HLWYM HEmails

From: Danielle Wyrick
Sent: Monday, September 19, 2005 11:18 AM
To: Deborah Waiting
Subject: FW: Well data
Attachments: Cuttings_Logs_Inyo_11-04.doc

-----Original Message-----
From: Christopher J Fridrich [mailto:fridrich@usgs.gov]
Sent: Thursday, February 24, 2005 10:51 AM
To: Danielle Wyrick
Subject: Re: Well data

Danielle:

The attached file contains the cuttings logs that I did for the Inyo wells. On these logs, I use the latest published stratigraphic scheme for Bat Mountain (Cemen and others, 1999) and for the Furnace Creek basin (Wright and others, 1999). For Bat Mountain, The Amargosa Valley Formation consists of four members. The lower two of these, the Conglomerate Member and the overlying Limestone Member, are stratigraphic/time equivalents of the Titus Canyon Formation of the Grapevine Mountains, and of the Ubehebe Formation of the Cottonwood Mountains (Snow and Lux, 1999). Most of the "Limestone Member" actually consists of volcaniclastic siltstone. The "Conglomerate Member" is a colluvial or alluvial deposit. The upper part of the Amargosa Valley Formation consists of two units, both of red pebbly volcaniclastic sandstone. Together, these are equivalent to the Panuga Formation of the Cottonwood Mountains, the Green Conglomerate of the Grapevine Mountains, and to the red sandstones found just south of Hell's Gate, at the mouth of Boundary Canyon, on the extreme northwest flank of the Funeral Mountains. The Kelley's Well Limestone, along with the Conglomerate and Sandstone Members of the Bat Mountain Formation, are stratigraphic equivalents to the Billie Mine Formation (Snow and Lux, 1999) of the Furnace Creek basin, which Wright and others (1999) insist is the basal part of the Artists Drive Formation. Whereas that is the way that McAllister originally defined the Artists Drive Formation, there is a profound angular unconformity and abrupt radical change in depositional environment at the contact between the basal Billie Mine section and the rest of the Artists Drive Formation, and thus I believe that Snow and Lux are absolutely right in designating the Billie Mine section as a completely different formation.

To put this into regional stratigraphic terms, the Cenozoic strata of the Death Valley region can be divided into 3 major sequences: (1) pre-basin-range, (2) syn-basin-range, and (3) post-tectonic. The boundaries between these three sequences are not time lines; they young to the northwest because basin-range extension moved like a wave across the region. The pre-basin-range sequence is represented in these wells by the equivalents of the (as old as ~40 Ma to ~19 Ma) Titus Canyon (Titus Canyon Group) and (~16-to-~14) Panuga Formations (Hell's Gate Group). These 2 groups are regionally separated by a profound disconfomity, at which the section of age 16 to 19 Ma is nearly always if not always missing, from the Garlock fault to the Las Vegas Valley shear zone, and from the Spring Mtns westward to the Sierra Nevada. This missing section abruptly reappears ~10 miles NE of Scotty's Castle, and is present under the northern part of the Nevada Test Site, but not the southern part. The syn-basin-range sequence is divisible into four major groups, which cover the age ranges from

~16-to-~11.5 Ma (Owlshead Group), from ~12.5 to ~5.5 Ma (Navadu Group), ~7-to-~3 Ma (Nemo Group), and ~4 Ma to present (Badwater Group). These groups overlap in age because the contacts between them young to the NW. In the Furnace Creek basin, the Owlshead Group is called Billie Mine Formation, the Navadu Group is called the Artists Drive Formation (excluding the Billie Mine section), the Nemo Group is called the Furnace Creek Formation, and the Badwater Group is called the Funeral Formation. In the Cottonwood Mtns, there is no Owlshead Group because it is too far west -- it was within the pre-tectonic area during the Owlshead tectonic stage. The other three groups in the Cottonwood Mountains are called the Navadu Formation (Navadu Group), the lower conglomerate, locally floored by the basalt of LeMoigne canyon (Nemo Group), and the volcanic marl, basalt of Ubehebe Wash, and upper conglomerate together (Badwater group). The major formation boundaries that separate these groups are regionally traceable. The base of the post-tectonic sequence is that point where faulting and tilting are buried upsection because basin-and range extension locally ceased. This sequence is absent by definition from Death Valley to the Sierras because that region still has active basin-range extension. However, the Furnace Creek and Amargosa Desert basins are post-tectonic. The only thing in these three wells that is post-tectonic is the surface alluvium. The fill of the Amargosa Desert basin, penetrated in BLM#2, is probably all part of the Navadu Group.

