KANSAS GEOLOGICAL SURVEY
The University of Kansas

2-March-2024

Core Report for MGPI Processing #1, Atchison, Kansas

Submitted to SCS Engineers by the Kansas Geological Survey

Core from the MGPI Processing #1 well was described per an MOU between SCS Engineers and the Kansas Geological Survey (KGS) as coordinated by Carrie Ridley (SCS) and Franek Hasiuk (KGS) 26-September-2023. A preliminary version of this report was shared during a workshop with SCS Engineers, KGS, and the Kansas Department of Health and Environment on 31-January-2024. This report dated 2-March-2024 is the final version.

Chain of custody and core processing

Core from the MGPI Processing #1 well was received at the KGS on 23-October-2023. Delivery was made of the shallower Chattanooga Shale (1811-feet to 1841-feet) by F. Hasiuk and was in the form of 8-foot wooden crates (two 4-foot rows). The core arrived encased in aluminum casing and was in overall good condition. On 9-November-2023, the Arbuckle Group core (2486-feet to 2546.2-feet) was delivered by F. Hasiuk and arrived in cardboard boxes and was not enclosed in aluminum. The original boxes were replaced for both cored intervals, the core was condensed to fill empty box space, and core depths were reconciled. 2 sections in the Arbuckle Group were noted as missing (from 2528-feet to 2529.2-feet and 2532.8-feet to 2533.5-feet; about 2-feet total).

Slabbing and sampling of the core was completed on 15-December-2023. Thin-Section billets were transferred to the University of Kansas Rock and Sample Preparation service laboratory. Thin-sections and billet material were subsequently returned (16-January-2024) to the KGS and have been curated with the core. Core plugs were returned to the KGS on 24-Jan-2024 and analyzed with a portable XRF. SCS Engineers collected a subset of the plugs and core slabs for further analysis (Appendix E).

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Core Description Report

Core: MGPI Processing #1, Atchison, Kansas
Description by: Jay Kalbas & Brendan Bream
Date: 22-December-2023
Interval: 1811 – 1841 feet
Unit: Chattanooga Shale

Overview

Thirty feet of continuous 4-inch diameter core was described from 1,811-1,841 ft in the *MGPI Processing #1* well (all depths referenced here are measured depths from the Kelly Bushing). After delivery, the entire core was slabbed and then arranged into 30 3-foot single boxes (butt boxes) and 15 2-foot triple boxes (slab boxes). Multiple attempts were made to obtain intact 1-inch diameter plugs (of 5 attempts, 2 were viable). Attempted plug depths (result) are as follows: 1811.94 (Fractured); 1817.68' (Fractured); 1837.59 (Viable); 1834.9.00 (Failed); 1840.84. Two 2-inch x 3-inch thin-section billets were cut at 1834.70 and 1840.65-ft.

Drilling-induced fracturing is prevalent throughout this cored interval resulting in discs up to ~0.2-feet with most <0.05-feet in height. The top of the core is the most competent zone from about 1811- to 1812.4-feet; there is reasonable preserved core from the top to ~1836-feet with a rubble zone to ~1840-feet; approximately 1-foot of core is intact at the base beneath the rubble zone. Open-hole wireline logs were run in the 12.25-inch shallow section from 250- to 2472-feet and includes the cored interval. There is significant borehole washout across the cored interval (up to 16-inches) likely the result of slower drilling rates during the coring process. No core depth to log depth adjustments were estimated as it is likely that the top of the cored interval corresponds to the ~2-feet of competent material at the top of the section and where the borehole diameter is closest to the bit size. The Gamma Ray is above 75 GAPI across the cored interval and in line with an overall increasing GR with depth from about 1775-feet (70 GAPI) to ~1890-feet (135 GAPI). Compensated density and neutron logs across the cored interval are not considered valid as most of the section is well above 30pu.

Description and Interpretation

Thirty feet of continuous core from 1,811-1,841 ft in the *MGPI Processing #1* well allow documentation of a protracted period of fine-grained sedimentation at this location. The stratigraphic succession is dominated by green-gray -to- gray, and dark gray medium-grained mudstone. Facies are persistently bioturbated throughout the succession suggesting at least suboxic (or better) bottom water conditions. A predominant wavy non-parallel lithofacies fabric is common and suggests some current or wave activity, although no evidence for symmetric or asymmetric current ripples was discovered (Fig. 1). Discontinuous and continuous parallel bedding was observed in intervals from 1,836.6 -to- 1,835.6 ft, 1,828 -to- 1,827.8 ft, and from 1,816.7 -to- 1,813.5 ft in section (Fig. 2) and may represent correlatable basin-wide events. For example, the abrupt vertical transition from at 1,822.3 ft from green-gray bioturbated, wavy non-parallel mMs to darker gray planar-parallel bedded mMs is interpreted to represent an abrupt change in bottom-water energy associated with a marine flooding surface or parasequence boundary (Fig. 3a). Churned lithofacies (Fig. 3b) just below the planar sedimentation likely represents a period of persistent faunal activity at the boundary uninterrupted by sedimentation immediately following the flooding event.

Figure 1. Green-gray medium-grained bioturbated mudstone at 1,839 ft of section. An underlying wavy non-parallel fabric is observable beneath planolites and chondrites burrows, which disrupt the original bedding. Note that a cm scale is placed in the background at the left side of the photograph.

Another example of an interpreted marine flooding surface is present at the abrupt vertical transition from 1,817 -to- 1,816.3 ft from thinly bedded mudstone with phosphatized fossil bone fragments overlain by homogeneous bedding (a result of churning from bioturbation) and subsequently by dark green-gray bioturbated mudstone (Fig 2). Fine-grained strata overlying the interpreted flooding surface is comprised of discontinuous planar-parallel to subparallel beds with a lower bioturbation intensity (biot=2; Fig. 4).

Evidence for alteration of fine-grained facies under oxygen-starved conditions is common throughout the core interval. Framboidal pyrite is evident at 1827 ft, 1,815 ft, and 1,811 ft in section (Figs. 2 and 5). Phosphatized and pyritized marine fossils are also common, for example, at 1,817ft (Fig. 6).

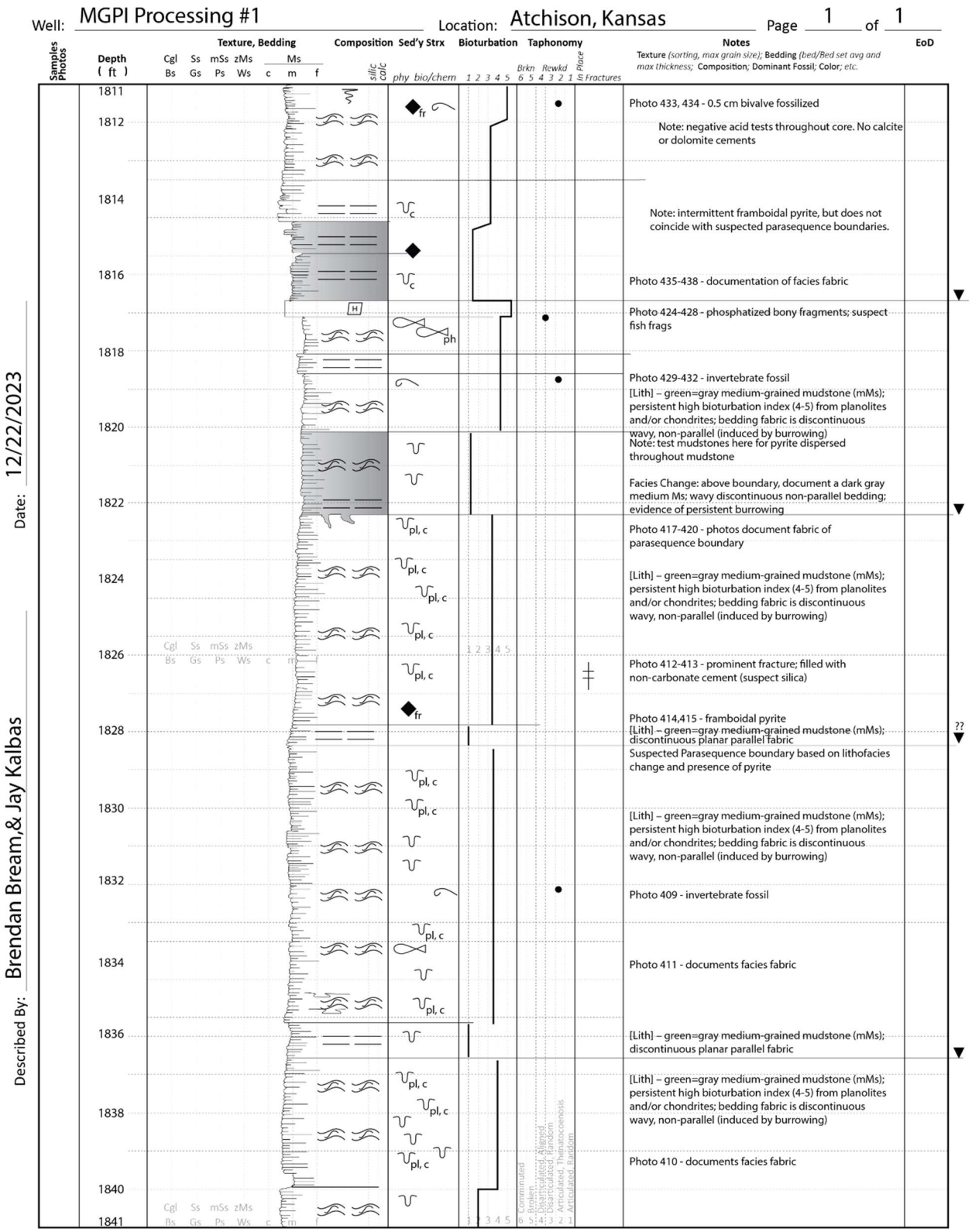
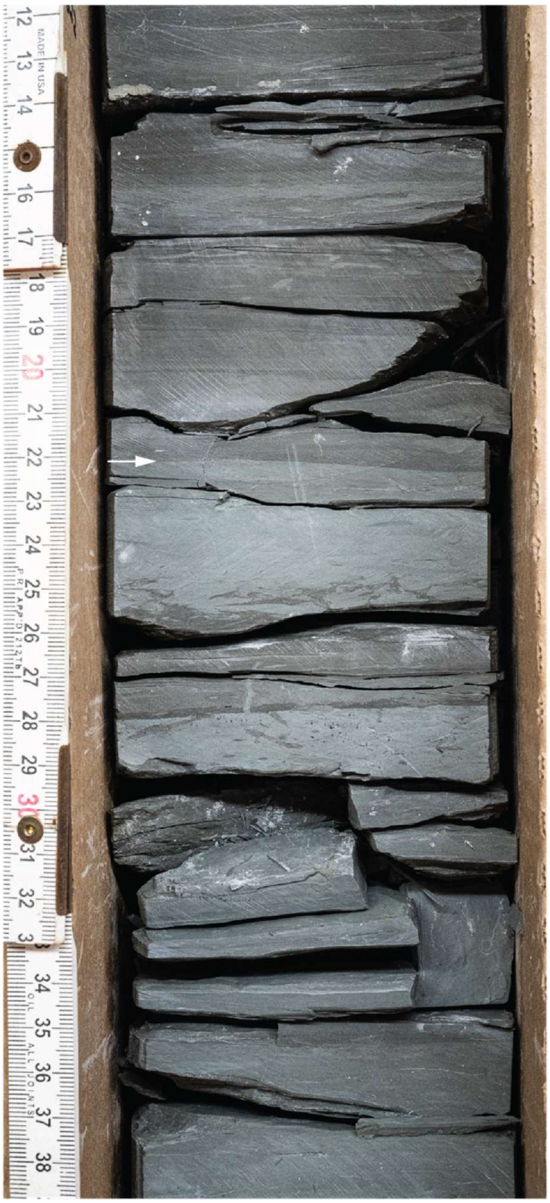


Figure 2. Core description.



