Provenance and Composition of Impactite Sands; AU Drill Core #09-04, Wetumpka Impact Structure, Alabama

by

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Abstract

The Wetumpka impact structure is a Late Cretaceous shallow-marine impact crater about 6 km in diameter located in central Alabama. The target consisted of Upper Cretaceous sediments that were unconformably overlying Piedmont schists and gneisses. An arcuate crystalline crater rim is surrounded on the east and northeast by Upper Cretaceous sedimentary units, on the north by Piedmont basement, and on the west by Quaternary alluvium.

There are several shallow drill cores at Wetumpka, including Auburn University drill core #09-04, which penetrated a depth of 217.7 m (715 feet) near the southeastern portion of the rim. The upper ~ 60 m (197 feet) of core is interpreted as a segment of slumped, overturned sedimentary section of megablocks that was formerly on the rim. Below this overturned section are 152 m (500 feet) of impactite sands with sedimentary blocks. The objective of the present project is to determine the provenance of the nearly 152 m (500 feet) of impactite sand in the lower part of drill core #09-04.

Thin-sections were made from 43 samples taken from impactite sand intervals in the lower portion of the drill core. Fining-upward trends were detected in eight intervals and this pattern is interpreted as the result of an aqueous settling process. Point-counting and statistical analysis of framework grain characteristics within the loosely consolidated sands indicate that the grains do not originate from a single target unit and provide reasonable evidence that they are derived from a mixture of the sedimentary and metamorphic target units.

Acknowledgments

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INTRODUCTION

The Wetumpka impact structure is an Upper Cretaceous marine impact crater in Elmore County, Alabama (King et al., 2002). The well preserved, ~6 km-diameter structure is located on the east side of the city of Wetumpka (geographic center at 32º31.2'N, 86º10.4'W; Figure 1). A horseshoe-shaped crystalline Piedmont rim is surrounded by Upper Cretaceous formations on the east and northeast, Piedmont rocks on the north, and Quaternary alluvium on the west and southwest. The crater is estimated to be 84.4 ± 1.4 m.y. based on (U-Th)/He dating of zircons and apatite (Wartho et al., 2012).

Geologists have noted an unusual disturbed area at Wetumpka as far back as the late 19th century (Smith et al., 1894). Smith, the second state geologist of Alabama, observed that the crystalline Piedmont rocks, which typically underlie Upper Cretaceous formations in the area, instead form an exposed, arcuate ridge with relatively high elevation. There was little interest in the structure until a team led by Thornton L. Neathery of the Geological Survey of Alabama reexamined the area during the late 1960s and early 1970s. Their paper was the first to suggest the structure is an astrobleme (Neathery et al., 1976). In 1998, David T. King, Jr. and T. L. Neathery obtained a grant from Vulcan Materials Company of Calera, Alabama to conduct the first core-drilling operations at the impact structure. In 1998, two core holes were drilled at approximately the geographic center of the structure. In 2002, King and others published the diagnostic evidence of a meteoritic impact, including shocked quartz and iridium enrichment found in these wells (King et al., 2002).

Figure 1. County map of Alabama showing the location of Wetumpka in relation to Montgomery and Birmingham. Location of Alabama shown in the inset map of the United States.

GEOLOGIC SETTING

The following description is summarized from King et al. (2006). During Late Cretaceous, the Wetumpka area was a shallow sea with water depths estimated to have been between 30 and 100 m (Figure 2). The target consisted of three main units: 1) pre-Cretaceous Piedmont basement; 2) Upper Cretaceous sediments; and 3) marine water. The lowest stratigraphic unit was crystalline, Piedmont basement rocks that dip slightly to the south-southwest. A package of three Upper Cretaceous sedimentary units rest unconformably on top of

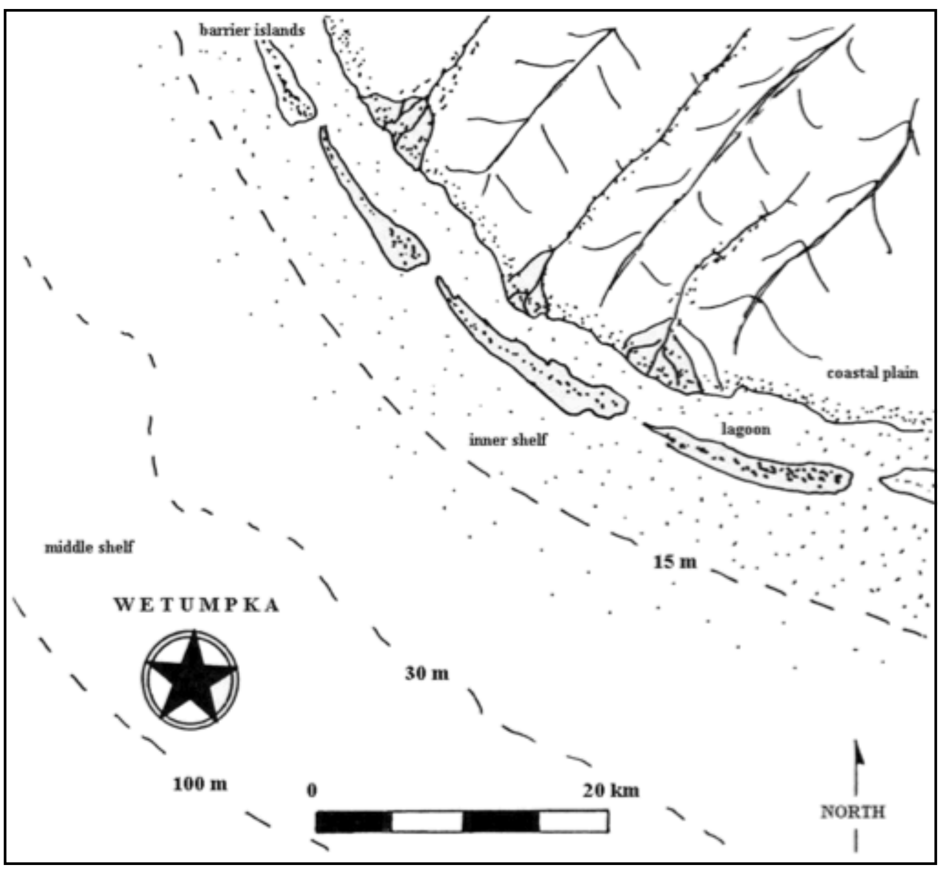


Figure 2. A paleogeographic reconstruction of the setting for the Wetumpka impact (from King et al., 2006).

the basement rocks: the Tuscaloosa Group (terrestrial clayey sand and gravel); the Eutaw Formation (marine sand); and the Mooreville Chalk (mainly a clay-chalk ooze).

There are two distinct terrains composing the Wetumpka impact structure. The crystalline-rim terrain (unit crt; Figure 3) is composed of pre-Cretaceous metamorphic rocks displaying foliation that is not consistent with the regional trend (i.e., dipping radially away from the center of the structure; King et al., 2002). The second terrain is the intra-structure terrain (unit ist; Figure 3), a mega-breccia consisting mainly of broken Upper Cretaceous formations in the form of lithic megablocks a few meters to a few 10s of meters in diameter.

The shallow sea covering the target rocks played an important role in producing the modern semi-circular shape of the crater. Variations of sediment thickness and the presence of water during the impact aided in the collapse of the southern rim (King et al., 2006). The resurgence of water following the impact likely further weakened the rim, causing it to collapse and thus open an avenue for aqueous and mass movement flow into the structure (King and Ormö, 2011).

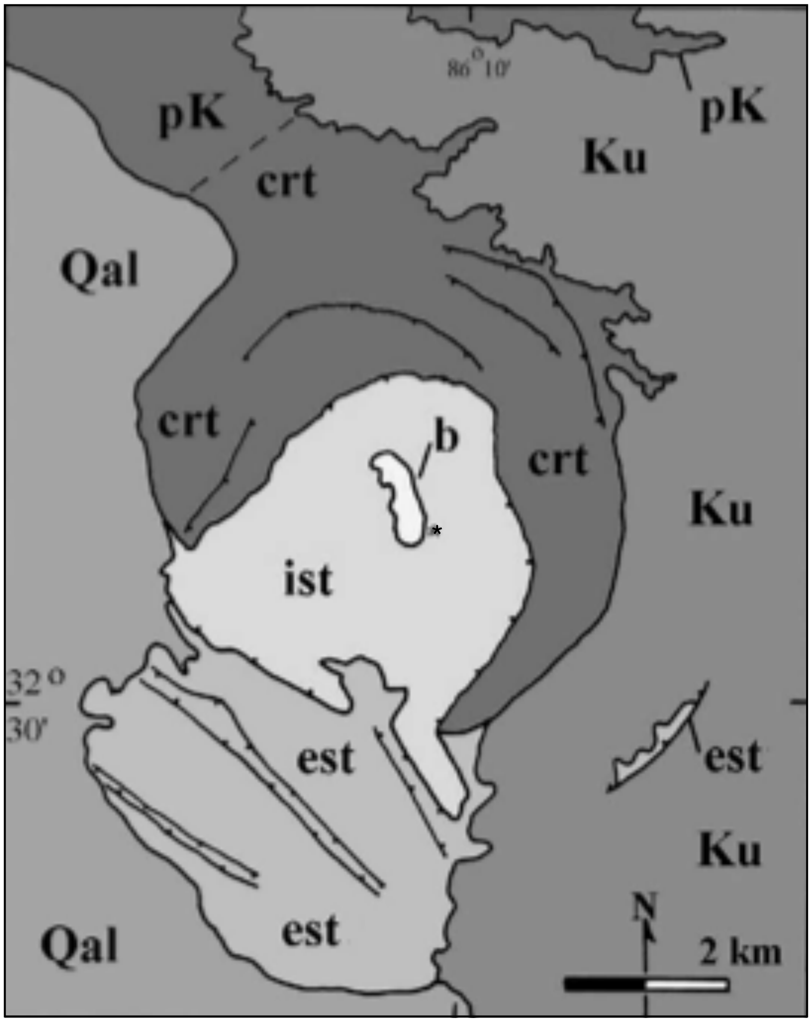


Figure 3. Crater terrains as described in the text. Crystalline-rim terrain (crt);intra-structure terrain(ist); extra-structure terrain (est); Upper Cretaceous undeformed units (Ku); pre-Cretaceous crystalline units unaffected by Wetumpka structure (pK). Faults are tick-marked on down side (from King et al., 2002).

CRATER FORMATION

The crater-forming process begins the moment a meteorite contacts the target. The following description of crater formation is condensed from French (1998). The cratering process is divided into three stages, each based on the main deformation mechanism: contact and compression, excavation, and modification.

First is the contact and compression stage. When the projectile first contacts the target material, a shockwave is produced in both the projectile and target. This stage lasts only as long as the time it takes for the wave to travel through the projectile from front to back, then back to front, at which point the projectile is vaporized. The contact and compression stage generally lasts less than a second for most impacts, after which the projectile plays no further role in crater formation. The excavation stage occurs when the crater is opened and most disintegrated material is ejected or pushed downward. During this stage, upper target rocks are ejected while deeper target rocks are compressed and driven downward to form a bowl-shaped transient crater. The duration of the excavation stage can range from a few seconds up to a few minutes and ends when the transient crater reaches it's maximum size. The modification stage begins immediately after the excavation stage. At this point in crater formation, the primary driving mechanisms are gravity and rock mechanics. Gravity causes the walls of the transient crater to collapse into the center and mix with fall-back ejecta to form a mixed breccia lens. Modification stage lasts longer than the excavation stage and, in fact, may have no definite end.

Upon impact, a compressional shock wave radiates through the target at speeds that can exceed 10 km/s (French, 1998). The shock wave deforms the crystal structures of many minerals, most notably quartz and feldspar. Planar deformation features (PDFs) in quartz and feldspars and partial melting of feldspars are unique products of meteoritic impacts.

Shocked materials, in particular shocked quartz, was first found in Wetumpka's polymict breccia below 300 ft (91 m) in both central wells drilled in 1998 (well locations marked by * in Figure 3; King et al., 2002). Later, shocked quartz was found in a central surficial breccia unit within the crater (unit b in Figure 3; Morrow and King, 2007). Crystallographic orientations of PDFs were measured using a four-axis universal stage and plotted on a histogram (King et al., 2002; Morrow and King, 2007). High concentrations of PDFs on certain crystallographic planes indicate the PDFs are the result of a very high strain-rate metamorphic process characteristic of a cosmic impact (as discussed by French, 1998). Measurements of PDF orientations within quartz grains found near the center of the crater suggest that shock levels in the Wetumpka structure were low, ~10 GPa (King et al., 2002).

Feather features (FFs) are another deformation microstructure in quartz and feldspar that are found in the central uplift regions of some complex impact craters (Kenkmann et al., 2009). Even though the existence of a central peak in the Wetumpka impact structure has not been confirmed, the occurrence of FFs in uplifted crystalline basement near the center of the Wetumpka impact structure has been interpreted as suggesting there may be some type of central peak (Rodesney et al., 2010).

PREVIOUS WORK

This project builds on previous work from a variety of different disciplines including drill-core analysis, sandstone petrography and provenance, and impact studies, that utilize multiple analytical techniques.

I. Drilling and Drill-Core Analysis

To date, there have been two drilling campaigns inside the crater (King and Ormö, 2011). The first drilling took place in 1998 at the Schroeder and Reeves core holes near the center of the structure (green and yellow circles, Figure 4). The 1998 drill cores were analyzed and logged by Reuben Johnson for his Master's thesis (Johnson, 2007). The second drilling program took place in 2009, and four wells were drilled in various locations around the crater. Drill core #09-01 was studied by Pascual Tabares Rodenas for his Master's thesis (Tabares Rodenas, 2012) and drill cores #09-03 and #09-04 were studied by James Markin for his Master's thesis (Markin, in progress).

Drill core #09-04 is of particular interest in the present study of impactite sandstone provenance at Wetumpka. Located in the southeastern portion of the interior structure terrain (unit ist; Figure 3), the core was analyzed and logged by James Markin (Markin, in progress). The precise location of drill core #09-04 is shown on Figure 4. In his study, Markin defined and characterized multiple lithofacies for the entire well (Table 1). Markin (in progress) concluded the upper portion of the well penetrated a slumped and overturned sedimentary flap based on a

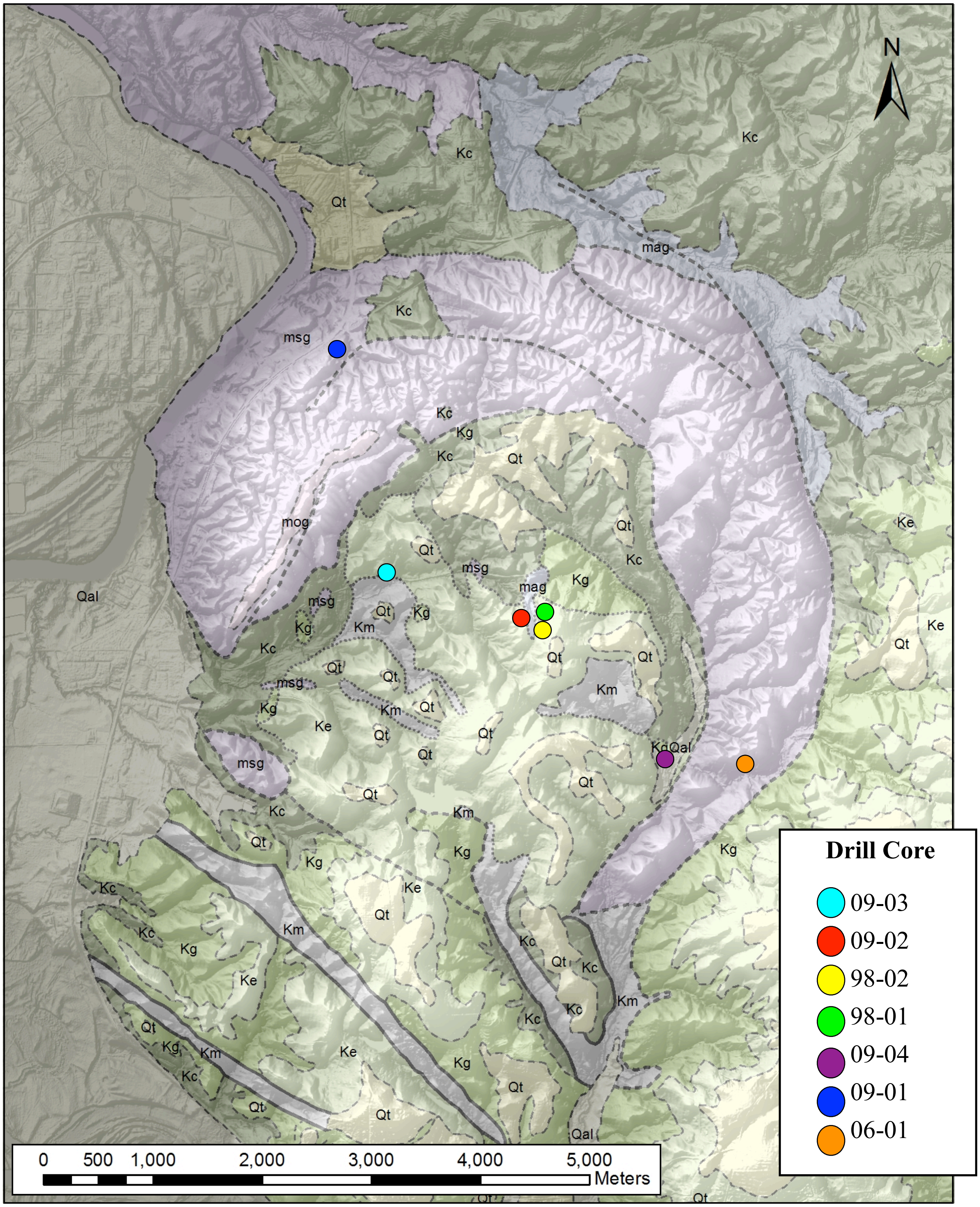


Figure 4. Geologic Map of the Wetumpka impact structure showing drill core locations. Map by Pascual Tabares Rodenas (2012).

folded sequence of Tuscaloosa Group and Eutaw Formation. Below the overturned flap is nearly 500 feet of impactite sands of which the specific origin and provenance is unknown (Markin, in progress). He subdivides these sands into lithofacies D1, D2, D5, D6, and D7 (Table 1).