To put it into hydrologic terms, the only part of the Travertine #2 well that was a significant water producer was the top 200 feet, despite that the Funeral Formation has its base at 1020 feet in this well. On the surface, Texas and Travertine Springs issue from the base of the Funeral Formation. However, the Travertine #2 was drilled off to the NE, in the middle of the Texas Spring syncline. On the surface, the Funeral Formation consists almost entirely of clean alluvial gravels, which are very permeable. Because the syncline was actively downwarping as the Funeral Formation was being deposited, there is "growth folding" in this formation, and the gravels in the middle of the syncline are interbedded with playa claystones, and even the gravels in this section are impermeable below 200 feet because they have a solid matrix of playa-type clays.

The BLM#1 TD'd in Paleozoic limestone or dolomite, probably of the Nopah Formation -- Cambrian carbonates in any case. The BLM#2 TD'd in the siltstones of the Titus Canyon Formation equivalent. Drilling was stopped when there was only enough money left to case the well to TD. Inyo County plans to eventually deepen the hole to hit the Paleozoic carbonate aquifer.

I hope that gives you the information you need. If you need anything else, give me a call.

Chris Fridrich
303-236-7950
<<...>>

Hearing Identifier: HLW_YuccaMountain_Hold_EX
Email Number: 397

Mail Envelope Properties (000401c5bd2d$4e303f90$c5c8a281)

Subject: FW: Well data
Sent Date: 9/19/2005 11:17:53 AM
Received Date: 9/19/2005 11:18:12 AM
From: Danielle Wyrick

Created By: dwyrick@cnwra.swri.edu

Recipients:
"Deborah Waiting" <dwaiting@cnwra.swri.edu>
Tracking Status: None

Post Office: Crayola

Files	**Size**	**Date & Time**
MESSAGE	6269	9/19/2005 11:18:12 AM
Cuttings_Logs_Inyo_11-04.doc	65088	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
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INYO – TRAVERTINE #2 (Travertine#1 was drilled by USGS to a TD of ~250')

Coordinates of surface location:
7.5' quadrangle: Furnace Creek, CA
Surface elevation:
Total Depth (TD): 1340 feet

DEPTH	ROCK TYPE
0' – 15':	**0' = Top of Pleistocene Alluvium** Alluvium, poorly consolidated, med. brownish-gray, clasts mainly of: Bonanza King Formation (Fm): dark-to-med.-gray dolomite (dolo) + limestone (ls), silty interbeds Carrara Fm [Cc]: mixed dark rusty-brown siltstone (sltstn), greenish-gray shale (sh), and dark greenish-gray dolo Zabriskie Quartzite [Cz]: purplish-pink quartzite (qtzt) Wood Canyon Formation [ZCw]: Dark brown sltstn and lesser dirty fine-grained (fg) sandstone (ss), trace (tr) of orange dolo Abundances: Cbk>Cz>Cc>>ZCw -- This provenance stays basically the same to the base of the Funeral Fm – however, a few horizons include Tertiary very-fine-grained (vfg) tuffaceous sltstn or waterlain tuff → but these probably represent thin interbeds, not clasts. Paleozoic Sh and stlstn are underrepresented relative to abundance in outcrop source area owing to their incompetence – they get ground into clay, but it's unclear how much of this nature did, and how much the drill-bit did
15' – 26.7':	**15' = Top Of Funeral Formation** Clayey alluvium, otherwise same-as-above (SAA), clay is light (lt) yellowish-tan
26.7' – 80':	Alluvium as from 0' - 15'
80'- 100':	Alluvium, as above, but through this interval, size of chips decreases strongly downward, suggesting downward-increasing consolidation
100' – 140':	Alluvium, SAA, but ground up fine
140' – 145':	Alluvium, SAA, but clayey
145' – 275'	Alluvium, SAA, but only very slightly clayey →This was the major water-producing interval?