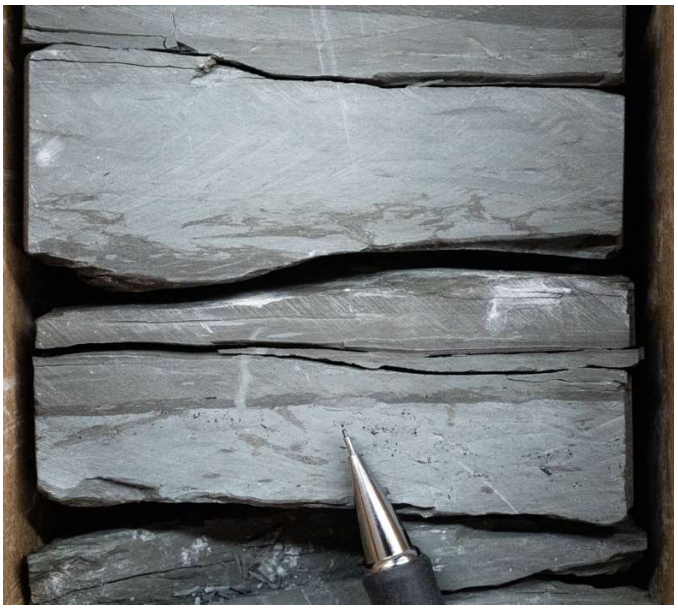


Figure 3. Subtle changes in the bedding fabric support an interpretation of abrupt landward shifts in shoreline positions. (a) Interpreted marine flooding surface (white arrow) at 1,822.3 ft in section. (b) Planolites burrows entrain darker, overlying mud facies downward into churned facies immediately below the marine flooding surface.

Figure 4. Dark green-gray discontinuous planar-parallel to subparallel facies from 1,816.7 to 1,815.5 ft of section overlie an interpreted marine flooding surface.

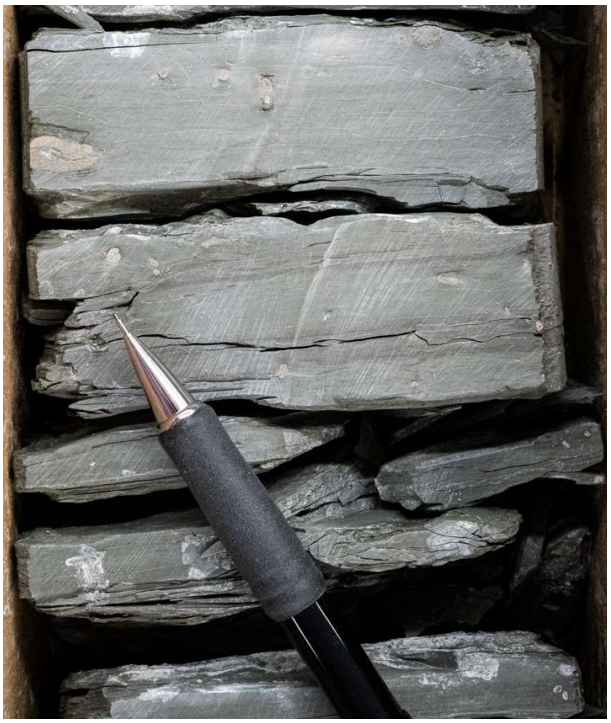


Figure 5. Pyrite framboids in core at 1,822.2 ft of section.

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Figure 6. Phosphatized and pyritized fossil material. (a) Phosphatized bony fragments from a disarticulated vertebrate (likely fish) marine organism (1,817 ft MD). (b) Pyritized bivalve fossil in mMs facies at 1,816.6 ft MD. (c) Pyritized bivalve fossil in mMs facies at 1,811.5 ft MD.

Figure 6a.

Figure 6b.

Figure 6c.
Fractures are observed in only one location in the cored interval, at 1,826.5 ft of section (Figs. 2 and 7). The fracture is filled with a gray-white mineral form that yielded a negative acid test (for either calcite or dolomite).

Core Description and Interpretation – Arbuckle Interval (2486-2546.2 feet)

The Arbuckle interval (Figure 1) is dominated by microbial facies, which include thrombolite and stromatolite boundstone and laminated microbial/algal mats. Thrombolites dominate the microbial facies in the core. Thrombolites are non-laminated, clotted microbial deposits that form relief (Figure 2A). Stromatolites are laminated microbial deposits that form relief (Figure 2B). Laminated microbial/algal mats (Figure 2C) coat sediment surfaces.

Thrombolites, stromatolites and mats trap and bind sediment as they grow and can be grainy or muddy in character. Thrombolites also can include primary pores as they grow, and sediment can fill or partially fill the pores, which is the case in most of the thrombolites in the core. Burrows can be common with thrombolites, and some of the thrombolite fabric in the core could be due to burrowing.

Fragmented, sand-sized skeletal grains (undifferentiated) are abundant throughout the Arbuckle interval and mostly occur as matrix with the microbial fabrics. Ooids are most abundant in basal portions of the core (2546.2 to 2437 ft). Siliciclastics occur locally, in matrix and fractures associated with thrombolites, or as discreet horizons (Figure 2D). The horizons preserve horizontal and ripple cross lamination.

Some thrombolites (locally stromatolites) are brecciated, which can be due to depositional processes or later processes in the paragenesis. One interval below a surface at 2505 ft is characterized by altered, silicified, and brecciated thrombolite facies (Figure 2E) which appears to be associated with diagenesis that occurred at the surface prior to deposition of overlying facies.

Diagenetic alteration includes early and later silicification, creation of secondary porosity, and dolomitization. Dolomitization occurs preferentially in areas with fragmented skeletal grains. Much of the thrombolite facies has vuggy porosity, which is related to areas of coarse-grained matrix filling primary pores that were preferentially dolomitized.

Arbuckle and time-equivalent carbonates in the Continental US are part of what is termed the great American carbonate bank consisting of hundreds of meters of largely dolomitized shallow subtidal to intertidal carbonates and associated siliciclastic cycles capped by a regional unconformity. Most of the facies in the core appear to have been deposited in shallow-subtidal environments, as evidence of intertidal environments is missing. The abundance of sand-size fragmented skeletal grains and ooids are indicative of a high-energy environment, likely above effective wave base. Several horizons with interlaminated clay and siliciclastic sand preserve ripple cross lamination and could reflect an intertidal environment. Similarly, a grainy carbonate horizon (2508 ft) preserves ripple cross lamination that may also reflect an intertidal environment, which might be supported by proximity to an overlying surface at 2505 ft evidencing possible subaerial exposure (Figure 2E).

