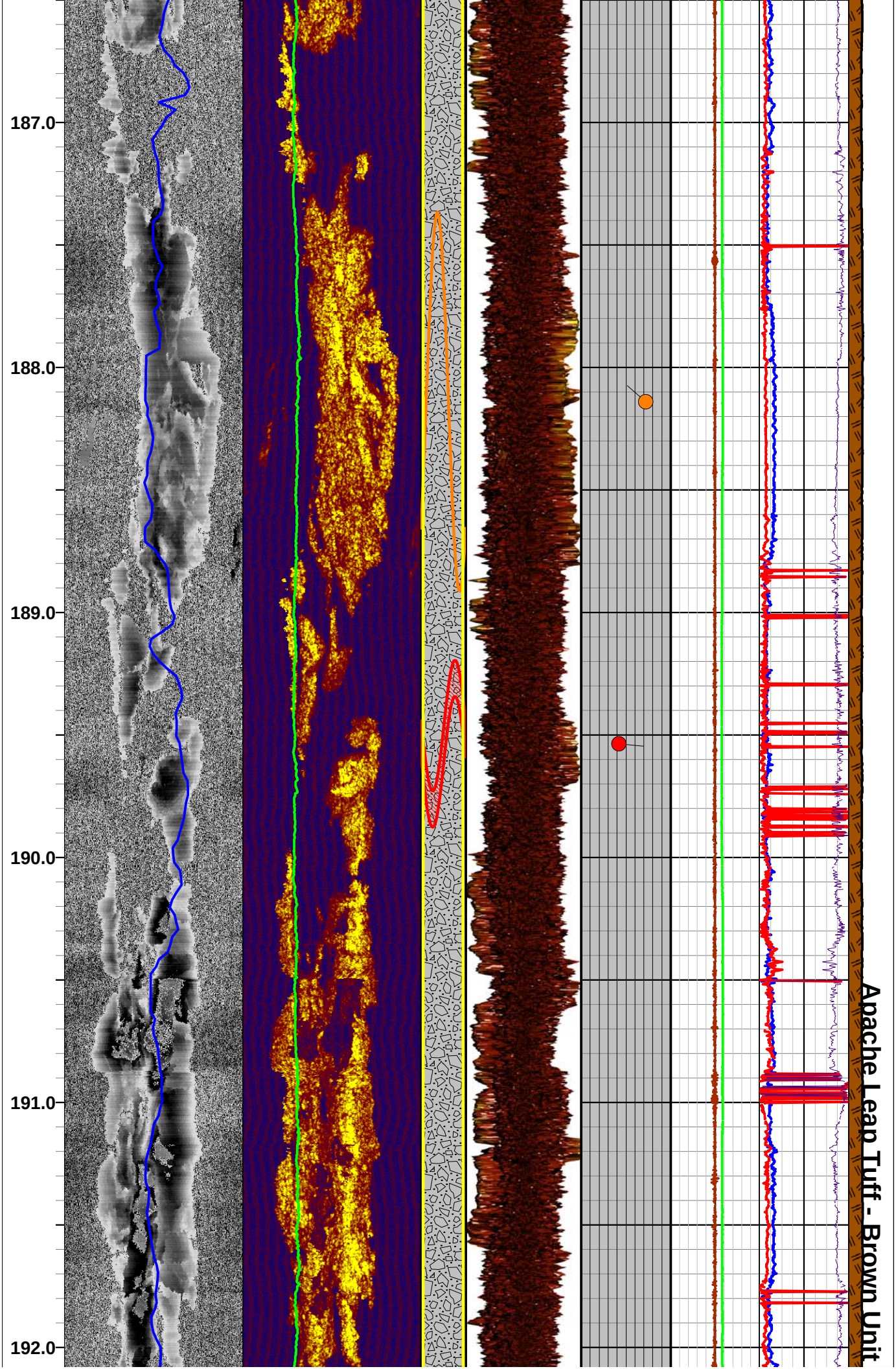
rown Unit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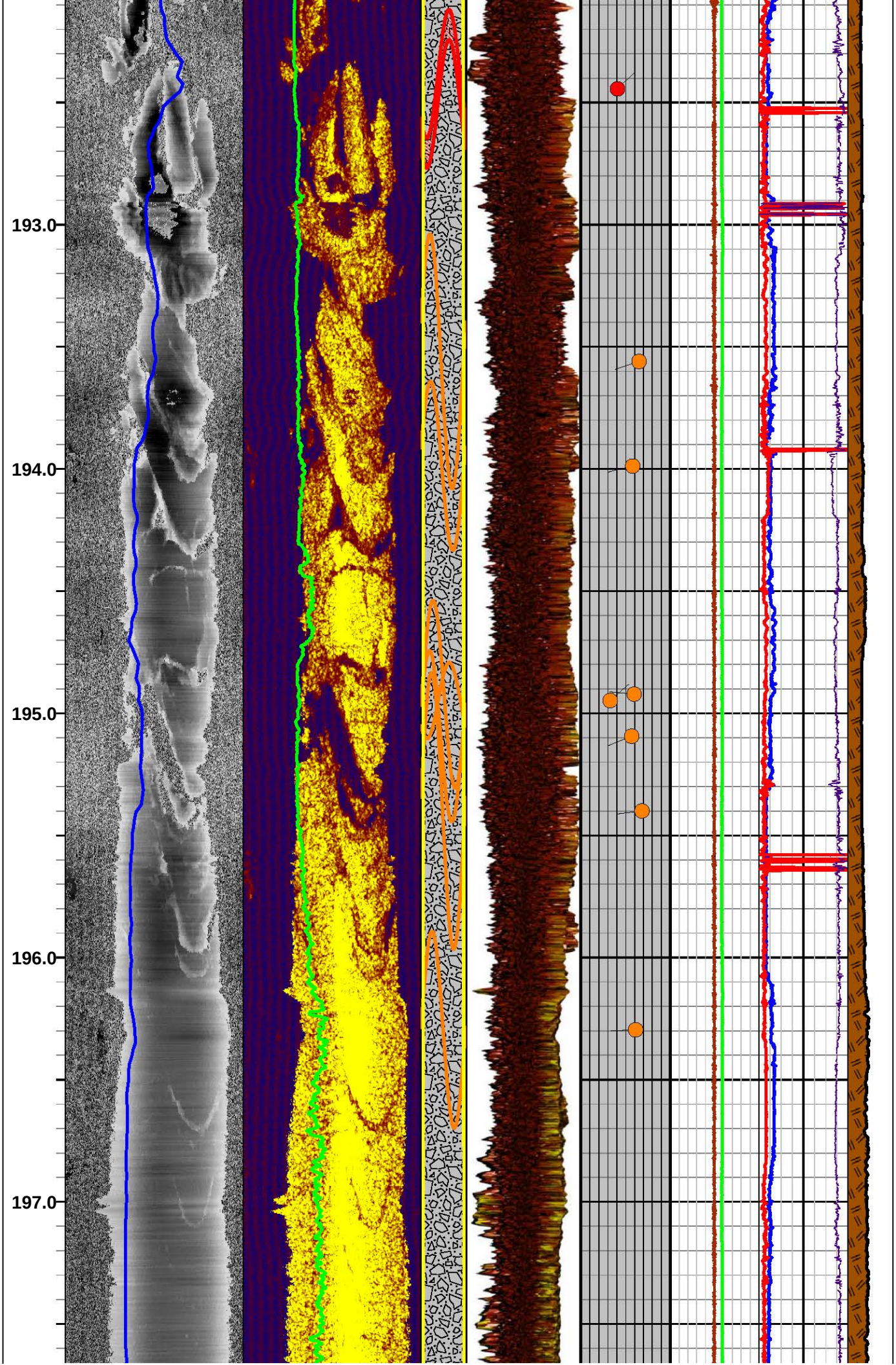
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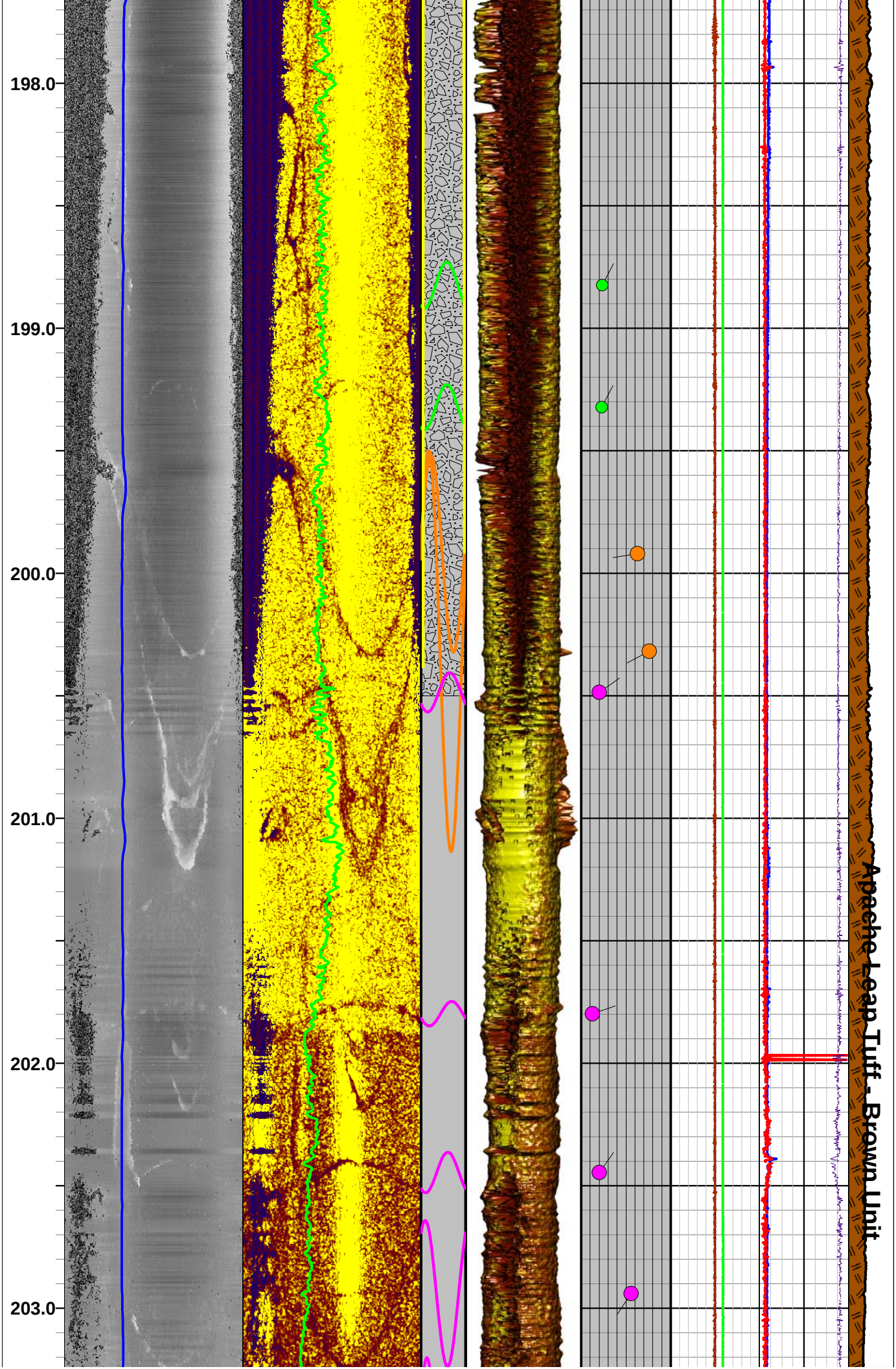
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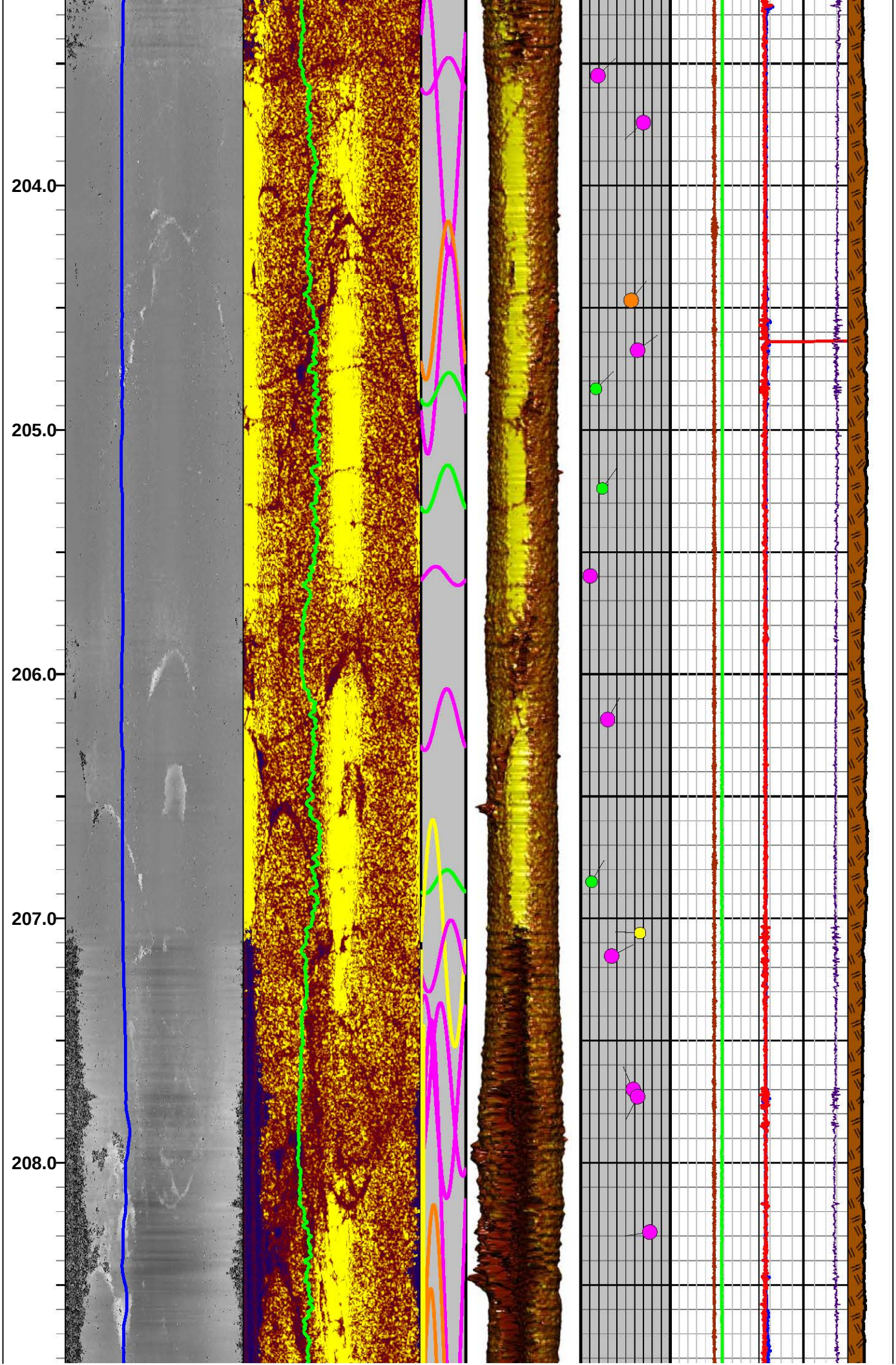
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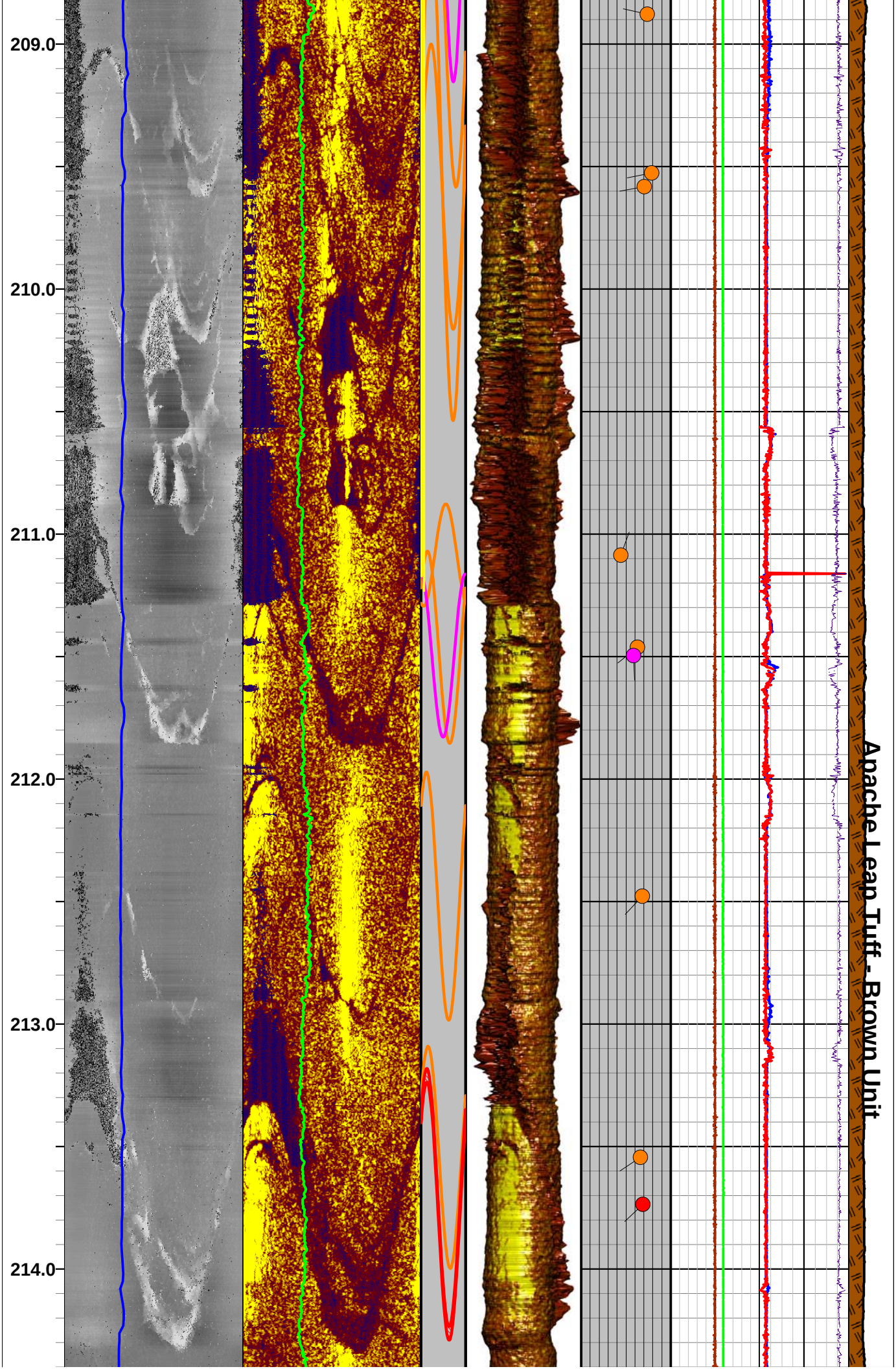
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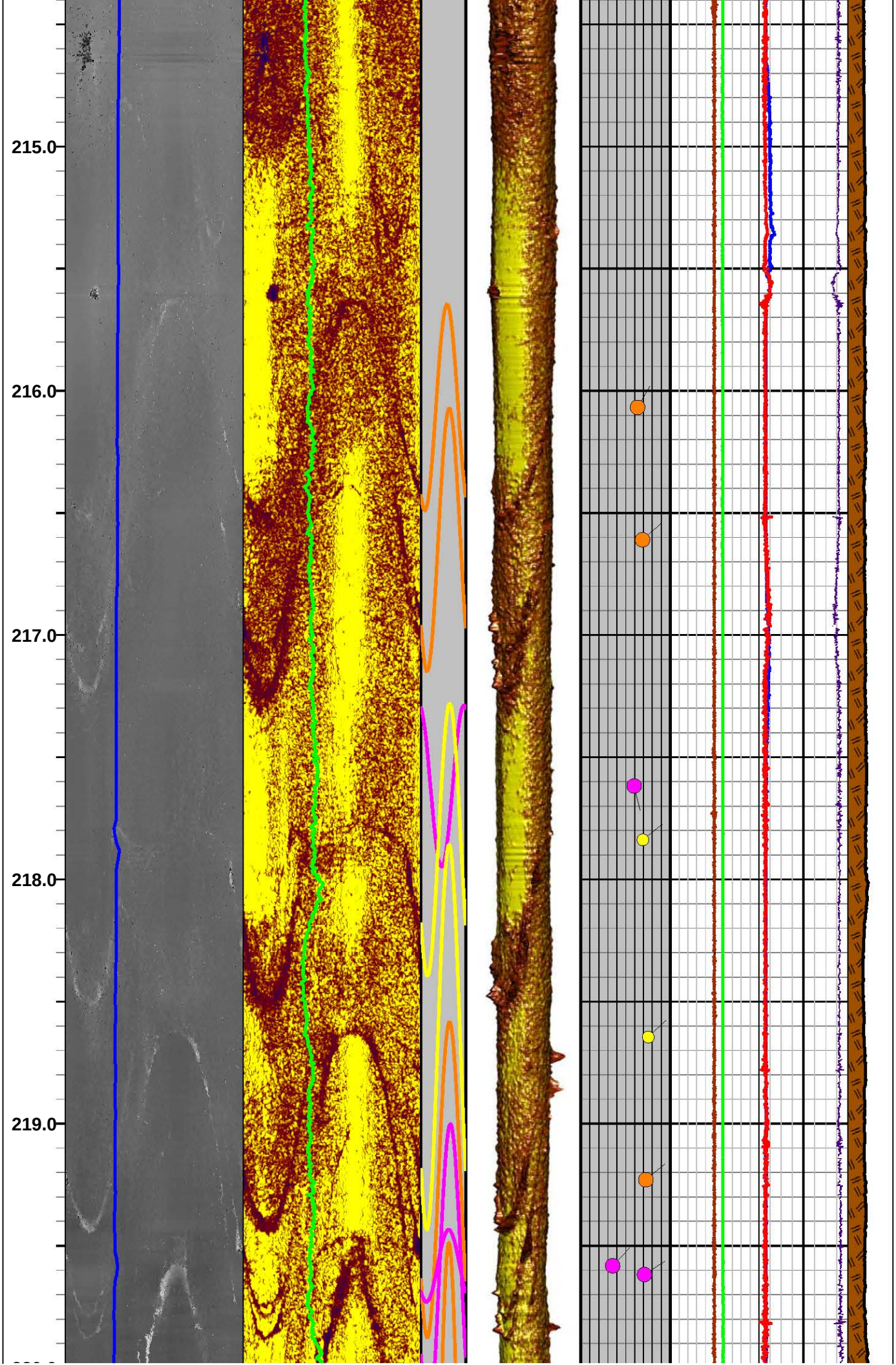
Apache Leap Tuff - Brown Unit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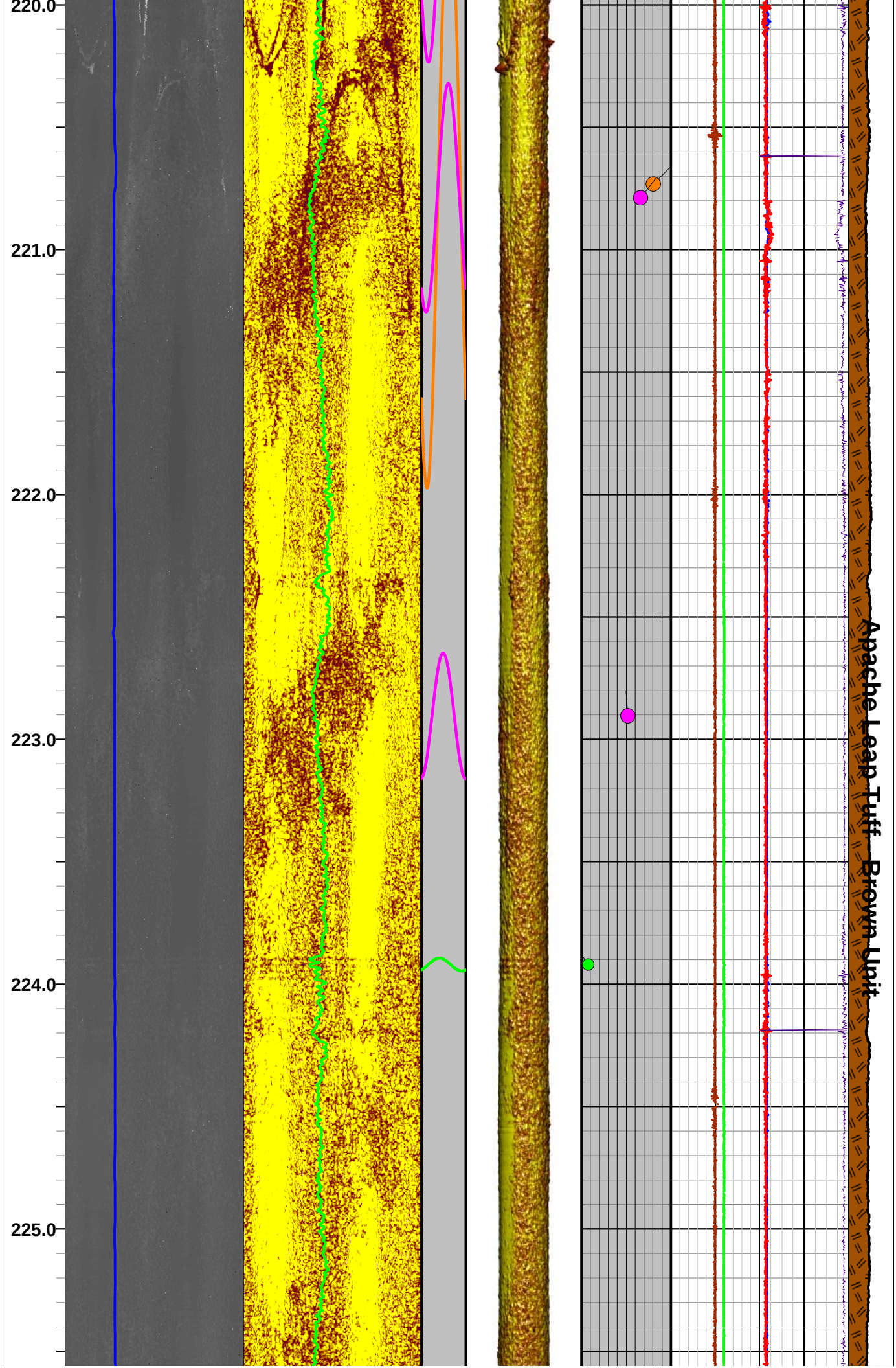
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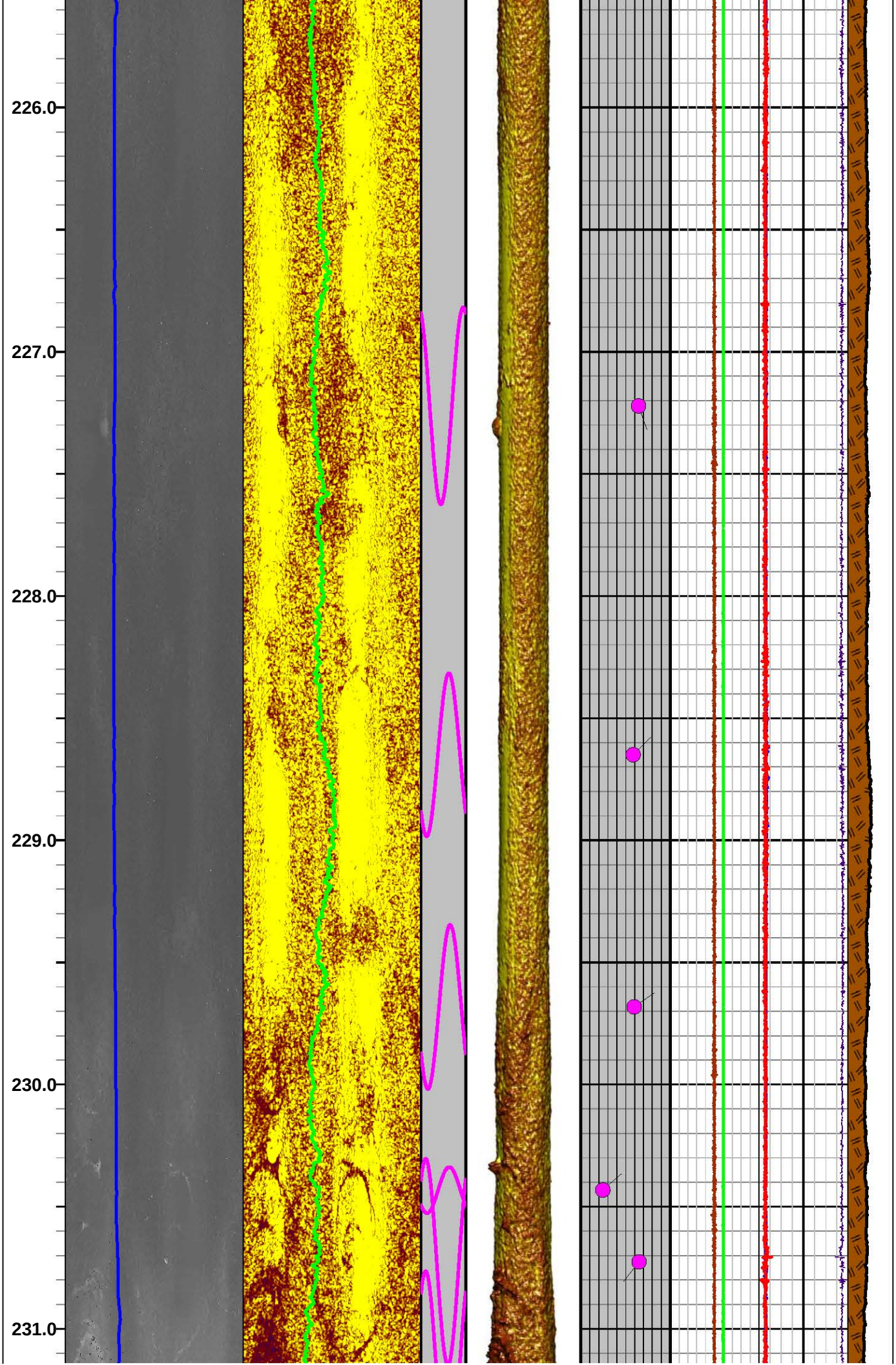
Apache Leap Tuff, Brown Unit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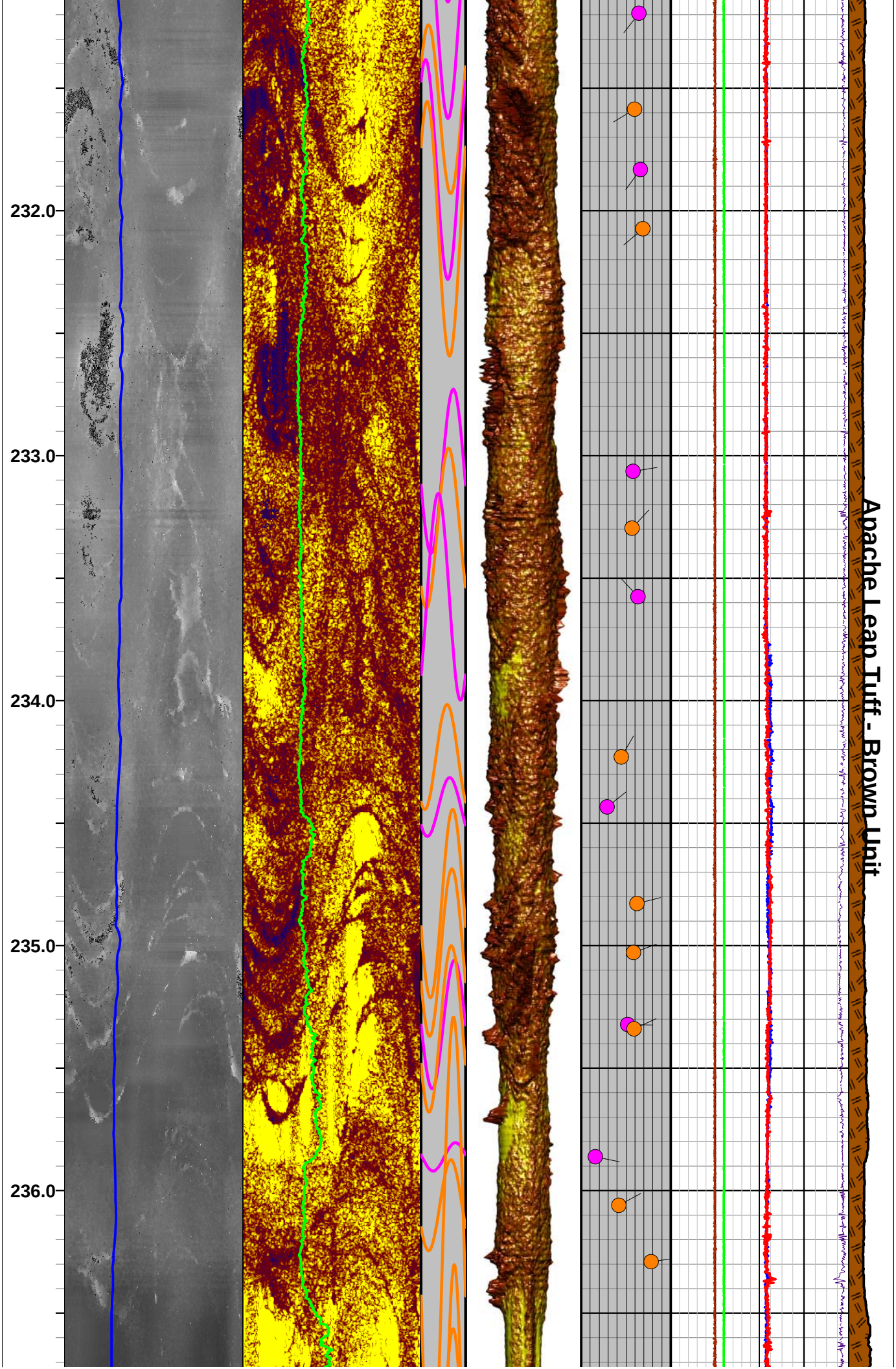
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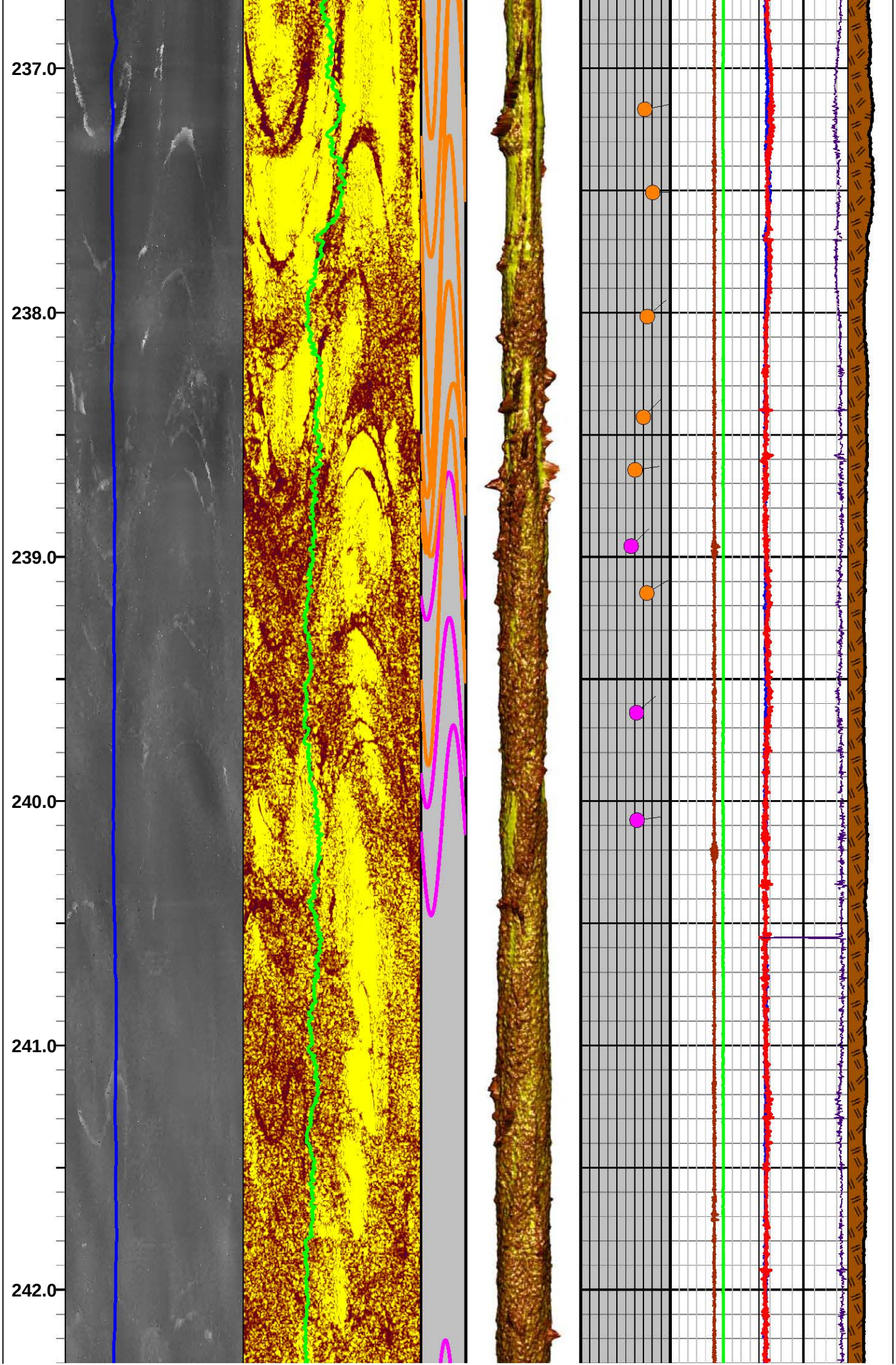