275’ – 280’:	Mixed claystone (just clay in sample) and alluvium - ~50/50, clay color is khaki
280’ – 365’:	Very pebbly claystone, same color as above
365’ – 485’:	Less pebbly claystone, a darker tan, here and below, mostly
485’ – 500’:	Clayey alluvium
500’ – 525’:	Alluvium, only slightly clayey
525’ – 535’:	Clayey alluvium
535’- 715’:	Very clayey alluvium, ~50/50 mix
715’ – 960’:	Tan claystone, slightly pebbly, very ashy tuff at 832’?
960’ – 975’:	Alluvium, slightly clayey at base, some ashy tuff present
975’ – 1020’:	Pebbly claystone
1020’ – 1035’:	**1020’ = Top of Furnace Creek Formation (?)** Claystone
1035’ – 1225’:	Pebbly claystone
1225’ – 1230’:	Clayey conglomerate, mix of Paleozoic and Tertiary volcanic clasts
1230’ – 1310’:	Very slightly pebbly claystone
1310’ – 1340’:	Slightly pebbly claystone, lighter tan than above

INY0 – BLM#1

UTM coordinates of surface location: 0547-590E + 4028-494N
7.5' quadrangle: Franklin Well, NV-CA
Surface elevation:
Total Depth (TD):

DEPTH	ROCK TYPE
0' – 105':	**Top of Quaternary Alluvium** Alluvium, mix of lithologies, including several Paleozoic Carbonates, mostly late Paleozoic, and Tertiary lithologies, including Kelley's Well LS, Red SS member of Amargosa Valley Fm, and trace of tuffs from top of LS member of Amargosa Valley Fm; Tertiary clasts, esp. Red SS member increase in abundance with depth
105' – 122.5':	Alluvium as above, but with abundant yellow sandstone and yellow clay (which could be a paleosol developed on underlying bedrock)
122.5'	**Angular Unconformity:** alluvium above is untilted; units below probably tilted ~25-30 degrees, based on exposures ~0.5 km to south
122.5' – 210':	**Eroded Top of Bat Mountain Formation** Sandstone, mostly fg, volcaniclastic, color alternates between light to medium red-orange to yellow-ochre, with sparse pebbles mostly of Paleozoic rocks, mainly carbonates and lesser qtzt, pebbles increase in abundance downward, plus there is a concentration of these at 170'-175'. Minor ashy waterlain tuff mixed in at 185'-190'; several other much lesser ashy tuffs occur mostly as traces of greenish yellow chips mixed in here and there
210' – 250':	Conglomerate with volcaniclastic sandstone matrix, color varies as above, pebble types as above, trace greenish tuffaceous fg ss interbeds, sparse waterlain tuff chips mixed in at 225-230 and 235-240, pebble-ss ratio decreases near base, so that it is a very pebbly sandstone at the base – overall, it is gently coarsening upward sequence.
250' – 325':	SAA, another coarsening upward sequence of ss matrix conglomerate grading down to very pebbly ss

325’ – 505’: Conglomerate with red volcaniclastic ss matrix, pebble –to-ss ratio significantly greater than above at top, but grades down into a sandier conglomerate at base, so it is another coarsening upward sequence overall

505’ – 625’: Sandstone, fine- to medium-grained, red, only slightly pebbly, except as noted below, with a few green ash partings here and there; more consolidated that the rocks above; more pebbly at 555’-560’; gritty at 565’-570’ and 580’-595’; gets finer and lighter in color (more orange) in bottom 25 feet.

625’ – 630’: **Top of Kelley’s Well Limestone**
Kelley’s Well LS mixed with ss, above, which may represent lag – check well log for actual top.

630’ – 665’: Freshwater Limestone, microcrystalline, ivory to light pink; sometimes light gray, with some minor red ss and pebbly interbeds, esp from 655-665

665’ – 680’: Red sandstone interbed in Kelly’s Well LS; actually mixed sandstone and limestone in cuttings, looks like ss above

680’ – 805’: Freshwater limestone, as above, pinkish ivory, very solid (unmixed) in this interval

805’ – 815’: **Top Of Red Sandstone Member of Amargosa Valley Fm**
Waterlain tuff with some mixed-in much lesser red ss, tuff has quartz, 2 feldspars, biotite, Fe-Ti-oxides, pale greenish-white

815’ – 820’: Sandstone, dark red, coarse, volcaniclastic, has pebbles of Paleozoic rocks-- carbonates>black chert=quartzite

820’ – 830’: Waterlain tuff as above; sandstone above may simply be a parting within a single, rather thick tuff

830’ – 915’: Sandstone, as above, but with abundant large biotite grains as part of the coarse sandstone, pebbly with clasts as described above, fines downward in general; silty ss from 880’-890’ and from 900’-905’