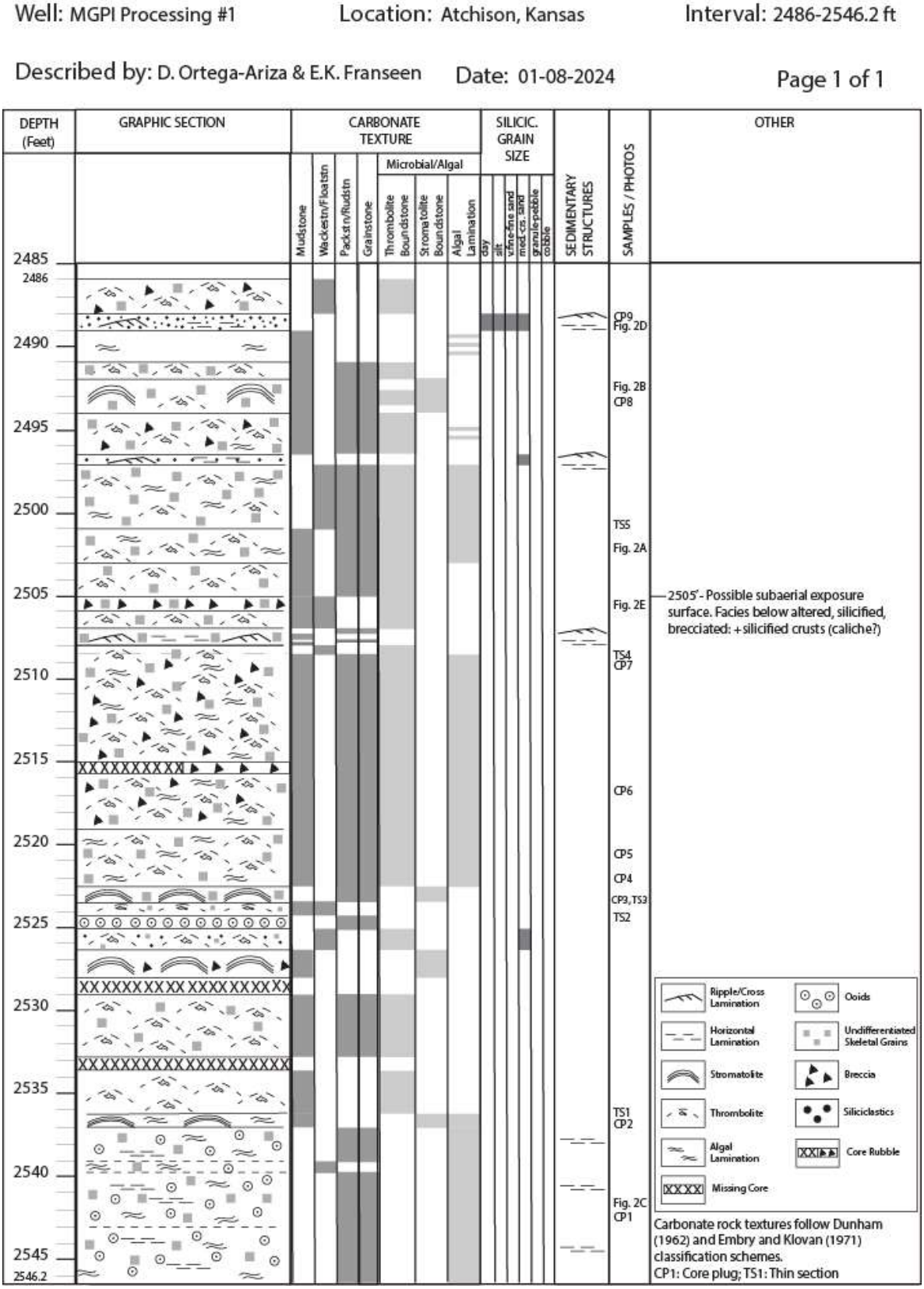


Figure 1. Arbuckle core description

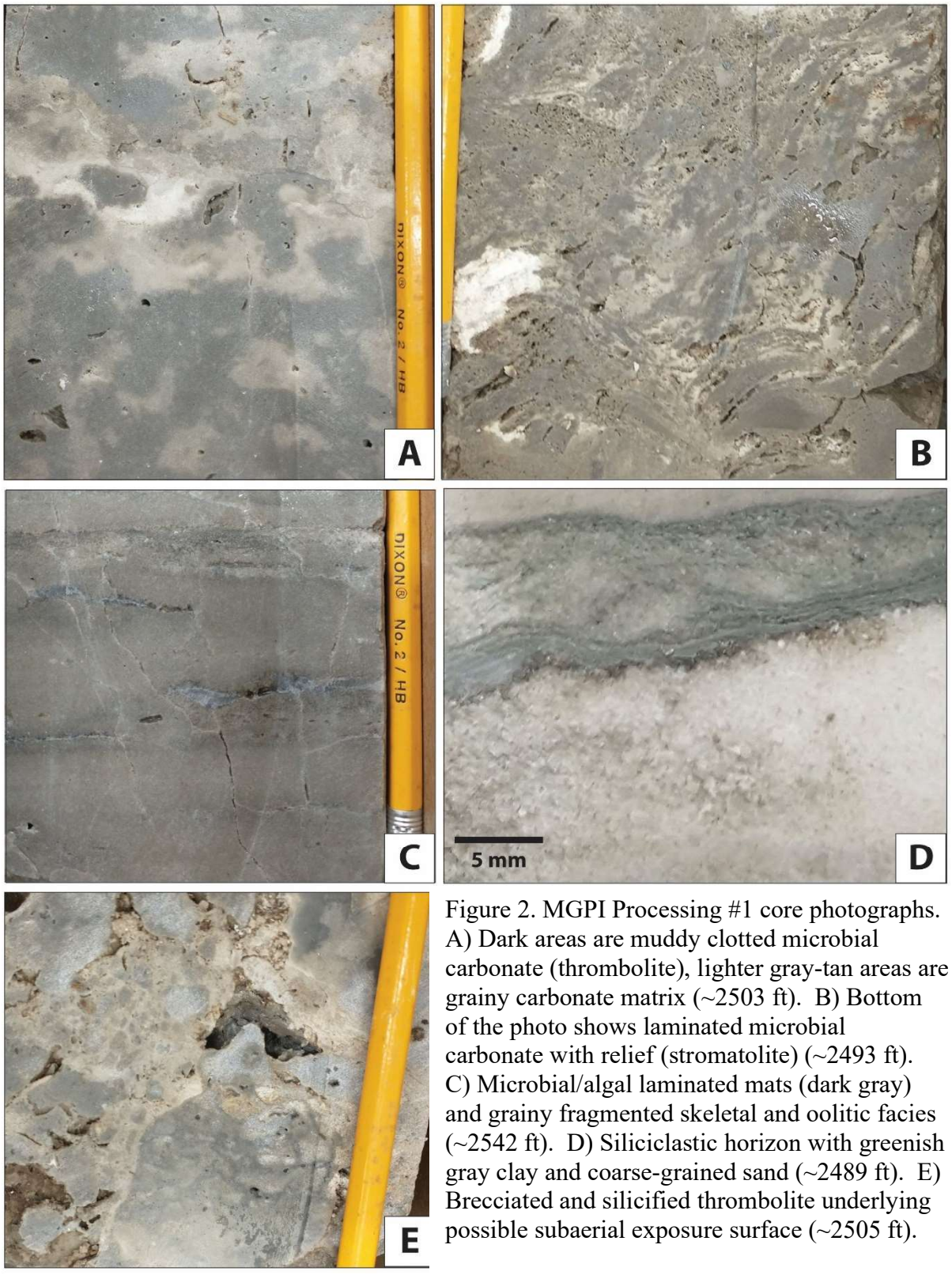
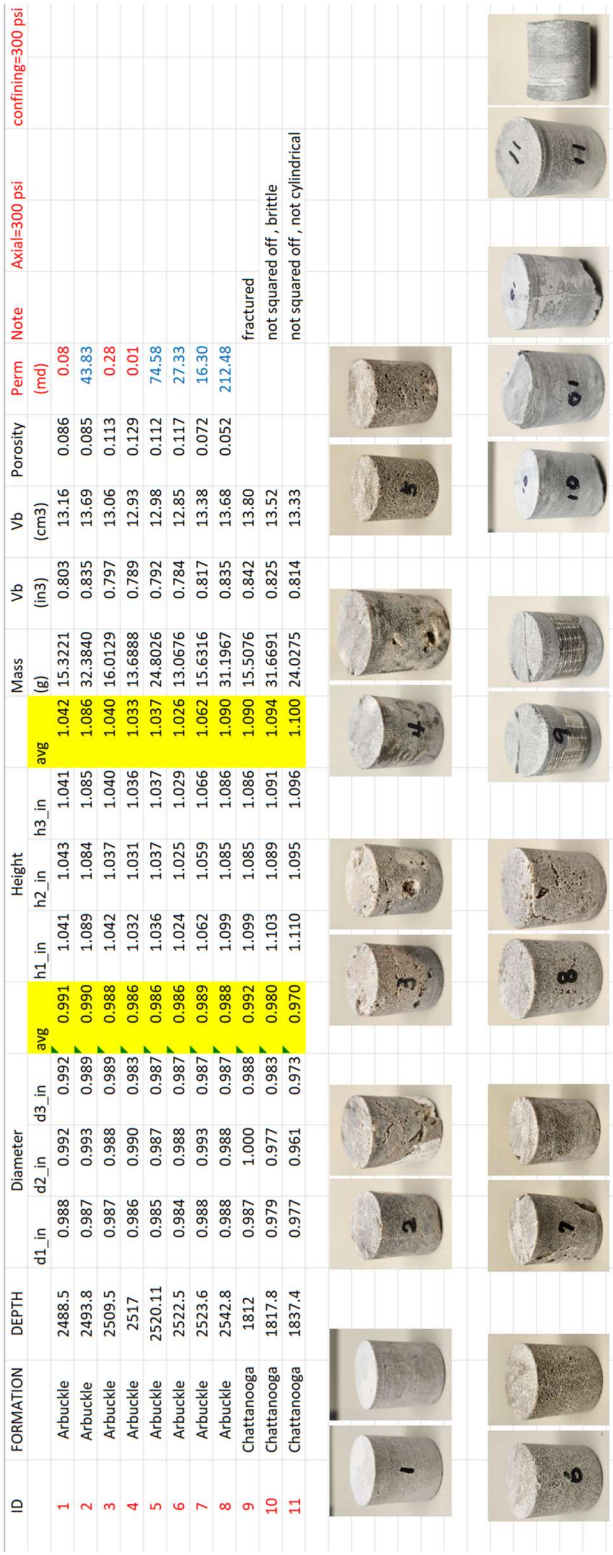


Figure 2. MGPI Processing #1 core photographs. A) Dark areas are muddy clotted microbial carbonate (thrombolite), lighter gray-tan areas are grainy carbonate matrix (~2503 ft). B) Bottom of the photo shows laminated microbial carbonate with relief (stromatolite) (~2493 ft). C) Microbial/algal laminated mats (dark gray) and grainy fragmented skeletal and oolitic facies (~2542 ft). D) Siliciclastic horizon with greenish gray clay and coarse-grained sand (~2489 ft). E) Brecciated and silicified thrombolite underlying possible subaerial exposure surface (~2505 ft).

Appendix A – Plug analysis (KU – Chemical & Petroleum Engineering). Pulse decay (unsteady state) method (red color perm) and Steady state method (blue color perm) were used to measure core permeability. Porosity was measured with helium gas expansion method based on Boyle's law.

ID	FORMATION	DEPTH	Diameter				Height				Mass	Vb	Vb	Porosity	Perm	Note	Axial=300 psi	confining=300 psi
			d1_in	d2_in	d3_in	avg	h1_in	h2_in	h3_in	avg	(g)	(in3)	(cm3)		(md)			
1	Arbuckle	2488.5	0.988	0.992	0.992	0.991	1.041	1.043	1.041	1.042	15.3221	0.803	13.16	0.086	0.08			
2	Arbuckle	2493.8	0.987	0.993	0.989	0.990	1.089	1.084	1.085	1.086	32.3840	0.835	13.69	0.085	43.83			
3	Arbuckle	2509.5	0.987	0.988	0.989	0.988	1.042	1.037	1.040	1.040	16.0129	0.797	13.06	0.113	0.28			
4	Arbuckle	2517	0.986	0.990	0.983	0.986	1.032	1.031	1.036	1.033	13.6888	0.789	12.93	0.129	0.01			
5	Arbuckle	2520.11	0.985	0.987	0.987	0.986	1.036	1.037	1.037	1.037	24.8026	0.792	12.98	0.112	74.58			
6	Arbuckle	2522.5	0.984	0.988	0.987	0.986	1.024	1.025	1.029	1.026	13.0676	0.784	12.85	0.117	27.33			
7	Arbuckle	2523.6	0.988	0.993	0.987	0.989	1.062	1.059	1.066	1.062	15.6316	0.817	13.38	0.072	16.30			
8	Arbuckle	2542.8	0.988	0.988	0.987	0.988	1.099	1.085	1.086	1.090	31.1967	0.835	13.68	0.052	212.48			
9	Chattanooga	1812	0.987	1.000	0.988	0.992	1.099	1.085	1.086	1.090	15.5076	0.842	13.80			fractured		
10	Chattanooga	1817.8	0.979	0.977	0.983	0.980	1.103	1.089	1.091	1.094	31.6691	0.825	13.52			not squared off , brittle		
11	Chattanooga	1837.4	0.977	0.961	0.973	0.970	1.110	1.095	1.096	1.100	24.0275	0.814	13.33			not squared off , not cylindrical		



Appendix B – Portable XRF analyses of plugs. KGS Olympus Vanta used (operator Kate Andrzejewski). Beam 1 time=30 seconds; Beam 2 time= 60 seconds; Beam 3 time = 30 seconds. Standards used: Blank silica, OREAS 70B; standards ran at beginning of analysis and after every 20 samples.

