THE MORPHOLOGY AND HISTORY OF EXFOLIATION ON ROCK DOMES IN THE SOUTHEASTERN UNITED STATES

by

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ABSTRACT

BENJAMIN IRVING WEISERBS. The morphology and history of exfoliation on rock domes in the Southeastern United States. (Under the direction of DR. MARTHA CARY EPPES)

Rock domes and associated surface-parallel exfoliation joints are evident in all tectonic and climatic settings, including the Blue Ridge and Piedmont provinces of the southeastern United States. Although large-scale dome exfoliation is traditionally attributed to pressure release via erosional unloading, alternative hypotheses exist for its formation; e.g. tectonic or insolation-driven deformation (e.g. Martel 2006; Collins and Stock 2016). However, there are currently limited, if any, field data regarding the morphology of such domes and their associated exfoliation slabs that might serve to test these hypotheses. The purpose of this study is to characterize the morphologic, topographic, and mechanical weathering characteristics of exfoliation slabs on three domes in the southeastern United States. The domes are located in a roughly linear transect across the Blue Ridge Escarpment (~36° latitude), including locations in the Piedmont (40 Acre Rock, SC), within the foothills (Rock Face, NC), and the in the Blue Ridge mountains (Stone Mountain, NC). All generations of exfoliation slabs (e.g. S1=most recently exposed, lowest, S2= the next overlying slab) were mapped at five sites, each characterized by a different aspect, for each dome. Slab thickness measurements were obtained for each slab generation at each site at each dome. To characterize the relative age of each slab generation, weathering characteristics including crack morphology and slab surface compressional strength (via Schmidt Hammer) were measured within ten 20x20cm boxes along a transect at each site. Overall, slab morphological characteristics are similar for all three domes, with three

generations of slabs present at the majority of sites. Although slab thicknesses vary somewhat between slab generations and domes, the average slab thicknesses are similar, in the range 15.58cm to 23.82cm (maximum thickness of 166 cm). Compressional strength is progressively lower with increasingly older slab generations at all domes, indicating a higher degree of weathering, with increasing slab generation. This result and other weathering characteristics provide evidence that the formation of each slab generation occurred at distinct, separate intervals. Overall, these preliminary analyses provide evidence that dome exfoliation processes are similar spatially and temporally for the three domes, despite their distinct differences in topography, and presumably, long-term exhumation history.

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CHAPTER 1: INTRODUCTION

Exfoliation domes, with their associated surface parallel exfoliation cracks (hereafter ‘sheet joints’) and detached surface parallel layers of rock (hereafter ‘slabs’) are generally some of the highest peaks in the surrounding topography. Among the earliest accounts of sheet joints, such as those found on domes, was De Saussure in 1797 in the French Alps. Since that time, geologists have noted and continued to explore the origins of exfoliation (referring hereafter to the process(es) that result in sheet joints and slabs) on dome surfaces. Exfoliation on domes has been generally attributed to stresses caused by the unloading of overburden sediment (e.g., Holzhousen 1989; Leith et al. 2014). However, additional hypotheses have been proposed for inducing the tensional stress necessary for exfoliation including: 1) regional compressive stresses interacting with ground surface convexity to result in tension, and 2) thermal-cycling and associated heating of outer rock layers compared to inner ones. Much of the current work supporting these hypotheses is comprised of numerical models. Little if any field data exist that might support or refute them. In addition, there is generally very limited research on exfoliation domes, overall, throughout the southeastern United States region. The purpose of this study is to describe, in detail for the first time, the morphological characteristics of three exfoliation domes located along a transect across the Piedmont and Blue Ridge of North Carolina and South Carolina. By comparing and contrasting the spatial and temporal characteristics of exfoliation on these domes, I hope to make new advances into understanding these common landforms.

1.1 Implications of the Research

Exfoliation cracking and associated exfoliation slabs may play a role in several aspects of regional geology, hydrology, and hazards. For example, such cracking often adds to slope failures (Twidale and Vidal Romaní 2005). As weathering continues to loosen sheet joints, the rock mass becomes unstable, resulting in rockfalls and slides (Martel 2006). Road cuts are extremely susceptible to this process since many roads undercut into slopes. Little if no data exist regarding the potential recurrence intervals of exfoliation that may drive these hazards.

Sheet joints are also important hydrologically. For example, water transport through granite differs depending on the homogeneity of the rock mass in regards to water pressure and microcrack porosity (Bonner et al., 1980). Crack density also influences how water moves through these granite masses, affecting shallow groundwater systems (Martel 2006).

Understanding exfoliation is also important for engineering applications. Granite is used as a material for underground disposal for radioactive waste, caverns to store liquid natural or petroleum gas, and the extraction of geothermal energy from hot dry rock (Nara 2015). Crack propagation in granites, used for either liquid gas or radioactive waste storage, could lead to serious and devastating environmental consequences, including contamination of aquifers (Nara 2015). Crack propagation affects daily construction and mining industries, as well (Martel 2006, 2011; Van Alst 2011).

CHAPTER 2: PREVIOUS LITERATURE

2.1 Exfoliation Domes

Large domes made of rock occur throughout the world. Various terms have been used to describe these features. ‘Bornhardt’ is the most common name used (Twidale and Vidal Romaní 2005). In turn, these landforms vary in size and curvature, resulting in other names. For example, ‘whalebacks’ or ‘dos de baleine’ are low, elongated and elliptical. Higher, asymmetrical features are known simply as ‘Elephant Rocks’ (dos d’elephant) (Twidale and Vidal Romaní 2005). Regardless of name, their prevalence in the literature indicates that exfoliation domes are a global phenomena. Hereafter, I employ the term exfoliation dome to refer to all such landforms.

Exfoliation domes in generals are domical in shape with exposed bedrock representing most the surface (Twidale and Vidal Romaní 2005). Well developed in mostly granite bedrock, the location is independent of surrounding topography and current climate (Twidale and Vidal Romaní 2005). The domes themselves are characterized by visible vertical (and near-vertical) fractures, forming orthogonal systems (Twidale and Vidal Romaní 2005). They are often found in multicyclic landscapes, indicating past cycles of relative uplift (Twidale and Vidal Romaní 2005).

There is no unifying hypothesis for how exfoliation domes form (Twidale and Vidal Romaní 2005). One hypothesis with significant supporting evidence is the scarp retreat hypothesis, first published in 1866 (Twidale and Vidal Romaní 2005). Under this hypothesis, weathering and erosion (in the presence of water) steepens the slope to form what is known as the ‘Piedmont angle’, the sharp angle that divides steep-sided hills and low relief plains, at the pluton’s base (Twidale and Vidal Romaní 2005). The process of formation is divided into two simplified major stages: (1) initiation by differential subsurface weathering, controlled by structure, and (2) the stripping of the regolith, depending on climate conditions (Twidale and Vidal Romaní 2005). Although the regional climate should affect this particular process of dome formation, there is no correlation between the variation in size and shape of exfoliation domes, and climate (Twidale and Vidal Romaní 2005). Exfoliation domes appear to form whenever conditions are structurally suitable, independent of topography (Twidale and Vidal Romaní 2005).

2.2 Exfoliation

Exfoliation and related features such as sheet joints and slabs occur as the result of offloading and pressure release (Holzhousen 1989; Twidale and Romaní; Martel 2006). Here, exfoliation is defined as fractures with an orientation parallel to the dome's surface (Twidale and Vidal Romaní 2005). 'The peeling of an onion's outer layers' is often used to describe the morphology off exfoliation (Gilbert 1904, Holzhousen 1989). However, in profile view, sheet joints typically terminate in a gradational manner, by which they expand outward and become less distinct (Holzhousen 1989). Overall, such surface-parallel fractures vary in scale, from grain sized microfissures to the division of macro-rock remnants (Holzhousen 1989; Twidale and Vidal Romaní 2005). Here, however, I restrict the use of the term 'slab' to macro-rock remnants that are greater than ~10cm thick over relatively large (~10^2 m^2) area, and 'sheet joints' to refer to the surface parallel cracks found under a slab, I will employ the term 'spall' to refer to smaller surface parallel layers of rock, essential miniature 'slabs'. The thickness and frequency of sheet joints are often cited to decrease with increasing depth where they disappear at depths greater than 100m deep in flat terrains and 15-30m deep in domes (Holzhousen 1989). In contrast, a correlation has been demonstrated in some localities between increasing spall thickness and increasing coarseness of the rock's grain size (Holzhousen 1989).

2.3 Crack Growth Related to Exfoliation

Subcritical crack growth occurs when stresses lower than the critical strength of a brittle elastic solid serve to promote fracture (e.g. Atkinson 1984). Over time, cracks will lengthen subcritically until a threshold for critical cracking is reached. It is important to understand, that despite competing hypotheses (explained below) to explain exfoliation, it is likely that stresses, much lower than the critical threshold necessary to fracture the rock of the exfoliation dome, are acting to produce sheet joints (Eppes and Keanini 2017l Bahat et al. 1991). Once these fractures reach critical lengths, then they might exfoliate rapidly, as observed in a recent video captured of an exfoliation event on Twain Harte, California (https://www.youtube.com/watch?v=yAZ1V_DJKV8).

Competing Hypotheses In Regards To Exfoliation Processes

It is most commonly assumed that sheet joints and their associated domes are the result of tensile stresses that arise during unloading of overburden stress, an idea first developed by Gilbert (1904) that still has support (Carlsson and Olsson 1982; Nadan and Engelder 2009). However, competing hypotheses exist (Leith 2014), including rainfall (Husen et al. 2007), fluid injection (Zoback and Harjes 1997), and earthquake activity (Stein et al. 1997, Twidale and Bourne 2014). In addition, there is some recent work attempting to attribute exfoliation to thermal cycling processes (Holzhousen 1989; Collins and Stock 2016). The following discussion is limited to the three primary hypotheses that have developed in the literature: (1) unloading of overburden stress, (2) interactions between regional compressive stresses and convex topographic curvature, and (3) thermal-cycling.

2.4 Unloading of Overburden Sediment or Rock

Focusing on Half Dome, California, Gilbert (1904) attributed exfoliation to the removal of large amounts of sediment from the dome, through erosional processes (Gilbert 1904; Jahns 1943; Holzhousen 1989; Nadan and Engelder 2009; Leith 2014) (Figure 1). Rocks that form at depth tend to expand toward the surface in response to erosion (Gilbert 1904, Jahns 1943; Holzhousen 1989) Consequently, tensile stress exceeds compressive related to confining pressures and cracking ensues, forming parallel to the eroded surface (Nadan and Engender 2009; Leith 2014). Similar hypotheses attribute the rapid exhumation to deglaciation (Carlsson and Olsson 1989; Leith 2014).

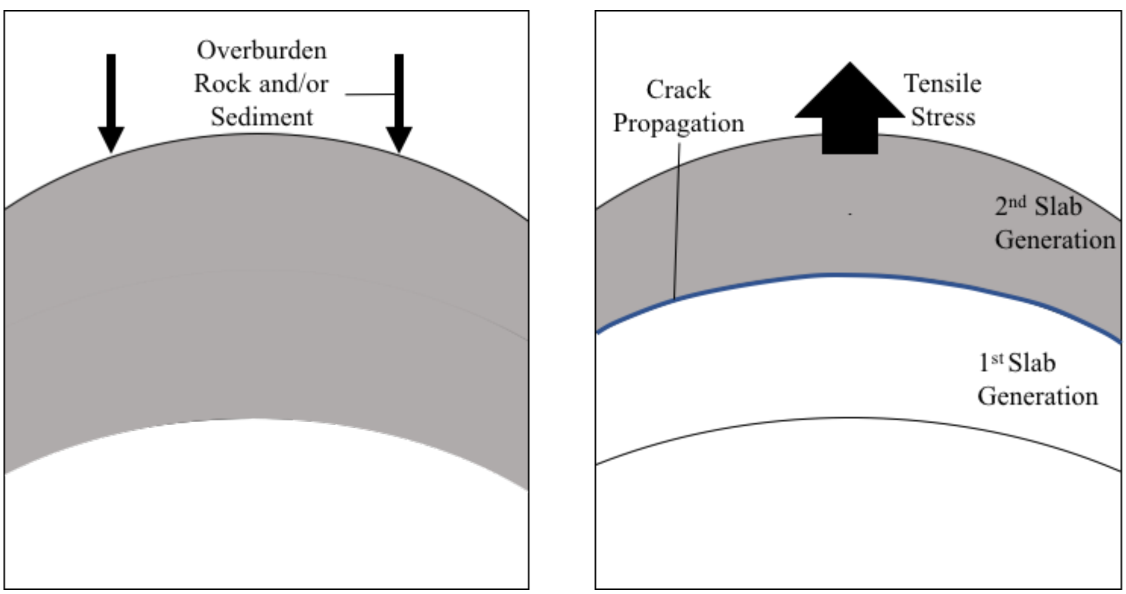

***Figure 1**. The removal of overburden sediment hypothesis. Once overlying rock and/or sediment is removed, tensional expansion occurs, forming new slabs (Leith et al. 2014).*

2.5 Interactions Between Regional Compressive Stresses and Convex Topographic Curvature

First proposed in 1923, Dale attributed exfoliation cracking to high compressive stress, parallel to the surface (Figure 2) (St. Clair et al. 2015; Martel 2006, 2011; Holzhousen 1989). Most effective in topography with high upward convexity, the tensile stress produced by compression exceeds the confining pressures of the rock, resulting in exfoliated cracks (Martel 2006 and 2011). In this case, exfoliation occurs when the product of compressive stress and surface curvature are greater than the unit weight of the rock and cosine of the slope (Martel 2006). In contrast to the removal of overburden rock and/or sediment, slope and curvature are thought to be more important factors contributing to the formation of exfoliated structures formed in this way. Thicker slabs are predicted for domes of low curvature. In contrast, thinner slabs will form where curvature values increase (Martel 2006). Granite is thought to be particularly susceptible to cracking by this mechanism due to its tolerance of high surface parallel compression (Martel 2011). Magnitudes of compressional stress were analyzed at Stone Mountain, GA (P_1= -10.3 MPa, P_2= -6.9 MPa) (Martel 2006), providing evidence that from tectonic regime standpoint, this is a viable hypothesis for dome formation in the southeastern United States.

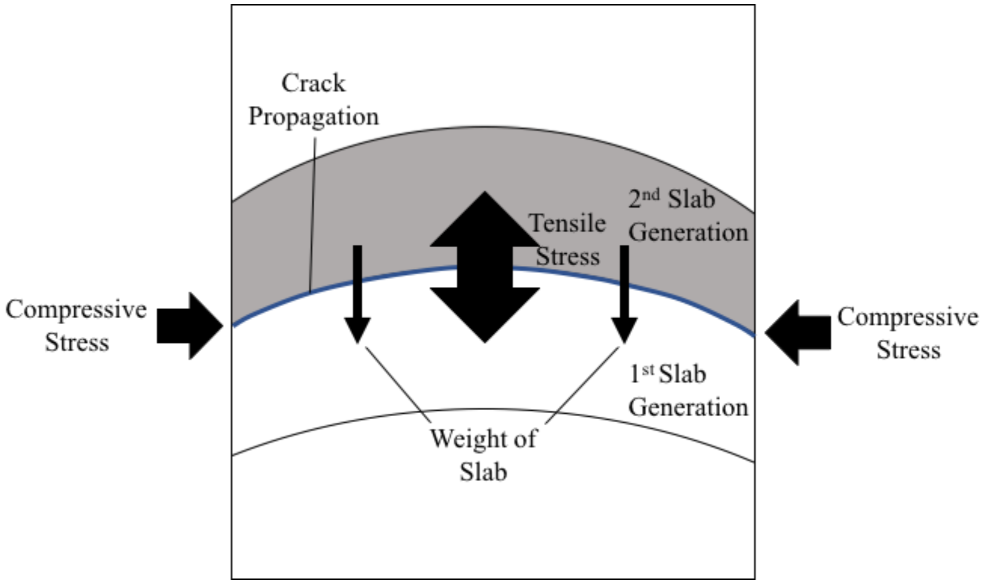

Figure 2. *Conceptual diagram representing tensile expansion due to compression where curvature is the largest.*

2.6 Thermal Cycling

Although first hypothesized by W.H.C Bartlett in 1832, thermal-related stresses have gained renewed attention with respect to rock cracking in recent years (e.g. Eppes et al. 2016; McFadden et al. 2005). Insolation, the solar radiation reaching the Earth's surface, causes rocks to expand as they are heated (Figure 3). The rock contracts when cooling occurs. It has been observed that many different timescales for cycles of heating and cooling might appear to induce these thermal stresses and result in cracking (Eppes et al. 2016). Possible periods for the cycles include hourly, diurnal, annual, and long-term climatic variations. As such, the thickness of the outer heated layers will vary with these timescales, possibly resulting in different depths of cracking. Thus, exfoliation caused by thermal-related stresses might also vary in thickness related to the dominant cycle of heating and cooling.

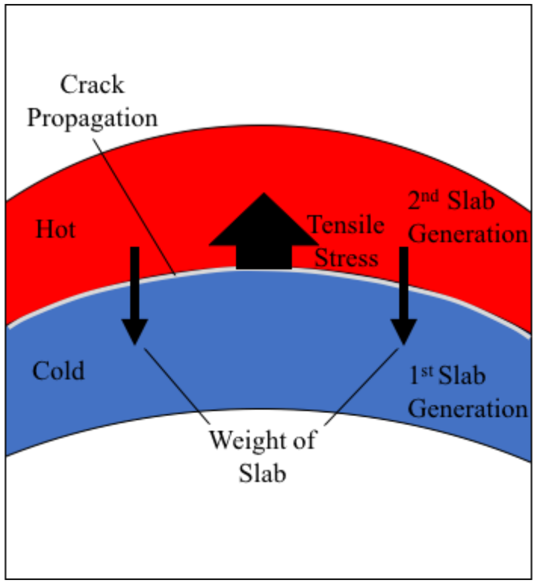

Figure 3*. Conceptual diagram of tensional stress resulting from thermal cycling. In contrast to its cooler core, the rock's outer layer is heated, resulting in stress that might produce exfoliation.*

2.7 Exfoliation in the southeastern United States

The most recent morphological investigation of exfoliation throughout the southeastern United States was performed by William White in 1945. White (1944, 1945), focused on Stone Mountain, NC and Stone Mountain, GA. He attributed dome formation to granular disintegration (Twidale and Vidal Romaní 2005). Granular disintegration is the physical disaggregation of mineral grains along grain boundaries. Believing that domes were homogeneous solid masses, White (1945) proposed that weathering took place in the subsurface, similar to the weathering of quarry stone and to the formation of the bornhardts described above (White 1945, Twidale and Vidal Romaní 2005). His reasoning was backed by the following evidence: the lack of spalls on either the surface or talus slopes at the base of the dome (White 1944). Fieldwork for this study at Stone Mountain, NC in January of 2016, documented evidence of spalls and slabs, both on the surface and at the base of the dome. Another problem with White's hypothesis is that he compared exfoliation at Stone Mountain, NC to those found at Half Dome in Yosemite National Park, CA (White 1944). Exfoliated slabs at Half Dome are much more prevalent than those located in the Southeast. Despite fewer occurrences, however, this does not eliminate exfoliation in the southeast United States. He did not document much smaller scales (sub meter) and they appear to be the dominant form in southeastern United States.

To further support his hypothesis, White attributed soil surrounding at Stone Mountain, GA to granular disintegration. These soils that surround the dome had the same composition of the granite mass (White 1944). These soils are known as gruss, a product of granular disintegration. These soils may be strong evidence against exfoliation, but only at Stone Mountain, GA. White did not see evidence of gruss at Stone Mountain, NC, providing counter-evidence that granular disintegration may not explain the variation in the size of southeastern granite domes.

2.8 Regional Geomorphic and Geologic Context

Since the mid-1980's, beryllium dating has become increasingly used to understand the Earth's eroding surfaces. Taken from purified quartz, ^{10}Be is formed predominately from cosmogenic rays (in the Earth's atmosphere) bombarding the Earth's surface. A reaction ensues with oxygen from the mineral structure of quartz (SiO_2), decaying radioactively (e.g., Portenga et al. 2013).

Erosion rates from the northwestern United States help put exhumation histories of domes found in the southeastern United States into geomorphological context (Portenga and Bierman 2011). Portenga and Bierman (2011) have collected, normalized, and compared 87 sites around the world to understand how geologic erosion rates are influenced by various Earth systems including the tectonic regime, climate, and the biosphere. Prior to this work, geoscientists had limited data and knowledge regarding to erosion and global climate models. Specifically to the Appalachian region, Jennifer Whitten's thesis (2009) discovered a mean summit erosion rate of 9.72 m m.y.$^{-1}$ in Shenandoah National Park, about 430 km to the northeast of this study's field area. In that study, Be^{10} dates showed slight correlation to slope and curvature (Whitten 2009).

In some regions, erosion rates have evidently increased approximately two and a half times since the last glacial maximum (LGM), possibly from frost-derived sediment (Marshall et al. 2015). Through their studies, (Portenga and Bierman 2011; Portenga et al. 2013) discovered that drainage basins erode faster than outcrops on main ridgelines. Basins have a higher frequency of soil coverage, reducing ^{10}Be (Portenga et al 2013). This could explain why the Appalachian Mountains have not fully eroded (Portenga et al. 2013). Although, depending on location (varying in characteristics in regards to climate and exhumation histories), all previous studies show that the Appalachian Mountains erode only a few meters per million years (median=5.7 m m.y.$^{-1}$) (Hancock and Kirwan 2007; Portenga and Bierman 2011; Portenga et al. 2013). ^{10}Be erosion dating, a more precise method, shows that erosional dates in the Appalachian Mountains are much smaller than previously thought (Hancock and Kirwan 2007; Portenga et al. 2013) based on studies of sediment fluxes to offshore basins (Pazazgalia and Brandon 1996; Sevon 1989), U-Th/ He dating (Spotilla 2004), and fission-track thermochronologies (Spotilla et al. 2004).

2.9 Blue Ridge Escarpment

The origin of the Blue Ridge Escarpment (BRE) has and continues to be debated (Spotilla et al. 2004). Studies by both Spotilla et al. (2004) and Pazzagalia and Gardner (2000) show evidence that the BRE was produced by flexural deformation, with erosion, during the continental breakup of Pangea. The topography of the BRE is higher than the Piedmont due to its evolutional westward erosional retreat (Spotilla et al. 2004). It is suggested that the different erosional rates of the BRE and Piedmont is the result of ruggedness. Erosion is increased by higher slopes and relief. As the escarpment moved westward, the increase of erosion rates moved westward as well following the migrating escarpment (Sullivan 2007). This explains the low erosion rates of the Piedmont. Due to the erosion rate differences, it is implied that the BRE and Piedmont were not continuous landforms, rather they were separate entities with vast topographic differences. Figure 4 shows differences in some measured erosion rates derived from the Blue Ridge Escarpment, the Blue Ridge and the Piedmont. In addition to topographic differences, contrasting cooling rates, A longer-term measure of exhumation and erosion, also suggest that the BRE is separate from the Piedmont. It is hypothesized that the BRE is part of a passive margin (Pazzagalia and Gardner 2000; Spotilla et al. 2004). The escarpment is also deemed one of the oldest passive margins of erosional origin (Spotilla et al. 2004) having formed when the Atlantic Ocean opened in the Jurassic (~200 m.y.) in the Triassic period (252 m.y). Throughout the Cenozoic era, long term erosional retreat propagated westward (Spotilla et al. 2004).

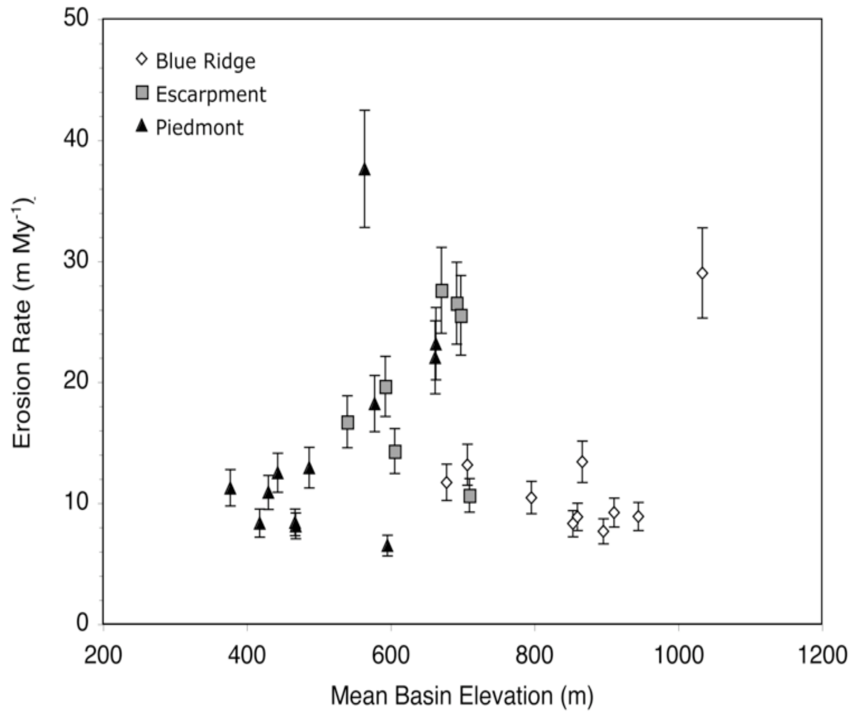

Figure 4*.Erosion rate vs Elevation; Erosion rates of the Blue Ridge Escarpment are faster than the Blue Ridge. The Blue Ridge erosion rates are similar to the Piedmont (Sullivan 2007).*

CHAPTER 3: METHODS

3.1 Field Areas

Three domes were chosen along a transect covering the geographical provinces of the Blue Ridge (Stone Mountain), Foothills (Rocky Face), and the Piedmont (Forty Acre Rock) (Figure 6). ^{10}Be-derived data suggest different erosion and exhumation rates for the three sites (Figure 4, Table 2). These exfoliation domes were also chosen for their good exposure and accessibility. Assuming that the Blue Ridge Escarpment is migrating westward (Spotilla et al. 2004), it may be assumed that exhumation age of the three domes decreases westward as well. The geologic age of the rocks comprising the domes generally increase westward.

Through a range of methods, tectonic stresses have been characterized throughout the United States (Figure 5) (Heidbach et al. 2016). Limited data with respect to the southeastern United States have been collected (Heidbach et al. 2016); only orientations of maximum horizontal compressive stresses have been observed. Compression is generally observed along a NE-SW trend.

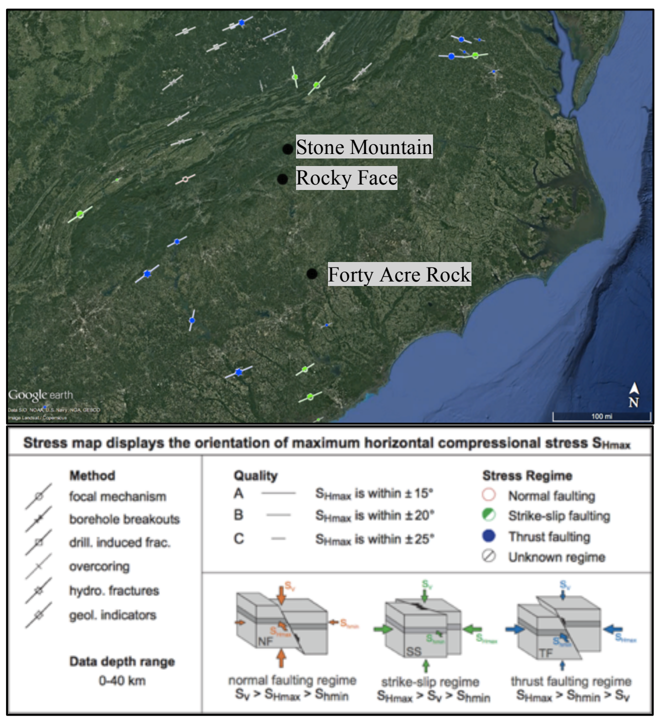

Figure 5*. Stress Map of the Southeastern United States.*

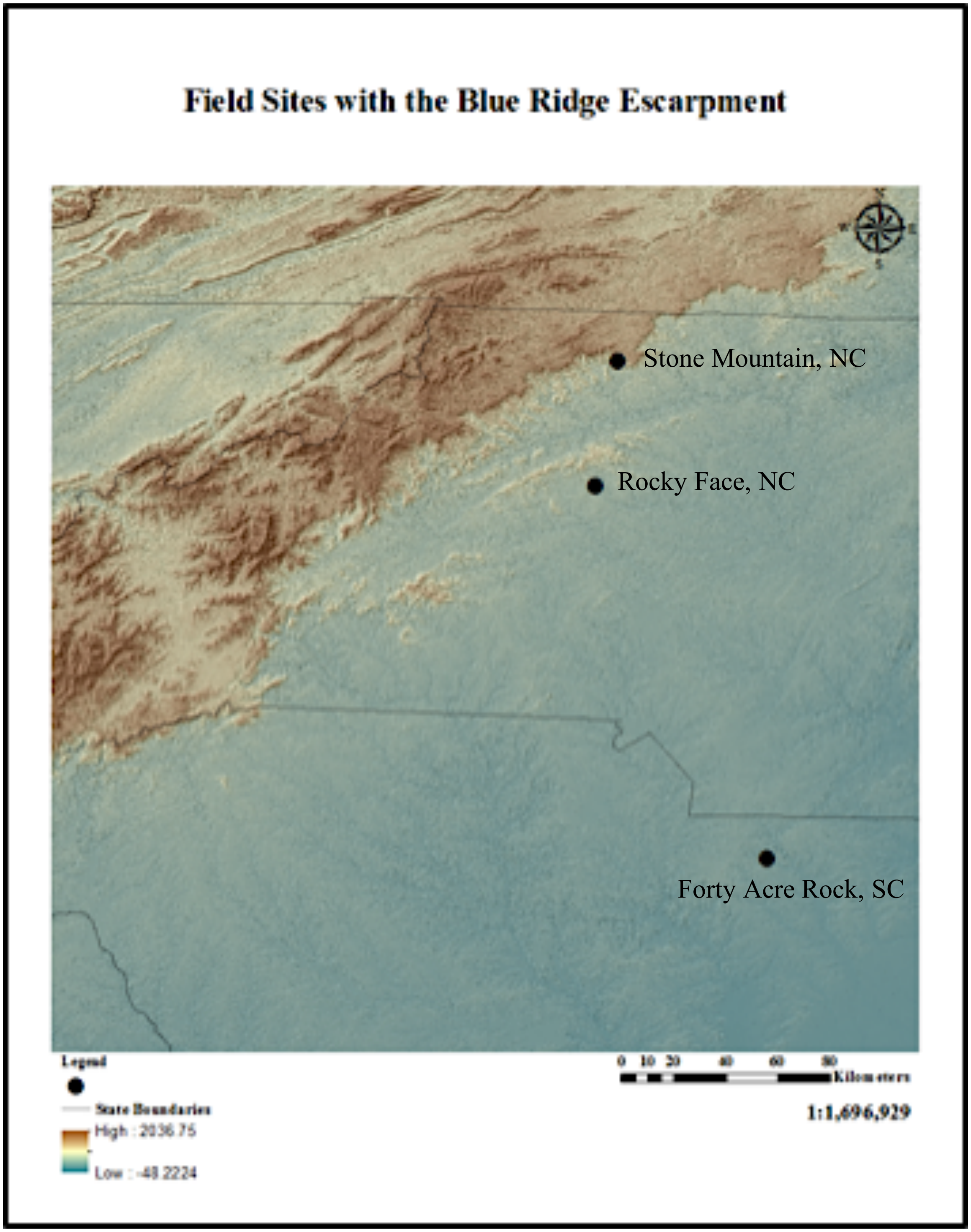

Figure 6. *Site map of all three domes with respect to the Blue Ridge Escarpment. Domes were chosen along transect traversing across the Blue Ridge Escarpment, covering the three major topographical provinces: Piedmont, foothills, and the Blue Ridge mountains*

Several generations of exfoliation events are evident at all three domes in the form of stacked sub-parallel slabs (Figure 7). As a convention, the stratigraphically lowest slab surface observed at each site is designated the mapping unit name: Slab 1. Slabs that were on top of the Slab 1 were given the designation of Slab 2, etc. For each exfoliation dome, five sites were identified around the dome surface (Figure 13,15,16) to characterize how dome, slab, and sheet joint morphology differed for different aspects. If, for example, thermal stresses are causing exfoliation, features might vary by aspect. Specific site selection was dependent, however, on the accessibility and presence of exposed rock.

***Figure** 7. An example photograph of the several units of slabs that were found at the majority of multiple sites of all three domes. Photo taken at northwest site of Stone Mountain, NC.*

3.2 Mapping

Google Earth imagery (WGS1984) was downloaded for each selected site at each dome. At each site, all features including all slabs, remnants (fragments of a previously extensive slab), visible vertical and horizontal fractures, and regions of the slabs covered by soil were mapped using the imagery as a basemap (Appendix A). Table 2 shows the key used.

TABLE 1: LEGEND FOR GEOMORPHIC MAPS

Feature	**Key**
Slab 1 (Youngest slab)	
Slab 2	
Slab 3	
Slab 4 (Oldest Slab)	
Soil	
Weathering Pit or Pool	
Additional Surface Parallel Fracture	
Vertical Fracture	
Vein	
Transect	
Anthropomorphic Features (Fences)	
Coordinate Location	
Boundaries not observed but expected	

A digital planimeter (KP-90N) was used to measure the surface area of each slab remnant at each site (Appendix B, Table 4-6).

3.3 General Observations

The following observations were made for each slab unit at each site

1. Vegetation coverage: Percentages of different types of vegetation were categorized for all remnants. Vegetation was classified as either trees, bushes, grasses, or lichen. In addition, the relative proportion of different types of lichen (black, light green, dark green, etc.) were quantified as well. Lichens on slab sides or undersides were not measured.

2. Maximum and average surface relief were measured on all remnant surfaces. Maximum relief (cm) was defined as the difference between the highest and lowest point on the slab's topography, not including the overall slope of the slab. The maximum relief was typically related to the thickness of evident spalls that

were not sufficiently extensive to be identified as a slab (Figure 8). Average relief was estimated by measuring the maximum relief in a representative area of .25m^2.

3. Surface dissection- The length between major vertical fractures within each slab. A numerical index was developed to characterize remnant dissection. 0 represents that the remnant/slab is not cracked at all. A slab with an index of 1 signifies that dissections of the remnant/slab are greater than two meters length apart. An index of 2 means that dissections are in between one and two meters. When the remnant/slab is heavily split, in which dissections are less than one meter apart, an index of 3 is given.

