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Data report: clast counts and petrography of gravels from Site C0007, IODP Expedition 316, Nankai Trough[1]

Christopher L. Fergusson[2]

Chapter contents

Abstract

Gravel beds drilled during Integrated Ocean Drilling Program Expedition 316 at Site C0007 in the eastern Nankai Trough, ~100 km offshore from the Kii Peninsula of Honshu, southwest Japan, have been investigated using 26 samples from two horizons (Cores 316-C0007C-17H and 316-C0007D-12R). The gravel from Core 316-C0007C-17H is from a 1.7 m thick layer, whereas the gravel from Core 316-C0007D-12R is from a layer 4.55 m thick. The upper parts of both layers are normally graded. The gravel is clast-supported, polymictic, of granule to pebble size, moderately to poorly sorted, and with subrounded to angular fragments. Clast types are similar from both cores with abundant fine-grained sedimentary clasts that are well cemented, and many clasts contain small quartz veins indicative of a source with a very low metamorphic grade. The main sedimentary clast types are chert of various colors (black, gray, light yellow-brown, clear, and rare red and purple), siltstone, and sandstone. Other clast types are vein quartz and igneous clasts of mainly intermediate volcanic composition, minor plutonic rock fragments, and minor metamorphic rock fragments. Intraformational soft mud fragments occur in most samples.

Introduction

Expedition 316 of the Integrated Ocean Drilling Program (IODP) undertook drilling and sampling at Site C0007 (33°01.23258′N, 136°47.94852′E) along the frontal thrust in the toe region of the Nankai Trough accretionary prism as part of the Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) offshore from the Kii Peninsula, Honshu, southwest Japan. The NanTroSEIZE project aims to establish controls on earthquake and tsunami genesis by drilling and sampling sediments and rocks in the eastern Nankai Trough. At Site C0007, turbidites and hemipelagic mud were sampled and the stratigraphy consisted of an overall coarsening and thickening upward succession with deep-marine basin deposits of the Shikoku Basin at the base overlain by trench wedge deposits, which are in turn overlain by lower slope deposits (see Expedition 316 Scientists, 2009a). Four gravel layers were encountered in channelized deposits of the upper trench wedge: Cores 316-C0007C-17H (157.09–159.125 m core depth below seafloor

[1]Fergusson, C.L., 2011. Data report: clast counts and petrography of gravels from Site C0007, IODP Expedition 316, Nankai Trough. *In* Kinoshita, M., Tobin, H., Ashi, J., Kimura, G., Lallemant, S., Screaton, E.J., Curewitz, D., Masago, H., Moe, K.T., and the Expedition 314/315/316 Scientists, *Proc. IODP,* 314/315/316: Washington, DC (Integrated Ocean Drilling Program Management International, Inc.).
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[2]School of Earth and Environmental Sciences, University of Wollongong, Wollongong NSW 2522, Australia. cferguss@uow.edu.au

[CSF]) and 316-C0007D-3R (190–190.6 m CSF), 316-C0007D-11R (266.5–266.6 m CSF), and 316-C0007D-12R (275.6–280.1 m CSF) (Fig. **F1**) (see Expedition 316 Scientists, **2009a**). Samples from the two thicker gravel-bearing intervals (9 samples from Core 316-C0007C-17H and 17 samples from Core 316-C0007D-12R; Fig. **F2**) have been counted for clast composition with accompanying petrographic study and geochemical analyses.

Methods and materials

Samples were requested postcruise and were initially selected evenly spaced throughout the gravel intervals. Some samples were taken at different places than those requested because of voids, sample depletion, and the local poor condition of the core. Bulk 4 cm long intervals were requested. Samples 316-C0007D-12R-5, 15.5–19.5 cm; 12R-5, 39.5–43.5 cm; and 12R-5, 55–59 cm, had volumes of 120 cm^3; Samples 12R-CC, 7–11 cm, and 12R-CC, 51–55 cm, had volumes of 50 cm^3 and all other samples had volumes of 20 cm^3. Some of the samples from Core 12R contained some mud matrix that was removed by washing the sample on a 2 mm mesh sieve. It is possible that some intraformational soft mud fragments were washed away during sieving and others may have disintegrated into smaller pieces. Intraformational mud fragments were counted although it is possible that some fragments may have been unintentionally broken into smaller pieces during handling prior to counting. It should also be noted that significant disturbance of the gravels during drilling and retrieval of core may have occurred.

A subsample was poured from each of the 19 sample bags from Core 316-C0007D-12R into a 2.5 cm diameter plastic cylindrical cup. Blue-stained epoxy resin was poured into the container and allowed to harden. One thin section was made for each of these samples. Only two thin sections were made from Core 316-C0007C-17H; one each from Samples 17H-1, 34–38 cm, and 17H-2, 49–53 cm. These two thin sections were made from a grain mount consisting of selected different clast types rather than an unsorted subsample, as was the case for all the thin sections from Core 316-C0007C-12R. Thin sections were made at the University of Wollongong (Australia) by standard thin section techniques.

After an extensive initial examination of the samples, a common set of clast categories was determined for all samples from Core 316-C0007C-17H and a slightly different set of categories was used for all samples from Core 316-C0007D-12R. This is because the gravels from Core 316-C0007D-12R are finer grained and it is more difficult to distinguish some clast types, such as chert, from very fine-grained sedimentary rock fragments. For each sample, clasts were divided into categories and clasts were counted. Identification of clasts types was assisted by using a binocular microscope and/or hand lens. All samples are poorly sorted and samples from Core 316-C0007D-12R include many sand-sized grains that were not removed by sieving through a 2 mm mesh sieve because of their angularity. Grains on the boundary between very coarse sand and granule grades (i.e., 2.0–2.5 mm) were not counted. Counts of clast types were undertaken on thin sections for samples from Core 316-C0007D-12R. Use of a transmitting light microscope enabled more categories of clast types to be used.

Grain size measurements of maximum grain diameters of 64–204 clasts were determined from all nine samples from Core 316-C0007C-17H.

Six larger clasts, representative of different clast types, from Sample 316-C0007C-17H-CC, 5–9 cm, were analyzed for major elements by X-ray fluorescence (XRF) at the School of Earth and Environmental Sciences, University of Wollongong (analyst Paul Carr).

Results

Description of gravel samples

Site C0007 gravels are clast-supported, granule to fine pebble grade, poorly to moderately sorted, polymictic, and have subrounded to angular clasts. Samples from Core 316-C0007C-17H lack mud matrix, and mud matrix is only locally developed in Core 316-C0007D-12R. In Core 316-C0007C-17H, the gravel is part of a 1.7 m thick layer that is normally graded in the topmost 1.5 m. In Core 316-C0007D-12R, the gravel is from a 4.55 m thick layer that is normally graded in the topmost 1.5 m. Gravel samples from Core 316-C0007C-17H were notably coarser than samples from Core 316-C0007D-12R. Gravels are of granule to fine pebble size in Core 316-C0007C-17H (Tables **T1, T2**). In Core 316-C0007D-12R the gravel is granule grade with abundant sand-sized grains.

Clast types are similar in both cores. The most common clast types are fine-grained sedimentary rock fragments (Tables **T3, T4, T5;** Figs. **F3, F4, F5**). Many of these clasts contain quartz veins. In Core 316-C0007D-12R, many clasts are categorized as combined vein quartz and fine-grained sedimentary rock fragments because quartz veins are so abundant

(>50% of the clast). Chert is common and mostly dark gray to black with minor quantities of light-colored yellow-brown and clear chert. In Core 316-C0007D-12R, rare clasts are red to purple chert (jasper). Sandstone clasts are also common in samples from both cores. Vein quartz clasts (5%–26%) are present in all samples. Igneous clasts are mainly intermediate volcanic rock fragments, with additional minor silicic rock fragments (including pumice), scarce basaltic rock, and minor plutonic rock fragments. Metamorphic rock fragments are also scarce. Light brown intraformational soft mud fragments occur in most samples.