		Ca		Mg		Si		Al		K		Fe	
		Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error
1	Silica stnd	<LOD	74	<LOD	1585	528808	467	<LOD	370	<LOD	89	16	5
2	OREAS 70B	28961	77	144695	933	223794	506	31461	205	4856	23	56913	157
3	MGPI 1 Arbuckle 5: 2520' 11" top	190070	439	106285	1019	58082	198	7770	143	2948	17	2911	23
4	MGPI 1 Arbuckle 5: 2520' 11" side	193691	512	104990	1167	32813	149	5379	149	1568	16	2583	24
5	MGPI 1 Arbuckle 5: 2520' 11" bottom	206870	459	114576	984	56434	190	6038	132	2902	16	3133	24
6	OREAS 70B	29296	76	147750	909	228348	503	32138	203	4783	22	56316	152
7	MGPI 1 Arbuckle 8: 2542' 8" top	221328	466	122788	958	70361	216	<LOD	354	<LOD	112	565	11
8	MGPI 1 Arbuckle 8: 2542' 8" side	231436	524	133956	1022	21822	103	488	110	<LOD	123	1214	15
9	MGPI 1 Arbuckle 8: 2542' 8" bottom	231338	496	131442	973	44247	157	<LOD	353	58	10	486	10
10	MGPI 1 Arbuckle 2: 2493' 8" top	242560	536	145461	1004	4746	50	1560	114	303	10	807	13
11	MGPI 1 Arbuckle 2: 2493' 8" side	231245	530	128107	1028	11183	72	3711	125	468	11	1547	17
12	MGPI 1 Arbuckle 2: 2493' 8" bottom	239663	517	150059	974	5466	52	773	107	199	10	1154	14
13	MGPI 1 Arbuckle 3: 2509' 5" top	228371	516	130077	1004	6163	55	961	109	309	10	2791	23
14	MGPI 1 Arbuckle 3: 2509' 5" side	235992	534	135507	1012	4080	49	750	109	174	10	1826	19
15	MGPI 1 Arbuckle 3: 2509' 5" bottom	241742	535	140459	995	1294	38	<LOD	357	192	10	995	14
16	MGPI 1 Arbuckle 4: 2517' top	242928	530	139639	981	5041	51	664	107	558	11	1052	14
17	MGPI 1 Arbuckle 4: 2517' side	241538	524	136752	972	7978	60	1970	112	676	11	1256	15
18	MGPI 1 Arbuckle 4: 2517' top 2	243300	526	140795	969	5184	51	809	106	574	11	1033	14
19	MGPI 1 Arbuckle 4: 2517' bottom	240212	526	136509	977	8410	61	1412	110	867	11	1440	16
20	MGPI 1 Arbuckle 6: 2522' 5" top	200751	444	111827	948	46475	164	5548	126	2475	15	2904	23
21	MGPI 1 Arbuckle 6: 2522' 5" side	201328	446	108456	947	48130	168	5780	126	2621	15	2482	21
22	MGPI 1 Arbuckle 6: 2522' 5" bottom	209375	456	115174	938	46450	162	5688	125	2234	15	2678	22
23	MGPI 1 Arbuckle 7: 2523' 6" top	214650	447	111907	905	70459	213	8210	134	5530	22	1812	18
24	MGPI 1 Arbuckle 7: 2523' 6" side	215849	466	112968	936	52528	177	8472	137	4299	19	2515	22
25	MGPI 1 Arbuckle 7: 2523' 6" bottom	225114	470	127954	916	47701	162	3550	115	2742	15	2213	20
26	Silica blank	<LOD	72	<LOD	1544	540352	461	<LOD	378	<LOD	84	<LOD	22
27	OREAS 70B	29815	74	148336	840	229899	483	32598	193	4828	22	57298	149
28	MGPI 1 Arbuckle 1: 2488'5" top	66847	140	37132	672	232668	440	91027	295	36365	85	41143	110
29	MGPI 1 Arbuckle 1: 2488'5" side	31183	103	14951	982	187434	540	73780	364	37518	125	46266	166
30	MGPI 1 Arbuckle 1: 2488'5" bottom	50579	112	31262	671	237584	456	91467	301	39285	93	43083	116
31	MGPI 1 Chattanooga 11: 1837' 4" top	234252	500	132472	941	25393	108	2128	110	1650	13	944	14
32	MGPI 1 Chattanooga 11: 1837' 4" side	222598	474	120850	927	43232	153	4181	118	2638	15	1352	16
33	MGPI 1 Chattanooga 11: 1837' 4" bottom	232810	486	134986	919	31627	122	3098	113	2082	14	1069	14
34	MGPI 1 Chattanooga 9: 1812' top	31693	71	30576	623	284608	483	93223	289	36321	83	43682	111
35	MGPI 1 Chattanooga 9: 1812' bottom	29868	70	29627	644	275985	491	87192	288	35303	84	43917	115
36	MGPI 1 Chattanooga 10: 1817' 8" top	18144	45	27298	601	289922	479	102150	297	41410	91	42081	105
37	MGPI 1 Chattanooga 10: 1817' 8" side	15865	47	22604	717	269935	537	97047	336	40302	104	39075	116

Units are in ppm; errors reported at 1 sigma; <LOD= below detectable limit

Ag, Bi, Pr, Se, W, were all below detectable limits

		Mn		S		P		Ti		Rb		Sr	
		Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error
1	Silica stnd	<LOD	187	<LOD	63	<LOD	31	<LOD	92	<LOD	2	<LOD	2
2	OREAS 70B	1120	17	2365	21	208	13	1793	71	32	1	73	1
3	MGPI 1 Arbuckle 5: 2520' 11" top	431	13	4797	24	69	17	<LOD	103	7	0	97	1
4	MGPI 1 Arbuckle 5: 2520' 11" side	338	13	3472	23	<LOD	116	<LOD	119	5	1	92	1
5	MGPI 1 Arbuckle 5: 2520' 11" bottom	339	12	2273	17	<LOD	97	219	74	5	0	98	1
6	OREAS 70B	1086	17	2299	21	249	13	1761	71	32	1	72	1
7	MGPI 1 Arbuckle 8: 2542' 8" top	131	10	2249	17	<LOD	90	<LOD	84	<LOD	2	94	1
8	MGPI 1 Arbuckle 8: 2542' 8" side	212	11	974	14	<LOD	99	<LOD	87	<LOD	3	87	1
9	MGPI 1 Arbuckle 8: 2542' 8" bottom	156	10	862	14	<LOD	93	<LOD	82	<LOD	3	96	1
10	MGPI 1 Arbuckle 2: 2493' 8" top	170	10	1661	15	<LOD	96	238	71	<LOD	3	101	1
11	MGPI 1 Arbuckle 2: 2493' 8" side	254	12	994	14	<LOD	103	<LOD	90	<LOD	3	92	1
12	MGPI 1 Arbuckle 2: 2493' 8" bottom	240	10	1247	14	<LOD	94	<LOD	80	<LOD	2	93	1
13	MGPI 1 Arbuckle 3: 2509' 5" top	430	13	1228	14	<LOD	101	<LOD	87	1	0	82	1
14	MGPI 1 Arbuckle 3: 2509' 5" side	251	12	1834	15	<LOD	101	<LOD	87	<LOD	3	98	1
15	MGPI 1 Arbuckle 3: 2509' 5" bottom	166	11	1536	15	<LOD	98	<LOD	84	1	0	100	1
16	MGPI 1 Arbuckle 4: 2517' top	181	11	1604	15	<LOD	97	<LOD	84	2	0	97	1
17	MGPI 1 Arbuckle 4: 2517' side	278	11	1100	13	<LOD	98	<LOD	85	2	0	93	1
18	MGPI 1 Arbuckle 4: 2517' top 2	159	10	1473	14	<LOD	96	<LOD	83	2	0	102	1
19	MGPI 1 Arbuckle 4: 2517' bottom	301	12	949	13	<LOD	98	<LOD	84	2	0	87	1
20	MGPI 1 Arbuckle 6: 2522' 5" top	253	11	4040	21	<LOD	95	428	72	6	0	106	1
21	MGPI 1 Arbuckle 6: 2522' 5" side	220	11	2309	17	218	17	258	73	5	0	109	1
22	MGPI 1 Arbuckle 6: 2522' 5" bottom	243	11	1818	16	<LOD	100	390	73	6	0	102	1
23	MGPI 1 Arbuckle 7: 2523' 6" top	424	13	1025	14	121	16	306	77	10	1	84	1
24	MGPI 1 Arbuckle 7: 2523' 6" side	465	13	917	14	236	17	404	76	8	1	82	1
25	MGPI 1 Arbuckle 7: 2523' 6" bottom	653	15	723	13	<LOD	87	217	73	5	0	60	1
26	Silica blank	31	7	<LOD	58	<LOD	29	<LOD	90	<LOD	2	<LOD	2
27	OREAS 70B	1085	17	2385	20	290	13	1805	70	33	1	71	1
28	MGPI 1 Arbuckle 1: 2488'5" top	645	15	1501	19	478	16	3888	95	169	1	94	1
29	MGPI 1 Arbuckle 1: 2488'5" side	577	18	1809	28	1251	22	4299	117	194	2	93	1
30	MGPI 1 Arbuckle 1: 2488'5" bottom	581	14	3046	22	147	14	4080	97	187	1	95	1
31	MGPI 1 Chattanooga 11: 1837' 4" top	283	12	621	13	<LOD	97	<LOD	87	3	0	89	1
32	MGPI 1 Chattanooga 11: 1837' 4" side	324	12	634	13	81	16	348	75	4	0	88	1
33	MGPI 1 Chattanooga 11: 1837' 4" bottom	309	12	721	13	<LOD	87	270	73	5	0	87	1
34	MGPI 1 Chattanooga 9: 1812' top	471	14	390	17	484	15	4903	97	169	1	88	1
35	MGPI 1 Chattanooga 9: 1812' bottom	472	14	406	17	286	14	5239	98	171	1	87	1
36	MGPI 1 Chattanooga 10: 1817' 8" top	358	12	274	16	1102	16	5363	97	182	1	87	1
37	MGPI 1 Chattanooga 10: 1817' 8" side	320	14	<LOD	125	1409	20	4708	107	171	1	82	1