Apache Leap Tuff - Brown Unit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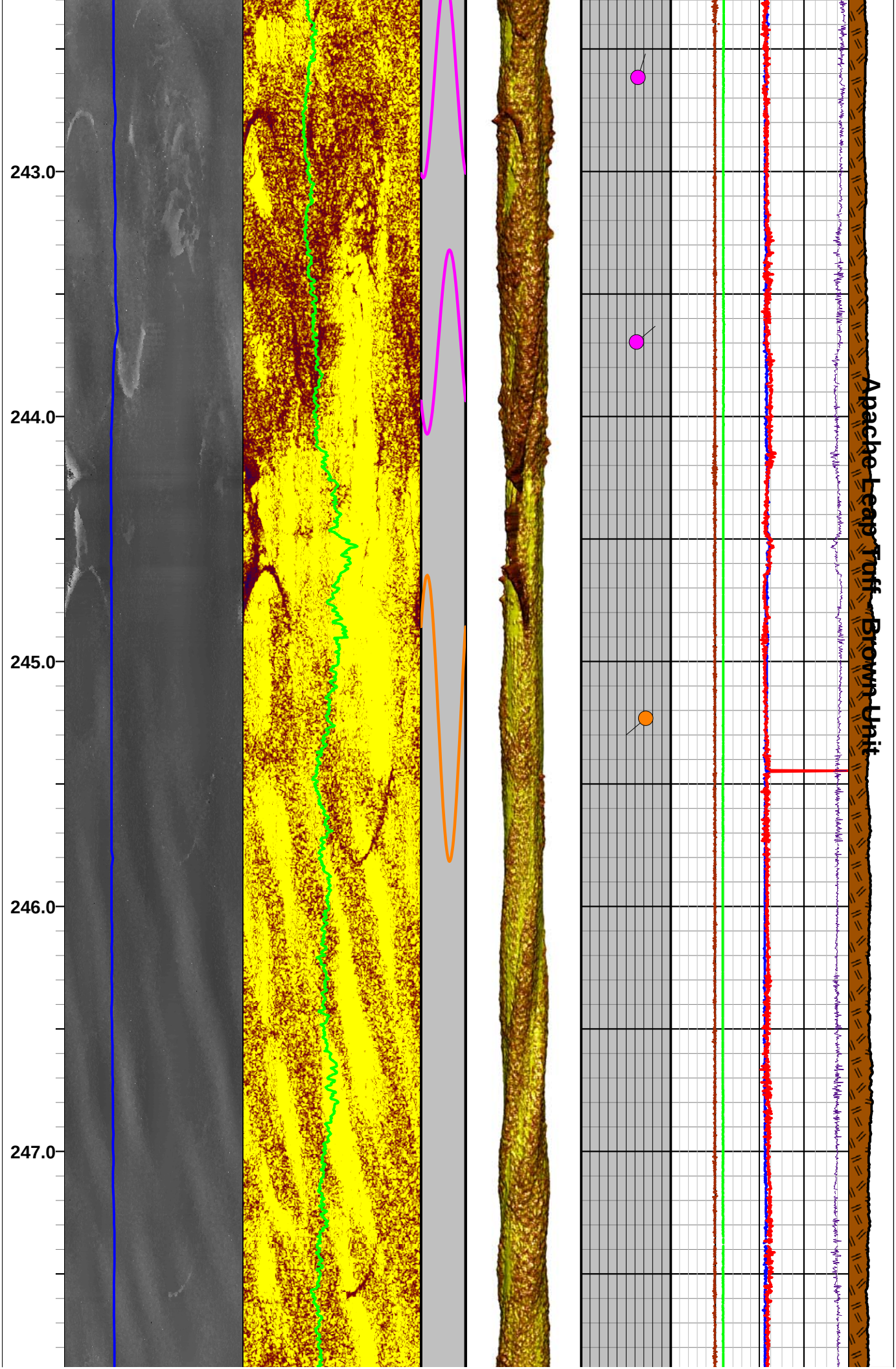
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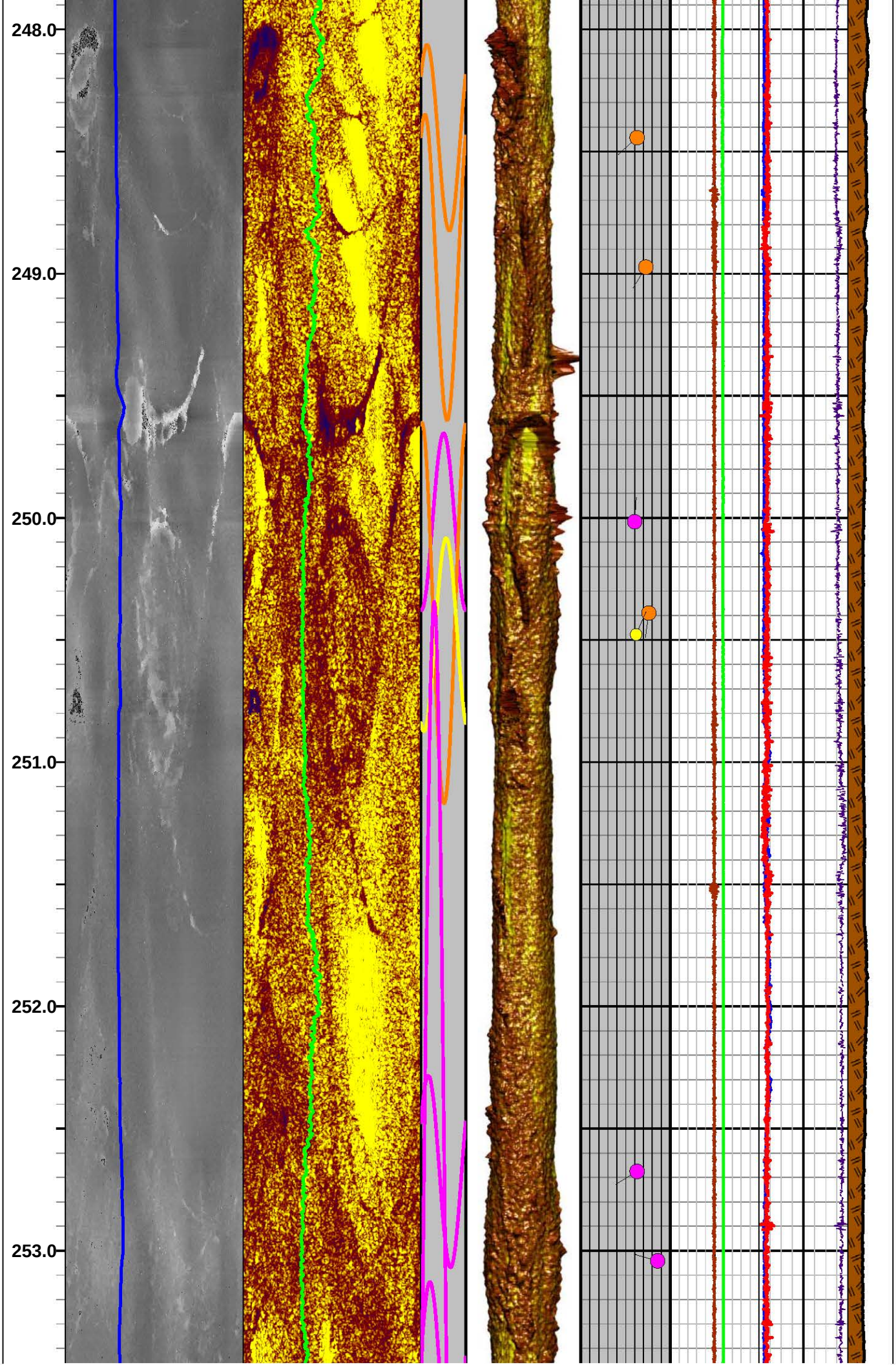
Apache Leap Tuff - Brown Unit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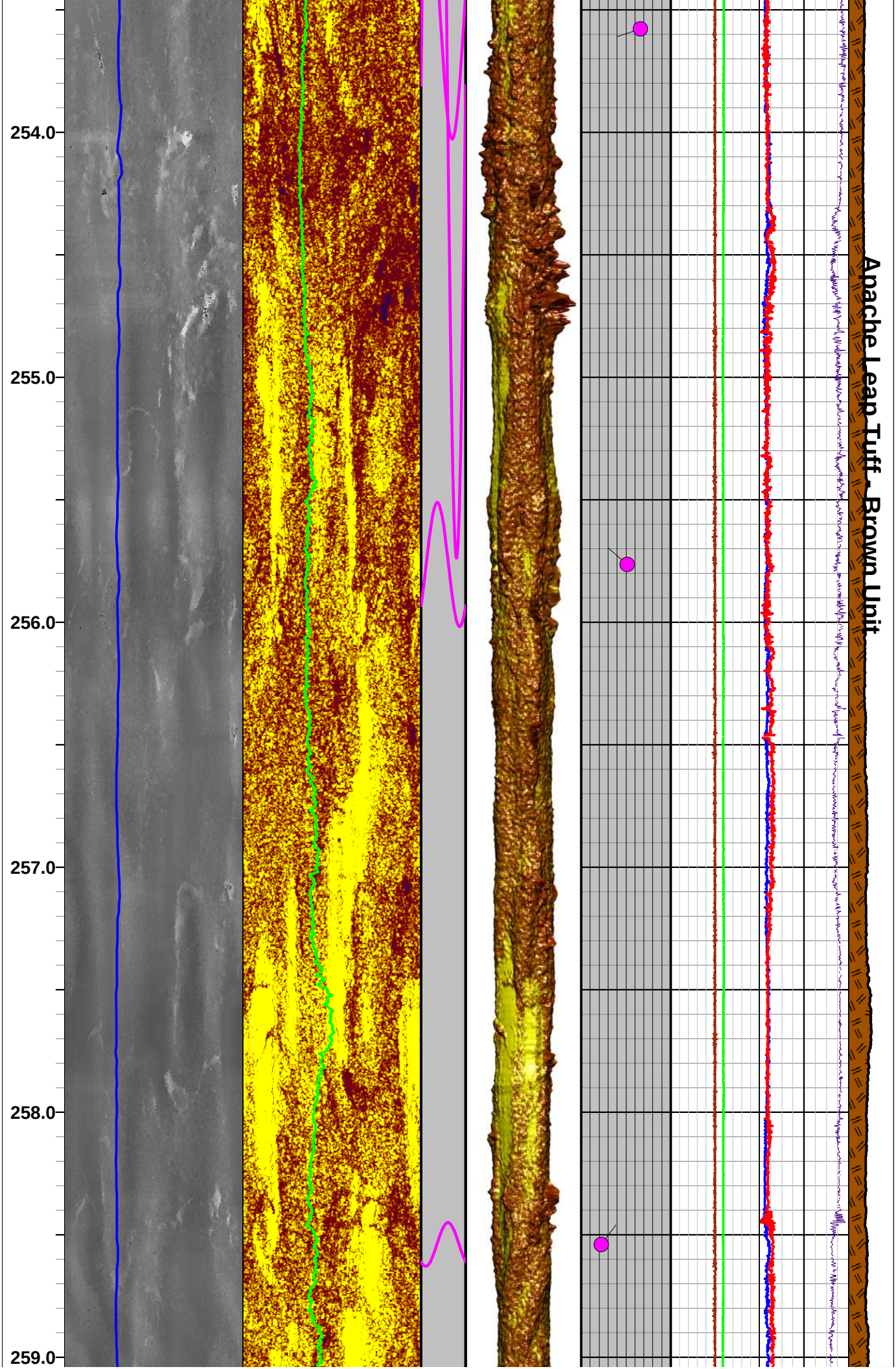
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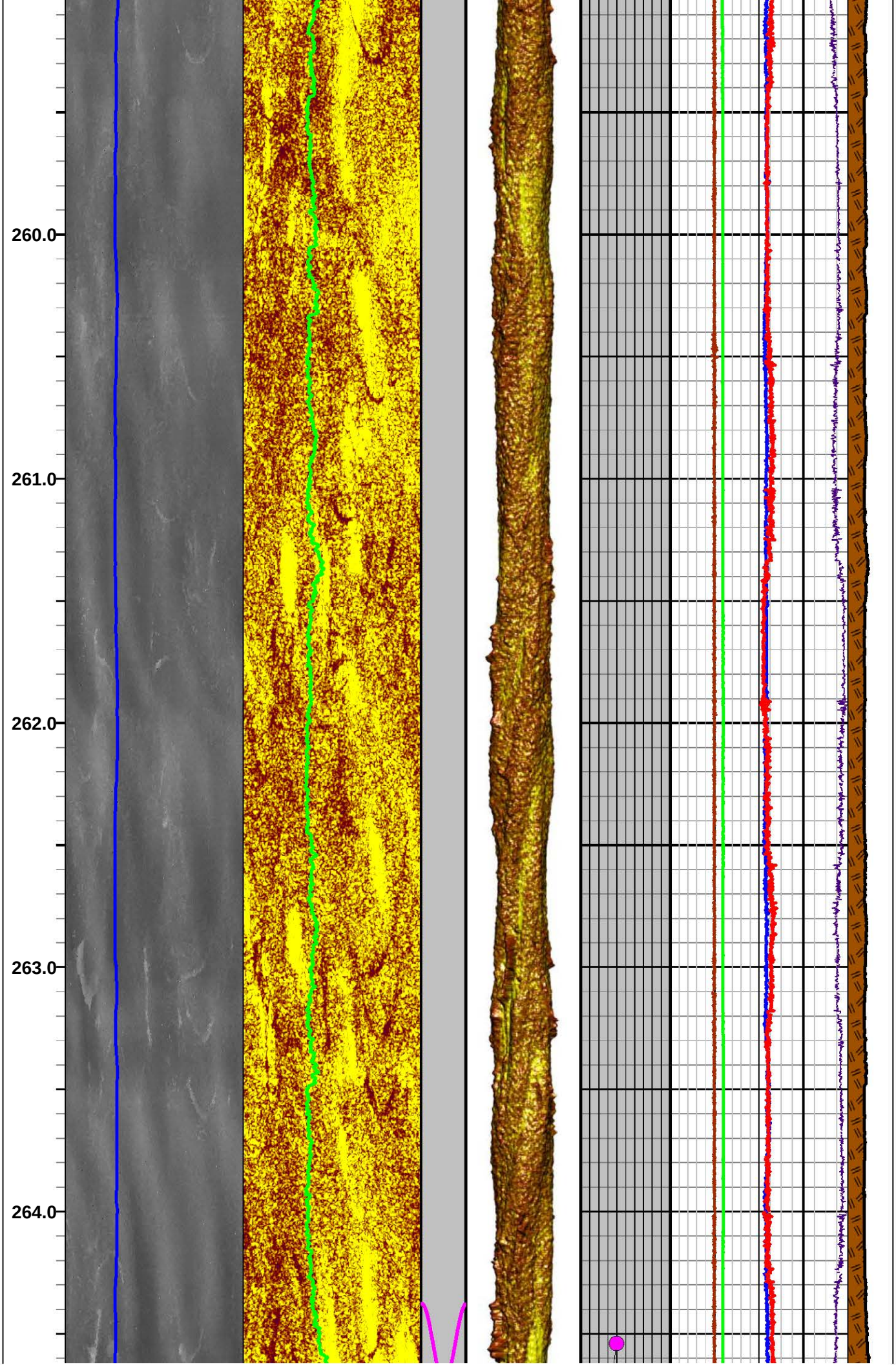
Apache Leap Tuff - Brown Unit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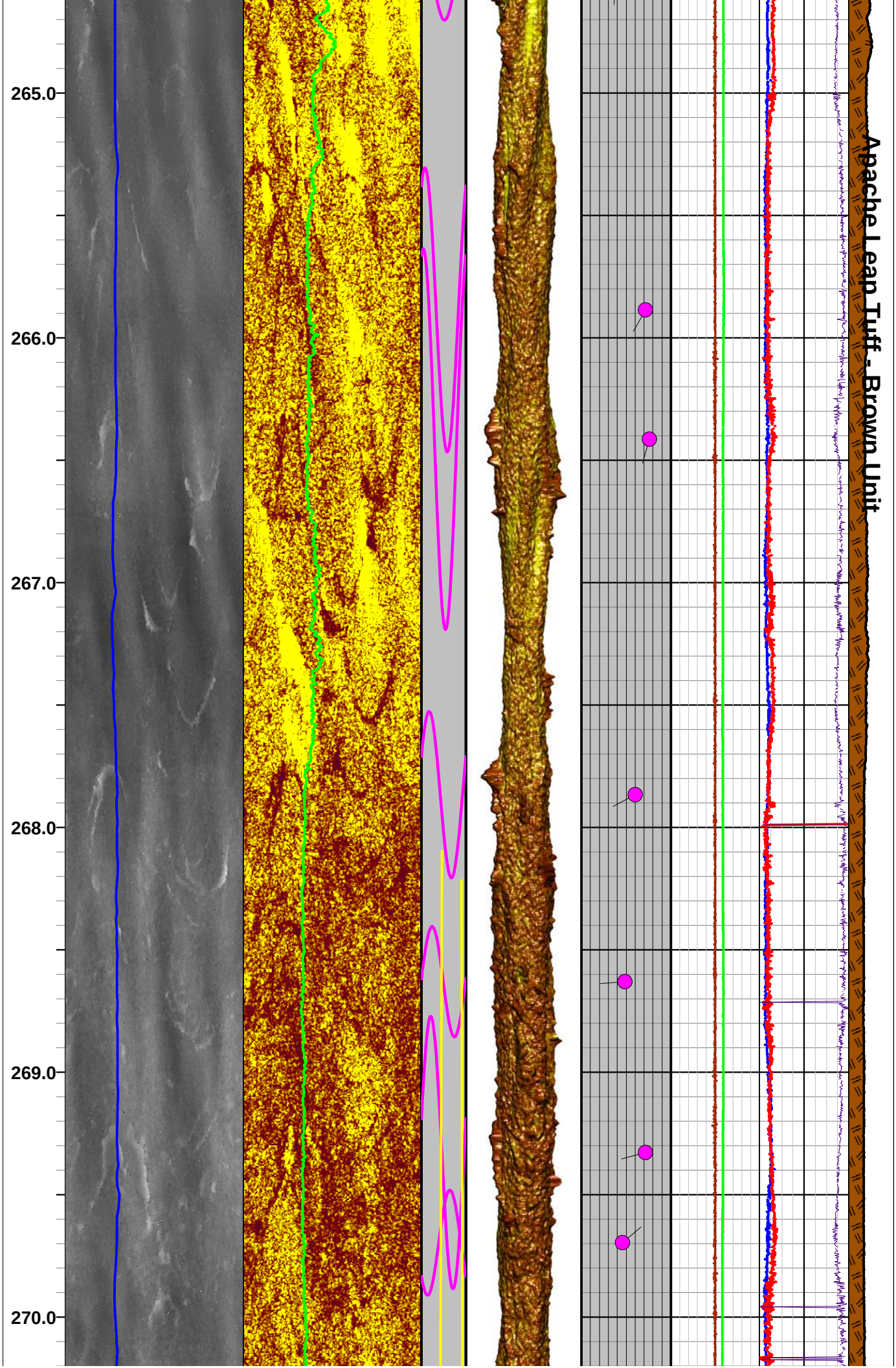
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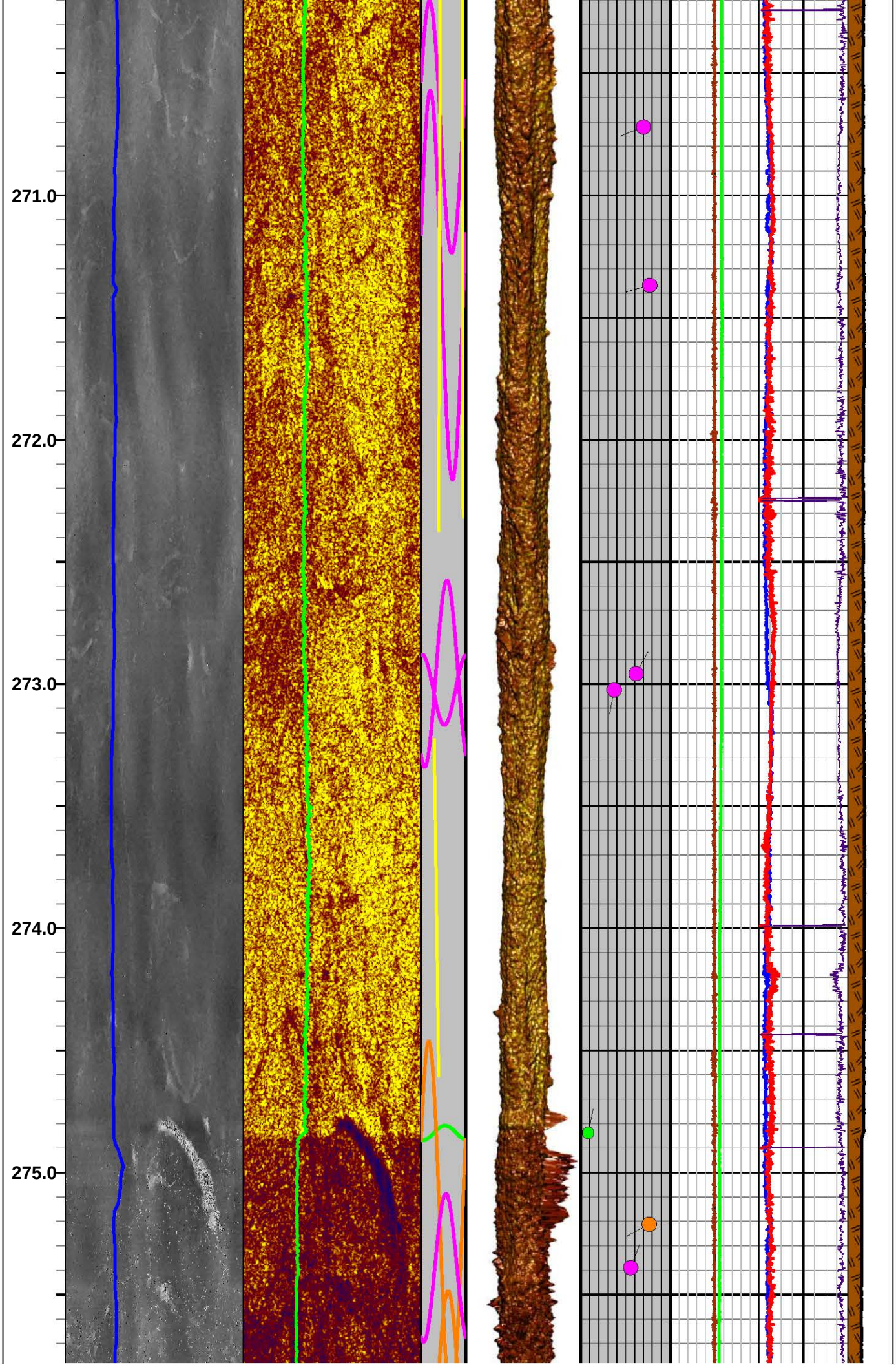
Apache Leap Tuff - Brown Unit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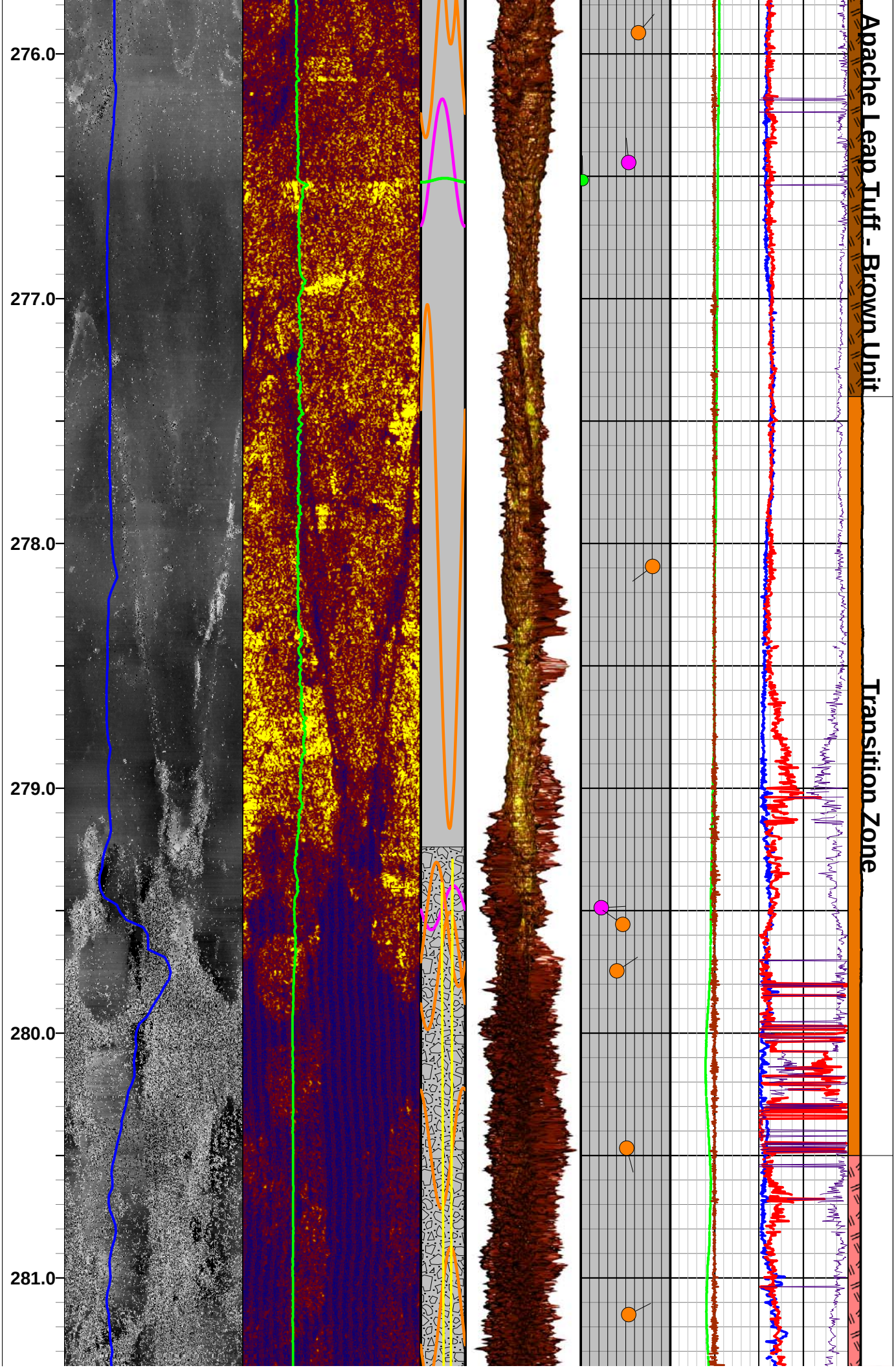
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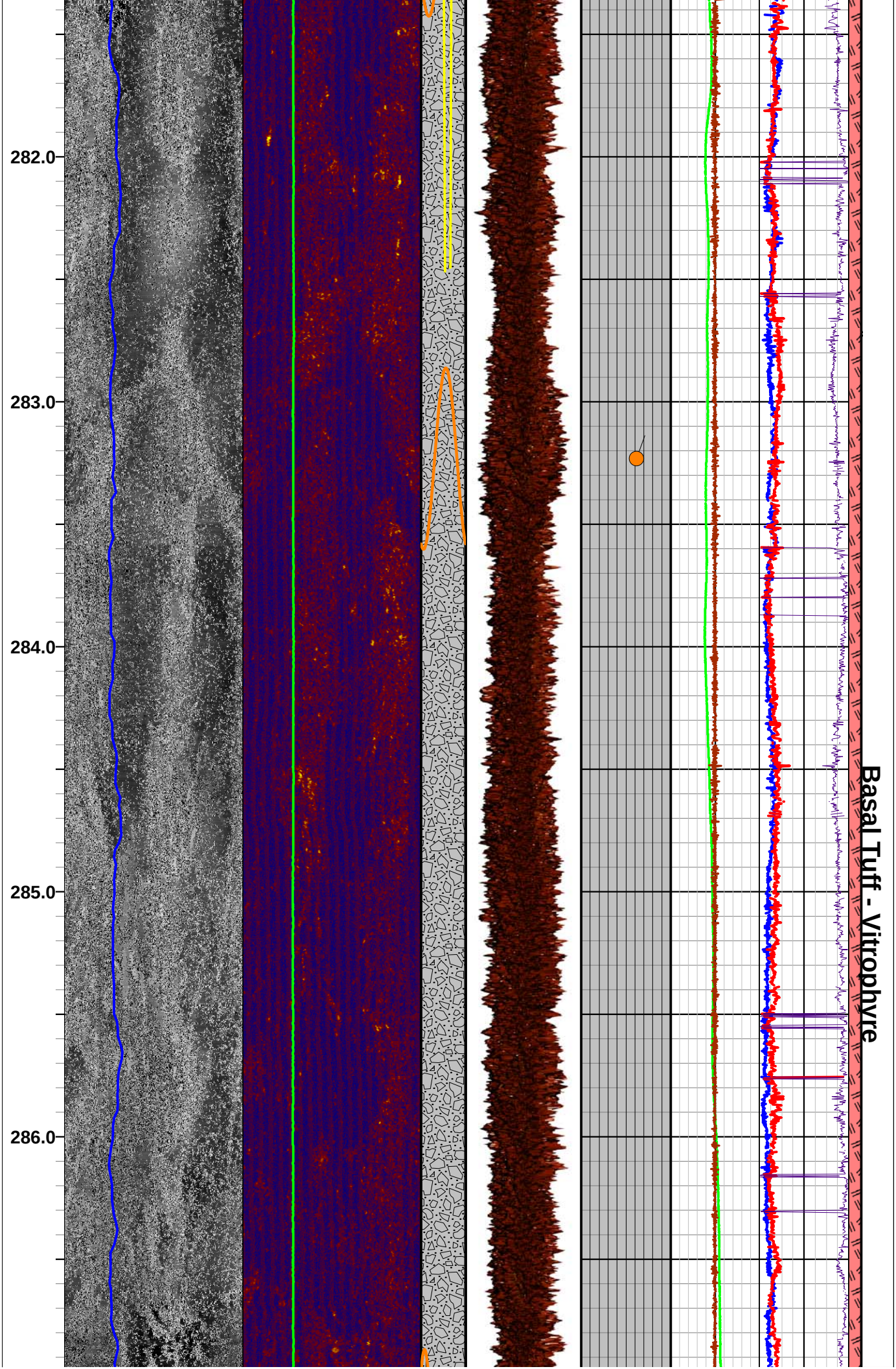
Apache Leap Tuff - Brown Unit
Transition Zone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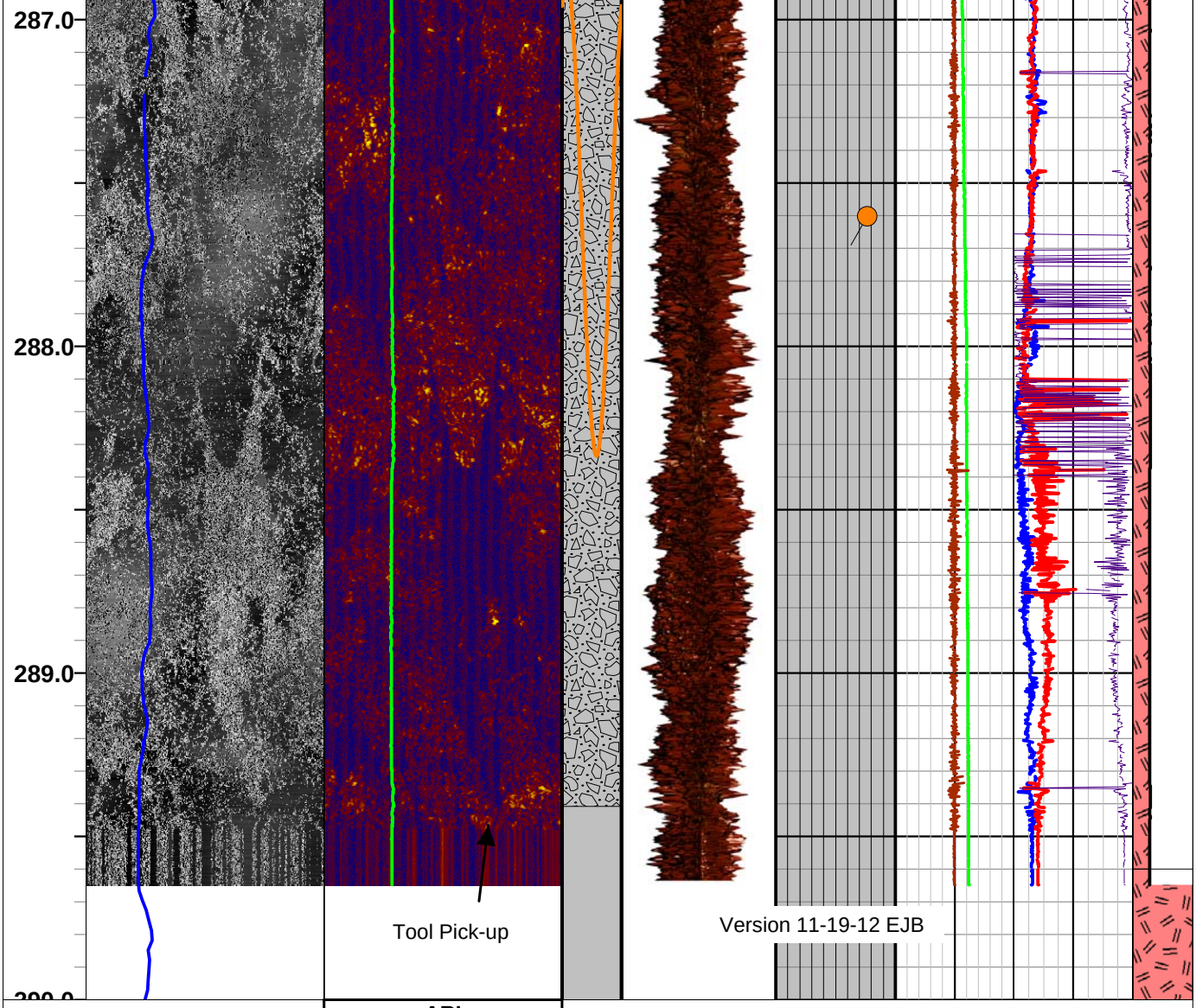
Basal Tuff - Vitrophyre