Petrography of clast types

It is clear from thin sections that all clast types display considerable variation in characteristics. Counts of clast types in the grain mounts from granule-sized gravel are given in Table **T5.**

Chert ranges from impure varieties to chert consisting almost wholly of silica (Fig. **F4A–F4F**). Many chert clasts have quartz veins. Radiolarians occur in some fragments (Fig. **F4C–F4F**). Some chert clasts are strongly recrystallized.

Siltstone is highly variable and includes silty claystone and impure chert. Most fragments are dark colored with fine to abundant veins of quartz and, less commonly, calcite and chlorite. Several of these clast types were chemically analyzed by Expedition 316 Scientists (see Table **T7** in Expedition 316 Scientists, 2009b) and were shown to consist mainly of quartz with lesser plagioclase and clay.

Sandstone is also highly varied (Fig. **F5**). Grain size ranges from very fine to fine sandstone with scarce medium-grained sandstone. Most sandstone clasts consist of quartz, minor plagioclase, and lithic grains (sedimentary, volcanic rock fragments, vein quartz, and plutonic rock fragments). Some lithic sandstone clasts contain radiolarian chert fragments. Pure quartz sandstone and sandstone with calcite cement are rare. Some sandstone clasts contain quartz veins. Rare lithic sandstone clasts show evidence of low-grade metamorphism.

As noted above for vein quartz, all gradations occur between pure vein quartz and vein quartz containing mostly slivers of sedimentary wall rocks.

Volcanic rock fragments are mainly intermediate in composition with less common silicic and mafic clasts. Intermediate clasts texturally are porphyritic with altered glassy groundmass and abundant phenocrysts of plagioclase and fewer pyroxene phenocrysts (Fig. **F6A–F6D**). Silicic volcanic rock fragments are porphyritic with quartz and feldspar phenocrysts in a recrystallized, very fine grained groundmass. Mafic clasts are also porphyritic with pyroxene and plagioclase phenocrysts in an altered glassy groundmass. Some volcanic rock fragments are partially altered to epidote and chlorite.

Plutonic rock fragments are mainly coarse to medium-grained plagioclase-rich clasts of intermediate composition and granitic clasts with quartz and feldspar crystals (Fig. **F6E–F6H**). Medium-grained to fine-grained holocrystalline clasts of mainly intermediate composition also occur, probably derived from shallow and/or small intrusions.

Metamorphic rock fragments include fine-grained metasedimentary rock fragments containing common fine-grained biotite (Fig. **F7**) probably derived from contact aureoles adjacent to intrusions.

Chemical analyses

The chert and vein quartz clasts, as expected, have very high silica values (>94%). The sandstone and siltstone fragments are also relatively high in silica (77% and 83%, respectively). A volcanic rock fragment, thought to be of intermediate composition, was higher in silica (72%) than expected and probably reflects alteration of the sample. The metamorphic rock was thought to be a metamorphosed mafic volcanic rock but it also is significantly higher in silica (71%) than expected. See Table **T6** for X-ray fluorescence (XRF) results.

Acknowledgments

This study used samples provided by the Integrated Ocean Drilling Program (IODP). Thin sections were made by José Abrantes at the School of Earth and Environmental Sciences, University of Wollongong. Associate Professor Paul Carr kindly arranged the XRF analyses at the University of Wollongong. Dr. Sol Buckman assisted with photographs of clasts in thin sections. The author is grateful for the useful review of Professor Kathleen Marsaglia and editorial input from Lorri Peters (IODP) and Professor Liz Screaton (Co-Chief Scientist, Expedition 316).

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Figure F1. Stratigraphic columns for Site C0007. Core recovery for Holes C0007A–C0007C. (**Continued on next page.**)

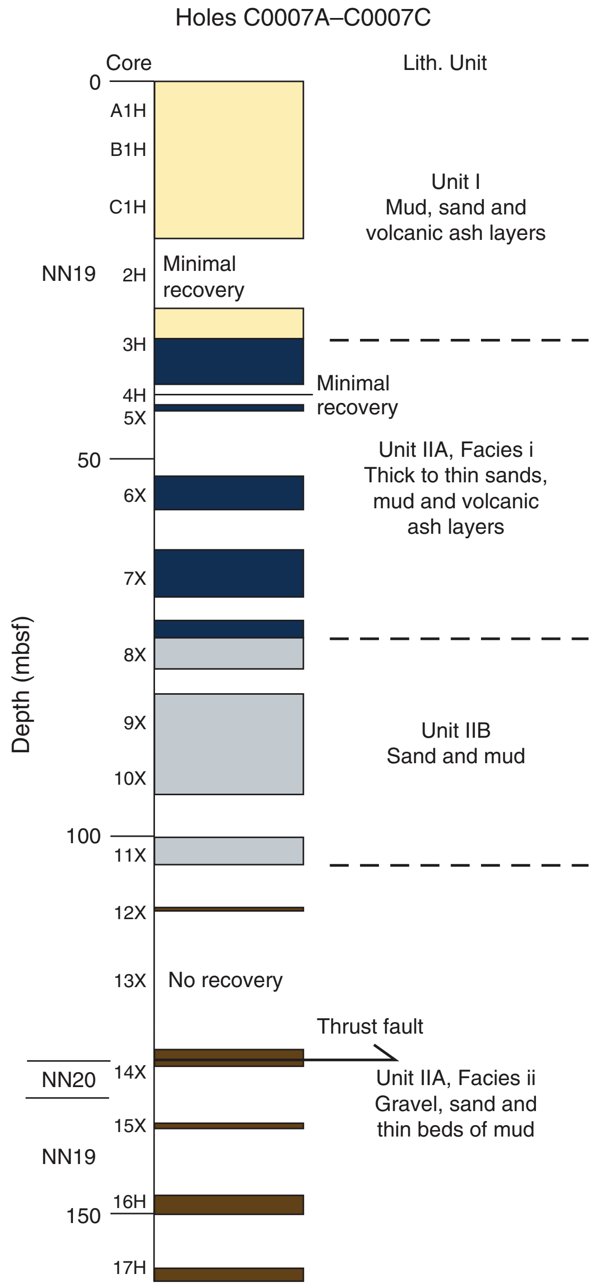

Figure F1 (continued). Core recovery for Hole C0007D.