915’ – 920’: Sandstone, much as above but finer and very tuffaceous

920’ – 960’:	Non-pebbly, dark red, medium-to-coarse-grained volcaniclastic ss, with coarser ss interbeds from 950’-960’
960’ – 975’:	Conglomerate with dark red biotite-rich volcaniclastic sandstone matrix, probably has cobbles as well as pebbles based on the size of the chips – these clasts include black chert, quartzite, some carbonates, and conspicuously, dense medium purplish-red rhyolite lava (or very densely welded ash-flow tuff lacking obvious fiamme) – as clasts
975’ – 990’:	Non-pebbly medium-to-fine grained dark red volcaniclastic sandstone
990’ – 1000’:	Same as 960’-975’, above
1000’ – 1060’:	Mixed medium-to-coarse-grained ss and siltstone, both dark red and volcaniclastic, biotite-rich
1060’ – 1070’:	Conglomerate with dark red coarse-to fine-grained volcaniclastic sandstone matrix, clasts of quartzite and black chert mainly
1070’ – 1075’:	Clayey, medium-grained, only slightly pebbly, dark red, volcaniclastic sandstone
1075’ – 1080’:	Conglomerate, with red ss matrix, mostly quartzite and black chert clasts, tr interbedded white ashy tuff
1080’ – 1120’:	Dark red sltstn, with a few pebbly horizons, mainly from 1085’-1090’, calcareous, esp. from 1095-1100, tuffaceous-volcaniclastic throughout
1120’ – 1130:	Light red-orange sltston, very calcareous
1130’ – 1145’:	Limestone, dense, pink, freshwater, with medium red shaly interbeds
1145’ – 1155’:	Red siltstone and interbedded claystone, calcareous
1155’ – 1165’:	Limestone, dense, ivory to lt. Gray, freshwater
1165’ – 1170’:	Claystone, slightly purplish red-brown
1170’ – 1180’:	Sandstone, fine-grained, calcareous, tan-gray tuffaceous

1180’ – 1190’:	Similar to above, but much more calcareous, a marl
1190’ – 1205’:	Siltstone, purplish-brown, calcareous
1205’ – 1210’:	Sandstone, very arkosic and biotite-rich, med. red
1210’ – 1215’:	Claystone, med. greenish-gray, very calcareous
1215’ – 1275’:	Interbedded siltstone and lesser fine-grained arkosic (tuffaceous) sandstone, mostly brownish-red, but greenish from 1240’-1245’, clayey from 1250’-1255’, and coarser (medium-grained ss) from 1255’-1265’
1275’ – 1335’:	Mostly clayey, silty limestone, lt gray, with numerous thin interbeds of calcareous fg ss and sltstn
1335’ – 1345’:	Similar to above but more sltston and ss (~50-50 w/ LS)
1345’ – 1385’:	Sandstone, fg, reddish-purple, very tuffaceous, with pebbles of dense rhyolite from 1355’-1360’, and finer-grained = mostly siltstone from 1370’-1375’
1385’ – 1390’:	Siltstone, purplish-red
1390’ – 1395’:	As above, with ashy tuff interbeds
1395’ – 1420’:	Tuff, vapor-phase altered, lavender, with abundant qtz, 2 fsps, biotite, Fe-Ti oxides.
1420’ – 1425’:	Same tuff as above, but moderately welded in this interval much denser, light reddish purple
1425’ – 1440’:	Same tuff as above but less welded to nonwelded (at base), mostly lavender
1440’ – 1445’:	Mixed lt greenish-gray nonwelded tuff and fg ss, purplish-red
1445’ – 1450’:	Sandstone, lt. purplish-red, tuffaceous
1450’ – 1455’:	Same as above, but siltstone
1455’ – 1460’:	Gritstone or conglomerate, clasts are mostly dense lt. reddish-purple rhyolite

1460’ – 1505’:	Siltstone, very tuffaceous, lavender-gray, with interbeds of claystone and fg sandstone
1505’ – 1510’:	Freshwater limestone, ivory, dense
1510’ – 1520’:	Tuff, off-white, nonwelded, rhyolitic, phenocrysts of qtz, fsp, Fe-Ti oxides>biotite
1520’ – 1530’:	Siltstone, very tuffaceous, lavender-gray, with lt. green coatings on fracture surfaces
1530’ – 1550’:	Tuff, nonwelded, off-white with greenish cast, silicified in top 10 feet, rhyolitic
1550’ – 1585’:	Siltstone, purplish-brown, probably tuffaceous but too fine-grained to tell
1585’ – 1595’:	Tuff, nonwelded, off-white, rhyolitic w/ conspicuous biotite
1595’ – 1610:	Siltstone, purplish-brown
1610’ – 1625’:	Siltstone, light gray
1625’ – 1635’:	Tuff, lt. green, nonwelded, w/ conspicuous biotite
1635’ – 1665’:	Siltstone, purplish-brown, interbeds of fg ss increase in abundance downward
1665’ – 1675’:	Tuff, nonwelded, off-white, rhyolitic
1675’ – 1680’:	Siltstone, purplish-brown
1680’ – 1695’:	Tuff, nonwelded, very lt. gray
1695’ – 1715’:	Siltstone, purplish-brown and lt. gray
1715’ – 1725’:	Tuff, nonwelded, off-white, rhyolitic
1725’ – 1730’:	Siltstone, lt. greenish gray
1730’ – 1735’:	Sandstone, fg, green, very tuffaceous
1735’ – 1745’:	Siltstone, purplish-brown
1745’ – 1750’:	Tuff, nonwelded, off-white, very ashy