Depth 1m:20m	Caliper 10 Inches 30	Centralized TT Oriented Mag North 0° 90° 180° 270° 0°	ARI 0 400	Amp-High Pass Oriented Mag North 0° 90° 180° 270° 0°	Amp-Static Oriented Mag North 0° 90° 180° 270° 0°	Amplitude-NM Oriented Mag North 0° 90° 180° 270° 0°	Bx	NVJt	ABI DIPA	3D 0°	Tadpole DIPT 0 100	Gravity 0.8 g 1.2	Mag Field 40 uT 60	RBR -90 270	Azimuth 0 360	Tilt 0 deg 10	Desc	Hard	Lith
1m:20m	HRES-19 ABI-43 Summary_ ~119.0 M to ~289.6 M																		

ABI Image Summary Legend

Mnemonics and Comments

Centralized TT = 2D plot of acoustic image travel time with probe position centralized. Oriented to magnetic north and plotted from left to right N-E-S-W-N

Caliper = 3-arm mechanical caliper of hole diameter plotted from 10 to 30 inches (blue line).

Max Acoustic Caliper = Maximum acoustic caliper of hole diameter calculated from Travel Time data

Max-Acoustic Caliper = Maximum acoustic caliper of hole diameter calculated from Travel Time data and plotted as orange line from 10 to 30 inches. Turned off due to elongation of hole diameter.

Ave-Acoustic Caliper = Average acoustic caliper of hole diameter calculated from Travel Time data and plotted as bright green line from 10 to 30 inches. Turned off due to elongation of hole diameter

Enlargements = Pink shaded zone between Avg-Acoustic Caliper and Max-Acoustic Caliper calculated from Travel Time data showing borehole enlargment. Turned off due to elongation of hole diameter.

Amplitude-NM = 2D plot of unfiltered acoustic image amplitude oriented to magnetic north. Plotted from left to right N-E-S-W-N. Image toggled off.

Amp-Static = 2D plot of acoustic image amplitude with Static normalization filter oriented to magnetic north. Plotted from left to Right N-E-S-W-N. Image toggled on.

Amp-High Pass = 2D plot of acoustic image amplitude with High Pass normalization filter oriented to magnetic north. Plotted from left to Right N-E-S-W-N. Image toggled on.

ARI = Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 400 (harder) as green line.

ABI = Planar strucutral features picked on acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis.

NVJt = Near Vertical (near parallel to hole axis) joint/fracture features picked on acoustic borehole image shown as colored sinusoid (color designation shown on header).

Bx = Apparent Breccia or Congomerate zones and Vugs/Vesicles/Cavities.

3-D = 3D cylindrical projection of ABI image using Centralized TT log for hole shape looking from North.

Tadpole = Tadpole plot of the ABI feature picks (fractures and bedding planes); plotted from 0 to 90 dip - see legend above. DIPT = True orientation; features corrected for hole deviation.

Mag Field = Total magnetic field strength as measured by fluxgate magnetometer in OBI or ABI deviation sensor - plotted 40-60 uT (green line).

Gravity = Total gravity (probe acceleration) as measured by 3-axis accelerometers in ABI deviation sensor - plotted 0.8-1.2 g (brown line).

Azimuth = Direction of tool tilt plotted 0 to 360 deg - represents borehole deviation direction (red line).

Tilt = Tool tilt (vertical = 0 and horizontal = 90) plotted 0 to 10 deg ; represents borehole deviation tilt from vertical (blue line).

RBR = Relative bearing - azimuth of the probe marker position to Magnetic North measured clockwise (thin purple line).

Lith = Major/principal lithology based on field geologic descriptions provided by Clear Creek staff.

Desc = Major/principal field geologic descriptions provided by Clear Creek staff.

Hard = Apparent rock harness from ARI used to silhouette lithology.