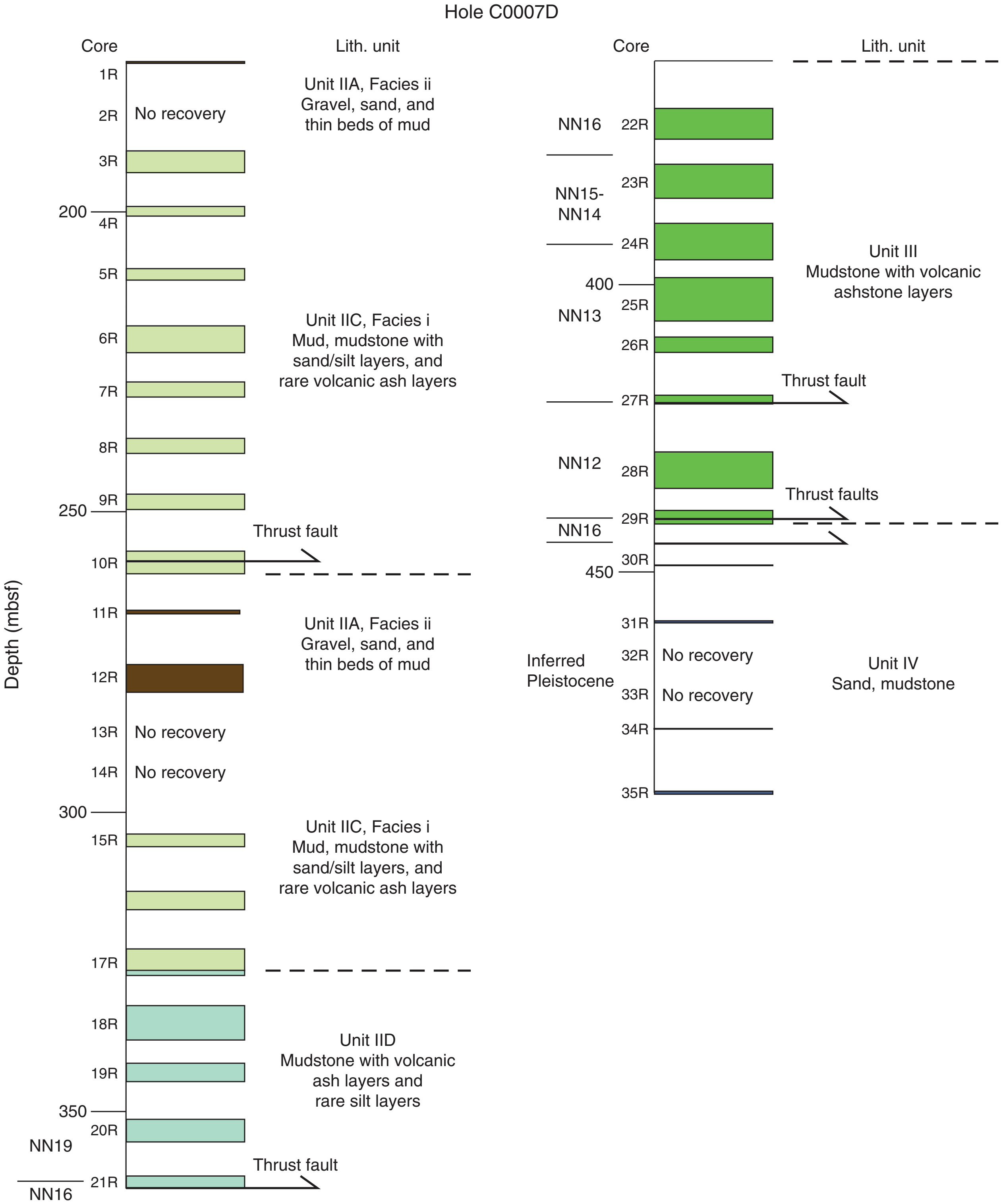

Figure F2. Sample locations in Cores 316-C0007C-17H and 316-C0007D-12R.

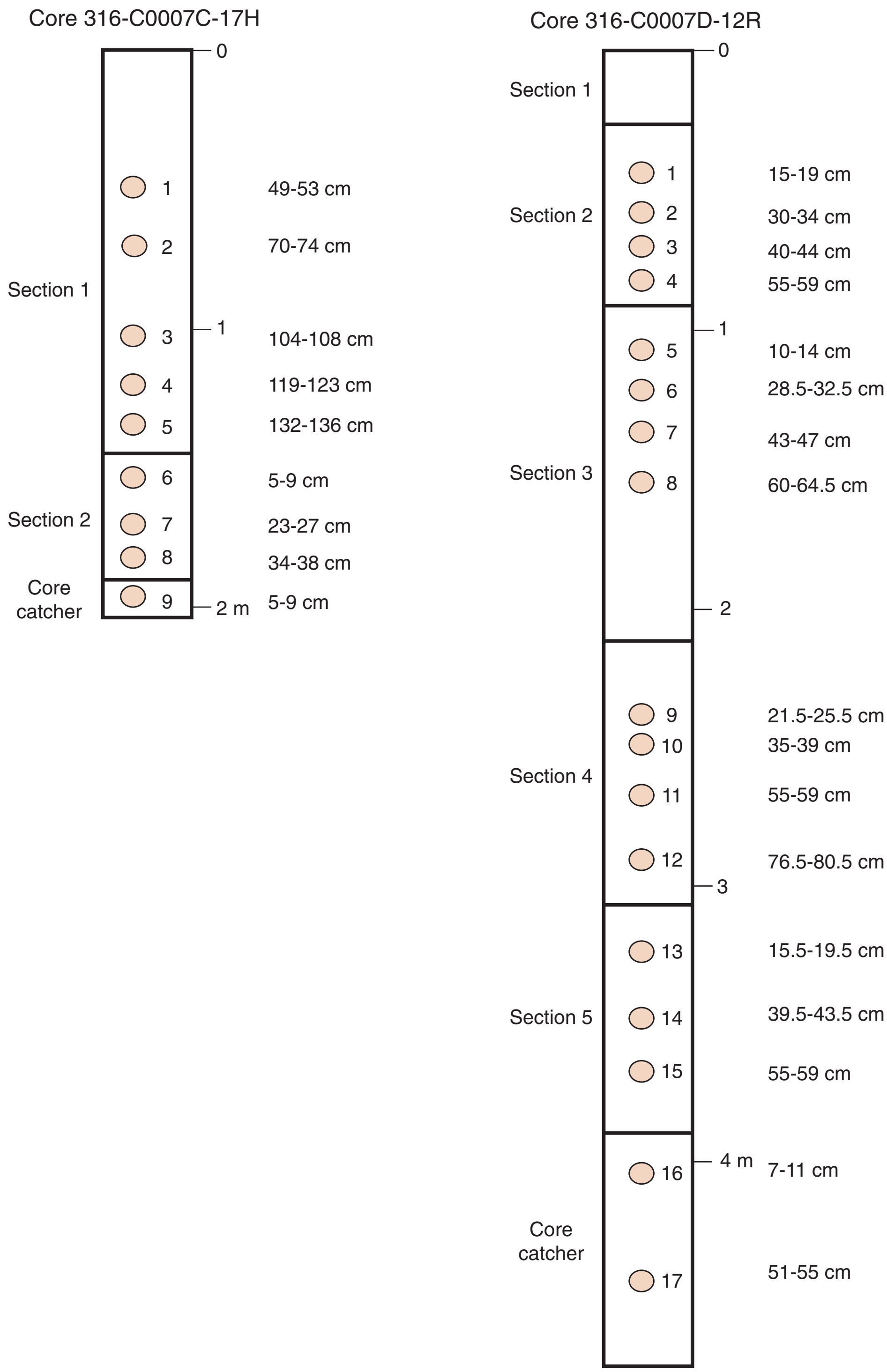

Figure F3. Clast counts for gravel samples from Site C0007. **A.** Core 316-C0007C-17H. (**Continued on next two pages.**)