Units are in ppm; errors reported at 1 sigma; <LO

Ag, Bi, Pr, Se, W, were all below detectable limits

		V		Cr		Ni		Zn		Co		Y	
		Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error
1	Silica stnd	<LOD	63	<LOD	38	<LOD	7	<LOD	6	12	3	<LOD	3
2	OREAS 70B	104	18	1203	19	2256	14	119	3	200	22	10	1
3	MGPI 1 Arbuckle 5: 2520' 11" top	<LOD	78	<LOD	48	<LOD	10	8	1	<LOD	32	2	1
4	MGPI 1 Arbuckle 5: 2520' 11" side	<LOD	89	<LOD	54	9	2	12	2	<LOD	34	<LOD	5
5	MGPI 1 Arbuckle 5: 2520' 11" bottom	<LOD	78	<LOD	47	<LOD	10	7	1	<LOD	32	<LOD	4
6	OREAS 70B	76	17	1181	19	2294	14	121	3	194	21	11	1
7	MGPI 1 Arbuckle 8: 2542' 8" top	<LOD	75	<LOD	45	<LOD	10	<LOD	7	<LOD	20	<LOD	4
8	MGPI 1 Arbuckle 8: 2542' 8" side	<LOD	80	<LOD	48	<LOD	10	7	1	<LOD	25	2	1
9	MGPI 1 Arbuckle 8: 2542' 8" bottom	<LOD	76	<LOD	46	<LOD	10	4	1	<LOD	20	<LOD	4
10	MGPI 1 Arbuckle 2: 2493' 8" top	<LOD	76	<LOD	47	9	2	5	1	<LOD	22	2	1
11	MGPI 1 Arbuckle 2: 2493' 8" side	<LOD	81	<LOD	49	<LOD	11	10	2	<LOD	27	2	1
12	MGPI 1 Arbuckle 2: 2493' 8" bottom	<LOD	77	<LOD	45	<LOD	10	7	1	<LOD	23	3	1
13	MGPI 1 Arbuckle 3: 2509' 5" top	<LOD	79	<LOD	47	<LOD	10	8	2	<LOD	32	2	1
14	MGPI 1 Arbuckle 3: 2509' 5" side	<LOD	80	<LOD	50	15	2	10	2	<LOD	28	<LOD	4
15	MGPI 1 Arbuckle 3: 2509' 5" bottom	<LOD	80	<LOD	48	<LOD	10	4	1	<LOD	24	<LOD	4
16	MGPI 1 Arbuckle 4: 2517' top	<LOD	78	<LOD	48	<LOD	10	5	1	<LOD	24	<LOD	4
17	MGPI 1 Arbuckle 4: 2517' side	<LOD	78	<LOD	48	7	2	7	1	<LOD	25	<LOD	4
18	MGPI 1 Arbuckle 4: 2517' top 2	<LOD	79	<LOD	48	<LOD	10	<LOD	8	<LOD	24	<LOD	4
19	MGPI 1 Arbuckle 4: 2517' bottom	<LOD	78	<LOD	48	11	2	6	1	<LOD	27	<LOD	4
20	MGPI 1 Arbuckle 6: 2522' 5" top	<LOD	77	<LOD	45	<LOD	10	5	1	<LOD	32	<LOD	4
21	MGPI 1 Arbuckle 6: 2522' 5" side	<LOD	77	35	11	7	2	5	1	<LOD	31	<LOD	4
22	MGPI 1 Arbuckle 6: 2522' 5" bottom	<LOD	79	33	11	7	2	<LOD	8	<LOD	31	<LOD	4
23	MGPI 1 Arbuckle 7: 2523' 6" top	<LOD	82	<LOD	47	<LOD	10	10	2	<LOD	28	2	1
24	MGPI 1 Arbuckle 7: 2523' 6" side	<LOD	79	33	11	8	2	14	2	<LOD	31	3	1
25	MGPI 1 Arbuckle 7: 2523' 6" bottom	<LOD	78	34	11	8	2	13	2	<LOD	29	2	1
26	Silica blank	<LOD	61	<LOD	38	<LOD	7	<LOD	6	10	3	<LOD	3
27	OREAS 70B	61	17	1200	19	2331	14	121	3	230	22	10	1
28	MGPI 1 Arbuckle 1: 2488'5" top	90	23	95	12	44	3	68	2	96	20	27	1
29	MGPI 1 Arbuckle 1: 2488'5" side	142	29	90	16	67	4	92	3	125	26	19	1
30	MGPI 1 Arbuckle 1: 2488'5" bottom	108	24	114	13	56	3	74	2	128	21	23	1
31	MGPI 1 Chattanooga 11: 1837' 4" top	<LOD	82	<LOD	49	<LOD	10	6	1	<LOD	24	4	1
32	MGPI 1 Chattanooga 11: 1837' 4" side	<LOD	82	34	11	9	2	8	2	<LOD	26	4	1
33	MGPI 1 Chattanooga 11: 1837' 4" bottom	<LOD	80	<LOD	46	<LOD	10	8	1	15	5	3	1
34	MGPI 1 Chattanooga 9: 1812' top	138	24	125	13	58	3	81	2	102	20	28	1
35	MGPI 1 Chattanooga 9: 1812' bottom	124	24	106	12	59	3	82	3	107	20	28	1
36	MGPI 1 Chattanooga 10: 1817' 8" top	144	24	127	12	62	3	87	2	120	19	30	1
37	MGPI 1 Chattanooga 10: 1817' 8" side	104	26	118	14	75	3	79	3	153	21	30	1

Units are in ppm; errors reported at 1 sigma; <LO

Ag, Bi, Pr, Se, W, were all below detectable limits

		Zr		Pb		U		Th		Hg		Nd	
		Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error
1	Silica stnd	3	1	<LOD	4	<LOD	6	8	2	<LOD	10	<LOD	3310
2	OREAS 70B	63	1	15	1	<LOD	6	11	2	<LOD	11	<LOD	4147
3	MGPI 1 Arbuckle 5: 2520' 11" top	10	1	3	1	<LOD	7	<LOD	12	<LOD	12	<LOD	4058
4	MGPI 1 Arbuckle 5: 2520' 11" side	4	1	<LOD	5	<LOD	8	12	2	<LOD	14	<LOD	4504
5	MGPI 1 Arbuckle 5: 2520' 11" bottom	6	1	<LOD	4	<LOD	7	9	2	<LOD	12	266	67
6	OREAS 70B	69	1	13	1	<LOD	6	9	2	<LOD	10	<LOD	4097
7	MGPI 1 Arbuckle 8: 2542' 8" top	5	1	<LOD	4	<LOD	7	<LOD	12	<LOD	12	<LOD	3953
8	MGPI 1 Arbuckle 8: 2542' 8" side	5	1	<LOD	5	<LOD	7	9	2	<LOD	12	<LOD	4138
9	MGPI 1 Arbuckle 8: 2542' 8" bottom	6	1	<LOD	4	<LOD	7	<LOD	12	<LOD	12	<LOD	4015
10	MGPI 1 Arbuckle 2: 2493' 8" top	4	1	<LOD	4	<LOD	7	<LOD	12	<LOD	12	<LOD	4150
11	MGPI 1 Arbuckle 2: 2493' 8" side	4	1	<LOD	5	<LOD	8	6	2	<LOD	12	<LOD	4129
12	MGPI 1 Arbuckle 2: 2493' 8" bottom	6	1	<LOD	4	<LOD	7	<LOD	12	<LOD	12	<LOD	3909
13	MGPI 1 Arbuckle 3: 2509' 5" top	4	1	<LOD	4	<LOD	7	<LOD	12	<LOD	13	<LOD	4073
14	MGPI 1 Arbuckle 3: 2509' 5" side	3	1	<LOD	5	<LOD	8	<LOD	12	<LOD	13	<LOD	4066
15	MGPI 1 Arbuckle 3: 2509' 5" bottom	3	1	<LOD	5	<LOD	7	7	2	<LOD	12	<LOD	4119
16	MGPI 1 Arbuckle 4: 2517' top	4	1	<LOD	5	<LOD	7	7	2	<LOD	12	<LOD	4068
17	MGPI 1 Arbuckle 4: 2517' side	4	1	<LOD	4	<LOD	7	<LOD	12	<LOD	12	<LOD	3981
18	MGPI 1 Arbuckle 4: 2517' top 2	4	1	<LOD	5	3	1	<LOD	12	<LOD	12	<LOD	3986
19	MGPI 1 Arbuckle 4: 2517' bottom	3	1	<LOD	5	<LOD	7	8	2	<LOD	12	<LOD	4096
20	MGPI 1 Arbuckle 6: 2522' 5" top	7	1	<LOD	4	<LOD	7	8	2	<LOD	12	<LOD	4119
21	MGPI 1 Arbuckle 6: 2522' 5" side	7	1	<LOD	4	<LOD	7	<LOD	12	<LOD	12	<LOD	3986
22	MGPI 1 Arbuckle 6: 2522' 5" bottom	6	1	<LOD	4	<LOD	7	6	2	<LOD	13	<LOD	4038
23	MGPI 1 Arbuckle 7: 2523' 6" top	24	1	3	1	3	1	8	2	<LOD	12	<LOD	4037
24	MGPI 1 Arbuckle 7: 2523' 6" side	14	1	<LOD	5	4	1	<LOD	12	<LOD	13	<LOD	4069
25	MGPI 1 Arbuckle 7: 2523' 6" bottom	13	1	<LOD	4	<LOD	7	7	2	<LOD	12	<LOD	3938
26	Silica blank	3	1	<LOD	4	<LOD	6	5	2	<LOD	10	<LOD	3333
27	OREAS 70B	66	1	12	1	3	1	13	2	<LOD	11	<LOD	4070
28	MGPI 1 Arbuckle 1: 2488'5" top	108	1	7	1	<LOD	7	19	2	<LOD	12	<LOD	4096
29	MGPI 1 Arbuckle 1: 2488'5" side	106	2	8	1	4	1	32	3	11	3	<LOD	5050
30	MGPI 1 Arbuckle 1: 2488'5" bottom	110	1	6	1	<LOD	7	19	2	<LOD	12	<LOD	4129
31	MGPI 1 Chattanooga 11: 1837' 4" top	31	1	<LOD	5	<LOD	7	7	2	<LOD	12	<LOD	3983
32	MGPI 1 Chattanooga 11: 1837' 4" side	49	1	<LOD	5	4	1	<LOD	12	<LOD	12	<LOD	3949
33	MGPI 1 Chattanooga 11: 1837' 4" bottom	16	1	<LOD	4	<LOD	7	6	2	<LOD	12	<LOD	3947
34	MGPI 1 Chattanooga 9: 1812' top	151	1	6	1	<LOD	7	15	2	7	2	<LOD	4016
35	MGPI 1 Chattanooga 9: 1812' bottom	153	1	8	1	<LOD	7	16	2	6	2	<LOD	3995
36	MGPI 1 Chattanooga 10: 1817' 8" top	170	1	7	1	<LOD	7	12	2	9	2	<LOD	3952
37	MGPI 1 Chattanooga 10: 1817' 8" side	157	1	5	1	<LOD	8	25	2	<LOD	13	<LOD	4334