Prepared by Erika J. Beam

Rev 11-19-12

Southwest Exploration Services, LLC
borehole geophysics & video services

ABI-OBI Combined - Deviation Plot: Bulls-Eye View

Survey Calculation Method : Minimum Curvature

Reference : Mag. North
Mag Declination : 11.5 Deg

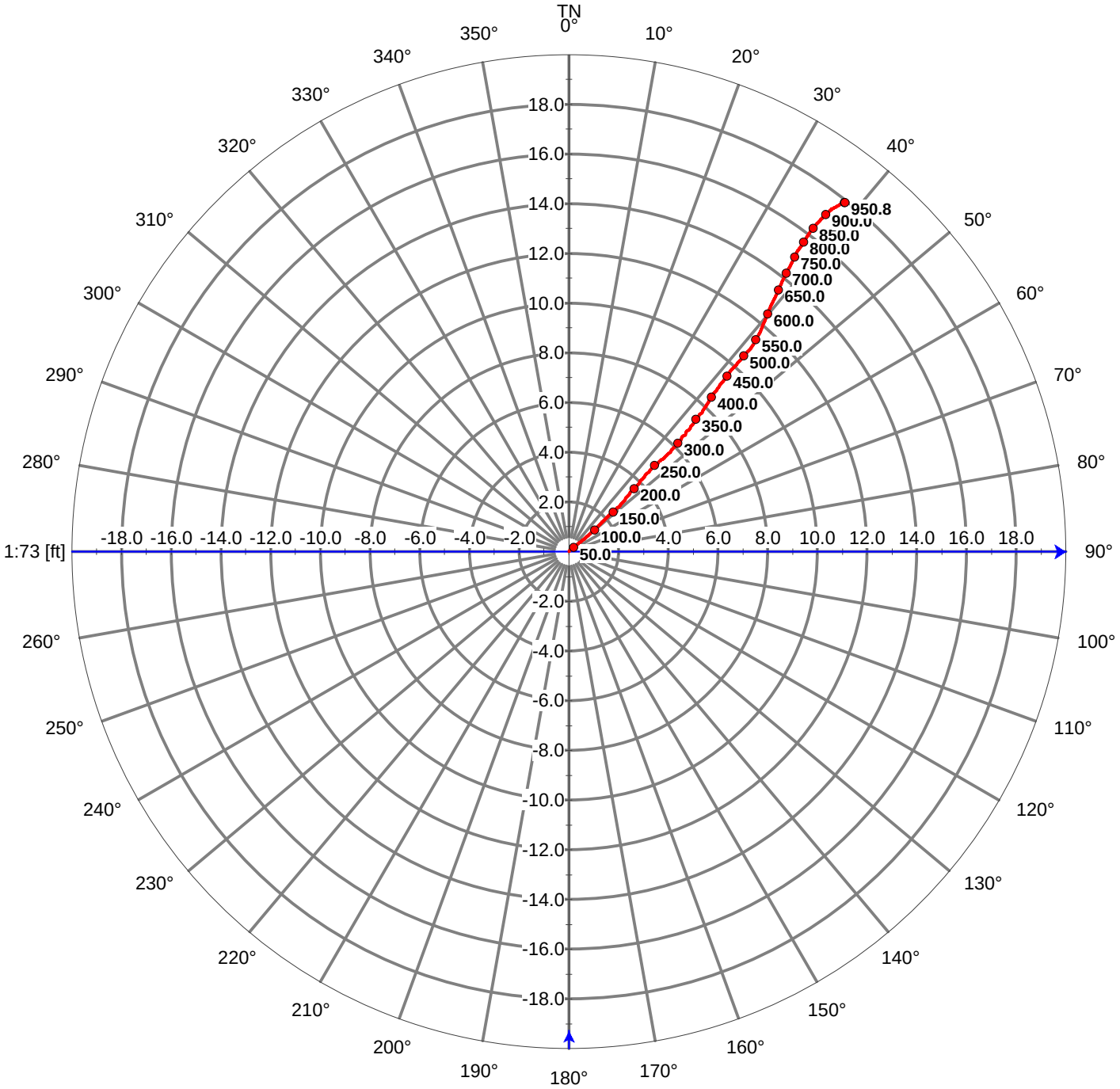
WELL #	HRES-19	DATE	11-4-12
CLIENT	RESOLUTION COPPER		
FIELD/SITE	OAK FLATS		
COUNTY	PINAL	STATE	AZ
OPERATOR	K. MITCHELL/E. BEAM	WITNESS	BARRY H. - CLEAR CREEK

FINAL LOCATION
CLOSURE DISTANCE 17.9 FT
CLOSURE ANGLE 50.3 DEG
TVD 950.6 FT

Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in context of measured interval only

Measured Interval SURF TO 291.4 M
Tool Zero Reference Ground Level
Tool used: OBI MK4/ABI-43

Centralized YES
Elevation:
Serial No:



Southwest Exploration Services, LLC
borehole geophysics & video services

ABI-OBI Combined - Deviation Plot: Vertical View

Survey Calculation Method : Minimum Curvature

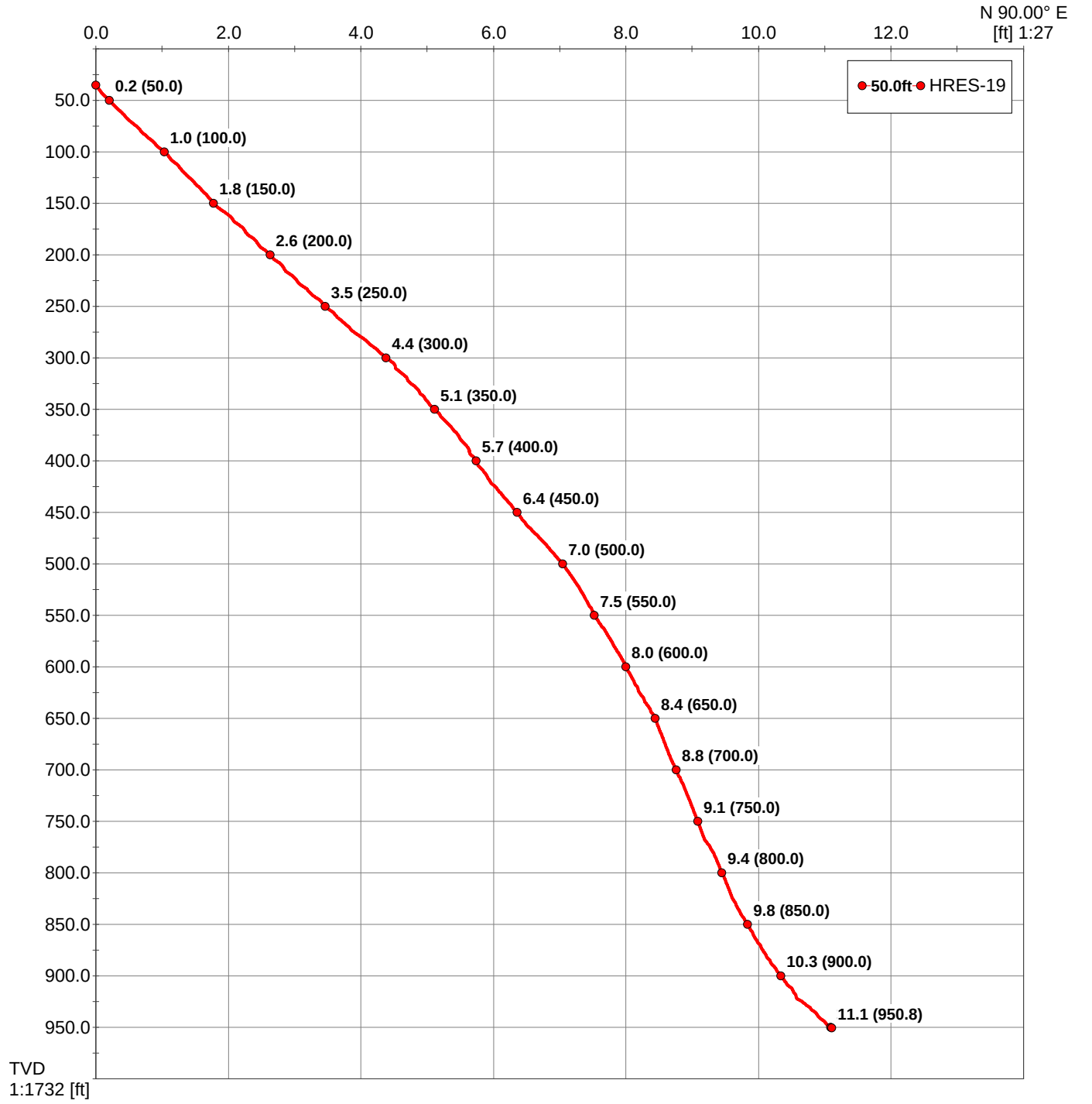
Reference : Mag. North
Mag Declination : 11.5 Deg

WELL #	HRES-19	DATE	11-4-12	FINAL LOCATION	
CLIENT	RESOLUTION COPPER			CLOSURE DISTANCE	17.9 FT
FIELD/SITE	OAK FLATS			CLOSURE ANGLE	50.3 DEG
COUNTY	PINAL	STATE	AZ	TVD	950.6 FT
OPERATOR	K. MITCHELL/E. BEAM	WITNESS	BARRY H. - CLEAR CREEK		

Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in contexted of measured interval only.

Measured Interval: SURF TO 291.4 M
Tool Zero Reference: Ground Level
Tool used: OBI MK4/ABI-43

Centralized: YES
Elevation:
Serial No:



Southwest Exploration Services, LLC
borehole geophysics & video services

ABI-OBI Combined - Deviation Plot: Closure View

Survey Calculation Method : Minimum Curvature

Reference : Mag. North
Mag Declination : 11.5 Deg

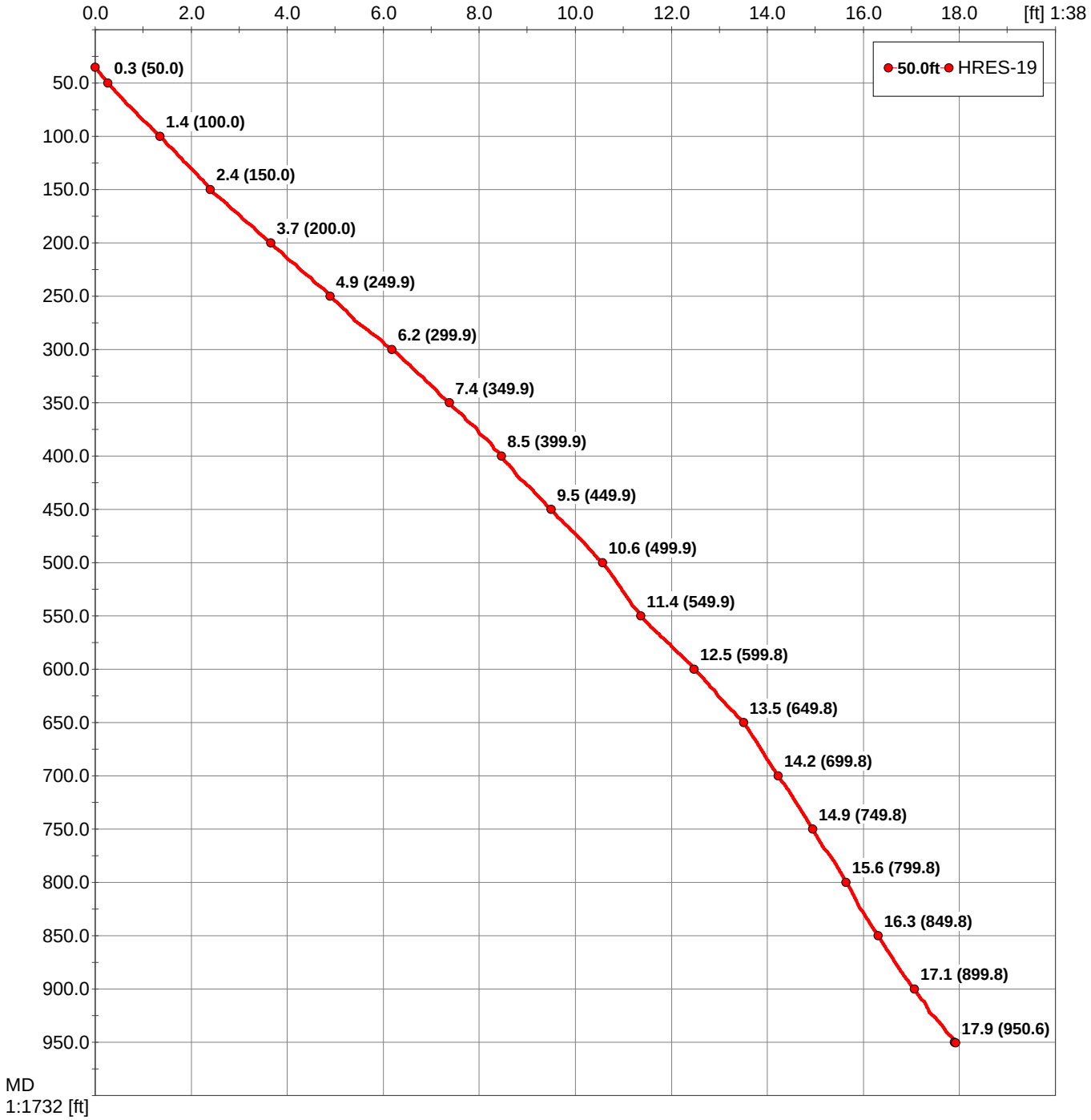
WELL #	HRES-19	DATE	11-4-12
CLIENT	RESOLUTION		
FIELD/SITE	OAK FLATS		
COUNTY	PINAL	STATE	AZ
OPERATOR	K. MITCHELL/E. BEAM	WITNESS	BARRY H - CLEAR CREEK

FINAL LOCATION
CLOSURE DISTANCE 17.9 FT
CLOSURE ANGLE 255.2 DEG
TVD 950.6 FT

Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in contexted of measured interval only.

Measured Interval SURF TO 291.4 M
Tool Zero Reference Ground Level
Tool used: OBI MK4/ABI-43

Centralized YES
Elevation:
Serial No:



MD
1:1732 [ft]

PLATE 3

QV-5 GEOPHYSICAL LOGS

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	QV-5 (ADWR 55-221850)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: CALIPER-GAMMA RAY
MORE: FLUID TEMP/RESIS

LOCATION
D(1-10)34CDD

SEC 34 TWP 1S RGE 10E

OTHER SERVICES
OBI
ABI
E-LOGS
SONIC

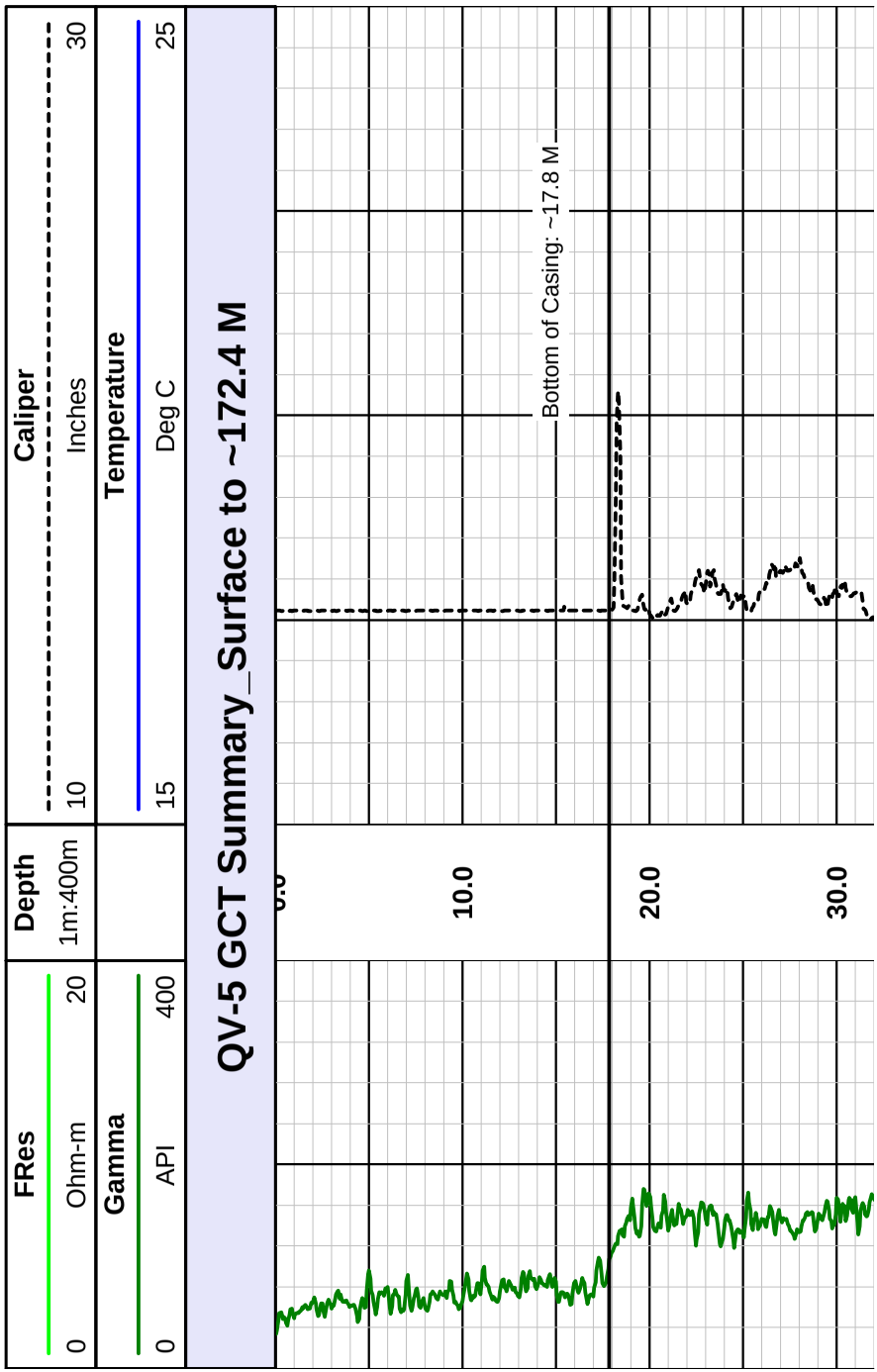
PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

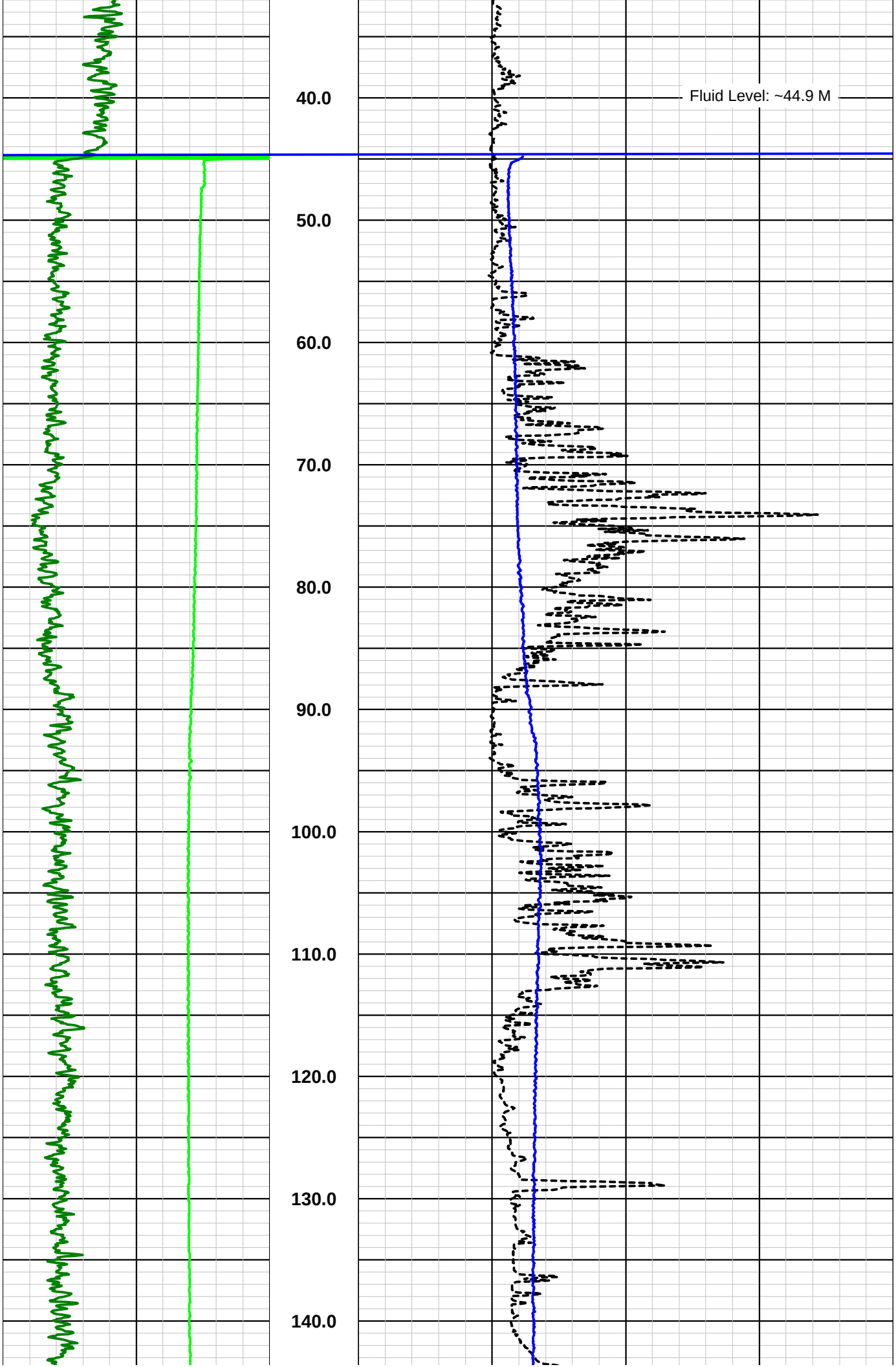
DATE	12-13-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	GAMMA-CALIPER-TEMP	DENSITY	N/A
DEPTH-DRILLER	173 M	LEVEL	40 M
DEPTH-LOGGER	173 M	MAX. REC. TEMP.	18.8 DEG C
BTM LOGGED INTERVAL	173 M	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	40 M	SAMPLE INTERVAL	.1 FT
DRILLER / RIG#	BOART LY	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	MSI 2PCA-PGA-F SN4953
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	6:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	22"	SURFACE	60 FT	16"	HWT	SURFACE	60 FT
2	15"	60 FT	388 FT				
3	14 3/4"	388 FT	TD				

COMMENTS:

.




Fluid Level: ~44.9 M
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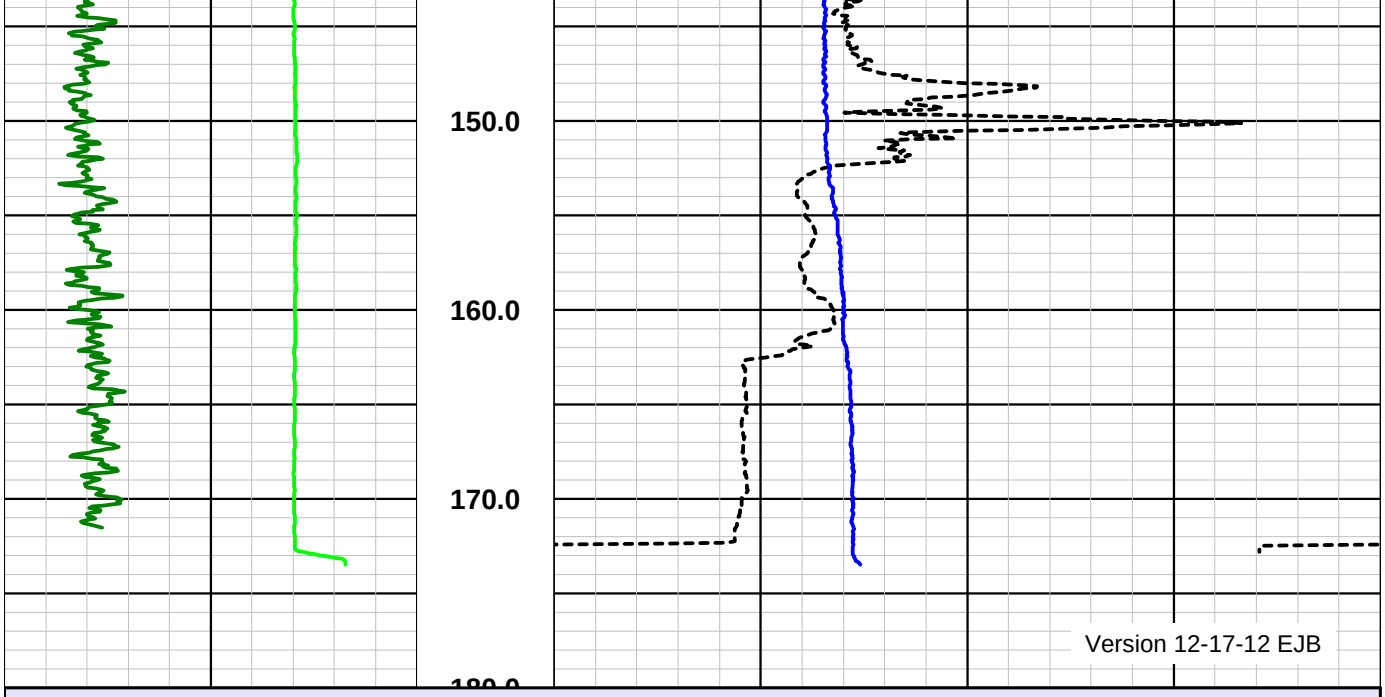
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0



QV-5 GCT Summary_Surface to ~172.4 M

Gamma		Temperature
0 API 400		15 Deg C 25
FRes	**Depth**	**Caliper**
0 Ohm-m 20	1m:400m	10 Inches 30

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	QV-5 (ADWR 55-221850)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: E-LOGS

MORE:

LOCATION
D(1-10)34CDD

SEC 34 TWP 1S RGE 10E

OTHER SERVICES
OBI
ABI
GAMMA-CALIPER
TEMP/FLUID RES
SONIC

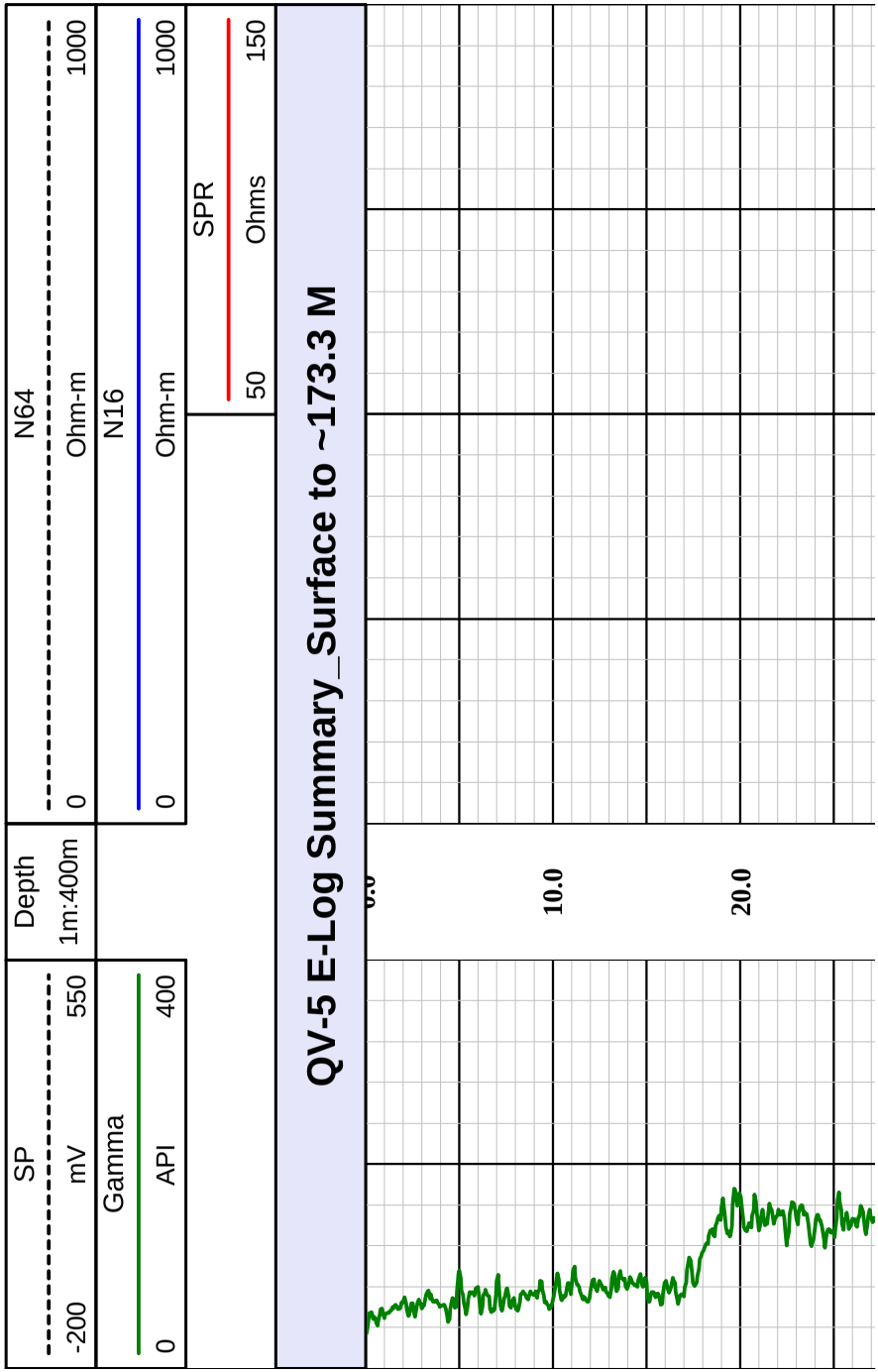
PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