3.4 Slab Thickness

For all remnants at each site, the exposed perimeter of the remnant was divided into ten equal increments at which to measure slab thickness (cm). All slab thicknesses were measured from the top of the slab to where it touches the underlying slab. Imperfections (caused by fluvial and additional weathering processes) were ignored (Figure 8)

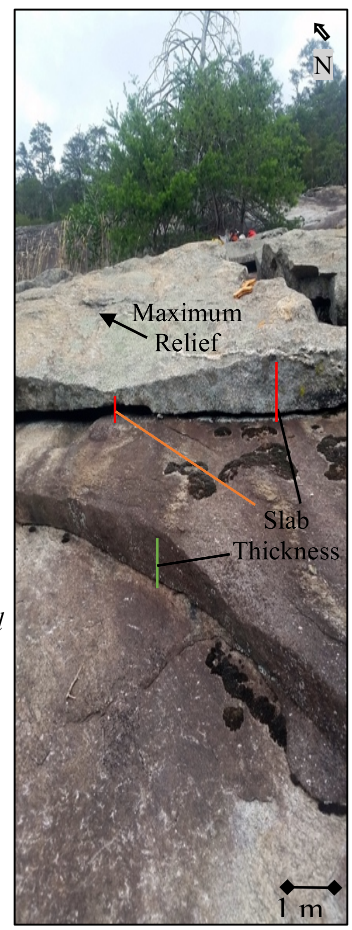

Figure 8. *Photo of RF-3 showing slab and remnants of S3.R22, S2.R1, and S1.R1. Slab thickness was measured disregarding imperfections. Red signifies slab thickness of slab 3 while green represents slab thickness of slab 2. Orange arrow shows slab thickness that has been undercut by fluvial or frictional forces. Maximum relief occurred on Slab 2.*

3.5 Weathering Characteristic Transects

Preliminary reconnaissance revealed that physical weathering is manifest at all sites as either cracks or spalls or both. Cracks are defined as linear porous spaces that separate a rock mass, independent of orientation. Spalls are cracks, parallel to the rock's outer surface. In some cases, it is clear that a surface-parallel layer of rock has 'peeled' off, but there was no remaining crack (Figure 10). These spalls as defined here, are miniature "slabs" oriented parallel to the rock's outer surface, and produced by surface-parallel cracking.

Representative remnants for each slab unit at each site were chosen for detailed measurement of their mesoscale (spall thickness greater than 1cm and/or crack length of $\geq$ 1m) and microscale (crack length < 2mm) mechanical weathering characteristics. One transect was completed for each slab at each site for each scale of measurement.

In order to collect data without introducing sampling bias, I measured all features in pre-defined locations along transects. The line of all transects was oriented perpendicular to slope and placed at the midpoint of the width of the remnant where possible, taking into account safety concerns. The length of these transects was the slope-perpendicular length of the remnant. If a remnant was less than 30m, all mesoscale features (see below) that intersected the transect within a width of 20cm of the transect tape were measured. If the remnant was 30m or greater in length, all mesoscale features were measured within 2000cm^2 (100cm x 20cm) area boxes, spaced at 5 m increments along the transect length. To measure microscale features, ten 400cm^2 boxes were evenly spaced along the length of the same transect, and all microscale features (defined below) found in the box were measured.

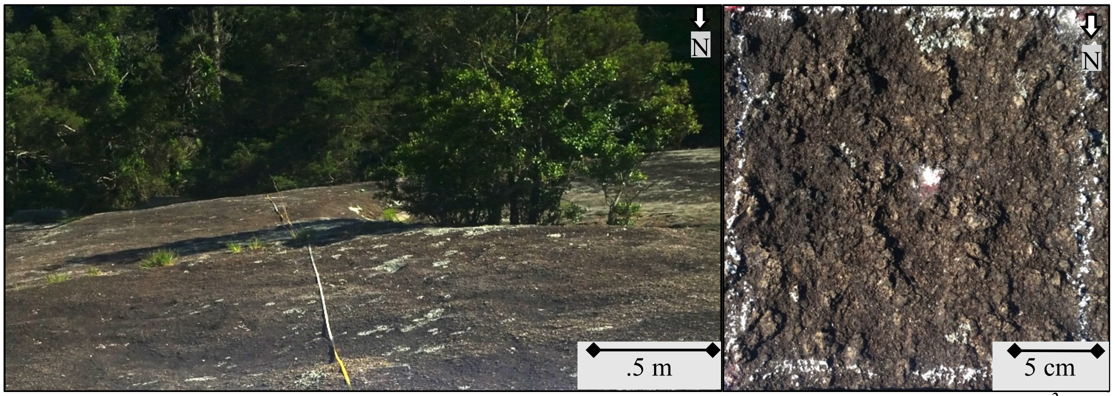

Figure 9. *(Left) Photo of transect at slab 3, remnant 1 of site 5 at Forty Acre Rock. (Right) 400cm*^{2} *box at FA-5:S3.M1.4*

3.6 Mesoscale

The following measurements were made for all mesoscale features meeting the previously defined criteria:

1. Crack Length (mm)- The total length of the surface exposure of the crack or spall edge.
2. Crack Width (mm)- The total width of a present cavity of the crack. The width measured was the average width of the crack.
3. Spall thickness (mm)- The thickness of the spall, measured at the intersection of a surface-parallel crack and a ~vertical fracture. The thickness measured was the average thickness.

3.7 Microscale

The following measurements were made for all microscale features meeting the previously defined criteria. For each box, general observations made (#1-7 below). For cracks within each box, #8-15 below were measured.

1. Average grain size of the rock surrounding the feature.
2. Surface strike (°) and dip (°) of the box surface.

3. Relief (cm)- Within a 1m diameter of the box's center, maximum relief was measured.
4. Cracks less than 2mm- Although cracks less than 2mm were not measured, it was noted whether the presence of these features were found within the box: 1 was recorded for presence and 0 meant that there were no cracks less than 2mm.
5. Granular disintegration- Evidence of granular disintegration can be seen as pitted microtopography where specific grains have been "plucked out." If granular disintegration was present, the number 1 was noted for its presence, while 0 signified the lack of evidence for granular disintegration.
6. Lichen- The presence of lichen or the lack of it within the box was recorded: a 1 or 0 was noted, respectively.
7. Fabric- The fabric (bedding, foliation, etc.) of the rock within the box or nearby vicinity was recorded, including its strike (°) and dip (°). If foliation only was present, then an index of 1 was given where observed.
8. Crack orientation- For crack orientation, 1 means that the crack is parallel to the surface while 2 means that the crack is perpendicular to the surface, and 3 signifies that the crack is neither parallel nor perpendicular to the surface.
9. Crack geometry- For each microfracture, the geometry of the surface on which it was found (convex/concave upward surface and whether the feature is parallel to the ground surface) was noted. For these observations, a numerical system was designed for each category: 1 was assigned to concave

upward surfaces while 2 signified convex upward surfaces. 3 means that the crack was located on an overhang surface.

10. Total crack length (mm)- The length of the exposure of the crack.
11. Crack length within $400cm^2$ box (mm)- Crack length is differentiated between total and within box to later calculate crack density (cm/mm^2)
12. Crack width- crack width measured if cavity greater than 1mm was present. The width measured was the average width of the crack. Crack width less than 1mm were labeled as <1mm, to separate from cracks that had no width.
13. Spall Thickness (mm)- The thickness of the spall measured at the intersection of a vertical and surface-parallel crack.
14. Crack strike (°) and dip (°)- Right hand rule was employed in all cases, whereby crack down-dip direction is always to the right (clockwise) of the crack strike.
15. Weathering Index- An index was assigned to every crack within each $400cm^2$ box (Figure 10). An index of 0 signified that the microfracture is fresh, with no signs of oxidation or weathering. 1 means that the crack is fresh, with very limited signs of oxidation or lichen coverage. A microfracture that has sharp edges with no rounded edges is an index of 2. 3 is sharp with occasional rounded edges. A crack labeled as 4 has rounded edges and void spaces with complete oxidation. A numerical index of 5 indicated that the crack is rounded and sealed, but still evident. The final weathering index of 6 was given to cracks that are well sealed with silica, with only the edge to show the microfracture's presence. Cracks that had signs of different weathering indices

were labeled with more than one weathering index. This later would define maximum, median, and minimum index of the crack.

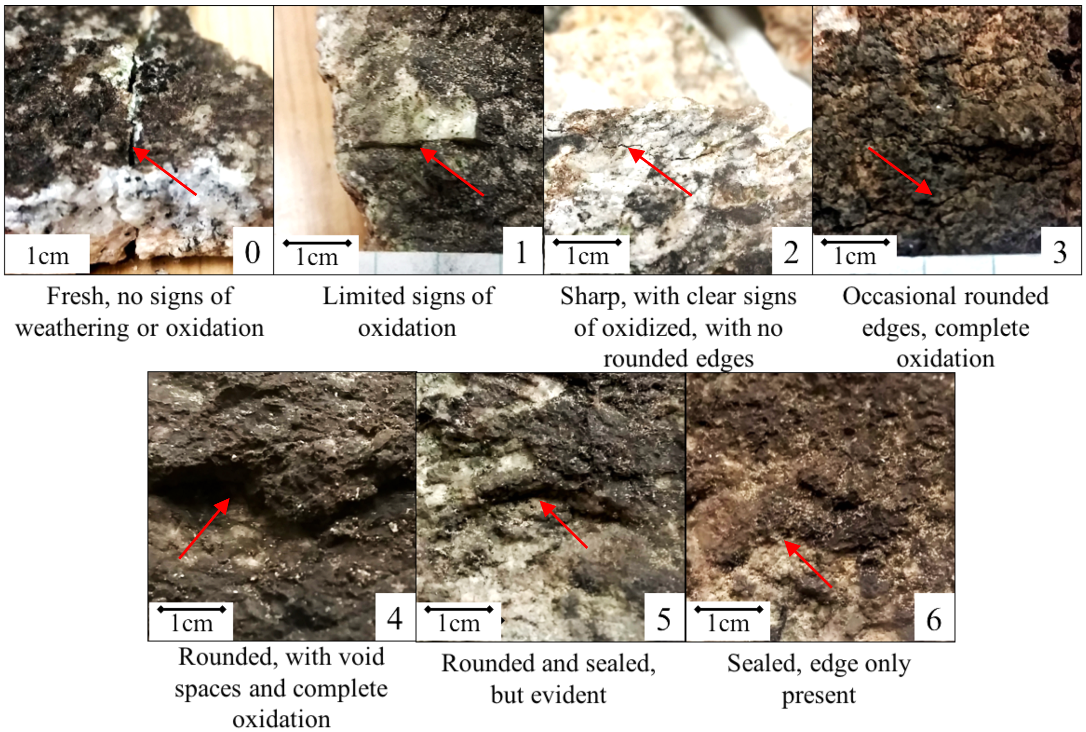

Figure 10. *Weathering index used for every crack located in every 400cm^2 box along a microscale transect.*

3.8 Rock Compressive Strength Measurements

For each box defined for the microscale measurements, rebound was measured using a generic N-type Schmidt hammer. In each box, nine Schmidt hammer measurements (Q) were made. The locations for each of the nine blows in all cases was the center of the box, the four corners, as well as four additional measurements made around the perimeter of a 1m diameter circle (Figure 11). More Schmidt hammer measurements provide better accuracy (Aydin and Basu 2005). Shobe et al. (2017) suggested the minimum amount of measurements required is 15-30. For this study, 90-100 measurements were made for each transect. The Schmidt hammer was calibrated before and after fieldwork was done, using an anvil.

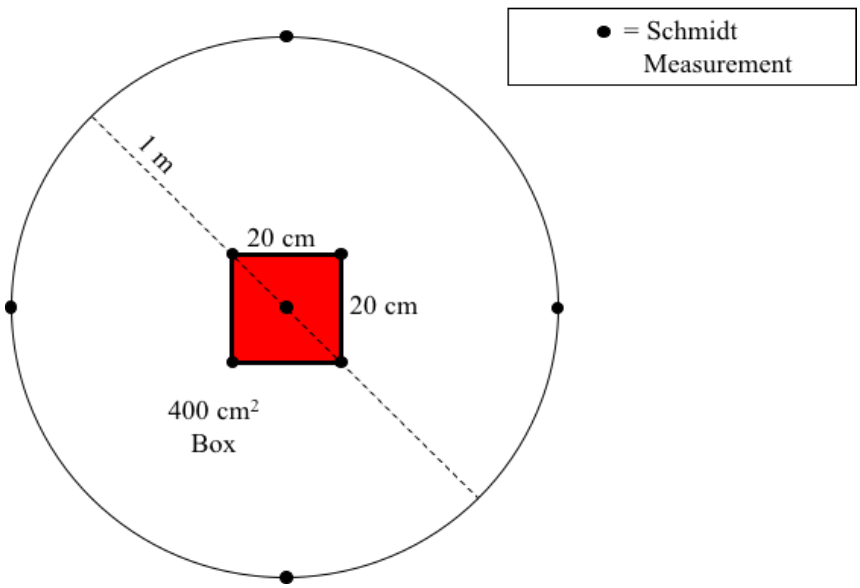

Figure 11. *Locations of 9 Schmidt measurements performed for each 400cm^2 box.*

3.9 Topographic Analysis

To derive an approximation of curvature, two transects were established for each dome using Google Earth orthoimagery: 1) across the length (A-A') of the dome and 2) across the width (B-B') of the dome (Figure 12). The transects intersected at the summit elevation. The summit elevation was divided each by the distance (m) of the length and width transect. The two proportions were averaged to obtain the curvature.

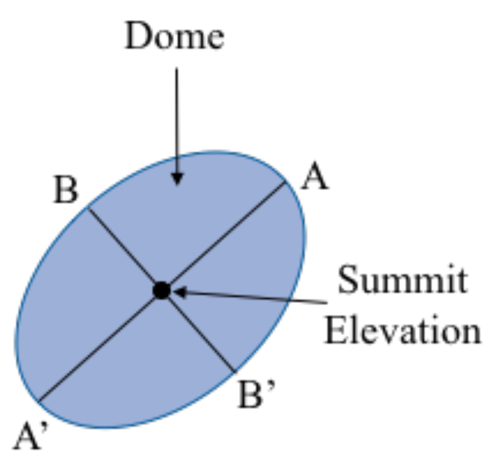

Figure 12*. Diagram of curvature calculation. Blue represents the dome.*

$$Curvature = AVG\left(\frac{Summit\ Elevation}{Lenght\ of\ the\ Dome}\right), \left(\frac{Summit\ Elevation}{Width\ of\ the\ Dome}\right)$$

3.10 Thin Sections

Wherever possible, samples were collected from every slab from every site. Samples were taken from the edge of each slab. Ten thin sections, each representing a different slab generation per dome, were created. Thin sections were cut having at least the outer edge of the sample exposed, and oriented so that both 'up' and north was known Impregnation with an epoxy resin was applied to each thin section.

CHAPTER 4: RESULTS

4.1 Forty Acre Rock

Located south of Taxahaw, SC (34.6685, -80.5261), Forty Acre Rock's exposed bedrock in plan view is only 0.056 km^2 (Appendix B, Table 4-6) (Figure 13), with an elevation of 168m (Figure 17). Established as a nature preserve by the South Carolina Department of Natural Resources, the area includes regional plant species such as the elf orpine, and the pool sprite, an endangered plant. In addition, to its wide variety of wild plant life, the site houses many bird species. In contrast to the other domes (as indicated by geomorphic maps), pools are present throughout the dome's exposed surface. Out of all domes studied, Forty Acre Rock experiences the highest mean annual temperature (16º C), but the lowest mean annual precipitation (1200 mm/year) (Table 2). The exfoliation dome is made of quartz monzonite, formed during the Alleghanian orogeny (297±9 m.y.). The bedrock map (Figure 13) shows the Pageland Pluton in blue (Porphyritic, course grained quartz monzonite; Carboniferous to Permian). Purple signifies intermediate to mafic metavolcanic to metasedimentary rocks, mainly volcaniclastic (Late Precambrian and/or Cambrian). Brown signifies Triassic and/or Jurassic diabase dikes. Beige represents Quaternary alluvial sediment (unconsolidated gravel, sand, silt, and clay in stream valleys), and tan represents light colored, unconsolidated quartz sand deposits (Tertiary to Quaternary).

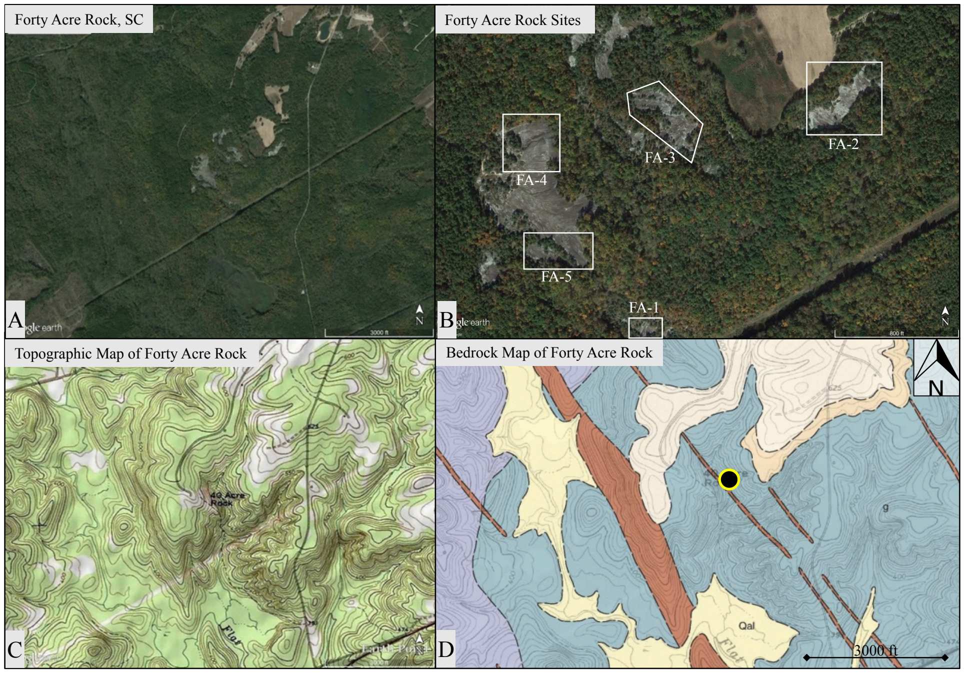

Figure 13. *a) Orthoimagery from Google Earth (WGS 1984, b) Sites on Google Earth orthimagery, c) Topographic map from USGS kmz. (1:24:000), and d) bedrock map of Forty Acre Rock (Butler and Howell 1978). Circle signifies location of dome.*

4.2 Rocky Face Recreational Area

This exfoliation dome (35.9681, -81.1105), north of Taylorsville, NC, was worked as a quarry throughout the early 1900's, with a prison camp to provide labor. Rocky Face Recreational Area (hereafter term "Rocky Face") is popular with many rock climbing enthusiasts due to its exposed surface. When first entering the park, the 30.48

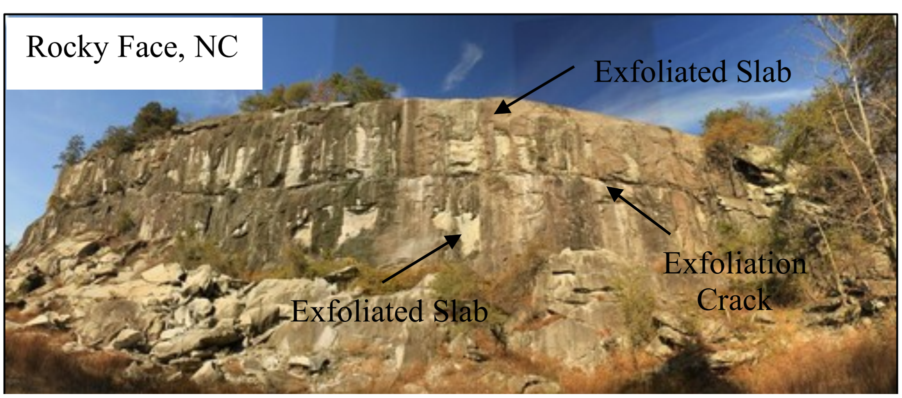

Figure 14. *Large surface-parallel fractures visible when first entering Rocky Face. Park. Submitted by Bob Smith on SummitPost.org 11/14/2012.*

meter high cliff exposes large exfoliated slabs (Figure 14). The dome's elevation is 548m (Figure 17).

Although exposed rock is present, the majority of Rocky Face mountain is covered in vegetation (Figure 15). The total rock formation (43.44km^2) is much larger than the dome (1.15km^2) (Table 2). Mean annual precipitation is 1320 mm/year, whereas mean annual temperature is 13.9 º C. A biotite-muscovite garnet quartz monzogranite, the pluton most likely formed during the Taconic orogeny (455-540 m.y.). The bedrock map (Figure 15) depicts the Toluca Granite (pink) which is a medium-grained, weakly to well-foliated biotite monzogranite (Early Ordovician and Cambrian). Green represents fine to medium-grained amphibolite (no younger than Cambrian). Brown signifies biotite gneiss (no younger than Cambrian). Yellow represents sillimanite-mica schist (no younger than Cambrian).

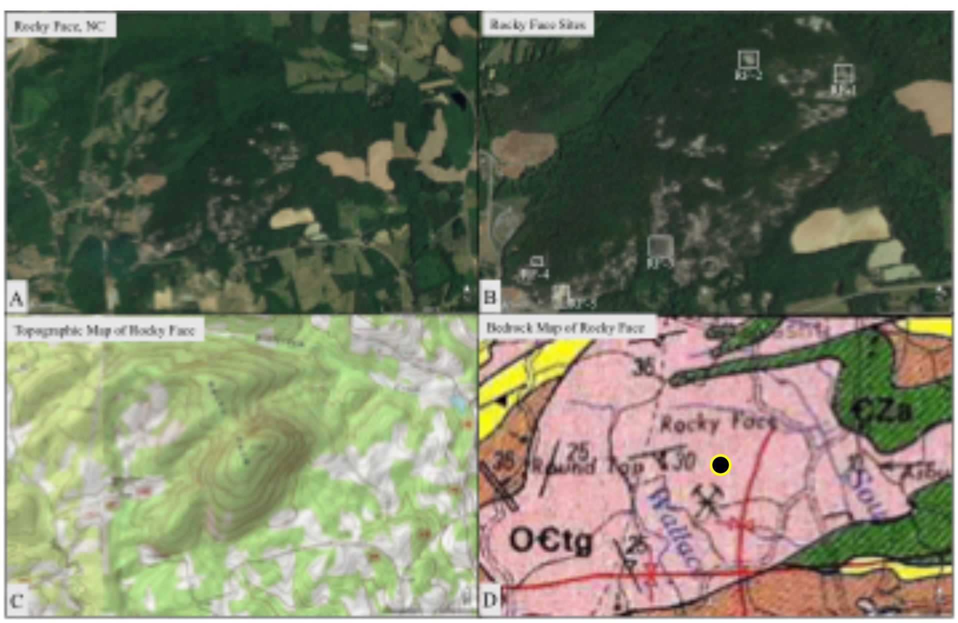

Figure 15. *a) Orthoimagery from Google Earth (WGS 1984), b) Sites on Google Earth orthimagery, c) Topographic map from USGS kmz. (1:24:000), and d) bedrock map of Rocky Face (Goldsmith et al. 1988). Circle shows location of dome.*

4.3 Stone Mountain

First settled by eastern European immigrants in the mid-1800's, Stone Mountain (36.3926, -81.0425), west of Roaring Gap was home to many self-sustaining communities (Figure 16). With an elevation of 703m (Figure 17), the site is clearly visible from long distances due to its prominence in the surrounding topography (Table 2) (Figure 16). Very similar to the climate of Rocky Face, Stone Mountain has mean annual precipitation (1330 mm/year) (Table 2) and the dome (1.33km^2) is only a small fraction of the entire 64.75 km^2 pluton. However, the exfoliation dome has much less vegetation than Rocky Face or Forty Acre Rock (Figure 19). Stone Mountain (394±17 m.y.) formed during the Acadian orogeny. Red represents biotite-muscovite monzogranite (Silurian to Devonian). Tan signifies dikes and sills of biotite-muscovite granitic rocks and pegmatites.

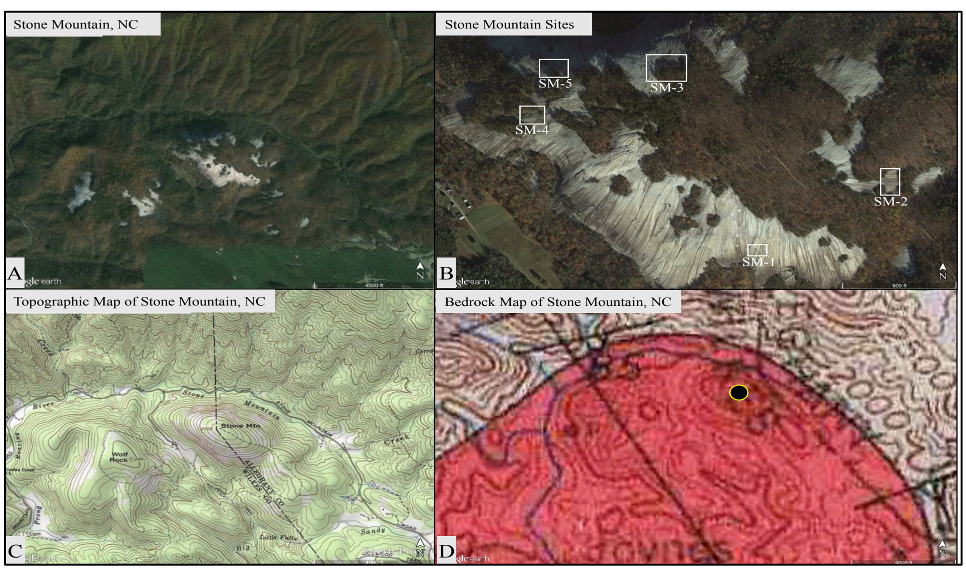

Figure 16*.a) Orthoimagery from Google Earth (WGS 1984), b) Sites on Google Earth orthimagery, c) Topographic map from USGS kmz. (1:24:000), and d) bedrock map of Stone Mountain (Rankin et al. 1972). Circle shows location of dome.*

Site	Elevation (m)[1]	Exposure Size (km^2)[2]	Climate[3]	Mean Annual Precipitation (mm/year)[4]	Mean Annual Temperature (°C)[5]	Mean Solar Radiation (W/m^2)[6]	Petrology[7]
40 Acre Rock, SC	168	0.0570	Cfa	1200	16.0	337	Quartz Monzonite (Carboniferous-Permian: 297±9 m.y.)
Rocky Face, NC	548	1.15	Cfa	1320	13.9	336	Biotite-Muscovite Garnet Quartz Monzogranite (Early Ordovician – Cambrian 455-540 m.y.)
Stone Mountain, NC	703	1.33	Cfa	1330	12.0	341	Biotite-Muscovite Monzogranite (Silurian-Devonian: 394±17 m.y.)

***Table 2**. Preliminary Data for field areas. Columns **1** and **2** (identified by superscripts) were assessed using Google Earth. Column **3** taken from Köppen Climate Classification System (Peel et al. 2007); Cfa stands for warm temperate, fully humid, and hot summers climate. Columns **4**, **5**, and **6** were taken from Thornton; P.E.; M.M. Thornton; B.W. Mayer; N. Wilhelmi; Y. Wei; R. Devarakonda; and R.B. Cook. 2014. Column 7 taken from USGS geologic bedrock maps.*

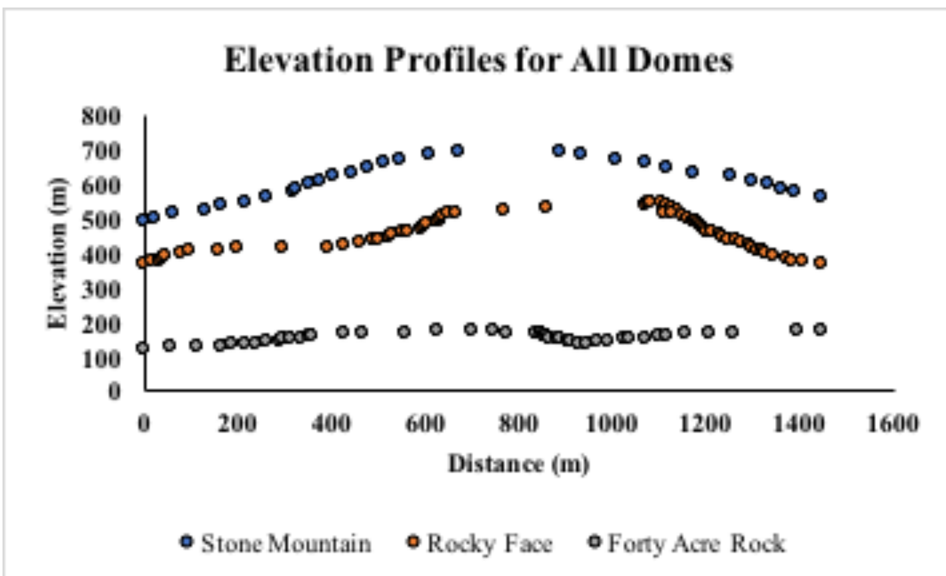

***Figure 17**. Elevation profiles of all domes taken from Google Earth. Profiles include the primary dome formation and not the entire pluton.*

4.4 Mapping and Overall Characteristics of Slabs and Domes

Exfoliated sheet joints separating large, continuous slabs were observed at all sites of all domes. 73% of all sites have 3-4 slab generations (Figure 18). In general, all slabs except slab 1 were broken into remnants, spread across all sites. Forty Acre Rock was the only dome to exhibit four slab generations (Figure 18). Rocky Face has the highest number of remnants (Appendix A).

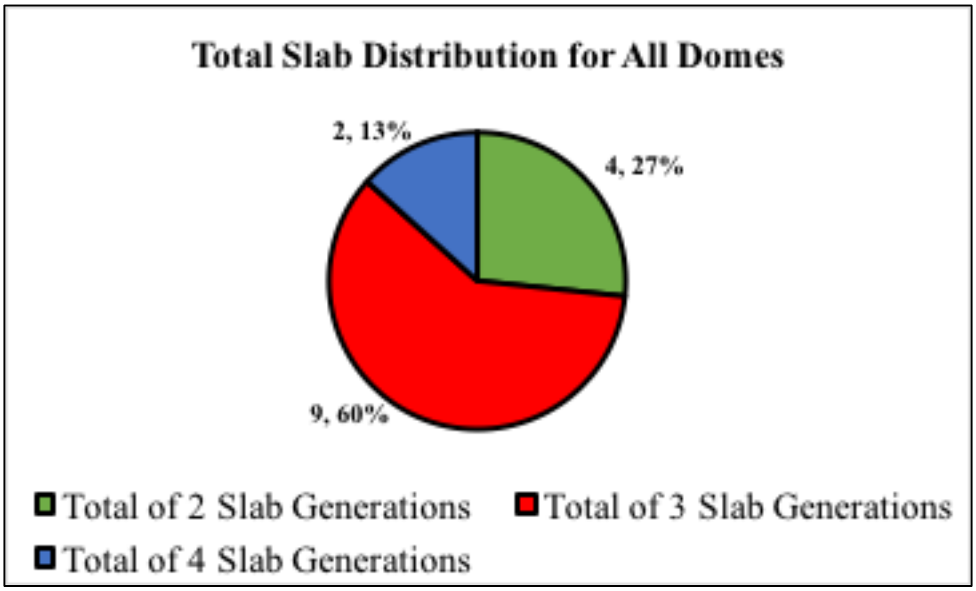

Figure 18. *Total Distribution of all slabs for all domes. Chart shows the total generation for all sites of all domes.*

Overall, vegetation and lichen percentage differ greatly for each dome (Figure 19). Forty Acre Rock exhibits the largest percentage of overall vegetation cover (63.50%±20.67) and lichen (57.75%±21.41). Rocky Face has the largest average and maximum relief (0.53cm±.082 and 18cm±22.46, respectively). However, the standard deviations are larger than the means, signifying the large diversity of data. Rocky Face also exhibits more dissection (1.11±1.39). Vegetation/lichen percentages and maximum/average relief, generally increased with increasing slab generation.

For all sites, Rocky Face has the least surface area exposure for all slabs (392.60±1783.14) (m^2) (Figure 19). Slab surface area decreases with slab generation. Surface area is not dependent on aspect. All other characteristics were independent of aspect, as well.

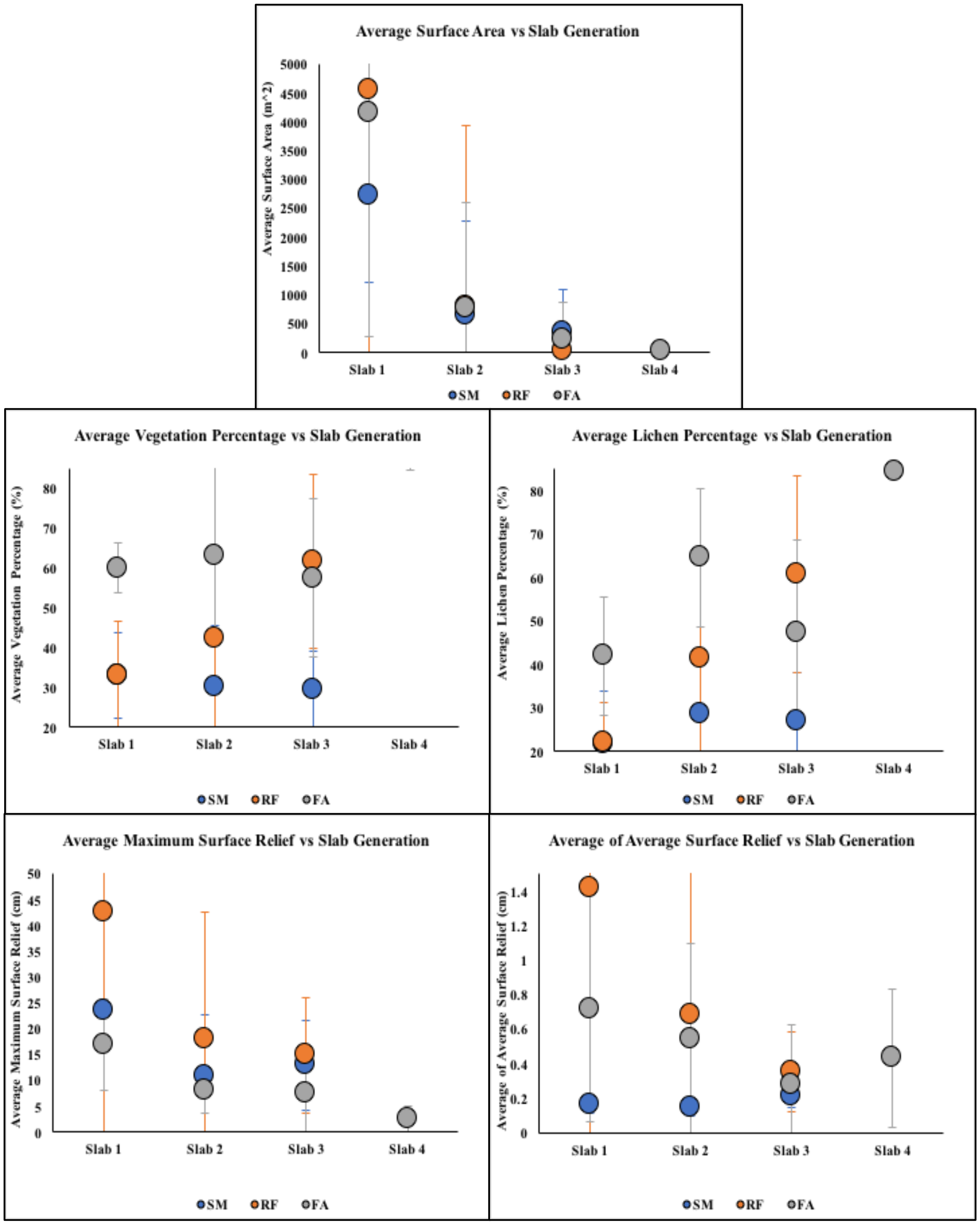

***Figure 19**. General observations vs. Slab Generation. (**Top**) Average Surface Area, (**Middle Left**) average vegetation, (**Middle Right**) average lichen, (**Bottom Left**) Maximum Surface Relief, and (**Bottom Right**) average of average surface relief.*

4.5 Slab Thickness

The average slab thickness for all domes ranged from 15.58cm to 23.82cm (Figure 20, 21). Rocky Face and Forty Acre Rock exhibit increases in thickness with increasing slab generation. However, the thickness of slabs at Stone Mountain decreased with increasing slab generation. There was no trend with slab thickness and aspect (Figure 21). There was no trend in slab generation and average maximum thickness.