Units are in ppm; errors reported at 1 sigma; <LO

Ag, Bi, Pr, Se, W, were all below detectable limits

		La		Ce		Ba		Sn		Sb		Cd	
		Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error	Conc	Error
1	Silica stnd	<LOD	1439	<LOD	1250	<LOD	799	<LOD	31	<LOD	43	<LOD	22
2	OREAS 70B	<LOD	1779	<LOD	1537	268	15	20	6	<LOD	37	<LOD	19
3	MGPI 1 Arbuckle 5: 2520' 11" top	<LOD	1712	<LOD	1487	<LOD	945	<LOD	36	<LOD	50	14	4
4	MGPI 1 Arbuckle 5: 2520' 11" side	<LOD	1875	<LOD	1649	<LOD	1035	23	6	35	9	<LOD	29
5	MGPI 1 Arbuckle 5: 2520' 11" bottom	<LOD	1709	<LOD	1481	<LOD	940	<LOD	36	<LOD	50	<LOD	25
6	OREAS 70B	82	26	<LOD	1517	253	15	17	6	27	8	19	4
7	MGPI 1 Arbuckle 8: 2542' 8" top	<LOD	1669	<LOD	1452	<LOD	920	<LOD	36	<LOD	49	13	4
8	MGPI 1 Arbuckle 8: 2542' 8" side	<LOD	1744	<LOD	1511	<LOD	958	20	6	<LOD	51	16	4
9	MGPI 1 Arbuckle 8: 2542' 8" bottom	98	28	<LOD	1457	<LOD	931	18	5	<LOD	50	<LOD	26
10	MGPI 1 Arbuckle 2: 2493' 8" top	<LOD	1731	<LOD	1511	<LOD	951	22	5	<LOD	50	19	4
11	MGPI 1 Arbuckle 2: 2493' 8" side	<LOD	1721	<LOD	1513	<LOD	955	<LOD	38	<LOD	52	22	4
12	MGPI 1 Arbuckle 2: 2493' 8" bottom	<LOD	1642	<LOD	1435	52	16	22	5	<LOD	49	13	4
13	MGPI 1 Arbuckle 3: 2509' 5" top	<LOD	1728	<LOD	1494	<LOD	949	<LOD	36	<LOD	50	13	4
14	MGPI 1 Arbuckle 3: 2509' 5" side	<LOD	1708	<LOD	1495	<LOD	934	<LOD	37	<LOD	52	<LOD	26
15	MGPI 1 Arbuckle 3: 2509' 5" bottom	<LOD	1729	<LOD	1508	<LOD	956	<LOD	37	<LOD	51	18	4
16	MGPI 1 Arbuckle 4: 2517' top	<LOD	1711	<LOD	1493	<LOD	947	<LOD	37	<LOD	50	19	4
17	MGPI 1 Arbuckle 4: 2517' side	<LOD	1675	<LOD	1464	50	15	<LOD	37	<LOD	51	<LOD	26
18	MGPI 1 Arbuckle 4: 2517' top 2	<LOD	1682	<LOD	1462	<LOD	924	<LOD	37	<LOD	50	13	4
19	MGPI 1 Arbuckle 4: 2517' bottom	<LOD	1726	<LOD	1498	<LOD	949	<LOD	37	<LOD	51	13	4
20	MGPI 1 Arbuckle 6: 2522' 5" top	<LOD	1736	<LOD	1512	<LOD	960	<LOD	36	<LOD	50	<LOD	26
21	MGPI 1 Arbuckle 6: 2522' 5" side	<LOD	1670	<LOD	1458	56	14	<LOD	37	<LOD	51	22	4
22	MGPI 1 Arbuckle 6: 2522' 5" bottom	<LOD	1706	<LOD	1482	48	15	19	6	<LOD	50	<LOD	26
23	MGPI 1 Arbuckle 7: 2523' 6" top	<LOD	1699	<LOD	1483	121	15	19	6	<LOD	50	16	4
24	MGPI 1 Arbuckle 7: 2523' 6" side	<LOD	1716	<LOD	1488	72	15	22	6	28	8	<LOD	26
25	MGPI 1 Arbuckle 7: 2523' 6" bottom	<LOD	1654	<LOD	1439	81	15	<LOD	36	<LOD	50	14	4
26	Silica blank	<LOD	1441	<LOD	1241	<LOD	801	15	5	<LOD	43	<LOD	22
27	OREAS 70B	<LOD	1740	<LOD	1504	238	15	<LOD	27	<LOD	37	<LOD	19
28	MGPI 1 Arbuckle 1: 2488'5" top	<LOD	1726	80	25	555	17	31	6	<LOD	43	15	4
29	MGPI 1 Arbuckle 1: 2488'5" side	<LOD	2168	75	17	290	12	<LOD	38	<LOD	53	<LOD	27
30	MGPI 1 Arbuckle 1: 2488'5" bottom	<LOD	1748	<LOD	1527	534	17	32	6	<LOD	43	16	4
31	MGPI 1 Chattanooga 11: 1837' 4" top	<LOD	1676	<LOD	1468	<LOD	921	<LOD	37	<LOD	51	14	4
32	MGPI 1 Chattanooga 11: 1837' 4" side	<LOD	1674	<LOD	1460	58	15	<LOD	37	<LOD	51	<LOD	26
33	MGPI 1 Chattanooga 11: 1837' 4" bottom	<LOD	1663	<LOD	1450	<LOD	913	17	5	<LOD	50	<LOD	25
34	MGPI 1 Chattanooga 9: 1812' top	124	28	79	25	530	17	33	6	38	8	<LOD	21
35	MGPI 1 Chattanooga 9: 1812' bottom	108	28	99	24	546	17	<LOD	31	<LOD	42	<LOD	22
36	MGPI 1 Chattanooga 10: 1817' 8" top	<LOD	1653	92	25	590	17	<LOD	30	<LOD	41	15	4
37	MGPI 1 Chattanooga 10: 1817' 8" side	88	25	134	22	467	15	33	6	<LOD	48	<LOD	24

Units are in ppm; errors reported at 1 sigma; <LO

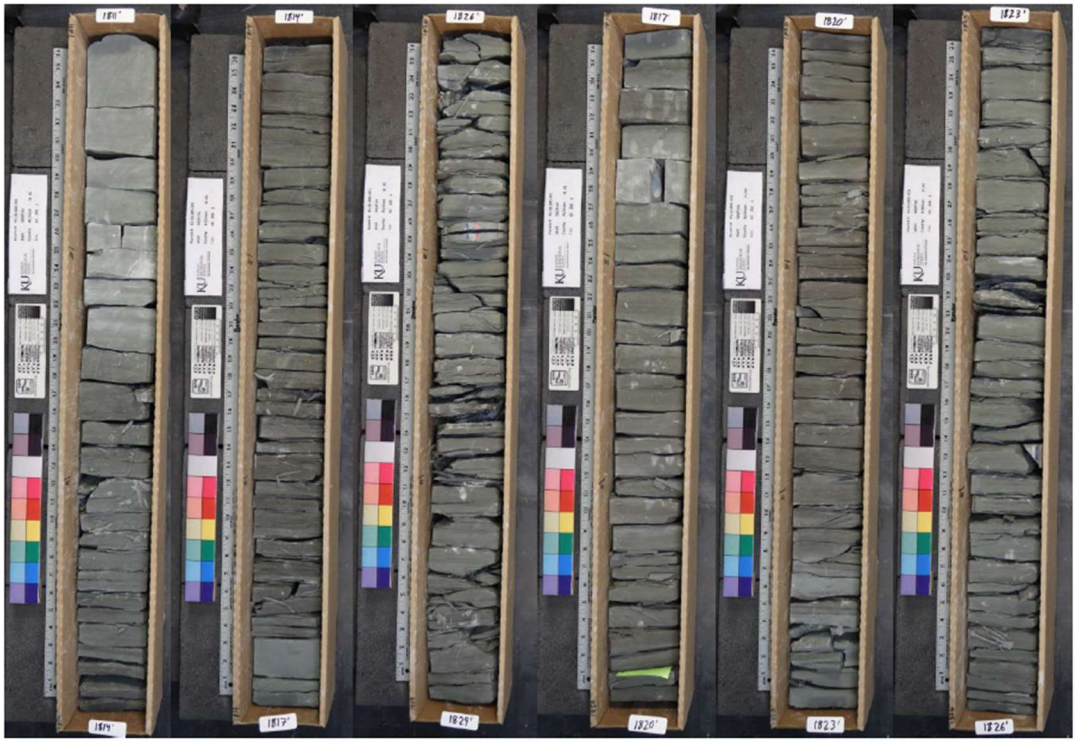
Ag, Bi, Pr, Se, W, were all below detectable limits

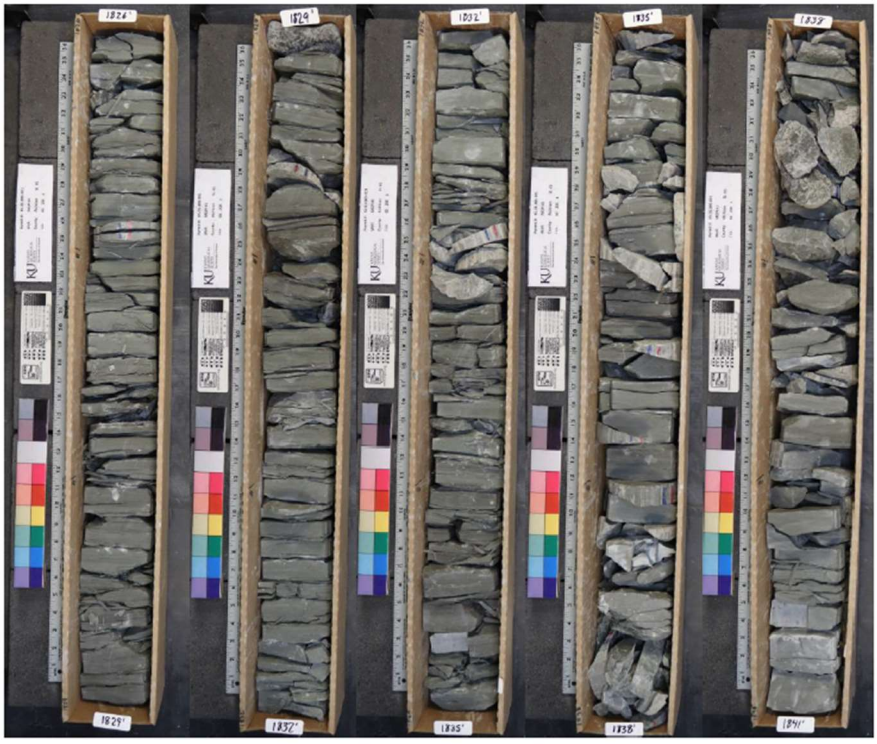
		Nb		Mo		Cu		As	
		Conc	Error	Conc	Error	Conc	Error	Conc	Error
1	Silica stnd	<LOD	4	<LOD	6	5	2	<LOD	3
2	OREAS 70B	<LOD	4	<LOD	5	48	4	108	2
3	MGPI 1 Arbuckle 5: 2520' 11" top	<LOD	5	<LOD	7	<LOD	11	<LOD	4
4	MGPI 1 Arbuckle 5: 2520' 11" side	<LOD	6	<LOD	8	<LOD	12	<LOD	4
5	MGPI 1 Arbuckle 5: 2520' 11" bottom	<LOD	5	<LOD	7	<LOD	11	<LOD	3
6	OREAS 70B	<LOD	4	4	1	51	4	124	2
7	MGPI 1 Arbuckle 8: 2542' 8" top	<LOD	5	4	1	<LOD	10	<LOD	3
8	MGPI 1 Arbuckle 8: 2542' 8" side	<LOD	5	4	1	<LOD	11	<LOD	4
9	MGPI 1 Arbuckle 8: 2542' 8" bottom	<LOD	5	<LOD	7	<LOD	11	<LOD	3
10	MGPI 1 Arbuckle 2: 2493' 8" top	<LOD	5	<LOD	7	<LOD	11	<LOD	3
11	MGPI 1 Arbuckle 2: 2493' 8" side	<LOD	5	<LOD	7	<LOD	11	<LOD	4
12	MGPI 1 Arbuckle 2: 2493' 8" bottom	<LOD	5	<LOD	7	<LOD	10	<LOD	3
13	MGPI 1 Arbuckle 3: 2509' 5" top	<LOD	5	<LOD	7	<LOD	11	<LOD	3
14	MGPI 1 Arbuckle 3: 2509' 5" side	<LOD	5	<LOD	7	<LOD	11	<LOD	4
15	MGPI 1 Arbuckle 3: 2509' 5" bottom	<LOD	5	<LOD	7	<LOD	11	<LOD	4
16	MGPI 1 Arbuckle 4: 2517' top	<LOD	5	<LOD	7	<LOD	11	<LOD	4
17	MGPI 1 Arbuckle 4: 2517' side	<LOD	5	<LOD	7	<LOD	11	<LOD	3
18	MGPI 1 Arbuckle 4: 2517' top 2	<LOD	5	<LOD	7	<LOD	11	<LOD	4
19	MGPI 1 Arbuckle 4: 2517' bottom	<LOD	5	<LOD	7	<LOD	11	<LOD	3
20	MGPI 1 Arbuckle 6: 2522' 5" top	<LOD	5	<LOD	7	9	2	<LOD	3
21	MGPI 1 Arbuckle 6: 2522' 5" side	<LOD	5	<LOD	7	<LOD	11	<LOD	3
22	MGPI 1 Arbuckle 6: 2522' 5" bottom	<LOD	5	<LOD	7	6	2	<LOD	3
23	MGPI 1 Arbuckle 7: 2523' 6" top	<LOD	5	<LOD	7	<LOD	11	<LOD	4
24	MGPI 1 Arbuckle 7: 2523' 6" side	<LOD	5	<LOD	7	7	2	<LOD	4
25	MGPI 1 Arbuckle 7: 2523' 6" bottom	<LOD	5	<LOD	7	<LOD	11	<LOD	3
26	Silica blank	<LOD	4	<LOD	6	<LOD	8	<LOD	3
27	OREAS 70B	<LOD	4	<LOD	5	55	4	128	2
28	MGPI 1 Arbuckle 1: 2488'5" top	7	1	<LOD	6	16	2	5	1
29	MGPI 1 Arbuckle 1: 2488'5" side	5	1	5	2	18	4	11	1
30	MGPI 1 Arbuckle 1: 2488'5" bottom	7	1	<LOD	6	110	3	8	1
31	MGPI 1 Chattanooga 11: 1837' 4" top	<LOD	5	<LOD	7	<LOD	11	<LOD	4
32	MGPI 1 Chattanooga 11: 1837' 4" side	<LOD	5	3	1	7	2	<LOD	4
33	MGPI 1 Chattanooga 11: 1837' 4" bottom	<LOD	5	<LOD	7	6	2	<LOD	3
34	MGPI 1 Chattanooga 9: 1812' top	11	1	<LOD	6	11	3	3	1
35	MGPI 1 Chattanooga 9: 1812' bottom	10	1	<LOD	6	<LOD	11	4	1
36	MGPI 1 Chattanooga 10: 1817' 8" top	12	1	<LOD	6	10	2	3	1
37	MGPI 1 Chattanooga 10: 1817' 8" side	9	1	5	1	31	3	5	1

