CRJ01-0201

Natural Gamma (CPS): 18 36 54 72 90 108 126 144 162

Caliper (Inches): 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5

Lithological Description

0-4.0 ft. SILT (ML); pale brown (10YR 6/3) with up to 10% siltstone and sandstone rock fragments. Mostly alluvial mud derived from sheet wash. Less than 10% very fine grained sand, highly calcareous.

4.0-4.5 ft. SILTY SAND (SM); moderately calcareous, mottled, very pale brown (10YR 7/4) and yellow (10YR 7/8).

4.5-5.0 ft. SANDSTONE; very fine grained rock fragment, yellowish gray (5Y 8/1), slightly calcareous.

5.0-14.0 ft. WEATHERED MANCOS SHALE BEDROCK: 5.0-9.0 ft. highly weathered silty shale, soft, mottled, from light gray (N7) to dark yellowish orange (10YR 6/6), with ~5% white gypsum and calcite crystals and masses, moderately calcareous.

9.0-12.0 ft. silty shale moderately weathered, layered, yellowish gray (5Y7/2), moderately calcareous, several % small white masses of gypsum.

10.5-11.0 ft. thin layer of siltstone that is highly calcareous and dark yellowish orange (10YR 6/6).

12.5-14.0 ft. shale becomes increasingly hard and less weathered.

14.0-14.5 ft. Blow refusal @ 14.3 ft. No Recovery.

14.5-301.0 ft. MANCOS SHALE:

14.5-29.0 ft. mostly siltstone, light olive gray (5Y 5/2) wavy bedding, black surfaces on some bedding is framboidal pyrite, slightly weathered, mostly horizontal bedding plane fractures spaced 0.2 to 0.3 ft. apart. Inclined fracture (~45 degrees) @ 16.0 ft. with white gypsum and calcite. Thin clayey zone at ~16.5 ft.

17.9-22.0 ft. layer of abundant burrows filled with limonitic-colored, dark yellowish orange (10YR 6/6) material, trace white calcite and gypsum. Horizontal fracturing more abundant at spacings of 0.1 ft or less.

22.0-27.0 ft. slightly weathered, mostly siltstone, wavy bedded to bioturbated, abundant horizontal fractures spaced approximately 0.2 ft. apart filled with gypsum. Yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), moderately calcareous. Core much more competent despite the horizontal fracturing.

27.0-29.0 ft. slight to nonweathered, less horizontal fracturing filled with gypsum and more dark bedding, which is largely colored by framboidal pyrite. Bedding continues to be bioturbated and wavy. Mostly yellowish gray (5Y 7/2).

29.0-35.0 ft. 4.0 ft. recovery - core loss spread over entire run - core severely parted on bedding with no angular fractures - core is moderately weathered, yellowish gray, some gypsum crystals, core is in fragments and pieces up to 0.05-0.1 ft. thick (long).

35.0-45.0 ft. good recovery 9.6 ft. -still fractured and broken to about 42.0 ft. with gypsum infilling and limonitic stain, normal dark gray coloration and the usual +/-5 degree bedding angle - all lost core is at top of the run. No major high angle fractures in the run - broken core is generally on the nearly horizontal bedding planes. Below 42.0 ft., core becomes largely unweathered.

45.0-55.0 ft. unweathered "fresh" core, moderate parting on bedding; some parting on fissile zones. Good Run.

55.0-65.0 ft. very good run - relatively hard, moderately calcic claystone, dry interior of core, horizontal bedding, usual crenulations and hairline gypsum fillings.

65.0-75.0 ft. very good recovery, breaks and parting on bedding, no fractures, slightly fissile in spots - dry core interior- moderately to strongly calcic.

75.0-85.0 ft. very competent run - excellent recovery. Claystone, dry core interior, slightly fissile from 77.0-78.0 ft., hard, moderately calcic, no fractures, no secondary mineralization, no indication of water.

85.0-95.0 ft. dark gray, horizontal bedding (at a 90 degree angle to core axis), thin bedding laminations, hard, dry core interior, minor mechanical breaks on bedding, short splinter from drilling stress at 92.7-93.0 ft.

95.0-105.0 ft. core splintered by mechanical stress from 97.0-98.5 ft., fissile break at 99.2 ft. Hard, calcic, dry core interior, no indication of formation water.

105.0-115.0 ft. dark colored silty claystone (medium gray, N5) approximately 90%, and light colored (very light gray, N8), very fine grained sandstone, which represents bioturbated layers ~10%. Bioturbated layers are as much as 0.05 ft. thick. Core hard and competent, dry when broken open. Bioturbated beds are quite contorted in places. Trace fine carbonaceous and framboidal pyrite on bedding. No natural fractures, slightly to moderately calcareous.

115.0-125.0 ft. core hard and competent, no natural fractures, dry when broken open. Bedding along some bioturbated layers is inclined as much as 25 degrees.

125.0-135.0 ft. core is hard and competent, no natural fractures, dry when broken open. Carbonaceous mats (up to 0.05 ft. long) occur on some bedding surfaces. Trace fossil imprints on some bedding surfaces.

135.0-145.0 ft. bioturbated bedding increases to as much as 15-20% of layering. Carbonaceous mats are on some bedding planes and they break easily. Core hard and competent, no natural fractures, dry when broken open. Thin fissile layer at ~140.0 ft.

145.0-155.0 ft. bioturbated bedding in as much as 30% of layering. Core is hard and competent, but breaks along finer grained, dark layers of silty claystone and carbonaceous material. Thin fissile layer at ~149 ft. and 155.3 ft.