Student t.tests were calculated for slab thickness measurements between domes, slabs, and sites (Appendix B, Table 24,25). A p-value of .05 or less means that the data are statistically different. Rocky Face was statistically different from the other two domes with respect to average thickness (P-values < 0.05) and maximum thickness (e.g. FA vs RF P-value = 0.193).

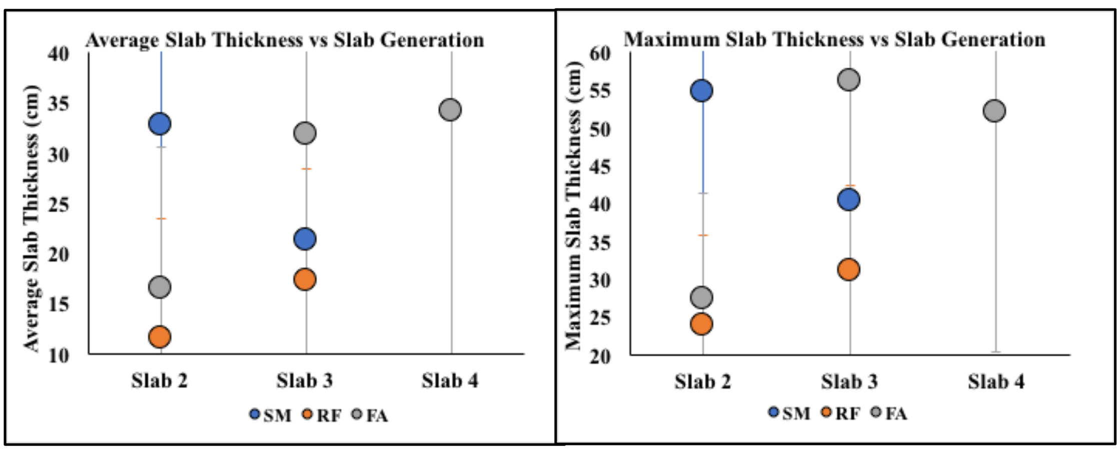

Figure 20. (From Left to Right) *Average slab thickness vs slab generation and maximum slab thickness vs slab generation.*

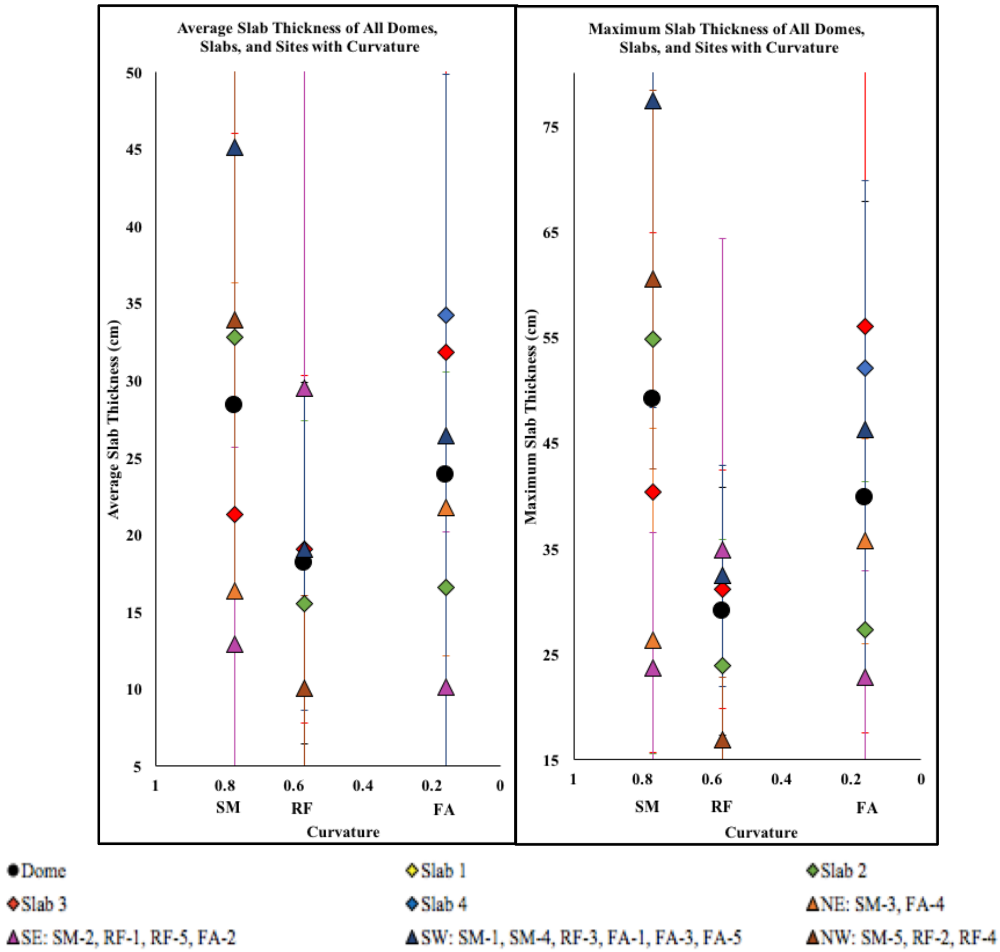

Figure 21. *Average and Maximum Slab Thickness for all domes, sites, and slabs.*

4.6 Cracks and Spalls

For cracks longer than 1m and/or spalls greater than 1cm in spall thickness, Forty Acre Rock has the largest average crack length (2518.15±6326.47mm) than Rocky Face and Stone Mountain. Average crack width and spall thickness are largest at Stone Mountain (176.87±370.26mm and 94.82±147.47mm, respectively) (Figure 22). In addition, mesoscale features generally increase in spall thickness westward (Figure 22). There is no trend with slab age and mesoscale spall thickness in regards to specific sites (Figure 22).

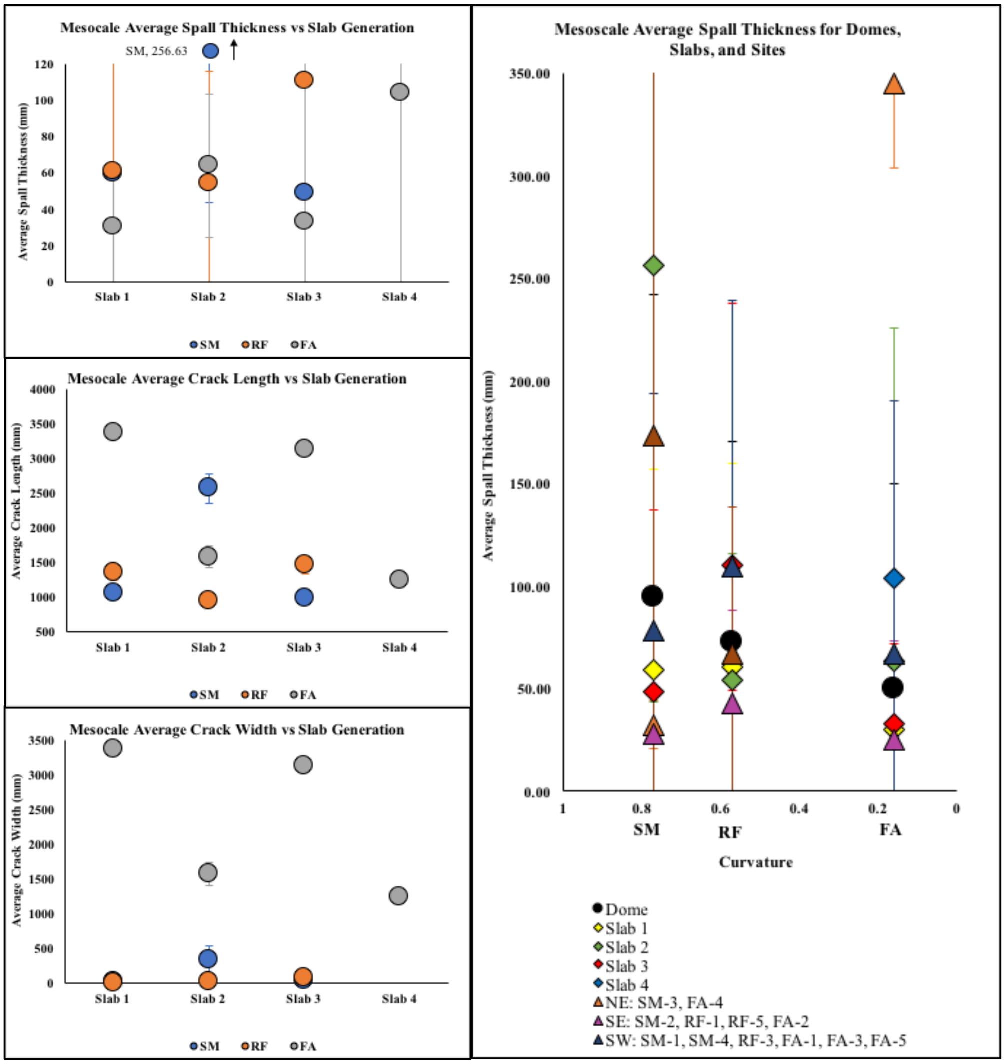

Figure 22. *Mesoscale crack morphology: (**Top Left**) Average spall thickness for all slab generations of all domes; (**Middle Left**) average crack length for all slab generations of all domes; (**Bottom Left**) average spall crack width for all slab generations of all domes; (**Right**) Average spall thickness for all domes, slab generations and sites.*

On the micro scale, Rocky Face exhibited longer (2520±6320 mm) cracks and smaller spall thicknesses (50.2±99.6 mm) than Forty Acre Rock or Stone Mountain (Figure 23, 24), the latter of which were statistically indistinguishable from each other. Crack lengths and spall thicknesses statistically vary between some slab generations at each dome, and are similar between other generations. Overall, there does not appear to be a trend of increasing or decreasing crack lengths or spall thicknesses with slab generation.

The majority of cracks measured are surface-parallel on convex surface topography for all domes. Average crack length ranges between 91.3±252mm (Stone Mountain) and 109 ±328mm (Rocky Face) (Figure 23, 24), all statistically similar. Crack length does not increase with slab generation for all domes. The length of microfissures is dependent on aspect at specific sites. Cracks lengths decrease westward for all domes on northeastern (128±420 mm to76.5±59.1mm) and southwestern sites (107±330mm to 80.1±122mm) (Figure 23, 24). The mean vectors of strike and dip of cracks at Forty Acre Rock and Rocky Face are 30.8°, 9.63° NE and 28.2°, 9.45 NE (Appendix B, Table 21,22; Figure 36-39). The mean vectors of strike and dip for cracks at Stone Mountain are 260°, 18.5° SW. (Appendix B, Table 23; Figure 40-41).

Forty Acre Rock's Slab 4 has the largest crack density of all domes (0.89±237mm) (Figure 23,24). Otherwise, density does not appear to increase with slab age nor does it correlate with aspect. Crack density is lowest in slab 2 for all domes (Figure 23).

Average crack widths on the domes increase westward geographically (0.01± 0.08mm to 5.42± 17.1mm) (Figure 23, 24) among the three domes. Forty Acre Rock and Stone Mountain are statistically similar (Appendix B, Table 27). Figure 14 shows that Rocky Face and Stone Mountain have similar ranges, in contrast to low measurements found at Forty Acre Rock. Increasing crack width with increasing slab generation can only be observed at Stone Mountain (Figure 23, 24). Width is not dependent on aspect.

Average spall thickness ranges from 3.97±5.00mm (Forty Acre Rock) to 4.60±10.07mm (Rocky Face) (Figure 23, 24). Similar to crack length spall thickness is statistically similar for all domes (Appendix B, Table 27). Spall thickness is also similar to crack width in that increasing spall thickness with increasing slab generation can only be found at Stone Mountain. Spall thickness does not increase with slab generation at Rocky Face nor Forty Acre Rock. Spall thickness is largest on East facing slopes for all domes. Slab 2 has the largest spall thickness at both Forty Acre Rock and Rocky Face.

On the dome scale, microfractures on Forty Acre Rock are the most weathered (5.62±1.14) (Figure 23, 24). According to the 1-6 index, cracks are sealed and rounded with frequent lack of visibility. Statistically different, there is no trend between domes. Cracks on Forty Acre Rock decrease in the weathering index with increasing slab generation (Figure 23), from 5.88±0.77 to 5.11±2.15.

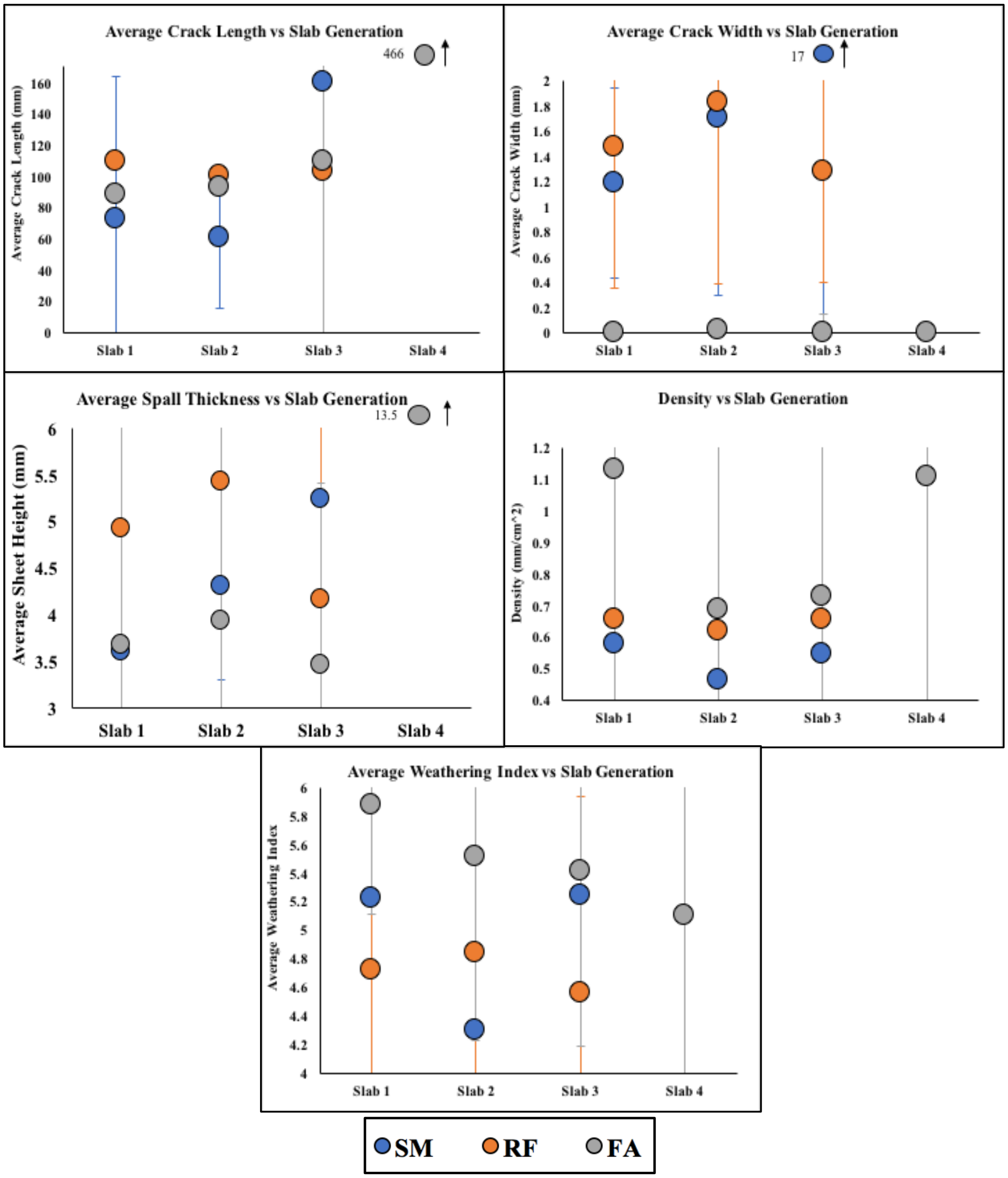

Figure 23. *Weathering Characteristics vs. Slab Generation: (**Top Left**) Average crack length, (**Top Right**) average crack width, (**Middle Left**) average spall thickness, (**Middle Right**) density, (**Bottom**) average weathering index.*

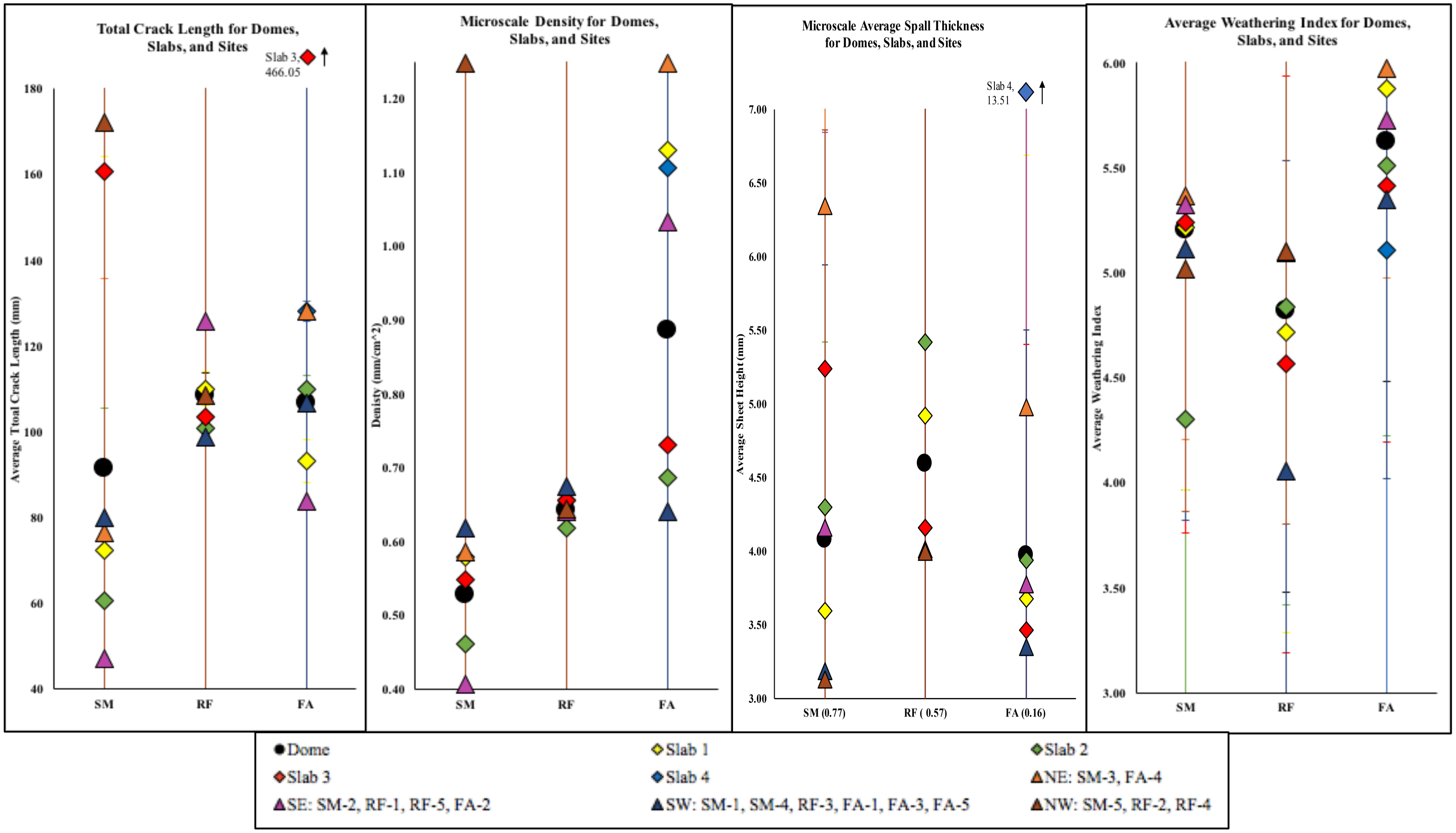

Figure 24. *Microscale crack morphology: (**From Left to Right**) Total crack length, density, average spall thickness, average weathering index for all domes, slabs, and sites.*

4.7 Schmidt Hammer Results

Stone Mountain has the largest average compressional strength (44.63±9.48) as indicated by Schmidt hammer Q values (Figure 25). Moving westward, compressional strength of the domes increase. Indicated by rebound values, compressional strength decreases with increasing slab generation, with Stone Mountain having the largest rebound measurements of all domes. The average Q values of all domes are statistically different from each other.

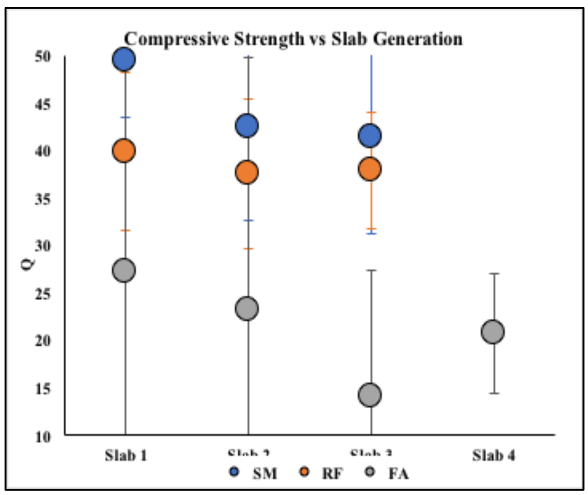

Figure 25. *Proprietary unit (Q) showing relationship between rebound and slab generation.*

4.8 Curvature

There is no correlation between dome curvature (as approximated by the proportion of length and dome elevation) and average slab thickness (Figure 21). Slab thickness does not decrease with increasing curvature.

4.9 Thin Section Analysis

Fractures on the micrometer scale (µm), generally increase in density with increasing slab age for each exfoliation dome (Figure 26, 27). In addition, fractures increase in length with age, as well. The proportion of clay minerals increase with increasing slab generation. More mature surfaces empirically have greater fracture density and feldspar weathering products than less mature surfaces at each dome.

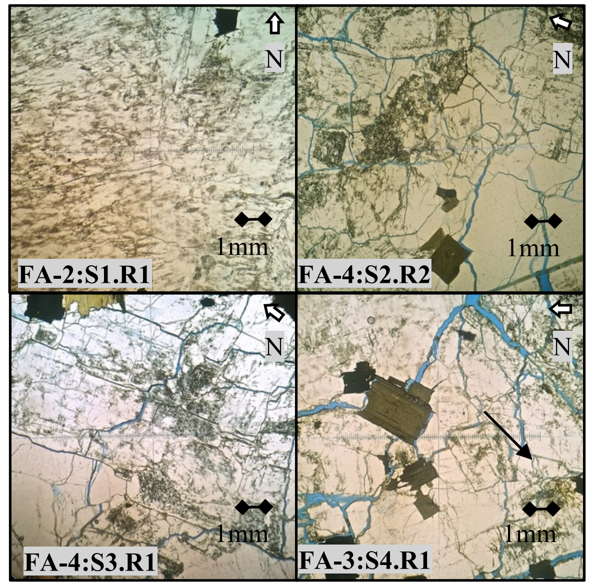

Figure 27. *Representative thin section pictures in plane-polarized light of slabs at Forty Acre Rock, increasing in slab age. Arrow represents chemical altering of mineralogy.*

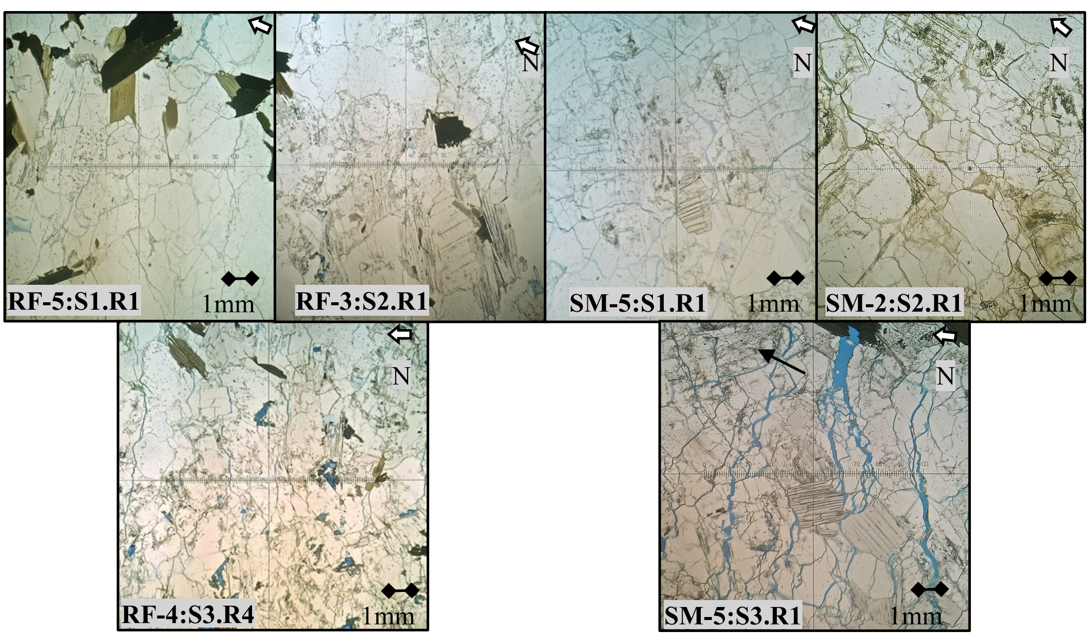

Figure 26. *Representative thin section micrographs in plane-polarized light of slabs at Rocky Face (**Left**) and Stone Mountain (**Right**), increasing in slab age (from left to right). Arrow represents chemical altering of mineralogy.*

CHAPTER 5: DISCUSSION

5.1 Comparisons Between Domes

Despite differences in geomorphology, climate, and erosion history all three domes studied generally exhibit three exfoliated slab generations with similar overall characteristics, suggesting that the processes that led to their formation are similar. In particular, for all domes, slab generations at different sites (meaning aspects), and maximum slab thicknesses are statistically similar (Appendix B, Table 25-26), suggesting that the process that formed the sheet joints are also similar. I propose that maximum thickness is more reflective of the initial process that formed the slabs rather than average thickness. It is unlikely that a crack would propagate from a shallower region to a deeper region due to the increase in confining pressure. The average thicknesses of slabs- which varies somewhat between domes, slabs, and aspect- likely reflects the tendency of the sheet joints to pinch out as they propagate and encounter topography. For example, Forty Acre Rock and Stone Mountain are statistically similar in average slab thickness, and are both statistically different from Rocky Face. Rocky Face has the highest average relief on slab surfaces (Figure 19), however. Statistically lower average and maximum slab thicknesses of Rocky Face might reflect that the slabs are "pinching out" due to the dome's irregular surface. Instead of overall dome curvature driving the thicknesses of the slabs, these data suggest that average slab thicknesses are related to how exfoliation cracks propagate after they are formed in response to the microtopography of the dome surface.

Although overall slab thicknesses are similar for all slabs at all sites and domes, their weathering characteristics, like compressive strength (Figure 25) vary between slab generations. I interpret this observation as evidence that significant time has occurred between exfoliation of superimposed slabs. Crack and spall characteristics on the slabs' surfaces were statistically similar to comparable aged slabs, suggesting similar mechanisms of weathering on all domes (Appendix B Table 27). Although these data cannot serve to quantify the time between each exfoliation interval, they can provide relative ages. As such, the data suggest that exfoliation- or erosion of exfoliating slabs- is a periodic process with sufficient time lapsing between exposure of subsequent slabs so that they may weather .

5.2 Testing Hypotheses for Exfoliation Formation

Compression

The data can now be examined in the context of the three main hypotheses presented earlier for exfoliation formation. First, the regions in which all domes are located are characterized by a similar contemporary compressional stress regime (Figure 5). However, there are insufficient data to determine to what extent the magnitude of this compression might vary between the three domes. The simple analysis of topographic curvature presented here indicates that Stone Mountain and Rocky Face exhibit significantly higher curvature overall than Forty Acre Rock (Figure 21). Thus, according to Martel (2006, 2011), if compression-driven interaction with topographic curvature is the primary mechanism for slab formation, slab thicknesses should be greater at Forty Acre Rock. The results indicate that all three domes have statistically similar slab thicknesses that do not correlate with curvature (Figure 20, Figure 21).

Unloading

As the Blue Ridge Escarpment retreats westward, exhumation age decreases (Spotilla et al. 2004). Generally, erosion rates are slower in the Piedmont than the Foothills or Blue Ridge Escarpment. Thus, if exhumation- driven stresses are driving exfoliation, it might be expected that the exposure of Forty Acre Rock is older than that of the other two domes. The weathering characteristic data are consistent with this hypothesis. The slabs at Forty Acre Rock and their weathering characteristics show a decrease in compressive strength (Figure 25), an increase in crack density (Figure 20, 21), and an increase in average weathering index assigned (Figure 20, 21). The majority of cracks and spalls had very small widths (Figure 20). With such a high weathering index, Forty Acre Rock has more weathered slabs due to the lack of crack width resulting from many cracks having been sealed, where only the edge is present.

Alternatively, the higher degree of weathering might simply reflect lower erosion rates in this portion of the Piedmont, compared to the other two sites. The observation that four generations of slabs are only present at Forty Acre Rock is important to interpretations of exhumation and erosion (Figure 18). Less weathering at Stone Mountain and Rocky Face suggest that these slabs are much younger than those of Forty Acre Rock. The reason Stone Mountain does not have a slab 4 might be due to that slab having been completely eroded. Slower erosion rates continually weather slabs at Forty Acre Rock, but not completely. Once a slab has formed, gravity-driven erosion due to higher curvature, slope and relief (Figure 19) might be more of a factor at Stone Mountain and Rocky Face. It cannot be ruled out that in the past, Forty Acre Rock could have possibly been topographically similar to Stone Mountain when the Blue Ridge

Escarpment was much closer. Erosion rates could have been higher, thereby driving more slab formation. As the Blue Ridge Escarpment moves westward, erosion rates have decreased. This would also explain the presence of older, more weathered slabs at Forty Acre Rock.

I propose a feedback between erosion rates and the frequency of slab exfoliation. Once a slab has been eroded away, the absence of the slab's weight could allow tensional expansion, regardless of the origin of the stress, allowing for a new slab generation to form at the site where the older slab was removed. This would be true for any of the proposed hypotheses of slab formation. The fact that Stone Mountain has less weathering and, presumably, faster erosion rates is consistent with this hypothesis. In contrast, slabs at Forty Acre Rock are much more weathered, suggesting that they take longer to fully erode away. This lack of erosion prevents newer slab generation, and leads to slower erosion. Thus, to some degree, the data presented herein support that unloading is contributing criteria of ongoing exfoliation.

Thermal Stresses

Most measured slab, spall, sheet joint crack characteristics did not vary consistently with dome aspect, suggesting that at that scale of thermal variability, thermal stress does not influence the features. The exception to this is sheet height, which consistently was lower on south-facing slopes

Recent studies have found that thermal-related tensional expansion can cause fractures in rock (Eppes et al. 2016). On multiple time scales (e.g. hourly, diurnal, seasonal, and yearly), the outer layers of a rock expand when heated and contract when cooled. In contrast to the cold core, tensional expansion results in fracturing of the rock at a depth that is proportional to the penetration of heating (Figure 3). The depth of penetration of a diurnal heat wave (using a standard thermal diffusivity of granite) is approximately 20-25cm. Although average slab thicknesses vary between domes (Figure 20, 21), the range is within this prediction Furthermore, spall thickness between microfractures are about 10cm and similar from slab generation to next generation (Figure 20). It is likely that thermal-driven processes at every scale are dictating the thickness of spalls. The differences in spall thickness and slab thickness could possibly be due to different scales of thermal cycles. Spall thickness are created by diurnal or smaller scales while slab thickness is determined by diurnal, seasonal, yearly, or even longer.

CHAPTER 6: CONCLUSION

Exfoliation domes are found around the globe. The formation of exfoliated slabs commonly has been attributed to the unloading hypothesis (Holzhousen 1989; Leith et al. 2014). However, other viable hypotheses exist, including curvature induced tension (Martel 2006, 2011) and thermal-driven processes (Collins and Stock 2016; Eppes 2016).

All domes studied herein have different topographic settings and presumed exhumation ages, yet they exhibit similar exfoliation characteristics through space and time. For example, all sites exhibited at least 2 generations of exfoliated slabs, while most sites exhibited 3 or 4 generations (73%). Maximum thicknesses, a proxy for the initial depth of cracking was statistically similar at all domes (29 to 49.1cm), while varying somewhat between slab generations and aspect. Average slab thickness varies between domes ranging between (15.6 and 23.8 cm). Overall, slabs exhibit greater weathering with increased slab generation, which is correlated with increased porosity and decreased compressive strength.

When comparing the competing hypotheses of tensional expansion, all are put into question. Due to higher erosion rates in the Blue Ridge, exfoliation slabs might form and erode more frequently than those of the Piedmont. As slabs erode, confining weight is removed and tensional expansion increases at increasing depths, possibly forming new slabs. Although I observed no correlations between slab thickness and dome curvature, this result could be due to the simplistic characterization of curvature and the limited number of domes examined. Average slab thicknesses ranged within the parameters of thermal diffusivity, consistent with insolation-driven cracking. In general, the results are consistent with all these hypotheses. Overall, this study provides a very detailed analysis on morphological characteristics of exfoliation and how they evolve through time.