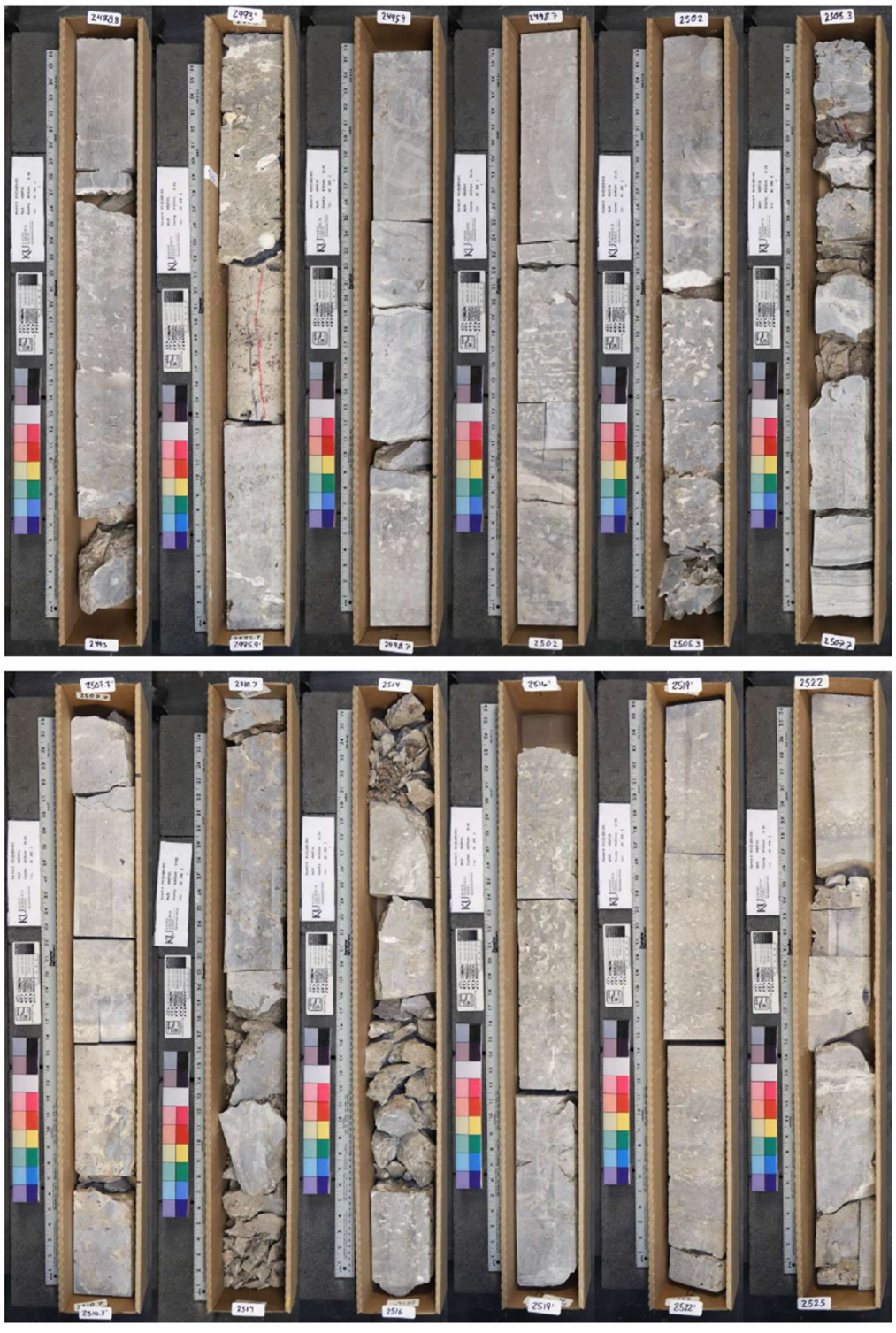
Units are in ppm; errors reported at 1 sigma; <LO

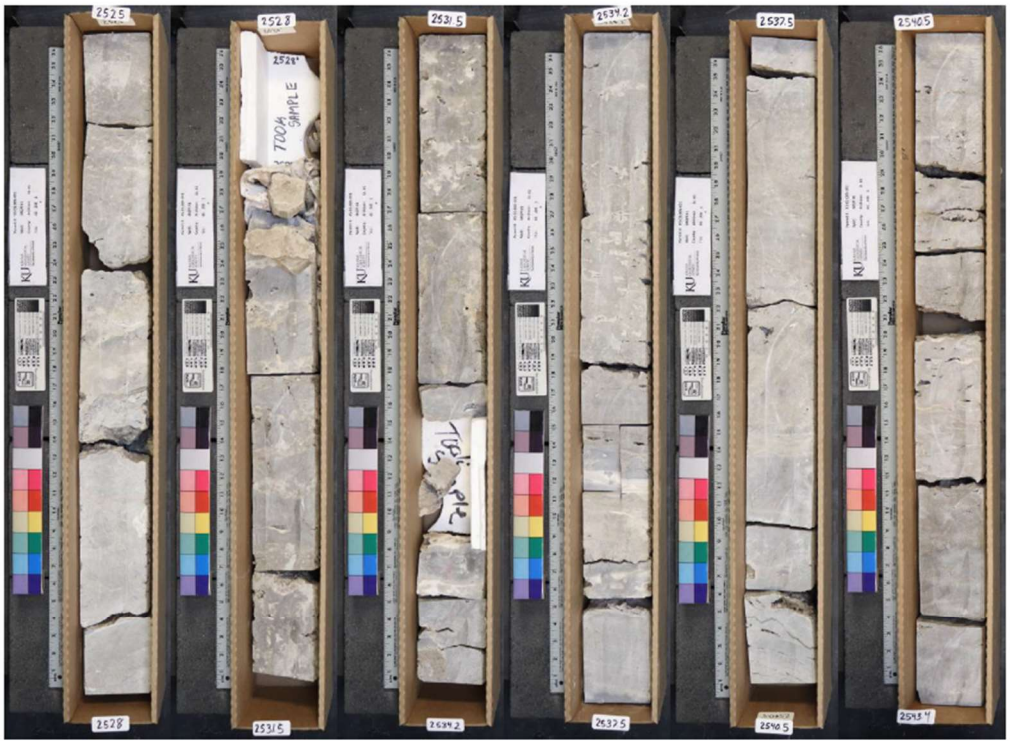
Ag, Bi, Pr, Se, W, were all below detectable limits