155.0-165.0 ft. bioturbated layering is ~20% from 155.5-157.0 ft., then decreases rapidly to 2-3% at 159.0 ft., and remains so to bottom of interval. Some near vertical stress fractures from 157.0-159.0 ft. No natural fractures. Core hard and competent and dry when broken open. Coiled nautiloid fossil at 159.2 ft. coated in fine pyrite. Below 159.0 ft., core is much finer grained and more competent.

165.0-175.0 ft. core placement is jumbled because core was extruded explosively from the barrel and scattered. Core through interval is mostly silty claystone with 2-3% bioturbated layering that is very fine grained sandstone. Several vertical stress fractures caused by drilling. Core from 174.5 to 175.5 ft. is placed correctly.

175.0-185.0 ft. silty claystone with 2-3% bioturbated (or storm) layering composed of very fine grained sandstone. Vertical stress fractures at top of interval at 175.5-176.0 ft. At 179.5-180.5 ft. and 181.0-181.5 ft. are vertical fractures that may be natural - no evidence of fluid movement along these tight fractures. At 180.5 and 181.8 ft. are thin fissile layers. Large flattened cephalopod at 177.3 ft.

185.0-195.0 ft. increase in bioturbated layering to ~5%, some of it is chaotic, especially from 186.0-187.0 ft. Vertical fracture at 189.5- 190.5 ft., appears to be drilling related stress. Bioturbated layering decreases below ~190.0 ft., to about 2-3%. Core is hard and competent throughout, dry when broken apart.

195.0-205.0 ft. bioturbated layering increases below ~202.0 ft. to ~5-10%. Some bioturbated layering is inclined as much as 20 degrees from horizontal. Core is hard and competent throughout, dry when broken open. Some fine carbonaceous material along bedding surfaces.

205.0-215.0 ft. bioturbated layering composes is nearly 10% of bedding from 206.0-211.0 ft., then decreases quickly to ~1% at 212.0 ft. and below. Core has fissile layers in many locations from 206.0 to 208.5 ft., below which the core is more competent and less broken. A couple of fissile layers from 211.0-212.0 ft. Core is dry when broken open. Fine carbonaceous material along many bedding surfaces.

215.0-225.0 ft. silty claystone with only ~10% bioturbated (or storm) layering consisting of lighter colored very fine grained sandstone. Some vertical fracturing at 218.0 and ~224.5-225.5 ft. is probably mechanical stress from drilling - no evidence of fluid movement along the tight fractures. Fissile, thin bedded layers at 221.7-221.9 ft., 222.3-222.5ft., 222.9 and 225.3 ft. Layering looks to dip 5-7 degrees. One or more of the fissile layers may be bentonite.

225.0-235.0 ft. core splintered by mechanical stress from 225.0-226.3 ft. From 227.0-229.0 ft., core softer and fissile - washed out and rounded. From 229.0-232.0 ft., core generally parted on bedding every 0.3-0.7 ft. From 232.0-235.0 ft., more competent core with only parting on bedding.

235.0-245.0 ft. very dark gray when wet, mostly medium dark gray (4) when dry, minor parting, no fractures, slightly fissile @239.3 ft. No secondary mineralization.

245.0-255.0 ft. very dark gray claystone. Splintered @245.8-246.4 ft., parted on bedding in a few places, otherwise unbroken. Very competent, horizontal bedding, dry core interior, no biocrenulations, no fractures, no formation water.

255.0-265.0 ft. splintered by mechanical stress @255.0-257.3 ft., and 259.0-261.0 ft., somewhat fissile @261.0,261.6, and 262.2 ft., otherwise moderately calcic, relatively hard, competent claystone.

265.0-275.0 ft. splintered 265.3-266.0 ft., and 273.0-275.0 ft. Good competent run, no fractures other than stress related, consistent color and hardness, normal bedding and parting, no secondary mineralization.

275.0-285.0 ft. splintered @ 275.0-276.0 ft., fissile (0.1 ft.) @284.0 ft., otherwise standard claystone with normal bedding, coloration, hardness, very competent and only slight parting on bedding planes, core interior is dry, no bioturbation.

285.0-295.0 ft. somewhat fissile overall, broken on fissile sections on bedding @ 285.6, 286.4, 287.0, and 287.3 ft., 288.4-289.0 ft., 291.2, 292.3,292.6, 293.3, and 294.5 ft.

295.0-301.0 ft. fissile and parted @297.4, 297.7, 297.9, 298.1, 298.6, 299.6, 300.0, 300.4, and 300.8 ft. No secondary mineralization, no angular fractures, dry core interior, normal bedding angle.

Lithologic Symbol

Depth (ft): 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300

ELEVATION (ft): 5020 5010 5000 4990 4980 4970 4960 4950 4940 4930 4920 4910 4900 4890 4880 4870 4860 4850 4840 4830 4820 4810 4800 4790 4780 4770 4760 4750 4740 4730

Optical Televiewer N E S W N

Acoustic Televiewer N E S W N

Rock Quality Designation (RQD): 20 40 60 80 100

Near Spaced Density g/cc: 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9

Far Spaced Density g/cc: 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9

Deep Induction Resistivity (Ohm-m): 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Neutron In Air (CPS): 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400

Neutron in Fluid (CPS): 910 970 1030 1090 1150 1210 1270 1330 1390 1450 1510 1570 1630 1690

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