It is important to note that impactite sand intervals occur between intact blocks of Tuscaloosa Group and Eutaw Formation which have various orientations and sizes (up to several meters). The present study examines only the impactite sands, not the intercalated blocks. The drill-core stratigraphy of Markin (in progress) can be found in Figure 5.

Group or Formation	Lithofacies	Description
Tuscaloosa Group	T2	Overbank/paleosol mud
	T3	Overbank/paleosol sand/sandstone
	T4	Contorted, laminated sand/sandstone
	T5	Fluidized sand/sandstone
	T6	Cross-stratified sand/sandstone
	T7	Cross-stratified granular-pebbly sand
	T8	Massive, reverse-graded, granular-pebbly sand
Eutaw Formation	E4	Fluidized sand/sandstone
	E7	Contorted, laminated sand/sandstone
	E8	Grayish-green to green-black, mud conglomerate
	E9	Disrupted sand
	E10	Interstratified, micaceous, lignitic-mud and sand
	E11	Rhythmic-laminated lignite and sand
	E12	Cross-laminated sand
	E13	Olive-gray, fossiliferous, clayshale
	E14	Carbonaceous shale
	E15	Sand lignite
(Unknown)	D1	Massive, structureless, impactite sand/sandstone
	D2	Fluidized impactite sand and sandstone
	D5	Contorted, impactite sand/sandstone
	D6	Massive, structureless, granular-pebbly impactite sand/sandstone
	D7	Inclined, poorly-moderately stratified impactite sand/sandstone
Metamorphic basement	C1	Saprolitized metamorphic rock

Table 1. List of lithofacies found in drill core #09-04 as characterized by Markin (in progress). Lithofacies are not listed in stratigraphic order.

II. Sandstone Provenance

The process of inferring standard sandstone provenance has been well established by Folk (1980), Dickinson (1985), Ingersoll (1988), and others. Detrital modes calculated from point counts of framework grains within a sandstone can be used to infer transport mechanisms, climate, and depositional environment of sandstones. Ultimately, tectonic setting controls the composition and distribution of sandstone. Therefore, tectonic setting can be interpreted based on the relative abundances of quartzose grains, feldspar grains, and lithic fragments (Folk, 1980; Dickinson, 1985; Ingersoll 1988).

III. Impactite Provenance Studies

Sedimentological studies similar to the present study have been conducted at two marine impact craters, the Chesapeake Bay impact structure and the Marquez Dome in southeast Texas.

A study of gravelly sands from the Chesapeake Bay impact structure was conducted using Dickinson's point-counting methods to determine the original target formation (Bartosova et al., 2010). The interval of gravelly sands in a Chesapeake Bay drill core (Eyreville B) is similar to the impactite sand interval in drill core #09-04. Both sediments are loosely consolidated and support megablocks of crystalline target rocks. Petrographic study indicated that the tectonic setting was a passive margin with a continental source (Bartosova et al., 2010). It was concluded that the gravelly sands originated mainly from the Lower Cretaceous Potomac Formation, one of the target formations, based on pollen flora and geochemical similarities. The sediments in drill core #09-04 are more analogous to the section of gravelly sands in the Eyreville B core from the Chesapeake Bay impact structure (Bartosova et al., 2010). The intervals in both impact structures appear to be pulverized target materials that do not macroscopically resemble any target units.

A study similar to the work on Chesapeake Bay was done earlier on the Marquez Dome, a ~15 km diameter impact structure in unconsolidated sediments in southeast Texas (Buchanan et al., 1998). A stratigraphic study of two wells located near the center of the crater concluded that the annular basin around the central peak is characterized by interbedded sands, silts, and shales of the target material (Buchanan et al., 1998). The Marquez Dome is a shallow marine impact crater and the internal structure could be similar to Wetumpka. However, unlike the Wetumpka impact structure, the Marquez Dome target did not consist of sedimentary target rocks resting unconformably upon crystalline basement rocks.

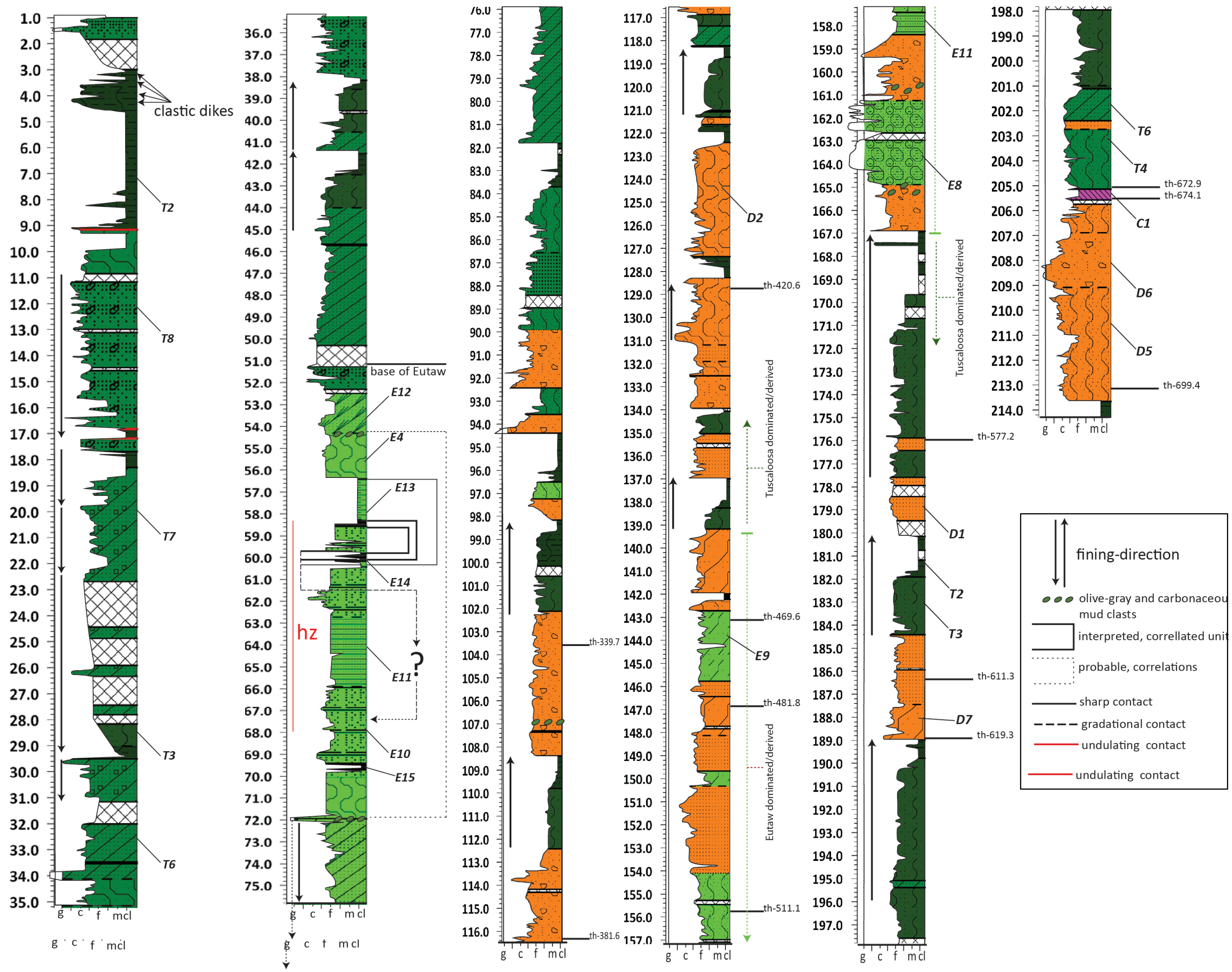


Figure 5. Well log showing lithofacies defined by Markin (in progress). Colors indicate the interpreted origin of the interval; green for Cretaceous sedimentary target, purple for metamorphic basement target, and orange for unknown origin (impactite sands in this study). Scale is in meters. The impactite sands commence at about 90 m (295 feet). From Markin (in progress).

OBJECTIVES

The objective of this thesis is to determine the provenance of the nearly 500 ft (152 m) of impactite sand in the bottom of drill core #09-04 (Figure 6). The identification of all minerals in this impactite sand, including shocked and non-shocked phases, metamorphic and sedimentary mineral assemblages will provide evidence of provenance during the cratering process. This, in turn, will provide valuable insight about the crater-forming process.

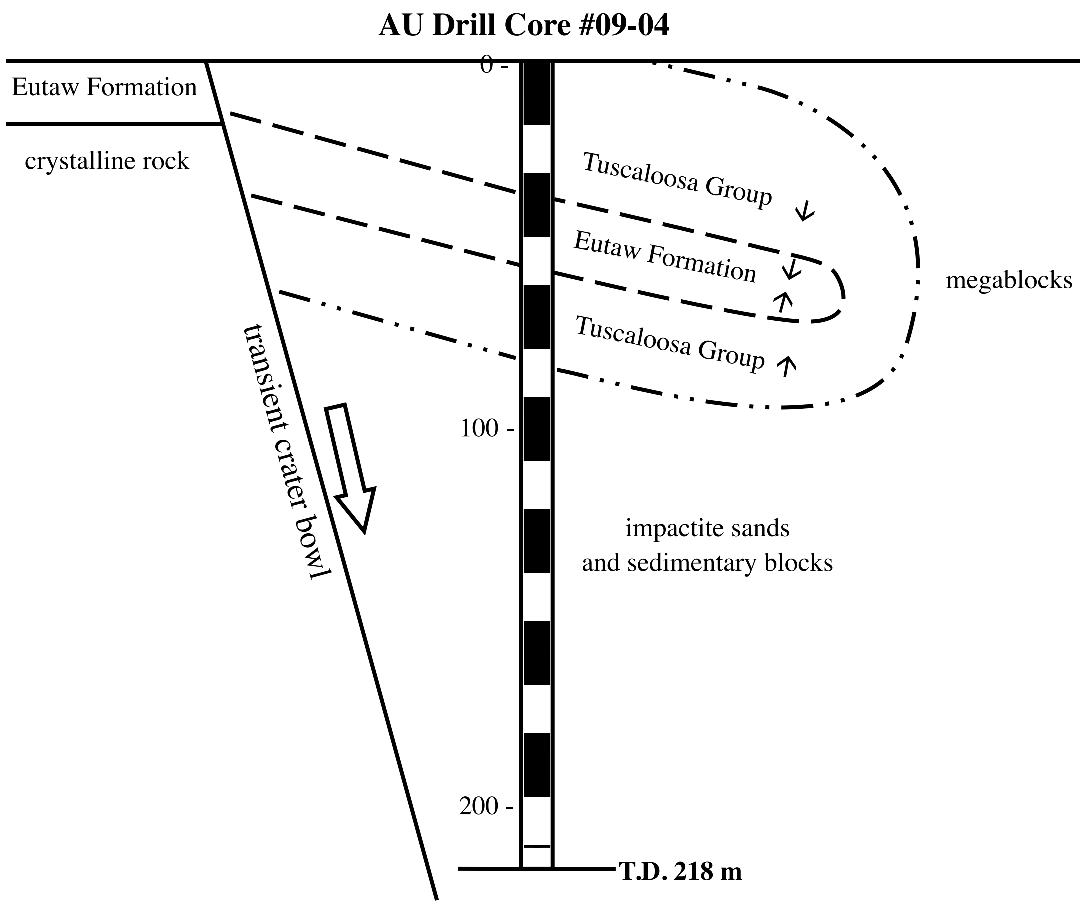


Figure 6. A schematic showing the major lithologic units in AU drill core #09-04. The upper portion of the core contains the slumped, overturned flap and is underlain by impactite sands and sedimentary blocks. Arrows indicate stratigraphic up direction on sedimentary units. From D. T. King, Jr (personal communication).

MATERIALS AND METHODS

I. Sample Selection

The sample selection process was guided by previous work by Markin (in progress; Figure 5). Sand samples were taken from every impactite sand interval (i.e., lithofacies D1, D2, D5, D6, and D7). These lithofacies are shown in the orange intervals in Figure 5. In an effort to reveal any vertical trends within larger intervals, multiple samples were taken from intervals greater than five feet thick. A total of 43 drill-core samples were collected for analysis. In addition, target comparison samples were collected from identifiable intact blocks located in and around the structure.

II. Thin-section Preparation

Thin-section analysis was necessary to identify mineralogy of framework grains and to accurately measure grain size and angularity. Unconventional epoxy methods had to be devised because of the friable nature of the sand samples.

Most samples were loosely consolidated and thin-sections could not be made using conventional methods. Artificial impregnation proved to be the most effective way to achieve a coherent sample that was easy to work with. Each sample was disaggregated by hand or by carefully crushing the sample as not to break individual grains. The loose sand was then poured into a silicone ice-cube tray (1.25 x 1.25 x 0.5 in) half-filled with Hillquist C-D impregnation epoxy and left to cure overnight on a hotplate set to "low." The resulting "pucks" were then hard and coherent enough to polish on glass plates with 120 grit without plucking grains or disaggregation. Each puck was polished on glass plates with 120, 400, and 1000 grit until a smooth, uniform surface was achieved. The pucks were dried on a hot plate set to "low" until completely dry, then mounted upon unfrosted petrographic microscope slides and left to cure overnight at room temperature. Dried samples were inspected for air bubbles and cracks in the slide. Undamaged samples were cut into "thick-sections" using a cut-off saw and ground down to a thickness between 30 and 45 microns.

Some samples collected from the drill core were sufficiently consolidated enough to be vacuum impregnated. These samples retained their sedimentary texture. Comparison of point counts between vacuum-impregnated samples and crushed-then-impregnated samples yielded the similar results. It was concluded that the artificial impregnation process did not influence preferential mixing or exclusion of certain framework grains.

III. Documentation and Point-counting Techniques

Careful documentation of thin-section surface areas plays a very important role in this study because individual grains must be observed multiple times at various stages of the analysis. Thin-sections were photographed in a grid (usually 25 photographs per thin section) and stitched together using image editing software to create an image of almost all of the sample area on the slide. Such high-resolution imagery of complete samples is necessary for later steps.

Each thin-section image was imported into JMicroVision software (v1.2.7) for point counting and image analysis. The framework grain classification for this project is based on Dickinson's (1985) scheme and can be found in Table 2. Point-counting was done using the point-counting feature in the JMicroVision software. A total of 300 random grains per sample

A. Quartzose Grains Qm = monocrystalline quartz (>0.625 mm) Qp = polycrystalline quartz (or chalcedony)
B. Feldspar Grains F = total feldspar grains
C. Unstable Lithic Fragments Lm = metamorphic lithic fragments Ls = sedimentary lithic fragments
D. Mica and Others M = mica (biotite, muscovite) Other (garnets, calcite, opaques)

Table 2. Classification scheme for point counting framework grains (after Dickinson, 1985).

(i.e., grains not arranged in a grid) were counted and classified using the scheme above. Data are shown in appendix I. After point-counting each sample, the image scale was calibrated to measure the long axis of each grain. Angularity was assessed visually for each grain using a scale from 0.1 - 0.9 proposed by Krumbein (1941; Figure 7). Mineralogy, grain size, and angularity data for 300 grains per sample (43 drill core and 10 control samples) were exported to a spreadsheet for statistical analysis. Figure 8 is an example of the JMicroVision project.

IV. Statistical Analysis

The data acquired from the thin-sections are suitable for a wide variety of analytical techniques. Depth plots can be made for virtually any parameter involving any combination of mineralogy, grain size, and angularity. In addition to depth plots, statistical analysis can determine if any difference between population distributions are real or if they are the result of chance sampling of a homogeneous population (Folk, 1980).

The data collected was prepared for analysis as Comma Separated Values (CSV) files to be used with “R,” statistical analysis software. R was used because it is capable of performing

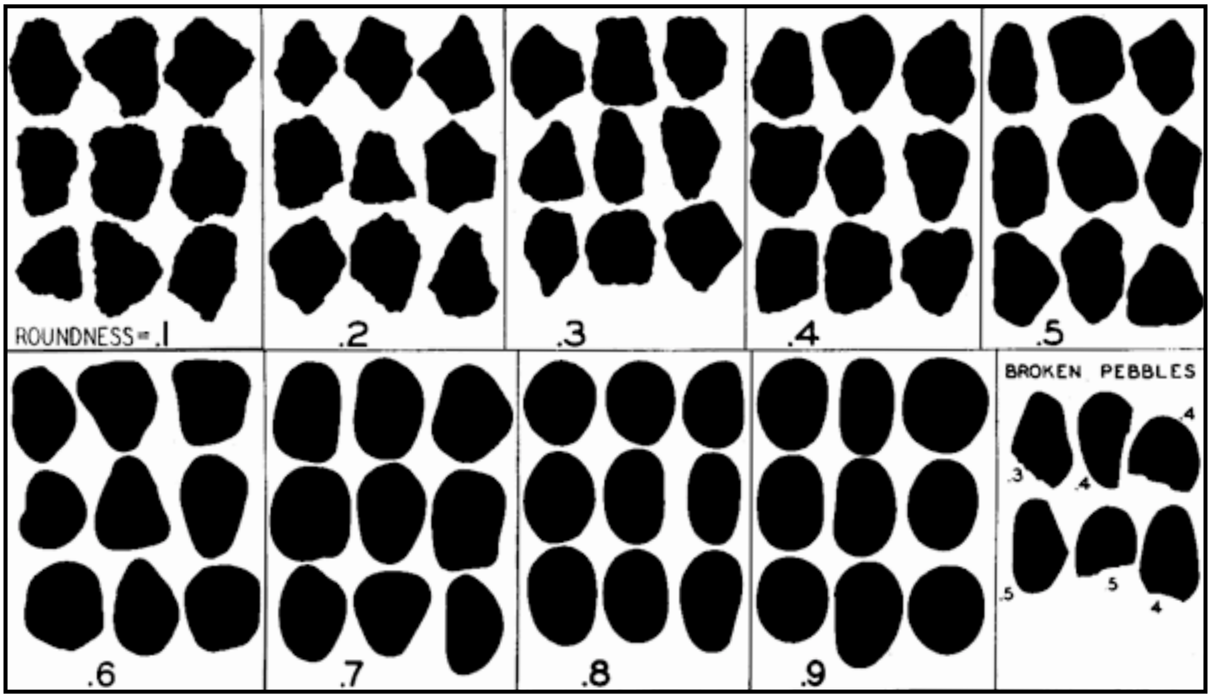


Figure 7. Visual guide for estimating grain roundness with 0.1 being least rounded and 0.9 being most rounded (from Krumbein, 1941).

more complex statistical tests than common productivity software. The following paragraphs provide a description of the tests that were used and how to interpret the results.