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APPENDIX A

TABLE 3: SITE LOCATIONS- COORDINANTES

Location	Latitude (°)	Longitude (º)	Aspect
Forty Acre	34.6685	-80.5261	n/a
FA-1	34.6662	-80.5237	SW
FA-2	34.6703	-80.5194	SE
FA-3	34.6700	-80.5232	SW
FA-4	34.6695	-80.5260	NE
FA-5	34.6680	-80.5256	SW
Rocky Face	35.9681	-81.1105	n/a
RF-1	35.9718	-81.1045	SE
RF-2	35.9723	-81.1089	NW
RF-3	35.9655	-81.1132	SW
RF-4	35.9649	-81.1189	NW
RF-5	35.9635	-81.1179	SE
Stone Mountain	36.3926	-81.0425	n/a
SM-1	36.3907	-81.0414	SW
SM-2	36.3923	-81.0381	SE
SM-3	36.3950	-81.0434	NE
SM-4	36.3939	-81.0466	SW
SM-5	36.3949	-81.0459	NW

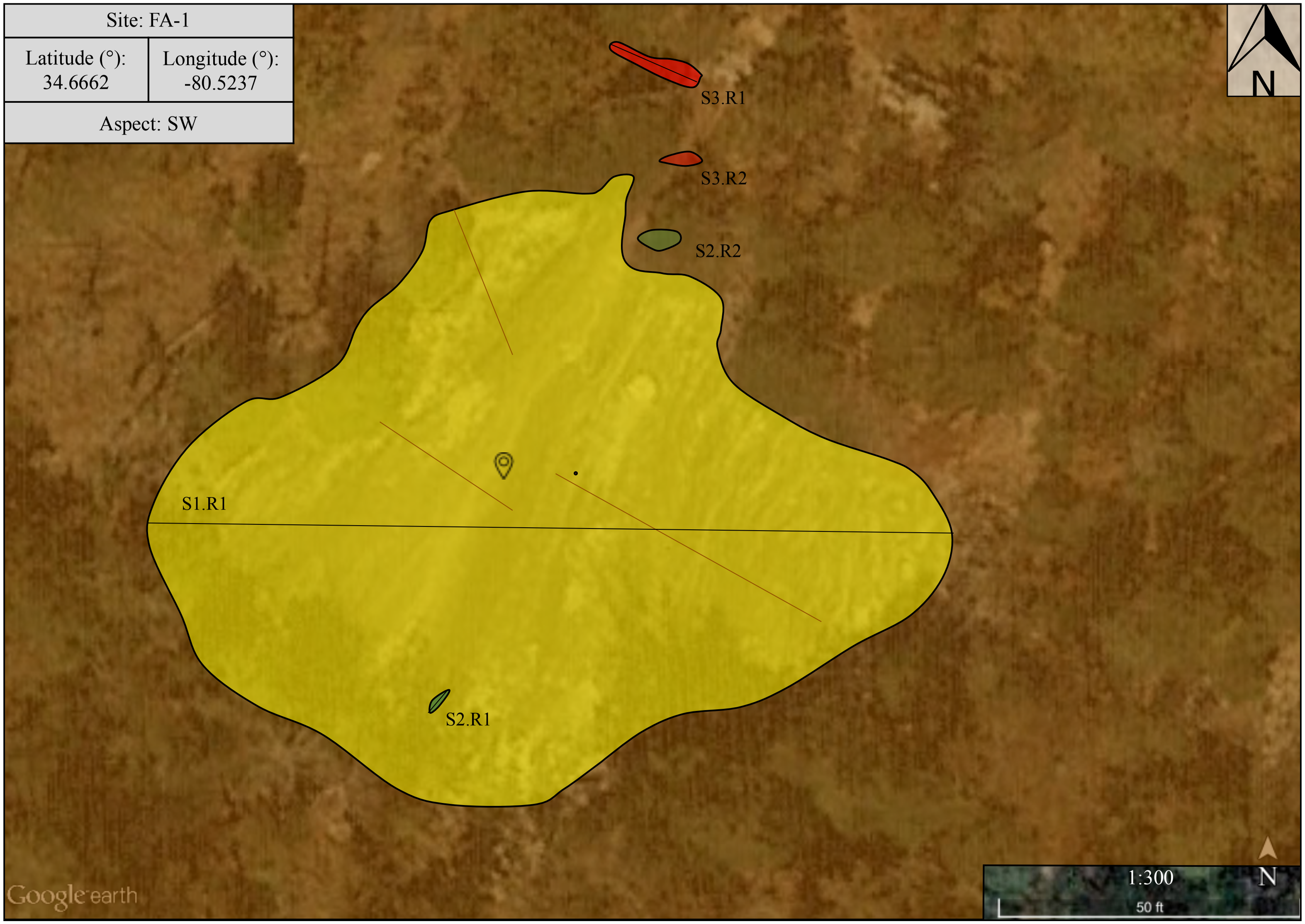

Figure 28.*Gemorphic Map: FA-1.*

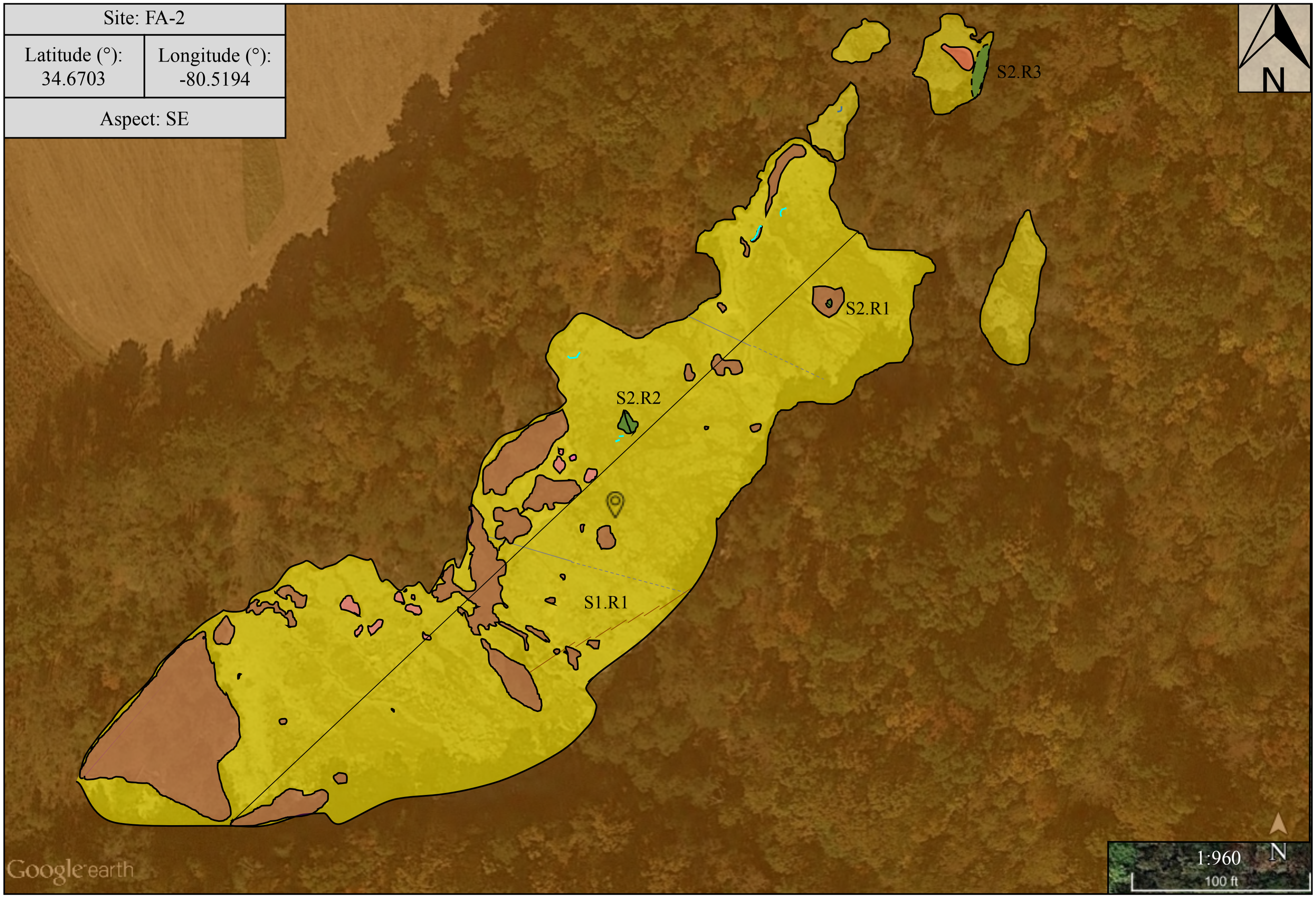

Figure 29. *Geomorphic Maps: FA-2.*

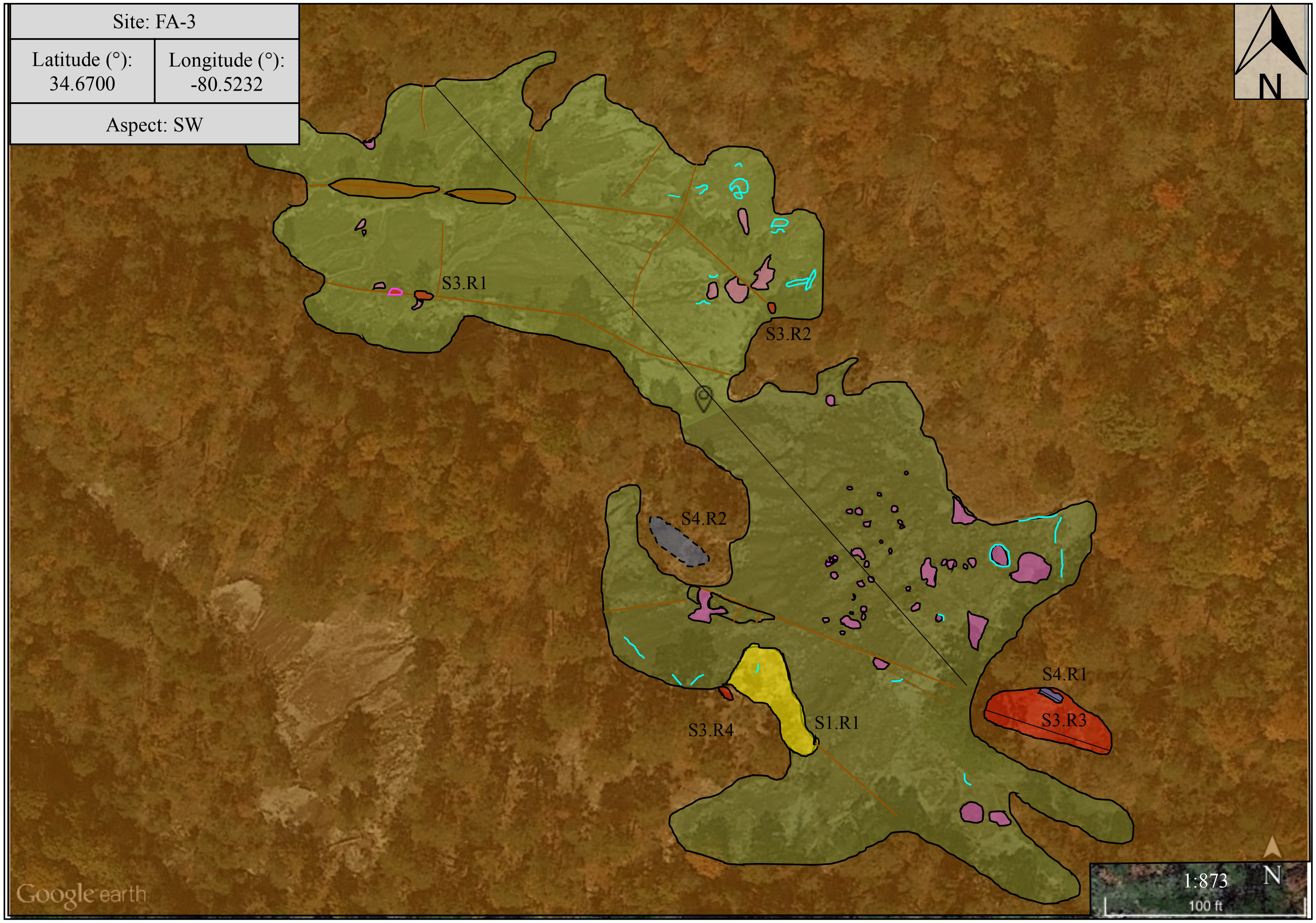

Figure 30. *Geomorphic Map: FA-3.*

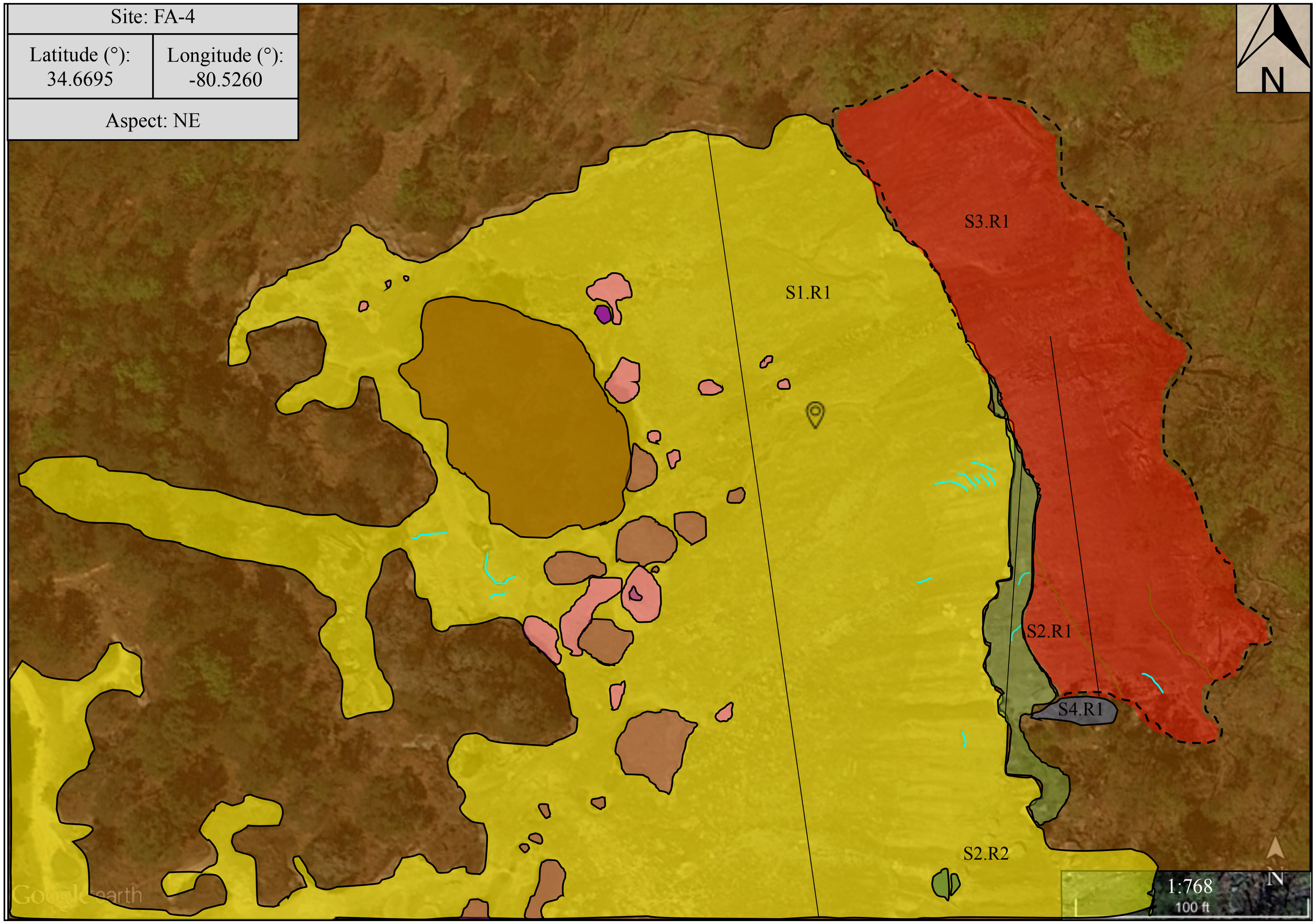

Figure 31. Geomorphic Map: FA-4.