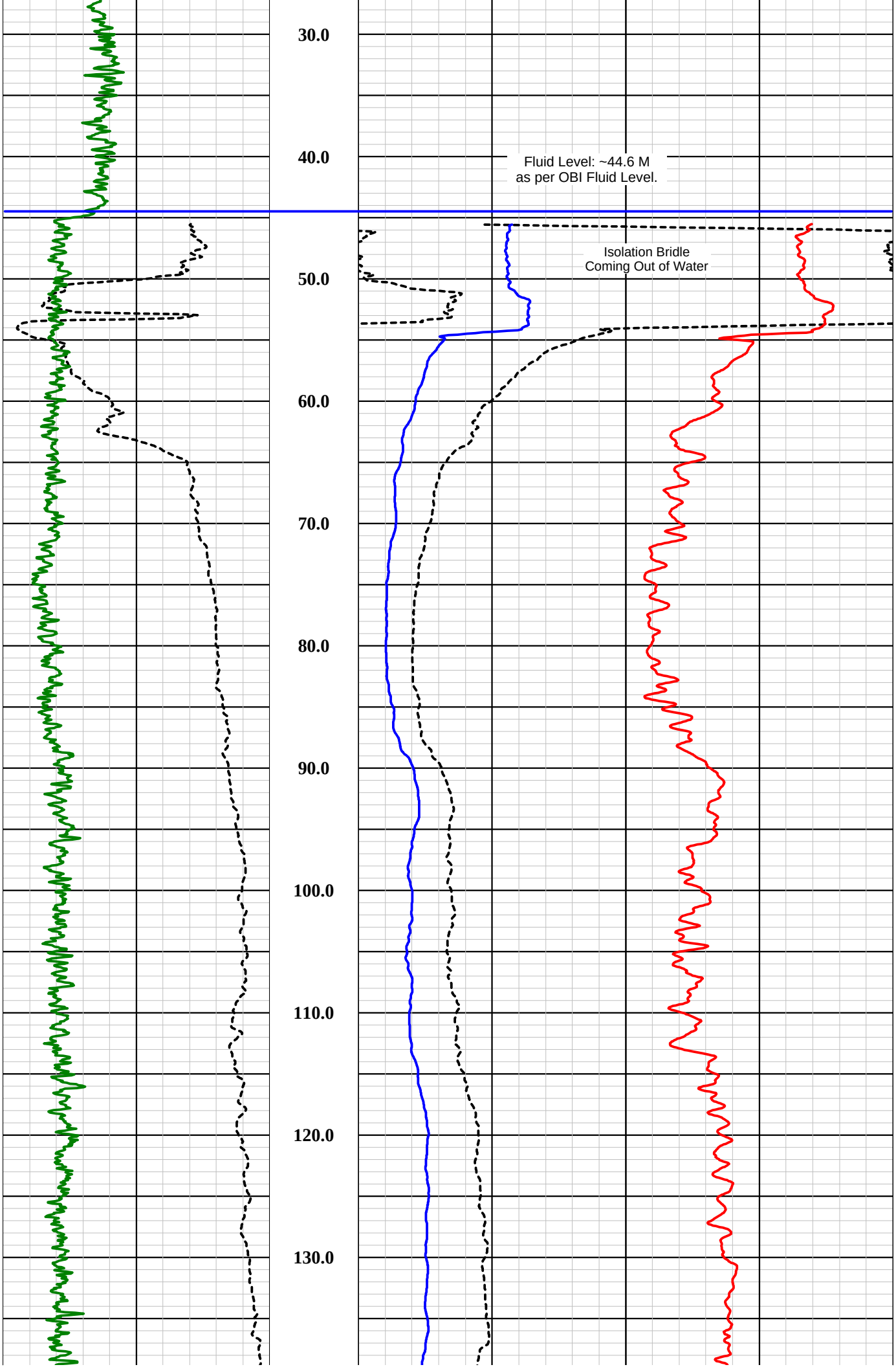
DATE	12-13-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	E-LOGS	DENSITY	N/A
DEPTH-DRILLER	173 M	LEVEL	40 m
DEPTH-LOGGER	173 M	MAX. REC. TEMP.	18.8 DEG C
BTM LOGGED INTERVAL	173 M	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	40 M	SAMPLE INTERVAL	.2 FT
DRILLER / RIG#	BOART LY	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	40 GRP SN 5513
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	6:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	22"	SURFACE	60 FT	16"	HWT	SURFACE	60 FT
2	15"	60 FT	388 FT				
3	14 3/4"	388 FT	TD				

COMMENTS:

.




30.0
40.0
Fluid Level: ~44.6 M
as per OBI Fluid Level.
Isolation Bridle
Coming Out of Water
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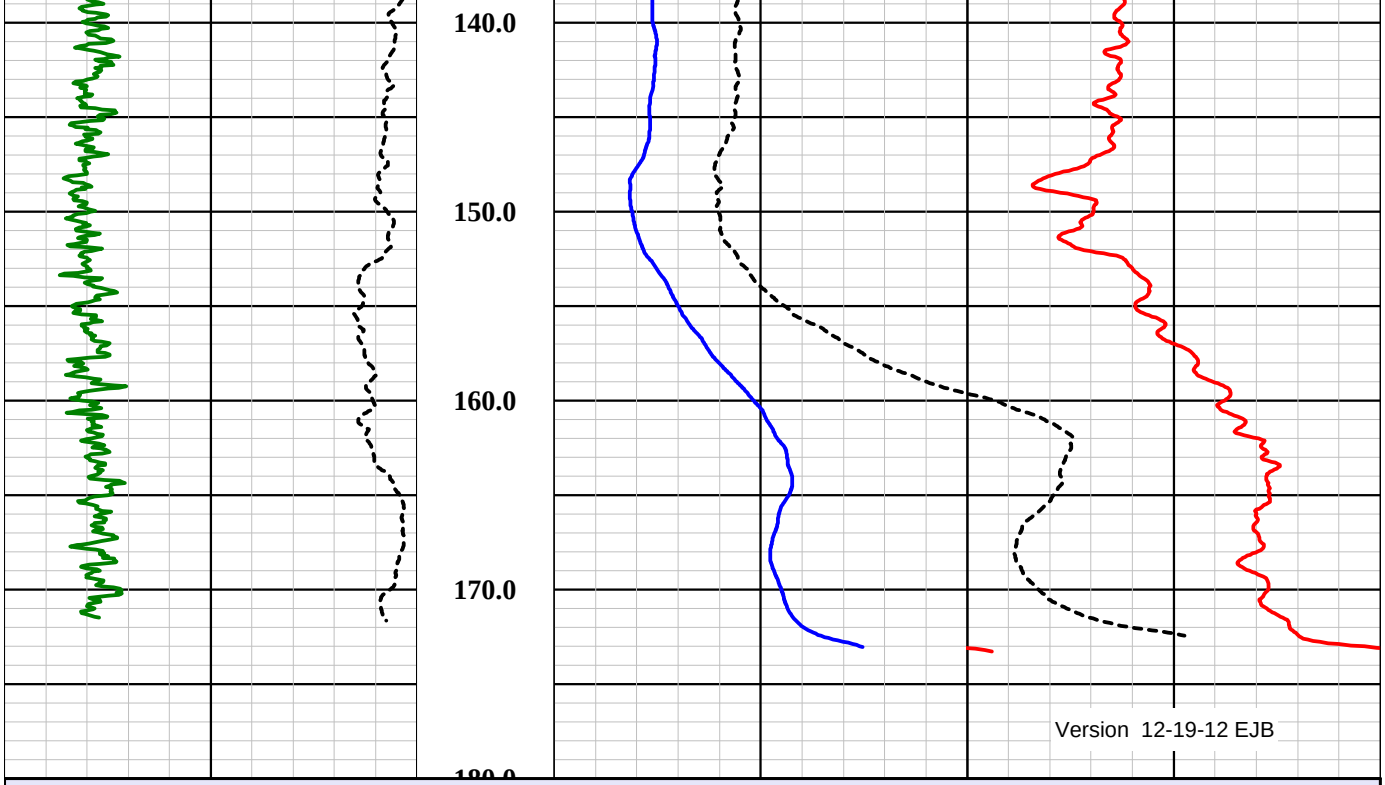
90.0
100.0
110.0
120.0
130.0



QV-5 E-Log Summary_Surface to ~173.3 M

		SPR: 50 Ohms 150
Gamma: 0 API 400		N16: 0 Ohm-m 1000
SP: -200 mV 550	Depth 1m:400m	N64: 0 Ohm-m 1000

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	QV-5 (ADWR 55-221850)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: SONIC 4 RX
MORE: GAMMA-CALIPER

LOCATION
D(1-10)34CDD

SEC 34 TWP 1S RGE 10E

OTHER SERVICES
OBI
ABI
E-LOGS
TEMP/FLUID RES

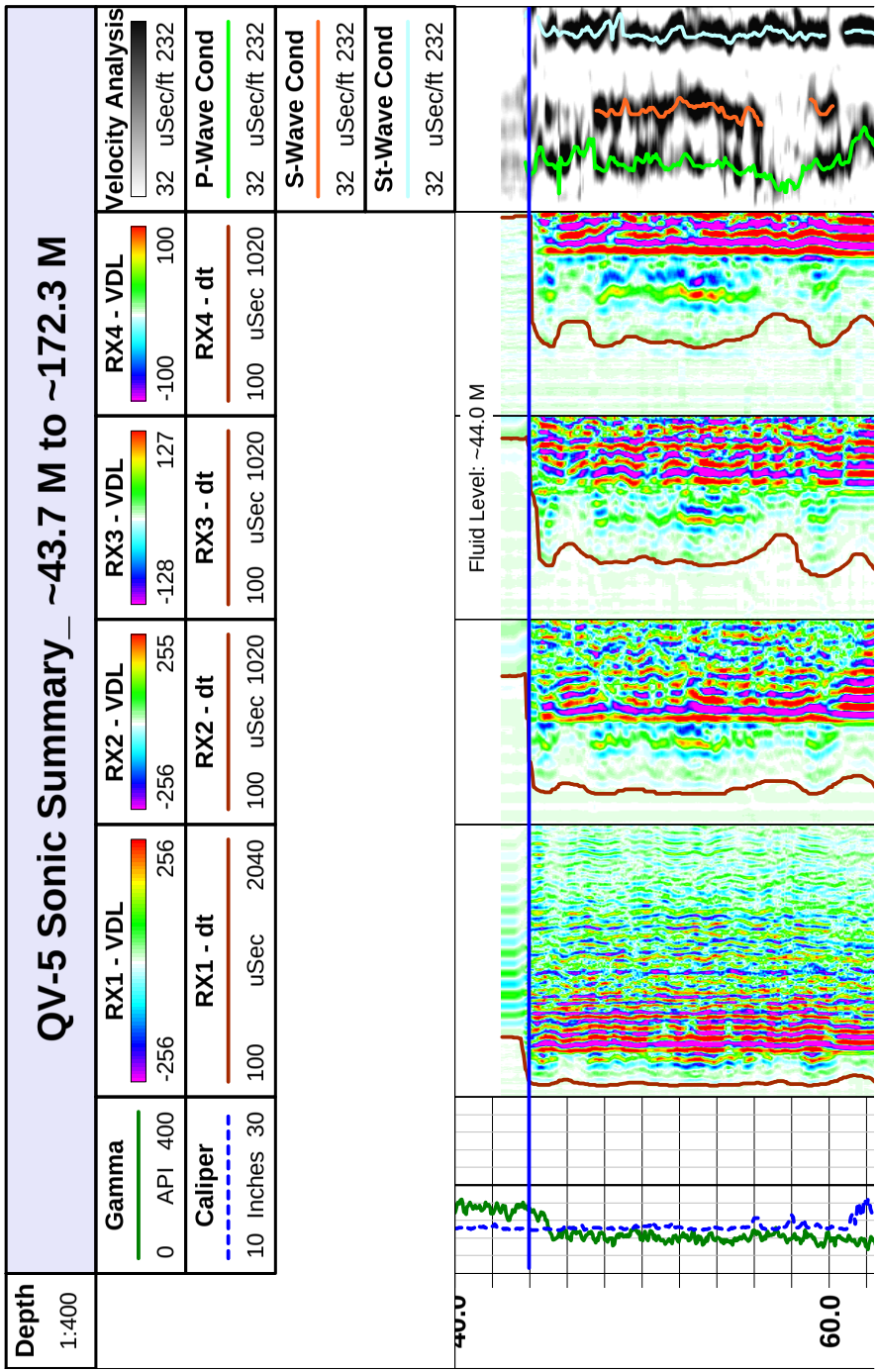
PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

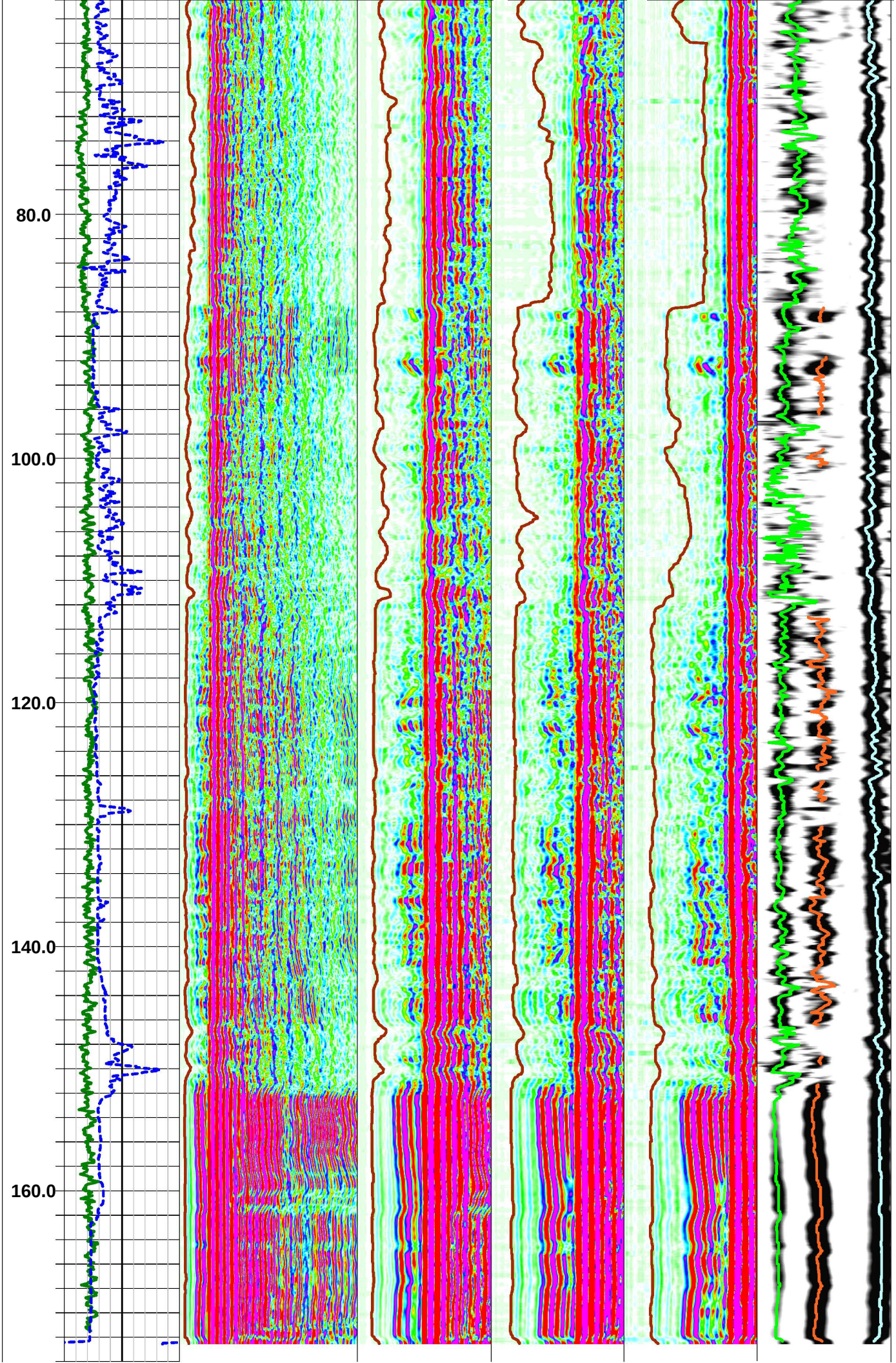
DATE	12-13-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	SONIC-GAMMA-CALIPER	DENSITY	N/A
DEPTH-DRILLER	170 M	LEVEL	40 M
DEPTH-LOGGER	170 M	MAX. REC. TEMP.	18.8 DEG C
BTM LOGGED INTERVAL	170 M	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	40 M	SAMPLE INTERVAL	.25 FT
DRILLER / RIG#	BOART LY	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	ALT SONIC 4RX SN 5185
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	6:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	22"	SURFACE	60 FT	16"	HWT	SURFACE	60 FT
2	15"	60 FT	388 FT				
3	14 3/4"	388 FT	TD				

COMMENTS:

.

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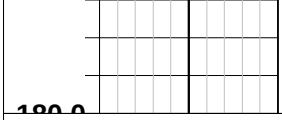
140.0
160.0



Version 12-19-12 EJB

						St-Wave Cond 32 uSec/ft 232
						S-Wave Cond 32 uSec/ft 232
	Caliper 10 Inches 30	RX1 - dt 100 uSec 2040	RX2 - dt 100 uSec 1020	RX3 - dt 100 uSec 1020	RX4 - dt 100 uSec 1020	P-Wave Cond 32 uSec/ft 232
	Gamma 0 API 400	RX1 - VDL -256 256	RX2 - VDL -256 255	RX3 - VDL -128 127	RX4 - VDL -100 100	Velocity Analysis 32 uSec/ft 232
Depth 1:400	QV-5 Sonic Summary_ ~43.7 M to ~172.3 M					

Full Waveform Sonic Summary Legend

Mnemonics and Comments

Gamma = Natural gamma ray log plotted from 0 to 400 API units (green line).

Caliper = 3-arm mechanical caliper of hole diameter plotted from 10-30 inches (blue line).

RX1 - VDL = Color variable density display of 0.6m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 2040 uSec.

RX1 - dt = P-wave travel time pick. Plotted 100 to 2040 uSec (brown line).

RX2 - VDL = Color variable density display of 0.8m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 1020 uSec.

RX2 - dt = P-wave travel time pick. Plotted 100 to 1020 uSec (brown line).

RX3 - VDL = Color variable density display of 1.0m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 1020 uSec.

RX3 - dt = P-wave travel time pick - if determined. Plotted 100 to 1020 uSec (brown line).

RX4 - VDL = Color variable density display of 1.2m Rx waveform; stacked over 5 waveforms, and plotted from 100 to 1020 uSec.

RX4 - dt = P-wave travel time pick - if determined. Plotted 100 to 1020 uSec (brown line).

Velocity Analysis = Gray scale variable density display of velocity semblence waveform of the stacked waveforms; plotted from 32 to 232 uSec/ft.

P-Wave-Cond = Apparent P-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft (green line).

S-Wave-Cond = Apparent S-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft - with conditional testing to remove invalid values (orange line).

St-Wave-Cond = Apparent Stoneley-wave transit time or slowness from maximum energy peak on semblence velocity waveform in uSec/ft. - with conditional testing to remove invalid values (light blue line).

Prepared by Erika J Beam
Version 12-10-12

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	QV-5 (ADWR 55-221850)
FIELD	RESOLUTION
COUNTY	PINAL
STATE	ARIZONA

TYPE OF LOGS: OPTICAL TELEVIEWER
MORE: 3-ARM CALIPER

LOCATION
D(1-10)34CDD

SEC 34 TWP 1S RGE 10E

OTHER SERVICES
GAMMA-
TEMP-FL. RESISTIVITY
ABI
E-LOGS
SONIC

PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

DATE	12-13-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	OPTICAL TELEVIEWER	DENSITY	N/A
DEPTH-DRILLER	170 M	LEVEL	40 M
DEPTH-LOGGER	45.5 M	MAX. REC. TEMP.	18.8 DEG C
BTM LOGGED INTERVAL	45.5 M	IMAGE ORIENTED TO:	MAG NORTH
TOP LOGGED INTERVAL	17.5 M	SAMPLE INTERVAL	0.0096 FT
DRILLER / RIG#	BOART LY	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	ALT OBI-M5 SN-5145
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	6:30 AM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	22"	SURFACE	60 FT	16"	HWT	SURFACE	60 FT
2	15"	60 FT	388 FT				
3	14 3/4"	388 FT	TD				

COMMENTS:

.

Major Lithology

- Apache Leap Tuff - Gray Unit
- Apache Leap Tuff - Brown Unit
- Apache Leap Tuff - White Unit
- Transition Zone
- Basal Tuff - Vitrophyre
- Basal Tuff
- No Cuttings
- Dacite Tuff

Optical Image Features Legend

- Bedding / Banding / Foliation / Veins
- Filled Fracture / Joint
- Btm of Casing

Partially Open Joint / Fracture

Minor Open Joint / Fracture

OJ/Fx terminates at Fx intersection

Unclassified

Sulfide Vein

Breakouts

Major Open Joint / Fracture

Fluid Level

Bx & NVJts Legend

Breccia or Conglomerate

Large Vugs/Vesicles (> 6")

Medium Vugs/Vesicles (2-6")

Small Vugs/Vesicles (< 2")

Conglomerate - sand matrix supported

Conglomerate - mud matrix supported

Conglomerate - clast supported

Broken Zone / Undifferentiated

Major Breakout

Minor Breakout

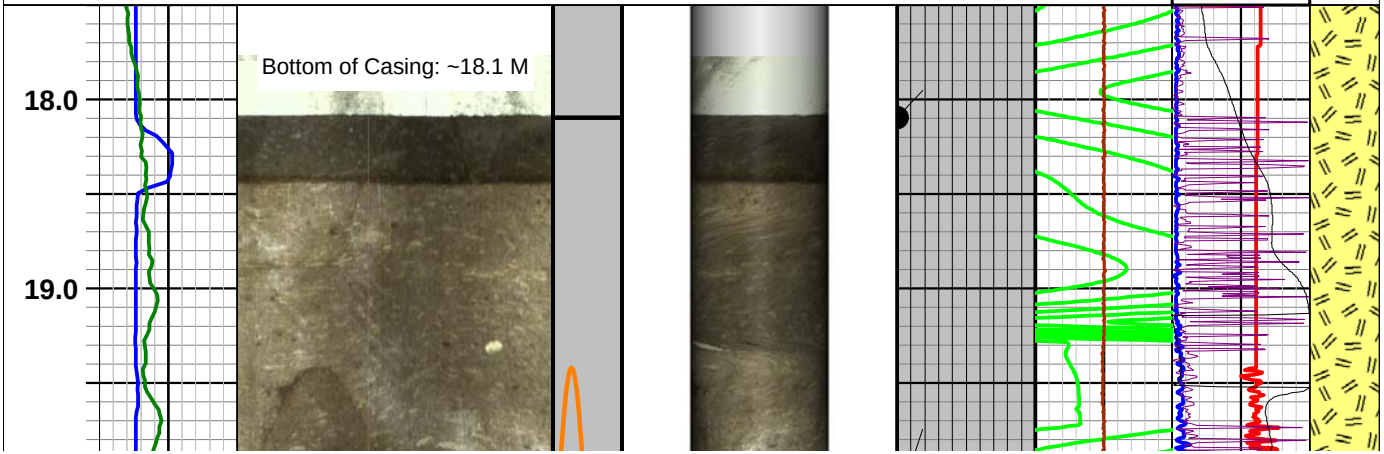
Tensile Fracture

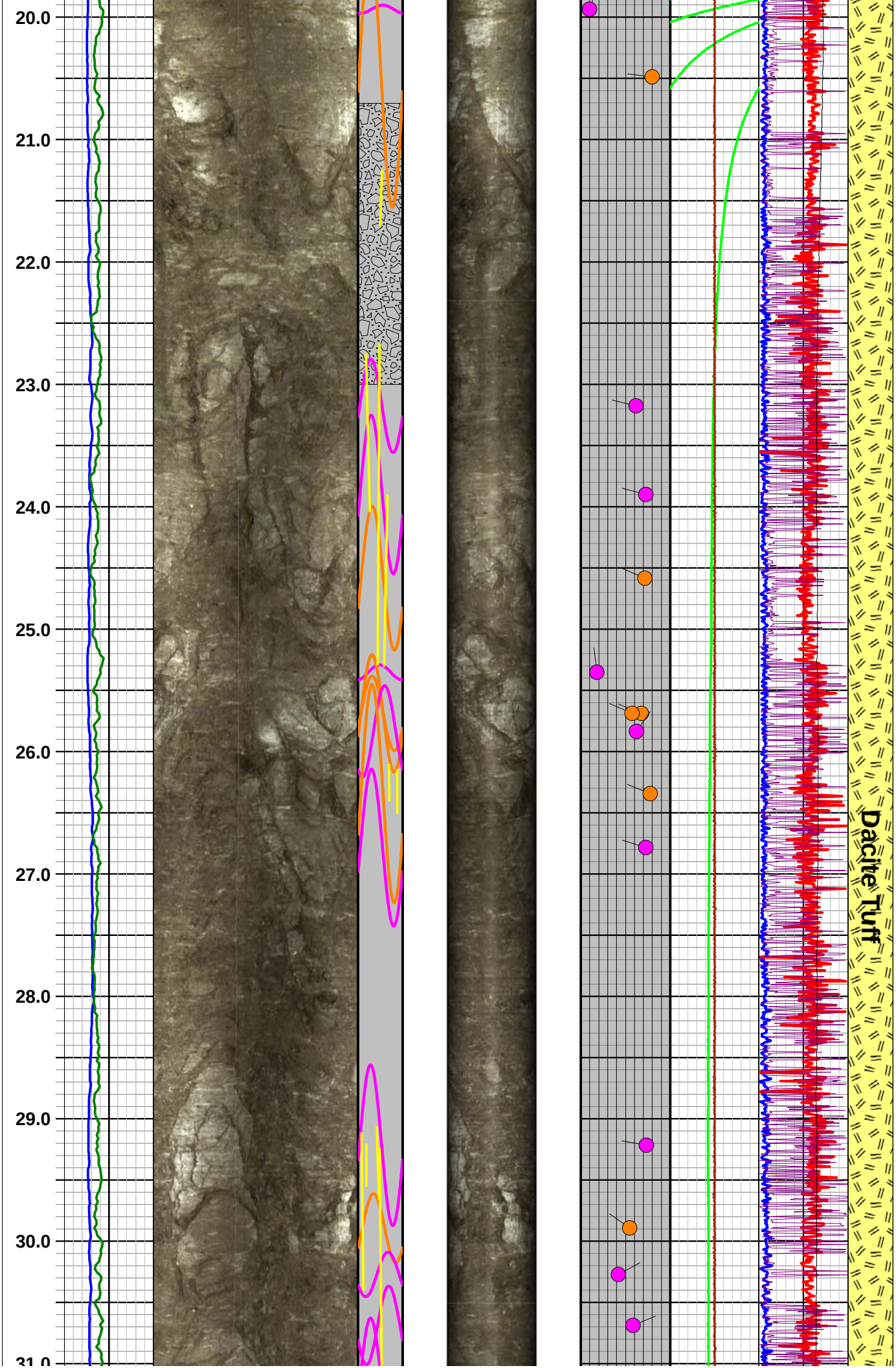
Filled Near Vertical Joint/Fx

Near Vertical Joint/Fx

QV-5 OBI-40 Summary_ ~ 18.1 M to ~ 44.6 M

Depth 1m:40m	Caliper 10 30	Image-NM Oriented Mag North 0° 90° 180° 270° 0°	OBI DIPA	3D 0°	Tadpole DIPT	Mag Field 40 uT 60	Tilt 0 Deg 4	Lith
	Gamma 0 400	Image_17.8M- 26.0M Rot'd by 148.5 deg 0° 90° 180° 270° 0°	NVJt			Gravity 0.8 G 1.2	Azi-Edited 0 360	Desc
			Bx				Roll 0 360	
							MRoll 0 360	