The X^2 (Chi square) test compares counts of discrete objects between samples, which was used to determine if there is a compositional relationship among the impactite sand lithofacies described by Markin (in progress). The Chi square test allows for multiple parameters to be compared (i.e., counts of Qm, Qp, and F between several samples), versus the Student's T-test which only compares two means. The versatility of the Chi square test makes it possible to compare all samples of a particular lithofacies, samples in a continuous interval, or randomly selected samples (Folk, 1980).

The other primary test used was the Wilcoxon Rank-Sum test, a non-parametric statistical hypothesis test. Unlike the Student's T-test, the Wilcoxon Rank-Sum test does not assume the data is normally distributed or require the sample sizes to be the same. The versatility of this test allows comparison of more than just the grain counts between samples. Grains counts, size, and angularity of samples from the drill core were compared to the control samples in an attempt to determine which target units were contributing most to individual parameters (Crawley, 2007).

Both statistical tests described above produce a “p-value.” This p-value is the probability (given in a percentage) of a certain event happening. In statistics, if p is less than 5%, the differences observed between the two means are considered acceptable (Folk, 1980).

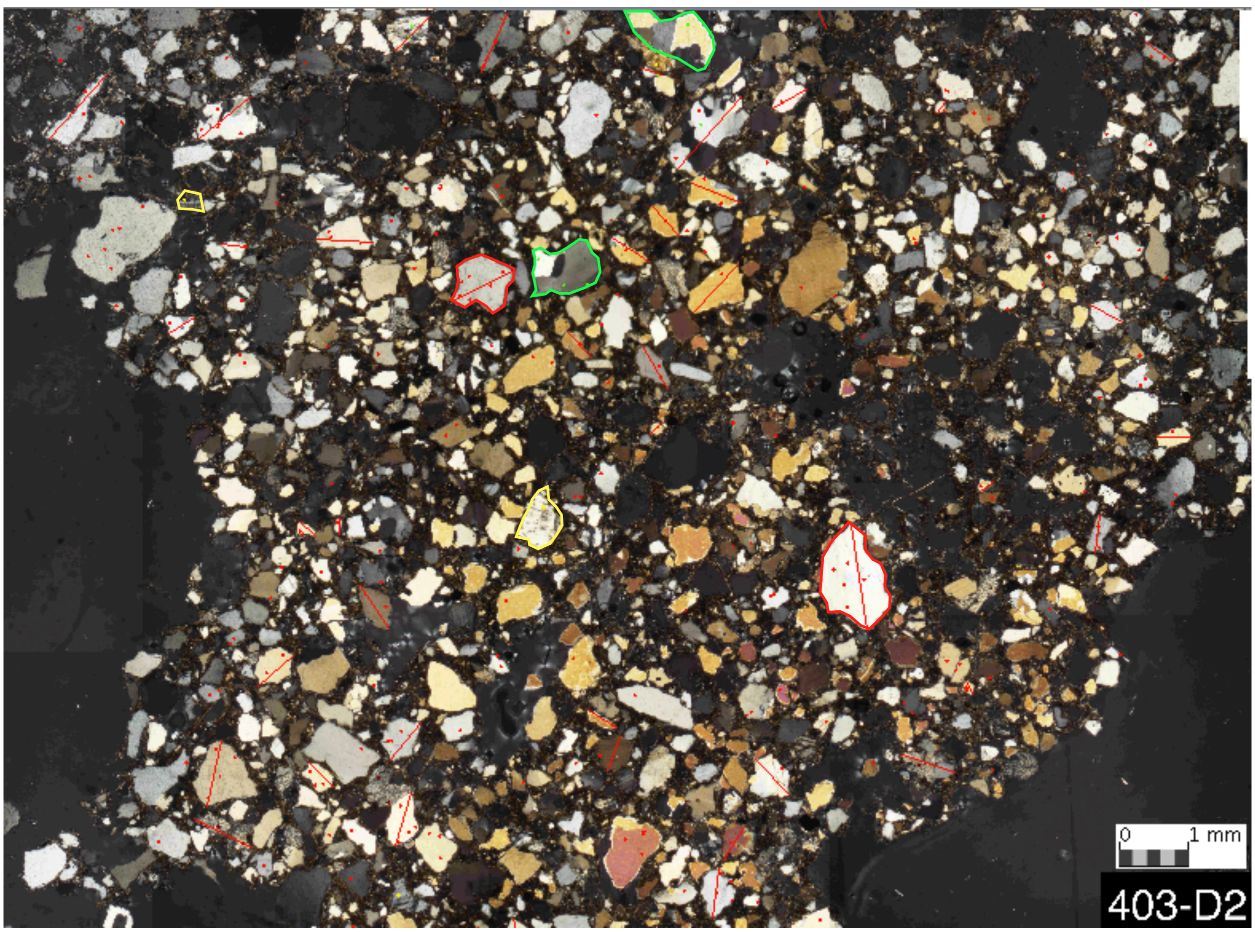


Figure 8. Photomosaic example of sample #403-D2 after partial analysis with JMicroVision software. Colored dots on grains indicate grain type (e.g. red dots indicate Qm, green indicate Qp, yellow indicate F). Some sample grains have been outlined with their corresponding colors. Red lines show the long axis of individual grains used for grain size statistics. Thin section is not standard thickness.

RESULTS AND DISCUSSION

Point counting and statistical analytical data revealed similar trends found by Markin (in progress). These results bring out some significant trends in the impactite sands that could only be discerned using the present methods.

I. Thin-Section and Point-Counting Results

Thin-section analysis of the impactite sands provides a means of determining mineralogy, size, and angularity of individual grains. All samples (drill core and samples from the target unit) were dominated by monocrystalline quartz (Qm). Secondary minerals were commonly polycrystalline quartz (Qp), feldspar (F; mostly microcline), and sedimentary lithic fragments (Ls). Abundance of secondary minerals varied depending on the sample - for example, some samples had a relatively large amount of Ls, but completely lacked F and vice-versa. Framework grains that did not fit the classification scheme in Table 2 were classified as “other.” Other grains were commonly hematite, calcite, or chert, and they represented a small percentage (<7%) of framework grains. A garnet was found in one sample and is good evidence that the metamorphic basement contributes to the sands in some way (Figure 9). Small amounts of hematite were observed filling vugs and coating quartz grains in many samples. Any calcite that was observed occurred as a cement between framework grains and was only identified in two thin sections within a single interval. The minerals observed in thin section are consistent with X-ray

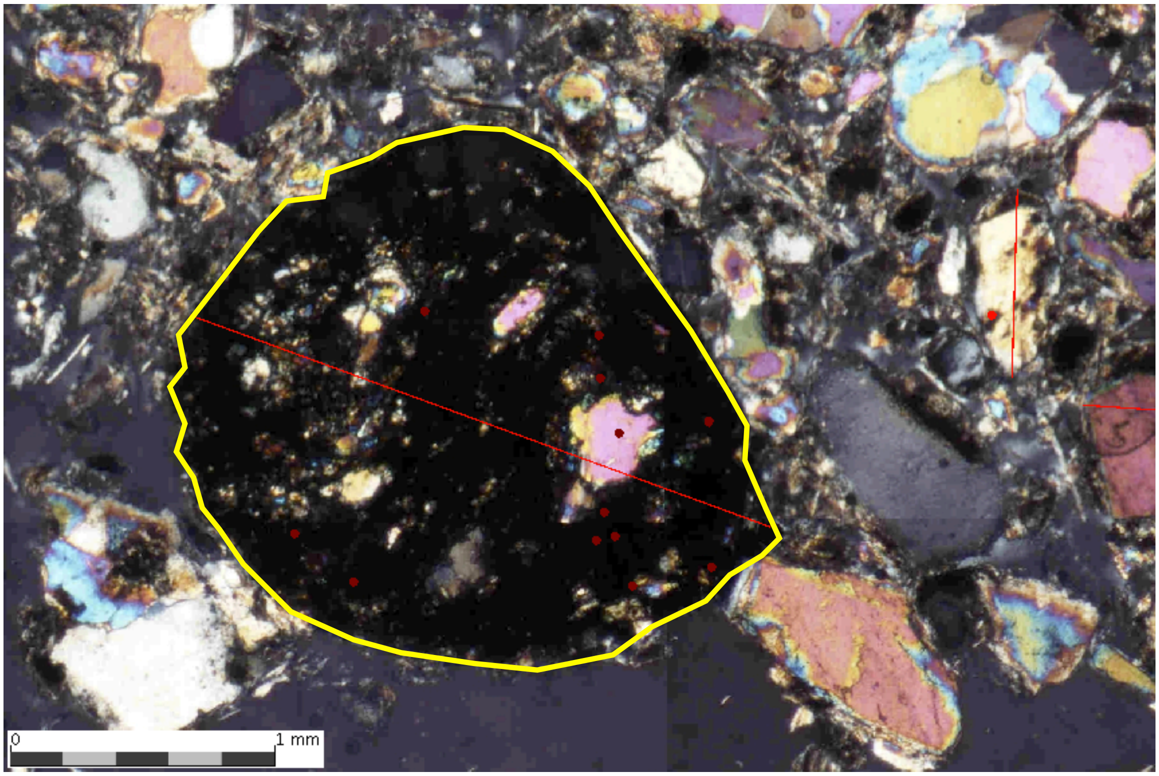


Figure 9. Photomicrograph of a garnet found in sample 308-D6. Photo was taken in cross-polarized light. Thin section is not standard thickness. Garnet is outlined in yellow.

diffraction analysis results by Rodesney et al. (2012). A complete table of point counting data is in Appendix 1.

Grain-size measurements for all samples pertain to framework grains that were included in the point counting. This is so because the fine fraction of the sample (less than 100 microns) was disregarded and not included in the analysis. Drill core and samples from the target units ranged from very coarse to medium sand, but most samples fell into the coarse sand category. In most instances, the Qp grains were larger than the Qm by 0.1-0.5 mm and were typically more rounded. Size differences between Qp and Qm were not enough to separate them into different grain size categories. Sorting also varied greatly from well-sorted to poorly sorted. Grain size and sorting show no clear relationship and have an R^2 value of 0.04. Angularity of grains were visually assessed using Figure 7 for comparison (Krumbein, 1941). Most framework grains of

Qm and Qp had an angularity of 0.35-0.45, with Qp grains being at the upper end of the range. Feldspar grains were almost always more rounded than Qm and Qp, values were typically 0.45-0.55 (Figure 10).

Depth plots of grain count, size, and angularity reveal notable trends in the data. The most notable observation in terms of determining provenance is the occurrence of metamorphic lithic fragments (Lm) in three consecutive samples at depths of 103.6 , 105.7, and 107.9 m (340, 347, and 354 feet, respectively). A garnet occurs in the sample from 93.8 m (308 feet). Other samples did have Lm, but had fewer than 8 grains per sample and were not adjacent to each other in the drill core. The frequency of Lm indicates that metamorphic basement rocks contribute more to the interval between 91.4 and 106.7 m (300 and 350 feet) depth than any other interval in the drill core. The basement rocks may have contributed to the other sand intervals, but their

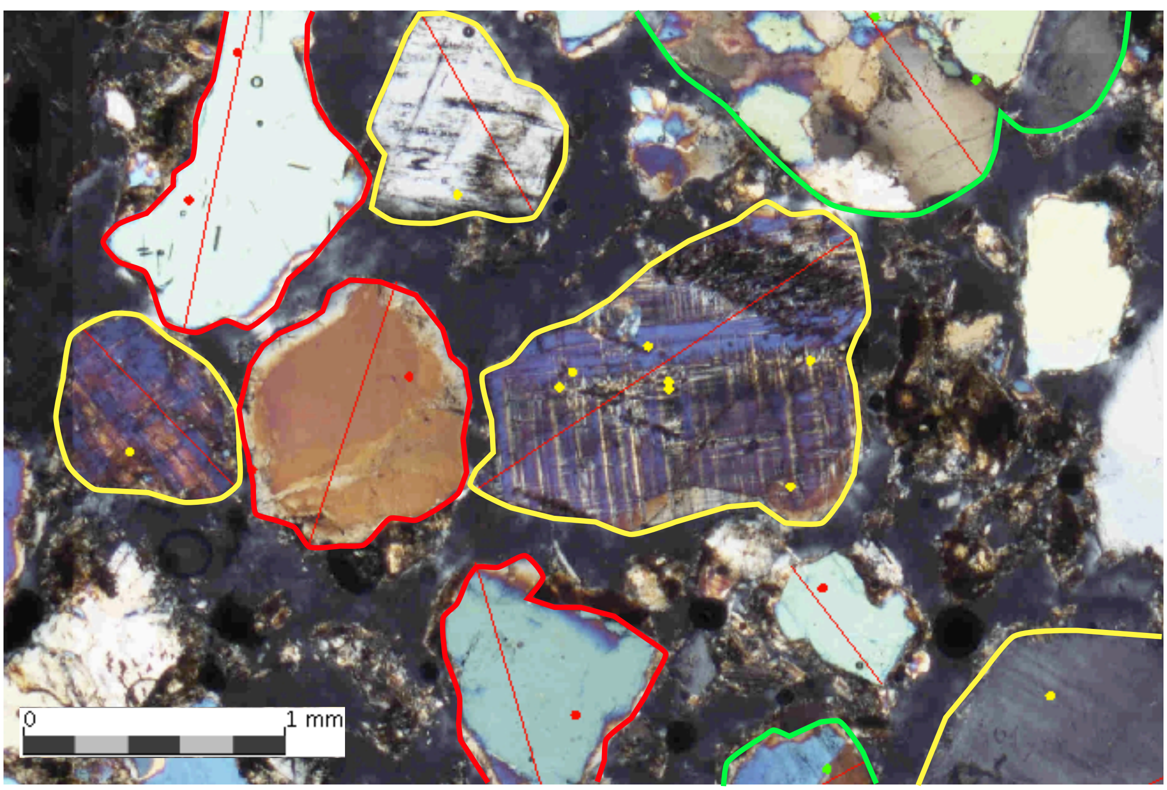


Figure 10. Photomicrograph showing the angularity relationship between Qm and F. Qm grains were slightly more angular than feldspar grains within individual samples. Thin section is not standard thickness.

contribution is either not detectable or falls within error of the point-counting technique. A block of basement rock was logged by Markin (in progress) at a depth of ~205.1 m (~ 673 feet) but sand samples above and below the metamorphic block did not contain Lm grains.

There also appears to be an inverse relationship between the presence of feldspar (F) and sedimentary lithic fragments (Ls; Figure 11). There are two competing hypotheses that can explain this relationship: 1) the two grain types have different sources, which can explain why there may be one but not the other; or 2) the feldspar grains are components of Ls that have not broken down into their constituent minerals. It is unclear which hypothesis outweighs the other, especially because the source of feldspar is largely unknown. The origin of the feldspar grains is discussed further below.

Plotting grain size versus depth for the major framework grains (Qm, Qp, and F; Figures 12-14) reveal trends in the sands intervals that were previously unrecognized. Grain size tends to fine upwards in many of the sand intervals for the Qm, Qp, and F framework grains. Similarly, Markin's log also shows grain size fining upward trends (arrows in Figure 6) in many of the sedimentary lithic blocks below a depth of 91 meters (~ 300 feet). It is likely that both the sedimentary lithic blocks and sand intervals underwent the same aqueous settling process.

II. Statistical Analysis

Statistical tests were performed to quantify the probability of physical characteristic relationships between samples. The two tests performed were the X^2 test and the Wilcoxon Rank-Sum test. Both tests produced probability values that were used to evaluate statistical relationships within the sand intervals.