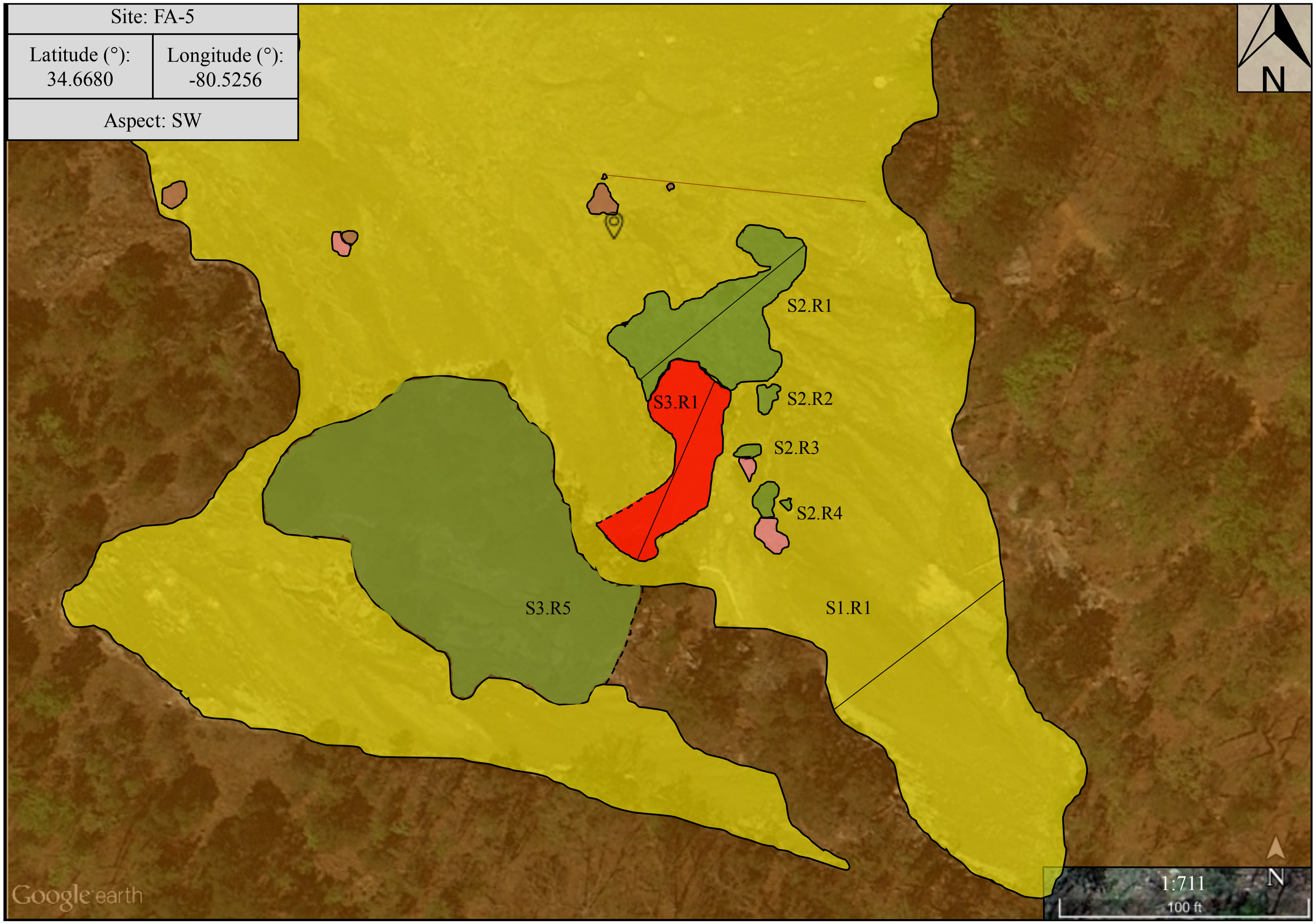

Figure 32. *Geomorphic Map; FA-5.*

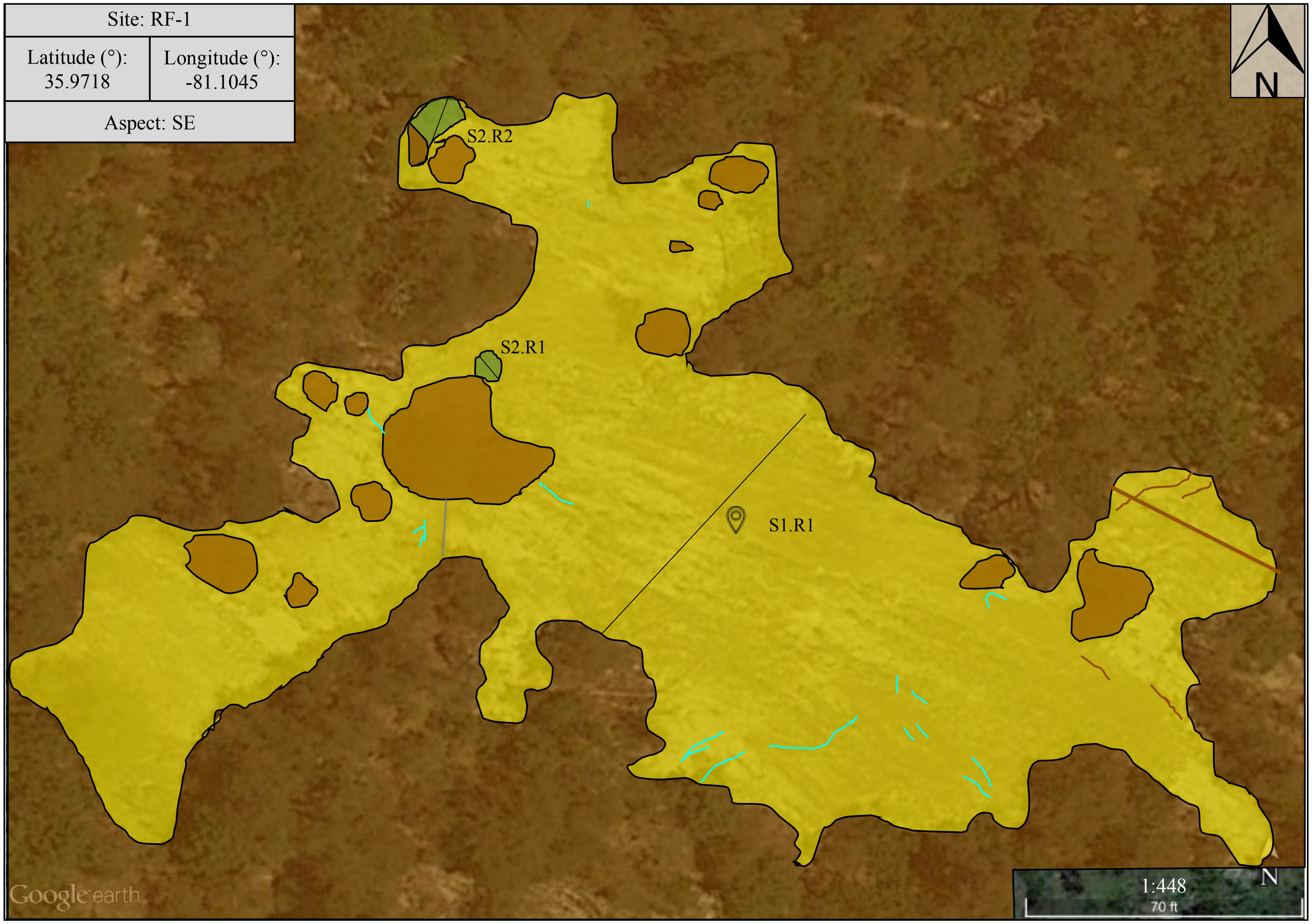

Figure 33. *Geomorphic Map: RF-1.*

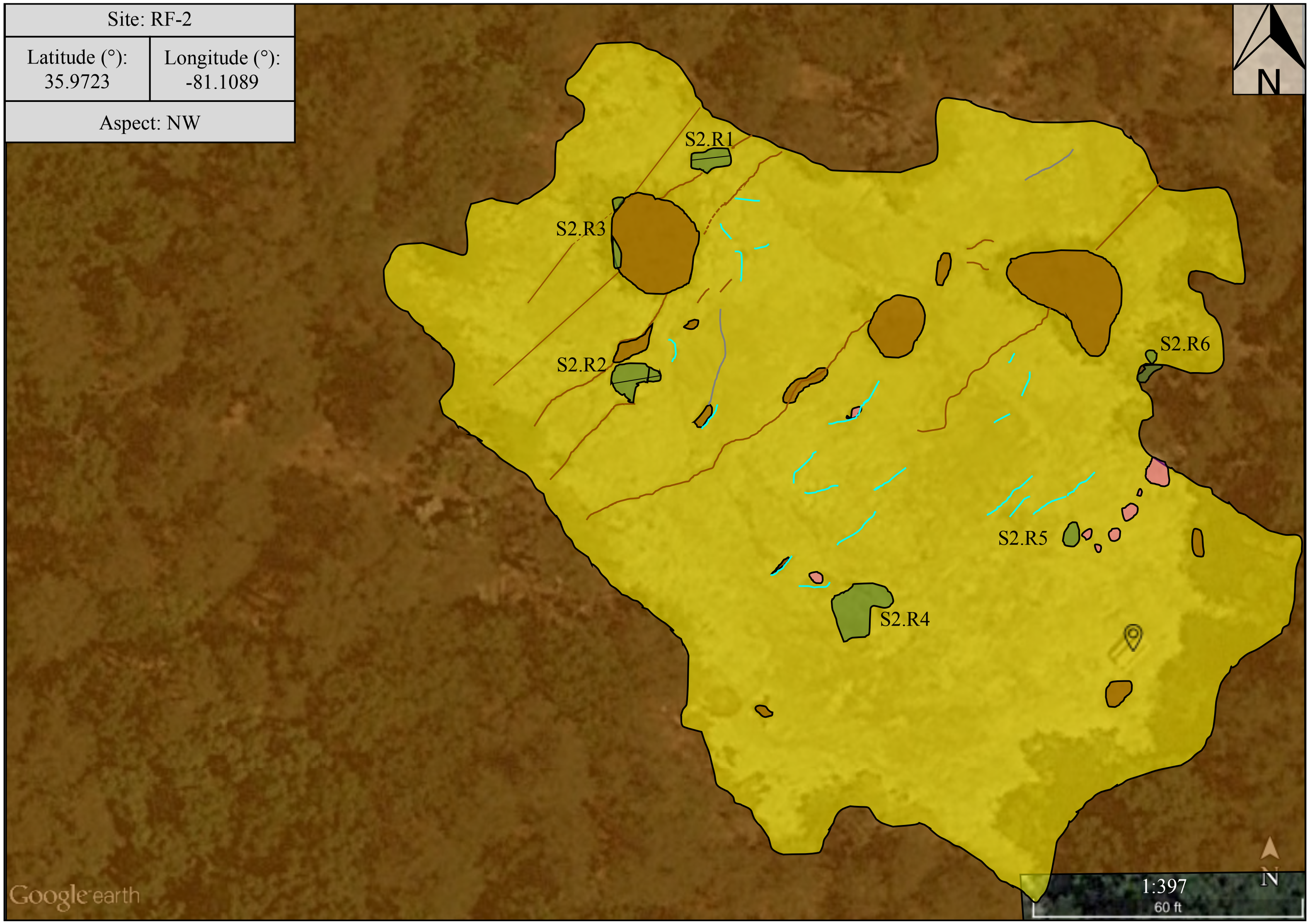

Figure 34. *Geomorphic Map: RF-2.*

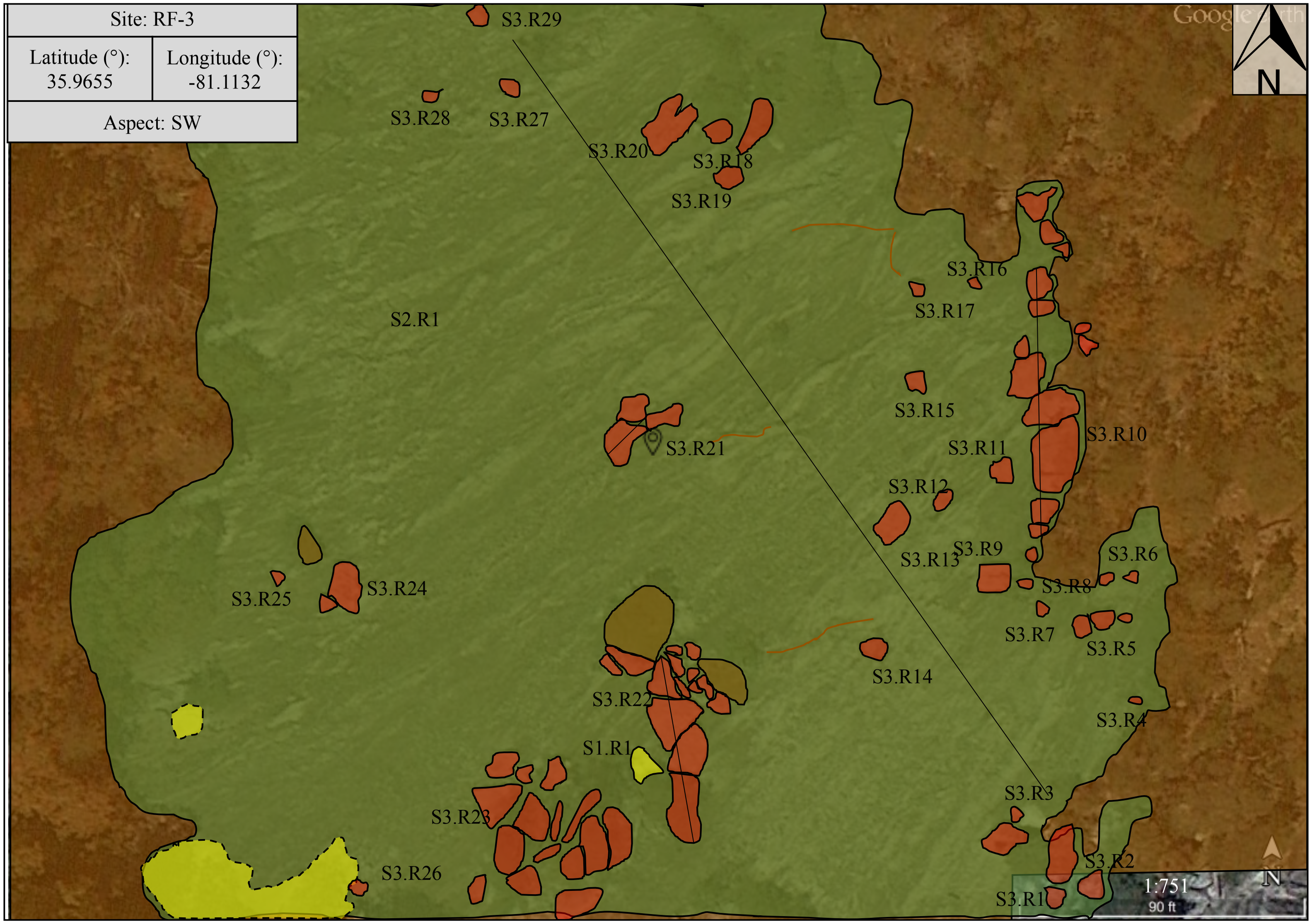

__Figure 35__. Geomorphic Map: RF-3.

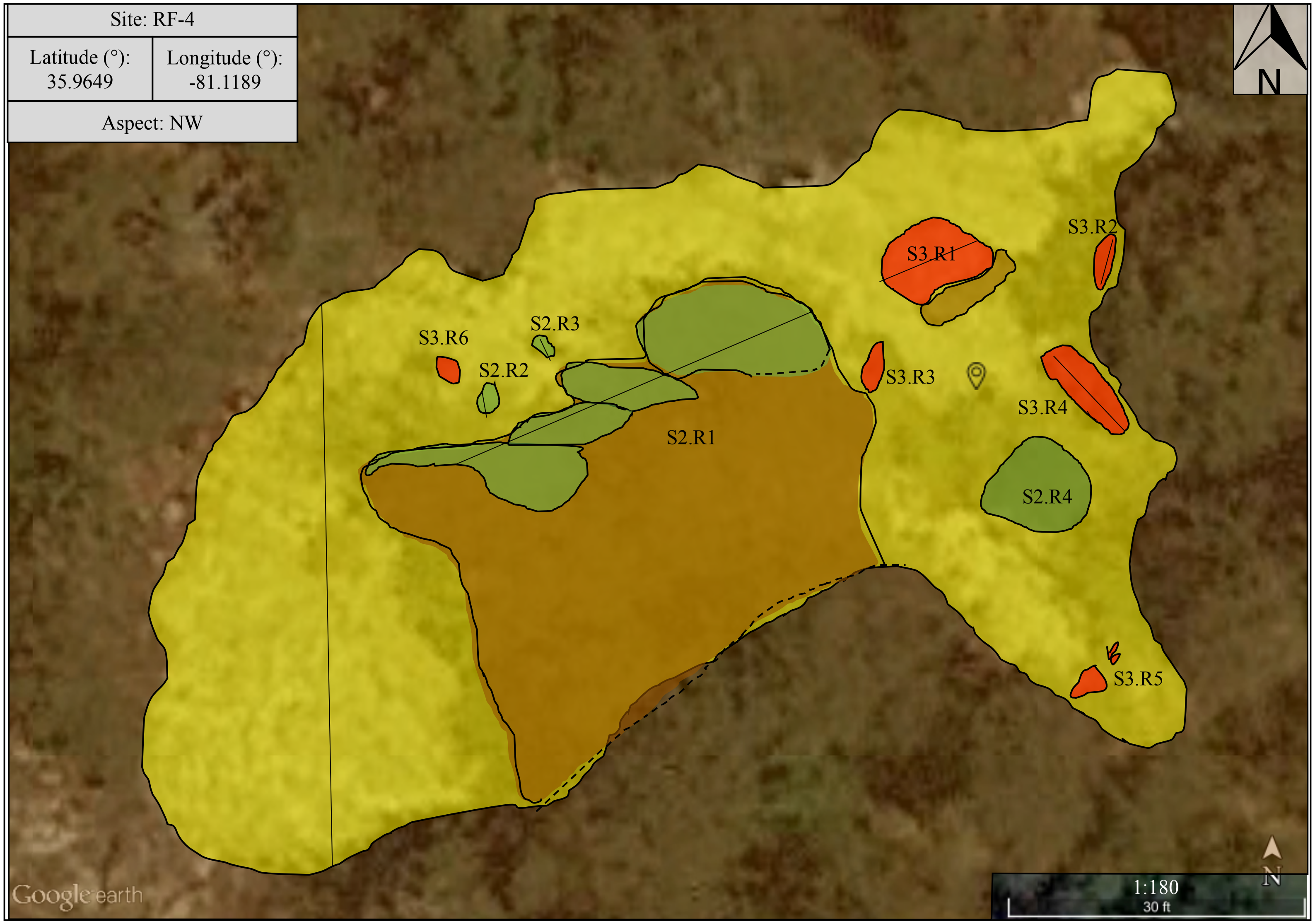

Figure 36. *Geomorphic Map: RF-4.*

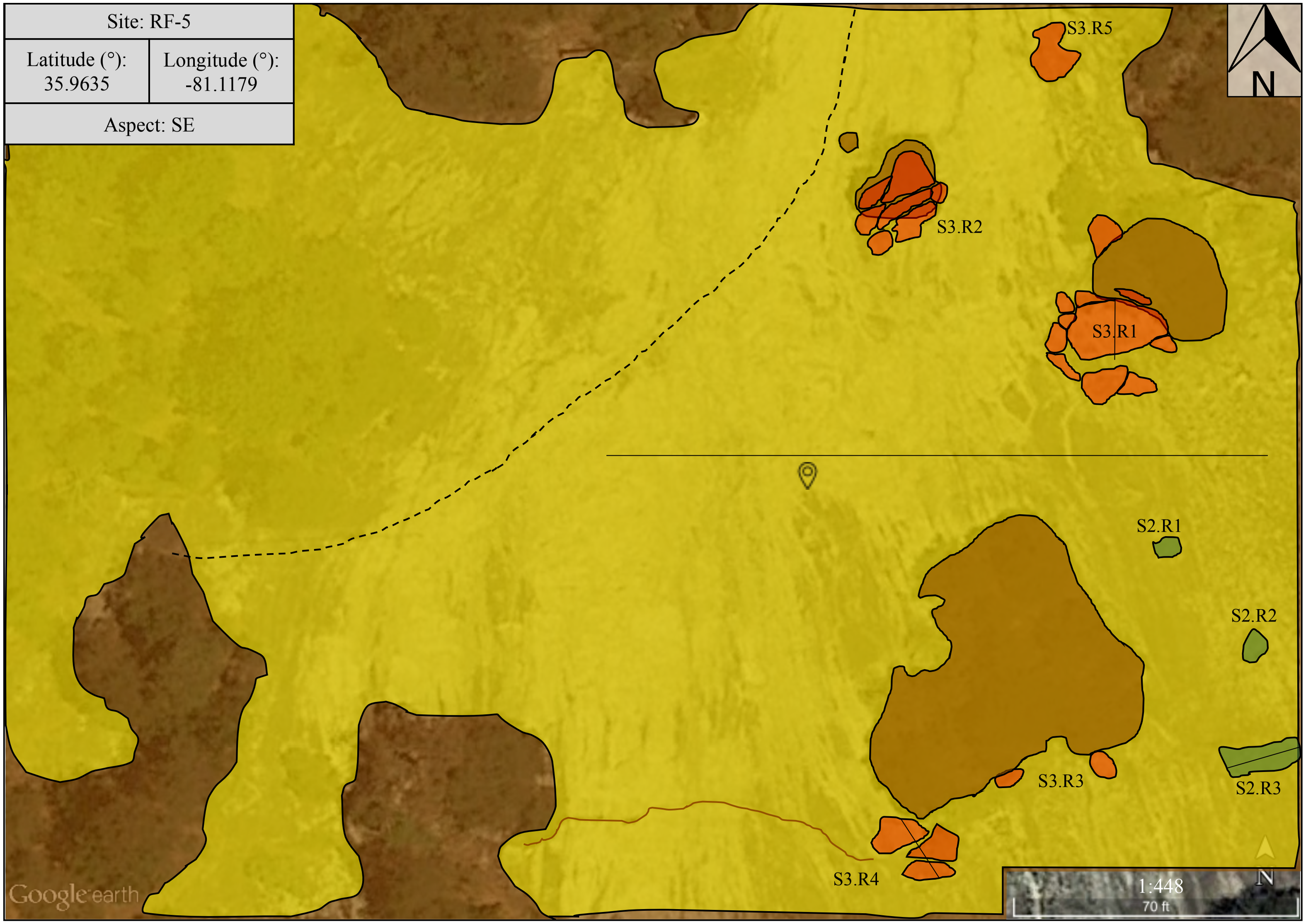

Figure 37. *Geomorphic Map: RF-5.*

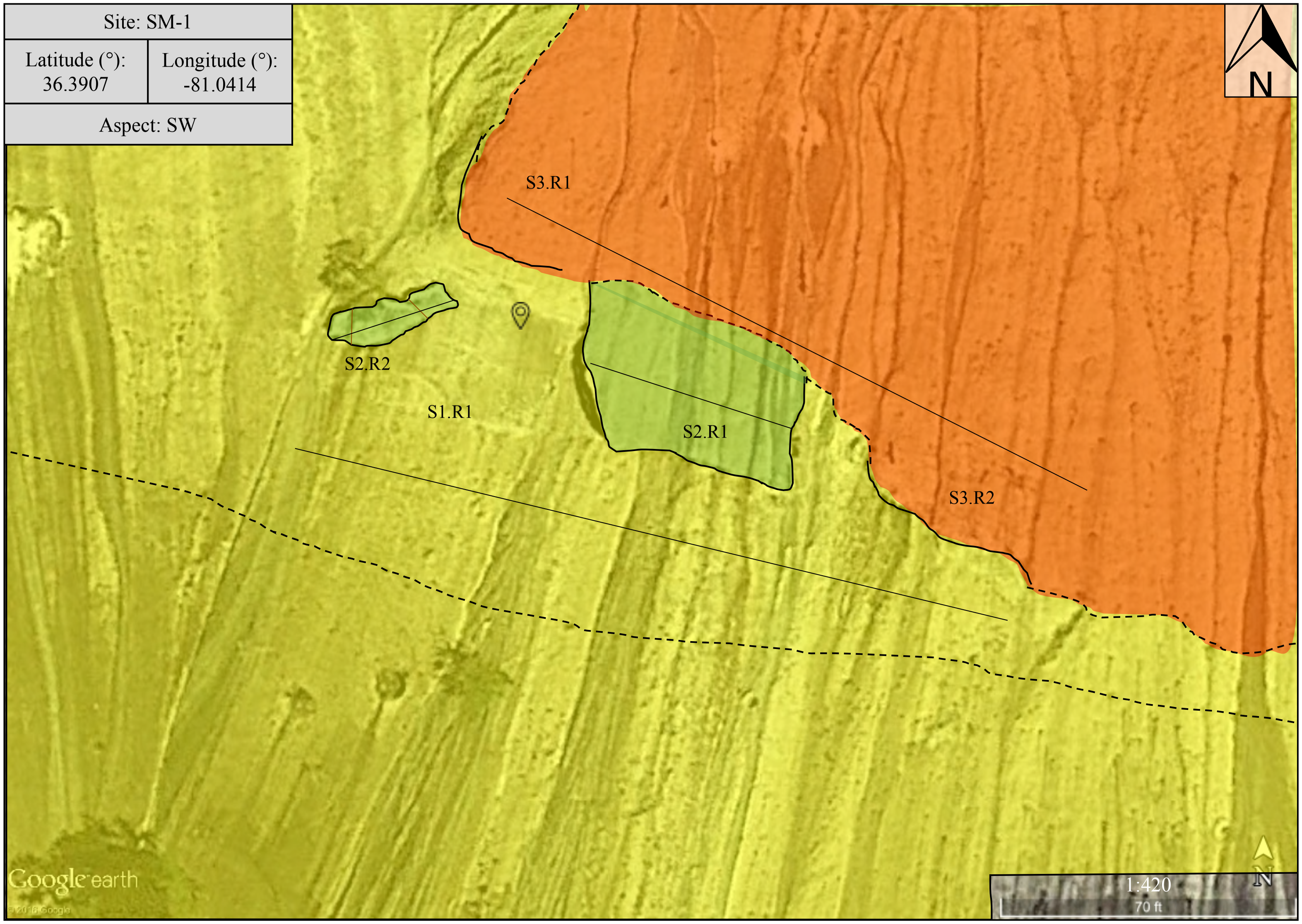

Figure 38. *Geomorphic Map: SM-1.*

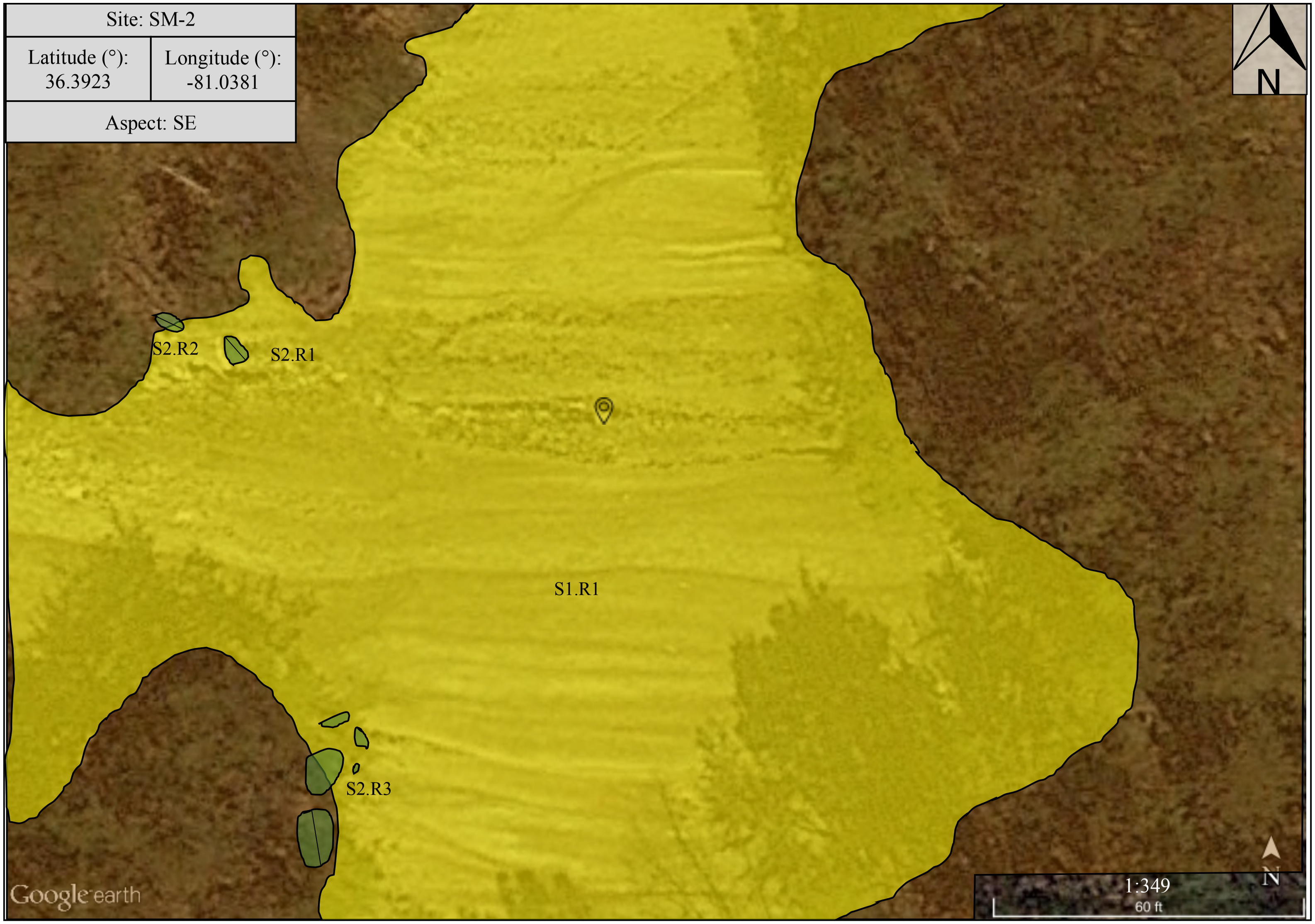

Figure 39. *Geomorphic Map: SM-2.*

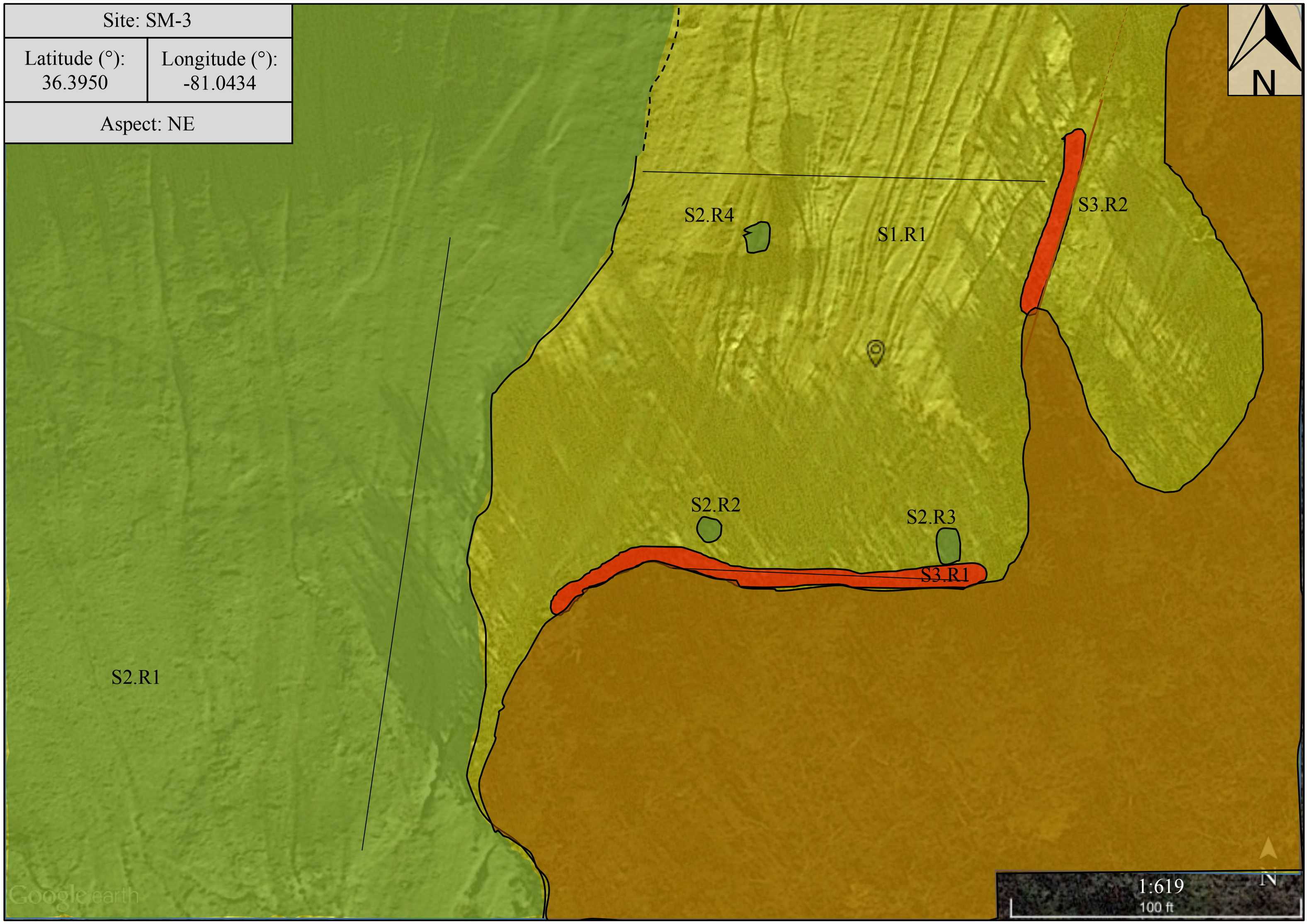

Figure 40. *Geomorphic Map: SM-3.*

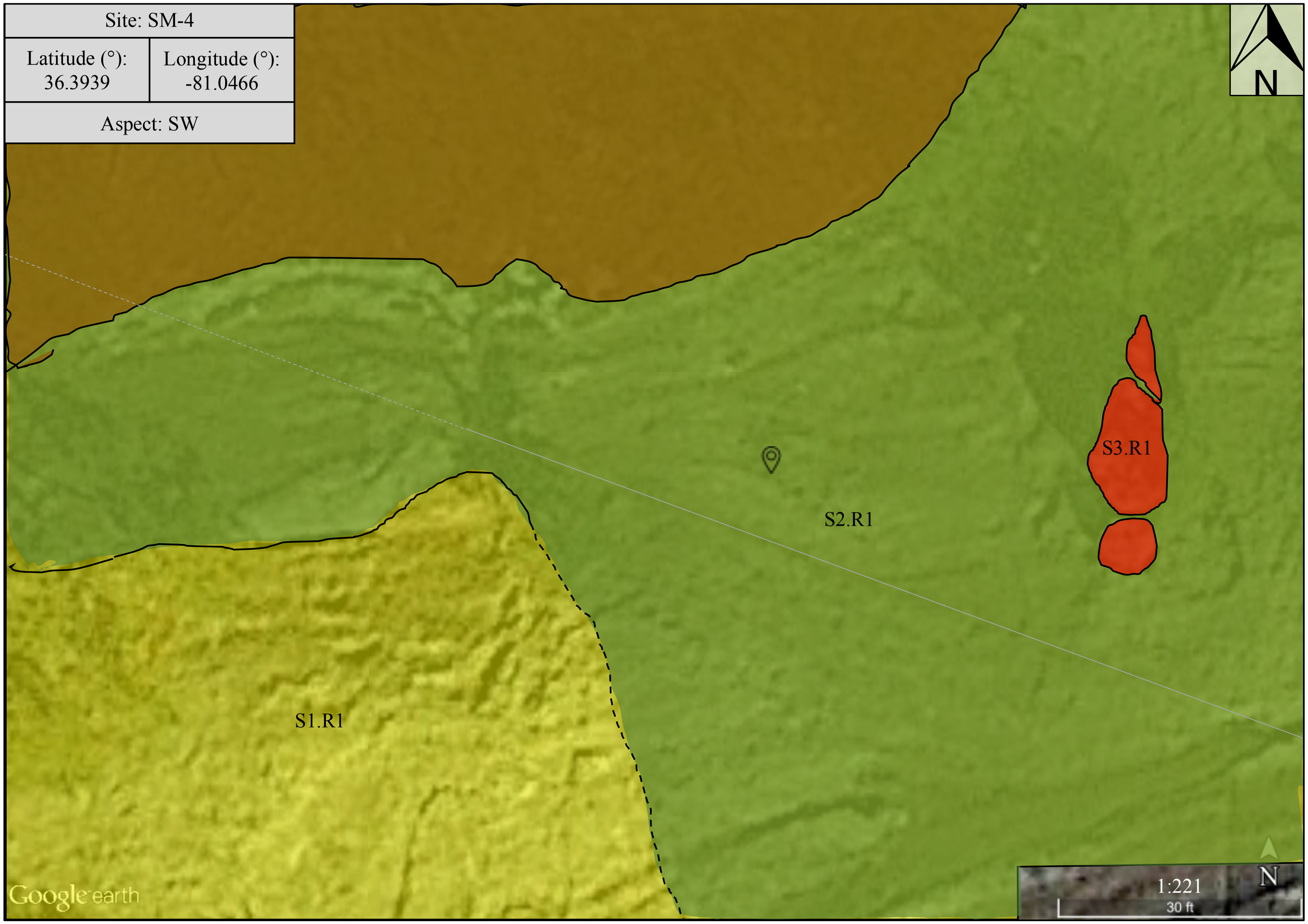

Figure 41. *Geomorphic Map: SM-4.*

Figure 42. *Geomorphic Map: SM-5.*

APPENDIX B

TABLE 4: GENERAL OBSERVATIONS AT FORTY ACRE ROCK- GENERAL CHARACTERISTICS OF EACH SLAB

Location	**Orientation**	**AVG Vegetation Percentage**	**AVG Lichen Percentage**	**AVG Maximum Surface Relief**	**AVG Average Surface Relief**	**AVG Surface Area (m^2)**	**AVG Surface Dissection**
FA	n/a	63.50	57.75	8.97	0.49	1110	0.75
FA:S1	n/a	60.00	42.00	16.86	0.72	4169	0.40
FA:S2	n/a	63.33	64.58	8.22	0.54	772	0.75
FA:S3	n/a	57.50	47.38	7.61	0.28	237	0.25
FA:S4	n/a	86.00	84.33	2.49	0.43	26	2.67
FA-4	NE	56.00	55.60	12.88	0.40	2043	0.80
FA-2	SE	73.33	68.33	12.92	1.00	1732	1.33
FA-1	SW	47.00	46.00	12.47	0.80	17	0.40
FA-3	SW	73.50	63.13	2.16	0.14	759	0.75
FA-5	SW	65.00	57.00	9.79	0.50	1359	0.71
Location	**Orientation**	**STDEV Vegetation Percentage**	**STDEV Lichen Percentage**	**STDEV Maximum Surface Relief**	**STDEV Average Surface Relief**	**STDEV Surface Relief**	**STDEV Surface Dissection**
FA	n/a	20.67	21.41	8.02	0.54	2384	1.08
FA:S1	n/a	6.32	13.64	8.82	0.66	3898	0.49
FA:S2	n/a	22.94	16.00	4.51	0.55	1831	1.09
FA:S3	n/a	19.84	21.17	8.84	0.35	630	0.43
FA:S4	n/a	1.41	0.94	2.51	0.40	17	0.47
FA-4	NE	20.43	13.61	44.11	1.28	3402	1.62
FA-2	SW	11.55	14.43	2.57	0.90	2906	0.00
FA-1	SW	29.92	28.00	10.37	0.57	33	0.55
FA-3	SW	11.19	11.02	25.88	3.67	2046	1.38
FA-5	SW	20.00	19.43	7.14	0.05	2829	0.52

TABLE 5: GENERAL OBSERVATIONS AT ROCKY FACE- GENERAL CHARACTERISTICS OF EACH SLAB

Location	Orientation	AVG Vegetation Percentage	AVG Lichen Percentage	AVG Maximum Surface Relief	AVG Average Surface Relief	AVG Surface Area (m^2)	AVG Surface Dissection
RF	n/a	54.25	52.61	18.00	0.53	393	1.11
RF:S1	n/a	33.20	22.20	42.50	1.42	4550	1.00
RF:S2	n/a	42.19	41.56	18.06	0.69	795	0.38
RF:S3	n/a	61.70	60.83	14.92	0.35	27	1.43
RF-1	SE	38.33	33.33	85.83	3.33	786	0.33
RF-5	SE	38.33	34.44	7.78	0.17	649	1.67
RF-3	SW	63.19	63.03	17.80	0.40	438	1.19
RF-2	NW	55.00	53.57	14.66	0.56	237	0.43
RF-4	NW	45.91	42.73	10.57	0.40	47	1.09
Location	**Orientation**	**STDEV Vegetation Percentage**	**STDEV Lichen Percentage**	**STDEV Maximum Surface Relief**	**STDEV Average Surface Relief**	**STDEV Surface Area**	**STDEV Surface Dissection**
RF	n/a	23.73	24.91	22.34	0.81	1783	1.38
RF:S1	n/a	13.60	8.91	49.95	1.86	4912	1.10
RF:S2	n/a	21.99	22.18	24.47	0.97	3152	0.86
RF:S3	n/a	21.91	22.70	11.13	0.23	54	1.48
RF-1	SE	2.89	5.77	63.94	2.08	1349	0.58
RF-5	SE	23.69	22.67	4.28	0.05	1894	1.58
RF-3	SW	24.78	24.95	12.74	0.27	2261	1.42
RF-2	NW	22.55	23.93	14.08	0.59	613	1.13
RF-4	NW	13.75	16.79	6.73	0.38	138	1.38

TABLE 6: GENERAL OBSERVATIONS AT STONE MOUNTAIN- GENERAL CHARACTERISTICS OF EACH SLAB

Location	Orientation	AVG Vegetation Percentage	AVG Lichen Percentage	AVG Maximum Surface Relief	AVG Average Surface Relief	AVG Surface Area (m^2)	AVG Surface Dissection
SM	n/a	30.55	26.40	14.30	0.17	1049	0.95
SM:S1	n/a	33.00	21.60	23.64	0.16	2732	0.00
SM:S2	n/a	30.00	28.50	10.75	0.15	657	1.09
SM:S3	n/a	29.42	26.91	13.03	0.21	366	1.50
SM-3	NE	23.33	19.17	10.66	0.13	1329	0.57
SM-2	SE	46.25	42.50	8.05	0.10	581	0.75
SM-1	SW	22.88	22.36	12.58	0.21	1534	0.75
SM-4	SW	35.00	28.33	14.00	0.23	434	2.00
SM-5	NW	30.00	23.75	28.88	0.20	1006	1.25
Location	**Orientation**	**STDEV Vegetation Percentage**	**STDEV Lichen Percentage**	**STDEV Maximum Surface Relief**	**STDEV Average Surface Relief**	**STDEV Surface Area**	**STDEV Surface Dissection**
SM	n/a	13.39	13.59	18.91	0.06	1645	1.36
SM:S1	n/a	10.77	12.18	31.18	0.05	1505	0.00
SM:S2	n/a	15.49	14.33	12.09	0.05	1629	1.44
SM:S3	n/a	9.71	11.08	8.68	0.06	719	1.26
SM-3	NE	15.38	13.20	16.36	0.05	2276	1.13
SM-2	SE	7.50	5.00	10.34	0.00	1146	1.50
SM-1	SW	12.10	12.31	5.85	0.02	1925	1.50
SM-4	SW	8.66	12.58	8.72	0.06	478	1.73
SM-5	NW	4.08	13.15	37.49	0.00	1497	1.50

TABLE 7: SLAB THICKNESS AT FORTY ACRE ROCK
10 SLAB THICKNESS MEASUREMENTS AROUND SLAB'S CIRCUMFERENCE

Location	Orientation	Count	Average Thickness (cm)	Maximum Thickness (cm)	Median Thickness (cm)	STDEV
FA	n/a	160.00	23.84	39.80	23.29	28.00
FA:S2	n/a	119.00	16.54	27.29	16.46	13.99
FA:S3	n/a	70.00	31.83	56.00	29.37	38.45
FA:S4	n/a	30.00	34.20	52.07	36.43	31.69
FA-4:S2	NE	20.00	38.13	53.25	41.38	13.73
FA-4:S3	NE	10.00	8.44	15.40	8.00	4.22
FA-4:S4	NE	10.00	18.74	38.40	19.60	11.11
FA-2:S2	SE	19.00	10.09	22.80	8.20	10.41
FA-1:S2	SW	20.00	18.40	30.05	17.28	13.11
FA-1:S3	SW	20.00	47.34	90.25	40.78	52.39
FA-3:S2	SW	10.00	12.23	21.00	12.80	4.33
FA-3:S3	SW	30.00	32.73	45.53	34.93	33.13
FA-3:S4	SW	20.00	41.93	58.90	44.85	35.57
FA-5:S2	SW	50.00	10.46	18.86	10.20	5.67
FA-5:S3	SW	10.00	21.48	59.50	11.25	20.23
FA-4:S2.R1	NE	10.00	46.38	62.00	47.00	8.06
FA-4:S2.R2	NE	10.00	29.88	44.50	35.75	13.26
FA-4:S3.R1	NE	10.00	8.44	15.40	8.00	4.22
FA-4:S4.R1	NE	10.00	18.74	38.40	19.60	11.11
FA-2:S2.R1	SE	9.00	2.91	10.10	2.10	2.93
FA-2:S2.R2	SE	10.00	16.56	35.50	14.30	10.49
FA-1:S2.R1	SW	10.00	8.23	17.10	6.55	6.63
FA-1:S2.R2	SW	10.00	28.57	43.00	28.00	9.63
FA-1:S3.R1	SW	10.00	6.97	14.50	6.05	4.02
FA-1:S3.R2	SW	10.00	87.70	166.00	75.50	47.05
FA-3:S2.R1	SW	10.00	12.23	21.00	12.80	4.33
FA-3:S3.R1	SW	10.00	14.16	24.20	12.35	6.01
FA-3:S3.R2	SW	10.00	7.99	13.00	8.95	3.31
FA-3:S3.R3	SW	10.00	76.04	99.40	83.50	20.32
FA-3:S4.R1	SW	10.00	72.74	98.80	78.00	24.66
FA-3:S4.R2	SW	10.00	11.12	19.00	11.70	4.85
FA-5:S2.R1	SW	10.00	7.78	13.10	7.30	4.33
FA-5:S2.R2	SW	10.00	10.37	18.50	9.55	5.03
FA-5:S2.R3	SW	10.00	10.16	22.10	8.80	6.79
FA-5:S2.R4	SW	10.00	12.86	22.60	14.30	6.24
FA-5:S2.R5	SW	10.00	11.13	18.00	11.05	4.27
FA-5:S3.R1	SW	10.00	21.48	59.50	11.25	20.23

TABLE 8: SLAB THICKNESS AT ROCKY FACE
10 SLAB THICKNESS MEASUREMENTS AROUND SLAB'S CIRCUMFERENCE

Location	Orientation	Count	Average Thickness (cm)	Maximum Thickness (cm)	Median Thickness (cm)	STDEV
RF	n/a	563.00	15.58	29.01	14.20	11.72
RF:S2	n/a	160.00	11.53	23.89	10.35	11.89
RF:S3	n/a	383.00	17.19	31.11	15.78	11.26
RF-1:S2	SE	20.00	29.45	47.75	14.20	14.06
RF-5:S2	SE	30.00	6.58	29.17	2.72	10.35
RF-5:S3	SE	40.00	15.59	27.60	14.63	8.88
RF-3:S2	SW	10.00	20.35	35.00	20.35	9.19
RF-3:S3	SW	283.00	19.01	29.77	14.83	11.79
RF-2:S2	NW	60.00	10.02	17.63	10.17	8.63
RF-4:S2	NW	40.00	6.34	14.60	5.39	4.29
RF-4:S3	NW	60.00	9.69	18.20	9.29	5.08
RF-1:S2.R1	SE	10.00	21.89	38.50	21.20	10.82
RF-1:S2.R2	SE	10.00	37.01	57.00	33.30	13.79
RF-5:S2.R1	SE	10.00	8.39	28.50	2.25	8.86
RF-5:S2.R2	SE	10.00	2.32	6.50	1.90	1.55
RF-5:S2.R3	SE	10.00	9.03	52.50	4.00	14.59
RF-5:S3.R1	SE	10.00	17.00	27.40	19.35	8.15
RF-5:S3.R2	SE	10.00	18.03	38.00	13.65	11.32
RF-5:S3.R3	SE	10.00	9.76	17.00	10.50	5.29
RF-5:S3.R4	SE	10.00	17.55	28.00	15.00	6.84
RF-3:S2.R1	SW	10.00	20.35	35.00	20.35	9.19
RF-3:S3.R1	SW	10.00	31.12	49.30	27.55	9.26
RF-3:S3.R2	SW	10.00	17.41	27.20	19.25	7.72
RF-3:S3.R3	SW	7.00	3.61	7.00	2.00	2.17
RF-3:S3.R4	SW	10.00	11.50	20.00	10.75	4.60
RF-3:S3.R5	SW	7.00	14.56	27.80	16.00	9.93
RF-3:S3.R6	SW	9.00	15.96	45.00	10.00	14.00
RF-3:S3.R7	SW	10.00	5.47	8.20	4.85	1.52
RF-3:S3.R8	SW	10.00	22.74	34.00	24.00	9.35
RF-3:S3.R9	SW	10.00	22.27	39.00	21.25	10.85
RF-3:S3.R10	SW	10.00	34.77	57.50	31.25	10.16
RF-3:S3.R11	SW	10.00	26.26	40.00	24.25	5.85
RF-3:S3.R12	SW	10.00	12.06	24.60	8.95	7.43
RF-3:S3.R13	SW	10.00	21.69	39.00	20.50	7.54
RF-3:S3.R14	SW	10.00	18.57	26.00	17.25	4.29
RF-3:S3.R15	SW	10.00	19.77	42.00	14.05	12.05
RF-3:S3.R16	SW	10.00	33.22	44.50	31.55	5.89
RF-3:S3.R17	SW	10.00	7.75	18.10	5.20	4.91
RF-3:S3.R18	SW	10.00	22.71	58.50	18.25	13.12
RF-3:S3.R19	SW	10.00	10.63	60.00	6.05	16.63
RF-3:S3.R20	SW	10.00	21.63	33.00	25.35	9.26
RF-3:S3.R21	SW	10.00	7.24	24.50	4.75	6.47
RF-3:S3.R22	SW	10.00	18.86	33.30	19.25	10.52
RF-3:S3.R23	SW	10.00	16.35	30.00	16.00	7.51
RF-3:S3.R24	SW	10.00	16.17	30.00	13.30	6.79
RF-3:S3.R25	SW	10.00	16.50	35.00	14.00	8.63
RF-3:S3.R26	SW	10.00	14.80	26.00	15.00	5.34

TABLE 8 (CONTINUED): SLAB THICKNESS AT ROCKY FACE
10 SLAB THICKNESS MEASUREMENTS AROUND SLAB'S CIRCUMFERENCE

Location	Orientation	Count	Average Thickness (cm)	Maximum Thickness (cm)	Median Thickness (cm)	STDEV
RF-3:S3.R27	SW	10.00	23.80	32.00	25.00	6.00
RF-3:S3.R28	SW	10.00	25.30	9.13	42.00	23.00
RF-3:S3.R29	SW	10.00	32.40	40.00	32.50	5.28
RF-2:S2.R1	NW	10.00	24.44	39.00	27.00	9.29
RF-2:S2.R2	NW	10.00	10.65	15.00	8.90	2.96
RF-2:S2.R3	NW	10.00	9.54	13.60	10.50	2.95
RF-2:S2.R4	NW	10.00	2.94	11.00	1.50	3.11
RF-2:S2.R5	NW	10.00	3.42	12.70	2.40	3.44
RF-2:S2.R6	NW	10.00	9.10	14.50	10.70	4.25
RF-4:S2.R1	NW	10.00	5.89	17.50	5.50	4.35
RF-4:S2.R2	NW	10.00	5.39	16.00	1.85	5.91
RF-4:S2.R3	NW	10.00	5.76	12.70	6.15	3.04
RF-4:S2.R4	NW	10.00	8.31	12.20	8.05	2.25
RF-4:S3.R1	NW	10.00	11.06	25.00	8.25	7.00
RF-4:S3.R2	NW	10.00	10.92	15.40	10.65	3.45
RF-4:S3.R3	NW	10.00	7.30	11.50	8.00	3.25
RF-4:S3.R4	NW	10.00	10.31	15.00	10.10	2.94
RF-4:S3.R5	NW	10.00	10.84	23.00	10.70	5.68
RF-4:S3.R6	NW	10.00	9.16	19.30	8.05	3.95

TABLE 9: SLAB THICKNESS AT STONE MOUNTAIN
10 SLAB THICKNESS MEASUREMENTS AROUND SLAB'S CIRCUMFERENCE

Location	Orientation	Count	Average Thickness (cm)	Average Maximum Thickness (cm)	Median Thickness (cm)	STDEV
SM	n/a	90.00	28.32	49.12	27.94	34.85
SM:S2	n/a	110.00	32.78	54.75	33.28	39.22
SM:S3	n/a	70.00	21.32	40.27	19.55	24.66
SM-3:S2	NE	40.00	26.57	42.10	26.98	37.40
SM-3:S3	NE	20.00	6.06	10.45	6.15	2.67
SM-2:S2	SE	30.00	12.84	23.70	11.97	9.20
SM-1:S2	SW	20.00	67.78	116.50	74.13	56.95
SM-1:S3	SW	20.00	13.37	27.90	12.15	7.83
SM-4:S2	SW	10.00	35.81	58.00	34.25	18.00
SM-4:S3	SW	10.00	63.35	107.00	62.00	33.29
SM-5:S2	NW	10.00	44.38	71.80	39.80	17.98
SM-5:S3	NW	20.00	23.51	49.10	19.13	17.95
SM-3:S2.R1	NE	10.00	81.61	120.00	87.50	38.30
SM-3:S2.R2	NE	10.00	7.76	20.40	5.65	7.22
SM-3:S2.R3	NE	10.00	6.10	9.50	6.00	2.05
SM-3:S2.R4	NE	10.00	10.80	18.50	8.75	4.56
SM-3:S3.R1	NE	10.00	6.28	10.10	6.10	2.09
SM-3:S3.R2	NE	10.00	5.83	10.80	6.20	3.13
SM-2:S2.R1	SE	10.00	20.18	43.60	17.25	11.72
SM-2:S2.R2	SE	10.00	6.53	10.50	6.70	3.00
SM-2:S2.R3	SE	10.00	11.80	17.00	11.95	3.57
SM-1:S2.R1	SW	10.00	26.85	81.00	20.25	20.74
SM-1:S2.R2	SW	10.00	108.71	152.00	128.00	52.02
SM-1:S3.R1	SW	10.00	8.75	27.80	7.25	6.91
SM-1:S3.R2	SW	10.00	17.99	28.00	17.05	5.67
SM-4:S2.R1	SW	10.00	35.81	58.00	34.25	18.00
SM-4:S3.R1	SW	10.00	63.35	107.00	62.00	33.29
SM-5:S2.R1	NW	10.00	44.38	71.80	39.80	17.98
SM-5:S3.R1	NW	10.00	37.28	73.00	32.70	14.42
SM-5:S3.R2	NW	10.00	9.74	25.20	5.55	7.57

TABLE 10: MESOSCALE AT FORTY ACRE ROCK
CRACKS THAT MEET THE REQUIREMENTS OF SPALL
THICKNESS >1CM AND/OR >1M LENGTH

Location	Orientation	AVG Crack Length (mm)	AVG Crack Width (mm)	AVG Spall Thickness (mm)
FA	n/a	2518.15	149.45	50.17
FA:S1	n/a	3366.27	n/a	30.35
FA:S2	n/a	1578.83	13.87	63.76
FA:S3	n/a	3138.33	11.11	32.70
FA:S4	n/a	1247.14	347.44	103.93
FA-4	NE	820.60	345.03	345.03
FA-2	SE	5196.82	25.00	25.00
FA-1	SW	746.05	8.67	8.67
FA-3	SW	6128.18	181.97	181.97
FA-5	SW	2404.12	10.00	10.00
Location	**Orientation**	**STDEV Crack Length (mm)**	**STDEV Crack Width (mm)**	**STDEV Spall Thickness (mm)**
FA	n/a	6326.47	200.35	99.61
FA:S1	n/a	6359.48	#DIV/0!	33.05
FA:S2	n/a	3588.38	9.56	162.21
FA:S3	n/a	9337.77	7.49	39.56
FA:S4	n/a	856.60	175.01	100.79
FA-4	NE	782.20	256.35	41.02
FA-2	SE	8053.59	7.07	48.27
FA-1	SW	982.39	2.31	45.23
FA-3	SW	14826.25	134.72	113.77
FA-5	SW	2886.86	0.00	212.30