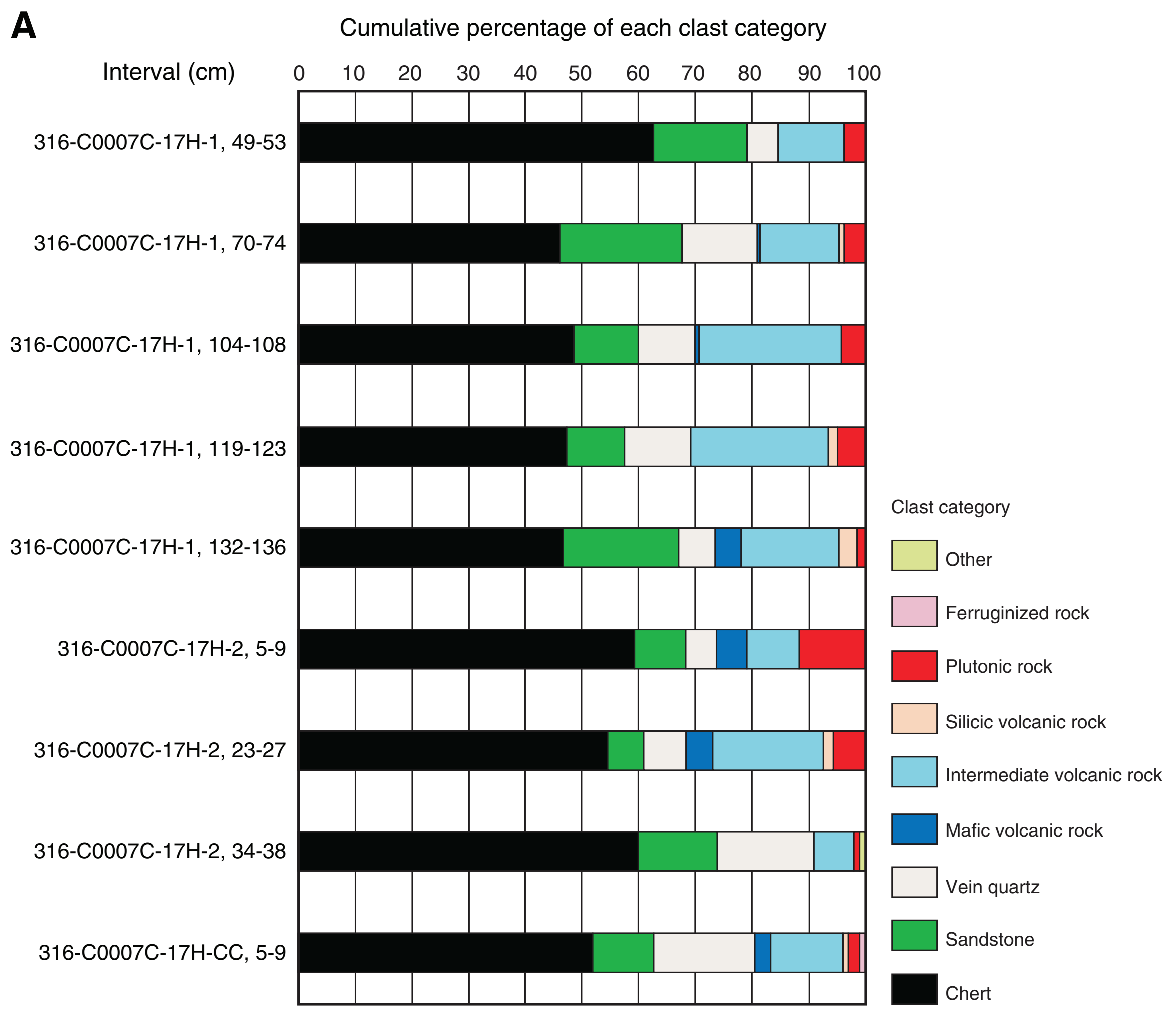

Figure F3 (continued). B. Core 316-C0007D-12R. (Continued on next page.)

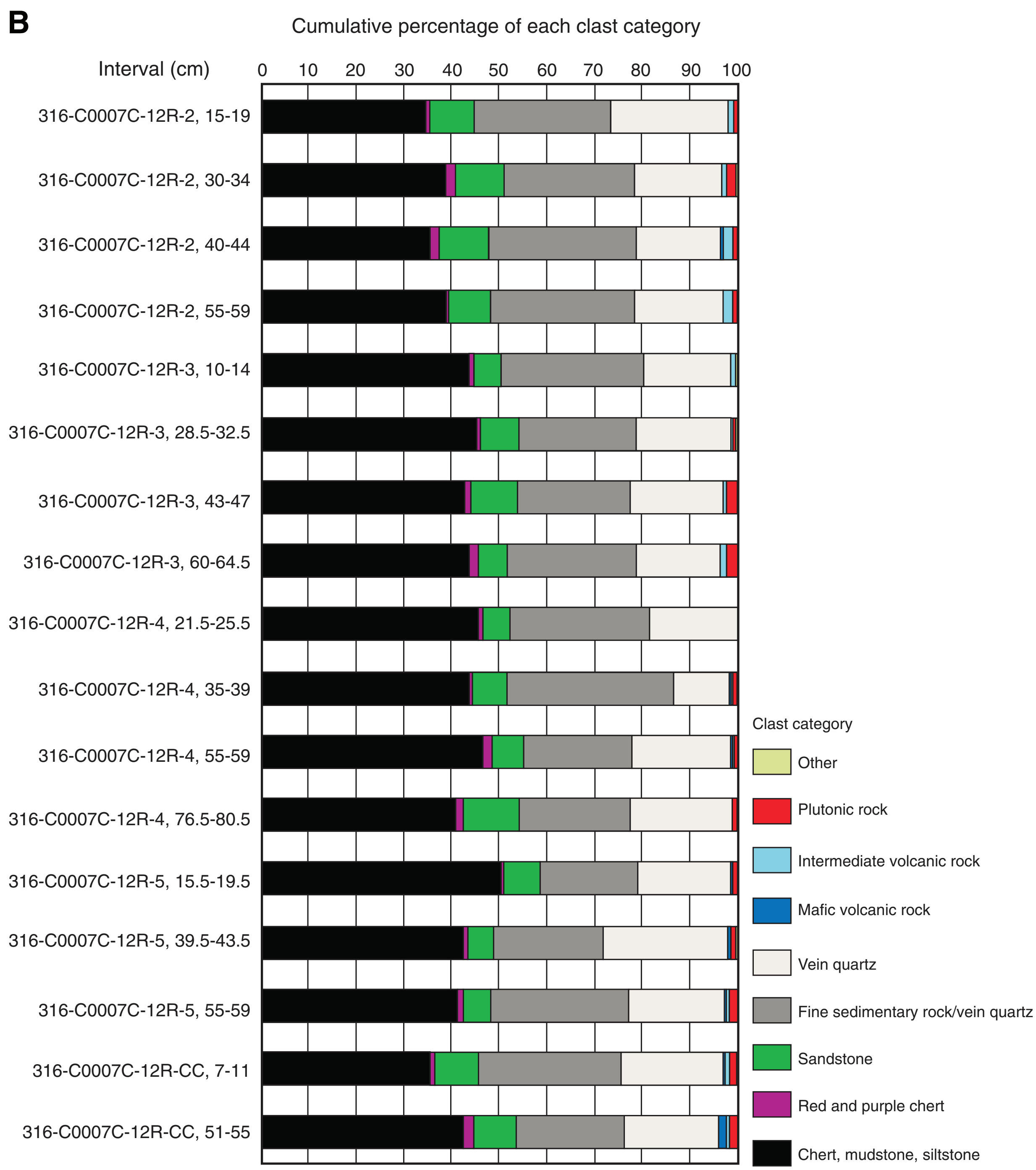

Figure F3 (continued). C. Core 316-C0007D-12R thin sections.