1750’ – 1770’:	Siltstone, lt. gray
1770’ – 1790’:	Limestone, freshwater, lt. gray, silty
1790’ – 1795’:	Claystone, med. gray
1795’ – 1830’:	Siltstone and lesser fg ss, interbedded, lt. greenish gray, all very tuffaceous
1830’ – 1840’:	Tuff, nonwelded, off-white
1840’ – 1920’:	Siltstone, lt. greenish gray
1920’ – 1925’:	Tuff, nonwelded, greenish white
1925’ – 1950’:	Siltstone, lt. greenish gray
1950’ – 1955’:	Tuff, nonwelded, greenish-white
1955’ – 1990’:	Siltstone, lt. greenish gray
1990’ – 2000’:	Mixed waterlain ashy white tuff and lt gray claystone
2000’ – 2060’:	Interbedded lt gray siltstone and claystone, very calcareous
2060’ – 2065’:	Tuff, nonwelded, greenish-white
2065’ – 2135’:	Lt greenish gray siltstone, very tuffaceous and calcareous to the point of being marly
2135’ – 2230’:	Mixed siltstone and lesser interedded claystone, very tuffaceous, lt. green with a few pink layers
2230’ – 2265’:	SAA, but more and darker reddish layers
2265’ – 2280’:	SAA, but more clayey (or else getting totally pulverized by the drill bit)
2280’ – 2360’:	Interbdedded fg ss and sltstn, med. gray with greenish and reddish, all very tuffaceous and calcareous
2360’ – 2390’:	SAA, but lt gray
2390’ – 2395’:	As above, but more tuffaceous
2395’ – 2415’:	Siltstone, purplish-gray, tuffaceous and calcareous

2415':	**Top of basal conglomerate of Amargosa Valley Formation**
2415' – 2440':	Conglomerate, Paleozoic clasts from many formations all mixed up, mostly carbonates, in a dirty red sandstone matrix
2440':	**Top of Paleozoic carbonate aquifer, formation unknown, but best guess is lower Cambrian (Nopah or Bonanza King Formation)**
2440' – 2780':	Dolomite, mostly medium gray, microcrystalline, dense
2780' – 2900':	Dolomite, light gray

INY0 – BLM#2

UTM coordinates of surface location: 0545-282E + 4030-308N
7.5' quadrangle: East of Echo Canyon, NV-CA
Surface elevation:
Total Depth (TD): 2700 feet (so far)

0' 75':	Alluvium, unconsolidated, clasts mainly of various Paleozoic formations, and much lesser Tertiary sandstone
75':	**Gradational top of Amargosa Desert Basin fill with overlying recent alluvium**
75' – 215':	Clay, yellowish tan, contains some grit and small pebbles of various Paleozoic formations
215' – 220':	Alluvium, as above
220' – 505'	Clay, as above, contains some grit and small pebbles of various Paleozoic formations
505' – 550':	Claystone, as above (meaning gritty-pebbly), gray
550' – 605':	Claystone, as above, yellowish-tan
605' – 615':	Gritstone or gravel of Paleozoic clasts, in a yellow-tan claystone matrix
615' – 635':	Claystone, as above, yellowish-tan
635' – 760':	Claystone, as above, gray
760' – 780':	Claystone, as above, dark gray
780' – 950':	Claystone and interbedded siltstone, gray
950' – 970':	Clayey siltstone, gray
970' – 990':	Mixed claystone and siltstone, ~50-50, gray
990' – 1220':	Siltstone>claystone, gray, sltstn is distinct calcareous, and becomes increasingly so with depth to 1930'
1220'- 1225':	Interbedded Claystone>siltstone, brown-gray
1225' – 1295':	Interbedded Siltstone>claystone>fg tuffaceous sandstone, mostly gray, some lt. brown beds