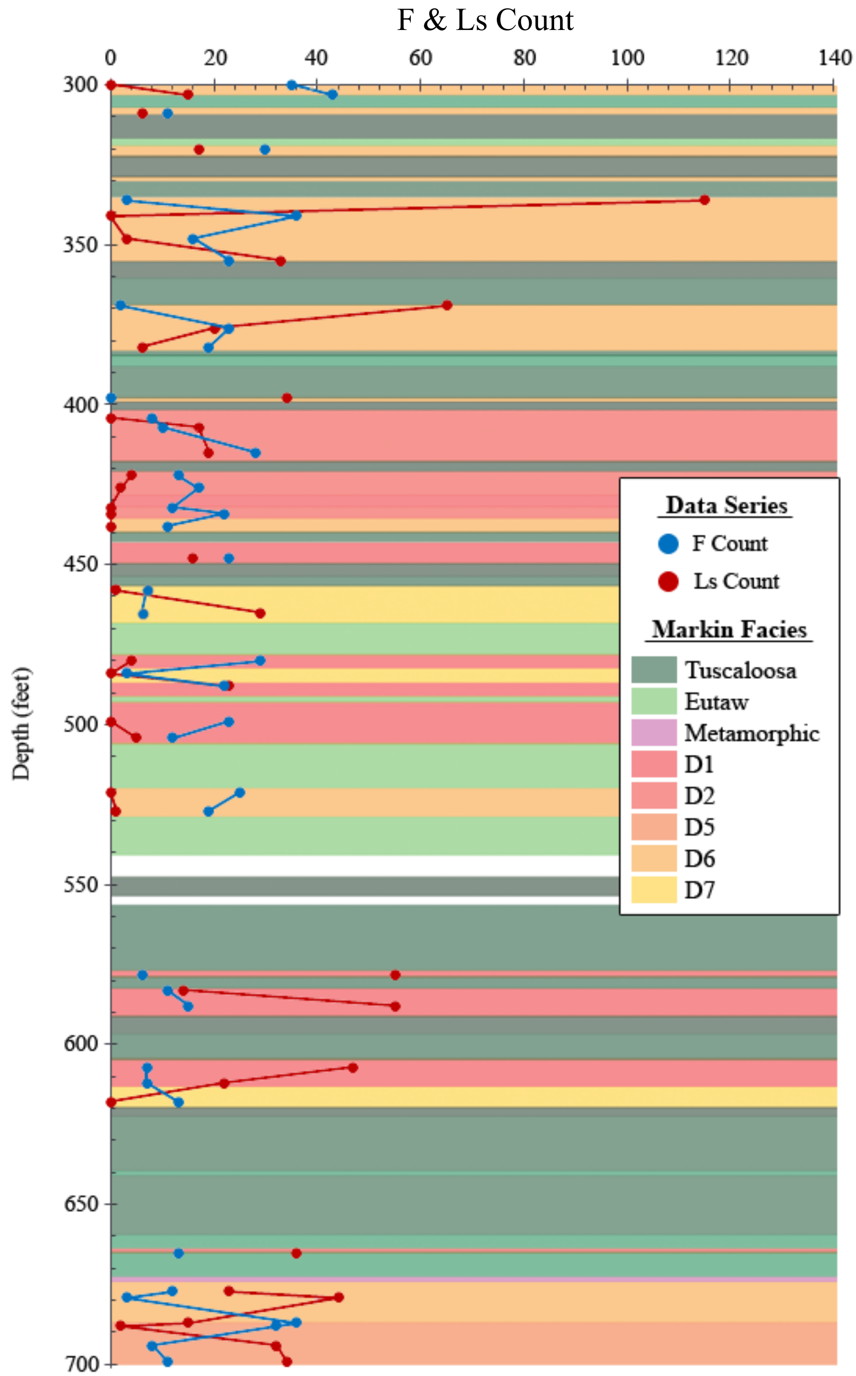


Figure 11. Plot showing the inverse relationship of F and Ls framework grains within drill core samples. Colored bars indicate the facies logged by Markin (in progress). A brief description of the lithofacies D1-D7 can be found in Table 1. White bars represent unrecovered sections of core. Samples were taken from impactite sands between blocks (Tuscaloosa, Eutaw, and Metamorphic).

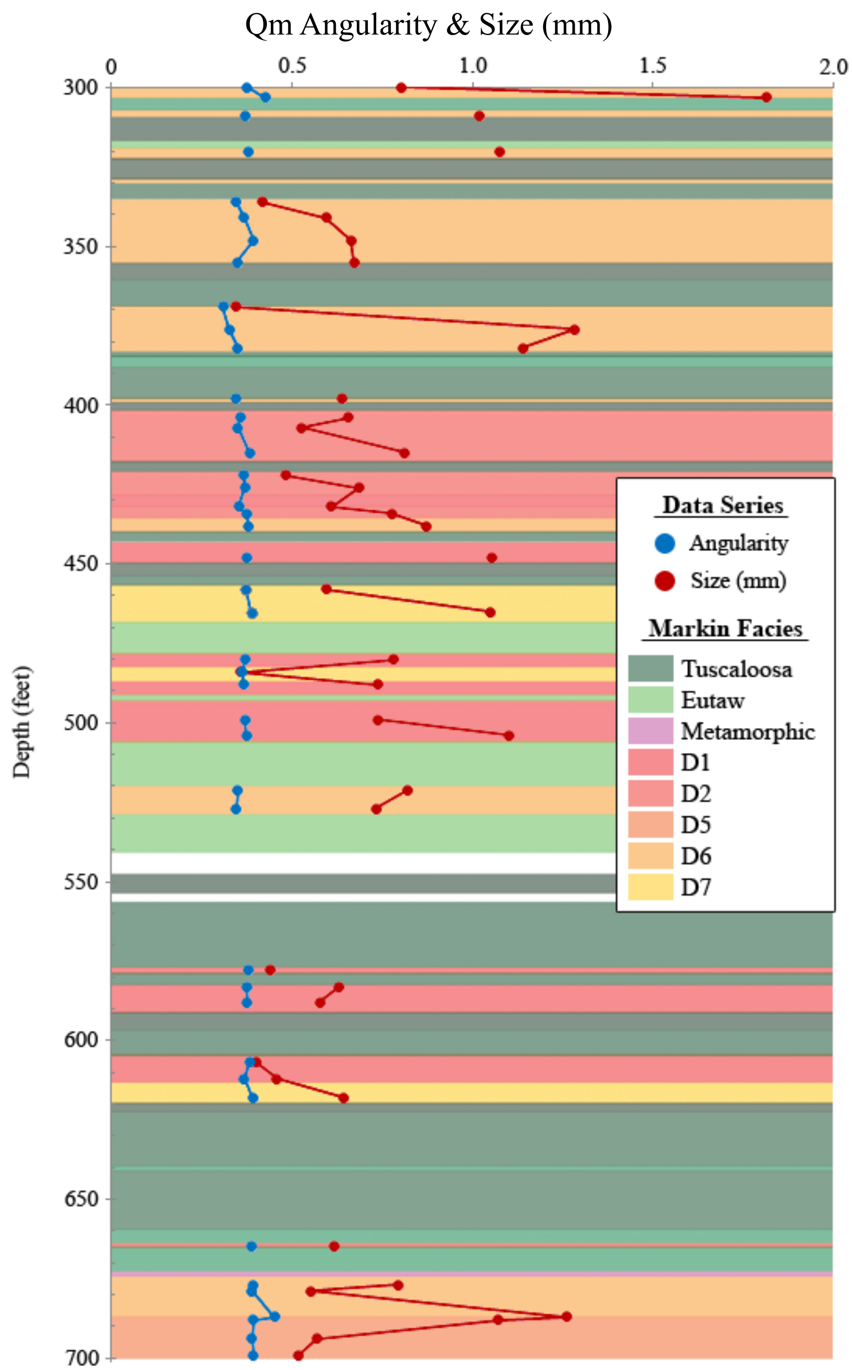


Figure 12. Plot of angularity and size (mm) vs. depth for drill core samples of Qm. Colored bars indicate the facies logged by Markin (in progress). A brief description of the lithofacies D1-D7 can be found in Table 1. White bars represent unrecovered sections of core. Samples were taken from impactite sands between blocks (Tuscaloosa, Eutaw, and Metamorphic). Angularity scale follows the scheme defined by Krumbein (1941; Figure 7) and has values of 0.1-0.9.

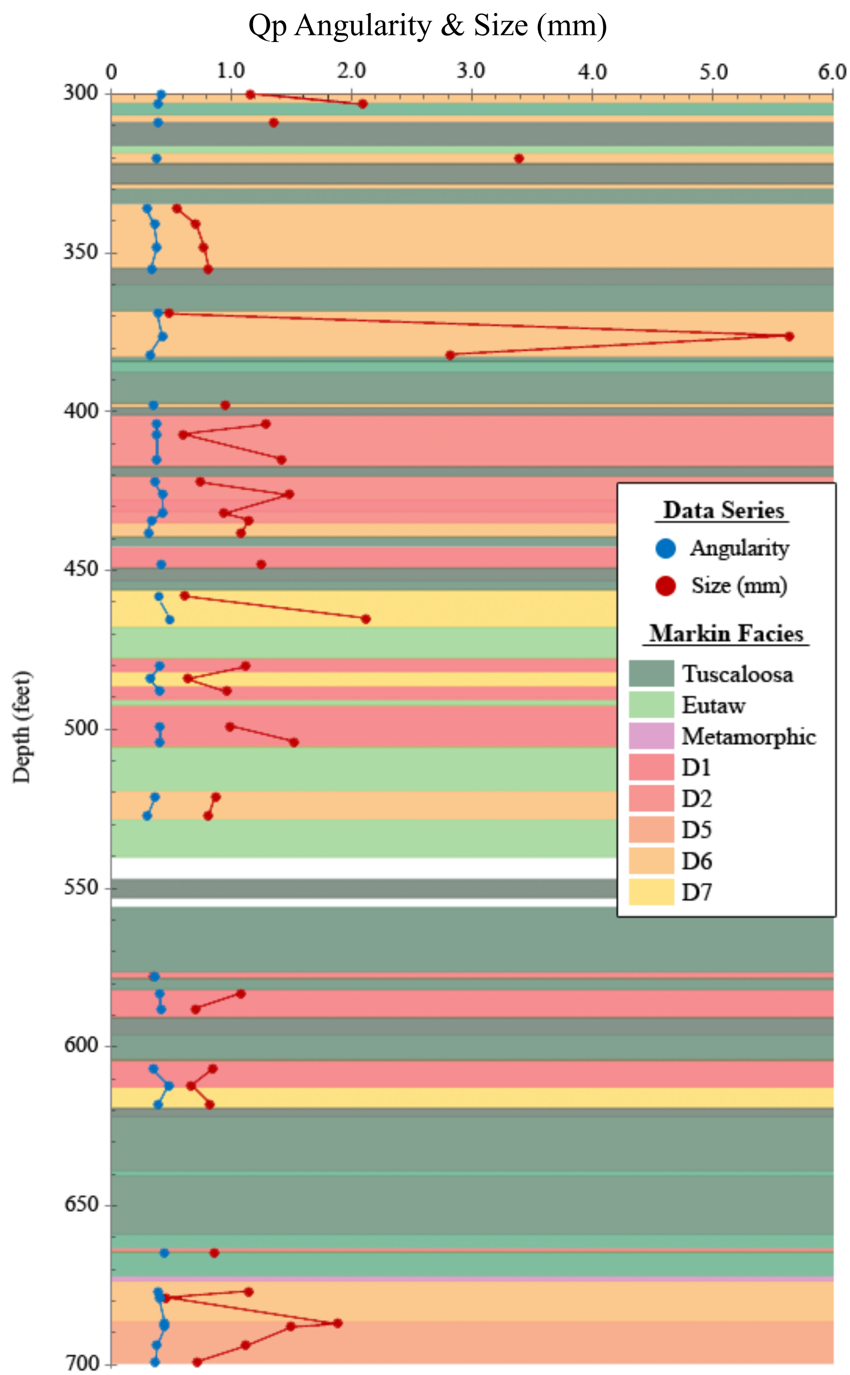


Figure 13. Plot of angularity and size (mm) vs. depth for drill core samples of Qp. Colored bars indicate the facies logged by Markin (in progress). A brief description of the lithofacies D1-D7 can be found in Table 1. White bars represent unrecovered sections of core. Samples were taken from impactite sands between blocks (Tuscaloosa, Eutaw, and Metamorphic). Angularity scale follows the scheme defined by Krumbein (1941; Figure 7) and has values of 0.1-0.9.

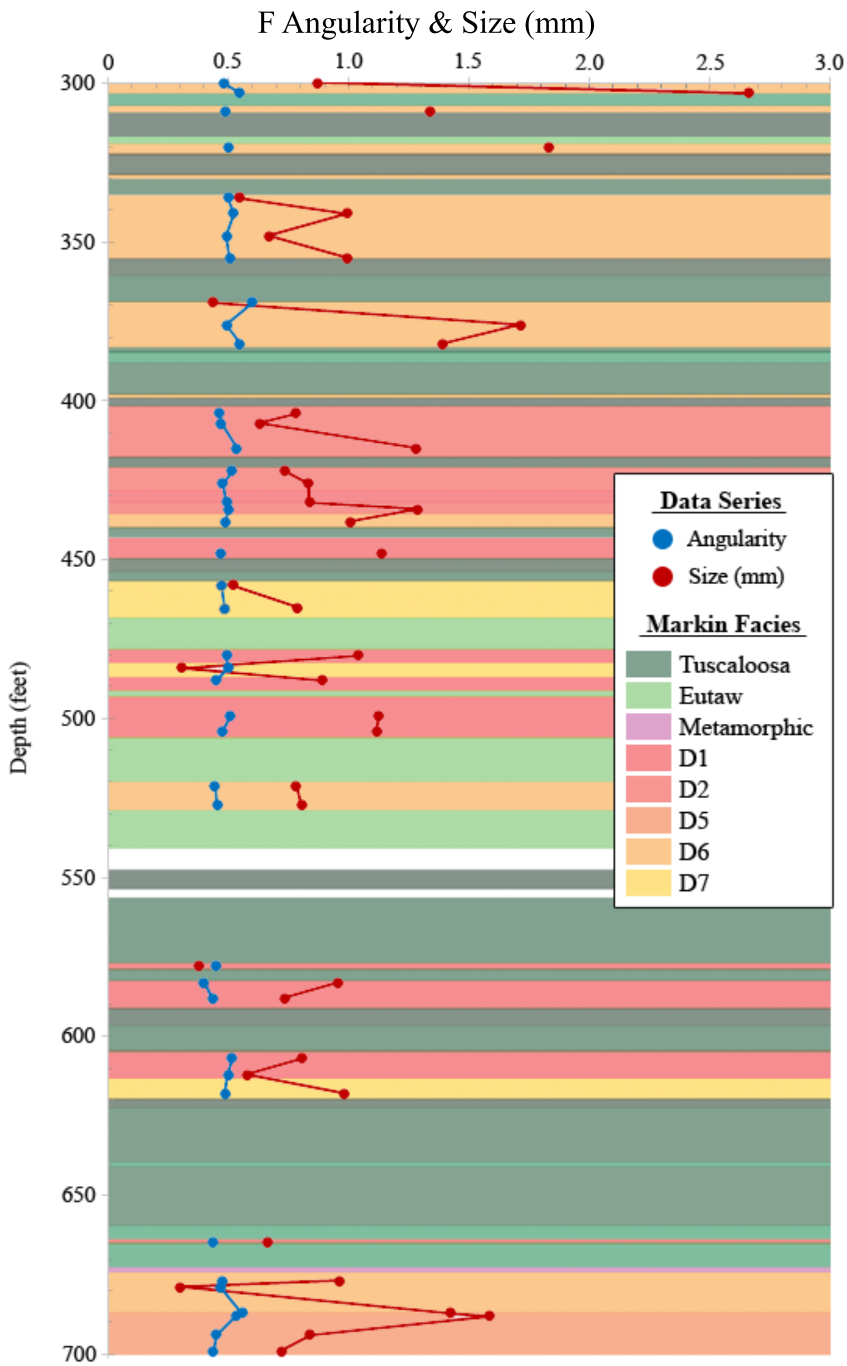


Figure 14. Plot of angularity and size (mm) vs. depth for drill core samples of F. Colored bars indicate the facies logged by Markin (in progress). A brief description of the lithofacies D1-D7 can be found in Table 1. White bars represent unrecovered sections of core. Samples were taken from impactite sands between blocks (Tuscaloosa, Eutaw, and Metamorphic). Angularity scale follows the scheme defined by Krumbein (1941; Figure 7) and has values of 0.1-0.9.

The lithofacies defined by Markin (in progress) all share macroscopic features (e.g., the D2 lithofacies were described as “fluidized impactite sand and sandstone”), and the X^2 test was used to determine if the lithofacies are compositionally related. Only the primary framework grains (Qp, Qm, and F) were used due to the complexity of the test and the high abundance of those minerals in every sample. The results of the X^2 test are in Table 3. The extremely low p-values indicate that there is no compositional relationship between the “D” lithofacies and any similarity is strictly macroscopic. If individual lithofacies did have similar compositions, it could be inferred that the macroscopic features, like the framework grains, were inherited from the target material. Any sedimentary structures, or lack thereof, is likely the result of post-crater depositional mechanisms instead of being inherited from the target material. If individual lithofacies did have similar compositions, it could be inferred that the macroscopic features, like the framework grains, were relict target material structures.

Lithofacies	X^2 Value	Degrees of Freedom	p-value
D1	113.29	22	2.84E-14
D2	70.29	10	3.90E-11
D5	33.44	6	8.63E-06
D6	463.07	32	6.72E-78
D7	35.96	6	2.81E-06

Table 3. Results of X^2 (Chi squared) tests comparing the composition of the lithofacies described by Markin (in progress). Degrees of freedom is the number of values in the final calculation of a statistic that are free to vary. Some lithofacies have more degrees of freedom because there are more samples in the statistical comparison. In p-values E is exponent (e.g. E-14 is 10^{-14}).

The Wilcoxon Rank-Sum test was used to compare characteristics of the impactite sands to samples from the target units - Tuscaloosa Group, Eutaw Formation, and metamorphic basement rocks. The objective of this test is to identify the provenance of the sands and quantify the degree of mixing. Relationships and p-values are in Table 4.

CONTROL SAMPLE	GRAIN TYPE	CHARACTERISTIC	P-VALUE
Eutaw Formation	Qm	Count	0.03
		Size	0.00
		Angularity	0.12
	Qp	Count	0.17
		Size	0.01
		Angularity	0.31
	F	Count	0.01
		Size	0.98
		Angularity	0.36
	Lm	Count	0.34
		Size	0.81
		Angularity	0.34
	Ls	Count	0.65
		Size	0.96
	Mica	Count	0.82
		Size	0.39
	Other	Count	0.49
		Size	0.35
Tuscaloosa Group	Qm	Count	0.03
		Size	0.01
		Angularity	0.04
	Qp	Count	0.00
		Size	0.01
		Angularity	0.03
	F	Count	0.01
		Size	0.42
		Angularity	0.01
	Lm	Count	0.34
		Size	0.81
		Angularity	0.34
	Ls	Count	0.55
		Size	0.03
	Mica	Count	0.09
		Size	0.21
	Other	Count	1.00
		Size	0.05
metamorphic basement	Qm	Count	0.01
	Qp	Count	0.33
	F	Count	0.05
	Lm	Count	0.34
	Ls	Count	0.03
	Mica	Count	0.00
	Other	Count	0.65

Table 4. A comparison of characteristics between drill core samples and the samples from the target units. P-values in the right column represent the probability that the two samples are the result of chance sampling. If the p-value is less than %5, differences are considered as real. Cells with a green fill have p-values that do not show a significant difference between the target unit samples and core samples.