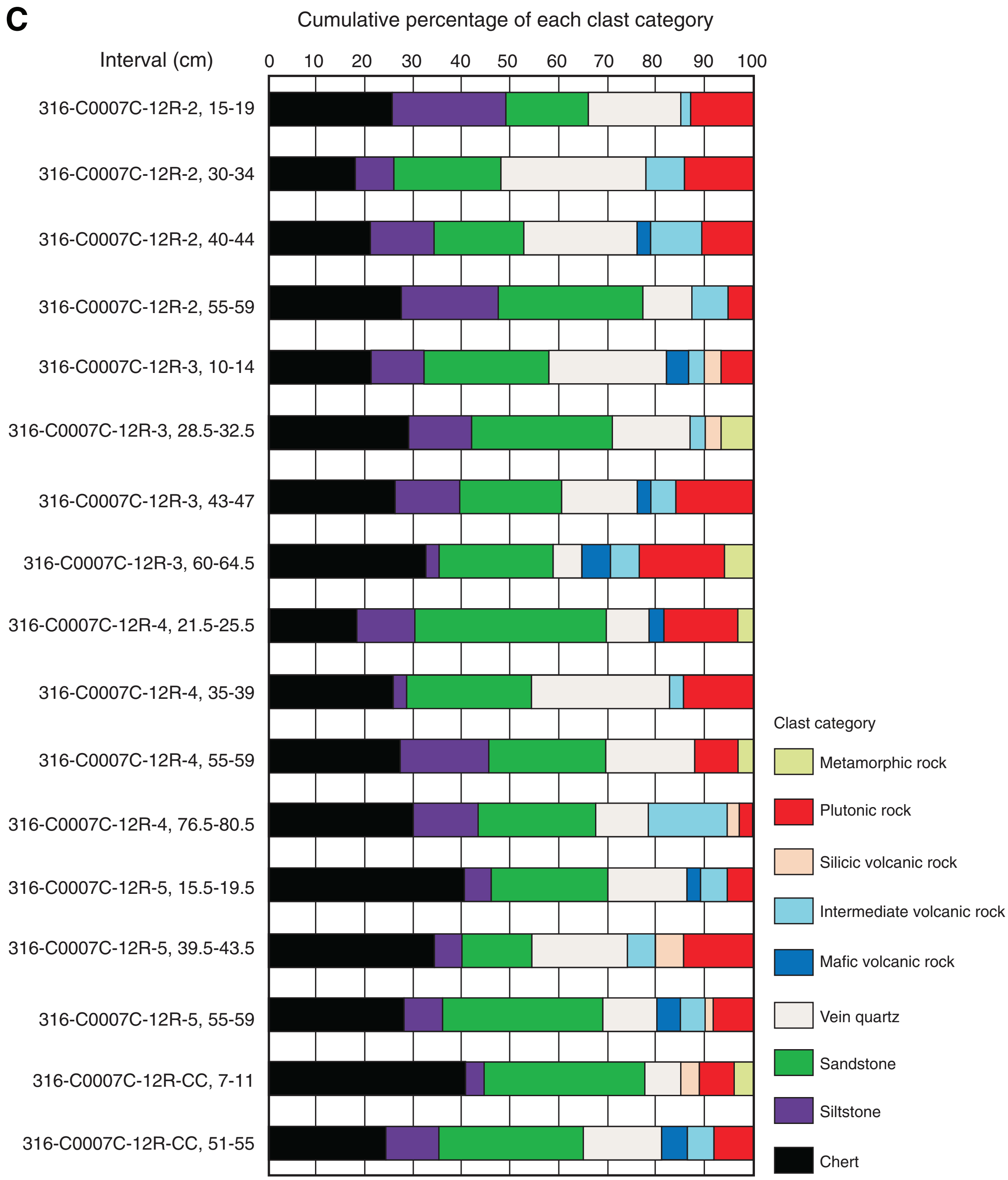

Figure F4. Photomicrographs of clast types in gravel (Sample 316-C0007D-12R-CC, 51–55 cm). **A, B.** Impure chert with quartz veins. **C, D.** Chert with quartz veins and poorly preserved radiolarians. **E, F.** Chert with radiolarian tests. **G, H.** Vein quartz. A, C, E, and G are under plane-polarized light and B, D, F, and H are under cross-polarized light.

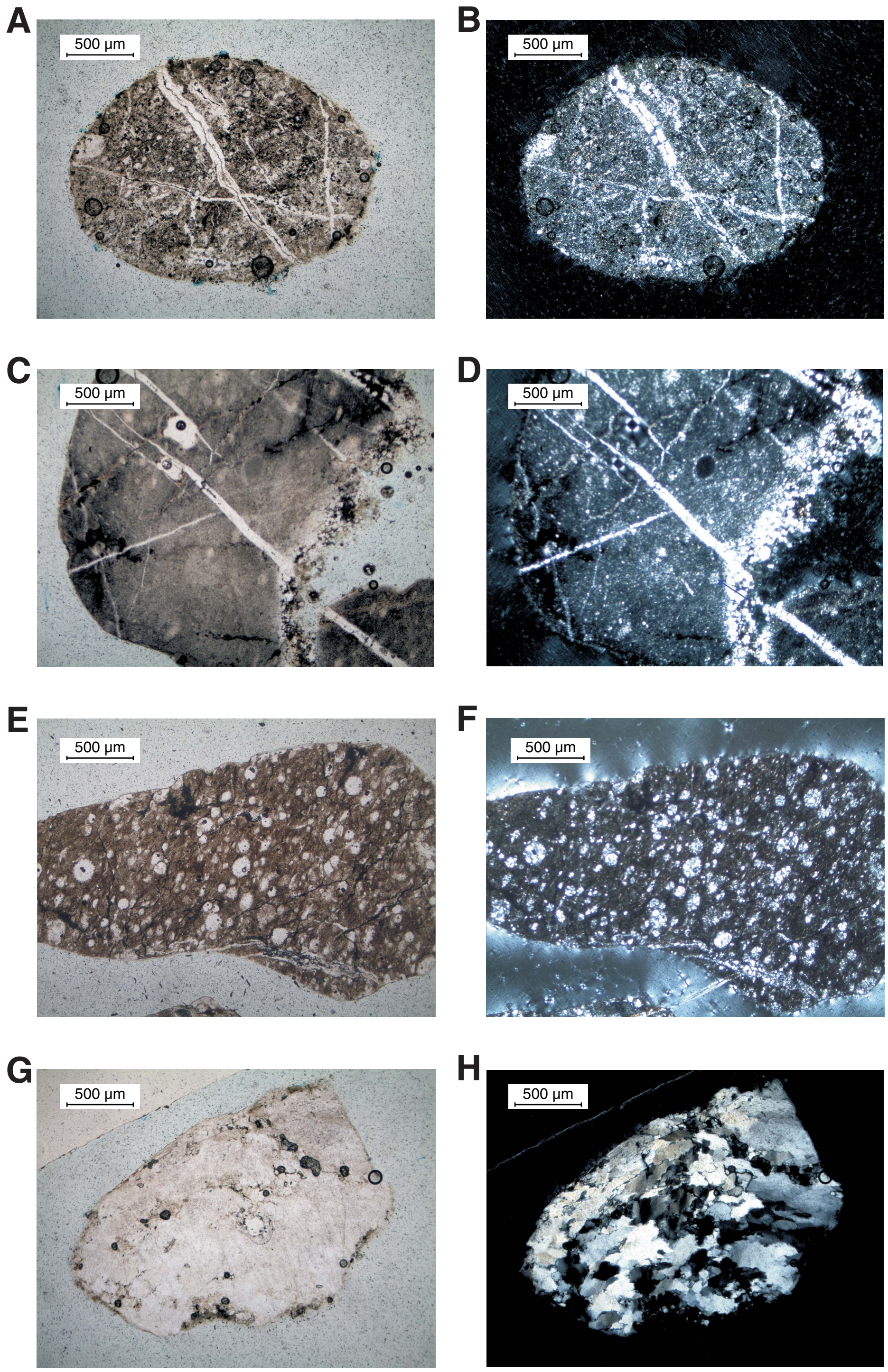

Figure F5. Photomicrographs of clast types in gravel. **A, B.** Very fine quartz sandstone. **C, D.** Fine to medium quartzose sandstone. **E, F.** Medium lithic sandstone with common intermediate volcanic rock fragments and quartz grains (Sample 316-C0007D-12R-4, 21–26 cm). **G, H.** Medium to coarse lithic sandstone dominated by intermediate volcanic rock fragments (A–D, G, and H: Sample 316-C0007D-12R-CC, 51–55 cm). A, C, E, and G are under plane-polarized light and B, D, F, and H are under cross-polarized light.