TABLE 11: MESOSCALE AT ROCKY FACE
CRACKS THAT MEET THE REQUIREMENTS OF
SPALL THICKNESS >1CM AND/OR >1M LENGTH

Location	Orientation	AVG Crack Length (mm)	AVG Crack Width (mm)	AVG Spall thickness (mm)
RF	n/a	1226.01	27.31	72.68
RF:S1	n/a	1343.98	0.63	60.80
RF:S2	n/a	945.04	10.99	54.37
RF:S3	n/a	1459.11	79.67	110.54
RF-1	SE	964.86	0.00	31.74
RF-5	SE	1191.40	14.75	53.30
RF-3	SW	1480.54	73.74	109.89
RF-2	NW	1351.11	0.00	60.89
RF-4	NW	1102.24	9.47	72.67
Location	**Orientation**	**STDEV Crack Length (mm)**	**STDEV Crack Width (mm)**	**STDEV Spall thickness (mm)**
RF	n/a	1258.92	115.01	97.59
RF:S1	n/a	1566.01	2.56	99.41
RF:S2	n/a	676.22	51.87	61.40
RF:S3	n/a	1488.34	198.08	127.60
RF-1	SE	1165.15	0.00	26.48
RF-5	SE	1172.12	52.78	65.49
RF-3	SW	1350.59	193.12	129.23
RF-2	NW	1280.93	0.00	42.88
RF-4	NW	1277.05	58.40	101.54

TABLE 12: MESOSCALE AT STONE MOUNTAIN CRACKS THAT MEET THE REQUIREMENTS OF SPALL THICKNESS >1CM AND/OR >1M LENGTH

Location	**Orientation**	**AVG Crack Length (mm)**	**AVG Crack Width (mm)**	**AVG Spall Thickness (mm)**
SM	n/a	1348.64	176.87	94.82
SM:S1	n/a	1058.76	7.70	59.34
SM:S2	n/a	2570.00	329.71	256.63
SM:S3	n/a	974.90	32.96	48.86
SM-3	NE	580.00	0.00	32.52
SM-2	SE	720.00	0.00	28.20
SM-1	SW	1069.48	19.00	97.90
SM-4	SW	1149.08	19.17	58.24
SM-5	NW	2563.75	264.52	173.18
Location	**Orientation**	**STDEV Crack Length (mm)**	**STDEV Crack Width (mm)**	**STDEV Spall Thickness (mm)**
SM	n/a	1783.10	370.26	147.47
SM:S1	n/a	1337.92	9.95	97.82
SM:S2	n/a	2934.29	491.74	212.87
SM:S3	n/a	1021.65	43.51	88.56
SM-3	NE	431.32	n/a	11.92
SM-2	SE	n/a	n/a	n/a
SM-1	SW	1319.98	1.41	141.02
SM-4	SW	1219.83	6.51	90.73
SM-5	NW	2953.28	445.61	222.93

TABLE 13: MESOSCALE DENSITY

DENSITY SUM OF CRACK MEASUREMENTS DIVIDED BY THE TOTAL AREA OF TRANSECTS

Location	Orientation	Density Length (mm/cm^2)	Location	Orientation	Density Length (mm/cm^2)	Location	Orientation	Density Length (mm/cm^2)
FA	n/a	0.43	**RF**	n/a	0.37	**SM**	n/a	0.15
FA:S1	n/a	0.43	**RF:S1**	n/a	0.20	**SM:S1**	n/a	0.09
FA:S2	n/a	0.24	**RF:S2**	n/a	0.28	**SM:S2**	n/a	0.14
FA:S3	n/a	0.51	**RF:S3**	n/a	0.59	**SM:S3**	n/a	0.23
FA:S4	n/a	0.81	**n/a**	n/a	n/a	**n/a**	n/a	n/a
FA-4	NE	0.10	**n/a**	n/a	n/a	**SM-3**	NE	0.01
FA-2	SE	3.71	**RF-1**	SE	0.38	**SM-2**	SE	0.01
n/a	n/a	n/a	**RF-5**	SE	4.55	**n/a**	n/a	n/a
FA-1	SW	0.14	**RF-3**	SW	0.30	**SM-1**	SW	0.16
FA-3	SW	0.79	**n/a**	n/a	n/a	**SM-4**	SW	0.18
FA-5	SW	0.34	**n/a**	n/a	n/a	**n/a**	n/a	n/a
n/a	n/a	n/a	**RF-2**	NW	0.12	**SM-5**	NW	4.99
n/a	n/a	n/a	**RF-4**	NW	0.55	**n/a**	n/a	n/a

MICROSCALEE DENSITY

DENSITY SUM OF CRACK MEASUREMENTS DIVIDED BY THE TOTAL AREA OF TRANSECTS

Location	Orientation	Density Length in Box (mm/cm^2)	Location	Orientation	Density Length in Box (mm/cm^2)	Location	Orientation	Density Length in Box (mm/cm^2)
FA	n/a	0.89	**RF**	n/a	0.64	**SM**	n/a	0.53
FA:S1	n/a	1.13	**RF:S1**	n/a	0.66	**SM:S1**	n/a	0.58
FA:S2	n/a	0.69	**RF:S2**	n/a	0.62	**SM:S2**	n/a	0.46
FA:S3	n/a	0.73	**RF:S3**	n/a	0.66	**SM:S3**	n/a	0.55
FA:S4	n/a	1.11	**n/a**	n/a	n/a	**n/a**	n/a	n/a
FA-4	NE	1.25	**n/a**	n/a	n/a	**SM-3**	NE	0.76
FA-2	SE	1.03	**RF-1**	SE	0.65	**SM-2**	SE	0.41
n/a	n/a	n/a	**RF-5**	SE	0.62	**n/a**	n/a	n/a
FA-1	SW	0.64	**RF-3**	SW	0.68	**SM-1**	SW	0.70
FA-3	SW	0.56	**n/a**	n/a	n/a	**SM-4**	SW	0.62
FA-5	SW	0.86	**n/a**	n/a	n/a	**n/a**	n/a	n/a
n/a	n/a	n/a	**RF-2**	NW	0.68	**SM-5**	NW	1.25
n/a	n/a	n/a	**RF-4**	NW	0.60	**n/a**	n/a	n/a

TABLE 14: MICROSCALE AT FORTY ACRE ROCK- CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orientation	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thick ness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
FA	n/a	0.98	1.98	0.01	106.76	78.90	3.97	5.42	5.62	5.82
FA:S1	n/a	1.00	2.00	0.00	88.80	78.62	3.67	5.65	5.88	6.11
FA:S2	n/a	0.99	2.00	0.02	93.19	68.32	3.94	5.34	5.51	5.68
FA:S3	n/a	0.96	1.94	0.00	109.91	57.81	3.46	5.22	5.41	5.60
FA:S4	n/a	0.89	1.79	0.00	466.05	395.53	13.51	5.05	5.11	5.16
FA-4	NE	0.99	1.98	0.00	128.04	106.71	4.98	5.75	5.97	6.19
FA-2	SE	1.00	2.00	0.00	83.87	65.06	3.78	5.54	5.73	5.91
FA-1	SW	0.91	1.89	0.00	142.99	104.78	2.63	4.99	5.18	5.37
FA-3	SW	0.98	1.96	0.04	67.77	59.11	3.61	5.14	5.33	5.52
FA-5	SW	1.00	2.00	0.00	109.44	60.08	3.81	5.34	5.53	5.72
FA-4:S1	NE	1.00	2.00	0.00	102.28	87.01	4.84	5.82	6.10	6.38
FA-4:S2	NE	1.00	2.00	0.00	74.13	58.06	3.50	5.91	6.10	6.28
FA-4:S3	NE	1.00	2.00	0.00	81.58	67.21	3.34	5.63	5.84	6.05
FA-4:S4	NE	0.82	1.64	0.00	767.73	648.18	20.76	5.27	5.27	5.27
FA-2:S1	SE	1.00	2.00	0.00	77.49	60.88	2.83	5.71	5.92	6.13
FA-2:S2	SE	1.00	2.00	0.00	92.22	70.55	5.03	5.33	5.48	5.64
FA-1:S1	SW	1.00	2.00	0.00	115.86	113.17	3.42	5.57	5.80	6.02
FA-1:S2	SW	0.91	2.00	0.00	207.86	128.36	0.53	4.36	4.46	4.57
FA-1:S3	SW	0.58	1.33	0.00	173.58	44.42	2.00	3.42	3.58	3.75
FA-3:S1	SW	1.00	2.00	0.00	92.85	91.69	3.28	5.65	5.96	6.27
FA-3:S2	SW	1.00	2.00	0.11	82.00	57.40	3.23	4.89	5.10	5.31
FA-3:S3	SW	0.95	1.89	0.00	40.97	40.71	4.21	5.11	5.21	5.32
FA-3:S4	SW	1.00	2.00	0.00	61.60	56.60	3.58	4.60	4.60	4.60
FA-5:S1	SW	1.00	2.00	0.00	59.89	54.26	3.67	5.40	5.56	5.72
FA-5:S2	SW	1.00	2.00	0.00	86.21	65.74	4.81	5.42	5.59	5.76
FA-5:S3	SW	1.00	2.00	0.00	153.30	61.24	3.42	5.26	5.48	5.70
FA-4:S1.R1.1	NE	1.00	2.00	0.00	100.91	100.82	4.41	6.27	6.27	6.27
FA-4:S1.R1.2	NE	1.00	2.00	0.00	106.90	91.00	2.56	6.40	6.70	7.00
FA-4:S1.R1.3	NE	1.00	2.00	0.00	154.17	143.33	6.37	5.67	6.08	6.50
FA-4:S1.R1.4	NE	1.00	2.00	0.00	154.60	154.60	5.68	6.00	6.30	6.60
FA-4:S1.R1.5	NE	1.00	2.00	0.00	134.14	90.14	5.36	5.43	6.14	6.86
FA-4:S1.R1.6	NE	1.00	2.00	0.00	43.00	34.00	4.00	5.60	5.80	6.00
FA-4:S1.R1.7	NE	1.00	2.00	0.00	129.00	77.80	3.40	5.60	6.10	6.60
FA-4:S1.R1.8	NE	1.00	2.00	0.00	100.00	70.56	4.99	5.44	5.89	6.33
FA-4:S1.R1.9	NE	1.00	2.00	0.00	61.00	61.00	3.13	5.83	5.92	6.00
FA-4:S1.R1.10	NE	1.00	2.00	0.00	52.75	52.75	8.70	5.50	5.50	5.50
FA-4:S2.R1.1	NE	1.00	2.00	0.00	74.25	61.75	2.30	6.00	6.00	6.00
FA-4:S2.R1.2	NE	1.00	2.00	0.00	46.86	46.86	3.37	5.57	5.93	6.29
FA-4:S2.R1.3	NE	1.00	2.00	0.00	47.33	47.33	5.43	5.00	5.50	6.00
FA-4:S2.R1.4	NE	1.00	2.00	0.00	45.00	45.00	4.28	6.00	6.08	6.17
FA-4:S2.R1.5	NE	1.00	2.00	0.00	76.75	67.00	4.23	6.75	6.75	6.75
FA-4:S2.R1.6	NE	1.00	2.00	0.00	43.00	34.00	4.00	5.60	5.80	6.00
FA-4:S2.R1.7	NE	1.00	2.00	0.00	50.60	50.60	2.58	5.60	6.00	6.40
FA-4:S2.R1.8	NE	1.00	2.00	0.00	87.00	72.00	3.05	6.00	6.00	6.00
FA-4:S2.R1.9	NE	1.00	2.00	0.00	104.00	55.25	3.68	5.25	5.75	6.25
FA-4:S2.R1.10	NE	1.00	2.00	0.00	159.00	71.25	2.98	5.50	5.50	5.50
FA-4:S3.R1.1	NE	1.00	2.00	0.00	92.40	76.40	1.94	5.60	5.70	5.80
FA-4:S3.R1.2	NE	1.00	2.00	0.00	205.00	96.67	3.60	5.67	6.17	6.67
FA-4:S3.R1.3	NE	1.00	2.00	0.00	47.38	47.38	3.39	5.63	5.75	5.88
FA-4:S3.R1.4	NE	1.00	2.00	0.00	176.00	110.17	3.73	5.50	6.17	6.83
FA-4:S3.R1.5	NE	1.00	2.00	0.00	114.00	114.00	3.06	6.20	6.30	6.40
FA-4:S3.R1.6	NE	1.00	2.00	0.00	45.14	45.14	4.04	6.14	6.29	6.43
FA-4:S3.R1.7	NE	1.00	2.00	0.00	43.25	40.88	3.19	5.13	5.13	5.13
FA-4:S3.R1.8	NE	1.00	2.00	0.00	53.71	53.71	3.49	5.00	5.43	5.86
FA-4:S3.R1.9	NE	1.00	2.00	0.00	76.17	76.17	3.85	6.33	6.42	6.50
FA-4:S3.R1.10	NE	1.00	2.00	0.00	36.50	36.50	1.80	5.00	5.00	5.00
FA-4:S4.R1.1	NE	1.00	2.00	0.00	450.00	230.00	14.40	7.00	7.00	7.00
FA-4:S4.R1.2	NE	1.00	2.00	0.00	125.00	125.00	12.00	7.00	7.00	7.00

TABLE 14: MICROSCALE AT FORTY ACRE ROCK (CONT.)- CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orientation	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thick ness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
FA-4:S4.R1.3	NE	1.00	2.00	0.00	3130.00	3055.00	54.50	5.50	5.50	5.50
FA-4:S4.R1.4	NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-4:S4.R1.5	NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-4:S4.R1.6	NE	1.00	2.00	0.00	110.00	110.00	3.10	7.00	7.00	7.00
FA-4:S4.R1.7	NE	1.00	2.00	0.00	60.00	60.00	4.50	5.00	5.00	5.00
FA-4:S4.R1.8	NE	1.00	2.00	0.00	380.00	115.00	22.40	7.00	7.00	7.00
FA-4:S4.R1.9	NE	1.00	2.00	0.00	790.00	200.00	50.00	7.00	7.00	7.00
FA-4:S4.R1.10	NE	1.00	2.00	0.00	270.00	180.00	13.00	7.00	7.00	7.00
FA-2:S1.R1.1	SE	1.00	2.00	0.00	102.00	89.14	2.20	5.57	5.79	6.00
FA-2:S1.R1.2	SE	1.00	2.00	0.00	52.25	52.25	3.60	6.00	6.06	6.13
FA-2:S1.R1.3	SE	1.00	2.00	0.00	30.22	30.22	1.58	5.67	6.00	6.33
FA-2:S1.R1.4	SE	1.00	2.00	0.00	58.30	58.30	2.35	5.40	5.75	6.10
FA-2:S1.R1.5	SE	1.00	2.00	0.00	85.60	85.00	1.66	6.20	6.20	6.20
FA-2:S1.R1.6	SE	1.00	2.00	0.00	47.00	44.60	3.54	5.60	5.75	5.90
FA-2:S1.R1.7	SE	1.00	2.00	0.00	223.14	80.29	4.91	5.29	5.43	5.57
FA-2:S1.R1.8	SE	1.00	2.00	0.00	107.75	102.75	1.53	7.00	7.00	7.00
FA-2:S1.R1.9	SE	1.00	2.00	0.00	64.00	64.00	2.47	6.17	6.42	6.67
FA-2:S1.R1.10	SE	1.00	2.00	0.00	52.83	43.00	3.78	5.00	5.42	5.83
FA-2:S2.R1.1	SE	1.00	2.00	0.00	85.00	37.50	3.75	5.00	5.25	5.50
FA-2:S2.R1.2	SE	1.00	2.00	0.00	107.50	80.17	9.08	5.42	5.58	5.75
FA-2:S2.R1.3	SE	1.00	2.00	0.00	125.00	60.00	11.70	6.00	6.00	6.00
FA-2:S2.R1.4	SE	1.00	2.00	0.00	182.00	96.00	6.78	4.60	5.00	5.40
FA-2:S2.R2.1	SE	1.00	2.00	0.00	67.83	58.83	1.97	5.25	5.25	5.25
FA-2:S2.R2.2	SE	1.00	2.00	0.00	96.86	86.71	3.30	5.43	5.64	5.86
FA-2:S2.R2.3	SE	1.00	2.00	0.00	60.00	52.50	1.58	5.67	5.92	6.17
FA-2:S2.R2.4	SE	1.00	2.00	0.00	75.00	75.00	1.20	7.00	7.00	7.00
FA-2:S2.R2.5	SE	1.00	2.00	0.00	81.00	71.00	9.46	5.00	5.20	5.40
FA-2:S2.R2.6	SE	1.00	2.00	0.00	56.67	56.67	2.80	5.00	5.00	5.00
FA-1:S1.R1.1	SW	1.00	2.00	0.00	41.80	41.80	3.88	5.80	5.80	5.80
FA-1:S1.R1.2	SW	1.00	2.00	0.00	63.67	36.33	3.40	6.00	6.17	6.33
FA-1:S1.R1.3	SW	1.00	2.00	0.00	71.50	71.50	3.83	5.75	6.38	7.00
FA-1:S1.R1.4	SW	1.00	2.00	0.00	3.20	3.20	3.30	5.00	5.00	5.00
FA-1:S1.R1.5	SW	1.00	2.00	0.00	253.45	253.45	3.17	5.36	5.73	6.09
FA-1:S1.R1.6	SW	1.00	2.00	0.00	65.33	62.17	2.93	5.33	5.42	5.50
FA-1:S1.R1.7	SW	1.00	2.00	0.00	99.00	92.75	2.28	5.00	5.25	5.50
FA-1:S1.R1.8	SW	1.00	2.00	0.00	101.80	101.80	3.68	5.20	5.50	5.80
FA-1:S1.R1.9	SW	1.00	2.00	0.00	103.00	103.00	5.15	6.00	6.00	6.00
FA-1:S1.R1.10	SW	1.00	2.00	0.00	64.75	64.75	2.95	6.50	6.63	6.75
FA-1:S2.R1.1	SW	1.00	2.00	0.00	250.00	200.00	0.60	7.00	7.00	7.00
FA-1:S2.R1.2	SW	1.00	2.00	0.00	90.00	90.00	0.48	7.00	7.00	7.00
FA-1:S2.R1.3	SW	1.00	2.00	0.00	240.00	250.00	0.25	7.00	7.00	7.00
FA-1:S2.R1.4	SW	0.50	2.00	0.00	665.00	200.00	0.80	5.00	5.50	6.00
FA-1:S2.R1.5	SW	1.00	2.00	0.00	331.00	200.00	0.18	3.00	3.25	3.50
FA-1:S2.R1.6	SW	0.00	1.00	2.00	3.00	4.00	7.00	8.00	9.00	10.00
FA-1:S2.R1.7	SW	1.00	2.00	0.00	31.50	116.00	1.20	6.00	6.00	6.00
FA-1:S2.R1.8	SW	1.00	2.00	0.00	25.00	25.00	1.10	5.00	5.00	5.00
FA-1:S2.R1.9	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S2.R1.10	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.1	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.2	SW	1.00	2.00	0.00	60.00	60.00	2.00	6.00	6.50	7.00
FA-1:S3.R1.3	SW	0.50	2.00	0.00	895.50	120.50	2.00	5.00	5.25	5.50
FA-1:S3.R1.4	SW	1.00	2.00	0.00	45.00	45.00	7.00	5.00	5.25	5.50
FA-1:S3.R1.5	SW	1.00	2.00	0.00	50.00	50.00	1.50	5.00	5.50	6.00
FA-1:S3.R1.6	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.7	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.8	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.9	SW	1.00	2.00	0.00	46.00	46.00	1.25	5.00	5.00	5.00
FA-1:S3.R1.10	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-3:S1.R1.1	SW	1.00	2.00	0.00	55.00	55.00	1.93	7.00	7.00	7.00

TABLE 14: MICROSCALE AT FORTY ACRE ROCK (CONT.)- CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orientation	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thick ness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
FA-3:S1.R1.2	SW	1.00	2.00	0.00	79.50	79.50	2.25	5.00	5.13	5.25
FA-3:S1.R1.3	SW	1.00	2.00	0.00	137.00	137.00	3.70	5.50	5.50	5.50
FA-3:S1.R1.4	SW	1.00	2.00	0.00	116.75	111.75	3.43	5.25	5.38	5.50
FA-3:S1.R1.5	SW	1.00	2.00	0.00	122.33	119.00	3.17	5.67	6.33	7.00
FA-3:S1.R1.6	SW	1.00	2.00	0.00	66.17	66.17	5.18	6.00	6.50	7.00
FA-3:S1.R1.7	SW	1.00	2.00	0.00	106.50	106.50	2.17	5.25	5.75	6.25
FA-3:S2.R2.1	SW	1.00	2.00	0.00	56.83	56.83	1.42	4.67	4.83	5.00
FA-3:S2.R2.2	SW	1.00	2.00	0.40	41.40	41.40	2.88	4.00	4.30	4.60
FA-3:S2.R2.3	SW	1.00	2.00	0.00	57.33	57.33	5.00	6.33	6.33	6.33
FA-3:S2.R2.4	SW	1.00	2.00	0.00	114.40	114.20	4.22	5.20	5.30	5.40
FA-3:S2.R2.5	SW	1.00	2.00	0.29	179.43	56.57	4.97	4.71	5.29	5.86
FA-3:S2.R2.6	SW	1.00	2.00	0.00	29.00	29.00	1.13	5.00	5.13	5.25
FA-3:S2.R2.7	SW	1.00	2.00	0.00	41.20	41.20	2.94	5.00	5.00	5.00
FA-3:S3.R3.1	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-3:S3.R3.2	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-3:S3.R3.3	SW	1.00	2.00	0.00	45.90	45.90	4.59	5.00	5.00	5.00
FA-3:S3.R3.4	SW	1.00	2.00	0.00	30.22	30.22	4.10	5.00	5.00	5.00
FA-3:S3.R3.5	SW	1.00	2.00	0.00	47.50	45.83	4.77	5.00	5.17	5.33
FA-3:S3.R3.6	SW	1.00	2.00	0.00	55.60	55.60	3.64	6.60	6.60	6.60
FA-3:S3.R3.7	SW	1.00	2.00	0.00	43.83	43.83	5.03	6.00	6.50	7.00
FA-3:S4.R1.1	SW	1.00	2.00	0.00	51.00	51.00	4.60	5.00	5.00	5.00
FA-3:S4.R1.2	SW	1.00	2.00	0.00	68.67	60.33	2.90	4.33	4.33	4.33
FA-5:S1.R1.1	SW	1.00	2.00	0.00	82.57	70.57	5.20	6.00	6.29	6.57
FA-5:S1.R1.2	SW	1.00	2.00	0.00	54.86	54.29	3.33	5.14	5.21	5.29
FA-5:S1.R1.3	SW	1.00	2.00	0.00	59.80	45.80	5.54	6.00	6.20	6.40
FA-5:S1.R1.4	SW	1.00	2.00	0.00	49.43	49.43	2.39	5.43	5.57	5.71
FA-5:S1.R1.5	SW	1.00	2.00	0.00	44.50	44.50	3.43	5.00	5.38	5.75
FA-5:S1.R1.6	SW	1.00	2.00	0.00	44.50	44.50	3.45	6.00	6.00	6.00
FA-5:S1.R1.7	SW	1.00	2.00	0.00	54.50	54.50	2.83	5.00	5.00	5.00
FA-5:S1.R1.8	SW	1.00	2.00	0.00	88.00	72.17	4.93	5.00	5.33	5.67
FA-5:S1.R1.9	SW	1.00	2.00	0.00	56.80	47.80	2.08	5.20	5.30	5.40
FA-5:S1.R1.10	SW	1.00	2.00	0.00	36.00	36.00	2.85	5.00	5.00	5.00
FA-5:S2.R1.1	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-5:S2.R1.2	SW	1.00	2.00	0.00	74.00	74.00	4.25	5.00	5.00	5.00
FA-5:S2.R1.3	SW	1.00	2.00	0.00	84.00	84.00	5.48	6.83	6.83	6.83
FA-5:S2.R1.4	SW	1.00	2.00	0.00	77.50	67.50	6.40	5.17	5.50	5.83
FA-5:S2.R1.5	SW	1.00	2.00	0.00	53.33	53.33	3.23	5.00	5.33	5.67
FA-5:S2.R1.6	SW	1.00	2.00	0.00	94.50	87.83	6.28	5.50	6.08	6.67
FA-5:S2.R1.7	SW	1.00	2.00	0.00	163.43	71.71	5.23	5.29	5.29	5.29
FA-5:S2.R1.8	SW	1.00	2.00	0.00	45.50	45.00	1.85	6.00	6.00	6.00
FA-5:S2.R1.9	SW	1.00	2.00	0.00	60.00	25.00	3.50	7.00	7.00	7.00
FA-5:S2.R1.10	SW	1.00	2.00	0.00	34.25	34.25	2.95	5.00	5.00	5.00
FA-5:S3.R1.1	SW	1.00	2.00	0.00	92.40	76.40	1.94	5.60	5.70	5.80
FA-5:S3.R1.2	SW	1.00	2.00	0.00	52.56	52.56	3.38	5.06	5.13	5.19
FA-5:S3.R1.3	SW	1.00	2.00	0.00	984.13	75.38	4.30	4.88	5.13	5.38
FA-5:S3.R1.4	SW	1.00	2.00	0.00	73.67	73.67	3.73	5.67	6.17	6.67
FA-5:S3.M1.5	SW	1.00	2.00	0.00	60.67	60.67	2.50	6.00	6.00	6.00
FA-5:S3.M1.6	SW	1.00	2.00	0.00	59.44	59.44	3.58	5.78	6.00	6.22
FA-5:S3.M1.7	SW	1.00	2.00	0.00	69.00	69.00	4.46	5.11	5.39	5.67
FA-5:S3.M1.8	SW	1.00	2.00	0.00	63.17	63.17	2.05	5.17	5.50	5.83
FA-5:S3.M1.9	SW	1.00	2.00	0.00	49.25	49.25	2.81	4.75	5.06	5.38
FA-5:S3.M1.10	SW	1.00	2.00	0.00	60.75	53.25	3.71	5.25	5.38	5.50

TABLE 15: STANDARD DEVIATION OF MICROSCALE AT FORTY ACRE ROCK-CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	STDEV Crack Parallel to	STDEV Surface where crack is	STDEV Crack Width	STDEV Crack Length	STDEV Crack Length in Box	STDEV Spall Thickness	STDEV Weathering Index Minimum	STDEV Weathering Index	STDEV Weathering Index Maximum
FA	n/a	0.12	0.22	0.08	386.02	236.68	5.00	1.13	1.14	1.24
FA:S1	n/a	0.00	0.00	0.00	151.79	135.35	3.02	0.80	0.77	0.91
FA:S2	n/a	0.07	0.00	0.14	124.44	52.36	4.16	1.29	1.29	1.34
FA:S3	n/a	0.19	0.35	0.00	557.83	38.88	1.94	1.18	1.22	1.34
FA:S4	n/a	0.32	0.63	0.00	1277.54	1279.38	21.60	2.15	2.15	2.17
FA-4	NE	0.10	0.21	0.00	419.53	412.67	7.90	1.02	1.00	1.13
FA-2	SE	0.00	0.00	0.00	111.27	41.07	4.88	0.85	0.82	0.88
FA-1	SW	0.28	0.46	0.00	337.36	250.77	2.08	1.96	1.99	2.07
FA-3	SW	0.14	0.27	0.19	80.58	47.44	2.21	1.10	1.15	1.26
FA-5	SW	0.00	0.00	0.00	570.61	36.10	2.19	0.82	0.84	0.97
FA-4:S1	NE	0.00	0.00	0.00	67.16	60.02	4.27	0.76	0.74	1.04
FA-4:S2	NE	0.00	0.00	0.00	65.14	36.11	1.58	0.90	0.83	0.83
FA-4:S3	NE	0.00	0.00	0.00	87.17	46.36	1.94	0.77	0.71	0.81
FA-4:S4	NE	0.40	0.81	0.00	1642.78	1666.93	26.45	2.80	2.80	2.80
FA-2:S1	SE	0.00	0.00	0.00	134.50	38.22	2.68	0.86	0.77	0.80
FA-2:S2	SE	0.00	0.00	0.00	70.54	44.28	6.58	0.79	0.81	0.91
FA-1:S1	SW	1.00	2.00	0.00	115.86	113.17	3.42	5.57	5.80	6.02
FA-1:S2	SW	0.91	2.00	0.00	207.86	128.36	0.53	4.36	4.46	4.57
FA-1:S3	SW	0.58	1.33	0.00	173.58	44.42	2.00	3.42	3.58	3.75
FA-3:S1	SW	0.00	0.00	0.00	64.02	63.42	2.15	0.69	0.72	0.87
FA-3:S2	SW	0.00	0.00	0.32	121.68	46.27	2.51	0.96	0.95	1.02
FA-3:S3	SW	0.23	0.45	0.00	21.08	20.36	1.93	1.39	1.45	1.54
FA-3:S4	SW	0.00	0.00	0.00	53.85	43.09	2.54	0.89	0.89	0.89
FA-5:S1	SW	0.00	0.00	0.00	43.82	31.44	2.19	0.69	0.69	0.79
FA-5:S2	SW	0.00	0.00	0.00	132.98	45.02	2.84	1.22	1.22	1.30
FA-5:S3	SW	0.00	0.00	0.00	829.01	34.12	1.66	0.65	0.71	0.89
FA-4:S1.R1.1	NE	1.00	2.00	0.00	100.91	100.82	4.41	6.27	6.27	6.27
FA-4:S1.R1.2	NE	1.00	2.00	0.00	106.90	91.00	2.56	6.40	6.70	7.00
FA-4:S1.R1.3	NE	1.00	2.00	0.00	154.17	143.33	6.37	5.67	6.08	6.50
FA-4:S1.R1.4	NE	1.00	2.00	0.00	154.60	154.60	5.68	6.00	6.30	6.60
FA-4:S1.R1.5	NE	1.00	2.00	0.00	134.14	90.14	5.36	5.43	6.14	6.86
FA-4:S1.R1.6	NE	1.00	2.00	0.00	43.00	34.00	4.00	5.60	5.80	6.00
FA-4:S1.R1.7	NE	1.00	2.00	0.00	129.00	77.80	3.40	5.60	6.10	6.60
FA-4:S1.R1.8	NE	1.00	2.00	0.00	100.00	70.56	4.99	5.44	5.89	6.33
FA-4:S1.R1.9	NE	1.00	2.00	0.00	61.00	61.00	3.13	5.83	5.92	6.00
FA-4:S1.R1.10	NE	1.00	2.00	0.00	52.75	52.75	8.70	5.50	5.50	5.50
FA-4:S2.R1.1	NE	1.00	2.00	0.00	74.25	61.75	2.30	6.00	6.00	6.00
FA-4:S2.R1.2	NE	1.00	2.00	0.00	46.86	46.86	3.37	5.57	5.93	6.29
FA-4:S2.R1.3	NE	1.00	2.00	0.00	47.33	47.33	5.43	5.00	5.50	6.00
FA-4:S2.R1.4	NE	1.00	2.00	0.00	45.00	45.00	4.28	6.00	6.08	6.17
FA-4:S2.R1.5	NE	1.00	2.00	0.00	76.75	67.00	4.23	6.75	6.75	6.75
FA-4:S2.R1.6	NE	1.00	2.00	0.00	43.00	34.00	4.00	5.60	5.80	6.00
FA-4:S2.R1.7	NE	1.00	2.00	0.00	50.60	50.60	2.58	5.60	6.00	6.40
FA-4:S2.R1.8	NE	1.00	2.00	0.00	87.00	72.00	3.05	6.00	6.00	6.00
FA-4:S2.R1.9	NE	1.00	2.00	0.00	104.00	55.25	3.68	5.25	5.75	6.25
FA-4:S2.R1.10	NE	1.00	2.00	0.00	159.00	71.25	2.98	5.50	5.50	5.50
FA-4:S3.R1.1	NE	1.00	2.00	0.00	92.40	76.40	1.94	5.60	5.70	5.80
FA-4:S3.R1.2	NE	1.00	2.00	0.00	205.00	96.67	3.60	5.67	6.17	6.67
FA-4:S3.R1.3	NE	1.00	2.00	0.00	47.38	47.38	3.39	5.63	5.75	5.88