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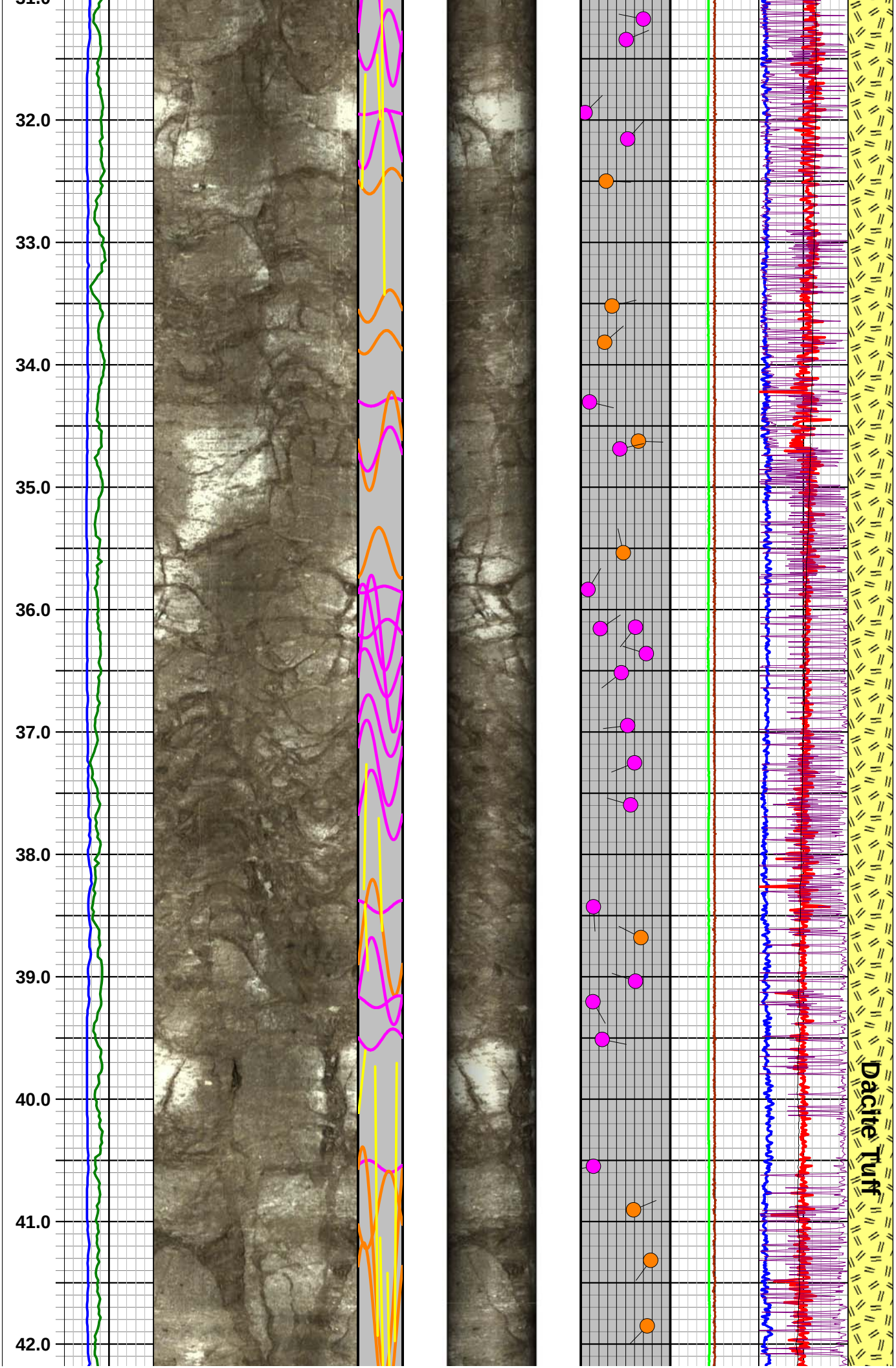
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
Dacite Tuff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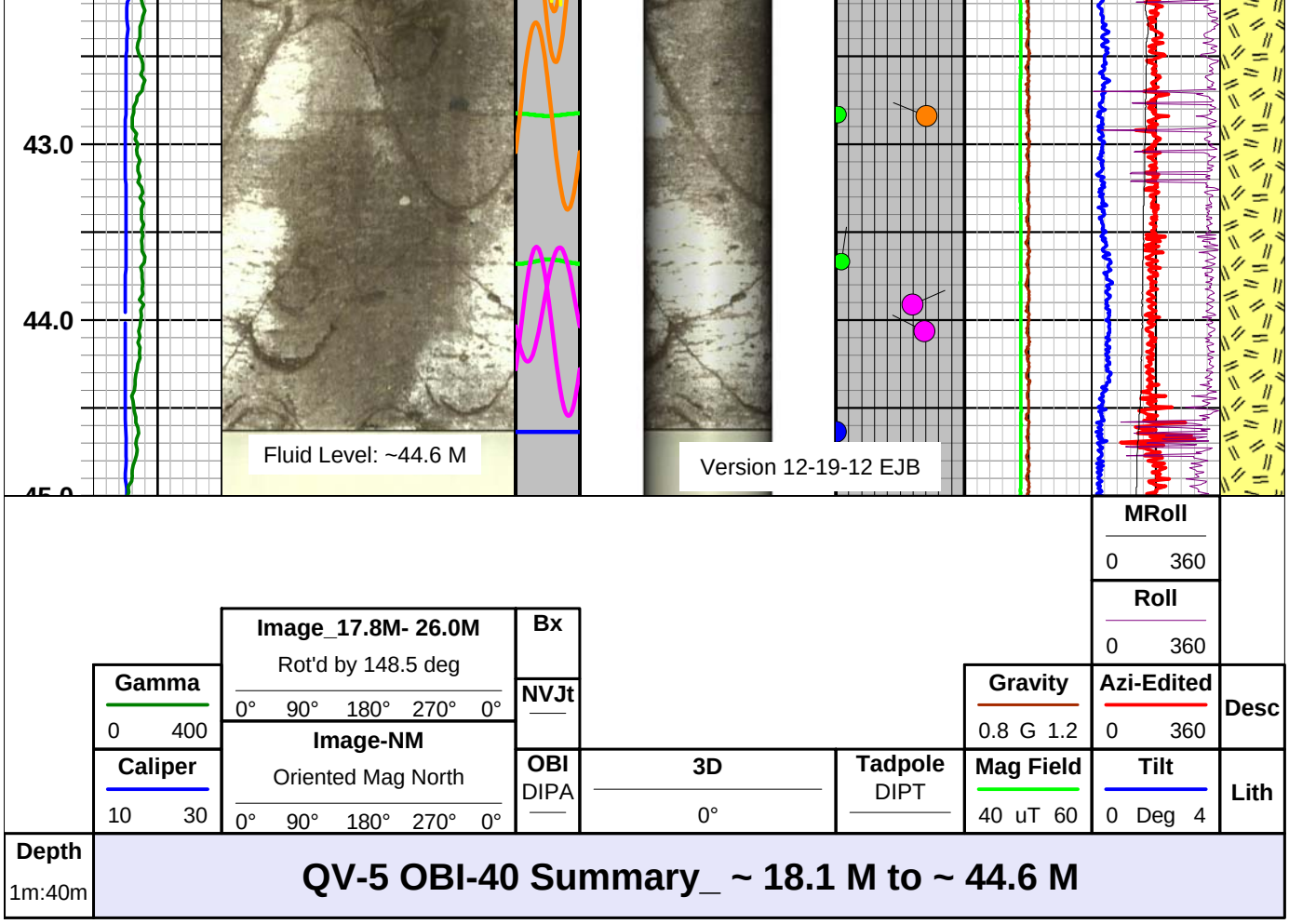
40.0
41.0
42.0
Dacite Tuff



Optical Image Summary Legend

Mnemonics and Comments

Caliper = 3-arm mechanical caliper of hole diameter plotted from 10-30 inches (blue line).

Gamma = Natural gamma ray log plotted from 0 to 400 API units (green line).

Image-NM = 2D plot of optical image oriented to magnetic north. Plotted from left to right N-E-S-W-N.

Image_17.8M - 26.0M = 2D plot of optical image non-oriented and rotated by 148.5 deg to correct for magnetic affect in proximity of steel casing. Plotted from left to Right N-E-S-W-N.

OBI = Planar features picked on optical borehole image shown as colored sinusoid (color designation shown on header). DIPA = dip apparent hole axis.

Bx = Apparent Breccia or Congomerate zones and Vugs/Vesicles/Cavities.

NVJt = Near Vertical (near parallel to hole axis) joint/fracture features picked on acoustic borehole image shown as colored sinusoid (color designation shown on header).

3D = 3D cylindrical projection of OBI image viewed from north.

Tadpole = Tadpole plot of the image feature picks (fractures and bedding planes); plotted from 0 to 90 dip - see legend above. DIPT = True orientation; features corrected for hole deviation.

Mag Field = Total magnetic field strength as measured by fluxgate magnetometer in OBI deviation sensor - plotted 40-60 uT (green line).

Gravity = Tool accelleration or gravity as measured by 3-axis accellerometers in OBI deviation sensor - plotted 0.8 - 1.2 G (brown line).

Azi-Edited = Direction of tool tilt plotted 0 to 360 deg; edited for anomalous magnetic influence - represents borehole deviation direction (red line).

Roll = Roll or gravity tool face angle is plotted 0 to 360 degrees. Roll is 90 degree if the y-axis of the probe (reference mark on the housing) points to the high side of the borehole. (purple line)

MRoll = MRoll or Magnetic Roll angle is plotted 0 to 360 degrees. MRoll is used when Tool Tilt is < 1 deg from vertical and two components of accelerometer are close to zero. At vertical, MRoll is 90 degree if the projection of the y-axis of the probe (reference mark on the housing) into a horizontal plane points to Magnetic North. (black line)

Tilt = Tool tilt (vertical = 0 and horizontal = 90) plotted 0 to 4 deg; represents borehole deviation tilt from vertical (blue line).

Lith = Major/principal lithology based on field geologic descriptions provided by Clear Creek staff.

Desc = Major/principal field geologic descriptions provided by Clear Creek staff.

Prepared by Erika J. Beam

Version 12-18-12

Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY	RESOLUTION COPPER CO
WELL ID	QV-5 (ADWR 55-221850)
FIELD	RESOLUTION
COUNTY	PINAL STATE ARIZONA

TYPE OF LOGS: ABI-43
MORE: 3-ARM CALIPER

LOCATION
D(1-10)34CDD

SEC 34 TWP 1S RGE 10E

OTHER SERVICES
OBI
GAMMA
TEMP/FLUID RES
E-LOGS
SONIC

PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM	GROUND LEVEL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GROUND LEVEL		G.L.

DATE	12-13-12	TYPE FLUID IN HOLE	FRESH WATER
RUN No	1	SALINITY	N/A
TYPE LOG	ABI-43	DENSITY	N/A
DEPTH-DRILLER	173 M	LEVEL	40 M
DEPTH-LOGGER	173 M	MAX. REC. TEMP.	18.8 DEG C
BTM LOGGED INTERVAL	173 M	IMAGE ORIENTED TO:	N/A
TOP LOGGED INTERVAL	40 M	SAMPLE INTERVAL	0.0096 FT
DRILLER / RIG#	BOART LY	LOGGING TRUCK	TRUCK -300
RECORDED BY / Logging Eng.	K. MITCHELL/E. BEAM	TOOL STRING/SN	ALT ABI-43 SN-91601
WITNESSED BY	CLEAR CREEK-BARRY	LOG TIME:ON SITE/OFF SITE	6:30 AM 1:00 PM

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	22"	SURFACE	60 FT	16"	HWT	SURFACE	60 FT
2	15"	60 FT	388 FT				
3	14 3/4"	388 FT	TD				

COMMENTS:

.

Major Lithology

- Apache Leap Tuff - Gray Unit
- Apache Leap Tuff - Brown Unit
- Apache Leap Tuff - White Unit
- Transition Zone
- Basal Tuff - Vitrophyre
- Basal Tuff
- No Cuttings
- Dacite Tuff

Acoustic Image Features Legend

- Bedding / Banding / Foliation / Veins
- Filled Fracture / Joint
- Btm of Casing

Partially Open Joint / Fracture

Minor Open Joint / Fracture

OJ/Fx terminates at Fx intersection

Unclassified

Sulfide Vein

Breakouts

Major Open Joint / Fracture

Fluid Level

Bx & NVJts Legend

Breccia or Conglomerate

Large Vugs/Vesicles (> 6")

Medium Vugs/Vesicles (2-6")

Small Vugs/Vesicles (< 2")