1295' - 1325':	SAA, but distinctly more consolidated from here down
1325' – 1330':	Interbedded Claystone>siltstone, gray
1330' – 1410':	Interbedded Siltstone>claystone=fg sandstone, gray
1410' – 1470':	Fine-grained interbedded sandstone=siltstone>claystone, gray
1470' – 1560':	SAA, but slightly more silty and yellowish-gray
1560' – 1700':	Interbedded Siltstone>fg sandstone, gray
1700' – 1870':	Fine-grained to vfg sandstone and subequal, interbedded siltstone, gray, sandstone is notably tuffaceous
1870' – 1875':	Siltstone, gray, calcareous
1875':	**Top of basal conglomerate of Amargosa Desert Basin fill**
1875' – 1930':	Very mixed lithologies, indicates it is a conglomerate, clasts are mostly of Tertiary lithologies – sandstones and siltstones, and freshwater Ls, but also some Paleozoic quartzite – probably the Eureka Quartzite, and a few carbonate clasts
1930':	**Unconformity: Erosional Top of a limestone – probably part of the Amargosa Valley Formation, perhaps correlative with one of the lower ones in Inyo-BLM#1: at 1505'-1510' or 1770'-1790', it cannot be correlative with the upper Amargosa Valley LS at 1130'-1165' in Inyo-BLM#1 because thick tuffs that underlie that LS are not present below**
1930' – 1985':	Limestone, Ivory, sometimes very light green, with interbeds of gray and reddish-brown siltstone
1985' – 1990':	Mixed green altered waterlain tuff, gray siltstone, and trace of freshwater limestone
1990' – 1995':	Tuff, green altered, waterlain
1995' – 2040':	Siltstone>fine-grained sandstone, gray with green ashy tuff interbeds

2040’ – 2045’:	SAA, but much more tuff
2045’ – 2095’:	Fine-grained sandstone> siltstone, mixed gray-green and lesser red, all very tuffaceous, esp. at 2070’-2075’
2095’ – 2155’:	Siltstone, mostly dark reddish brown, with some greenish tuffaceous interbeds
2155’ – 2175’:	SAA, but gray, and contains some fg sandstone interbeds
2175’ – 2190’:	Siltstone, mostly dark reddish brown, with some greenish tuffaceous interbeds
2190’ – 2195’:	SAA, but more of the greenish interbeds
2195’ – 2205’:	Siltstone, medium-dark gray
2205’ – 2290’:	Siltstone and lesser fg sandstone, mixed reddish brown, gray, and greenish-gray, which is more tuffaceous
2290’ – 2295’:	SAA, but with a few chips of freshwater limestone
2295’ – 2315’:	Siltstone, reddish brown, grading down to gray
2315’ – 2320’:	Limestone, ivory freshwater, mixed with reddish-brown siltstone
2320’ – 2340’:	Limestone, ivory freshwater
2340’ – 2355’:	Limestone, ivory freshwater, mixed with reddish-brown and gray siltstone
2355’ – 2365’:	Limestone, ivory freshwater
2365’ – 2380’:	Sandstone, dark reddish-brown, tuffaceous fg
2380’ – 2400’:	Mixed siltstone>fg ss>freshwater LS
2400’ – 2435’:	Siltstone, reddish brown, except 2420-2425, which is more greenish
2435’ – 2455’:	SAA, but grayish
2455’ – 2460’:	Sandstone, fg tuffaceous greenish gray, minor red siltstone
2460’ – 2495’:	Siltstone, gray>reddish bwn>>greenish gray, with minor

fine-grained sandstone

2495’ – 2500’:	Sandstone, fg, very tuffaceous, med gray, lots of biotite
2500’ – 2505’:	Siltstone>fg ss, both gray
2505’ – 2510’:	Siltstone, dark reddish brown
2510’ – 2515’:	SAA, with minor fg ss
2515’ – 2520’:	Siltstone, gray and dark reddish brown
2520’ – 2540’:	Siltstone>fg ss, both gray, become more greenish with depth
2540’ – 2555’:	Siltstone, gray and dark reddish brown
2555’ – 2560’:	Mixed freshwater LS, ivory and dark reddish brown siltstone
2560’ – 2630’:	Siltstone, greenish gray to red-gray
2630’ – 2690’:	Sandstone, fg to vfg, greenish gray, with lesser reddish-brown siltstone
2690’ – 2700’:	Sandstone, green fg very tuffaceous, with minor reddish-brown siltstone