Drill-core samples statistically have more in common with the Eutaw Formation than the Tuscaloosa Group. Of the 18 characteristics tested, the Eutaw Formation has 14 in common with the drill core samples, versus 9 for the Tuscaloosa Group. It appears that both target formations contributed metamorphic lithic fragments, micas, and “other” grains to the impactite sands. Based on the lack of metamorphic lithic fragments in the control samples, the source of Lm in the drill-core samples is likely the result of pulverized basement material. All target materials likely sourced mica grains (mostly biotite) as they are abundant in all of the samples.

Because the impactite sands do not share all characteristics with a single target unit, the sands are interpreted as a mixture of all three target units. The consistent fining upwards trend in each of the intervals suggest that the units formed synchronously as the result of an aqueous settling process during the modification stage of crater formation. If these intervals were intact blocks of the sedimentary target, the fining direction would be more random and include intervals that coarsen upwards.

III. Comparison to Other Impact Structures

The two other notable impact craters studies of similar “impactite sand” units were compared to the Wetumpka impact structure. Unfortunately, both studies have more differences than similarities with Wetumpka in terms of drill-core location within the crater, depth, and lithology. A comparison of the craters and sand intervals are in Table 5.

Auburn University drill core #09-04 was taken from the southeastern portion of the crater interior, near the crater rim (see Figure 4) and has a total depth of 214 meters or 702 feet (Markin, in progress). By comparison, the Eyreville B drill core from the Eocene Chesapeake

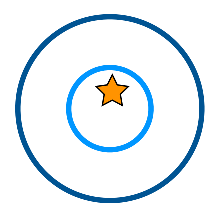
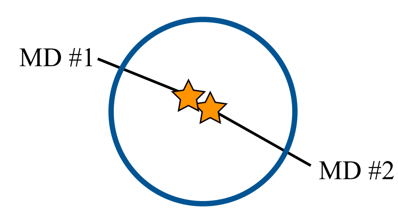
	WETUMPKA	CHESAPEAKE BAY	MARQUEZ DOME
Diameter	~ 6 km	85 km	13 km
Age	Cretaceous 84.4 ± 1.4 m.y. old	Paleogene 35.3 m.y. old	Paleogene 58 ± 3.1 m.y. old
Target	Shallow marine. Poorly consolidated sediments unconformably atop hard crystalline rock.	Shallow marine. Poorly consolidated sediments unconformably atop hard crystalline rock.	Several transgressive/regressive sequences of limestone, mudstone, sand and shale.
Drill Core of Interest	Auburn University Drill Core #09-04	Eyreville B core	Marquez Dome # 1 (MD # 1) Marquez Dome # 2 (MD # 2)
Drill Core Location(s)			
Impactite Sand Interval(s)	90-213 meters (295-699 feet)	1371-1397 meters (4498-4583 feet)	Samples taken throughout drill core where lithologic changes occur. (481 m & 274 m)
Shock Metamorphic Features	None	Suevites, shocked and melted clasts (no suevite or shocked materials found in gravelly sand interval)	Some PDFs
Origin of Sand	Mostly a mix a sedimentary target units with some basement influence.	Potomac Formation (sedimentary target unit)	Lower most target materials uplifted as part of the central peak
Primary Analytical Method	Point-counting modal analysis	Geochemical, palynological, and point-counting analysis	Geochemical and thin-section analysis

Table 5. A comparison of the Wetumpka, Chesapeake Bay, and Marquez Dome impact structures. Drill core locations (orange stars) are shown relative to the crater rim (blue circles). The light blue inner circle marks the margin of the central crater within the Chesapeake Bay structure. Shock metamorphic features listed are only those found in the drill cores containing impactite sand intervals. (Bartosova et al., 2010; Buchanan et al., 1998)

Bay impact was drilled near the center of the crater and has a total depth of 1766 meters (5794 feet; Bartosova et al., 2010). Crater size is also very different, Chesapeake Bay and Wetumpka have diameters of 85 km and ~6 km, respectively. The "gravelly sand" intervals within the Eyreville B drill core are much deeper than the Wetumpka intervals, 1371-1397 meters (4498-4583 feet) versus 90-213 meters (295-699 feet) in the Wetumpka core.

Differences aside, both structures have intervals of impactite sand of unknown origin. Of the three intervals noted in the study of the Eyreville B core, the Wetumpka sands are most similar to the "Upper gravelly sand." Both are mainly composed of sand, with few gravel-sized clasts. Most notably, the Upper gravelly sands fine upward and feature "warped (flow?) layers" similar to structures described by Markin (in progress). However, the other two intervals in the Eyreville B core contain higher concentrations of gravel and do not fine upwards. Like Wetumpka, the fining upwards sequences are not consistent throughout the entire core.

Ultimately, the provenance of the sandy-gravelly intervals in the Eyreville B core was not determined by point-counting of framework grains, but through palynological and geochemical analysis. The primary application of the point counting in the Eyreville B study is for comparison of macroscopic structures. It is also worth noting that the interval from 867-1096 meters (2844-3507 feet) of the Eyreville B core is described as "sediment boulders and sand" and could be analogous to the sand intervals in AU drill core #09-04 (Bartosova et al., 2010).

The other structure similar to Wetumpka is the Marquez Dome in central Texas. An impact into unconsolidated sediments in a near-shore environment, the Marquez Dome is 13 km in diameter and 58 ± 3.1 m.y. old (Buchanan et al., 1998). Two cores located near the center of the crater were drilled to delineate the structure. The two boreholes, MD #1 and MD #2, are 481 m and 274 m (1580 feet and 900 feet) deep, respectively. Similar to the sand intervals in the

Wetumpka core, Marquez Dome sand intervals located near the central peak are "best explained as a mixture of a variety of lithologies (with no preserved bedding structures) from deeper in the stratigraphic section" (Buchanan et al., 1998). The Marquez Dome target formations have a wider variety of lithologies than those in Wetumpka and allowed researchers to come to a more definitive interpretation of impactite intervals in the drill cores. As in the Chesapeake Bay structure, drill-core intervals in the Marquez Dome were mostly compared using geochemical data.

No evidence of shock metamorphism was found in any of the sand intervals in the Eyreville B core and PDFs were scarce in the Marquez Dome drill cores. This is consistent with the lack of shock metamorphic features found in AU drill core #09-04. Macroscopic "flow" features and finding upwards trends are similar between intervals in the Eyreville B and Wetumpka cores. Unfortunately, no macroscopic bedding features are noted in the Marquez Dome cores, including the presence of fining-upwards trends.

CONCLUSIONS

Analysis of the impactite sands found in AU drill core #09-04 provides reasonable evidence that they are derived from a mixture of the three different target materials. Point-counting and statistical analysis of framework grain characteristics within the loosely consolidated sands indicate that the grains did not originate from a single target unit. Fining-upward trends within individual sand intervals suggest that these units simultaneously underwent an aqueous settling process during the modification stage of crater formation. It is also interpreted that these intervals are individual units between lithic sedimentary target blocks rather than being just one homogeneous "matrix" unit of the crater filling breccia. Being distinct sedimentological units means these sands settled over and among slump blocks as the impactite sand was deposited. This is a previously unknown and unrecognized effect of the modification stage of Wetumpka.

Statistical analysis results indicate that the facies defined by Markin (in progress) are strictly macroscopic and are not lithologically similar. This relationship is interpreted as evidence that the generation of the impactite sands is not lithologically controlled.

The sands are similar to a "gravelly-sand" interval within the Eyreville B drill core of the Chesapeake Bay impact structure (Bartosova et al., 2010). Both the Chesapeake and Wetumpka craters feature fining upwards sequences and are composed of disintegrated target material. Taking crater morphology and the relatively shallow nature of the sands into account, the

Wetumpka sands are most likely analogous to the "sediment boulders and sand" interval found at the shallow depths in the Eyreville B core (Bartosova et al., 2010).

Point-counting modal analysis has proven to be an effective method in determining the provenance of the impactite sands in AU drill core #09-04, despite the lithologic similarities between the Tuscaloosa Group and Eutaw Formation. Geochemical analysis of the sands would likely provide a more definitive to answer the question of provenance, but was not necessary in the present study.

Drill cores in impact craters are generally located near the geographic center in an attempt to delineate the structure. The shallow nature and off-center location of the drill core within the Wetumpka structure could prove significant as a means of comparison for future studies of modeling crater formation. The occurrence of the impactite sands and sedimentary blocks beneath the slumped and overturned sedimentary flap, along with the absence of shock metamorphic features indicate that sands were likely emplaced during the modification stage of crater formation.

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APPENDIX I

A) Point-Count Data

Sample	Depth (ft)	Qm	Qp	Feldspar	Lm	Ls	Mica	Other
299-D6	**299**	196	54	35	4	0	11	0
302-D6	**302**	128	96	43	0	15	18	0
308-D6	**308**	199	69	11	0	6	1	14
319-D6	**319**	164	89	30	0	17	0	0
335-D6	**335**	143	10	3	0	115	21	8
340-D6	**340**	171	32	36	24	0	37	0
347-D6	**347**	199	54	16	12	3	0	16
354-D6	**354**	187	31	23	8	33	0	18
368-D6	**368**	187	19	2	0	65	9	18
375-D6	**375**	162	95	23	0	20	0	0
381-D6	**381**	210	59	19	2	6	2	2
397-D6	**397**	244	19	0	0	34	2	1
403-D2	**403**	263	20	8	0	0	0	9
406-D2	**406**	250	20	10	0	17	0	3
414-D2	**414**	209	40	28	0	19	0	4
421-D2	**421**	256	25	13	0	4	1	1
425-D2	**425**	233	48	17	0	2	0	0
431-D1	**431**	233	48	12	0	0	0	7
433-D2	**433**	195	63	22	0	0	0	20
437-D6	**437**	250	39	11	0	0	0	0
447-D1	**447**	194	61	23	2	16	2	2
457-D7	**457**	253	39	7	0	1	0	0
464-D7	**464**	199	54	6	0	29	4	8
479-D1	**479**	227	40	29	0	4	0	0
483-D7	**483**	273	19	3	0	0	2	3
487-D1	**487**	216	37	22	0	23	0	2
498-D1	**498**	243	28	23	0	0	2	4
503-D1	**503**	243	40	12	0	5	0	0
520-D6	**520**	251	23	25	0	0	0	1
526-D6	**526**	254	25	19	0	1	0	1
577-D1	**577**	218	11	6	0	55	4	6
582-D1	**582**	237	29	11	0	14	9	0
587-D1	**587**	186	19	15	0	55	6	19
606-D1	**606**	231	8	7	0	47	7	0
611-D1	**611**	229	15	7	8	22	14	5
617-D7	**617**	260	25	13	0	0	2	0
644-D1	**644**	227	24	13	0	36	0	0
676-D5	**676**	200	57	12	2	23	6	0
678-D6	**678**	226	7	3	1	44	12	7
686-D6	**686**	174	70	36	0	15	5	0
687-D5	**687**	198	66	32	0	2	2	0
693-D5	**693**	209	38	8	5	32	6	2
698-D5	**698**	222	31	11	1	34	0	1

B) Grain Size (data in mm)

Sample	Depth (ft)	Qm	Qp	Feldspar	Lm	Ls	Mica	Other
299-D6	**299**	0.80	1.15	0.87	1.02		0.33	
302-D6	**302**	1.81	2.09	2.66		1.85	1.21	
308-D6	**308**	1.02	1.35	1.34		1.48	0.74	2.11
319-D6	**319**	1.08	3.39	1.83		1.90		
335-D6	**335**	0.42	0.55	0.54		1.60	0.31	0.21
340-D6	**340**	0.60	0.71	0.99	1.04		0.74	
347-D6	**347**	0.66	0.77	0.67	1.16	1.49		0.40
354-D6	**354**	0.67	0.81	0.99	1.15	0.96		0.39
368-D6	**368**	0.35	0.48	0.43		0.83	0.37	0.33
375-D6	**375**	1.28	5.64	1.71		4.10		
381-D6	**381**	1.14	2.82	1.39	1.65	0.95	0.95	0.33
397-D6	**397**	0.64	0.95			1.34	0.83	0.42
403-D2	**403**	0.66	1.28	0.78				0.79
406-D2	**406**	0.53	0.60	0.63		2.29		0.53
414-D2	**414**	0.81	1.42	1.28		1.36		0.42
421-D2	**421**	0.49	0.74	0.73		1.87	0.69	0.13
425-D2	**425**	0.69	1.48	0.83		1.04		
431-D1	**431**	0.61	0.94	0.84				0.44
433-D2	**433**	0.78	1.15	1.29				0.24
437-D6	**437**	0.87	1.08	1.01				
447-D1	**447**	1.06	1.25	1.14	1.34	1.28	0.93	0.35
457-D7	**457**	0.60	0.62	0.52		0.66		
464-D7	**464**	1.05	2.12	0.79		2.18	1.15	0.48
479-D1	**479**	0.78	1.12	1.04		1.95		
483-D7	**483**	0.36	0.64	0.31			0.33	0.46
487-D1	**487**	0.74	0.96	0.89		1.54		0.72
498-D1	**498**	0.74	0.99	1.13			0.77	0.98
503-D1	**503**	1.10	1.52	1.11		1.34		
520-D6	**520**	0.82	0.87	0.78				1.31
526-D6	**526**	0.73	0.81	0.80		2.41		0.66
577-D1	**577**	0.44	0.35	0.38		0.88	0.45	0.28
582-D1	**582**	0.63	1.08	0.96		1.08	0.64	
587-D1	**587**	0.58	0.70	0.73		1.53	0.60	0.73
606-D1	**606**	0.40	0.84	0.80		1.59	0.49	
611-D1	**611**	0.46	0.67	0.58	0.77	0.83	0.39	0.48
617-D7	**617**	0.64	0.82	0.98			0.55	
644-D1	**644**	0.62	0.86	0.66		1.38		
676-D5	**676**	0.79	1.14	0.96	0.91	1.82	0.70	
678-D6	**678**	0.55	0.46	0.30	0.54	0.96	0.77	0.48
686-D6	**686**	1.26	1.88	1.42		1.56	1.31	
687-D5	**687**	1.07	1.50	1.59		2.19	0.85	
693-D5	**693**	0.57	1.12	0.84	1.27	1.15	0.56	0.73
698-D5	**698**	0.52	0.72	0.72	1.19	1.19		0.34

C) Grain Size (data in phi)

Sample	Depth (ft)	Qm	Qp	Feldspar	Lm	Ls	Mica	Other
299-D6	**299**	0.49	-0.05	0.36	-0.01		1.60	
302-D6	**302**	-0.75	-0.91	-1.27		-0.84	-0.11	
308-D6	**308**	0.14	-0.36	-0.31		-0.51	0.44	-0.99
319-D6	**319**	0.04	-1.65	-0.70		-0.86		
335-D6	**335**	1.40	0.95	0.92		-0.58	1.73	2.33
340-D6	**340**	0.92	0.57	0.21	0.01		0.59	
347-D6	**347**	0.73	0.44	0.60	-0.18	-0.48		1.56
354-D6	**354**	0.67	0.39	0.14	-0.09	0.11		1.42
368-D6	**368**	1.65	1.15	1.20		0.32	1.54	1.74
375-D6	**375**	-0.13	-2.24	-0.69		-1.64		
381-D6	**381**	0.03	-1.14	-0.39	-0.69	0.10	0.07	1.62
397-D6	**397**	0.79	0.21			-0.36	0.39	1.26
403-D2	**403**	0.78	-0.25	0.47				0.36
406-D2	**406**	1.02	0.81	0.69		-1.18		0.95
414-D2	**414**	0.44	-0.20	-0.23		-0.38		1.37
421-D2	**421**	1.14	0.60	0.49		-0.88	0.55	2.90
425-D2	**425**	0.67	-0.19	0.32		-0.05		
431-D1	**431**	0.81	0.21	0.31				1.19
433-D2	**433**	0.50	-0.06	-0.32				2.06
437-D6	**437**	0.38	0.13	0.04				
447-D1	**447**	0.11	-0.23	-0.12	-0.42	-0.19	0.41	1.64
457-D7	**457**	0.87	0.78	0.99		0.61		
464-D7	**464**	0.17	-0.89	0.38		-1.08	-0.17	1.13
479-D1	**479**	0.47	-0.08	0.08		-0.96		
483-D7	**483**	1.56	0.88	1.70			1.64	1.16
487-D1	**487**	0.54	0.12	0.21		-0.54		0.49
498-D1	**498**	0.63	0.14	-0.01			0.40	0.04
503-D1	**503**	-0.02	-0.54	-0.12		-0.27		
520-D6	**520**	0.40	0.27	0.41				-0.39
526-D6	**526**	0.51	0.34	0.39		-1.27		0.60
577-D1	**577**	1.40	1.56	1.45		0.32	1.24	1.89
582-D1	**582**	0.84	0.03	0.23		-0.08	0.83	
587-D1	**587**	0.95	0.62	0.55		-0.52	0.87	0.61
606-D1	**606**	1.40	0.30	0.35		-0.60	1.23	
611-D1	**611**	1.26	0.73	0.84	0.41	0.34	1.43	1.08
617-D7	**617**	0.82	0.32	0.09			0.97	
644-D1	**644**	0.82	0.28	0.65		-0.36		
676-D5	**676**	0.49	-0.10	0.08	0.13	-0.83	0.56	
678-D6	**678**	1.25	1.18	1.84	0.90	0.12	0.53	1.14
686-D6	**686**	-0.12	-0.80	-0.44		-0.60	-0.33	
687-D5	**687**	0.03	-0.50	-0.62		-1.13	0.36	
693-D5	**693**	1.02	0.02	0.40	-0.34	-0.14	0.88	0.55
698-D5	**698**	1.03	0.55	0.51	-0.25	-0.18		1.54