Conglomerate - sand matrix supported

Conglomerate - mud matrix supported

Conglomerate - clast supported

Broken Zone / Undifferentiated

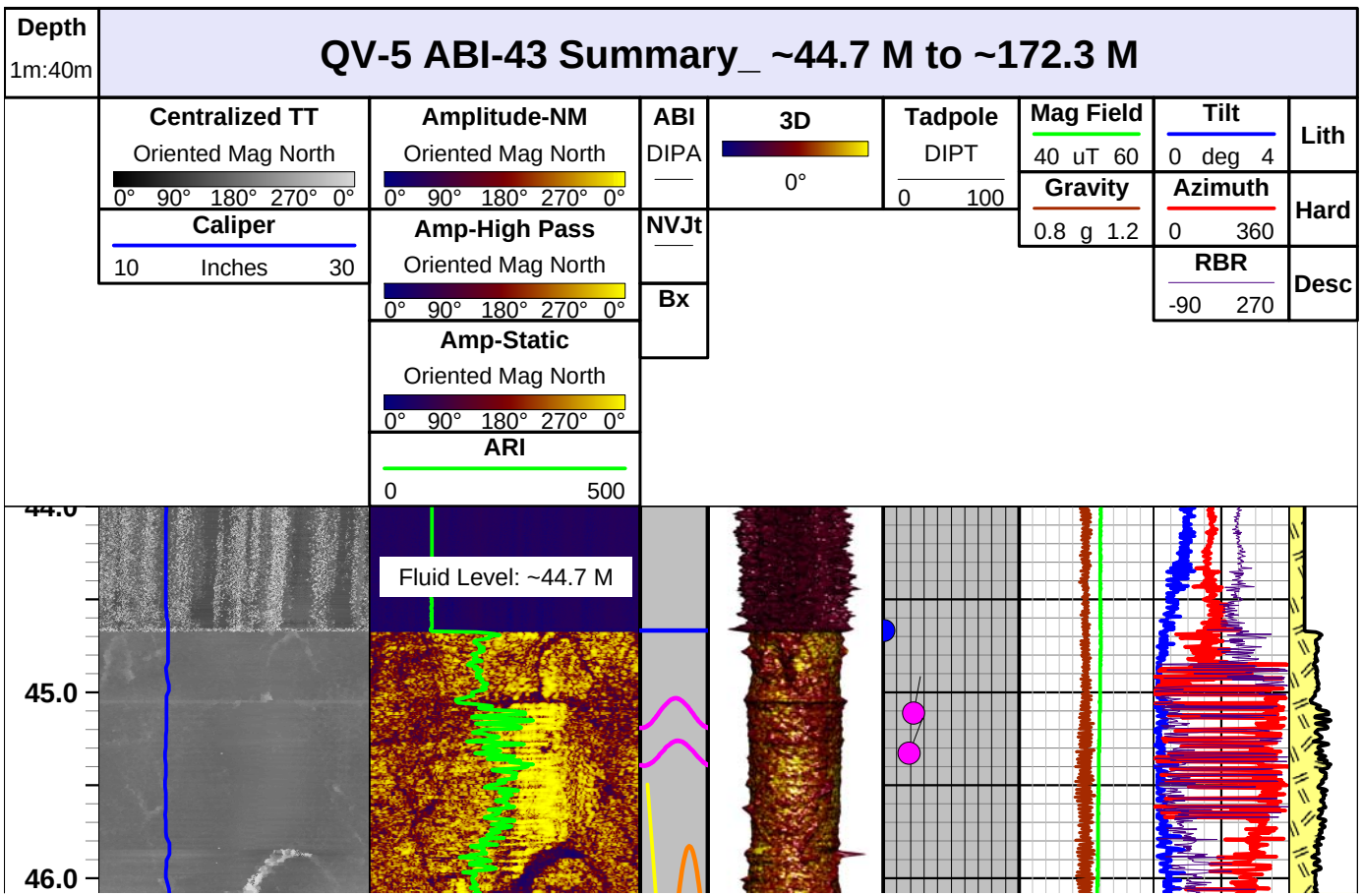
Major Breakout

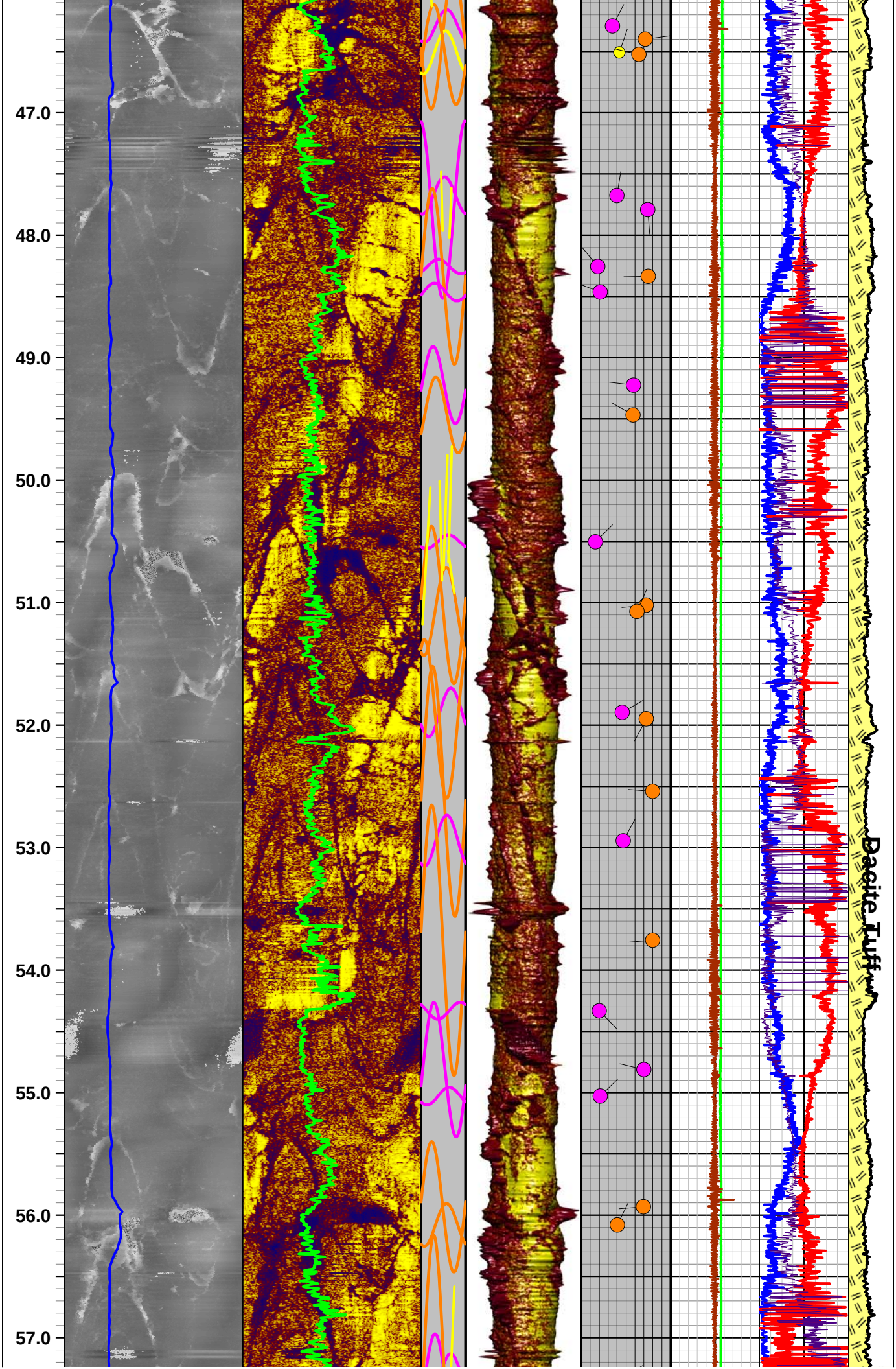
Minor Breakout

Tensile Fracture

Filled Near Vertical Joint/Fx

Near Vertical Joint/Fx

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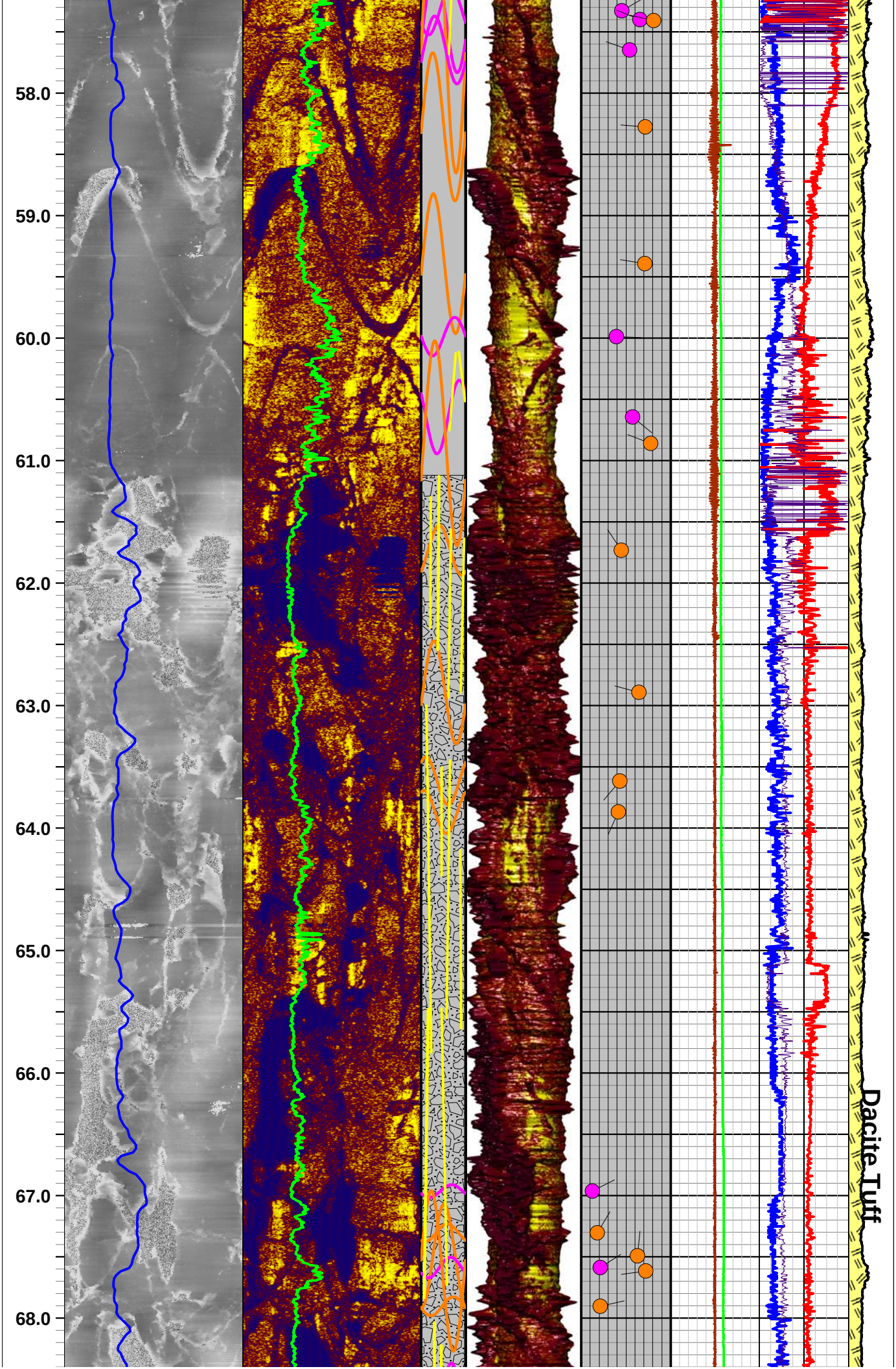
Dacite Tuff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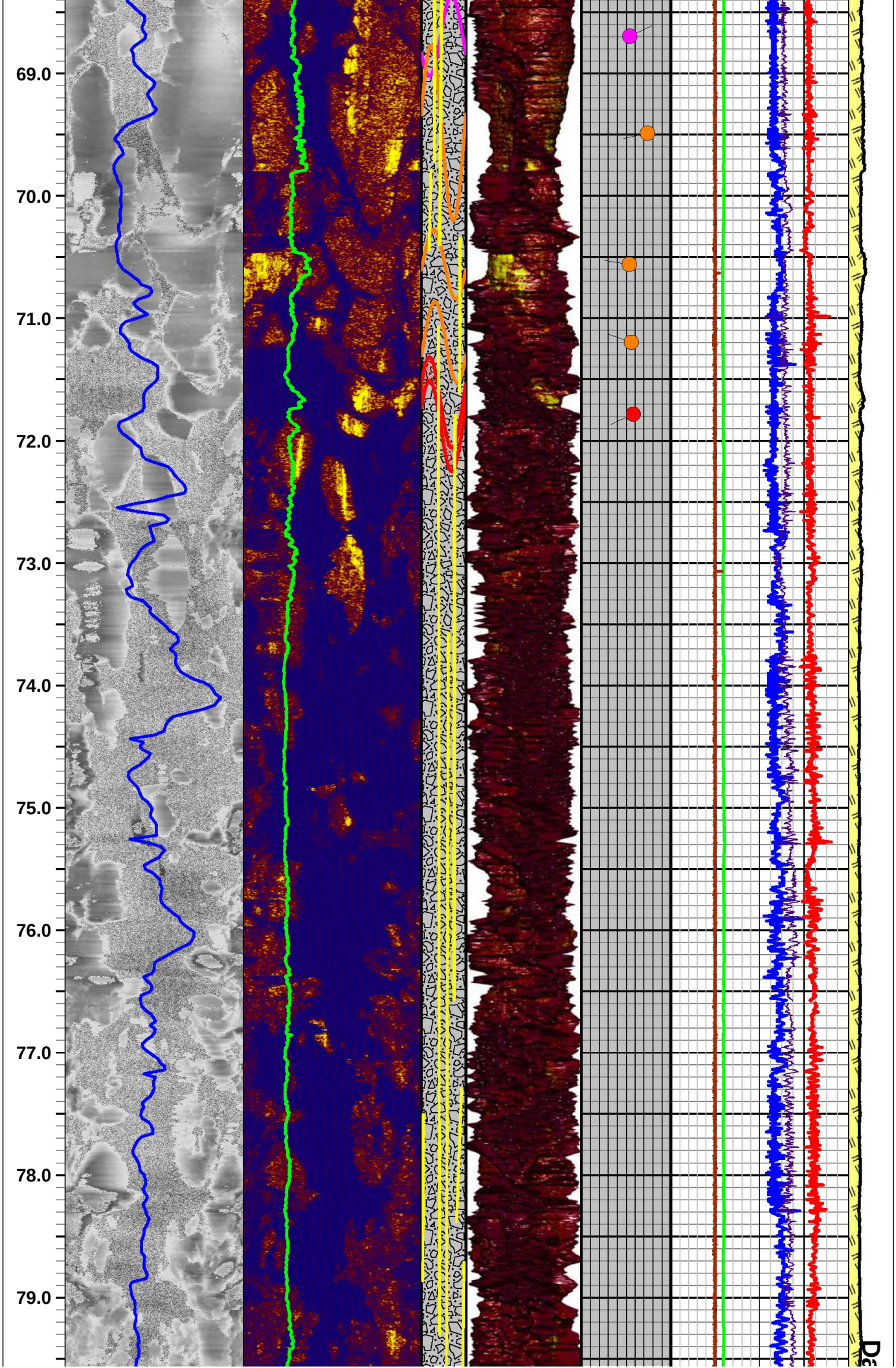
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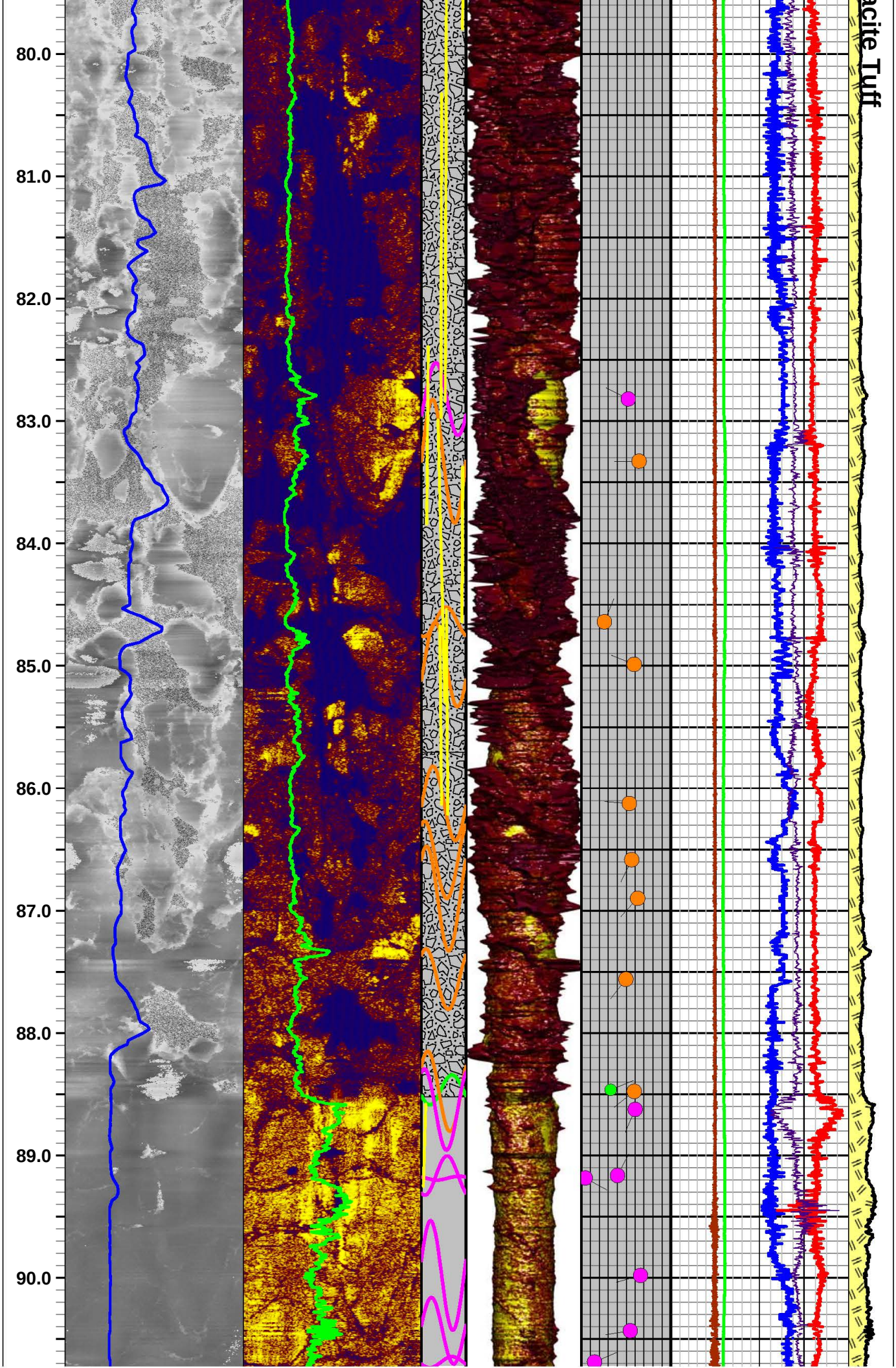
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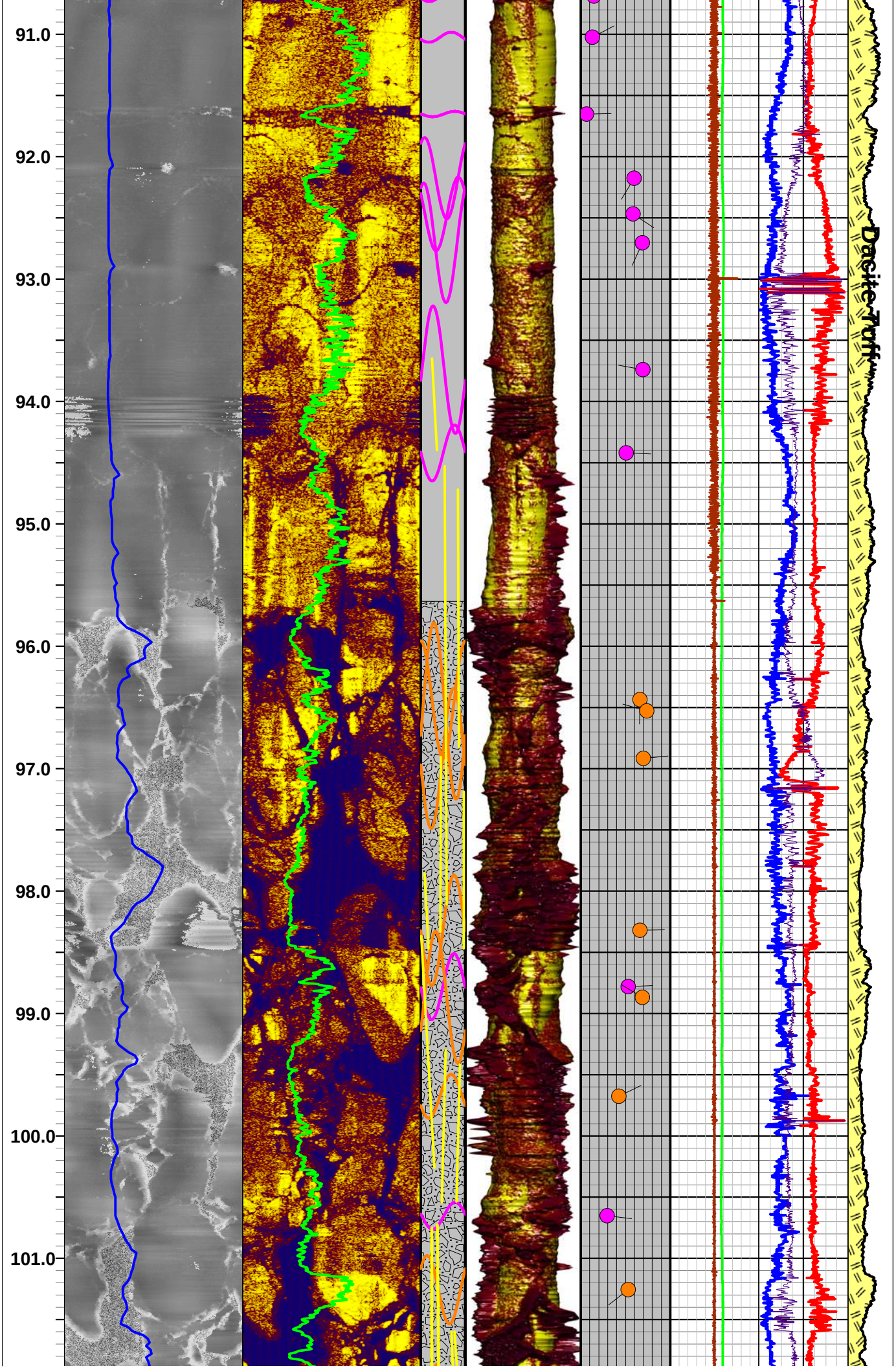
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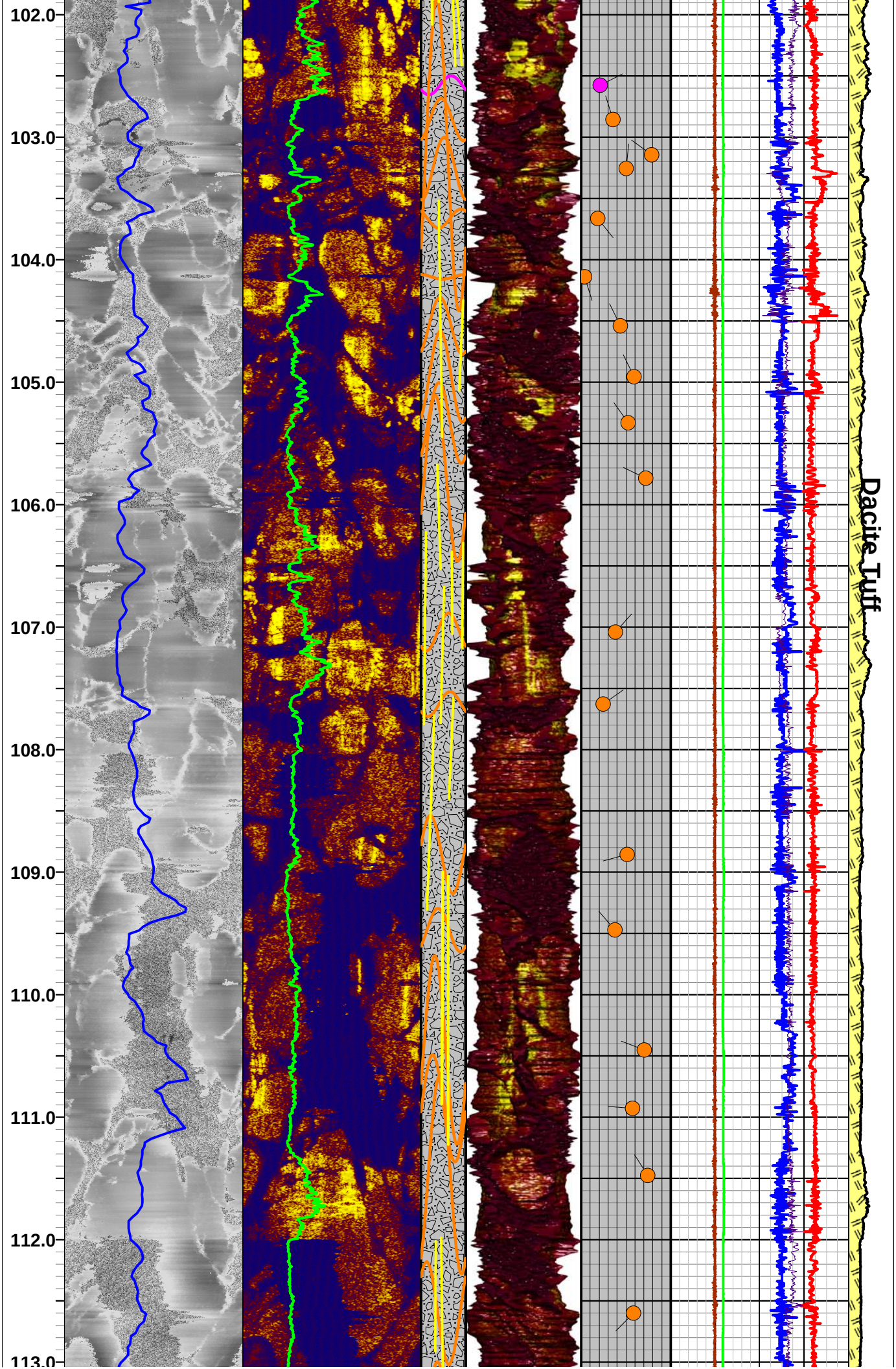
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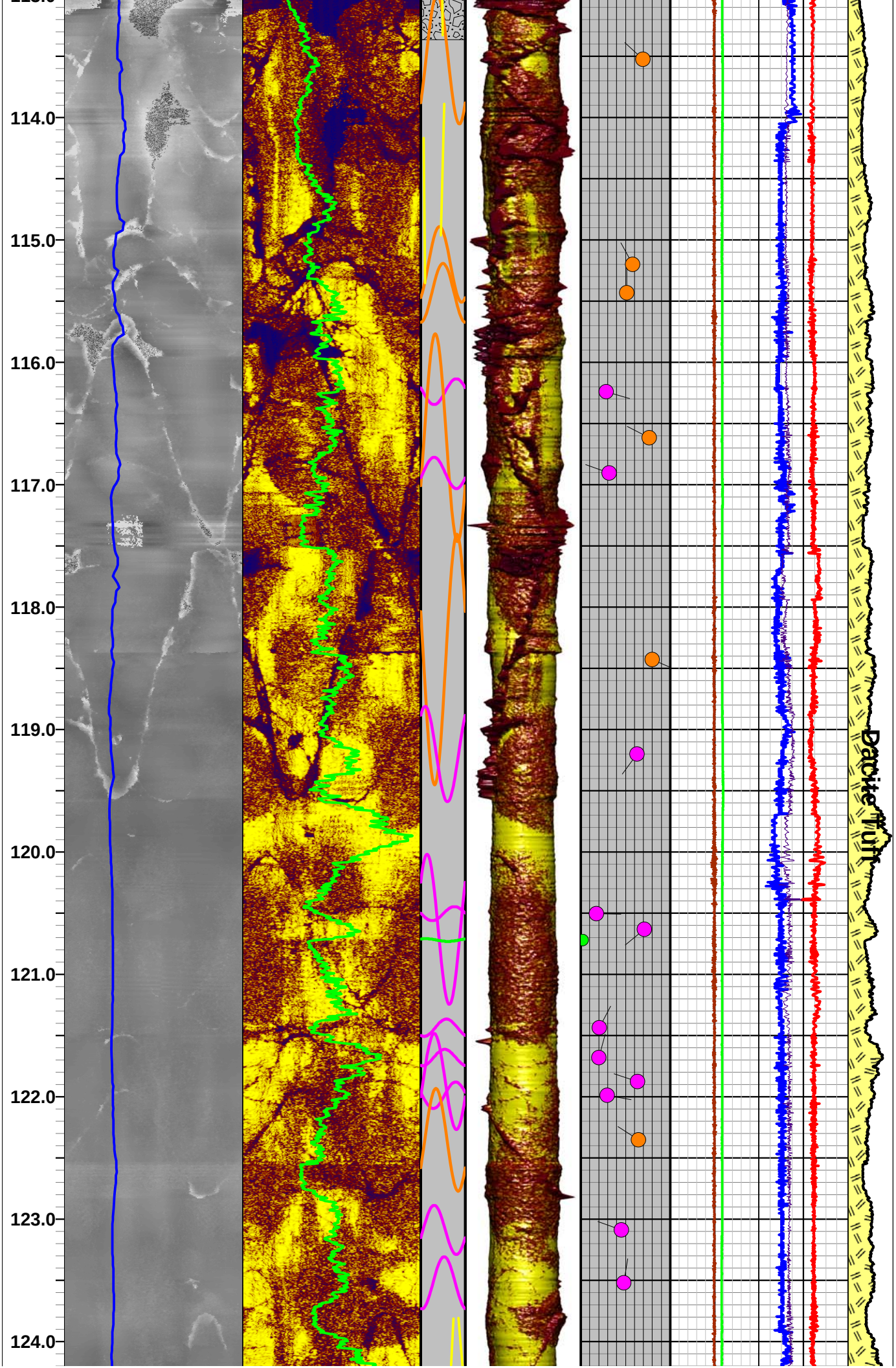
Dacite Tuff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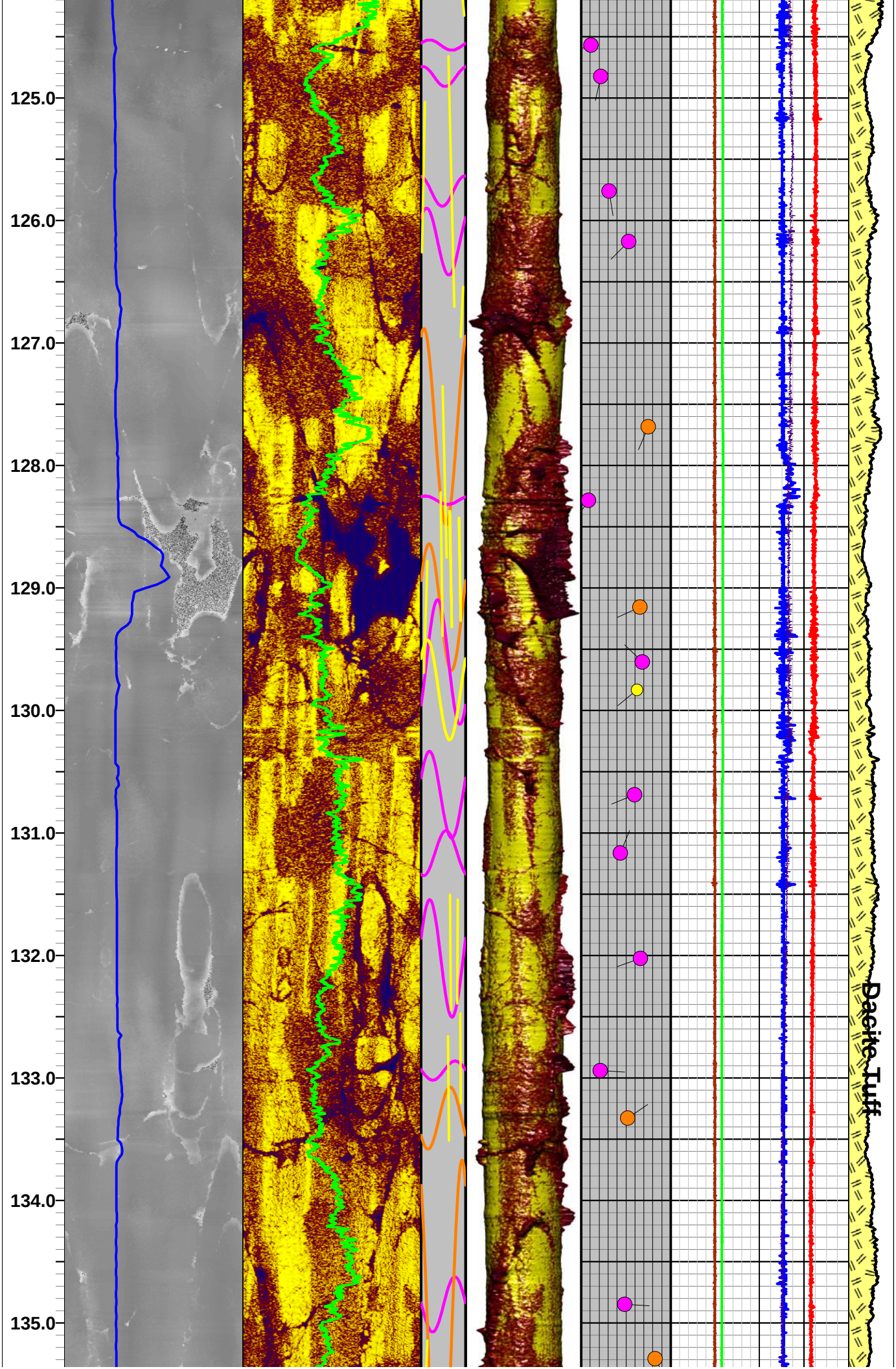
Bachie Tuff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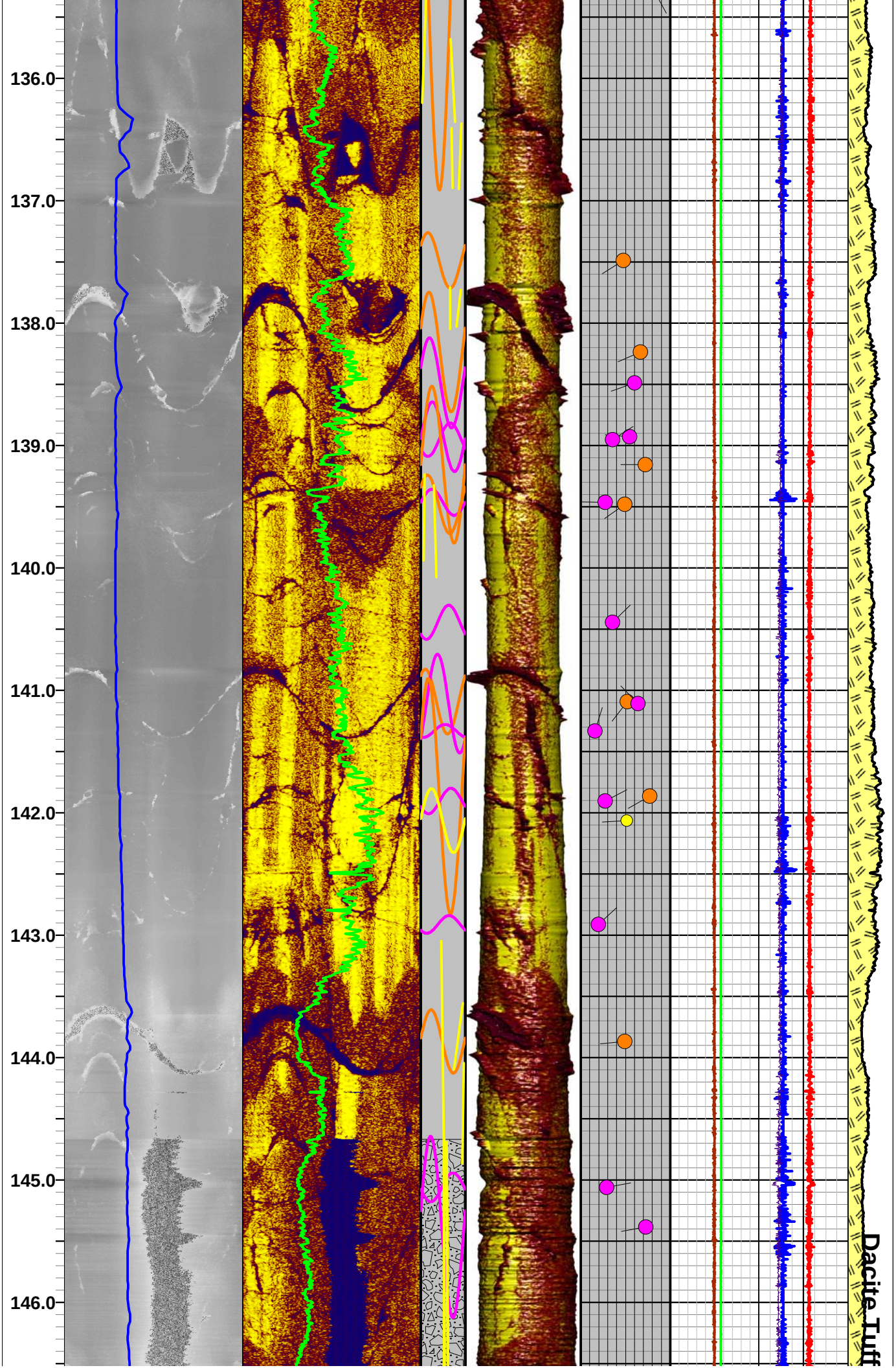
Dacite Tuff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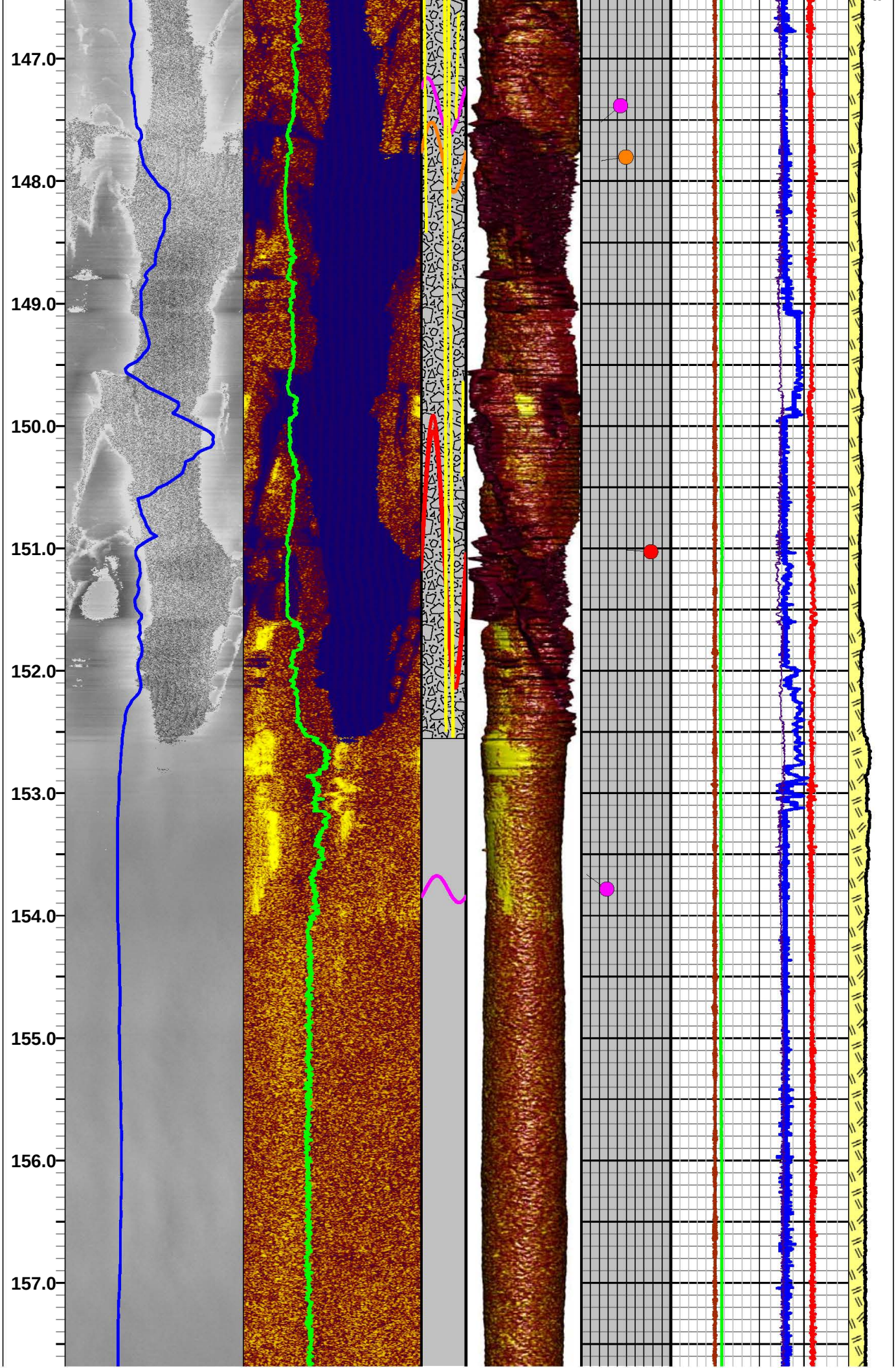
Dacite Tuff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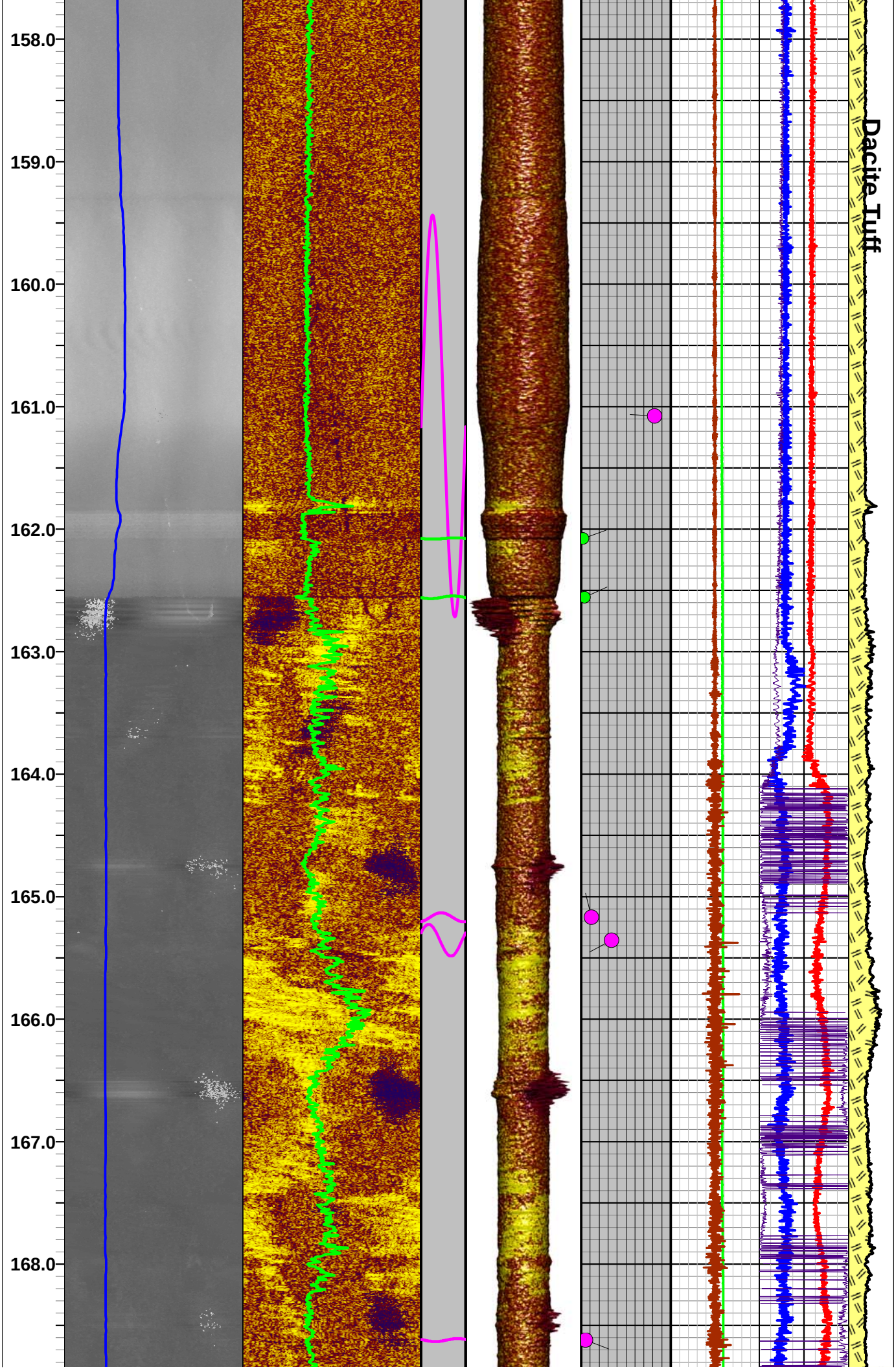
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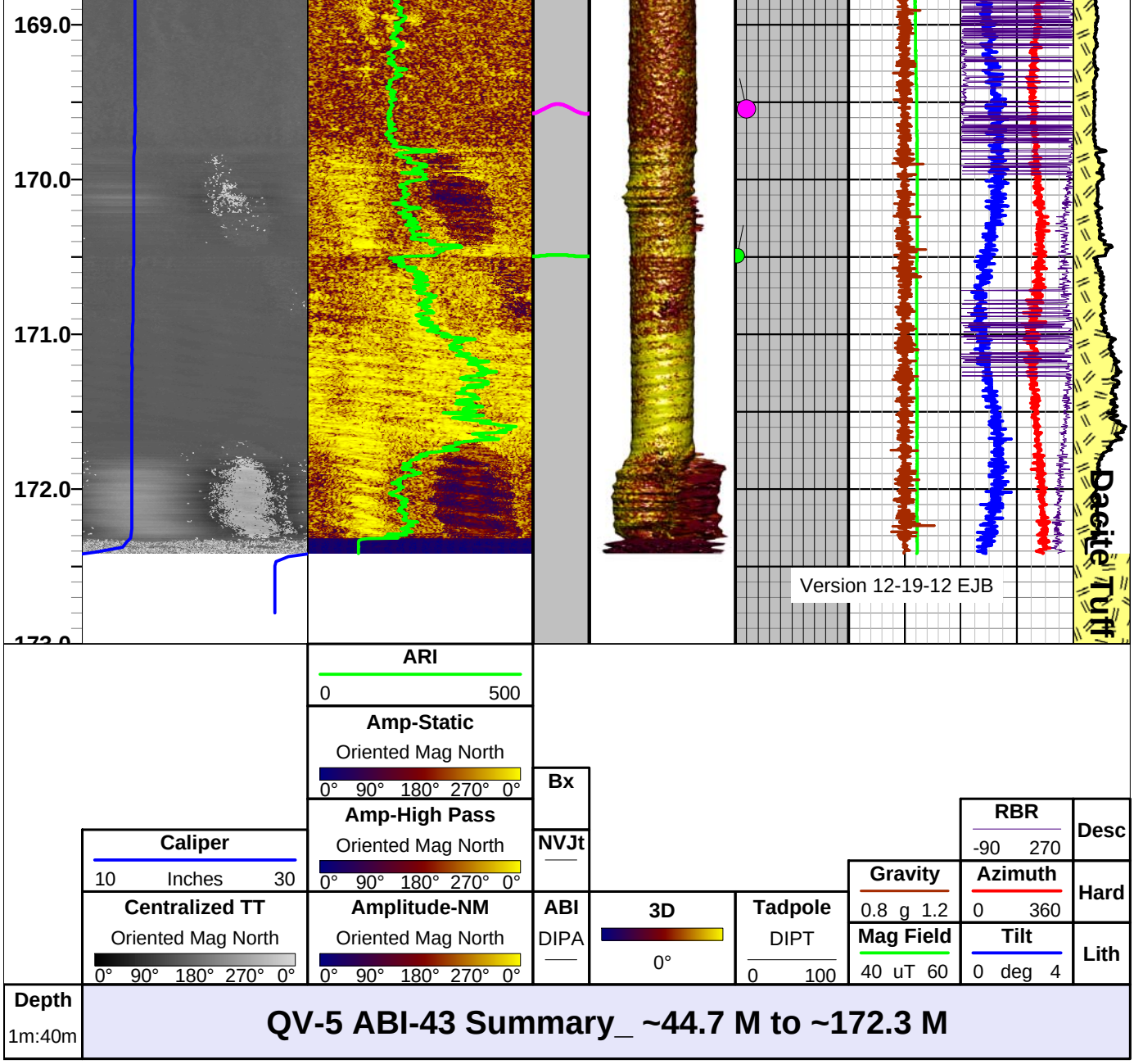