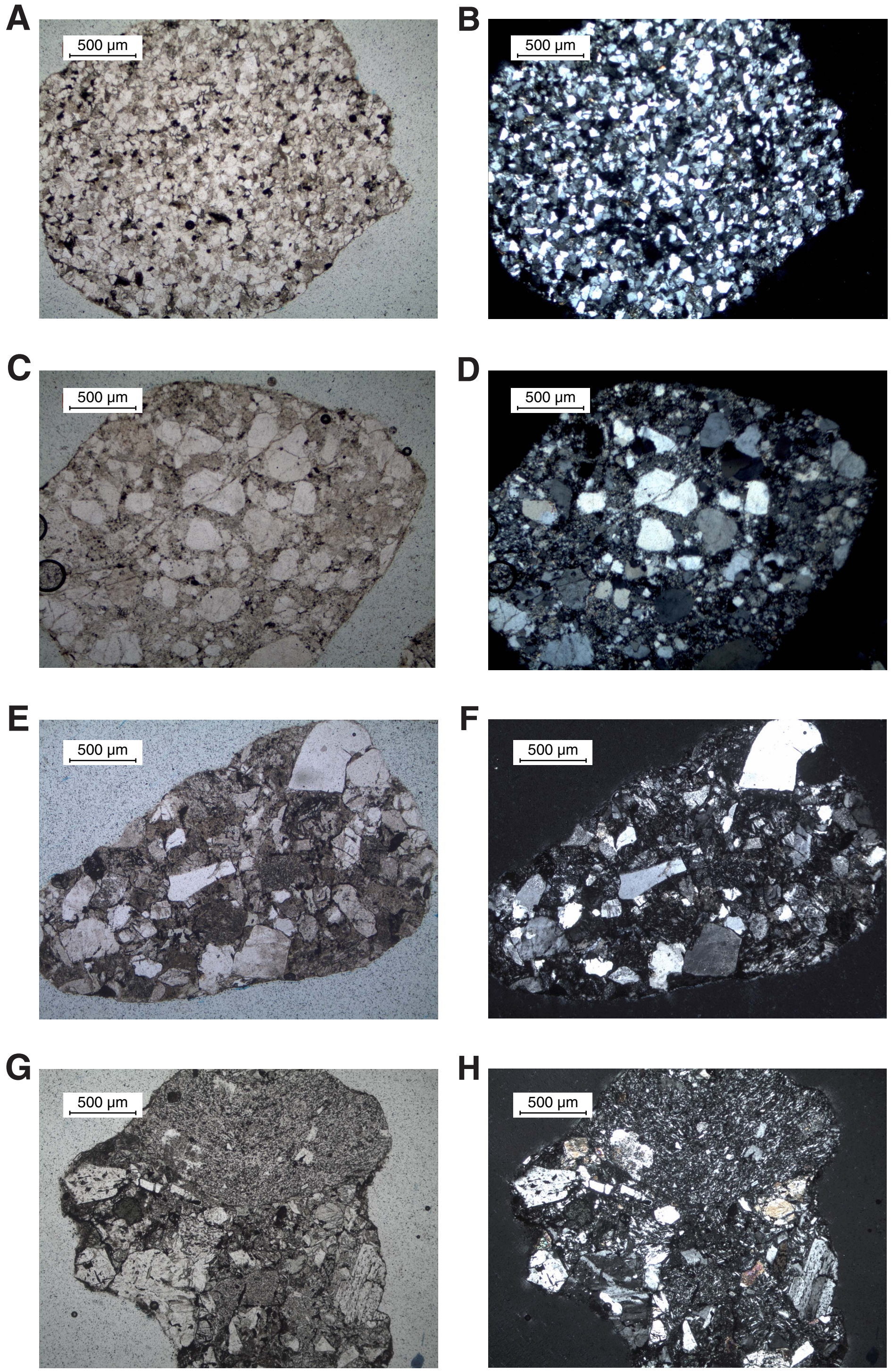

Figure F6. Photomicrographs of clast types in gravel. **A, B.** Porphyritic intermediate volcanic rock fragment (Sample 316-C0007D-12R-CC, 51–55 cm). **C, D.** Porphyritic intermediate volcanic rock fragment with plagioclase and orthopyroxene phenocrysts (Sample 316-C0007D-12R-2, 40–44 cm). **E, F.** Plutonic rock fragment with plagioclase, orthoclase, and quartz (Sample 316-C0007D-12R-4, 21–26 cm). **G, H.** Plutonic rock fragment with plagioclase, orthoclase, and quartz (Sample 316-C0007D-12R-4, 55–59 cm). A, C, E, and G are under plane-polarized light and B, D, F, and H are under cross-polarized light.