D) Grain Angularity Data

Sample	Depth (ft)	Qm	Qp	Feldspar	Lm	Ls	Mica	Other
299-D6	**299**	0.38	0.41	0.48	0.33	0.00		
302-D6	**302**	0.43	0.39	0.55		0.35		
308-D6	**308**	0.37	0.40	0.49		0.35		0.58
319-D6	**319**	0.38	0.38	0.50		0.39		
335-D6	**335**	0.35	0.30	0.50		0.36		0.49
340-D6	**340**	0.37	0.37	0.52	0.40	0.00		
347-D6	**347**	0.39	0.38	0.49	0.35	0.30		0.49
354-D6	**354**	0.35	0.34	0.50	0.53	0.36		0.49
368-D6	**368**	0.31	0.39	0.60		0.34		0.43
375-D6	**375**	0.33	0.43	0.49		0.29		
381-D6	**381**	0.35	0.32	0.55	0.30	0.42		0.30
397-D6	**397**	0.34	0.35	0.00		0.38		0.60
403-D2	**403**	0.36	0.39	0.46		0.00		0.31
406-D2	**406**	0.35	0.38	0.47		0.24		0.40
414-D2	**414**	0.38	0.38	0.54		0.35		0.55
421-D2	**421**	0.37	0.36	0.52		0.33		0.20
425-D2	**425**	0.37	0.43	0.48		0.40		0.00
431-D1	**431**	0.35	0.44	0.49		0.00		0.20
433-D2	**433**	0.37	0.34	0.50		0.00		0.10
437-D6	**437**	0.38	0.31	0.49		0.00		
447-D1	**447**	0.38	0.41	0.47	0.30	0.32		0.55
457-D7	**457**	0.37	0.39	0.47		0.50		
464-D7	**464**	0.39	0.49	0.48		0.36		0.50
479-D1	**479**	0.37	0.41	0.49		0.25		
483-D7	**483**	0.37	0.32	0.50		0.00		0.43
487-D1	**487**	0.37	0.41	0.45		0.34		0.50
498-D1	**498**	0.37	0.41	0.51		0.00		0.20
503-D1	**503**	0.37	0.41	0.48		0.28		
520-D6	**520**	0.35	0.37	0.44		0.00		0.30
526-D6	**526**	0.35	0.30	0.45		0.40		0.40
577-D1	**577**	0.38	0.36	0.45		0.32		0.42
582-D1	**582**	0.38	0.41	0.40		0.39		0.00
587-D1	**587**	0.38	0.42	0.43		0.32		0.30
606-D1	**606**	0.38	0.35	0.51		0.33		0.00
611-D1	**611**	0.37	0.48	0.50	0.44	0.31		0.44
617-D7	**617**	0.39	0.39	0.48		0.00		
644-D1	**644**	0.39	0.44	0.44		0.30		
676-D5	**676**	0.39	0.40	0.48	0.50	0.30		
678-D6	**678**	0.39	0.40	0.47	0.50	0.31		0.41
686-D6	**686**	0.45	0.44	0.56		0.36		
687-D5	**687**	0.40	0.44	0.53		0.30		
693-D5	**693**	0.39	0.38	0.45	0.44	0.28		0.35
698-D5	**698**	0.39	0.37	0.44	0.40	0.31		0.50

E) Statistics Data of Samples From the Target Units

Sample	Count							Size (mm)							Angularity						
	Qm	Qp	F	Lm	Ls	Mica	Other	Qm	Qp	F	Lm	Ls	Mica	Other	Qm	Qp	F	Lm	Ls	Mica	Other
Eutaw																					
E1	246	40	0	0	11	0	3	0.32	0.44	0.00	0.00	0.97	0.00	0.34	0.34	0.37	0.00	0.00	0.38	0.00	0.60
E2	265	8	0	0	17	6	4	0.30	0.48	0.00	0.00	1.49	0.53	0.82	0.37	0.38	0.00	0.00	0.36	0.00	0.30
E3	253	18	1	0	23	3	2	0.33	0.45	0.37	0.00	1.80	0.46	0.46	0.36	0.37	0.60	0.00	0.28	0.00	0.35
Tuscaloosa																					
T1	182	110	2	0	5	0	1	1.48	3.02	0.85	0.00	1.67	0.00	0.00	0.36	0.49	0.45	0.00	0.26	0.00	0.00
T2	172	110	0	0	7	0	11	1.23	4.78	0.00	0.00	2.60	0.00	2.03	0.34	0.48	0.00	0.00	0.49	0.00	0.53
T3	173	125	0	0	2	0	0	1.51	6.51	0.00	0.00	2.14	0.00	0.00	0.35	0.41	0.00	0.00	0.30	0.00	0.00
Metamorphic																					
P65.2	104	39	9	0	0	142	6														
P135.8	117	45	4	0	0	132	2														
P255	131	60	3	0	0	105	1														

E) Thin-section Sample Data

Data for each sample is provided in this appendix. Samples from the target units are included at the very end. A brief description of how to read the data presented in this appendix is provided next to each table below.

Sample 299-D6							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	196	54	35	4	0	11	0
Size (mm)	0.80	1.15	0.87	1.02	0.00	0.33	0.00
Size (phi)	0.49	−0.05	0.36	−0.01	0.00	1.60	0.00
Angularity	0.38	0.41	0.48	0.33	0.00	0.00	0.00

1. Summary table. This table provides raw count data for each sample and average grain size and angularity (e.g., The 196 Qm grains in sample 299-D6 have an average size of 0.80 mm and an average angularity of 0.38).

Grains Size Statistics							
Mean:	0.38						
Standard Deviation:	0.74						
Skewness:	0.25						
Kurtosis:	−0.04						

2. Statistics table. Provides grain size statistics based on phi sizes for all measured grains in the sample.

Phi Size	**Qm**	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
−2.5	0	0	0	0	0	0	0
−1.5	2	9	0	0	0	0	0
−0.5	50	17	13	2	0	0	0
0.5	102	26	17	2	0	0	0
1.5	35	2	5	0	0	3	0
2.5	7	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	196	54	35	4	0	3	0

3. Distribution table. This table plots grain size in 1 phi increments versus grain type. The number in the phi size column is the median value for the range. (e.g., -1.5 phi includes grains ranging from -2 to -3 phi). The -2.5 phi category includes grains -2 phi and larger. The 3.5 phi category includes grains 3 phi and smaller.

Angularity	**Qm**	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
0.1	0	1	0	0	0	0	0
0.2	15	3	0	1	0	0	0
0.3	75	11	2	2	0	0	0
0.4	53	15	11	0	0	0	0
0.5	45	21	15	1	0	0	0
0.6	7	3	6	0	0	0	0
0.7	1	0	1	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	196	54	35	4	0	0	0

4. Angularity table. This table shows how many of each grain type falls into a particular angularity category (e.g., 15 Qm grains had an angularity of 0.2).

Sample 302-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	128	96	43	0	15	18	0
Size (mm)	1.81	2.09	2.66	0.00	1.85	1.21	0.00
Size (phi)	-0.75	-0.91	-1.27	0.00	-0.84	-0.11	0.00
Angularity	0.43	0.39	0.55	0.00	0.35	0.00	0.00

Grains Size Statistics						
Mean:	-0.84					
Standard Deviation:	0.71					
Skewness:	0.82					
Kurtosis:	0.74					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	54	47	31	0	6	2	0
-0.5	58	34	6	0	8	9	0
0.5	14	14	6	0	1	6	0
1.5	1	0	0	0	0	1	0
2.5	1	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	128	95	43	0	15	18	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	3	6	0	0	1	1	0
0.3	28	29	0	0	8	2	0
0.4	47	33	4	0	4	0	0
0.5	33	24	16	0	2	0	0
0.6	17	3	21	0	0	0	0
0.7	0	0	2	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	128	95	43	0	15	3	0

Sample 308-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	199	69	11	0	6	1	14
Size (mm)	1.02	1.35	1.34	0.00	1.48	0.74	2.11
Size (phi)	0.14	−0.36	−0.31	0.00	−0.51	0.44	−0.99
Angularity	0.37	0.40	0.49	0.00	0.35	0.00	0.58

Grains Size Statistics							
Mean:	−0.05						
Standard Deviation:	0.74						
Skewness:	0.64						
Kurtosis:	0.06						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5	0	0	0	0	0	0	0
−1.5	0	0	0	0	0	0	12
−0.5	94	56	8	0	6	0	0
0.5	78	13	2	0	0	1	2
1.5	24	0	1	0	0	0	0
2.5	3	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	199	69	11	0	6	1	14

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	21	3	0	0	0	0	0
0.3	70	21	0	0	3	0	0
0.4	59	22	3	0	3	0	1
0.5	44	21	6	0	0	0	0
0.6	5	2	2	0	0	0	12
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	199	69	11	0	6	0	13

Sample 319-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	164	89	30	0	17	0	0
Size (mm)	1.08	3.39	1.83	0.00	1.90	0.00	0.00
Size (phi)	0.04	−1.65	−0.70	0.00	−0.86	0.00	0.00
Angularity	0.38	0.38	0.50	0.00	0.39	0.00	0.00

Grains Size Statistics							
Mean:	−0.58						
Standard Deviation:	1.00						
Skewness:	0.04						
Kurtosis:	−0.93						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5	0	22	0	0	0	0	0
−1.5	12	59	16	0	6	0	0
−0.5	73	4	10	0	11	0	0
0.5	65	4	4	0	0	0	0
1.5	14	0	0	0	0	0	0
2.5	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	164	89	30	0	17	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	13	0	0	0	0	0	0
0.3	57	31	1	0	8	0	0
0.4	48	46	4	0	3	0	0
0.5	41	9	19	0	5	0	0
0.6	5	3	6	0	1	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	164	89	30	0	17	0	0

Sample 335-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	143	10	3	0	115	21	8
Size (mm)	0.42	0.55	0.54	0.00	1.60	0.31	0.21
Size (phi)	1.40	0.95	0.92	0.00	-0.58	1.73	2.33
Angularity	0.35	0.30	0.50	0.00	0.36	0.00	0.49

Grains Size Statistics						
Mean:	0.61					
Standard Deviation:	1.17					
Skewness:	0.02					
Kurtosis:	-0.98					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	24	0	0
-0.5	1	0	0	0	72	0	0
0.5	47	5	1	0	19	0	0
1.5	64	5	2	0	0	3	3
2.5	28	0	0	0	0	1	4
3.5	3	0	0	0	0	0	1
Total	143	10	3	0	115	4	8

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	1	0	0
0.2	30	2	0	0	6	0	1
0.3	45	6	0	0	49	0	1
0.4	42	2	0	0	45	0	0
0.5	24	0	3	0	11	0	2
0.6	2	0	0	0	3	0	4
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	143	10	3	0	115	0	8

Sample 340-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	171	32	36	24	0	37	0
Size (mm)	0.60	0.71	0.99	1.04	0.00	0.74	0.00
Size (phi)	0.92	0.57	0.21	0.01	0.00	0.59	0.00
Angularity	0.37	0.37	0.52	0.40	0.00	0.00	0.00

Grains Size Statistics						
Mean:	0.68					
Standard Deviation:	0.76					
Skewness:	0.33					
Kurtosis:	-0.32					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	20	2	19	12	0	8	0
0.5	69	24	12	11	0	22	0
1.5	74	6	3	1	0	6	0
2.5	8	0	2	0	0	1	0
3.5	0	0	0	0	0	0	0
Total	171	32	36	24	0	37	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	21	5	0	2	0	0	0
0.3	52	11	1	6	0	1	0
0.4	59	8	1	9	0	1	0
0.5	35	6	23	4	0	0	0
0.6	3	2	11	3	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	170	32	36	24	0	2	0

Sample 347-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	199	54	16	12	3	0	16
Size (mm)	0.66	0.77	0.67	1.16	1.49	0.00	0.40
Size (phi)	0.73	0.44	0.60	-0.18	-0.48	0.00	1.56
Angularity	0.39	0.38	0.49	0.35	0.30	0.00	0.49

Grains Size Statistics							
Mean:	0.66						
Standard Deviation:	0.68						
Skewness:	0.42						
Kurtosis:	0.25						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	31	12	0	9	2	0	0
0.5	99	34	15	3	1	0	5
1.5	65	8	1	0	0	0	3
2.5	4	0	0	0	0	0	4
3.5	0	0	0	0	0	0	1
Total	199	54	16	12	3	0	13

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	17	2	0	1	0	0	0
0.3	56	20	1	5	3	0	1
0.4	61	20	1	5	0	0	3
0.5	53	10	12	1	0	0	5
0.6	12	2	2	0	0	0	4
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	199	54	16	12	3	0	13

Sample 354-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	187	31	23	8	33	0	18
Size (mm)	0.67	0.81	0.99	1.15	0.96	0.00	0.39
Size (phi)	0.67	0.39	0.14	-0.09	0.11	0.00	1.42
Angularity	0.35	0.34	0.50	0.53	0.36	0.00	0.49

Grains Size Statistics						
Mean:	0.56					
Standard Deviation:	0.62					
Skewness:	0.26					
Kurtosis:	0.47					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	22	8	7	3	14	0	0
0.5	116	20	15	5	19	0	5
1.5	47	3	1	0	0	0	12
2.5	2	0	0	0	0	0	1
3.5	0	0	0	0	0	0	0
Total	187	31	23	8	33	0	18

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	33	7	0	0	5	0	0
0.3	68	12	0	0	10	0	3
0.4	54	6	8	2	13	0	3
0.5	26	6	6	2	3	0	5
0.6	6	0	9	4	2	0	7
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	187	31	23	8	33	0	18

Sample 368-D6							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	187	19	2	0	65	9	18
Size (mm)	0.35	0.48	0.43	0.00	0.83	0.37	0.33
Size (phi)	1.65	1.15	1.20	0.00	0.32	1.54	1.74
Angularity	0.31	0.39	0.60	0.00	0.34	0.00	0.43

Grains Size Statistics							
Mean:	1.33						
Standard Deviation:	0.79						
Skewness:	-0.07						
Kurtosis:	-0.63						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	0	0	0	0	12	0	0
0.5	27	8	0	0	47	2	2
1.5	102	10	2	0	6	6	12
2.5	55	1	0	0	0	1	3
3.5	3	0	0	0	0	0	1
Total	187	19	2	0	65	9	18

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	73	3	0	0	11	0	2
0.3	47	3	0	0	28	0	4
0.4	45	6	0	0	14	0	2
0.5	19	7	0	0	10	0	6
0.6	3	0	2	0	2	0	4
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	187	19	2	0	65	0	18

Sample 375-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	162	95	23	0	20	0	0
Size (mm)	1.28	5.64	1.71	0.00	4.10	0.00	0.00
Size (phi)	-0.13	-2.24	-0.69	0.00	-1.64	0.00	0.00
Angularity	0.33	0.43	0.49	0.00	0.29	0.00	0.00

Grains Size Statistics							
Mean:	-0.95						
Standard Deviation:	1.32						
Skewness:	-0.01						
Kurtosis:	0.05						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	3	16	0	0	12	0	0
-1.5	23	21	13	0	1	0	0
-0.5	59	11	4	0	3	0	0
0.5	68	2	5	0	4	0	0
1.5	8	0	0	0	0	0	0
2.5	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	161	50	22	0	20	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	51	5	0	0	6	0	0
0.3	49	14	1	0	12	0	0
0.4	34	33	6	0	1	0	0
0.5	23	38	10	0	1	0	0
0.6	5	5	6	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	162	95	23	0	20	0	0

Sample 381-D6							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	210	59	19	2	6	2	2
Size (mm)	1.14	2.82	1.39	1.65	0.95	0.95	0.33
Size (phi)	0.03	-1.14	-0.39	-0.69	0.10	0.07	1.62
Angularity	0.35	0.32	0.55	0.30	0.42	0.00	0.30

Grains Size Statistics							
Mean:	-0.22						
Standard Deviation:	0.96						
Skewness:	-0.44						
Kurtosis:	-0.07						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	16	0	0	0	0	0
-1.5	25	16	0	0	0	0	0
-0.5	71	14	14	2	2	1	0
0.5	89	12	3	0	4	1	0
1.5	25	1	1	0	0	0	2
2.5	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	210	59	18	2	6	2	2

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	44	14	0	1	0	0	1
0.3	70	26	1	0	2	0	0
0.4	55	12	0	1	1	0	1
0.5	26	6	7	0	3	0	0
0.6	15	1	11	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	210	59	19	2	6	0	2

Sample 397-D6							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	244	19	0	0	34	2	1
Size (mm)	0.64	0.95	0.00	0.00	1.34	0.83	0.42
Size (phi)	0.79	0.21	0.00	0.00	-0.36	0.39	1.26
Angularity	0.34	0.35	0.00	0.00	0.38	0.00	0.60

Grains Size Statistics							
Mean:	0.62						
Standard Deviation:	0.73						
Skewness:	-0.02						
Kurtosis:	-0.36						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	21	7	0	0	28	1	0
0.5	128	10	0	0	5	0	0
1.5	89	2	0	0	1	1	1
2.5	5	0	0	0	0	0	0
3.5	1	0	0	0	0	0	0
Total	244	19	0	0	34	2	1

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	52	2	0	0	3	0	0
0.3	81	10	0	0	11	0	0
0.4	64	3	0	0	10	0	0
0.5	44	4	0	0	9	0	0
0.6	3	0	0	0	1	0	1
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	244	19	0	0	34	0	1

Sample 403-D2							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	263	20	8	0	0	0	9
Size (mm)	0.66	1.28	0.78	0.00	0.00	0.00	0.79
Size (phi)	0.78	-0.25	0.47	0.00	0.00	0.00	0.36
Angularity	0.36	0.39	0.46	0.00	0.00	0.00	0.31

Grains Size Statistics							
Mean:	0.69						
Standard Deviation:	0.75						
Skewness:	0.08						
Kurtosis:	-0.62						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	37	16	3	0	0	0	0
0.5	128	3	3	0	0	0	9
1.5	84	1	2	0	0	0	0
2.5	14	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	263	20	8	0	0	0	9