TABLE 15: STANDARD DEVIATION OF MICROSCALE AT FORTY ACRE ROCK (CONT.)-
CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	STDEV Crack Parallel to	STDEV Surface where crack is	STDEV Crack Width	STDEV Crack Length	STDEV Crack Length in Box	STDEV Spall Thickness	STDEV Weathering Index Minimum	STDEV Weathering Index	STDEV Weathering Index Maximum
FA-4:S3.R1.4	NE	1.00	2.00	0.00	176.00	110.17	3.73	5.50	6.17	6.83
FA-4:S3.R1.5	NE	1.00	2.00	0.00	114.00	114.00	3.06	6.20	6.30	6.40
FA-4:S3.R1.6	NE	1.00	2.00	0.00	45.14	45.14	4.04	6.14	6.29	6.43
FA-4:S3.R1.7	NE	1.00	2.00	0.00	43.25	40.88	3.19	5.13	5.13	5.13
FA-4:S3.R1.8	NE	1.00	2.00	0.00	53.71	53.71	3.49	5.00	5.43	5.86
FA-4:S3.R1.9	NE	1.00	2.00	0.00	76.17	76.17	3.85	6.33	6.42	6.50
FA-4:S3.R1.10	NE	1.00	2.00	0.00	36.50	36.50	1.80	5.00	5.00	5.00
FA-4:S4.R1.1	NE	1.00	2.00	0.00	450.00	230.00	14.40	7.00	7.00	7.00
FA-4:S4.R1.2	NE	1.00	2.00	0.00	125.00	125.00	12.00	7.00	7.00	7.00
FA-4:S4.R1.3	NE	1.00	2.00	0.00	3130.00	3055.00	54.50	5.50	5.50	5.50
FA-4:S4.R1.4	NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-4:S4.R1.5	NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-4:S4.R1.6	NE	1.00	2.00	0.00	110.00	110.00	3.10	7.00	7.00	7.00
FA-4:S4.R1.7	NE	1.00	2.00	0.00	60.00	60.00	4.50	5.00	5.00	5.00
FA-4:S4.R1.8	NE	1.00	2.00	0.00	380.00	115.00	22.40	7.00	7.00	7.00
FA-4:S4.R1.9	NE	1.00	2.00	0.00	790.00	200.00	50.00	7.00	7.00	7.00
FA-4:S4.R1.10	NE	1.00	2.00	0.00	270.00	180.00	13.00	7.00	7.00	7.00
FA-2:S1.R1.1	SE	1.00	2.00	0.00	102.00	89.14	2.20	5.57	5.79	6.00
FA-2:S1.R1.2	SE	1.00	2.00	0.00	52.25	52.25	3.60	6.00	6.06	6.13
FA-2:S1.R1.3	SE	1.00	2.00	0.00	30.22	30.22	1.58	5.67	6.00	6.33
FA-2:S1.R1.4	SE	1.00	2.00	0.00	58.30	58.30	2.35	5.40	5.75	6.10
FA-2:S1.R1.5	SE	1.00	2.00	0.00	85.60	85.00	1.66	6.20	6.20	6.20
FA-2:S1.R1.6	SE	1.00	2.00	0.00	47.00	44.60	3.54	5.60	5.75	5.90
FA-2:S1.R1.7	SE	1.00	2.00	0.00	223.14	80.29	4.91	5.29	5.43	5.57
FA-2:S1.R1.8	SE	1.00	2.00	0.00	107.75	102.75	1.53	7.00	7.00	7.00
FA-2:S1.R1.9	SE	1.00	2.00	0.00	64.00	64.00	2.47	6.17	6.42	6.67
FA-2:S1.R1.10	SE	1.00	2.00	0.00	52.83	43.00	3.78	5.00	5.42	5.83
FA-2:S2.R1.1	SE	1.00	2.00	0.00	85.00	37.50	3.75	5.00	5.25	5.50
FA-2:S2.R1.2	SE	1.00	2.00	0.00	107.50	80.17	9.08	5.42	5.58	5.75
FA-2:S2.R1.3	SE	1.00	2.00	0.00	125.00	60.00	11.70	6.00	6.00	6.00
FA-2:S2.R1.4	SE	1.00	2.00	0.00	182.00	96.00	6.78	4.60	5.00	5.40
FA-2:S2.R2.1	SE	1.00	2.00	0.00	67.83	58.83	1.97	5.25	5.25	5.25
FA-2:S2.R2.2	SE	1.00	2.00	0.00	96.86	86.71	3.30	5.43	5.64	5.86
FA-2:S2.R2.3	SE	1.00	2.00	0.00	60.00	52.50	1.58	5.67	5.92	6.17
FA-2:S2.R2.4	SE	1.00	2.00	0.00	75.00	75.00	1.20	7.00	7.00	7.00
FA-2:S2.R2.5	SE	1.00	2.00	0.00	81.00	71.00	9.46	5.00	5.20	5.40
FA-2:S2.R2.6	SE	1.00	2.00	0.00	56.67	56.67	2.80	5.00	5.00	5.00
FA-1:S1.R1.1	SW	1.00	2.00	0.00	41.80	41.80	3.88	5.80	5.80	5.80
FA-1:S1.R1.2	SW	1.00	2.00	0.00	63.67	36.33	3.40	6.00	6.17	6.33
FA-1:S1.R1.3	SW	1.00	2.00	0.00	71.50	71.50	3.83	5.75	6.38	7.00
FA-1:S1.R1.4	SW	1.00	2.00	0.00	3.20	3.20	3.30	5.00	5.00	5.00
FA-1:S1.R1.5	SW	1.00	2.00	0.00	253.45	253.45	3.17	5.36	5.73	6.09
FA-1:S1.R1.6	SW	1.00	2.00	0.00	65.33	62.17	2.93	5.33	5.42	5.50
FA-1:S1.R1.7	SW	1.00	2.00	0.00	99.00	92.75	2.28	5.00	5.25	5.50
FA-1:S1.R1.8	SW	1.00	2.00	0.00	101.80	101.80	3.68	5.20	5.50	5.80
FA-1:S1.R1.9	SW	1.00	2.00	0.00	103.00	103.00	5.15	6.00	6.00	6.00
FA-1:S1.R1.10	SW	1.00	2.00	0.00	64.75	64.75	2.95	6.50	6.63	6.75

TABLE 15: STANDARD DEVIATION OF MICROSCALE AT FORTY ACRE ROCK (CONT.)-
CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	STDEV Crack Parallel to	STDEV Surface where crack is	STDEV Crack Width	STDEV Crack Length	STDEV Crack Length in Box	STDEV Spall Thickness	STDEV Weathering Index Minimum	STDEV Weathering Index	STDEV Weathering Index Maximum
FA-1:S2.R1.1	SW	1.00	2.00	0.00	250.00	200.00	0.60	7.00	7.00	7.00
FA-1:S2.R1.2	SW	1.00	2.00	0.00	90.00	90.00	0.48	7.00	7.00	7.00
FA-1:S2.R1.3	SW	1.00	2.00	0.00	240.00	250.00	0.25	7.00	7.00	7.00
FA-1:S2.R1.4	SW	0.50	2.00	0.00	665.00	200.00	0.80	5.00	5.50	6.00
FA-1:S2.R1.5	SW	1.00	2.00	0.00	331.00	200.00	0.18	3.00	3.25	3.50
FA-1:S2.R1.6	SW	0.00	1.00	2.00	3.00	4.00	7.00	8.00	9.00	10.00
FA-1:S2.R1.7	SW	1.00	2.00	0.00	31.50	116.00	1.20	6.00	6.00	6.00
FA-1:S2.R1.8	SW	1.00	2.00	0.00	25.00	25.00	1.10	5.00	5.00	5.00
FA-1:S2.R1.9	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S2.R1.10	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.1	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.2	SW	1.00	2.00	0.00	60.00	60.00	2.00	6.00	6.50	7.00
FA-1:S3.R1.3	SW	0.50	2.00	0.00	895.50	120.50	2.00	5.00	5.25	5.50
FA-1:S3.R1.4	SW	1.00	2.00	0.00	45.00	45.00	7.00	5.00	5.25	5.50
FA-1:S3.R1.5	SW	1.00	2.00	0.00	50.00	50.00	1.50	5.00	5.50	6.00
FA-1:S3.R1.6	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.7	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.8	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-1:S3.R1.9	SW	1.00	2.00	0.00	46.00	46.00	1.25	5.00	5.00	5.00
FA-1:S3.R1.10	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-3:S1.R1.1	SW	1.00	2.00	0.00	55.00	55.00	1.93	7.00	7.00	7.00
FA-3:S1.R1.2	SW	1.00	2.00	0.00	79.50	79.50	2.25	5.00	5.13	5.25
FA-3:S1.R1.3	SW	1.00	2.00	0.00	137.00	137.00	3.70	5.50	5.50	5.50
FA-3:S1.R1.4	SW	1.00	2.00	0.00	116.75	111.75	3.43	5.25	5.38	5.50
FA-3:S1.R1.5	SW	1.00	2.00	0.00	122.33	119.00	3.17	5.67	6.33	7.00
FA-3:S1.R1.6	SW	1.00	2.00	0.00	66.17	66.17	5.18	6.00	6.50	7.00
FA-3:S1.R1.7	SW	1.00	2.00	0.00	106.50	106.50	2.17	5.25	5.75	6.25
FA-3:S2.R2.1	SW	1.00	2.00	0.00	56.83	56.83	1.42	4.67	4.83	5.00
FA-3:S2.R2.2	SW	1.00	2.00	0.40	41.40	41.40	2.88	4.00	4.30	4.60
FA-3:S2.R2.3	SW	1.00	2.00	0.00	57.33	57.33	5.00	6.33	6.33	6.33
FA-3:S2.R2.4	SW	1.00	2.00	0.00	114.40	114.20	4.22	5.20	5.30	5.40
FA-3:S2.R2.5	SW	1.00	2.00	0.29	179.43	56.57	4.97	4.71	5.29	5.86
FA-3:S2.R2.6	SW	1.00	2.00	0.00	29.00	29.00	1.13	5.00	5.13	5.25
FA-3:S2.R2.7	SW	1.00	2.00	0.00	41.20	41.20	2.94	5.00	5.00	5.00
FA-3:S3.R3.1	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-3:S3.R3.2	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-3:S3.R3.3	SW	1.00	2.00	0.00	45.90	45.90	4.59	5.00	5.00	5.00
FA-3:S3.R3.4	SW	1.00	2.00	0.00	30.22	30.22	4.10	5.00	5.00	5.00
FA-3:S3.R3.5	SW	1.00	2.00	0.00	47.50	45.83	4.77	5.00	5.17	5.33
FA-3:S3.R3.6	SW	1.00	2.00	0.00	55.60	55.60	3.64	6.60	6.60	6.60
FA-3:S3.R3.7	SW	1.00	2.00	0.00	43.83	43.83	5.03	6.00	6.50	7.00
FA-3:S4.R1.1	SW	1.00	2.00	0.00	51.00	51.00	4.60	5.00	5.00	5.00
FA-3:S4.R1.2	SW	1.00	2.00	0.00	68.67	60.33	2.90	4.33	4.33	4.33
FA-5:S1.R1.1	SW	1.00	2.00	0.00	82.57	70.57	5.20	6.00	6.29	6.57
FA-5:S1.R1.2	SW	1.00	2.00	0.00	54.86	54.29	3.33	5.14	5.21	5.29
FA-5:S1.R1.3	SW	1.00	2.00	0.00	59.80	45.80	5.54	6.00	6.20	6.40
FA-5:S1.R1.4	SW	1.00	2.00	0.00	49.43	49.43	2.39	5.43	5.57	5.71
FA-5:S1.R1.5	SW	1.00	2.00	0.00	44.50	44.50	3.43	5.00	5.38	5.75

TABLE 15: STANDARD DEVIATION OF MICROSCALE AT FORTY ACRE ROCK (CONT.)-
CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	STDEV Crack Parallel to	STDEV Surface where crack is	STDEV Crack Width	STDEV Crack Length	STDEV Crack Length in Box	STDEV Spall Thickness	STDEV Weathering Index Minimum	STDEV Weathering Index	STDEV Weathering Index Maximum
FA-5:S1.R1.6	SW	1.00	2.00	0.00	44.50	44.50	3.45	6.00	6.00	6.00
FA-5:S1.R1.7	SW	1.00	2.00	0.00	54.50	54.50	2.83	5.00	5.00	5.00
FA-5:S1.R1.8	SW	1.00	2.00	0.00	88.00	72.17	4.93	5.00	5.33	5.67
FA-5:S1.R1.9	SW	1.00	2.00	0.00	56.80	47.80	2.08	5.20	5.30	5.40
FA-5:S1.R1.10	SW	1.00	2.00	0.00	36.00	36.00	2.85	5.00	5.00	5.00
FA-5:S2.R1.1	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FA-5:S2.R1.2	SW	1.00	2.00	0.00	74.00	74.00	4.25	5.00	5.00	5.00
FA-5:S2.R1.3	SW	1.00	2.00	0.00	84.00	84.00	5.48	6.83	6.83	6.83
FA-5:S2.R1.4	SW	1.00	2.00	0.00	77.50	67.50	6.40	5.17	5.50	5.83
FA-5:S2.R1.5	SW	1.00	2.00	0.00	53.33	53.33	3.23	5.00	5.33	5.67
FA-5:S2.R1.6	SW	1.00	2.00	0.00	94.50	87.83	6.28	5.50	6.08	6.67
FA-5:S2.R1.7	SW	1.00	2.00	0.00	163.43	71.71	5.23	5.29	5.29	5.29
FA-5:S2.R1.8	SW	1.00	2.00	0.00	45.50	45.00	1.85	6.00	6.00	6.00
FA-5:S2.R1.9	SW	1.00	2.00	0.00	60.00	25.00	3.50	7.00	7.00	7.00
FA-5:S2.R1.10	SW	1.00	2.00	0.00	34.25	34.25	2.95	5.00	5.00	5.00
FA-5:S3.R1.1	SW	1.00	2.00	0.00	92.40	76.40	1.94	5.60	5.70	5.80
FA-5:S3.R1.2	SW	1.00	2.00	0.00	52.56	52.56	3.38	5.06	5.13	5.19
FA-5:S3.R1.3	SW	1.00	2.00	0.00	984.13	75.38	4.30	4.88	5.13	5.38
FA-5:S3.R1.4	SW	1.00	2.00	0.00	73.67	73.67	3.73	5.67	6.17	6.67
FA-5:S3.M1.5	SW	1.00	2.00	0.00	60.67	60.67	2.50	6.00	6.00	6.00
FA-5:S3.M1.6	SW	1.00	2.00	0.00	59.44	59.44	3.58	5.78	6.00	6.22
FA-5:S3.M1.7	SW	1.00	2.00	0.00	69.00	69.00	4.46	5.11	5.39	5.67
FA-5:S3.M1.8	SW	1.00	2.00	0.00	63.17	63.17	2.05	5.17	5.50	5.83
FA-5:S3.M1.9	SW	1.00	2.00	0.00	49.25	49.25	2.81	4.75	5.06	5.38
FA-5:S3.M1.10	SW	1.00	2.00	0.00	60.75	53.25	3.71	5.25	5.38	5.50

TABLE 16: MICROSCALE AT ROCKY FACE- CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thickness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
RF	n/a	1.00	2.00	1.59	108.56	66.71	4.60	4.67	4.82	4.93
RF:S1	n/a	1.00	2.01	1.47	110.03	66.92	4.92	4.57	4.72	4.83
RF:S2	n/a	0.99	1.98	1.83	100.74	66.69	5.42	4.66	4.84	4.94
RF:S3	n/a	1.02	2.03	1.28	103.50	64.61	4.16	4.45	4.56	4.68
RF-1	SE	1.00	2.00	0.00	159.36	93.18	12.79	5.31	5.40	5.49
RF-5	SE	1.00	2.00	3.80	92.34	64.50	3.38	5.27	4.79	4.91
RF-3	SW	0.95	1.96	1.63	98.63	71.06	4.02	3.82	4.05	4.18
RF-2	NW	1.00	2.00	1.00	79.79	58.14	3.85	4.66	4.80	4.91
RF-4	NW	1.06	2.05	1.18	137.08	61.68	4.14	4.70	5.40	5.53
RF-1:S1	SE	1.00	2.00	0.00	64.26	60.84	2.85	4.89	5.00	5.11
RF-1:S2	SE	1.00	2.00	0.00	249.70	123.90	22.23	5.70	5.78	5.85
RF-5:S1	SE	1.00	2.00	0.00	61.18	60.46	3.94	5.79	5.89	6.00
RF-5:S2	SE	1.00	2.00	0.00	64.51	57.91	2.65	5.16	5.27	5.38
RF-5:S3	SE	1.00	2.00	3.80	141.74	74.02	3.79	5.05	5.21	5.37
RF-3:S1	SW	1.00	2.00	3.85	123.63	92.96	3.30	4.00	4.19	4.37
RF-3:S2	SW	0.97	1.94	1.83	94.29	64.71	4.95	3.34	3.76	3.89
RF-3:S3	SW	0.90	1.96	1.00	88.58	63.96	3.76	4.06	4.17	4.29
RF-2:S1	NW	1.00	2.00	1.00	100.73	63.84	5.34	4.70	4.84	4.97
RF-2:S2	NW	1.00	2.00	0.00	61.77	53.23	2.57	4.63	4.74	4.86
RF-4:S1	NW	1.00	2.00	1.23	171.05	65.00	3.78	4.82	4.93	5.05
RF-4:S2	NW	0.97	1.94	0.00	118.58	63.42	3.08	4.81	4.92	5.03
RF-4:S3	NW	1.31	2.31	1.00	80.73	51.96	6.22	4.31	4.37	4.42
RF-1:S1.R1.1	SE	1.00	2.00	0.00	65.00	65.00	1.13	5.00	5.33	5.67
RF-1:S1.R1.2	SE	1.00	2.00	0.00	86.25	78.13	3.94	4.63	4.63	4.63
RF-1:S1.R1.3	SE	1.00	2.00	0.00	25.00	25.00	2.00	6.00	6.00	6.00
RF-1:S1.R1.4	SE	1.00	2.00	0.00	40.00	40.00	3.03	5.33	5.67	6.00
RF-1:S1.R1.5	SE	1.00	2.00	0.00	21.00	21.00	1.90	3.00	3.00	3.00
RF-1:S1.R1.6	SE	1.00	2.00	0.00	25.00	25.00	2.90	6.00	6.00	6.00
RF-1:S1.R1.7	SE	1.00	2.00	0.00	72.50	72.50	1.70	5.00	5.00	5.00
RF-1.S2.R1.1	SE	1.00	2.00	0.00	88.33	45.00	11.07	6.33	6.33	6.33
RF-1.S2.R1.2	SE	1.00	2.00	0.00	203.33	103.33	23.33	5.33	5.50	5.67
RF-1.S2.R1.3	SE	1.00	2.00	0.00	198.75	157.50	27.78	6.50	6.50	6.50
RF-1.S2.R1.4	SE	1.00	2.00	0.00	215.75	215.75	26.30	5.50	5.50	5.50
RF-1.S2.R2.1	SE	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RF-1.S2.R2.2	SE	1.00	2.00	0.00	815.50	125.00	26.15	6.50	6.75	7.00
RF-1.S2.R2.3	SE	1.00	2.00	0.00	276.67	96.67	24.27	6.00	6.17	6.33
RF-5:S1.R1.1	SE	1.00	2.00	0.00	30.00	30.00	2.60	5.00	5.00	5.00
RF-5:S1.R1.2	SE	1.00	2.00	0.00	126.67	126.67	10.07	7.00	7.00	7.00
RF-5:S1.R1.3	SE	1.00	2.00	0.00	75.00	75.00	5.70	5.00	5.00	5.00
RF-5:S1.R1.4	SE	1.00	2.00	0.00	67.33	67.33	4.00	6.00	6.50	7.00
RF-5:S1.R1.5	SE	1.00	2.00	0.00	39.50	39.50	2.80	5.00	5.00	5.00
RF-5:S1.R1.6	SE	1.00	2.00	0.00	66.83	66.83	3.67	7.00	7.00	7.00
RF-5:S1.R1.7	SE	1.00	2.00	0.00	25.00	25.00	4.20	5.00	5.00	5.00
RF-5:S1.R1.8	SE	1.00	2.00	0.00	50.00	50.00	2.32	5.17	5.42	5.67
RF-5:S1.R1.9	SE	1.00	2.00	0.00	65.50	55.50	3.50	5.00	5.00	5.00
RF-5:S1.R1.10	SE	1.00	2.00	0.00	30.00	30.00	2.30	5.00	5.00	5.00
RF-5:S2.R3.1	SE	1.00	2.00	0.00	45.80	45.80	1.44	5.00	5.00	5.00
RF-5:S2.R3.2	SE	1.00	2.00	0.00	50.20	50.20	3.06	5.30	5.65	6.00
RF-5:S2.R3.3	SE	1.00	2.00	0.00	82.89	58.44	3.10	5.00	5.00	5.00

TABLE 16: MICROSCALE AT ROCKY FACE (CONT.)- CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thickness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
RF-5:S2.R3.4	SE	1.00	2.00	0.00	41.25	39.25	2.98	5.50	5.50	5.50
RF-5:S2.R3.5	SE	1.00	2.00	0.00	22.00	22.00	1.90	5.00	5.00	5.00
RF-5:S2.R3.6	SE	1.00	2.00	0.00	100.60	100.60	2.14	5.00	5.20	5.40
RF-5:S2.R3.7	SE	1.00	2.00	0.00	30.33	30.33	2.13	5.00	5.00	5.00
RF-5:S2.R3.8	SE	1.00	2.00	0.00	64.67	61.67	3.27	5.67	5.83	6.00
RF-5:S2.R3.9	SE	1.00	2.00	0.00	21.00	21.00	2.30	5.00	5.00	5.00
RF-5:S2.R3.10	SE	1.00	2.00	0.00	107.50	92.50	2.65	5.00	5.00	5.00
RF-5:S3.R1.1	SE	1.00	2.00	0.00	520.20	88.00	2.24	4.80	4.80	4.80
RF-5:S3.R1.2	SE	1.00	2.00	0.00	97.75	87.13	6.19	6.00	6.31	6.63
RF-5:S3.R1.3	SE	1.00	2.00	0.00	61.00	61.00	3.20	5.00	5.00	5.00
RF-5:S3.R1.4	SE	1.00	2.00	0.00	42.75	42.75	2.23	5.00	5.38	5.75
RF-5:S3.R1.5	SE	1.00	2.00	0.00	44.50	44.50	1.75	4.00	4.00	4.00
RF-5:S3.R4.1	SE	1.00	2.00	3.80	99.14	78.00	5.34	5.00	5.00	5.00
RF-5:S3.R4.2	SE	1.00	2.00	0.00	163.50	101.88	3.00	4.50	4.81	5.13
RF-5:S3.R4.3	SE	1.00	2.00	0.00	79.00	78.00	1.80	5.00	5.00	5.00
RF-5:S3.R4.4	SE	1.00	2.00	0.00	39.20	34.60	3.58	5.20	5.30	5.40
RF-5:S3.R4.5	SE	1.00	2.00	0.00	35.00	35.00	3.70	5.00	5.00	5.00
RF-3:S1.R1.1	SW	1.00	2.00	0.00	50.00	50.00	6.30	5.00	5.00	5.00
RF-3:S1.R1.2	SW	1.00	2.00	0.00	164.83	127.33	1.80	3.00	3.50	4.00
RF-3:S1.R1.3	SW	1.00	2.00	2.50	300.00	111.00	10.20	4.00	4.00	4.00
RF-3:S1.R1.4	SW	1.00	2.00	0.00	250.00	130.00	3.50	3.00	3.00	3.00
RF-3:S1.R1.5	SW	1.00	2.00	0.00	34.00	34.00	1.40	3.00	3.00	3.00
RF-3:S1.R1.6	SW	1.00	2.00	0.00	82.33	82.33	2.13	3.83	4.08	4.33
RF-3:S1.R1.7	SW	1.00	2.00	0.00	40.00	40.00	2.10	5.00	5.00	5.00
RF-3:S1.R1.8	SW	1.00	2.00	0.00	94.17	76.67	3.03	5.33	5.42	5.50
RF-3:S1.R1.9	SW	1.00	2.00	0.00	260.00	40.00	4.10	5.00	5.00	5.00
RF-3:S1.R1.10	SW	1.00	2.00	5.20	118.67	129.00	6.60	3.33	3.33	3.33
RF-3:S2.R1.1	SW	1.00	2.00	0.00	65.00	65.00	2.95	5.00	5.00	5.00
RF-3:S2.R1.2	SW	1.00	2.00	0.00	71.40	54.40	4.88	5.80	5.80	5.80
RF-3:S2.R1.3	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RF-3:S2.R1.4	SW	1.00	2.00	1.00	282.67	47.33	30.63	5.33	6.00	6.67
RF-3:S2.R1.5	SW	1.00	2.00	0.00	70.67	70.67	1.30	2.67	2.83	2.00
RF-3:S2.R1.6	SW	1.00	2.00	1.00	59.50	59.50	1.50	3.17	3.50	3.83
RF-3:S2.R1.7	SW	1.00	2.00	0.00	25.00	25.00	1.20	2.00	2.00	2.00
RF-3:S2.R1.8	SW	1.00	2.00	0.00	60.17	60.17	2.28	2.50	2.83	3.17
RF-3:S2.R1.9	SW	1.00	2.00	0.00	40.00	40.00	4.55	5.00	5.00	5.00
RF-3:S2.R1.10	SW	1.00	2.00	3.50	155.00	114.33	2.37	1.33	2.08	2.83
RF-3:S3.R10.1	SW	1.00	2.00	0.00	80.00	80.00	3.00	5.00	5.00	5.00
RF-3:S3.R10.2	SW	1.00	2.00	0.00	87.50	71.67	2.10	4.00	4.33	4.67
RF-3:S3.R10.3	SW	1.00	2.00	0.00	80.00	80.00	1.20	3.67	3.67	3.67
RF-3:S3.R10.4	SW	1.00	2.00	0.00	95.20	95.20	2.18	4.20	4.30	4.40
RF-3:S3.R21.1	SW	1.00	2.00	0.00	71.60	71.60	9.06	5.00	5.00	5.00
RF-3:S3.R21.2	SW	1.00	2.00	0.00	137.60	49.60	13.24	4.20	4.30	4.40

TABLE 16: MICROSCALE AT ROCKY FACE (CONT.)- CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thickness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
RF-3:S3.R21.3	SW	0.50	2.00	1.00	108.50	72.63	1.29	3.63	3.94	4.25
RF-3:S3.R22.1	SW	1.00	2.00	0.00	106.22	55.33	1.93	3.56	3.61	3.67
RF-3:S3.R22.2	SW	1.00	2.00	0.00	36.43	36.43	2.87	4.71	4.71	4.71
RF-3:S3.R22.3	SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RF-2:S1.R1.1	NW	1.00	2.00	1.00	65.90	56.90	2.84	4.10	4.30	4.50
RF-2:S1.R1.2	NW	1.00	2.00	0.00	82.50	38.75	3.90	4.50	4.63	4.75
RF-2:S1.R1.3	NW	1.00	2.00	0.00	57.83	57.83	1.67	5.00	5.08	5.17
RF-2:S1.R1.4	NW	1.00	2.00	0.00	52.40	52.40	6.14	6.40	6.70	7.00
RF-2:S1.R1.5	NW	1.00	2.00	0.00	77.50	77.50	1.20	3.00	3.00	3.00
RF-2:S1.R1.6	NW	1.00	2.00	0.00	68.43	68.43	2.09	3.71	3.79	3.86
RF-2:S1.R1.7	NW	1.00	2.00	0.00	498.33	131.67	32.00	7.00	7.00	7.00
RF-2:S2.R1.1	NW	1.00	2.00	0.00	70.00	70.00	3.20	4.60	4.70	4.80
RF-2:S2.R1.2	NW	1.00	2.00	0.00	106.38	66.88	4.45	4.88	5.13	5.38
RF-2:S2.R1.3	NW	1.00	2.00	0.00	36.00	35.00	1.40	3.00	3.00	3.00
RF-2:S2.R1.4	NW	1.00	2.00	0.00	58.38	52.13	2.88	5.88	6.19	6.50
RF-2:S2.R1.5	NW	1.00	2.00	0.00	65.00	65.00	1.70	4.33	4.33	4.33
RF-2:S2.R2.1	NW	1.00	2.00	0.00	37.50	37.50	1.58	4.00	4.00	4.00
RF-2:S2.R2.2	NW	1.00	2.00	0.00	40.20	40.20	1.42	4.20	4.20	4.20
RF-2:S2.R2.3	NW	1.00	2.00	0.00	36.67	36.67	1.60	5.00	5.00	5.00
RF-2:S2.R2.4	NW	1.00	2.00	0.00	44.00	44.00	1.00	3.00	3.00	3.00
RF-2:S2.R2.5	NW	1.00	2.00	0.00	59.00	59.00	2.33	3.67	3.67	3.67
RF-4:S1.R1.1	NW	1.00	2.00	1.00	92.27	75.00	4.43	4.64	4.68	4.73
RF-4:S1.R1.2	NW	1.00	2.00	1.00	88.86	67.14	7.54	5.14	5.29	5.43
RF-4:S1.R1.3	NW	1.00	2.00	0.00	57.50	56.25	2.80	5.00	5.00	5.00
RF-4:S1.R1.4	NW	1.00	2.00	0.00	76.17	58.33	4.90	4.67	5.00	5.33
RF-4:S1.R1.5	NW	1.00	2.00	0.00	51.13	51.13	2.09	4.75	4.75	4.75
RF-4:S1.R1.6	NW	1.00	2.00	0.00	162.75	162.75	1.48	4.50	5.13	5.75
RF-4:S1.R1.7	NW	1.00	2.00	0.00	51.33	51.33	5.10	5.00	5.00	5.00
RF-4:S1.R1.8	NW	1.00	2.00	0.00	42.42	39.33	3.22	5.08	5.08	5.08
RF-4:S1.R1.9	NW	1.00	2.00	1.70	2045.00	87.67	1.13	4.00	4.17	4.33
RF-4:S1.R1.10	NW	1.00	2.00	0.00	53.00	53.00	2.30	5.00	5.00	5.00
RF-4:S2.R1.1	NW	1.00	2.00	0.00	35.50	35.50	4.65	5.00	5.00	5.00
RF-4:S2.R1.2	NW	1.00	2.00	0.00	50.50	50.50	1.95	6.50	6.50	6.50
RF-4:S2.R1.3	NW	1.00	2.00	0.00	35.00	35.00	1.43	4.33	4.67	5.00
RF-4:S2.R1.4	NW	1.00	2.00	0.00	46.40	46.40	1.98	4.80	5.20	5.60
RF-4:S2.R2.1	NW	1.00	2.00	0.00	282.00	114.00	5.00	4.60	4.60	4.60
RF-4:S2.R2.2	NW	1.00	2.00	0.00	51.40	47.40	3.58	5.40	5.40	5.40
RF-4:S2.R2.3	NW	1.00	2.00	0.00	385.00	101.67	5.50	4.67	4.83	5.00
RF-4:S2.R3.1	NW	1.00	2.00	0.00	58.33	58.33	1.03	5.00	5.00	5.00
RF-4:S2.R3.2	NW	1.00	2.00	0.00	51.40	47.40	3.58	5.40	5.40	5.40
RF-4:S2.R3.3	NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RF-4:S3.R1.1	NW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RF-4:S3.R1.2	NW	1.00	2.00	0.00	62.50	47.50	1.05	3.00	3.00	3.00
RF-4:S3.R1.3	NW	1.00	2.00	0.00	36.50	36.50	3.25	2.50	2.50	2.50
RF-4:S3.R1.4	NW	1.00	2.00	0.00	97.00	72.00	9.78	4.75	4.75	4.75
RF-4:S3.R2.1	NW	1.00	2.00	0.00	37.00	37.00	1.10	5.00	5.00	5.00
RF-4:S3.R2.2	NW	2.00	3.00	0.00	148.63	71.38	12.75	4.75	4.81	4.88

TABLE 16: MICROSCALE AT ROCKY FACE (CONT.)- CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thickness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
RF-4:S3.R2.3	NW	1.00	2.00	0.00	22.00	22.00	0.10	5.00	5.00	5.00
RF-4:S3.R4.1	NW	1.00	2.00	0.00	50.50	50.50	1.50	5.00	5.00	5.00
RF-4:S3.R4.2	NW	1.00	2.00	0.00	31.00	31.00	1.85	5.50	5.50	5.50
RF-4:S3.R4.3	NW	1.00	2.00	1.00	34.00	34.00	1.40	4.33	4.67	5.00

TABLE 17: STANDARD DEVIATION MICROSCALE AT ROCKY FACE (CONT.)- CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	STDEV Crack Parallel to	STDEV Surface where crack is	STDEV Crack Width	STDEV Crack Length	STDEV Crack Length in Box	STDEV Spall Thickness	STDEV Weathering Index Minimum	STDEV Weathering Index	STDEV Weathering Index Maximum
RF-5:S2.R3.2	SE	0.00	0.00	n/a	24.05	24.05	0.76	0.48	0.67	0.94
RF-5:S2.R3.2	SE	0.00	0.00	n/a	24.05	24.05	0.76	0.48	0.67	0.94
RF-5:S2.R3.3	SE	0.00	0.00	n/a	59.19	28.54	1.26	0.00	0.00	0.00
RF-5:S2.R3.4	SE	0.00	0.00	n/a	19.31	21.19	1.56	1.00	1.00	1.00
RF-5:S2.R3.5	SE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-5:S2.R3.6	SE	0.00	0.00	n/a	63.97	63.97	1.17	0.00	0.45	0.89
RF-5:S2.R3.7	SE	0.00	0.00	n/a	0.58	0.58	2.01	0.00	0.00	0.00
RF-5:S2.R3.8	SE	0.00	0.00	n/a	21.57	18.82	2.48	0.58	0.76	1.00
RF-5:S2.R3.9	SE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-5:S2.R3.10	SE	0.00	0.00	n/a	60.07	37.53	0.37	0.00	0.00	0.00
RF-5:S3.R1.1	SE	0.00	0.00	n/a	1034.76	77.50	1.53	0.45	0.45	0.45
RF-5:S3.R1.2	SE	0.00	0.00	n/a	87.33	60.15	7.96	0.53	0.46	0.52
RF-5:S3.R1.3	SE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-5:S3.R1.4	SE	0.00	0.00	n/a	10.81	10.81	0.99	0.00	0.25	0.50
RF-5:S3.R1.5	SE	0.00	0.00	n/a	27.58	27.58	0.49	1.41	1.41	1.41
RF-5:S3.R4.1	SE	0.00	0.00	n/a	45.43	31.33	2.27	0.00	0.00	0.00
RF-5:S3.R4.2	SE	0.00	0.00	n/a	153.06	60.80	2.40	0.76	0.26	0.35
RF-5:S3.R4.3	SE	0.00	0.00	n/a	76.37	74.95	0.57	0.00	0.00	0.00
RF-5:S3.R4.4	SE	0.00	0.00	n/a	17.92	19.28	1.43	0.45	0.67	0.89
RF-5:S3.R4.5	SE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-3:S1.R1.1	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-3:S1.R1.2	SW	0.00	0.00	n/a	131.50	93.08	0.93	1.10	1.00	1.10
RF-3:S1.R1.3	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-3:S1.R1.4	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-3:S1.R1.5	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-3:S1.R1.6	SW	0.00	0.00	n/a	38.67	38.67	1.14	1.72	1.59	1.51
RF-3:S1.R1.7	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-3:S1.R1.8	SW	0.00	0.00	n/a	83.87	43.67	1.55	1.37	1.36	1.38
RF-3:S1.R1.9	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-3:S1.R1.10	SW	0.00	0.00	n/a	108.31	50.57	7.81	0.58	0.58	0.58
RF-3:S2.R1.1	SW	0.00	0.00	n/a	14.14	14.14	0.92	0.00	0.00	0.00
RF-3:S2.R1.2	SW	0.00	0.00	n/a	41.89	33.68	2.39	0.84	0.84	0.84
RF-3:S2.R1.3	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-3:S2.R1.4	SW	0.00	0.00	n/a	444.59	37.29	27.50	1.15	0.87	0.58
RF-3:S2.R1.5	SW	0.00	0.00	n/a	45.62	45.62	0.26	0.58	0.29	1.73
RF-3:S2.R1.6	SW	0.00	0.00	n/a	43.94	43.94	0.74	2.04	1.84	1.72
RF-3:S2.R1.7	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RF-3:S2.R1.8	SW	0.00	0.00	n/a	28.81	28.81	1.20	1.38	1.13	0.98
RF-3:S2.R1.9	SW	0.00	0.00	n/a	21.21	21.21	4.88	0.00	0.00	0.00
RF-3:S2.R1.10	SW	0.00	0.00	n/a	132.10	66.61	1.54	0.52	0.38	0.41
RF-3:S3.R10.1	SW	0.00	0.00	n/a	50.74	50.74	0.96	0.00	0.00	0.00
RF-3:S3.R10.2	SW	0.00	0.00	n/a	64.09	51.64	0.79	1.67	1.75	1.97
RF-3:S3.R10.2	SW	0.00	0.00	n/a	64.09	51.64	0.79	1.67	1.75	1.97
RF-3:S3.R10.3	SW	0.00	0.00	n/a	51.96	51.96	1.48	1.15	1.15	1.15
RF-3:S3.R10.4	SW	0.00	0.00	n/a	56.48	56.48	1.03	1.64	1.79	1.95