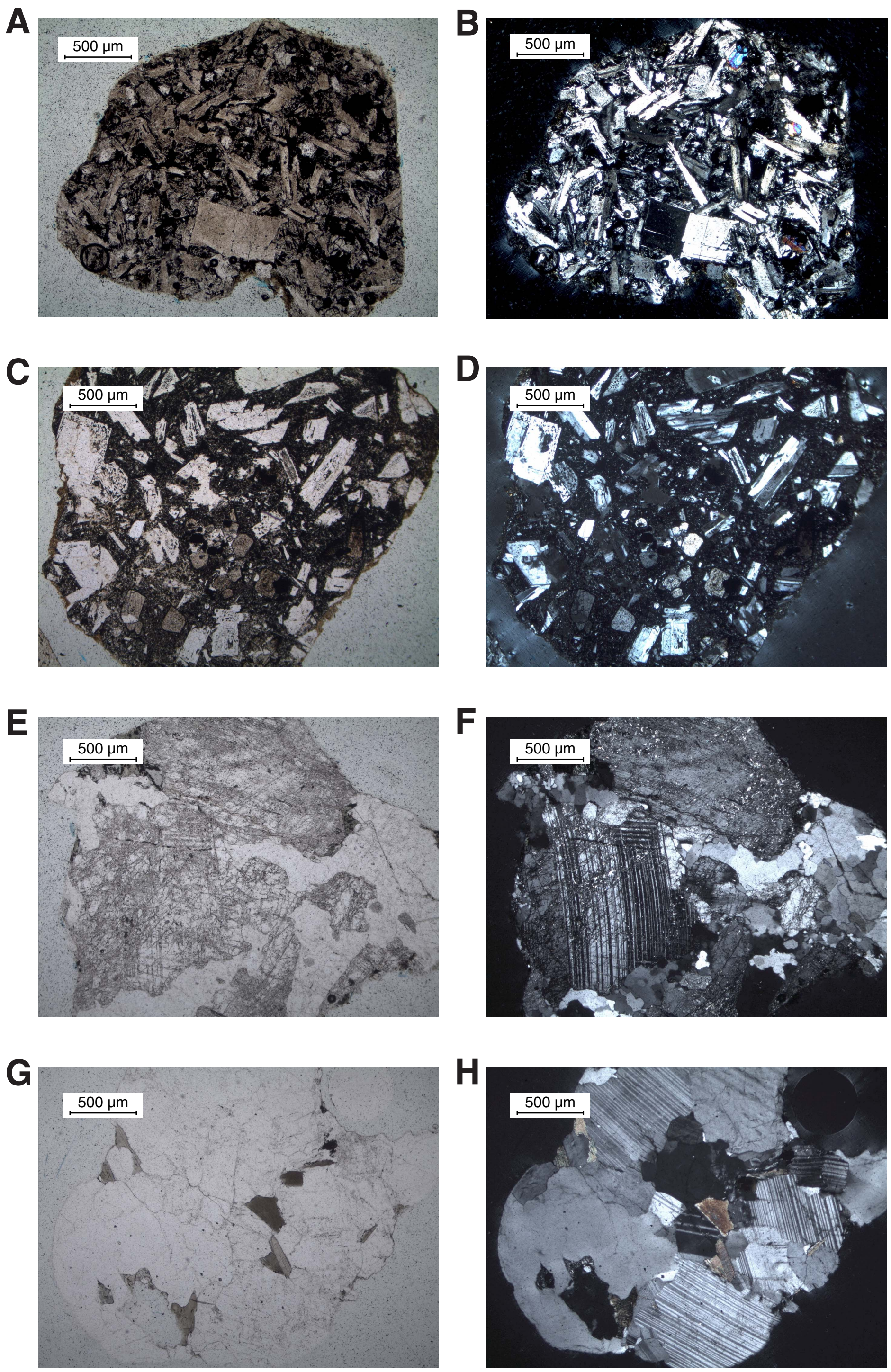

Figure F7. Photomicrographs of metasiltstone fragment. Note abundant biotite and a lack of foliation in (**A**) plane- and (**B**) cross-polarized light (Sample 316-C0007D-12R-4, 21–26 cm).

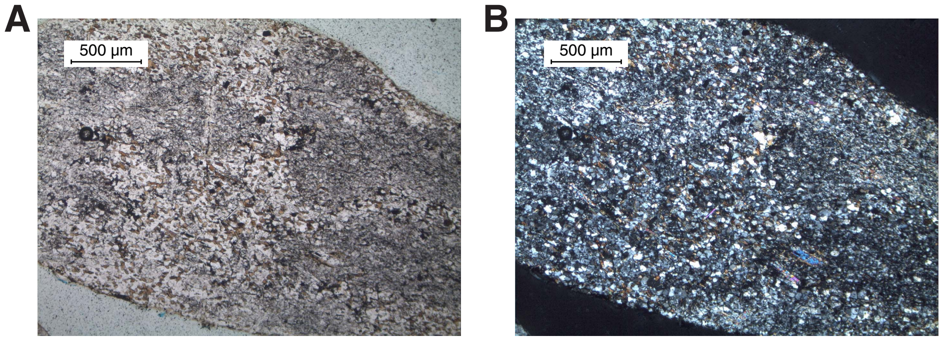

Table T1. Measurements of maximum grain diameters in gravel samples, Expedition 316.

	316-C0007C-								
Core, section, interval (cm):	17H-1, 49–53	17H-1, 70–74	17H-1, 104–108	17H-1, 119–123	17H-1, 132–136	17H-2, 5–9	17H-2, 23–27	17H-2, 34–38	17H-CC, 5–9
Diameter (cm)									
3.3	0	0	0	0	0	1	0	0	0
2.2	0	0	0	0	0	1	1	1	0
2.1	0	0	0	0	0	1	1	1	0
2.0	0	0	0	0	1	0	1	0	1
1.9	0	0	0	0	0	0	2	1	1
1.8	0	0	0	0	1	0	0	1	1
1.7	0	1	0	0	1	1	0	1	2
1.6	0	0	0	1	3	2	0	2	0
1.5	0	1	2	5	6	2	3	3	1
1.4	0	0	1	5	5	0	0	0	3
1.3	0	0	5	3	5	4	0	2	7
1.2	0	2	14	8	3	4	3	4	7
1.1	0	3	7	7	2	3	6	5	5
1.0	3	6	15	18	12	7	16	8	8
0.9	1	7	6	10	4	13	16	4	4
0.8	2	10	17	15	3	13	19	13	12
0.7	11	27	22	22	7	18	16	14	15
0.6	11	18	12	12	5	9	7	16	9
0.5	40	32	16	18	5	15	12	11	15
0.4	51	49	12	6		8	1	9	2
0.3	85	44	11	9	1	9	4	4	9
Total:	204	200	140	139	64	111	108	100	102

Table T2. Average maximum grain diameters in gravel samples, Expedition 316.

Core, section, interval (cm)	Number of clasts	Average diameter (cm)
316-C0007C-		
17H-1, 49–3	204	0.42
17H-1, 70–4	200	0.54
17H-1, 104–08	140	0.77
17H-1, 119–23	139	0.81
17H-1, 132–36	64	1.05
17H-2, 5–9	111	0.80
17H-2, 23–27	108	0.86
17H-2, 34–38	100	0.82
17H-CC, 5–9	102	0.84

Table T3. Raw clast count and percentage clast count for gravel samples, Expedition 316.

Core, section, interval (cm)	Chert (black, gray, light yellow-brown, clear)	Sandstone	Vein quartz	Mafic volcanic rock	Intermediate volcanic rock	Silicic volcanic rock	Plutonic rock	Ferruginized rock	Other	Total	Shell	Gray-brown soft mudstone (intraformational)	Total
316-C0007C-													
Raw count:													
17H-1, 49–53	449	121	38	1	83	0	27	0	0	719	2	71	792
17H-1, 70–74	187	88	53	2	57	4	15	0	0	406	1	55	462
17H-1, 104–108	68	16	14	1	35	0	6	0	0	140	0	0	140
17H-1, 119–123	66	14	16	0	34	2	7	0	0	139	0	6	145
17H-1, 132–136	30	13	4	3	11	2	1	0	0	64	0	1	65
17H-2, 5–9	66	10	6	6	10	0	13	0	0	111	0	1	112
17H-2, 23–27	59	7	8	5	21	2	6	0	0	108	0	0	108
17H-2, 34–38	60	14	17	0	7	0	1	0	1	100	1	0	101
17H-CC, 5–9	53	11	18	3	13	1	2	1	0	102	0	2	104
Percentage:													
17H-1, 49–53	62	17	5	0	12	0	4	0	0	100			
17H-1, 70–74	46	22	13	0	14	1	4	0	0	100			
17H-1, 104–108	49	11	10	1	25	0	4	0	0	100			
17H-1, 119–123	47	10	12	0	24	1	5	0	0	100			
17H-1, 132–136	47	20	6	5	17	3	2	0	0	100			
17H-2, 5–9	59	9	5	5	9	0	12	0	0	100			
17H-2, 23–27	55	6	7	5	19	2	6	0	0	100			
17H-2, 34–38	60	14	17	0	7	0	1	0	1	100			
17H-CC, 5–9	52	11	18	3	13	1	2	1	0	100			

Table T4. Raw clast count and percentage clast count for gravel samples, Expedition 316.

Core, section, interval (cm)	Chert, mudstone, siltstone	Red and purple chert	Sandstone	Fine sedimentary rock/vein quartz	Vein quartz	Mafic volcanic rock	Intermediate volcanic rock	Plutonic rock	Other	Total	Shell	Gray-brown soft mudstone (intraformational)	Total
316-C0007D-													
Raw count:													
12R-2, 15–19	148	4	40	122	105	1	5	3	0	428	1	4	433
12R-2,2, 30–34	162	10	42	115	76	0	5	8	1	419		13	432
12R-2,2, 40–44	157	9	46	136	78	3	9	4	0	442		15	457
12R-2,2, 55–59	181	2	41	140	86	0	10	4	0	464		2	466
12R-2,3, 10–14	186	4	24	128	77	0	4	0	2	425		13	438
12R-2,3, 28.5–32.5	187	3	34	101	83	0	1	3	1	413		4	417
12R-2,3, 43–47	199	5	46	110	90	0	4	9	1	464		7	471
12R-2,3, 60–64.5	207	8	29	127	83	0	7	10	0	471		2	473
12R-2,4, 21.5–25.5	202	4	26	129	82	0	0	0	0	443		1	444
12R-2,4, 35–39	221	3	37	176	60	2	1	5	0	505		9	514
12R-2,4, 55–59	275	11	40	135	122	2	1	4	1	591		6	597
12R-2,4, 76.5–80.5	191	7	55	109	101	0	0	4	0	467		12	479
12R-2,5, 15.5–19.5	334	4	50	137	129	3	0	6	0	663	1	3	667
12R-2,5, 39.5–43.5	233	5	29	125	143	3	0	6	2	546		5	551
12R-2,5, 55–59	269	8	37	189	132	2	5	9	1	652		5	657
12R-2,CC, 7–11	180	5	45	152	109	1	4	9	0	505		7	512
12R-2,CC, 51–55	193	10	40	104	89	7	4	7	0	454		5	459
Percentage:													
12R-2,2, 15–19	35	1	9	29	25	0	1	1	0	100			
12R-2,2, 30–34	39	2	10	27	18	0	1	2	0	100			
12R-2,2, 40–44	36	2	10	31	18	1	2	1	0	100			
12R-2,2, 55–59	39	0	9	30	19	0	2	1	0	100			
12R-2,3, 10–14	44	1	6	30	18	0	1	0	0	100			
12R-2,3, 28.5–32.5	45	1	8	24	20	0	0	1	0	100			
12R-2,3, 43–47	43	1	10	24	19	0	1	2	0	100			
12R-2,3, 60–64.5	44	2	6	27	18	0	1	2	0	100			
12R-2,4, 21.5–25.5	46	1	6	29	19	0	0	0	0	100			
12R-2,4, 35–39	44	1	7	35	12	0	0	1	0	100			
12R-2,4, 55–59	47	2	7	23	21	0	0	1	0	100			
12R-2,4, 76.5–80.5	41	1	12	23	22	0	0	1	0	100			
12R-2,5, 15.5–19.5	50	1	8	21	19	0	0	1	0	100			
12R-2,5, 39.5–43.5	43	1	5	23	26	1	0	1	0	100			
12R-2,5, 55–59	41	1	6	29	20	0	1	1	0	100			
12R-2,CC, 7–11	36	1	9	30	22	0	1	2	0	100			
12R-2,CC, 51–55	43	2	9	23	20	2	1	2	0	100			

Table T5. Raw clast count and percentage clast count for thin sections of gravel samples, Expedition 316. (**See table note.**)

Core, section, interval (cm)	Chert	Siltstone	Sandstone	Vein quartz	Mafic volcanic rock	Intermediate volcanic rock	Silicic volcanic rock	Plutonic rock	Metamorphic rock	Total	Gray-brown soft mudstone (intraformational)					
316-C0007D-																
Raw count:																
12R-2, 15–19	12	11	8	9	0	1	0	6	0	47	3					
12R-2, 30–34	9	4	11	15	0	4	0	7	0	50	2					
12R-2, 40–44	8	5	7	9	1	4	0	4	0	38	9					
12R-2, 55–59	11	8	12	4	0	3	0	2	0	40	4					
12R-3, 10–14	19	10	23	22	4	3	3	6	0	90	4					
12R-3, 28.5–32.5	9	4	9	5	0	1	1	0	2	31	0					
12R-3, 43–47	10	5	8	6	1	2	0	6	0	38	1					
12R-3, 60–64.5	11	1	8	2	2	2	0	6	2	34	1					
12R-4, 21.5–25.5	6	4	13	3	1	0	0	5	1	33	2					
12R-4, 35–39	9	1	9	10	0	1	0	5	0	35	1					
12R-4, 55–59	9	6	8	6	0	0	0	3	1	33	2					
12R-4, 76.5–80.5	11	5	9	4	0	6	1	1	0	37	1					
12R-5, 15.5–19.5	15	2	9	6	1	2	0	2	0	37	2					
12R-5, 39.5–43.5	12	2	5	7	0	2	2	5	0	35	0					
12R-5, 55–59	17	5	20	7	3	3	1	5	0	61	3					
12R-CC, 7–11	11	1	9	2	0	0	1	2	1	27	0					
12R-CC, 51–55	9	4	11	6	2	2	0	3	0	37	1					
Percentage:												SRF	VQ	PRF	VRF	MRF
12R-2, 15–19	26	23	17	19	0	2	0	13	0	100		66	19	13	2	0
12R-2, 30–34	18	8	22	30	0	8	0	14	0	100		48	30	14	8	0
12R-2, 40–44	21	13	18	24	3	11	0	11	0	100		53	24	11	13	0
12R-2, 55–59	28	20	30	10	0	8	0	5	0	100		78	10	5	8	0
12R-3, 10–14	21	11	26	24	4	3	3	7	0	100		58	24	7	11	0
12R-3, 28.5–32.5	29	13	29	16	0	3	3	0	6	100		71	16	0	6	6
12R-3, 43–47	26	13	21	16	3	5	0	16	0	100		61	16	16	8	0
12R-3, 60–64.5	32	3	24	6	6	6	0	18	6	100		59	6	18	12	6
12R-4, 21.5–25.5	18	12	39	9	3	0	0	15	3	100		70	9	15	3	3
12R-4, 35–39	26	3	26	29	0	3	0	14	0	100		54	29	14	3	0
12R-4, 55–59	27	18	24	18	0	0	0	9	3	100		70	18	9	0	3
12R-4, 76.5–80.5	30	14	24	11	0	16	3	3	0	100		68	11	3	19	0
12R-5, 15.5–19.5	41	5	24	16	3	5	0	5	0	100		70	16	5	8	0
12R-5, 39.5–43.5	34	6	14	20	0	6	6	14	0	100		54	20	14	11	0
12R-5, 55–59	28	8	33	11	5	5	2	8	0	100		69	11	8	11	0
12R-CC, 7–11	41	4	33	7	0	0	4	7	4	100		78	7	7	4	4
12RCC, 51–55	24	11	30	16	5	5	0	8	0	100		65	16	8	11	0

Note: SRF = sedimentary rock fragment, VQ = vein quartz, PRF = plutonic rock fragment, VRF = volcanic rock fragment, MRF = metamorphic rock fragment.

Table T6. X-ray fluorescence major chemical analyses of six representative clasts, Expedition 316, Sample C0007C-17H, CC, 5–9 cm.

Major element oxide (wt%)	Chert	Vein quartz	Siltstone	Volcanic rock	Metamorphic rock	Sandstone
SiO_2	96.11	94.31	82.76	72.15	70.73	76.55
TiO_2	0.03	0.04	0.15	0.40	0.33	0.33
Al_2O_3	0.89	1.99	7.52	12.56	12.94	10.67
Fe_2O_3	0.20	0.18	0.92	2.84	3.09	3.45
MnO	0.00	0.01	0.02	0.03	0.04	0.02
MgO	0.01	0.05	0.23	0.85	0.97	1.03
Na_2O	0.16	0.17	2.52	3.64	3.43	2.49
CaO	0.06	0.06	0.24	0.59	0.73	0.26
K_2O	0.24	0.39	1.50	2.55	2.88	2.23
P_2O_5	0.03	0.02	0.07	0.13	0.04	0.07
SO_3	0.06	0.01	0.34	0.42	1.77	0.87
Total:	97.79	97.23	96.28	96.15	96.95	97.98