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	37	1	0	0	0	0	0
0.3	98	3	2	0	0	0	8
0.4	72	14	2	0	0	0	1
0.5	49	2	1	0	0	0	0
0.6	7	0	3	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	263	20	8	0	0	0	9

Sample 406-D2							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	250	20	10	0	17	0	3
Size (mm)	0.53	0.60	0.63	0.00	2.29	0.00	0.53
Size (phi)	1.02	0.81	0.69	0.00	-1.18	0.00	0.95
Angularity	0.35	0.38	0.47	0.00	0.24	0.00	0.40

Grains Size Statistics						
Mean:	0.87					
Standard Deviation:	0.70					
Skewness:	-1.30					
Kurtosis:	2.16					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	13	0	0
-0.5	15	0	0	0	4	0	0
0.5	95	13	8	0	0	0	2
1.5	138	7	2	0	0	0	1
2.5	2	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	250	20	10	0	17	0	3

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	47	3	0	0	11	0	1
0.3	78	4	0	0	6	0	0
0.4	79	8	4	0	0	0	0
0.5	40	4	5	0	0	0	2
0.6	6	1	1	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	250	20	10	0	17	0	3

Sample 414-D2							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	209	40	28	0	19	0	4
Size (mm)	0.81	1.42	1.28	0.00	1.36	0.00	0.42
Size (phi)	0.44	-0.20	-0.23	0.00	-0.38	0.00	1.37
Angularity	0.38	0.38	0.54	0.00	0.35	0.00	0.55

Grains Size Statistics							
Mean:	0.25						
Standard Deviation:	0.76						
Skewness:	-0.11						
Kurtosis:	0.00						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	3	8	0	0	2	0	0
-0.5	47	11	16	0	14	0	0
0.5	122	17	11	0	3	0	1
1.5	36	4	1	0	0	0	3
2.5	1	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	209	40	28	0	19	0	4

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	22	3	0	0	2	0	0
0.3	53	17	0	0	9	0	0
0.4	81	7	4	0	5	0	1
0.5	45	11	10	0	2	0	2
0.6	8	2	14	0	1	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	1
0.9	0	0	0	0	0	0	0
Total	209	40	28	0	19	0	4

Sample 421-D2							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	256	25	13	0	4	1	1
Size (mm)	0.49	0.74	0.73	0.00	1.87	0.69	0.13
Size (phi)	1.14	0.60	0.49	0.00	-0.88	0.55	2.90
Angularity	0.37	0.36	0.52	0.00	0.33	0.00	0.20

Grains Size Statistics							
Mean:	1.04						
Standard Deviation:	0.63						
Skewness:	-0.33						
Kurtosis:	1.02						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	1	0	0
-0.5	1	5	0	0	3	0	0
0.5	100	13	12	0	0	1	0
1.5	142	7	1	0	0	0	0
2.5	13	0	0	0	0	0	1
3.5	0	0	0	0	0	0	0
Total	256	25	13	0	4	1	1

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	38	4	0	0	1	0	1
0.3	64	9	0	0	2	0	0
0.4	96	4	3	0	0	0	0
0.5	55	8	5	0	1	0	0
0.6	3	0	5	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	256	25	13	0	4	0	1

Sample 425-D2							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	233	48	17	0	2	0	0
Size (mm)	0.69	1.48	0.83	0.00	1.04	0.00	0.00
Size (phi)	0.67	-0.19	0.32	0.00	-0.05	0.00	0.00
Angularity	0.37	0.43	0.48	0.00	0.40	0.00	0.00

Grains Size Statistics							
Mean:	0.51						
Standard Deviation:	0.77						
Skewness:	-0.57						
Kurtosis:	1.36						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	13	0	0	0	0	0
-0.5	39	6	6	0	1	0	0
0.5	122	27	10	0	1	0	0
1.5	67	2	1	0	0	0	0
2.5	5	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	233	48	17	0	2	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	25	6	1	0	0	0	0
0.3	77	8	1	0	0	0	0
0.4	79	9	1	0	2	0	0
0.5	45	16	12	0	0	0	0
0.6	7	9	2	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	233	48	17	0	2	0	0

Sample 431-D1							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	233	48	12	0	0	0	7
Size (mm)	0.61	0.94	0.84	0.00	0.00	0.00	0.44
Size (phi)	0.81	0.21	0.31	0.00	0.00	0.00	1.19
Angularity	0.35	0.44	0.49	0.00	0.00	0.00	0.20

Grains Size Statistics							
Mean:	0.69						
Standard Deviation:	0.60						
Skewness:	0.03						
Kurtosis:	-0.34						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	9	16	4	0	0	0	0
0.5	141	27	8	0	0	0	0
1.5	81	4	0	0	0	0	2
2.5	2	1	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	233	48	12	0	0	0	2

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	46	3	1	0	0	0	2
0.3	79	7	1	0	0	0	0
0.4	59	14	1	0	0	0	0
0.5	34	18	4	0	0	0	0
0.6	15	6	5	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	233	48	12	0	0	0	2

Sample 433-D2							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	195	63	22	0	0	0	20
Size (mm)	0.78	1.15	1.29	0.00	0.00	0.00	0.24
Size (phi)	0.50	−0.06	−0.32	0.00	0.00	0.00	2.06
Angularity	0.37	0.34	0.50	0.00	0.00	0.00	0.10

Grains Size Statistics							
Mean:	0.31						
Standard Deviation:	0.70						
Skewness:	0.43						
Kurtosis:	0.42						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5	0	0	0	0	0	0	0
−1.5	0	4	0	0	0	0	0
−0.5	49	31	18	0	0	0	0
0.5	108	24	4	0	0	0	0
1.5	34	4	0	0	0	0	0
2.5	4	0	0	0	0	0	1
3.5	0	0	0	0	0	0	0
Total	195	63	22	0	0	0	1

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	1
0.2	32	10	0	0	0	0	0
0.3	51	32	1	0	0	0	0
0.4	56	9	6	0	0	0	0
0.5	46	11	7	0	0	0	0
0.6	10	1	8	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	195	63	22	0	0	0	1

Sample 437-D6							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	250	39	11	0	0	0	0
Size (mm)	0.87	1.08	1.01	0.00	0.00	0.00	0.00
Size (phi)	0.38	0.13	0.04	0.00	0.00	0.00	0.00
Angularity	0.38	0.31	0.49	0.00	0.00	0.00	0.00

Grains Size Statistics						
Mean:	0.33					
Standard Deviation:	0.72					
Skewness:	-0.39					
Kurtosis:	0.24					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	9	6	0	0	0	0	0
-0.5	56	10	6	0	0	0	0
0.5	141	18	5	0	0	0	0
1.5	42	5	0	0	0	0	0
2.5	2	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	250	39	11	0	0	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	28	10	0	0	0	0	0
0.3	79	18	0	0	0	0	0
0.4	70	8	2	0	0	0	0
0.5	56	2	8	0	0	0	0
0.6	17	1	1	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	250	39	11	0	0	0	0

Sample 447-D1							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	194	61	23	2	16	2	2
Size (mm)	1.06	1.25	1.14	1.34	1.28	0.93	0.35
Size (phi)	0.11	-0.23	-0.12	-0.42	-0.19	0.41	1.64
Angularity	0.38	0.41	0.47	0.30	0.32	0.00	0.55

Grains Size Statistics						
Mean:	0.01					
Standard Deviation:	0.72					
Skewness:	0.49					
Kurtosis:	-0.26					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	7	3	0	0	4	0	0
-0.5	84	37	12	2	4	1	0
0.5	75	20	10	0	8	0	0
1.5	27	1	1	0	0	1	1
2.5	1	0	0	0	0	0	1
3.5	0	0	0	0	0	0	0
Total	194	61	23	2	16	2	2

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	19	3	0	0	2	0	0
0.3	69	17	0	2	10	0	0
0.4	49	17	9	0	3	0	0
0.5	53	18	12	0	1	0	1
0.6	4	6	2	0	0	0	1
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	194	61	23	2	16	0	2

Sample 457-D7							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	253	39	7	0	1	0	0
Size (mm)	0.60	0.62	0.52	0.00	0.66	0.00	0.00
Size (phi)	0.87	0.78	0.99	0.00	0.61	0.00	0.00
Angularity	0.37	0.39	0.47	0.00	0.50	0.00	0.00

Grains Size Statistics							
Mean:	0.86						
Standard Deviation:	0.61						
Skewness:	0.37						
Kurtosis:	-0.46						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	20	1	0	0	0	0	0
0.5	133	25	3	0	1	0	0
1.5	91	13	4	0	0	0	0
2.5	9	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	253	39	7	0	1	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	26	3	0	0	0	0	0
0.3	91	10	1	0	0	0	0
0.4	71	17	1	0	0	0	0
0.5	56	7	4	0	1	0	0
0.6	9	2	1	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	253	39	7	0	1	0	0

Sample 464-D7							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	199	54	6	0	29	4	8
Size (mm)	1.05	2.12	0.79	0.00	2.18	1.15	0.48
Size (phi)	0.17	-0.89	0.38	0.00	-1.08	-0.17	1.13
Angularity	0.39	0.49	0.48	0.00	0.36	0.00	0.50

Grains Size Statistics							
Mean:	-0.12						
Standard Deviation:	0.97						
Skewness:	0.31						
Kurtosis:	-0.57						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	15	28	0	0	21	0	0
-0.5	79	20	0	0	7	3	0
0.5	69	5	6	0	1	1	2
1.5	31	1	0	0	0	0	6
2.5	5	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	199	54	6	0	29	4	8

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	18	2	0	0	2	0	0
0.3	61	4	1	0	17	0	0
0.4	60	9	0	0	3	0	2
0.5	47	23	4	0	4	0	4
0.6	13	16	1	0	3	0	2
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	199	54	6	0	29	0	8

Sample 479-D1							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	227	40	29	0	4	0	0
Size (mm)	0.78	1.12	1.04	0.00	1.95	0.00	0.00
Size (phi)	0.47	-0.08	0.08	0.00	-0.96	0.00	0.00
Angularity	0.37	0.41	0.49	0.00	0.25	0.00	0.00

Grains Size Statistics							
Mean:	0.34						
Standard Deviation:	0.63						
Skewness:	0.03						
Kurtosis:	-0.15						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	48	22	16	0	4	0	0
0.5	146	18	12	0	0	0	0
1.5	32	0	1	0	0	0	0
2.5	1	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	227	40	29	0	4	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	18	1	0	0	2	0	0
0.3	79	11	2	0	2	0	0
0.4	82	11	3	0	0	0	0
0.5	48	17	19	0	0	0	0
0.6	0	0	5	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	227	40	29	0	4	0	0

Sample 483-D7							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	273	19	3	0	0	2	3
Size (mm)	0.36	0.64	0.31	0.00	0.00	0.33	0.46
Size (phi)	1.56	0.88	1.70	0.00	0.00	1.64	1.16
Angularity	0.37	0.32	0.50	0.00	0.00	0.00	0.43

Grains Size Statistics							
Mean:	1.51						
Standard Deviation:	0.54						
Skewness:	-0.33						
Kurtosis:	1.31						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	0	5	0	0	0	0	0
0.5	31	5	0	0	0	0	1
1.5	198	9	3	0	0	2	2
2.5	44	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	273	19	3	0	0	2	3

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	32	6	0	0	0	0	0
0.3	98	5	0	0	0	0	1
0.4	80	6	0	0	0	0	0
0.5	59	2	3	0	0	0	2
0.6	4	0	0	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	273	19	3	0	0	0	3

Sample 487-D1							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	216	37	22	0	23	0	2
Size (mm)	0.74	0.96	0.89	0.00	1.54	0.00	0.72
Size (phi)	0.54	0.12	0.21	0.00	-0.54	0.00	0.49
Angularity	0.37	0.41	0.45	0.00	0.34	0.00	0.50

Grains Size Statistics						
Mean:	0.38					
Standard Deviation:	0.61					
Skewness:	0.03					
Kurtosis:	-0.06					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	6	0	0
-0.5	38	14	7	0	14	0	0
0.5	132	23	15	0	3	0	2
1.5	45	0	0	0	0	0	0
2.5	1	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	216	37	22	0	23	0	2

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	19	2	0	0	2	0	0
0.3	75	12	3	0	11	0	0
0.4	81	6	7	0	9	0	0
0.5	41	15	10	0	1	0	2
0.6	0	2	2	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	216	37	22	0	23	0	2

Sample 498-D1							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	243	28	23	0	0	2	4
Size (mm)	0.74	0.99	1.13	0.00	0.00	0.77	0.98
Size (phi)	0.63	0.14	−0.01	0.00	0.00	0.40	0.04
Angularity	0.37	0.41	0.51	0.00	0.00	0.00	0.20

Grains Size Statistics							
Mean:	0.53						
Standard Deviation:	0.76						
Skewness:	0.09						
Kurtosis:	−0.69						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5	0	0	0	0	0	0	0
−1.5	0	0	0	0	0	0	0
−0.5	57	10	12	0	0	0	0
0.5	101	16	9	0	0	2	3
1.5	79	2	2	0	0	0	0
2.5	6	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	243	28	23	0	0	2	3

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	29	3	1	0	0	0	3
0.3	80	6	3	0	0	0	0
0.4	71	5	1	0	0	0	0
0.5	58	13	6	0	0	0	0
0.6	5	1	12	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	243	28	23	0	0	0	3

Sample 503-D1							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	243	40	12	0	5	0	0
Size (mm)	1.10	1.52	1.11	0.00	1.34	0.00	0.00
Size (phi)	-0.02	-0.54	-0.12	0.00	-0.27	0.00	0.00
Angularity	0.37	0.41	0.48	0.00	0.28	0.00	0.00

Grains Size Statistics							
Mean:	-0.09						
Standard Deviation:	0.61						
Skewness:	0.46						
Kurtosis:	0.00						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	10	0	0	0	1	0	0
-0.5	125	35	10	0	2	0	0
0.5	99	5	2	0	2	0	0
1.5	9	0	0	0	0	0	0
2.5	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	243	40	12	0	5	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	30	0	0	0	1	0	0
0.3	79	12	1	0	4	0	0
0.4	70	14	2	0	0	0	0
0.5	52	12	8	0	0	0	0
0.6	12	2	1	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	243	40	12	0	5	0	0

Sample 520-D2							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	251	23	25	0	0	0	1
Size (mm)	0.82	0.87	0.78	0.00	0.00	0.00	1.31
Size (phi)	0.40	0.27	0.41	0.00	0.00	0.00	-0.39
Angularity	0.35	0.37	0.44	0.00	0.00	0.00	0.30

Grains Size Statistics							
Mean:	0.39						
Standard Deviation:	0.56						
Skewness:	-0.05						
Kurtosis:	-0.23						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	66	4	6	0	0	0	1
0.5	148	19	16	0	0	0	0
1.5	37	0	3	0	0	0	0
2.5	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	251	23	25	0	0	0	1

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	37	0	0	0	0	0	0
0.3	102	10	4	0	0	0	1
0.4	67	10	7	0	0	0	0
0.5	37	3	13	0	0	0	0
0.6	8	0	1	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	251	23	25	0	0	0	1

Sample 526-D6							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	254	25	19	0	1	0	1
Size (mm)	0.73	0.81	0.80	0.00	2.41	0.00	0.66
Size (phi)	0.51	0.34	0.39	0.00	-1.27	0.00	0.60
Angularity	0.35	0.30	0.45	0.00	0.40	0.00	0.40

Grains Size Statistics							
Mean:	0.48						
Standard Deviation:	0.42						
Skewness:	0.20						
Kurtosis:	0.54						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	1	0	0
-0.5	29	1	4	0	0	0	0
0.5	192	23	13	0	0	0	1
1.5	33	1	2	0	0	0	0
2.5	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	254	25	19	0	1	0	1

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	38	5	0	0	0	0	0
0.3	102	15	3	0	0	0	0
0.4	72	4	4	0	1	0	1
0.5	39	1	11	0	0	0	0
0.6	3	0	1	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	254	25	19	0	1	0	1

Sample 577-D1							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	218	11	6	0	55	4	6
Size (mm)	0.44	0.35	0.38	0.00	0.88	0.45	0.28
Size (phi)	1.40	1.56	1.45	0.00	0.32	1.24	1.89
Angularity	0.38	0.36	0.45	0.00	0.32	0.00	0.42

Grains Size Statistics							
Mean:	1.22						
Standard Deviation:	0.85						
Skewness:	-0.27						
Kurtosis:	-0.48						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	16	0	0	0	21	0	0
0.5	34	1	1	0	26	1	0
1.5	122	7	5	0	7	3	3
2.5	42	3	0	0	1	0	3
3.5	4	0	0	0	0	0	0
Total	218	11	6	0	55	4	6

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	1	0	0	0	0	0	0
0.2	27	1	0	0	11	1	1
0.3	57	4	0	0	27	0	2
0.4	68	4	3	0	14	0	0
0.5	55	2	3	0	3	0	1
0.6	10	0	0	0	0	0	2
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	218	11	6	0	55	1	6

Sample 582-D1							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	237	29	11	0	14	9	0
Size (mm)	0.63	1.08	0.96	0.00	1.08	0.64	0.00
Size (phi)	0.84	0.03	0.23	0.00	-0.08	0.83	0.00
Angularity	0.38	0.41	0.40	0.00	0.39	0.00	0.00

Grains Size Statistics							
Mean:	0.70						
Standard Deviation:	0.77						
Skewness:	0.17						
Kurtosis:	-0.63						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	35	14	7	0	10	1	0
0.5	101	13	1	0	4	4	0
1.5	88	2	3	0	0	4	0
2.5	13	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	237	29	11	0	14	9	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	24	3	0	0	1	1	0
0.3	76	8	3	0	3	0	0
0.4	77	2	5	0	7	0	0
0.5	55	15	3	0	2	0	0
0.6	5	1	0	0	1	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	237	29	11	0	14	1	0

Sample 587-D1							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	186	19	15	0	55	6	19
Size (mm)	0.58	0.70	0.73	0.00	1.53	0.60	0.73
Size (phi)	0.95	0.62	0.55	0.00	-0.52	0.87	0.61
Angularity	0.38	0.42	0.43	0.00	0.32	0.00	0.30

Grains Size Statistics						
Mean:	0.62					
Standard Deviation:	0.85					
Skewness:	-0.17					
Kurtosis:	-0.45					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	14	0	0
-0.5	17	3	2	0	31	0	5
0.5	77	13	10	0	10	3	10
1.5	85	2	3	0	0	3	3
2.5	7	1	0	0	0	0	1
3.5	0	0	0	0	0	0	0
Total	186	19	15	0	55	6	19

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	1	0	0
0.2	28	2	1	0	12	0	9
0.3	51	3	3	0	24	0	5
0.4	49	4	3	0	10	0	3
0.5	50	10	6	0	8	0	0
0.6	8	0	2	0	0	0	2
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	186	19	15	0	55	0	19

Sample 606-D1							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	231	8	7	0	47	7	0
Size (mm)	0.40	0.84	0.80	0.00	1.59	0.49	0.00
Size (phi)	1.40	0.30	0.35	0.00	-0.60	1.23	0.00
Angularity	0.38	0.35	0.51	0.00	0.33	0.00	0.00

Grains Size Statistics						
Mean:	1.03					
Standard Deviation:	0.91					
Skewness:	-0.75					
Kurtosis:	0.10					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	14	0	0
-0.5	0	2	1	0	28	0	0
0.5	54	5	6	0	5	3	0
1.5	143	1	0	0	0	2	0
2.5	34	0	0	0	0	2	0
3.5	0	0	0	0	0	0	0
Total	231	8	7	0	47	7	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	35	2	0	0	11	0	0
0.3	53	2	0	0	18	0	0
0.4	66	2	0	0	10	0	0
0.5	67	2	6	0	8	0	0
0.6	10	0	1	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	231	8	7	0	47	0	0

Sample 611-D1							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	229	15	7	8	22	14	5
Size (mm)	0.46	0.67	0.58	0.77	0.83	0.39	0.48
Size (phi)	1.26	0.73	0.84	0.41	0.34	1.43	1.08
Angularity	0.37	0.48	0.50	0.44	0.31	0.00	0.44

Grains Size Statistics							
Mean:	1.14						
Standard Deviation:	0.68						
Skewness:	-0.03						
Kurtosis:	-0.90						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	1	0	0	0	3	0	0
0.5	78	9	5	8	18	3	2
1.5	124	6	2	0	1	9	3
2.5	26	0	0	0	0	2	0
3.5	0	0	0	0	0	0	0
Total	229	15	7	8	22	14	5

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	41	0	0	0	8	0	1
0.3	57	5	0	1	6	0	0
0.4	67	1	1	4	6	0	1
0.5	61	1	5	2	2	0	2
0.6	3	8	1	1	0	0	1
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	229	15	7	8	22	0	5

Sample 617-D7							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	260	25	13	0	0	2	0
Size (mm)	0.64	0.82	0.98	0.00	0.00	0.55	0.00
Size (phi)	0.82	0.32	0.09	0.00	0.00	0.97	0.00
Angularity	0.39	0.39	0.48	0.00	0.00	0.00	0.00

Grains Size Statistics						
Mean:	0.75					
Standard Deviation:	0.71					
Skewness:	-0.02					
Kurtosis:	0.09					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	31	3	6	0	0	0	0
0.5	129	21	7	0	0	1	0
1.5	87	1	0	0	0	1	0
2.5	13	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	260	25	13	0	0	2	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	1	0	0	0	0	0	0
0.2	24	4	0	0	0	0	0
0.3	70	6	1	0	0	0	0
0.4	79	4	0	0	0	0	0
0.5	71	10	12	0	0	0	0
0.6	15	1	0	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	260	25	13	0	0	0	0

Sample 664-D1							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	227	24	13	0	36	0	0
Size (mm)	0.62	0.86	0.66	0.00	1.38	0.00	0.00
Size (phi)	0.82	0.28	0.65	0.00	-0.36	0.00	0.00
Angularity	0.39	0.44	0.44	0.00	0.30	0.00	0.00

Grains Size Statistics						
Mean:	0.63					
Standard Deviation:	0.71					
Skewness:	-0.13					
Kurtosis:	0.19					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	6	0	0
-0.5	22	6	0	0	18	0	0
0.5	118	18	11	0	12	0	0
1.5	78	0	2	0	0	0	0
2.5	9	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	227	24	13	0	36	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	1	0	0	0	1	0	0
0.2	28	0	1	0	14	0	0
0.3	62	6	2	0	11	0	0
0.4	55	7	4	0	6	0	0
0.5	67	7	3	0	3	0	0
0.6	14	4	3	0	1	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	227	24	13	0	36	0	0

Sample 676-D5							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	200	57	12	2	23	6	0
Size (mm)	0.79	1.14	0.96	0.91	1.82	0.70	0.00
Size (phi)	0.49	-0.10	0.08	0.13	-0.83	0.56	0.00
Angularity	0.39	0.40	0.48	0.50	0.30	0.00	0.00

Grains Size Statistics						
Mean:	0.26					
Standard Deviation:	0.73					
Skewness:	0.27					
Kurtosis:	-0.43					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	3	0	0
-0.5	59	31	7	0	20	0	0
0.5	93	25	5	2	0	6	0
1.5	42	1	0	0	0	0	0
2.5	6	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	200	57	12	2	23	6	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	1	0	0	0	0	0	0
0.2	29	2	0	0	8	0	0
0.3	41	19	2	0	9	0	0
0.4	46	19	3	0	5	0	0
0.5	77	13	3	2	1	0	0
0.6	6	4	4	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	200	57	12	2	23	0	0

Sample 678-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	226	7	3	1	44	12	7
Size (mm)	0.55	0.46	0.30	0.54	0.96	0.77	0.48
Size (phi)	1.25	1.18	1.84	0.90	0.12	0.53	1.14
Angularity	0.39	0.40	0.47	0.50	0.31	0.00	0.41

Grains Size Statistics							
Mean:	1.06						
Standard Deviation:	0.98						
Skewness:	-0.43						
Kurtosis:	-0.61						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	28	0	0	0	22	3	0
0.5	32	4	0	1	22	5	4
1.5	117	3	2	0	0	4	3
2.5	47	0	1	0	0	0	0
3.5	2	0	0	0	0	0	0
Total	226	7	3	1	44	12	7

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	41	0	0	0	15	0	0
0.3	46	2	0	0	17	0	3
0.4	50	3	1	0	5	0	1
0.5	70	2	2	1	7	0	2
0.6	19	0	0	0	0	0	1
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	226	7	3	1	44	0	7

Sample 686-D6							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	174	70	36	0	15	5	0
Size (mm)	1.26	1.88	1.42	0.00	1.56	1.31	0.00
Size (phi)	-0.12	-0.80	-0.44	0.00	-0.60	-0.33	0.00
Angularity	0.45	0.44	0.56	0.00	0.36	0.00	0.00

Grains Size Statistics						
Mean:	-0.34					
Standard Deviation:	0.76					
Skewness:	0.42					
Kurtosis:	0.47					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	15	31	0	0	1	1	0
-0.5	93	32	31	0	12	4	0
0.5	49	6	4	0	2	0	0
1.5	16	1	1	0	0	0	0
2.5	1	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	174	70	36	0	15	5	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	6	1	0	0	1	0	0
0.3	29	17	0	0	6	0	0
0.4	37	13	4	0	6	0	0
0.5	72	28	7	0	2	0	0
0.6	30	11	25	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	174	70	36	0	15	0	0

Sample 687-D5							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	198	66	32	0	2	2	0
Size (mm)	1.07	1.50	1.59	0.00	2.19	0.85	0.00
Size (phi)	0.03	-0.50	-0.62	0.00	-1.13	0.36	0.00
Angularity	0.40	0.44	0.53	0.00	0.30	0.00	0.00

Grains Size Statistics							
Mean:	-0.16						
Standard Deviation:	0.66						
Skewness:	0.99						
Kurtosis:	1.60						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	5	10	0	0	2	0	0
-0.5	113	47	30	0	0	1	0
0.5	68	7	2	0	0	1	0
1.5	10	2	0	0	0	0	0
2.5	2	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	198	66	32	0	2	2	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	13	0	0	0	0	0	0
0.3	63	14	2	0	2	0	0
0.4	55	18	4	0	0	0	0
0.5	54	25	8	0	0	0	0
0.6	13	9	18	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	198	66	32	0	2	0	0

Sample 693-D5							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	209	38	8	5	32	6	2
Size (mm)	0.57	1.12	0.84	1.27	1.15	0.56	0.73
Size (phi)	1.02	0.02	0.40	−0.34	−0.14	0.88	0.55
Angularity	0.39	0.38	0.45	0.44	0.28	0.00	0.35

Grains Size Statistics							
Mean:	0.72						
Standard Deviation:	0.88						
Skewness:	0.15						
Kurtosis:	−0.82						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5	0	0	0	0	0	0	0
−1.5	0	0	0	0	0	0	0
−0.5	21	20	5	5	24	0	0
0.5	86	14	1	0	6	4	1
1.5	80	3	2	0	2	2	1
2.5	22	1	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	209	38	8	5	32	6	2

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	28	9	0	0	16	0	0
0.3	45	8	1	1	11	0	1
0.4	66	6	2	1	3	0	1
0.5	61	12	5	3	1	0	0
0.6	9	3	0	0	1	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	209	38	8	5	32	0	2

Sample 698-D5							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	222	31	11	1	34	0	1
Size (mm)	0.52	0.72	0.72	1.19	1.19	0.00	0.34
Size (phi)	1.03	0.55	0.51	-0.25	-0.18	0.00	1.54
Angularity	0.39	0.37	0.44	0.40	0.31	0.00	0.50

Grains Size Statistics						
Mean:	0.82					
Standard Deviation:	0.62					
Skewness:	-0.34					
Kurtosis:	0.20					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	2	3	2	1	19	0	0
0.5	102	23	9	0	15	0	0
1.5	111	5	0	0	0	0	1
2.5	7	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	222	31	11	1	34	0	1

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	19	5	0	0	8	0	0
0.3	58	6	1	0	17	0	0
0.4	70	15	5	1	6	0	0
0.5	68	4	5	0	3	0	1
0.6	7	1	0	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	222	31	11	1	34	0	1

Sample E1							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	246	40	0	0	11	0	3
Size (mm)	0.32	0.44	0.00	0.00	0.97	0.00	0.34
Size (phi)	1.73	1.27	0.00	0.00	0.06	0.00	1.60
Angularity	0.34	0.37	0.00	0.00	0.38	0.00	0.60

Grains Size Statistics						
Mean:	1.61					
Standard Deviation:	0.61					
Skewness:	-0.27					
Kurtosis:	0.74					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	0	0	0	0	0	0
-1.5	0	0	0	0	0	0	0
-0.5	0	0	0	0	5	0	0
0.5	19	16	0	0	6	0	0
1.5	158	21	0	0	0	0	2
2.5	66	3	0	0	0	0	0
3.5	3	0	0	0	0	0	0
Total	246	40	0	0	11	0	2

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	57	7	0	0	3	0	0
0.3	80	9	0	0	0	0	0
0.4	67	15	0	0	4	0	0
0.5	37	7	0	0	4	0	0
0.6	5	2	0	0	0	0	2
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	246	40	0	0	11	0	2

Sample E2							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	265	8	0	0	17	6	4
Size (mm)	0.30	0.48	0.00	0.00	1.49	0.53	0.82
Size (phi)	1.82	1.11	0.00	0.00	−0.44	0.96	0.46
Angularity	0.37	0.38	0.00	0.00	0.36	0.00	0.30

Grains Size Statistics							
Mean:	1.64						
Standard Deviation:	0.72						
Skewness:	−1.71						
Kurtosis:	3.95						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5	0	0	0	0	0	0	0
−1.5	0	0	0	0	2	0	0
−0.5	0	0	0	0	11	0	2
0.5	13	4	0	0	3	4	1
1.5	169	3	0	0	1	2	1
2.5	83	1	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	265	8	0	0	17	6	4

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	45	0	0	0	2	0	1
0.3	69	3	0	0	5	0	2
0.4	72	4	0	0	8	0	1
0.5	74	1	0	0	2	0	0
0.6	5	0	0	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	265	8	0	0	17	0	4

Sample E3							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	253	18	1	0	23	3	2
Size (mm)	0.33	0.45	0.37	0.00	1.80	0.46	0.46
Size (phi)	1.71	1.25	1.45	0.00	−0.70	1.11	1.14
Angularity	0.36	0.37	0.60	0.00	0.28	0.00	0.35

Grains Size Statistics							
Mean:	1.49						
Standard Deviation:	0.82						
Skewness:	−1.92						
Kurtosis:	4.26						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5	0	0	0	0	0	0	0
−1.5	1	0	0	0	13	0	0
−0.5	0	0	0	0	6	0	0
0.5	13	5	0	0	3	0	1
1.5	176	12	1	0	1	3	1
2.5	63	1	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	253	18	1	0	23	3	2

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	61	4	0	0	7	0	0
0.3	63	5	0	0	14	0	1
0.4	64	2	0	0	1	0	1
0.5	52	6	0	0	1	0	0
0.6	13	1	1	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	253	18	1	0	23	0	2

Sample T1							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	182	110	2	0	5	0	1
Size (mm)	1.48	3.02	0.85	0.00	1.67	0.00	0.00
Size (phi)	−0.32	−1.52	0.24	0.00	−0.73	0.00	0.00
Angularity	0.36	0.49	0.45	0.00	0.26	0.00	0.00

Grains Size Statistics						
	−0.77					
Standard Deviation:	0.93					
Skewness:	0.35					
Kurtosis:	−0.88					

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5	0	0	0	0	0	0	0
−1.5	40	91	0	0	1	0	0
−0.5	74	18	0	0	4	0	0
0.5	58	1	2	0	0	0	0
1.5	10	0	0	0	0	0	0
2.5	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	182	110	2	0	5	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	29	1	0	0	2	0	0
0.3	78	8	0	0	3	0	0
0.4	32	29	1	0	0	0	0
0.5	31	40	1	0	0	0	0
0.6	12	32	0	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	182	110	2	0	5	0	0

Sample T2							
	Qm	**Qp**	**F**	**Lm**	**Ls**	**Mica**	**Other**
Count	172	110	0	0	7	0	11
Size (mm)	1.23	4.78	0.00	0.00	2.60	0.00	2.03
Size (phi)	−0.14	−2.07	0.00	0.00	−1.38	0.00	−0.96
Angularity	0.34	0.48	0.00	0.00	0.49	0.00	0.53

Grains Size Statistics							
Mean:	−0.91						
Standard Deviation:	1.16						
Skewness:	−0.19						
Kurtosis:	−0.93						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5	0	72	0	0	0	0	0
−1.5	19	17	0	0	7	0	6
−0.5	86	20	0	0	0	0	5
0.5	54	1	0	0	0	0	0
1.5	13	0	0	0	0	0	0
2.5	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	172	110	0	0	7	0	11

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	48	7	0	0	0	0	1
0.3	52	12	0	0	0	0	0
0.4	37	9	0	0	2	0	0
0.5	21	46	0	0	4	0	3
0.6	13	36	0	0	1	0	4
0.7	1	0	0	0	0	0	1
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	172	110	0	0	7	0	9

Sample T3							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	173	125	0	0	2	0	0
Size (mm)	1.51	6.51	0.00	0.00	2.14	0.00	0.00
Size (phi)	-0.38	-2.47	0.00	0.00	-1.03	0.00	0.00
Angularity	0.35	0.41	0.00	0.00	0.30	0.00	0.00

Grains Size Statistics							
Mean:	-1.25						
Standard Deviation:	1.34						
Skewness:	-0.11						
Kurtosis:	-1.09						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5	0	74	0	0	0	0	0
-1.5	0	23	0	0	0	0	0
-0.5	53	10	0	0	1	0	0
0.5	59	18	0	0	1	0	0
1.5	53	0	0	0	0	0	0
2.5	8	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1	0	0	0	0	0	0	0
0.2	34	4	0	0	0	0	0
0.3	62	12	0	0	2	0	0
0.4	46	77	0	0	0	0	0
0.5	26	29	0	0	0	0	0
0.6	5	3	0	0	0	0	0
0.7	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0
Total	173	125	0	0	2	0	0

Sample P65.2							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	104	39	9	0	0	142	6
Size (mm)							
Size (phi)							
Angularity							

Grains Size Statistics						
Mean:						
Standard Deviation:						
Skewness:						
Kurtosis:						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5							
-1.5							
-0.5							
0.5							
1.5							
2.5							
3.5							
Total	0	0	0	0	0	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1							
0.2							
0.3							
0.4							
0.5							
0.6							
0.7							
0.8							
0.9							
Total	0	0	0	0	0	0	0

Sample P135.8							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	117	45	4	0	0	132	2
Size (mm)							
Size (phi)							
Angularity							

Grains Size Statistics						
Mean:						
Standard Deviation:						
Skewness:						
Kurtosis:						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
−2.5							
−1.5							
−0.5							
0.5							
1.5							
2.5							
3.5							
Total	0	0	0	0	0	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1							
0.2							
0.3							
0.4							
0.5							
0.6							
0.7							
0.8							
0.9							
Total	0	0	0	0	0	0	0

Sample P255							
	Qm	Qp	F	Lm	Ls	Mica	Other
Count	131	60	3	0	0	105	1
Size (mm)							
Size (phi)							
Angularity							

Grains Size Statistics						
Mean:						
Standard Deviation:						
Skewness:						
Kurtosis:						

Phi Size	Qm	Qp	F	Lm	Ls	Mica	Other
-2.5							
-1.5							
-0.5							
0.5							
1.5							
2.5							
3.5							
Total	0	0	0	0	0	0	0

Angularity	Qm	Qp	F	Lm	Ls	Mica	Other
0.1							
0.2							
0.3							
0.4							
0.5							
0.6							
0.7							
0.8							
0.9							
Total	0	0	0	0	0	0	0