Appendix C – Core Box Photos





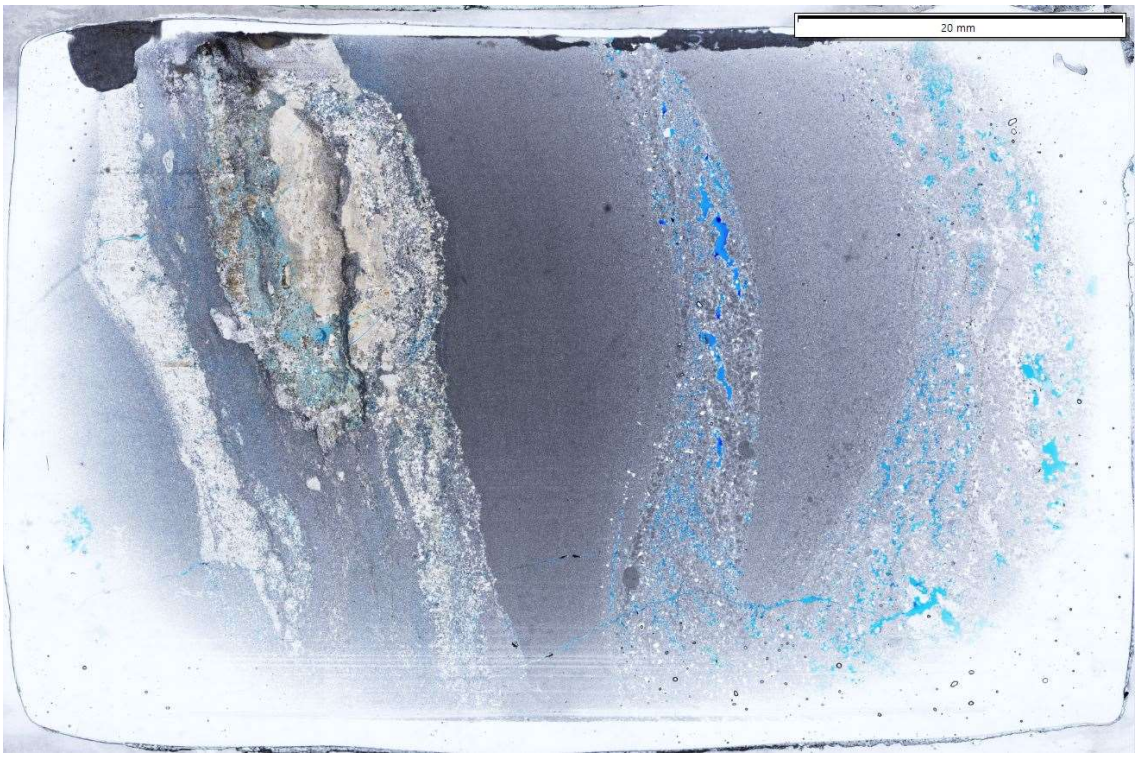



2525
2528
2528
2528
1004
SAMPLE
2531.5
2534.2
2537.5
2540.5
2543.4

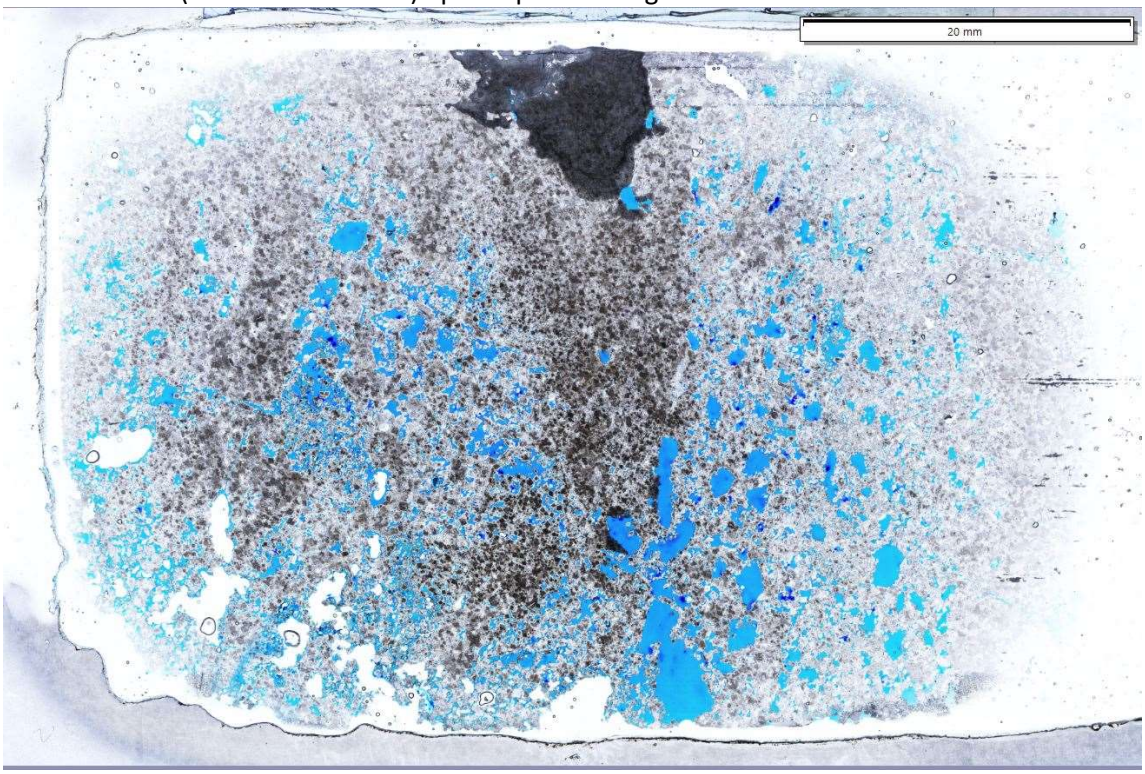

2543.4

Appendix D – Thin-Sections

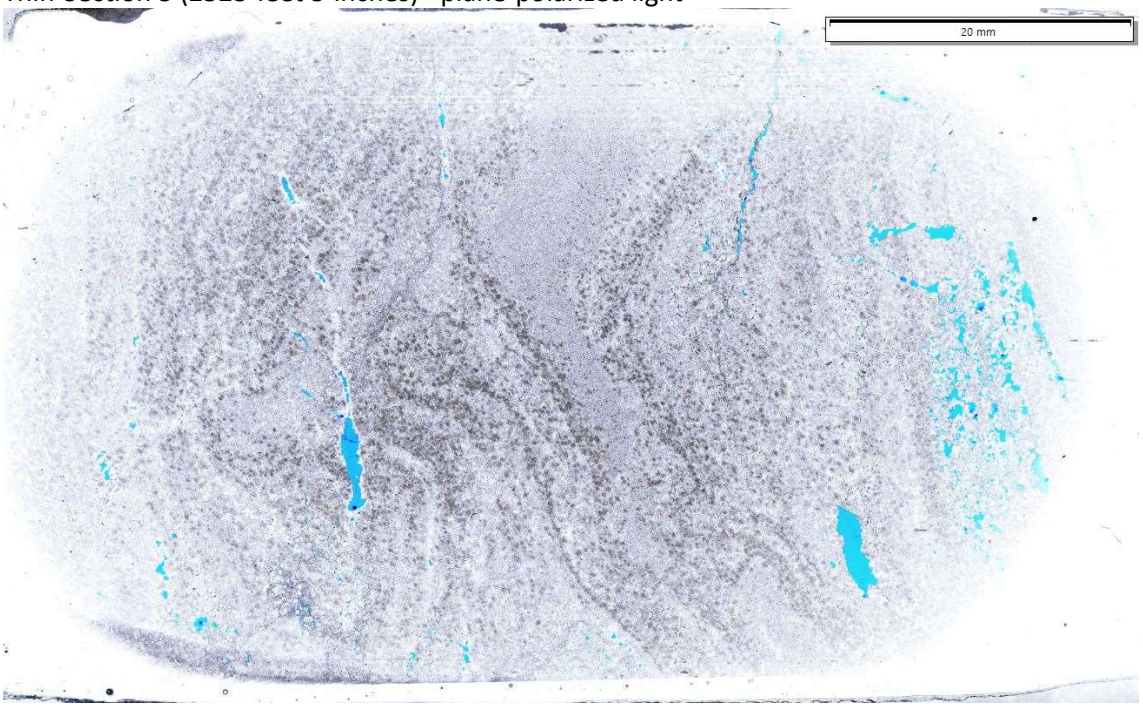
Thin-Section 1 (2536-feet 5-inches)– plane-polarized light



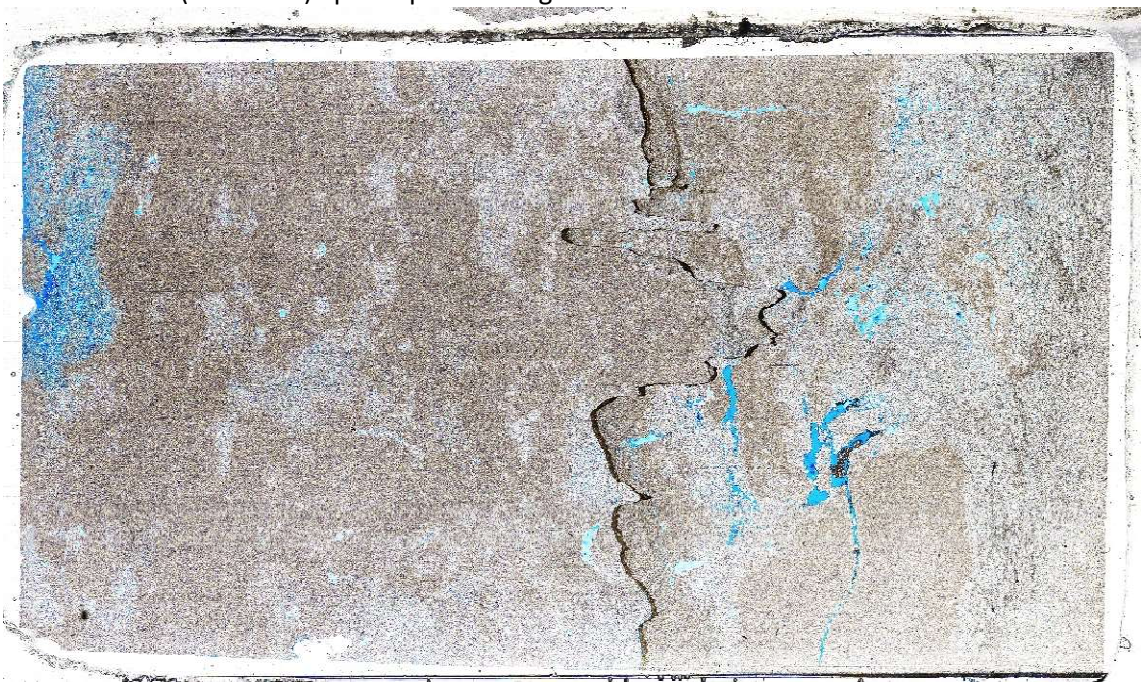
Thin-Section 2 (2524-feet 9-inches)– plane-polarized light



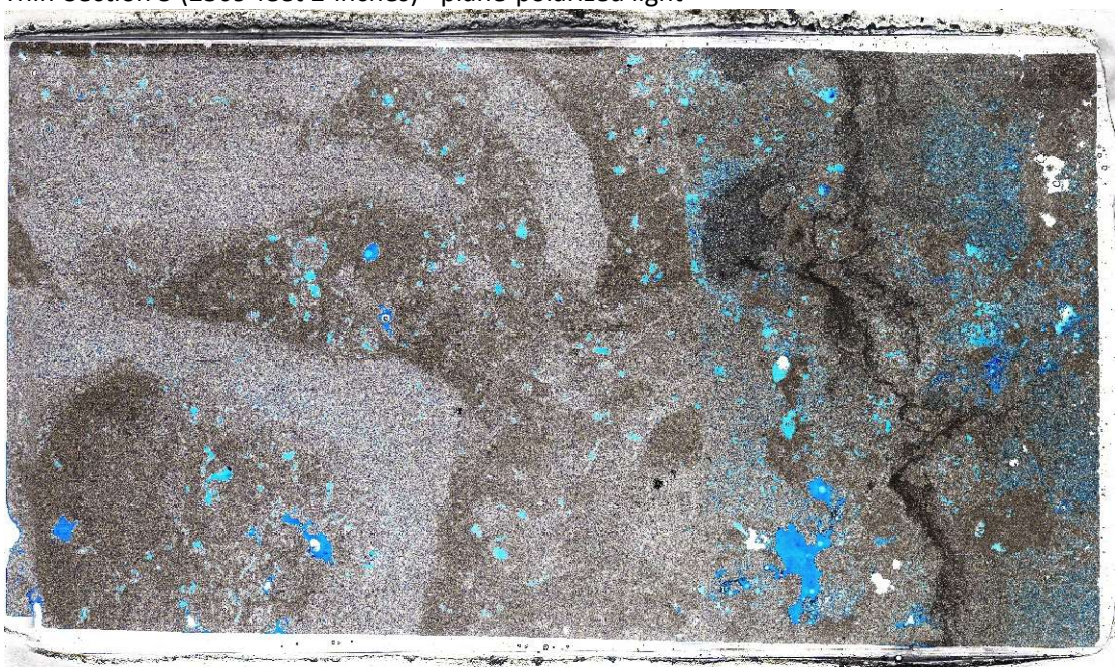
Thin-Section 3 (2523-feet 3-inches)– plane-polarized light



Thin-Section 4 (2501-feet)– plane-polarized light



Thin-Section 5 (2509-feet 2-inches)– plane-polarized light



Thin-Section 6 (1840.65-feet)– plane-polarized light

Thin-Section 7 (1834.8-feet)– plane-polarized light

Appendix E. Documentation of samples removed by SCS Engineers for additional analyses.