ABI Image Summary Legend

Mnemonics and Comments

Centralized TT = 2D plot of acoustic image travel time with probe position centralized. Oriented to magnetic north and plotted from left to right N-E-S-W-N

Caliper = 3-arm mechanical caliper of hole diameter plotted from 10 to 30 inches (blue line).

Max-Acoustic Caliper = Maximum acoustic caliper of hole diameter calculated from Travel Time data and plotted as orange line from 10 to 30 inches. Turned off due to elongation of hole diameter.

Ave-Acoustic Caliper = Average acoustic caliper of hole diameter calculated from Travel Time data and plotted as bright green line from 10 to 30 inches. Turned off due to elongation of hole diameter

Enlargements = Pink shaded zone between Avg-Acoustic Caliper and Max-Acoustic Caliper calculated from Travel Time data showing borehole enlargment. Turned off due to elongation of hole diameter.

Amplitude-NM = 2D plot of unfiltered acoustic image amplitude oriented to magnetic north. Plotted from left to right N-E-S-W-N. Image toggled on.

Amp-Static = 2D plot of acoustic image amplitude with Static normalization filter oriented to magnetic north. Plotted from left to Right N-E-S-W-N. Image toggled on.

Amp-High Pass = 2D plot of acoustic image amplitude with High Pass normalization filter oriented to magnetic north. Plotted from left to Right N-E-S-W-N. Image toggled off.

ARI = Acoustic Reflectance Index or relative rock hardness from ABI Amplitude log. Plotted 0 (soft) to 500 (harder) as green line.

ABI = Planar strucutral features picked on acoustic borehole image shown as colored sinusoid (color designation shown on header) DIPA = dip apparent hole axis.

NVJt = Near Vertical (near parallel to hole axis) joint/fracture features picked on acoustic borehole image shown as colored sinusoid (color designation shown on header).

Bx = Apparent Breccia or Congomerate zones and Vugs/Vesicles/Cavities.

3-D = 3D cylindrical projection of ABI image using Centralized TT log for hole shape looking from North.

Tadpole = Tadpole plot of the ABI feature picks (fractures and bedding planes); plotted from 0 to 90 dip - see legend above. DIPT = True orientation; features corrected for hole deviation.

Mag Field = Total magnetic field strength as measured by fluxgate magnetometer in OBI or ABI deviation sensor - plotted 40-60 uT (green line).

Gravity = Total gravity (probe acceleration) as measured by 3-axis accelerometers in ABI deviation sensor - plotted 0.8-1.2 g (brown line).

Azimuth = Direction of tool tilt plotted 0 to 360 deg - represents borehole deviation direction (red line).

Tilt = Tool tilt (vertical = 0 and horizontal = 90) plotted 0 to 4 deg ; represents borehole deviation tilt from vertical (blue line).

RBR = Relative bearing - azimuth of the probe marker position to Magnetic North measured clockwise (thin purple line).

Lith = Major/principal lithology based on field geologic descriptions provided by Clear Creek staff.

Desc = Major/principal field geologic descriptions provided by Clear Creek staff.

Hard = Apparent rock harness from ARI used to silhouette lithology.

Prepared by Erika J. Beam

Version 12-10-12

Southwest Exploration Services, LLC
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ABI-OBI Combined - Deviation Plot: Bulls-Eye View

Survey Calculation Method : Minimum Curvature

Reference : MAG NORTH
Mag Declination : 11.5 Deg

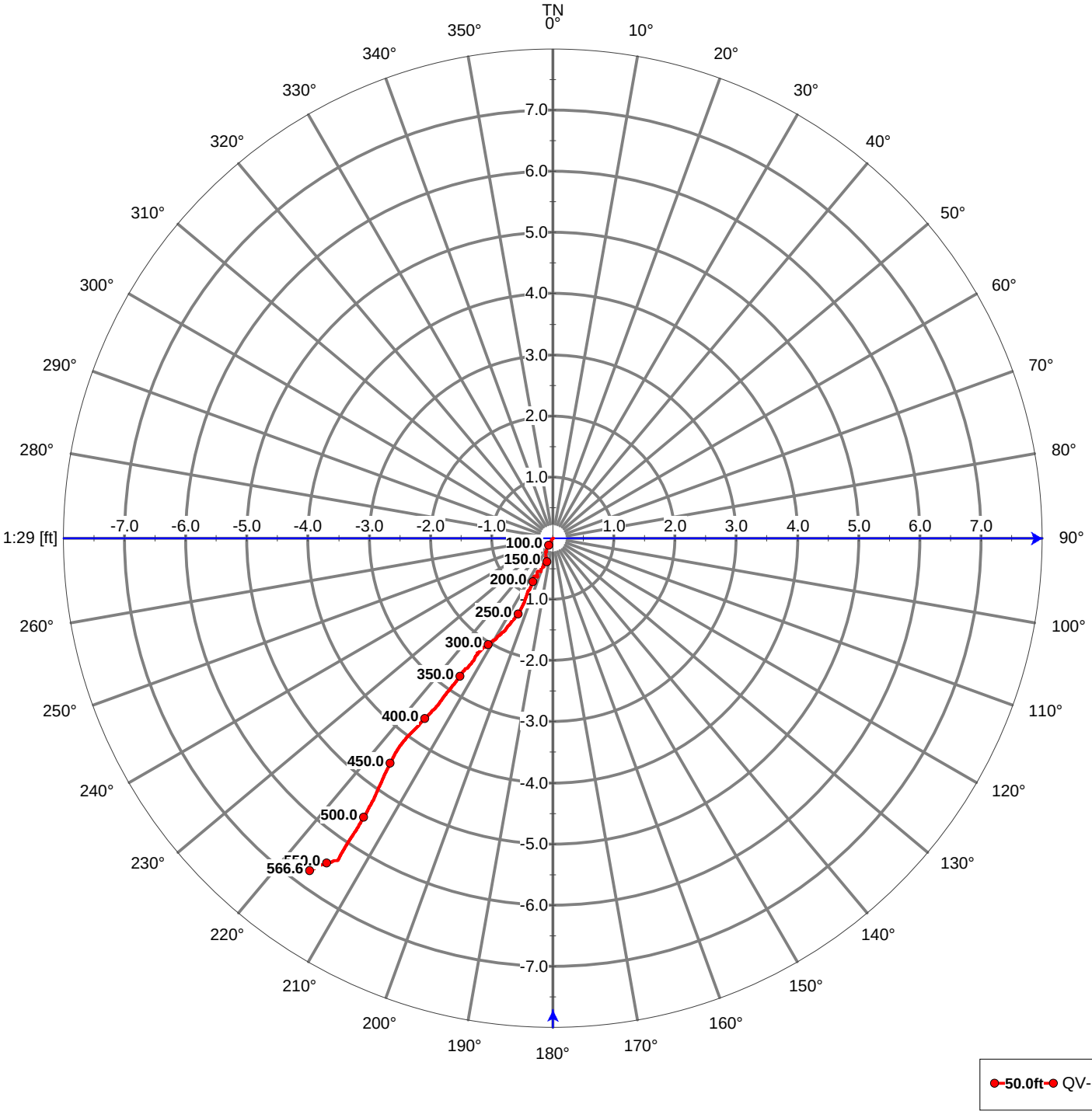
WELL #	QV-5	DATE	12-13-12
CLIENT	RESOLUTION COPPER		
FIELD/SITE	QUEEN VALLEY		
COUNTY	PINAL	STATE	AZ
OPERATOR	K. MITCHELL/E.BEAM	WITNESS	Client

FINAL LOCATION
CLOSURE DISTANCE 6.7 FT
CLOSURE ANGLE 216.3 DEG
TVD 566.6 FT

Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in contexted of measured interval only.

Measured Interval 54.1' TO 566.6'
Tool Zero Reference Ground Level
Tool used: ALT ABI-40 & OBI-40 MK4

Centralized Yes
Elevation:
Serial No:



Southwest Exploration Services, LLC
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ABI-OBI Combined - Deviation Plot: Vertical View

Survey Calculation Method : Minimum Curvature

Reference : Mag. North
Mag Declination : 11.5 Deg

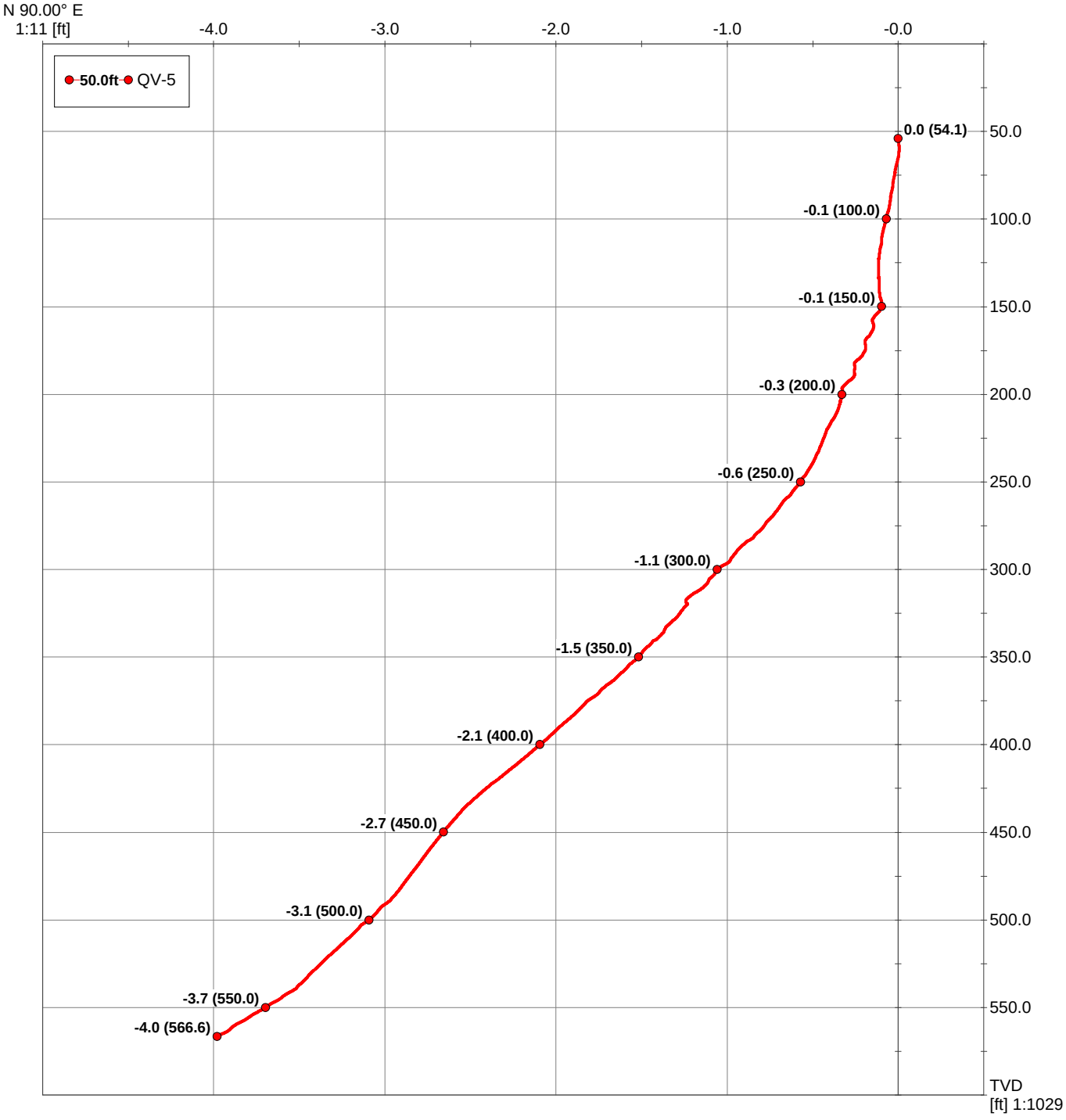
WELL #	QV-5	DATE	12/13/12
CLIENT	RESOLUTION COPPER		
FIELD/SITE	QUEEN VALLEY		
COUNTY	PINAL	STATE	AZ
OPERATOR	K. MITCHELL/E. BEAM	WITNESS	CLIENT

FINAL LOCATION
CLOSURE DISTANCE 6.7 FT
CLOSURE ANGLE 216.3 DEG
TVD 566.6 FT

Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in contexted of measured interval only.

Measured Interval 54.1' TO 566.6'
Tool Zero Reference Ground Level
Tool used: ALT ABI-43 & OBI-40 MK5

Centralized
Elevation:
Serial No:



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ABI-OBI Combined - Deviation Plot: Closure View

Survey Calculation Method : Minimum Curvature

Reference : Mag. North
Mag Declination : 11.5 Deg

WELL # QV-5
CLIENT RESOLUTION COPPER
FIELD/SITE QUEEN VALLEY
COUNTY PINAL STATE AZ
OPERATOR K. MITCHELL/E. BEAM WITNESS CLIENT

DATE 12-13-12

FINAL LOCATION
CLOSURE DISTANCE 6.7 FT
CLOSURE ANGLE 216.3 DEG
TVD 566.6 FT

Note: Calculated values (Closure Distance, Closure Angle & True Vertical Depth) are in contexted of measured interval only.

Measured Interval 54.1' TO 566.6'
Tool Zero Reference Ground Level
Tool used: ALT ABI-40 & OBI-40 MK4

Centralized Yes
Elevation:
Serial No: