Appendix to Final Report for MT-2210-08-NC-05
Rapid Quantification of Ceramic Paste Recipes using Digital Capture and Image Analysis

Petrographic Report of Moon Site Thin Sections
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Explanation of Methods and summary of findings: petrographic analysis of 52 pottery samples

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The petrographic analysis of 52 pottery thin sections was conducted to evaluate compositional and textural variability in the samples for comparison to digital scanning data. Point counts were made for quantifying relative abundance of inclusions. This procedure involved using a petrographic microscope with a mechanical stage and generally followed recommendations by Stoltman (1989, 1991, 2000). A counting interval of 1 mm by 1mm was used in all cases. Each point or stop of the stage was assigned to one of the following categories: clay matrix, void, silt particles, shell temper void, grog temper or clay lumps, bone temper, ferric nodules or concretions, and very fine through very coarse quartz and other aplastics of varying compositions. For cases in which fewer than 200 points were counted (n=2), the thin sections were rotated 180° on the mechanical stage and counted a second time (after Stoltman 2000:306). Most thin sections contained two or more slices, such that rotation and recounting was not necessary in most cases. One or more slices per thin section were counted. Point counts were made using the 10X objective, but the 25X objective (with plane-polarized light) was used to search for occurrence of siliceous microfossils such as sponge spicules and phytoliths. The 25x objective with crossed polars was used to assess the presence of mica. Size of aplastics was estimated with an eyepiece micrometer with reference to the Wentworth Scale (Rice 1987:38). A comparison chart of percent particle abundance (Rice 1987:349 [Figure 12.2]) was also used for estimating relative abundance of constituents occurring in low frequency. This sample of 52 thin sections was analyzed "blind," in that I have no prior knowledge of site provenance, nor pottery type or surface treatment for the sample. All analyses were conducted by Ann S. Cordell in the FLMNH Ceramic Technology Laboratory (FLMNH-CTL).

Raw point-count data are listed in Appendix A1 and A2. By convention, the total counts exclude the number of counted voids (Stoltman 1991:107). Percentage data are listed in Appendix B. Point-count data were used to calculate Stoltman's sand size index (2000:314) for siliceous sands, but it was also adapted to provide a shell-size index. A second set of sand and shell size indices is also listed which takes into account the size difference between very fine and fine particle sizes. In the second index, very fine grains are given a value of 0.5 while fine grains have a value of 1. Counts of silt and other matrix constituents (mica, ferric concretions, clay lumps, rock fragments) were excluded from these calculations. Sand and shell size data and indices are listed in Appendix C. Relative frequency and presence/absence data are recorded for minority constituents in Appendix D. Percentages, sand and shell size indices, catalogue number, and ranked data are summarized in Appendix E, which formed the basis for computer analysis and statistical comparisons of petrographic data using SAS for the PC (SAS Institute Inc. 2008). Heading abbreviations and coded data are provided in the key to data coding.

Principal constituents

The prominent constituents in the sample include shell temper and a variety of other constituents that may be temper or natural constituents of the source clays. Shell temper was evident exclusively as platy voids left from dissolution of shell. Some shell voids were filled with debris that might hinder detection with the digital scanning. Abundance of shell temper in the sample ranged from occasional (<5%) to "common" (>15%). Most samples contained frequent or common occurrence. Percentage of shell temper is inversely related to percentage of sand, which may or may not have been added. Shell sizes ranged from very fine to very coarse, with a few occurrences with length dimensions in the granule and pebble size ranges (Wentworth sizes). A frequency distribution was constructed for shell size index, and samples were divided into three categories (Key to data). However, each grouping shows considerable variability in individual size categories. In group A, most shell temper is medium through very coarse, with coarse being the modal size in most cases. Medium and coarse sizes are modal in group B, but fine through very coarse sizes are also consistently present. Fine and medium shell sizes are modal, but very fine through very coarse sizes are also consistently present. When other data are considered (shell abundance, sand abundance, etc.) shell size was always extremely variable.

Other principal constituents include quartz, clay lumps, ferric nodules and concretions, some of which contain quartz, and possible grog. Quartz aplastics falling into silt and very fine Wentworth particle sizes are usually also considered as naturally occurring constituents of the clay source (Rice 1987:411; also see Stoltman 1989:149-150, 1991:109-111). Most of the fine through coarse quartz and quartzite grains are subrounded and rarely exceed medium in size. Particle size variability indicates poor sorting among difference sizes. Frequency is under 10% in all but seven cases. When very fine sand is excluded from the calculations, the frequency exceeds 5% in only seven cases. These figures cast suspicion on whether or not these sand constituents (mainly quartz and polycrystalline quartz) are added temper or incidental to the source clays.

Clay lumps are generally subrounded and color in PPL ranges from same as matrix colors to reddish colors from iron staining. Clay lumps may have resulted from incomplete mixing during paste preparation in most cases. Ferric nodules and concretions are generally considered natural constituents, but some could also be incidental to detrital tempers. Some clay lumps and sandy ferric constituents might represent grog. But these generally lacked angular features characteristic of sherd temper. There were no cases in which I was completely convinced that grog temper was present. Relative abundance of ferric and clay lump constituents was generally low, favoring the naturally present hypothesis. I suspect digital scanning would successfully resolve most of the ferric nodules and concretions, but consistency in resolving clay lumps might be more difficult to achieve. They would probably be resolved with ferric nodules and concretions.

Accessory constituents

Other constituents that are generally occasional or rare in most cases include polycrystalline quartz or quartzite; plagioclase and microcline feldspars; mica, mostly muscovite; mafic minerals, mostly hornblende and epidote, rarely pyroxene; and a variety of rock fragments. Mica is present, or rare, to occasional in most cases and is frequent to common in only three cases. Mica particle sizes rarely exceeded very fine in length. Given small particle size and generally low frequency, it is doubtful that mica inclusions would be visible in hand sample in most cases, necessitating petrographic methods for detection. Mica in these samples would probably not be resolved with digital scanning. Mica is considered to be a natural constituent of the source clays.

Feldspars and mafic minerals are rare to occasional constituents in most cases. They may be naturally occurring constituents of the source clays or incidental to sand tempers. These grains would probably have the same chance as quartz in being detected in digital scanning. Counts of these constituents were included in sand totals for calculating sand percentage and sand size indices.

Rock fragments include chert, sandstone, some with a schistose texture, uid plutonic igneous or metamorphic with felsic composition, and what appears to be volcanic rock fragments of siliceous composition, approaching that of ryholite. It was sometimes difficult to distinguish between volcanic, plutonic, and sandstone rock fragments. Source rocks for the mineral constituents and rock fragments appear to include sedimentary, volcanic, plutonic igneous, and metamorphic sources. Identifications would benefit from consideration of the geological contexts for the samples. These constituents were generally subrounded and so low in frequency that they must be natural to the source clay or alluvially-deposited detrital grains incidental to sand tempers. Some of these rock fragments might be resolved in digitial scanning as uid birefringent grains and/or sands and/or ferric or clay lump constituents.

Bone temper was observed in a few cases. Relative abundance ranges is up to frequent in two cases, but even in these cases, the abundance of shell temper indicates that bone temper was incidental. Bone temper would probably be resolved with digital scanning in two cases as some uid isotropic grain.

Other constituents in most samples include siliceous microfossils, specifically sponge spicules and opal phytoliths, and diatoms. Sponge spicules are needle-shaped rods composed of silica that formed the skeletal support for some freshwater sponge genera (Borremans and Shaak 1986). Opal phytoliths are botanical microfossils composed of silica (Rapp and Mulholland 1992). Diatoms are unicellular algae with ornate cell walls made of silica (Round et al. 2007). These constituents are generally considered natural constituents of the source clays and can only be detected with petrographic methods. Sponge spicules were not observed in only three cases, and phytoliths were not observed in only one case. Forty-four percent of the samples show mere presence or rare occurrence (P) of sponge spicules, while 50% show occasional occurrence (1%

to 1-3%). The sponge spicules are generally fragmented. Phytoliths were rare in 62% of the cases and occasional in 38%. Sponge spicules and phytoliths occur together in most cases. Diatoms were observed more rarely in the sample. They were missed entirely during initial search for siliceous microfossils. Occurrence is so rare that documenting their occurrence was very time consuming. Remnants of circular valves of a freshwater centric diatom, such as *Cyclotella* (Round et al. 2007:144), were rare constituents in many cases. Faint remnants of freshwater pennate diatoms were observed in a few cases. In most cases, diatoms were observed in samples that also contained occasional (1% to 1-3%) sponge spicules and phytoliths. The data may indicate a clay source or sources with variable, but low, frequency of fragmented sponge spicules and phytoliths, and more rarely, diatoms.

Resource and temper categories

Before considering groupings in terms of source clays, it should be noted that shell temper seemed to "interfere" with the ability to define homogeneous categories on the basis of ranges of percentages of shell and non-shell constituents. Therefore, counts of shell temper were deleted from calculations of percentages of silt, sands, clay lumps and ferric constituents. In retrospect, with this consideration in mind, it would have been beneficial to have specified the minimum number of counts as minimum number of non-shell counts. Eliminating shell counts for some comparisons resulted in total counts less than 200 for 20 cases (Appendix B2). This might be a concern for 12 cases in which count totals were in which total counts excluding shell were greater than 5% under the 200 count minimum, especially for six cases in which totals were greater than 10% less than 200. Thus, in a few cases, the point counts may not provide accurate estimates of constituent abundance. For example, calculated percentages of some constituents seemed too high in some cases, and too low in others. To compensate for this, frequency distributions were constructed for shell temper, sand, silt, matrix, and a few other constituents. Frequency range membership was "ground-truthed" ("slide-truthed"?) by quick reexamination of the thin sections. Several cases were reassigned to different frequency ranges that seemed a better fit in terms of gross visual characteristics. This may explain a few discrepancies in percentages that seem too high or low for specified ranges (in Key to data). This ground-truthing process also helped distinguish groupings that could conceivably be replicated by the digital scanning process.

Mica, sponge spicules, phytoliths, and diatoms are considered significant for defining clay resource groupings among the pottery samples as these constituents are considered naturally occurring in some source clays. Ferric nodules and concretions and clay lumps may be included in this list and were combined for purposes of statistical analysi. Point count data were compared, controlling for these constituents to ascertain if any statistically significant groupings existed. Mean abundance data were compared tested for statistical significance using the using the *t* statistic.[1] Results of the t-tests are recorded in Appendix F. The general null hypothesis for the comparisons is that the paste categories do not differ significantly in the attributes measured or observed; i.e., they represent samples of the same population and any differences noted can be attributed to chance or small sample size. The alternative hypothesis is that differences between samples are statistically significant; i.e., they represent different clay sources or temper recipes, and chance and/or small sample size can be eliminated as the source of the differences.

For mica, the two predominant categories (present and 1-3%; see Key to data) show similarities in mean values of percentages of for most attributes (Table 1a). This may indicate mica was not considered an important or critical constituent in decisions regarding temper choices or abundances. Statistically significant differences were documented only for mean percentage of silt. Pottery with higher relative frequency of mica tends to have more silt. Although the differences in mean percentage of silt are statistically significant, there is a lot of overlap in the range and intuitively, a mean of 4% does not seem significantly higher than a mean of 3%. Thus, it is likely that relative frequencies ranging from "present" to 1-3% may represent natural variability within a particular clay source or sources. Three cases with higher relative frequency (3-5%) may indicate a different clay source, or at least one extreme in variability of the primary source clay. Although there are only three cases in the sample, these show the highest amount of silt and sand, and lowest amounts of matrix, ferric and clay lumps, and shell temper. The three cases show variable sponge spicule, phytolith, and diatom content. For most of the remaining discussions, these three cases are excluded.

For sponge spicules, the two main categories are "present" and "1%, 1-3%" (see Key to data). Pottery in these groupings show statistically significant differences in percentages of matrix, silt, and sand (Table 1b). In these comparisons, percentages of silt and sand tend to be higher in cases with more sponge spicules. I suspect that the range of present to 1-3% may represent variability within a given source clay(s). The presence of more sand, whether added or naturally present could cause increasing fragmentation of spicules, thereby increasing their relative frequency in the paste.

For phytoliths, the two main categories are "present" and "1%, 1-3%" (see Key to data) Samples within each category show similar mean values of percentages of for most attributes (Table 1c).

For diatoms, the two categories are "not observed" and "observed" (see Key to data). Pottery in these groupings show statistically significant differences in matrix, silt, sand, and shell temper (Table 1d). As was the case with sponge spicules, percentages of silt and sand tend to be higher in cases in which diatoms were observed. This might be expected given that diatoms were most consistently recognized in cases also characterized by occasional sponge spicules.

For ferric and clay lumps (combined), the two main categories are "0-2%" and "3-11%" (see Key to data). The difference in mean percentage of these two groupings is statistically significant, but pottery in these groupings are otherwise similar (Table 1e).

Variability within these constituent categories with respect to each other is listed in Appendix G1. This listing shows little covariation between constituents, except in the case of siliceous microfossils. Considering all the data, a potential source clay generally contains mica, siliceous microfossils, and ferric/clay lumps in variable but low quantities. This source accounts for most of the pottery samples (49 of the 52 thin sections). These samples can be broken down into four matrix clay categories on the basis of relative percentages of silt and very fine sand (see Key to data). These categories may represent extremes and intermediate points along a continuum of variability within the source clay(s). The first matrix clay group, A1, is extremely fine-textured with very low silt (0-2%) and very fine sand content (0-1%). The fourth matrix group, A4, is on the other end of a possible continuum, and is characterized by 4-7% silt and 4-6% very fine sand. Groups A2 and A3 are intermediate between the former two extremes. Matrix clay groups A2, A3, and A4 are approximately equally represented in the sample. Each grouping is characterized by variable fine to medium sands (which may or may not be temper) and shell temper (Table 2a and Appendix G2).

Matrix clay B consists of the three cases with relatively high mica content. This group is also characterized by relatively high silt and very fine sand content.

Three categories of relative abundance of shell temper were recognized among the main sample of 49 sherds (see Key to data). Common to abundant shell temper ranges from 15% to

32% in the sample. Although this is a large range, the samples grouped together in terms of gross visual characteristics. Frequent to common shell temper ranges from 10% to 15%. Occasional to frequent shell temper ranges from 4% to 10%, but 10% appears to be too high an estimate in terms of gross visual characteristics. Digital scanning techniques may be able to replicate these categories when shell voids are considered exclusively. However, each shell temper category is characterized by variable composition in terms of matrix clay, and sizable variation in percentages of silt, very fine sand, fine and medium sand (combined) and total sand (Table 2b and Appendix G2).

Four categories of relative abundance of sand constituents were recognized among the main sample of 49 sherds (see Key to data). Sand content decreases from A through D. Categories A and D form relatively homogeneous groupings in terms of matrix clay composition, shell temper, and percentages of silt, very fine sand, and fine-medium sand. Categories B and C are the predominant groupings, but these categories are is characterized by variable composition in terms of matrix clay and sizable variation in percentages of shell temper, silt, very fine sand and fine- medium sand (Table 2c and Appendix G2). It may be difficult for the digital scanning methods to differentiate these categories.

The range of variability in the sand and shell constituents in the subsample of 49 thin sections can be divided into four categories, referred to here as ware groups (see Key to data). These categories represent relatively homogenous groupings in terms of shell temper and sand constituents, more so than groupings defined by shell abundance or sand abundance alone. Each represents a relatively homogenous grouping in terms of silt, sands, and shell temper (Table 2d and Appendix G2). The first ware group, A1, is extremely fine-textured, with very low silt and sand content. Mean percentage of shell temper for this group is relatively high at 18%. Ware group A2 is characterized by higher quantities of silt and sands and mean percentage of shell temper at 14%. Ware group A3 also has a shell temper mean of 14%, but amounts of silt and sands are greater. Ware group A4 is the sandiest, with lowest percentage of shell temper. Most of the cases occur in ware groups A2 and A3. If the sand component was naturally present in the source clay(s), then the amount of shell added would have been determined by silt and sand components. The similarity between A2 and A3 in terms of amount of shell temper may indicate the relative degree of acceptable variation in silt and sand constituents for a specified proportion of shell temper. Ware group B is equivalent to matrix clay B. It is hoped that ware groups A1 through A4 could be differentiated with digital scanning methods. Ware group B would probably be lumped with ware group A4 in terms of digital scanning.

Footnotes

[1]All t-test statistics were computed using the Statistical Analysis System PROC TTEST procedure (using pooled variance and 1-tailed tests).

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Key To Data

variable name and value labels	definition or ranges	appendix number
counted		A1
N	not counted	A1
Y	yes, counted	A1
.	total counts when more than one slice per slide counted	A1
particle sizes		A2B, C1, C2
vf	very fine	A2B, C1, C2
f	fine	A2B, C1, C2
m,med	medium	A2A,A2B, C1, C2
c	coarse	A2B, C1, C2
vc	very coarse	A2B, C1, C2
gr	granule	A2B, C1, C2
pb	pebble	A2B, C1, C2
general		
ferric, Fe	ferric concretion or nodule	A2B
Fe w/sand	ferric concretion or nodule, containing sand	A2B
CL	clay lumps	A2B
ss	sandstone	A2B
volc	possible volcanic rock	A2B
Q	quartz	A1, A2A
polyxQ, PQ	polycrystalline quartz or quartzite	A1, A2A, A2B, B1, C1
K-spar	microcline felspar	A1, A2A, A2B
plag	plagioclase feldspar	A1, A2A, A2B
UID feld	UID feldspar	A1, A2A
spc	sponge spicule	A2B, D
phyto	phytolith	A2B, D
amph	amphibole	A2B
porph	porphyritic	D
trach	trachytic	D
p&t	porphyritic&trachytic	D
px	pyroxene	D
chr wood	charred wood	D
TQ	total quartz	B1, B2
TFe	total ferric	B1
Tsand	total sand (Q, PQ, feldpars)	B1, B2

Tfeld	total feldspars (plag, k-spar, UID)	B1, B2, C1
TCLFe	total of clay lumps, grog, Fe and Fe w/sand	B1, B2
particle size index	for sand	C1
sumT.5 sand	sum of contribution of SSI with vf=.5	C1
sumT1 sand	sum of contribution of SSI with vf=1	C1
ssi.5 sand	sand size index (vf=.5)	C1, E
ssi1 sand	sand size index (vf=1)	C1, E
particle size index	for shell	C2
sumT.5 shell	sum of contribution of ShSI with vf=.5	C2
sumT1 shell	sum of contribution of ShSI with vf=1	C2
shsi.5 shell	shell size index with vf=.5	C2 ,E
shsi1 shell	shell size index with vf=1	C2 ,E
ranked data		
rankmica	relative frequency range	D, E
A	P (present)	D, E
B	1%, 1-3%	D, E
C	3-5%	D, E
rankphyto	relative frequency range	D, E
a	. (none)	D, E
b	P (present)	D, E
c	1%, 1-3%	D, E
rankspc	relative frequency range	D, E
a	. (none)	D, E
b	P (present)	D, E
c	1%, 1-3%	D, E
diatoms	values	E
a	not observed	E
b	present	E
rankshell	percent ranges	B1, E
a	15-32% shell	B1, E
b	(8%)10-15% shell	B1, E

c	4-8% (10%) shell	B1, E
rank shell size	SHSSI.5	C2,E
a	2.55-3.10	C2,E
b	2.16-2.52	C2,E
c	1.77-2.12	C2,E
ranked data continued		
rank matrix (-shell)	percent ranges	B2, E
a, ab	95-98%, 93-97%	B2, E
b	91-94%	B2, E
c	85-90%	B2, E
d	80-84%	B2, E
rank matrix+FeCL (-shell)	percent ranges	B2, E
a	98-98%	B2, E
b	89-93%	B2, E
c	85-88%	B2, E
d	81-84%	B2, E
e	76-79%	B2, E
rank sand (-shell)	percent ranges	B2, E
a	9-14%	B2, E
b	6-8%	B2, E
c	2-5%	B2, E
d	0-1%	B2, E
rank silt (-shell)	percent ranges	B2, E
a	4-7% (1 case 11%)	B2, E
b	2-5%	B2, E
c	0-1%	B2, E
rank vfsand	percent ranges	E
a	0-1%	E
b	2-3%	E
c	4%	E
d	11%	E
rank silt+vf	percent ranges	E
a	0-2%	E
b	3-5%	E
c	6-7%	E

d	8-10%	E
e	15-16%	E
ranked data continued		
rank fmsand	rank fine-medium(+coarse) sand	E
a	0-1%	E
b	2%	E
c	3-5%	E
d	6-9%	E
rank TCLFe	percent ranges	B2, E
a	3-11%	B2, E
b	0-2%	B2, E
rank sand size	SSI.5 ranges	C, E
a	no sand, 0.50-0.83	C, E
b	0.85-1.19	C, E
c	1.31-1.77	C, E
rank vfmsize	sand size variability	E
a	fine or medium sizes modal	E
b	vf modal, with unequal f and m	E
c	vf modal with equal f and m	E
sand sorting		C, E
.	no sand, not applicable	C, E
bm	bimodal sorting	C, E
ps	poor sorting	C, E
gs/ps	intermediate sorting	C, E
gs	good sorting	C, E
bone data		D, E
.	not present	D, E
P?	possibly present	D, E
P	present	D, E
ocfr	occasional to frequent	D, E
freq	frequent	D, E
grog data	definition	D, E

.	not present	D, E
Fe?	possible but could be Fe concretion or nodule	D, E
M	maybe/possibly present	D, E
M,Fe?	maybe/possibly present, but could also be Fe concretion or nodule	D, E
other data		
clay lump data		D, E
.	not present	D, E
P	present	D, E
P SS	present, some stained (Fe) or color otherwise different from matrix	D, E
P ST	present, stained (Fe) or color otherwise different from matrix	D, E

matrix clay	definition		silt	vf sand
A1	very low silt, very fine sand	E	0-2%	0-1%
A2	low silt, very fine sand	E	2-4%	1-2%
A3	low-moderate silt, very fine sand	E	3-5%	2-4%
A4	moderate silt, very fine sand	E	4-7%	4-6%
B	frequent mica, moderate to high silt, very fine sand	E	5-11%	4-11%

Note: the "E" header cell in the matrix clay table is printed in the third column.

ware group	definition	E
A1	matrix clay A1, A2; shell A; sand D	E
A2	matrix clay A2, A3; shell B, A; sand C	E
A3	matrix clay A4, A3; shell B; sand A,B	E
A4	matrix clay A4, A3; shell C; sand B	E
B	matrix clay B; shell B,C; sand A	E

Cordell Appendix A1 – Point Count Data

thin section #	sample#	counte d	# void s	# matri x	# sil t	#vf quart z	# fine quart z	# me d Q	# C quart z	# poly X Q	# K-spa r	# pla g	# UI D feld	# mic a	# gro g	# clay lump s	# shel l	# ferri c	Fe w/ san d	#othe r	tota l
1a	1-238-2-7	Y	4	109	7	1	2	2	.	1	.	.	4	.	2	1	3	6	2	2	142
1b	1-238-2-7	Y	4	80	7	.	2	1	.	.	.	.	.	.	1	.	6	1	1	1	100
1T	1-238-2-7	.	8	189	14	1	4	3	.	1	.	.	4	.	3	1	9	7	3	3	242
2aT	2-196-2-7	Y	15	160	11	6	3	2	.	1	.	.	1	.	.	2	34	1	.	6	227
2b	2-196-2-7	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
2c	2-196-2-7	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
3aT	3-417-2-48	Y	22	204	6	3	2	2	.	.	.	.	3	.	.	6	28	3	2	.	259
3b	3-417-2-48	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
4a(2x)	4-367-2-1	Y	6	110	5	.	.	.	.	.	.	1	.	.	.	.	26	.	.	.	142
4b(2x)	4-367-2-1	Y	8	108	4	1	.	.	.	.	.	.	.	.	.	.	18	1	.	.	132
4T	4-367-2-1	.	14	218	9	1	.	.	.	.	.	1	.	.	.	.	44	1	.	.	274
5a	5-454-2-11	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
5b	5-454-2-11	Y	8	104	4	2	6	3	.	2	.	1	2	.	.	1	18	3	2	.	148
5c	5-454-2-11	Y	17	95	3	2	6	.	.	1	.	.	2	.	.	1	23	1	.	2	136
5T	5-454-2-11	.	25	199	7	4	12	3	.	3	.	1	4	.	.	2	41	4	2	2	284
6a	6-103-2-6	Y	16	126	6	4	2	1	.	1	1	2	3	.	.	1	24	1	3	.	175
6b	6-103-2-6	Y	14	129	4	3	1	.	.	.	.	.	2	.	.	.	45	2	5	1	192
6T	6-103-2-6	.	30	255	10	7	3	1	.	1	1	2	5	.	.	1	69	3	8	1	367
7aT	7-361-2-9	Y	14	164	6	3	1	.	.	1	.	.	4	.	1	.	25	3	10	.	218
7b	7-361-2-9	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
8a	8-67-2-2	Y	4	88	2	3	.	.	.	1	.	.	1	.	.	1	7	.	.	.	103
8b	8-67-2-2	Y	4	74	4	.	1	.	.	.	.	.	1	.	.	1	17	2	3	1	104

8T	8-67-2-2	.	8	162	6	3	1	.	.	1	.	.	2	.	.	2	24	2	3	1	207
9a	9-40-2-13	Y	3	95	9	2	2	2	.	.	.	.	.	.	.	.	6	.	.	.	116
9b	9-40-2-13	Y	7	113	8	1	.	1	.	1	.	1	4	.	.	.	9	2	.	.	140
9T	9-40-2-13	.	10	208	17	3	2	3	.	1	.	1	4	.	.	.	15	2	.	.	256
10a	10-108-2-1	Y	8	113	5	2	2	.	.	1	.	.	3	.	.	8	19	2	3	1	159
10b	10-108-2-1	Y	10	109	8	4	1	.	.	.	.	.	1	.	.	5	18	1	4	1	152
10c	10-108-2-1	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
10T	10-108-2-1	.	18	222	13	6	3	.	.	1	.	.	4	.	.	13	37	3	7	2	311
11aT	11-69-2-18	Y	7	155	7	.	5	1	.	.	.	.	2	.	1	3	29	4	1	1	209
11b	11-69-2-18	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
12aT	12-357-2-3	Y	6	147	5	9	10	1	.	3	.	1	4	.	.	1	18	5	5	2	211
12b	12-357-2-3	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
12c	12-357-2-3	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
12d	12-357-2-3	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
13a	13-405-2-9	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
13b	13-405-2-9	Y	10	126	12	3	6	3	.	.	.	1	1	.	.	1	34	.	.	1	188
13c	13-405-2-9	N	3	79	4	1	.	3	.	.	.	.	2	.	.	.	8	.	.	.	97
13T	13-405-2-9	.	13	205	16	4	6	6	.	.	.	1	3	.	.	1	42	.	.	1	285
14a	14-0-2-2	Y	8	116	19	2	3	2	.	1	.	1	1	.	.	.	15	1	1	.	162
14b	14-0-2-2	Y	5	92	10	4	4	3	1	.	.	1	1	.	.	.	14	2	.	1	133
14T	14-0-2-2	.	13	208	29	6	7	5	1	1	.	2	2	.	.	.	29	3	1	1	295
15a	15-231-2-2	Y	7	123	7	2	.	.	.	.	.	.	1	.	.	7	10	.	6	.	156
15b	15-231-2-2	Y	3	75	1	3	.	1	.	.	.	.	1	.	.	2	9	.	2	2	96
15c	15-231-2-2	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

15T	15-231-2-2	.	10	198	8	5	.	1	.	.	.	.	2	.	.	9	19	.	8	2	252
16a	16-165-2-8	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
16bT	16-165-2-8	Y	8	156	9	1	3	.	.	.	.	2	1	.	.	5	29	6	8	2	222
16c	16-165-2-8	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
17a	17-13-2-9	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
17bT	17-13-2-9	Y	15	151	7	1	2	2	.	2	1	2	3	.	1	1	35	1	.	1	210
18aT	18-88-2-10	Y	6	166	7	1	.	1	.	.	.	.	1	.	.	.	25	2	2	1	206
18b	18-88-2-10	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
18c	18-88-2-10	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
19aT	19-121-2-15	Y	10	186	9	9	2	2	.	3	.	1	2	.	1	1	26	.	.	2	244
19b	19-121-2-15	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
19c	19-121-2-15	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
20aT	20-1124-2-12	Y	6	184	11	5	4	4	.	7	.	.	2	.	.	1	28	.	.	4	250
20b	20-1124-2-12	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
20c	20-1124-2-12	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
21a	21-3-2-12	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
21bT	21-3-2-12	Y	8	163	10	.	.	2	.	.	.	.	2	.	.	10	24	2	10	.	223
22a(2x)	22-733-2-1	Y	8	137	7	.	.	2	.	.	.	1	2	.	.	.	13	2	1	3	168
22b(2x)	22-733-2-1	Y	4	103	7	2	1	1	.	2	.	1	1	.	.	.	11	.	1	1	131
22T	22-733-2-1	.	12	240	14	2	1	3	.	2	.	2	3	.	.	.	24	2	2	4	299
23a	23-350-2-3	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
23b	23-350-2-3	Y	7	87	.	.	.	.	.	.	.	1	.	.	.	2	24	2	.	1	117
23c	23-350-2-3	Y	9	105	.	.	.	.	.	.	.	.	.	.	.	.	44	1	.	.	150
23T	23-350-2-3	.	16	192	.	.	.	.	.	.	.	1	.	.	.	2	68	3	.	1	267

24a	24-244-2-7	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
24b	24-244-2-7	Y	5	100	4	.	.	.	.	.	.	.	2	.	.	3	34	3	2	.	148
24c	24-244-2-7	Y	7	109	1	.	.	.	.	.	.	.	.	.	.	4	31	4	1	.	150
24T	24-244-2-7	.	12	209	5	.	.	.	.	.	.	.	2	.	.	7	65	7	3	.	298
25a	25-1028-2-8	Y	10	119	6	3	.	1	.	.	.	.	2	.	.	5	23	1	7	.	167
25b	25-1028-2-8	Y	5	94	4	1	1	.	.	.	.	.	.	.	.	1	21	2	10	.	134
25c	25-1028-2-8	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
25T	25-1028-2-8	.	15	213	10	4	1	1	.	.	.	.	2	.	.	6	44	3	17	.	301
26a	26-452-2-2	Y	6	127	7	3	6	.	.	1	1	.	4	.	.	1	25	2	1	1	179
26b	26-452-2-2	Y	9	118	6	2	1	1	.	1	.	.	1	.	.	2	23	2	1	1	159
26c	26-452-2-2	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
26T	26-452-2-2	.	15	245	13	5	7	1	.	2	1	.	5	.	.	3	48	4	2	2	338
27aT	27-51-2-11	Y	6	170	10	5	4	2	.	1	.	.	4	.	.	.	22	2	1	3	224
27b	27-51-2-11	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
28a	28-322-2-5	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
28bT	28-322-2-5	Y	14	151	3	.	.	.	.	.	.	.	.	.	.	10	33	2	1	.	200
28c	28-322-2-5	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
29aT	29-154-2-22	Y	7	157	6	2	3	.	.	1	.	1	.	.	.	2	19	3	6	.	200
29b	29-154-2-22	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
30aT	30-453-2-1	Y	11	226	9	.	1	.	.	.	.	.	.	.	.	2	36	.	.	.	274
30b	30-453-2-1	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
31a	31-69-2-17	Y	6	141	2	3	2	1	.	.	.	.	.	.	.	3	28	1	10	.	191
31b	31-69-2-17	Y	13	107	4	4	1	.	.	.	.	1	2	.	.	5	24	2	13	.	163
31c	31-69-2-17	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
31T	31-69-2-17		19	248	6	7	3	1	.	.	.	1	2	.	.	8	52	3	23	.	354

32a	32-3-2-17	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
32b	32-3-2-17	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
32cT	32-3-2-17	Y	16	168	15	7	5	8	2	.	.	1	1	.	.	4	14	.	.	2	227
33aT	33-99-2-1	Y	5	149	7	3	2	.	.	.	.	.	1	.	.	1	34	2	8	.	207
33b	33-99-2-1	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
33c	33-99-2-1	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
34a	34-37-2-2	Y	11	113	2	3	2	.	.	1	.	.	1	.	.	.	26	.	.	1	149
34b	34-37-2-2	Y	3	53	2	3	.	.	.	1	.	.	1	.	.	.	19	.	1	2	82
34c	34-37-2-2	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
34T	34-37-2-2	.	14	166	4	6	2	.	.	2	.	.	2	.	.	.	45	.	1	3	231
35a	35-171-2-8	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
35bT	35-171-2-8	Y	16	188	7	5	2	3	.	1	.	2	2	.	1	1	18	4	.	4	238
36a?T	36-32-2-2	Y	4	181	5	1	2	.	.	2	.	2	2	.	.	1	22	.	.	3	221
36b	36-32-2-2	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
37a	37-1070-2-8	Y	9	137	7	.	1	2	1	.	.	.	.	.	.	1	16	.	.	1	166
37b	37-1070-2-8	Y	4	140	4	1	1	4	1	.	.	1	1	.	.	1	17	.	.	2	173
37T	37-1070-2-8	.	13	277	11	1	2	6	2	.	.	1	1	.	.	2	33	.	.	3	339
38a	38-103-2-4	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
38b	38-103-2-4	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
38cT	38-103-2-4	Y	8	158	3	2	1	.	.	.	.	.	2	.	.	9	32	2	3	4	216
39a	39-330-2-1	Y	5	99	5	3	.	.	.	.	.	.	1	.	.	3	16	.	1	.	128
39b	39-330-2-1	Y	8	101	5	8	.	.	.	1	.	.	1	.	.	2	16	.	1	.	135
39T	39-330-2-1	.	13	200	10	11	.	.	.	1	.	.	2	.	.	5	32	.	2	.	263
40a	40-254-2-12	Y	13	70	2	.	3	.	.	.	.	1	.	.	.	.	41	.	.	1	118
40b	40-254-2-12	Y	7	73	2	2	.	.	.	.	.	.	.	.	.	.	32	1	.	1	111
40T	40-254-2-12	.	20	143	4	2	3	.	.	.	.	1	.	.	.	.	73	1	.	2	229

41a	41-4-2-14	Y	10	108	2	.	4	.	.	.	.	1	.	.	.	.	11	4	3	2	135
41b	41-4-2-14	Y	10	110	4	1	3	1	.	.	.	.	.	.	.	2	14	.	2	2	139
41c	41-4-2-14	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
41T	41-4-2-14	.	20	218	6	1	7	1	.	.	.	1	.	.	.	2	25	4	5	4	274
42a	42-19-2-2	Y	5	87	6	1	.	5	.	1	.	.	.	.	.	1	17	.	3	1	122
42b	42-19-2-2	Y	2	93	3	2	3	.	1	1	.	.	1	.	.	.	17	.	2	1	124
42c	42-19-2-2	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
42T	42-19-2-2	.	7	180	9	3	3	5	1	2	.	.	1	.	.	1	34	.	5	2	246
43aT	43-1028-2-8	Y	10	191	9	10	10	2	.	1	1	2	1	.	.	.	27	3	3	1	261
43b	43-1028-2-8	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
44a	44-273-2-10	Y	7	81	6	6	1	.	.	1	.	.	2	.	.	.	13	1	.	2	113
44b	44-273-2-10	Y	6	89	5	14	.	.	.	.	.	1	.	.	.	.	7	.	.	.	116
44T	44-273-2-10	.	13	170	11	20	1	.	.	1	.	1	2	.	.	.	20	1	.	2	229
45a	45-254-2-7	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
45b	45-254-2-7	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
45cT	45-254-2-7	Y	4	165	1	.	.	.	.	.	.	.	.	.	.	1	41	3	.	.	211
46a	46-333-2-5	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
46bT	46-333-2-5	Y	7	156	11	6	7	1	.	2	.	1	4	.	.	2	17	.	.	2	209
46c	46-333-2-5	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
47a	47-1150-2-1	Y	6	124	1	1	3	.	.	.	.	2	1	.	.	.	25	.	.	.	157
47b	47-1150-2-1	Y	4	129	7	.	1	.	.	.	.	1	.	.	.	1	24	.	.	1	164
47c	47-1150-2-1	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
47T	47-1150-2-1	.	10	253	8	1	4	.	.	.	.	3	1	.	.	1	49	.	.	1	321
48aT	48-464-2-7	Y	21	197	2	.	.	.	.	.	.	.	.	.	.	2	53	1	.	.	255
48b	48-464-2-7	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

49a	49-1133-2-1	Y	8	139	6	3	.	.	.	.	.	.	1	.	.	8	26	5	8	2	198
49b	49-1133-2-1	Y	13	131	5	3	.	.	.	.	.	.	2	.	.	8	34	3	4	1	191
49c	49-1133-2-1	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
49T	49-1133-2-1	.	21	270	11	6	.	.	.	.	.	.	3	.	.	16	60	8	12	3	389
50a	50-1104-2-3	Y	7	127	6	5	1	.	.	.	.	.	.	.	.	6	35	3	7	1	191
50b	50-1104-2-3	Y	8	103	3	2	.	.	.	1	.	1	2	.	.	5	45	1	3	.	166
50c	50-1104-2-3	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
50T	50-1104-2-3	.	15	230	9	7	1	.	.	1	.	1	2	.	.	11	80	4	10	1	357
51a	17-1056-2-1	Y	8	79	3	1	2	1	.	.	.	.	3	.	.	.	23	1	3	.	116
51b	17-1056-2-1	Y	7	76	4	4	3	.	.	.	.	.	.	.	.	1	17	.	1	.	106
51T	17-1056-2-1	.	15	155	7	5	5	1	.	.	.	.	3	.	.	1	40	1	4	.	222
52a	40-61-2-10	Y	12	89	7	4	2	.	.	.	.	.	.	.	.	1	15	.	1	4	123
52b	40-61-2-10	Y	6	81	1	2	1	.	.	.	.	.	2	.	.	.	15	1	8	2	113
52T	40-61-2-10	.	18	170	8	6	3	.	.	.	.	.	2	.	.	1	30	1	9	6	236

Cordell Report Appendix B – Point Count Percent

thin section #	sample#	total	TQ	Tsand	Tfeld	TCLFe	%voids	%matrix	% aplastics	%sand	% TCLFe	%shell	%silt	%TQ	%polyxQ	%Tfeld	%clay lumps	%Tfe
1	1-238-2-7	242	8	13	4	14	3%	78%	22%	5%	6%	4%	6%	3%	<1%	2%	2%	4%
2	2-196-2-7	227	11	12	1	3	6%	70%	30%	5%	1%	15%	5%	5%	<1%	<1%	1%	<1%
3	3-417-2-48	259	7	10	3	11	8%	79%	21%	4%	4%	11%	2%	3%	.	1%	2%	2%
4	4-367-2-1	274	1	2	1	1	5%	80%	20%	1%	<1%	16%	3%	<1%	.	<1%	.	<1%
5	5-454-2-11	284	19	27	5	8	8%	70%	30%	10%	3%	14%	2%	7%	1%	2%	1%	2%
6	6-103-2-6	367	11	20	8	12	8%	70%	30%	5%	3%	19%	3%	3%	<1%	2%	<1%	3%
7	7-361-2-9	218	4	9	4	14	6%	75%	25%	4%	6%	12%	3%	2%	<1%	2%	<1%	6%
8	8-67-2-2	207	4	7	2	7	4%	78%	22%	3%	3%	12%	3%	2%	<1%	1%	1%	2%
9	9-40-2-13	256	8	14	5	2	4%	81%	19%	5%	1%	6%	7%	3%	<1%	2%	.	1%
10	10-108-2-1	311	9	14	4	23	6%	71%	29%	4%	7%	12%	4%	3%	<1%	1%	4%	3%
11	11-69-2-18	209	6	8	2	9	3%	74%	26%	4%	4%	14%	3%	3%	.	1%	2%	2%
12	12-357-2-3	211	20	28	5	11	3%	70%	30%	13%	5%	8%	2%	10%	1%	2%	<1%	5%
13	13-405-2-9	285	16	20	4	1	4%	72%	28%	7%	<1%	15%	6%	6%	.	1%	<1%	.
14	14-0-2-2	295	19	24	4	4	4%	70%	30%	8%	1%	10%	10%	6%	<1%	1%	.	1%
15	15-231-2-2	252	6	8	2	17	4%	79%	21%	3%	7%	8%	3%	2%	.	1%	4%	3%
16	16-165-2-8	222	4	7	3	19	4%	70%	30%	3%	9%	13%	4%	2%	.	1%	2%	6%
17	17-13-2-9	210	5	13	6	3	7%	72%	28%	6%	1%	17%	3%	2%	1%	3%	1%	<1%
18	18-88-2-10	206	2	3	1	4	3%	81%	19%	1%	2%	12%	3%	1%	.	<1%	.	2%
19	19-121-2-15	244	13	19	3	2	4%	76%	24%	8%	1%	11%	4%	5%	1%	1%	1%	.
20	20-1124-2-12	250	13	22	2	1	2%	74%	26%	9%	<1%	11%	4%	5%	3%	1%	<1%	.
21	21-3-2-12	223	2	4	2	22	4%	73%	27%	2%	10%	11%	4%	1%	.	1%	4%	5%
22	22-733-2-1	299	6	13	5	4	4%	80%	20%	4%	1%	8%	5%	2%	1%	2%	.	1%
23	23-350-2-3	267	.	1	1	5	6%	72%	28%	<1%	2%	26%	.	.	.	<1%	1%	1%
24	24-244-2-7	298	.	2	2	17	4%	70%	30%	1%	6%	22%	2%	.	.	1%	2%	3%
25	25-1028-2-8	301	6	8	2	26	5%	71%	29%	3%	9%	15%	3%	2%	.	1%	2%	7%
26	26-452-2-2	338	13	21	6	9	4%	72%	28%	6%	3%	14%	4%	4%	1%	2%	1%	2%
27	27-51-2-11	224	11	16	4	3	3%	76%	24%	7%	1%	10%	4%	5%	<1%	2%	.	1%

28	28-322-2-5	200	.	.	.	13	6%	76%	24%	.	6%	16%	2%	.	.	.	5%	2%
29	29-154-2-22	200	5	7	1	11	3%	78%	22%	4%	6%	10%	3%	2%	<1%	<1%	1%	4%
30	30-453-2-1	274	1	1	.	2	4%	82%	18%	<1%	1%	13%	3%	<1%	.	.	1%	.
31	31-69-2-17	354	11	14	3	34	5%	70%	30%	4%	10%	15%	2%	3%	.	1%	2%	7%
32	32-3-2-17	227	22	24	2	4	7%	74%	26%	11%	2%	6%	7%	10%	.	1%	2%	.
33	33-99-2-1	207	5	6	1	11	2%	72%	28%	3%	5%	16%	3%	2%	.	<1%	<1%	5%
34	34-37-2-2	231	8	12	2	1	6%	72%	28%	5%	<1%	20%	2%	4%	1%	1%	.	<1%
35	35-171-2-8	238	10	15	4	6	6%	79%	21%	6%	2%	8%	3%	4%	<1%	2%	1%	2%
36	36-32-2-2	221	3	9	4	1	2%	82%	18%	4%	<1%	10%	2%	1%	1%	2%	<1%	.
37	37-1070-2-8	339	11	13	2	2	4%	82%	18%	4%	1%	10%	3%	3%	.	1%	1%	.
38	38-103-2-4	216	3	5	2	14	4%	73%	27%	2%	6%	15%	1%	1%	.	1%	4%	2%
39	39-330-2-1	263	11	14	2	7	5%	76%	24%	5%	3%	12%	4%	4%	<1%	1%	2%	1%
40	40-254-2-12	229	5	6	1	1	8%	62%	38%	3%	<1%	32%	2%	2%	.	<1%	.	<1%
41	41-4-2-14	274	9	10	1	11	7%	80%	20%	4%	4%	9%	2%	3%	.	<1%	1%	3%
42	42-19-2-2	246	12	15	1	6	3%	73%	27%	6%	2%	14%	4%	5%	1%	<1%	<1%	2%
43	43-1028-2-8	261	22	27	4	6	4%	73%	27%	10%	2%	10%	3%	8%	<1%	2%	.	2%
44	44-273-2-10	229	21	25	3	1	5%	74%	26%	11%	<1%	9%	5%	9%	<1%	1%	.	<1%
45cT	45-254-2-7	211	.	.	.	4	2%	78%	22%	.	2%	19%	<1%	.	.	.	<1%	1%
46	46-333-2-5	209	14	21	5	2	3%	75%	25%	10%	1%	8%	5%	7%	1%	2%	1%	.
47	47-1150-2-1	321	5	9	4	1	3%	79%	21%	3%	<1%	15%	2%	2%	.	1%	<1%	.
48	48-464-2-7	255	.	.	.	3	8%	77%	23%	.	1%	21%	1%	.	.	.	1%	<1%
49	49-1133-2-1	389	6	9	3	36	5%	69%	31%	2%	9%	15%	3%	2%	.	1%	4%	5%
50	50-1104-2-3	357	8	12	3	25	4%	64%	36%	3%	7%	22%	2%	2%	<1%	1%	3%	4%
51	17-1056-2-1	222	11	14	3	6	6%	70%	30%	6%	3%	18%	3%	5%	.	1%	<1%	2%
52	40-61-2-10	236	9	11	2	11	7%	72%	28%	5%	5%	13%	3%	4%	.	1%	<1%	4%

Cordell Report Appendix C1 – Sand Size

thin section #	sample#	sand size rank	sand sorting	# vf quartz	# fine quartz	# med Q	# C Q	T Q	# vf feld+P Q	# fine feld+P Q	# med feld+P Q	# coarse feld+P Q	T feldP Q	Tvf sand	Tfine sand	Tmed sand	T C sand	T sand	sumT. 5 sand	sumT 1 sand	ssi. 5 sand	ssi1 sand
1	1-238-2-7	c	bm	1	4	3	.	8	2	2	1	.	5	3	6	4	.	13	15.5	17	1.19	1.31
2	2-196-2-7	c	bm	6	3	2	.	11	2	.	.	.	2	8	3	2	.	13	11	15	0.85	1.15
3	3-417-2-48	c	bm	3	2	2	.	7	3	.	.	.	3	6	2	2	.	10	9	12	0.90	1.20
4	4-367-2-1	a	.	1	.	.	.	1	1	.	.	.	1	2	.	.	.	2	1	2	0.50	1.00
5	5-454-2-11	c	ps	4	12	3	.	19	1	7	.	.	8	5	19	3	.	27	27.5	30	1.09	1.11
6	6-103-2-6	d	gs/ps	7	3	1	.	11	6	3	.	.	9	13	6	1	.	20	14.5	21	0.72	1.05
7	7-361-2-9	c	bm	3	1	.	.	4	3	.	2	.	5	6	1	2	.	9	8	11	0.89	1.22
8	8-67-2-2	d	ps	3	1	.	.	4	1	2	.	.	3	4	3	.	.	7	5	7	0.71	1.00
9	9-40-2-13	c	bm	3	2	3	.	8	3	2	1	.	6	6	4	4	.	14	15	18	1.07	1.29
10	10-108-2-1	d	bm	6	3	.	.	9	5	.	.	.	5	11	3	.	.	14	8.5	14	0.61	1.00
11	11-69-2-18	c	bm	.	5	1	.	6	1	.	1	.	2	1	5	2	.	8	9.5	10	1.19	1.25
12	12-357-2-3	d	ps	9	10	1	.	20	3	5	.	.	8	12	15	1	.	28	23	29	0.82	1.04
13	13-405-2-9	c	bm	4	6	6	.	16	3	.	1	.	4	7	6	7	.	20	23.5	27	1.18	1.35
14	14-0-2-2	c	bm	6	7	5	1	19	4	.	.	1	5	10	7	5	2	24	28	33	1.17	1.38
15	15-231-2-2	d	bm	5	.	1	.	6	1	1	.	.	2	6	1	1	.	8	6	9	0.75	1.12
16	16-165-2-8	c	bm	1	3	.	.	4	1	1	1	.	3	2	4	1	.	7	7	8	1.00	1.14
17	17-13-2-9	c	ps	1	2	2	.	5	4	2	1	1	8	5	4	3	1	13	15.5	18	1.19	1.38
18	18-88-2-10	a	.	1	.	1	.	2	1	.	.	.	1	2	.	1	.	3	3	4	1.00	1.33
19	19-121-2-15	c	bm	9	2	2	.	13	2	2	2	.	6	11	4	4	.	19	17.5	23	0.92	1.21
20	20-1124-2-12	c	bm	5	4	4	.	13	2	5	2	.	9	7	9	6	.	22	24.5	28	1.11	1.27
21	21-3-2-12	d	bm	.	.	2	.	2	2	.	.	.	2	2	.	2	.	4	5	6	1.25	1.50
22	22-733-2-1	b	bm	2	1	3	.	6	2	1	2	2	7	4	2	5	2	13	20	22	1.54	1.69
23	23-350-2-3	a	.	.	.	.	.	.		1	.	.	1	.	1	.	.	1	1	1	1.00	1.00
24	24-244-2-7	d	gs	.	.	.	.	.	1	1	.	.	2	1	1	.	.	2	1.5	2	0.75	1.00
25	25-1028-2-8	d	bm	4	1	1	.	6	1	1	.	.	2	5	2	1	.	8	6.5	9	0.81	1.12
26	26-452-2-2	c	bm	5	7	1	.	13	5	2	1	.	8	10	9	2	.	21	18	23	0.86	1.10
27	27-51-2-11	c	bm	5	4	2	.	11	3	1	1	.	5	8	5	3	.	16	15	19	0.94	1.19

28	28-322-2-5	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
29	29-154-2-22	d	ps	2	3	.	.	5	1	1		.	2	3	4	.	.	7	5.5	7	0.79	1.00
30	30-453-2-1	a	.	.	1	.	.	1	.	.	.	.	.	.	1	.	.	1	1	1	1.00	1.00
31	31-69-2-17	d	ps	7	3	1	.	11	2	1	.	.	3	9	4	1	.	14	10.5	15	0.75	1.07
32	32-3-2-17	b	bm	7	5	8	2	22	2	.	.	.	2	9	5	8	2	24	31.5	36	1.31	1.50
33	33-99-2-1	d	bm	3	2	.	.	5	.	1	.	.	1	3	3	.	.	6	4.5	6	0.75	1.00
34	34-37-2-2	d	bm	6	2	.	.	8	2	2	.	.	4	8	4	.	.	12	8	12	0.67	1.00
35	35-171-2-8	c	bm	5	2	3	.	10	2	1	2	.	5	7	3	5	.	15	16.5	20	1.10	1.33
36	36-32-2-2	c	bm	1	2	.	.	3	3	.	3	.	6	4	2	3	.	9	10	12	1.11	1.33
37	37-1070-2-8	b	bm	1	2	6	2	11	1	.	1	.	2	2	2	7	2	13	23	24	1.77	1.85
38	38-103-2-4	d	bm	2	1	.	.	3	2	.	.	.	2	4	1	.	.	5	3	5	0.60	1.00
39	39-330-2-1	d	gs/ps	11	.	.	.	11	3	.	.	.	3	14	.	.	.	14	7	14	0.50	1.00
40	40-254-2-12	d	bm	2	3	.	.	5	.	1	.	.	1	2	4	.	.	6	5	6	0.83	1.00
41	41-4-2-14	c	bm	1	7	1	.	9	.	1	.	.	1	1	8	1	.	10	10.5	11	1.05	1.10
42	42-19-2-2	b	bm	3	3	5	1	12	.	2	1	.	3	3	5	6	1	15	21.5	23	1.43	1.53
43	43-1028-2-8	d	ps	10	10	2	.	22	3	2	.	.	5	13	12	2	.	27	22.5	29	0.83	1.07
44	44-273-2-10	d	gs	20	1	.	.	21	2	2	.	.	4	22	3	.	.	25	14	25	0.56	1.00
45	45-254-2-7	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
46	46-333-2-5	c	bm	6	7	1	.	14	2	4	1	.	7	8	11	2	.	21	19	23	0.90	1.10
47	47-1150-2-1	c	bm	1	4	.	.	5	.	2	2	.	4	1	6	2	.	9	10.5	11	1.17	1.22
48	48-464-2-7	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
49	49-1133-2-1	d	bm	6	.	.	.	6	1	2	.	.	3	7	2	.	.	9	5.5	9	0.61	1.00
50	50-1104-2-3	d	gs/ps	7	1	.	.	8	4	.	.	.	4	11	1	.	.	12	6.5	12	0.54	1.00
51	17-1056-2-1	d	bm	5	5	1	.	11	2	1	.	.	3	7	6	1	.	14	11.5	17	0.82	1.21
52	40-61-2-10	d	gs/ps	6	3	.	.	9	2	.	.	.	2	8	3	.	.	11	7	11	0.64	1.00

Cordell Report Appendix C2 – Shell Size

thin section #	sample#	rank shell size	vf shell	fine shell	med shell	coarse shell	vc shell	gr shell	pb shell	T# shell	sum.5 shell	sum1 shell	shsi.5 shell	shsi1 shell
1	1-238-2-7	c	1	2	4	2	.	.	.	9	16.5	17	1.83	1.89
2	2-196-2-7	a	.	3	9	15	7	.	.	34	94	94	2.76	2.76
3	3-417-2-48	a	1	6	5	9	7	.	.	28	71.5	72	2.55	2.57
4	4-367-2-1	b	3	8	13	11	9	.	.	44	104.5	106	2.38	2.41
5	5-454-2-11	c	3	14	13	9	2	.	.	41	76.5	78	1.87	1.90
6	6-103-2-6	b	5	14	16	21	12	1	.	69	164.5	167	2.38	2.42
7	7-361-2-9	b	.	4	10	8	2	1	.	25	61	61	2.44	2.44
8	8-67-2-2	c	3	7	8	5	1	.	.	24	43.5	45	1.81	1.88
9	9-40-2-13	c	1	5	6	3		.	.	15	26.5	27	1.77	1.80
10	10-108-2-1	b	.	9	8	13	6	1	.	37	93	93	2.51	2.51
11	11-69-2-18	c	4	6	9	7	2	.	1	29	61	63	2.10	2.17
12	12-357-2-3	b	.	3	6	6	3	.	.	18	45	45	2.50	2.50
13	13-405-2-9	b	1	12	11	12	6	.	.	42	94.5	95	2.25	2.26
14	14-0-2-2	a	2	5	7	7	4	4	.	29	77	78	2.66	2.69
15	15-231-2-2	a	.	1	3	9	5	1	.	19	59	59	3.10	3.10
16	16-165-2-8	b	1	9	7	9	2	1	.	29	63.5	64	2.19	2.21
17	17-13-2-9	b	.	6	10	18	1	.	.	35	84	84	2.40	2.40
18	18-88-2-10	b	1	3	11	7	2	1	.	25	59.5	60	2.38	2.40
19	19-121-2-15	b	2	5	8	6	4	1	.	26	61	62	2.35	2.38
20	20-1124-2-12	b	1	7	5	9	5	1	.	28	69.5	70	2.48	2.50
21	21-3-2-12	c	3	7	8	5	.	1	.	24	44.5	46	1.85	1.92
22	22-733-2-1	b	.	4	8	10	1	1	.	24	59	59	2.46	2.46
23	23-350-2-3	c	9	17	12	24	5	1	.	68	142.5	147	2.10	2.16
24	24-244-2-7	c	7	23	13	13	8	1	.	65	128.5	132	1.98	2.03
25	25-1028-2-8	a	2	8	7	18	7	1	1	44	116	117	2.64	2.66
26	26-452-2-2	b	1	10	13	20	4	.	.	48	112.5	113	2.34	2.35
27	27-51-2-11	b	1	3	6	8	4	.	.	22	55.5	56	2.52	2.54
28	28-322-2-5	c	4	5	12	9	3	.	.	33	70	72	2.12	2.18

29	29-154-2-22	a	.	2	3	9	5	.	.	19	55	55	2.90	2.90
30	30-453-2-1	a	2	6	9	10	5	3	1	36	96	97	2.67	2.69
31	31-69-2-17	b	9	8	13	11	10	1	.	52	116.5	121	2.24	2.33
32	32-3-2-17	b	.	2	6	5	1	.	.	14	33	33	2.36	2.36
33	33-99-2-1	b	1	8	9	9	7	.	.	34	81.5	82	2.40	2.41
34	34-37-2-2	c	3	10	16	14	2	.	.	45	93.5	95	2.08	2.11
35	35-171-2-8	c	1	11	1	2	2	1	.	18	32.5	33	1.81	1.83
36	36-32-2-2	a	.	4	5	6	7	.	.	22	60	60	2.73	2.73
37	37-1070-2-8	b	2	11	7	6	5	2	.	33	74	75	2.24	2.27
38	38-103-2-4	c	3	7	7	14	1	.	.	32	68.5	70	2.14	2.19
39	39-330-2-1	c	4	9	6	9	4	.	.	32	66	68	2.06	2.12
40	40-254-2-12	b	3	19	20	24	4	3	.	73	163.5	165	2.24	2.26
41	41-4-2-14	a	.	8	6	8	2	1	.	25	57	57	2.88	2.88
42	42-19-2-2	b	3	9	8	9	5	.	.	34	73.5	75	2.16	2.21
43	43-1028-2-8	b	3	5	9	5	4	1	.	27	60.5	62	2.24	2.30
44	44-273-2-10	b	.	5	7	5	2	1	.	20	47	47	2.35	2.35
45	45-254-2-7	c	5	11	13	8	3	1	.	41	80.5	83	1.96	2.02
46	46-333-2-5	b	1	6	3	3	4	.	.	17	37.5	38	2.21	2.24
47	47-1150-2-1	b	4	11	16	12	4	2	.	49	107	109	2.18	2.22
48	48-464-2-7	b	3	13	17	14	3	2	1	53	118.5	120	2.24	2.26
49	49-1133-2-1	c	11	14	20	12	3	.	.	60	107.5	113	1.79	1.88
50	50-1104-2-3	c	7	23	21	19	9	1	.	80	166.5	170	2.08	2.12
51	17-1056-2-1	a	1	6	7	17	6	3	.	40	110.5	111	2.76	2.78
52	40-61-2-10	a	3	4	6	11	3	3	.	30	77.5	79	2.58	2.63

Cordell Report Appendix D – Minority Grains

thin section #	polyx Q	plag	kspar	uid feld	perthite	grog	claylump	chert	sandstone	ss schist	ryolite?	other volc	felsic	amphibole	epidote	mica	mica rank	bone	phyto	phyto rank	spc	spc rank	cyclotella diatoms	pennate diatoms	OTHER
1	1%	.	P	2%	.	Fe?	P SS	P	P	.	P	.	P	.	P	1%	b	.	1-3%	c	P	b	.	.	.
2	1%	P	.	1%	.	.	.	P	P	.	P	.	P	P	P	P	a	.	1-3%	c	1-3%	c	P	P	pyroxene
3	P	P	.	1%	.	Fe?	P SS	P	P	.	P	.	.	P	P	P	a	.	P	b	P	b	.	.	.
4	P	P	.	P	.	.	.	.	.	.	P?	.	.	.	P	P	a	.	1-3%	c	P	b	P?	P?	.
5	1%	1%	P	2%	.	Fe?	P SS	P	P	P	P	Ppor ph	P	1%	P	P	a	.	P	b	P	b	.	.	.
6	P	P	P	2%	.	Fe?	P SS	P	P	.	P	.	.	P	.	P	a	.	P	b	1%	c	.	.	.
7	1%	P	P	2%	.	M,Fe ?	.	P	P	.	P	.	P	P	P	P	a	.	P	b	1-3%	c	.	P	.
8	P	.	P	1%	.	Fe?	P SS	P	.	.	.	.	.	.	P	P	a	.	P	b	P	b	.	.	.
9	1%	P	P	2%	.	.	.	P	P	P	P	.	P	P	P	1-3%	b	.	1%	c	1%	c	.	.	.
10	P	1%	.	1%	.	M	P SS	P	P	P	P	.	.	P	P	1-3%	b	.	P?	b	1%	c	.	.	chr wood
11	P	P	.	1%	.	Fe?	.	P	P	P	P	.	P	P	P	P	a	.	1-3%	c	P	b	.	.	.
12	1%	P	P	2%	.	M,Fe ?	P SS	P	P	.	P	.	P	P	P-1%	P	a	.	1%	c	1%	c	.	.	.
13	1%	1%	.	1%	.	.	P	P	P	.	P	Ptrac h	P	P	P	1-3%	b	.	P?	b	1-3%	c	P?	.	pyroxene rock?
14	1%	1%	P	1%	P	.	.	P	P	.	P	.	P	P	P-1%	3-5%	c	.	P	b	1-3%	c	P	.	.
15	P	P	P	1%	P	M,Fe ?	P SS	P	P	.	P	Ppor ph	P	.	P	P	a	.	P	b	P	b	.	.	.
16	P	P	P	1%	.	M,Fe ?	P SS	P	P	.	P	.	P	P	.	P-1%	a	.	P	b	P	b	.	.	.
17	1%	P	1%	2%	.	M	P	P	P	.	P	.	P	1%	P	P	a	.	P	b	P	b	.	.	.
18	P	.	P	P	.	Fe?	.	P	.	.	.	.	P	P	P-1%	3%	b	.	1-3%	c	.	a	.	.	limonite?
19	1%	P	1%	1%	.	.	P SS	P	P	P	P	.	P	P	P	1%	b	.	P	b	1-3%	c	P	P	.
20	3%	P	1%	1-3%	.	.	P	P	P	.	P	Ptrac h	P	1%	P	1%	b	P?	1%	c	1-3%	c	P?	P?	limonite?
21	P	.	Pvoidf ill	1%	.	Fe?	P SS	P	P	.	P	.	.	P	P	1%	b	.	P	b	1%	c	.	.	.
22	1%	P	P	1%	P	.	.	.	P	.	P	.	P	P	P	P	a	.	1-3%	c	1-3%	c	P	P	isotropic
23	P	P	.	.	.	.	P SS	p	.	.	.	.	.	.	.	P	a	.	P	b	P	b	.	.	.
24	.	P	.	1%	P	M,Fe ?	P SS	.	.	.	P	.	.	.	P	1%	b	.	1%	c	P	b	.	.	.
25	1%	1%	.	1%	.	M,Fe ?	P SS	.	P	.	P	Pp&t	.	P	P	P	a	.	P	b	1%	c	.	.	.
26	1%	P	1%	2%	.	.	P SS	P	P	.	P	.	.	P	P	P	a	.	1-3%	c	1-3	c	.	.	.

																				%				
27	1%	P	P	2%	P	.	P SS	P	P	.	P	.	P	P	P	1%	b	.	1-3%	c	1-3%	c	P	.	.
28	P	P	.	.	.	.	P SS	.	P	.	.	.	P	.	.	P	a	.	P	b	.	a	.	.	.
29	P	P	.	P	.	M,Fe ?	P SS	.	.	.	.	.	P?	P	.	P-1%	a	.	P	b	1-3%	c	P	P	.
30	P	P	.	P	.	.	P SS	.	P?	.	P?	.	.	P	.	P	a	.	P	b	P	b	.	.	.
31	P	P	.	1%	.	Fe?	P SS	.	.	.	?	.	.	P	P	P	a	.	P	b	P	b	.	.	.
32	1%	1%	1%	1%	.	.	P SS (lter&dker)	P	P	P	P	Ptrach	P	P	P	1-3%	b	.	P	b	1-3%	c	P	P	.
33	P	P	.	1%	.	Fe?	P SS	P	P	.	P	.	.	P	P	P	a	.	P	b	P	b	.	.	.
34	1%	P	P	1%	P	.	.	P	P	P	P	.	.	P	P	P	a	.	1%	c	P?	b	.	.	pyroxene
35	3%	1%	P	1%	.	void fill	P stained	P	P	.	P	.	.	P	P	1-3%	b	.	P	b	1%	c	P	.	pyroxene
36	1%	1%	P	1%	.	.	P SS	P	P	.	P	.	.	P	P	1-3%	b	.	1%	c	1-3%	c	P	.	px, zircon
37	1%	P	1%	1%	.	.	P	P	P	.	P	.	P	P	P	P	a	.	1%	c	1%	c	P	.	isotropic
38	1%	P	P	1%	.	.	P	P	P	.	P	.	P	1%	P	P	a	.	P	b	P	b	.	.	chr wood
39	P	P	.	1%	.	.	P SS	.	P	.	P	.	.	P	P	P	a	.	P	b	1%	c	.	.	.
40	P	1%	P	P	.	.	.	.	P	.	P	.	.	P	P	3%	b	freq	P	b	P	b	.	.	.
41	1%	P	.	P	.	Fe?	P SS	P	P	P	P	.	P	P	.	P	a	.	1-3%	c	1%	c	P	.	.
42	1%	P	P	1%	P	.	P SS	P	P	.	P	.	P	P	P	1-3%	b	.	P	b	1-3%	c	P?	.	.
43	P	P	P	1%	.	Fe?	P SS	P	P	.	P	.	.	.	P	P	a	.	P	b	1%	c	P?	.	.
44	P	P	.	1%	.	.	.	P	.	.	P?	.	.	P	P	3-5%	c	.	.	a	.	a	.	.	limonite?
45	P	.	P	.	.	.	P SS	P	.	.	.	.	.	.	.	P	a	.	1%	c	P	b	.	.	.
46	1-3%	P	P	2%	.	.	P SS	P	P	.	P	.	P	P	P	3-5%	c	P	1%	c	1%	c	P	.	biotite,chr wood
47	1%	P	P	1%	P	.	P SS	P	P	.	P	.	P	P	P	3%	b	.	1-3%	c	P	b	.	.	felsic w/ epidote
48	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1%	b	.	P	b	P	b	.	.	.
49	1%	P	P	1%	.	Fe?	P SS	.	P	.	P	.	.	P	P	P	a	.	P	b	P	b	.	.	.
50	1%	P	.	1%	.	Fe?	P SS	P	P	.	P	.	P	1%	P	1%	b	.	P	b	P	b	.	.	chalcedony
51	P	P	P	2%	P	Fe?	P SS	P	P	P	P	.	P	P	P	P	a	.	P	b	1%	c	.	P	.
52	.	P	P	1%	.	Fe?	.	P	P	.	P	.	.	P	P	P	a	ocfr	P	b	P	b	.	.	.