TABLE 18: MICROSCALE AT STONE MOUNTAIN--CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thickness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
SM	n/a	1.00	2.00	5.42	91.31	62.34	4.08	4.97	5.20	5.43
SM:S1	n/a	1.00	2.00	1.19	72.34	59.89	3.60	5.00	5.22	5.44
SM:S2	n/a	1.00	2.00	1.70	60.62	55.96	4.3	18.22	4.30	4.94
SM:S3	n/a	1.00	2.00	16.98	160.77	70.60	5.24	19.77	5.24	4.85
SM-3	NE	1.00	2.00	1.00	76.48	70.66	4.16	5.10	5.32	5.54
SM-2	SE	1.00	2.00	1.00	47.20	43.67	2.09	4.72	4.97	5.22
SM-1	SW	1.00	2.00	1.00	82.88	57.80	4.29	5.03	5.25	5.47
SM-4	SW	1.00	2.00	4.00	77.34	59.97	3.13	4.77	5.02	5.26
SM-5	NW	1.00	2.00	13.33	172.02	73.59	6.35	5.13	5.37	5.61
SM-3:S1	NE	1.00	2.00	1.00	88.19	87.65	2.60	5.19	5.45	5.72
SM-3:S2	NE	1.00	2.00	0.00	70.32	67.15	6.62	5.41	5.61	5.80
SM-3:S3	NE	1.00	2.00	0.00	69.53	54.36	3.23	4.64	4.83	5.03
SM-2:S1	SE	1.00	2.00	1.00	45.64	45.64	1.88	4.71	5.08	5.45
SM-2:S2	SE	1.00	2.00	1.00	49.63	40.59	2.41	4.74	4.80	4.85
SM-1:S1	SW	1.00	2.00	0.00	63.34	48.38	4.37	4.94	5.31	5.69
SM-1:S2	SW	1.00	2.00	1.00	61.03	51.44	3.40	4.97	5.08	5.19
SM-1:S3	SW	1.00	2.00	0.00	124.41	73.41	5.17	5.18	5.37	5.56
SM-4:S1	SW	1.00	2.00	4.00	98.15	65.59	3.28	4.87	5.08	5.28
SM-4:S2	SW	1.00	2.00	0.00	48.00	47.16	2.33	4.58	4.98	5.39
SM-4:S3	SW	1.00	2.00	0.00	81.12	66.81	3.86	4.85	4.96	5.08
SM-5:S1	NW	1.00	2.00	1.00	61.31	60.97	4.00	5.83	5.93	6.03
SM-5:S2	NW	1.00	2.00	3.80	69.83	69.00	5.96	4.80	4.95	5.10
SM-5:S3	NW	1.00	2.00	16.98	396.18	91.57	9.19	4.75	5.23	5.71
SM-3:S1.M1.1	NE	1.00	2.00	1.00	55.43	55.43	2.86	4.57	4.79	5.00
SM-3:S1.M1.2	NE	1.00	2.00	0.00	123.40	122.40	2.04	5.60	6.10	6.60
SM-3:S1.M1.3	NE	1.00	2.00	1.00	95.00	95.00	1.98	4.80	4.90	5.00
SM-3:S1.M1.4	NE	1.00	2.00	0.00	134.17	131.17	3.27	5.33	5.67	6.00
SM-3:S1.M1.5	NE	1.00	2.00	0.00	70.67	70.67	3.03	5.00	5.00	5.00
SM-3:S1.M1.6	NE	1.00	2.00	0.00	85.33	85.33	2.97	5.83	6.33	6.83
SM-3:S1.M1.7	NE	1.00	2.00	0.00	54.50	54.50	2.60	4.75	4.88	5.00
SM-3:S1.M1.8	NE	1.00	2.00	0.00	73.33	73.33	1.97	6.00	6.50	7.00
SM-3:S1.M1.9	NE	1.00	2.00	0.00	78.33	78.33	2.00	5.00	5.00	5.00
SM-3:S1.M1.10	NE	1.00	2.00	0.00	110.00	110.00	2.90	5.00	5.00	5.00
SM-3:S2.M2.1	NE	1.00	2.00	0.00	97.50	77.50	2.20	5.00	5.00	5.00
SM-3:S2.M2.2	NE	1.00	2.00	0.00	94.25	86.75	4.00	5.63	5.94	6.25
SM-3:S2.M2.3	NE	1.00	2.00	0.00	125.00	125.00	4.70	5.00	5.00	5.00
SM-3:S2.M2.4	NE	1.00	2.00	0.00	70.13	70.13	5.69	5.50	5.75	6.00
SM-3:S2.M2.5	NE									
SM-3:S2.M2.6	NE	1.00	2.00	0.00	82.25	74.75	8.55	6.00	6.38	6.75
SM-3:S2.M2.7	NE	1.00	2.00	0.00	40.50	40.50	7.72	5.00	5.00	5.00
SM-3:S2.M2.8	NE	1.00	2.00	0.00	73.83	73.83	9.88	5.67	6.00	6.33
SM-3:S2.M2.9	NE	1.00	2.00	0.00	39.40	39.40	8.60	5.00	5.00	5.00
SM-3:S2.M2.10	NE	1.00	2.00	0.00	36.00	36.00	2.20	5.00	5.00	5.00
SM-3:S3.M1.1	NE	1.00	2.00	0.00	124.00	61.38	4.44	5.00	5.00	5.00
SM-3:S3.M1.2	NE	1.00	2.00	0.00	41.40	41.40	3.20	5.60	5.90	6.20
SM-3:S3.M1.3	NE	1.00	2.00	0.00	70.00	70.00	3.30	5.00	5.00	5.00
SM-3:S3.M1.4	NE	1.00	2.00	0.00	70.00	70.00	3.50	4.25	4.38	4.50
SM-3:S3.M1.5	NE	1.00	2.00	0.00	62.00	60.33	1.97	3.67	3.83	4.00
SM-3:S3.M1.6	NE	1.00	2.00	0.00	59.50	49.00	3.10	5.75	5.75	5.75
SM-3:S3.M1.7	NE	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-3:S3.M1.8	NE	1.00	2.00	0.00	51.60	46.60	2.52	5.60	6.10	6.60
SM-3:S3.M1.9	NE	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-3:S3.M1.10	NE	1.00	2.00	0.00	58.75	58.75	3.73	5.00	5.00	5.00
SM-2:S1.M1.1	SE	1.00	2.00	1.00	28.20	28.20	1.32	5.00	5.50	6.00
SM-2:S1.M1.2	SE	1.00	2.00	0.00	47.50	47.50	2.00	5.50	6.13	6.75
SM-2:S1.M1.3	SE	1.00	2.00	1.00	40.33	40.33	2.13	4.00	4.50	5.00

TABLE 18: MICROSCALE AT STONE MOUNTAIN (CONT.)- -CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thickness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
SM-2:S1.M1.4	SE	1.00	2.00	0.00	48.75	48.75	1.93	5.25	5.88	6.50
SM-2:S1.M1.4	SE	1.00	2.00	0.00	48.75	48.75	1.93	5.25	5.88	6.50
SM-2:S1.M1.5	SE	1.00	2.00	0.00	30.00	30.00	1.00	5.00	5.00	5.00
SM-2:S1.M1.6	SE	1.00	2.00	0.00	45.00	45.00	1.80	5.00	5.00	5.00
SM-2:S1.M1.7	SE	1.00	2.00	0.00	32.00	32.00	0.70	5.00	5.00	5.00
SM-2:S1.M1.8	SE	1.00	2.00	0.00	48.43	48.43	2.06	5.00	5.07	5.14
SM-2:S1.M1.9	SE	1.00	2.00	0.00	71.25	71.25	2.93	5.00	5.00	5.00
SM-2:S1.M1.10	SE	1.00	2.00	0.00	31.50	31.50	1.90	2.00	2.75	3.50
SM-2:S2.M1.1	SE	1.00	2.00	0.00	67.00	67.00	2.60	5.00	2.50	0.00
SM-2:S2.M1.2	SE	1.00	2.00	0.00	32.00	32.00	1.30	5.00	5.50	6.00
SM-2:S2.M1.3	SE	1.00	2.00	0.00	35.50	35.50	2.90	5.00	5.00	5.00
SM-2:S2.M1.4	SE	1.00	2.00	0.00	32.67	32.67	2.60	5.00	5.00	5.00
SM-2:S2.M2.1	SE	1.00	2.00	0.00	40.00	40.00	1.50	5.00	5.00	5.00
SM-2:S2.M2.2	SE	1.00	2.00	0.00	42.50	42.50	1.53	5.00	5.63	6.25
SM-2:S2.M2.3	SE	1.00	2.00	0.00	46.50	35.00	2.07	4.17	4.17	4.17
SM-2:S2.M3.1	SE	1.00	2.00	1.00	43.25	43.25	2.60	4.75	4.88	5.00
SM-2:S2.M3.2	SE	1.00	2.00	1.00	65.00	65.00	3.90	4.00	4.50	5.00
SM-2:S2.M3.3	SE	1.00	2.00	0.00	101.67	43.33	3.93	5.00	5.00	5.00
SM-1:S1.M1.1	SW	1.00	2.00	0.00	52.80	52.80	4.14	5.40	6.00	6.60
SM-1:S1.M1.2	SW	1.00	2.00	0.00	47.50	47.50	3.72	5.33	5.92	6.50
SM-1:S1.M1.3	SW	1.00	2.00	0.00	40.00	40.00	4.80	6.00	6.50	7.00
SM-1:S1.M1.4	SW	1.00	2.00	0.00	28.33	28.33	4.53	5.33	5.83	6.33
SM-1:S1.M1.5	SW									
SM-1:S1.M1.6	SW	1.00	2.00	0.00	140.83	61.00	7.73	5.50	5.92	6.33
SM-1:S1.M1.7	SW	1.00	2.00	0.00	70.00	70.00	1.67	5.00	5.00	5.00
SM-1:S1.M1.8	SW	1.00	2.00	0.00	59.60	59.60	5.40	5.80	6.00	6.20
SM-1:S1.M1.9	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-1:S1.M1.10	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-1.S2.M1.1	SW	1.00	2.00	1.00	47.00	47.00	1.95	4.50	4.50	4.50
SM-1.S2.M1.2	SW	1.00	2.00	0.00	41.25	41.25	1.43	5.00	5.13	5.25
SM-1.S2.M1.3	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-1.S2.M1.4	SW	1.00	2.00	0.00	45.00	45.00	0.90	7.00	7.00	7.00
SM-1.S2.M1.5	SW	1.00	2.00	0.00	50.00	50.00	2.52	5.00	5.00	5.00
SM-1.S2.M5.1	SW	1.00	2.00	0.00	43.20	43.20	4.02	5.60	5.80	6.00
SM-1.S2.M5.2	SW	1.00	2.00	0.00	205.00	137.50	5.30	5.00	5.00	5.00
SM-1.S2.M5.3	SW	1.00	2.00	0.00	49.33	49.33	4.83	5.00	5.33	5.67
SM-1.S2.M5.4	SW	1.00	2.00	0.00	33.33	33.33	3.13	5.00	5.00	5.00
SM-1.S2.M5.5	SW	1.00	2.00	0.00	71.14	45.57	4.56	5.00	5.00	5.00
SM-1:S3.M1.1	SW	1.00	2.00	0.00	58.00	58.00	2.30	5.00	5.00	5.00
SM-1:S3.M1.2	SW	1.00	2.00	0.00	61.43	57.14	3.14	6.43	6.71	7.00
SM-1:S3.M1.3	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-1:S3.M1.4	SW	1.00	2.00	0.00	55.33	55.33	4.07	5.67	5.83	6.00
SM-1:S3.M1.5	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-1:S3.M2.1	SW	1.00	2.00	0.00	132.71	75.00	9.47	6.00	6.29	6.57
SM-1:S3.M2.2	SW	1.00	2.00	0.00	107.33	107.33	5.23	5.00	5.00	5.00
SM-1:S3.M2.3	SW	1.00	2.00	0.00	243.75	123.75	5.33	5.50	5.88	6.25
SM-1:S3.M2.4	SW	1.00	2.00	0.00	255.00	91.00	6.00	5.00	5.00	5.00
SM-1:S3.M2.5	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-4:S1.M1.1	SW	1.00	2.00	0.00	42.00	42.00	2.43	3.50	3.88	4.25
SM-4:S1.M1.2	SW	1.00	2.00	0.00	77.40	77.40	3.66	5.80	5.90	6.00
SM-4:S1.M1.3	SW	1.00	2.00	4.00	40.25	40.25	2.80	4.25	4.38	4.50
SM-4:S1.M1.4	SW	1.00	2.00	0.00	95.00	95.00	3.58	5.00	5.38	5.75
SM-4:S1.M1.5	SW	1.00	2.00	0.00	70.00	57.50	1.55	5.00	5.00	5.00
SM-4:S1.M1.6	SW	1.00	2.00	0.00	214.20	116.20	2.90	5.00	5.50	6.00
SM-4:S1.M1.7	SW	1.00	2.00	0.00	100.00	100.00	2.50	4.00	4.50	5.00
SM-4:S1.M1.8	SW	1.00	2.00	0.00	220.50	44.25	9.68	5.50	5.63	5.75

TABLE 18: MICROSCALE AT STONE MOUNTAIN (CONT.)- -CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	AVG Crack Parallel to	AVG Surface where crack is	AVG Crack Width (mm)	AVG Crack Length (mm)	AVG Crack Length in Box (mm)	AVG Spall Thickness (mm)	AVG Weathering Index Minimum	AVG Weathering Index	AVG Weathering Index Maximum
SM-4:S1.M1.9	SW	1.00	2.00	4.00	38.75	38.75	2.75	4.75	4.88	5.00
SM-4:S1.M1.10	SW	1.00	2.00	0.00	33.50	33.50	1.30	5.00	5.00	5.00
SM-4:S2.M1.1	SW	1.00	2.00	0.00	52.50	52.50	2.45	4.50	4.75	5.00
SM-4:S2.M1.2	SW	1.00	2.00	0.00	77.40	77.40	3.66	5.80	5.90	6.00
SM-4:S2.M1.3	SW	1.00	2.00	4.00	40.25	40.25	2.80	4.25	4.38	4.50
SM-4:S2.M1.4	SW	1.00	2.00	0.00	134.17	131.17	3.27	5.33	5.67	6.00
SM-4:S2.M1.5	SW	1.00	2.00	0.00	70.67	70.67	3.03	5.00	5.00	5.00
SM-4:S2.M1.6	SW	1.00	2.00	0.00	85.33	85.33	2.97	5.83	6.33	6.83
SM-4:S2.M1.7	SW	1.00	2.00	0.00	100.00	100.00	2.50	4.00	4.50	5.00
SM-4:S2.M1.8	SW	1.00	2.00	0.00	220.50	44.25	9.68	5.50	5.63	5.75
SM-4:S2.M1.9	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-4:S2.M1.10	SW	1.00	2.00	0.00	55.75	55.75	2.20	5.00	5.00	5.00
SM-4:S3.M1.1	SW	1.00	2.00	0.00	245.00	180.00	8.70	4.50	4.75	5.00
SM-4:S3.M1.2	SW	1.00	2.00	0.00	41.40	41.40	3.20	5.60	5.90	6.20
SM-4:S3.M1.3	SW	1.00	2.00	0.00	75.00	75.00	5.70	5.00	5.00	5.00
SM-4:S3.M1.4	SW	1.00	2.00	0.00	102.00	82.00	4.40	5.67	5.83	6.00
SM-4:S3.M1.5	SW	1.00	2.00	0.00	73.80	63.80	3.82	5.00	5.00	5.00
SM-4:S3.M1.6	SW	1.00	2.00	0.00	59.50	49.00	3.10	5.75	5.75	5.75
SM-4:S3.M1.7	SW	1.00	2.00	0.00	60.50	60.50	2.98	4.25	4.50	4.75
SM-4:S3.M1.8	SW	1.00	2.00	0.00	37.00	37.00	7.70	5.00	5.50	6.00
SM-4:S3.M1.9	SW	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM-4:S3.M1.10	SW	1.00	2.00	0.00	120.00	100.00	3.20	5.00	5.00	5.00
SM-5:S1.M1.1	SW	1.00	2.00	0.00	30.00	25.00	2.60	5.00	5.00	5.00
SM-5:S1.M1.2	SW	1.00	2.00	0.00	126.67	126.67	10.07	7.00	7.00	7.00
SM-5:S1.M1.3	SW	1.00	2.00	0.00	75.00	75.00	5.70	5.00	5.00	5.00
SM-5:S1.M1.4	SW	1.00	2.00	0.00	66.75	66.75	4.03	6.25	6.63	7.00
SM-5:S1.M1.5	SW	1.00	2.00	0.00	39.50	39.50	3.30	5.00	5.00	5.00
SM-5:S1.M1.6	SW	1.00	2.00	0.00	66.83	66.83	3.45	7.00	7.00	7.00
SM-5:S1.M1.7	SW	1.00	2.00	0.00	25.00	25.00	4.10	5.00	5.00	5.00
SM-5:S1.M1.8	SW	1.00	2.00	1.00	50.00	50.00	2.70	5.17	5.42	5.67
SM-5:S1.M1.9	SW	1.00	2.00	0.00	65.50	65.50	2.90	5.00	5.00	5.00
SM-5:S1.M1.10	SW	1.00	2.00	0.00	30.00	30.00	2.70	5.00	5.00	5.00
SM-5:S2.M1.1	SW	1.00	2.00	0.00	116.67	116.67	5.10	5.00	5.00	5.00
SM-5:S2.M1.2	SW	1.00	2.00	0.00	88.33	88.33	9.70	3.67	3.67	3.67
SM-5:S2.M1.3	SW	1.00	2.00	3.80	54.00	54.00	8.10	4.75	4.88	5.00
SM-5:S2.M1.4	SW	1.00	2.00	0.00	61.00	61.00	4.48	5.00	5.10	5.20
SM-5:S2.M1.5	SW	1.00	2.00	0.00	39.50	39.50	3.30	5.00	5.00	5.00
SM-5:S2.M1.6	SW	1.00	2.00	0.00	90.25	84.00	7.78	5.25	5.75	6.25
SM-5:S2.M1.7	SW	1.00	2.00	0.00	97.50	97.50	5.05	5.00	5.50	6.00
SM-5:S2.M1.8	SW	1.00	2.00	0.00	54.33	54.33	5.03	5.67	5.67	5.67
SM-5:S2.M1.9	SW	1.00	2.00	0.00	90.00	90.00	10.70	4.67	4.83	5.00
SM-5:S2.M1.10	SW	1.00	2.00	0.00	48.33	48.33	3.77	5.00	5.00	5.00
SM-5:S3.M1.1	SW	1.00	2.00	8.30	925.00	160.00	22.95	4.50	4.75	5.00
SM-5:S3.M1.2	SW	1.00	2.00	0.00	175.25	90.25	7.50	5.25	5.88	6.50
SM-5:S3.M1.3	SW	1.00	2.00	7.37	1248.33	118.33	15.87	4.67	4.67	4.67
SM-5:S3.M1.4	SW	1.00	2.00	0.00	77.40	75.60	5.14	5.20	5.90	6.60
SM-5:S3.M1.5	SW	1.00	2.00	0.00	55.00	55.00	2.60	5.00	5.50	6.00
SM-5:S3.M1.6	SW	1.00	2.00	83.20	1198.33	111.67	18.53	4.67	5.17	5.67
SM-5:S3.M1.7	SW	1.00	2.00	0.00	70.00	70.00	2.95	3.50	3.75	4.00
SM-5:S3.M1.8	SW	1.00	2.00	1.00	89.33	89.33	2.50	5.00	6.00	7.00
SM-5:S3.M1.9	SW	1.00	2.00	0.00	90.00	90.00	10.70	4.67	4.83	5.00
SM-5:S3.M1.10	SW	1.00	2.00	1.00	41.00	41.00	2.25	4.00	4.50	5.00

TABLE 19: STANDARD DEVIATION OF MICROSCALE AT STONE MOUNTAIN-CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	STDEV Crack Parallel to	STDEV Surface where crack is	STDEV Crack Width	STDEV Crack Length	STDEV Crack Length in Box	STDEV Spall Thickness	STDEV Weathering Index Minimum	STDEV Weathering Index	STDEV Weathering Index Maximum
SM	n/a	n/a	n/a	17.08	252.41	45.15	4.89	1.21	1.24	1.36
SM:S1	n/a	n/a	n/a	0.75	91.97	44.28	3.47	1.23	1.25	1.37
SM:S2	n/a	n/a	n/a	1.40	45.01	34.71	2.98	1.09	1.12	1.28
SM:S3	n/a	n/a	n/a	32.62	469.89	48.19	7.60	1.44	1.48	1.58
SM-3	NE	n/a	n/a	0.00	59.11	50.51	2.68	1.10	1.12	1.23
SM-2	SE	n/a	n/a	0.00	27.41	18.52	0.87	0.95	1.00	1.25
SM-1	SW	n/a	n/a	0.00	125.18	40.66	4.64	1.51	1.58	1.70
SM-4	SW	n/a	n/a	0.00	119.66	51.19	3.73	1.18	1.15	1.26
SM-5	NW	n/a	n/a	28.39	549.54	45.17	8.40	1.15	1.16	1.28
SM-3:S1	NE	n/a	n/a	0.00	63.70	63.08	1.00	0.73	0.76	0.93
SM-3:S2	NE	n/a	n/a	n/a	52.31	45.00	2.89	0.71	0.75	0.93
SM-3:S3	NE	n/a	n/a	n/a	60.19	30.70	1.65	1.61	1.60	1.65
SM-2:S1	SE	n/a	n/a	0.00	20.96	20.96	0.78	0.94	0.90	0.99
SM-2:S2	SE	n/a	n/a	0.00	35.53	13.70	0.91	0.98	1.14	1.51
SM-1:S1	SW	n/a	n/a	n/a	106.29	30.93	5.20	1.72	1.83	1.97
SM-1:S2	SW	n/a	n/a	n/a	59.10	34.12	1.95	0.97	1.00	1.09
SM-1:S3	SW	n/a	n/a	n/a	176.00	50.46	5.91	1.78	1.84	1.94
SM-4:S1	SW	n/a	n/a	n/a	175.70	66.31	5.15	0.98	1.02	1.19
SM-4:S2	SW	n/a	n/a	n/a	19.93	19.72	0.95	1.36	1.24	1.31
SM-4:S3	SW	n/a	n/a	n/a	72.48	50.06	3.19	1.26	1.26	1.32
SM-5:S1	NW	n/a	n/a	n/a	36.61	36.91	3.36	1.04	1.01	1.05
SM-5:S2	NW	n/a	n/a	n/a	37.67	36.91	3.67	1.27	1.34	1.47
SM-5:S3	NW	n/a	n/a	32.62	939.20	55.60	13.57	0.75	0.88	1.12
SM-3:S1.M1.1	NE	n/a	n/a	n/a	20.73	20.73	1.08	0.53	0.27	0.00
SM-3:S1.M1.2	NE	n/a	n/a	n/a	111.91	113.00	0.66	0.55	0.42	0.55
SM-3:S1.M1.3	NE	n/a	n/a	n/a	37.58	37.58	0.75	0.45	0.22	0.00
SM-3:S1.M1.4	NE	n/a	n/a	n/a	111.10	109.01	1.10	0.52	0.75	1.10
SM-3:S1.M1.5	NE	n/a	n/a	n/a	22.94	22.94	1.33	0.00	0.00	0.00
SM-3:S1.M1.6	NE	n/a	n/a	n/a	42.08	42.08	1.16	0.98	0.61	0.41
SM-3:S1.M1.7	NE	n/a	n/a	n/a	33.21	33.21	1.05	0.50	0.25	0.00
SM-3:S1.M1.8	NE	n/a	n/a	n/a	37.86	37.86	0.71	1.00	0.50	0.00
SM-3:S1.M1.9	NE	n/a	n/a	n/a	18.93	18.93	0.36	0.00	0.00	0.00
SM-3:S1.M1.10	NE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-3:S2.M2.1	NE	n/a	n/a	n/a	38.89	67.18	0.14	0.00	0.00	0.00
SM-3:S2.M2.2	NE	n/a	n/a	n/a	82.40	62.32	1.77	0.74	0.73	0.89
SM-3:S2.M2.3	NE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-3:S2.M2.4	NE	n/a	n/a	n/a	42.89	42.89	2.71	0.76	0.76	0.93
SM-3:S2.M2.5	NE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-3:S2.M2.6	NE	n/a	n/a	n/a	81.73	67.46	2.10	1.15	0.75	0.50
SM-3:S2.M2.7	NE	n/a	n/a	n/a	11.81	11.81	1.42	0.00	0.00	0.00
SM-3:S2.M2.8	NE	n/a	n/a	n/a	33.68	33.68	0.86	0.82	0.84	1.03
SM-3:S2.M2.9	NE	n/a	n/a	n/a	5.64	5.64	1.15	0.00	0.00	0.00
SM-3:S2.M2.10	NE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-3:S3.M1.1	NE	n/a	n/a	n/a	102.72	35.98	2.19	0.00	0.00	0.00
SM-3:S3.M1.2	NE	n/a	n/a	n/a	16.49	16.49	0.71	0.89	0.65	0.45
SM-3:S3.M1.3	NE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-3:S3.M1.4	NE	n/a	n/a	n/a	19.58	19.58	1.30	1.50	1.25	1.00
SM-3:S3.M1.5	NE	n/a	n/a	n/a	32.74	32.25	0.57	1.53	1.61	1.73
SM-3:S3.M1.6	NE	n/a	n/a	n/a	21.44	6.83	1.41	0.96	0.96	0.96
SM-3:S3.M1.7	NE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-3:S3.M1.8	NE	n/a	n/a	n/a	18.04	21.97	1.60	0.55	0.55	0.55
SM-3:S3.M1.9	NE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-3:S3.M1.10	NE	n/a	n/a	n/a	27.80	27.80	0.57	0.00	0.00	0.00
SM-2:S1.M1.1	SE	n/a	n/a	n/a	6.46	6.46	0.68	0.71	0.71	0.71
SM-2:S1.M1.2	SE	n/a	n/a	n/a	23.64	23.64	1.11	0.58	0.48	0.50
SM-2:S1.M1.3	SE	n/a	n/a	n/a	15.57	15.57	0.21	0.00	0.00	0.00
SM-2:S1.M1.4	SE	n/a	n/a	n/a	16.52	16.52	0.51	0.50	0.48	0.58

TABLE 19: STANDARD DEVIATION OF MICROSCALE AT STONE MOUNTAIN (CONT.)-
CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	STDEV Crack Parallel to	STDEV Surface where crack is	STDEV Crack Width	STDEV Crack Length	STDEV Crack Length in Box	STDEV Spall Thickness	STDEV Weathering Index Minimum	STDEV Weathering Index	STDEV Weathering Index Maximum
SM-4:S1.M1.1	SW	n/a	n/a	n/a	16.71	16.71	0.68	1.00	1.03	1.50
SM-4:S1.M1.2	SW	n/a	n/a	n/a	58.81	58.81	3.12	0.84	0.89	1.00
SM-4:S1.M1.3	SW	n/a	n/a	n/a	8.96	8.96	1.13	0.96	0.95	1.00
SM-4:S1.M1.4	SW	n/a	n/a	n/a	49.33	49.33	3.24	0.00	0.48	0.96
SM-4:S1.M1.5	SW	n/a	n/a	n/a	72.53	42.98	0.92	0.00	0.00	0.00
SM-4:S1.M1.6	SW	n/a	n/a	n/a	375.05	156.00	1.39	1.22	1.46	1.73
SM-4:S1.M1.7	SW	n/a	n/a	n/a	70.71	70.71	0.14	1.41	2.12	2.83
SM-4:S1.M1.8	SW	n/a	n/a	n/a	353.26	17.25	15.42	1.00	0.95	0.96
SM-4:S1.M1.9	SW	n/a	n/a	n/a	10.31	10.31	1.18	0.50	0.25	0.00
SM-4:S1.M1.10	SW	n/a	n/a	n/a	12.02	12.02	0.42	0.00	0.00	0.00
SM-4:S2.M1.1	SW	n/a	n/a	n/a	3.54	3.54	0.64	0.71	0.35	0.00
SM-4:S2.M1.2	SW	n/a	n/a	n/a	58.81	58.81	3.12	0.84	0.89	1.00
SM-4:S2.M1.3	SW	n/a	n/a	n/a	8.96	8.96	1.13	0.96	0.95	1.00
SM-4:S2.M1.4	SW	n/a	n/a	n/a	111.10	109.01	1.10	0.52	0.75	1.10
SM-4:S2.M1.5	SW	n/a	n/a	n/a	22.94	22.94	1.33	0.00	0.00	0.00
SM-4:S2.M1.6	SW	n/a	n/a	n/a	42.08	42.08	1.16	0.98	0.61	0.41
SM-4:S2.M1.7	SW	n/a	n/a	n/a	70.71	70.71	0.14	1.41	2.12	2.83
SM-4:S2.M1.8	SW	n/a	n/a	n/a	353.26	17.25	15.42	1.00	0.95	0.96
SM-4:S2.M1.9	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-4:S2.M1.10	SW	n/a	n/a	n/a	23.64	23.64	0.80	0.00	0.00	0.00
SM-4:S3.M1.1	SW	n/a	n/a	n/a	120.21	28.28	6.36	0.71	0.35	0.00
SM-4:S3.M1.2	SW	n/a	n/a	n/a	16.49	16.49	0.71	0.89	0.65	0.45
SM-4:S3.M1.3	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-4:S3.M1.4	SW	n/a	n/a	n/a	102.50	68.02	4.35	1.15	1.04	1.00
SM-4:S3.M1.5	SW	n/a	n/a	n/a	12.97	23.73	1.64	0.00	0.00	0.00
SM-4:S3.M1.6	SW	n/a	n/a	n/a	21.44	6.83	1.41	0.96	0.96	0.96
SM-4:S3.M1.7	SW	n/a	n/a	n/a	32.88	32.88	1.11	0.96	1.08	1.26
SM-4:S3.M1.8	SW	n/a	n/a	n/a	9.90	9.90	6.08	0.00	0.71	1.41
SM-4:S3.M1.9	SW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-4:S3.M1.10	SW	n/a	n/a	n/a	113.14	84.85	1.56	0.00	0.00	0.00
SM-5:S1.M1.1	NW	n/a	n/a	n/a	7.07	0.00	0.42	0.00	0.00	0.00
SM-5:S1.M1.2	NW	n/a	n/a	n/a	66.58	66.58	8.69	0.00	0.00	0.00
SM-5:S1.M1.3	NW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-5:S1.M1.4	NW	n/a	n/a	n/a	22.34	22.34	2.11	0.96	0.48	0.00
SM-5:S1.M1.5	NW	n/a	n/a	n/a	0.71	0.71	0.99	0.00	0.00	0.00
SM-5:S1.M1.6	NW	n/a	n/a	n/a	30.14	30.14	1.24	0.00	0.00	0.00
SM-5:S1.M1.7	NW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-5:S1.M1.8	NW	n/a	n/a	n/a	16.92	16.92	0.97	0.98	1.02	1.21
SM-5:S1.M1.9	NW	n/a	n/a	n/a	28.99	28.99	1.41	0.00	0.00	0.00
SM-5:S1.M1.10	NW	n/a	n/a	n/a	0.00	0.00	0.57	0.00	0.00	0.00
SM-5:S2.M1.1	NW	n/a	n/a	n/a	55.08	55.08	4.12	0.00	0.00	0.00
SM-5:S2.M1.2	NW	n/a	n/a	n/a	40.72	40.72	2.03	2.31	2.31	2.31
SM-5:S2.M1.3	NW	n/a	n/a	n/a	17.91	17.91	5.05	0.50	0.25	0.00
SM-5:S2.M1.4	NW	n/a	n/a	n/a	23.82	23.82	2.03	0.00	0.22	0.45
SM-5:S2.M1.5	NW	n/a	n/a	n/a	0.71	0.71	0.99	0.00	0.00	0.00
SM-5:S2.M1.6	NW	n/a	n/a	n/a	20.90	13.44	5.22	0.50	0.65	0.96
SM-5:S2.M1.7	NW	n/a	n/a	n/a	74.25	74.25	2.47	0.00	0.71	1.41
SM-5:S2.M1.8	NW	n/a	n/a	n/a	22.50	22.50	3.16	1.15	1.15	1.15
SM-5:S2.M1.9	NW	n/a	n/a	n/a	60.83	60.83	14.55	0.58	0.29	0.00
SM-5:S2.M1.10	NW	n/a	n/a	n/a	10.41	10.41	1.03	0.00	0.00	0.00
SM-5:S3.M1.1	NW	n/a	n/a	n/a	1166.73	84.85	22.98	0.71	0.35	0.00
SM-5:S3.M1.2	NW	n/a	n/a	n/a	83.71	67.31	4.02	0.50	0.48	0.58
SM-5:S3.M1.3	NW	n/a	n/a	n/a	2028.29	80.05	24.37	0.58	0.58	0.58

TABLE 19: TANDARD DEVIATION OF MICROSCALE AT STONE MOUNTAIN (CONT.)-
CRACK MEASUREMENTS WITHIN 400CM^2 BOXES ALONG TRANSECT

Location	Orient.	STDEV Crack Parallel to	STDEV Surface where crack is	STDEV Crack Width	STDEV Crack Length	STDEV Crack Length in Box	STDEV Spall Thickness	STDEV Weathering Index Minimum	STDEV Weathering Index	STDEV Weathering Index Maximum
SM-5:S3.M1.4	NW	n/a	n/a	n/a	23.85	21.47	1.99	0.45	0.42	0.55
SM-5:S3.M1.5	NW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SM-5:S3.M1.6	NW	n/a	n/a	n/a	1959.12	87.51	27.69	0.58	1.04	1.53
SM-5:S3.M1.7	NW	n/a	n/a	n/a	14.14	14.14	2.19	2.12	1.77	1.41
SM-5:S3.M1.8	NW	n/a	n/a	n/a	42.03	42.03	0.80	0.00	0.00	0.00
SM-5:S3.M1.9	NW	n/a	n/a	n/a	60.83	60.83	14.55	0.58	0.29	0.00
SM-5:S3.M1.10	NW	n/a	n/a	n/a	12.73	12.73	0.35	0.00	0.00	0.00

TABLE 20: ROSE DIAGRAM STATISTICS-FORTY ACRE ROCK

Variable	Dome Strike	Dome Dip	Site 1-Strike	Site 1-Dip	Site 2-Strike	Site 2-Dip	Site 3-Strike	Site 3-Dip	Site 4-Strike	Site 4-Dip	Site 5-Strike	Site 5-Dip
Number of Observations	655	656	69	69	126	127	105	105	185	182	170	170
Mean Vector (μ)	30.8°	9.628°	79.942°	12.352°	0.254°	6.689°	163.502°	6.218°	358.951°	12.443°	37.439°	9.553°
Length of Mean Vector (r)	0	1	1	1	0	1	1	1	1	0.993	0.467	0.991
Concentration	1	40	1	26	1	145	2	240	2	74.403	1.053	53.262
Circular Variance	1	0	0	0	1	0	0	0	0	0.007	0.533	0.009
Circular Standard Deviation	89.158°	9.147°	67.205°	11.262°	81.261°	4.759°	52.703°	3.704°	54.085°	6.665°	70.744°	7.888°
Standard Error of Mean	5.19°	0.357°	9.037°	1.356°	9.52°	0.422°	5.212°	0.361°	4.053°	0.494°	6.268°	0.605°
95% Confidence Interval (-/+) for μ	20.625°	8.928°	62.225°	9.694°	341.591°	5.861°	153.284°	5.509°	351.005°	11.474°	25.151°	8.367°
	40.975°	10.328°	97.658°	15.009°	18.917°	7.517°	173.719°	6.926°	6.897°	13.411°	49.728°	10.739°
99% Confidence Interval (-/+) for μ	17.429°	8.708°	56.66°	8.859°	335.729°	5.601°	150.075°	5.286°	348.509°	11.17°	21.291°	7.995°
	44.171°	10.548°	103.224°	15.844°	24.779°	7.777°	176.929°	7.149°	9.393°	13.715°	53.588°	11.112°
Grand Mean Vector (GM)	16.69°											
95% Confidence Interval (-/+) for GM	4.531°											
	56.884°											
99% Confidence Interval (-/+) for GM	1.412°											
	95.205°											

FORTY ACRE ROCK- STRIKE

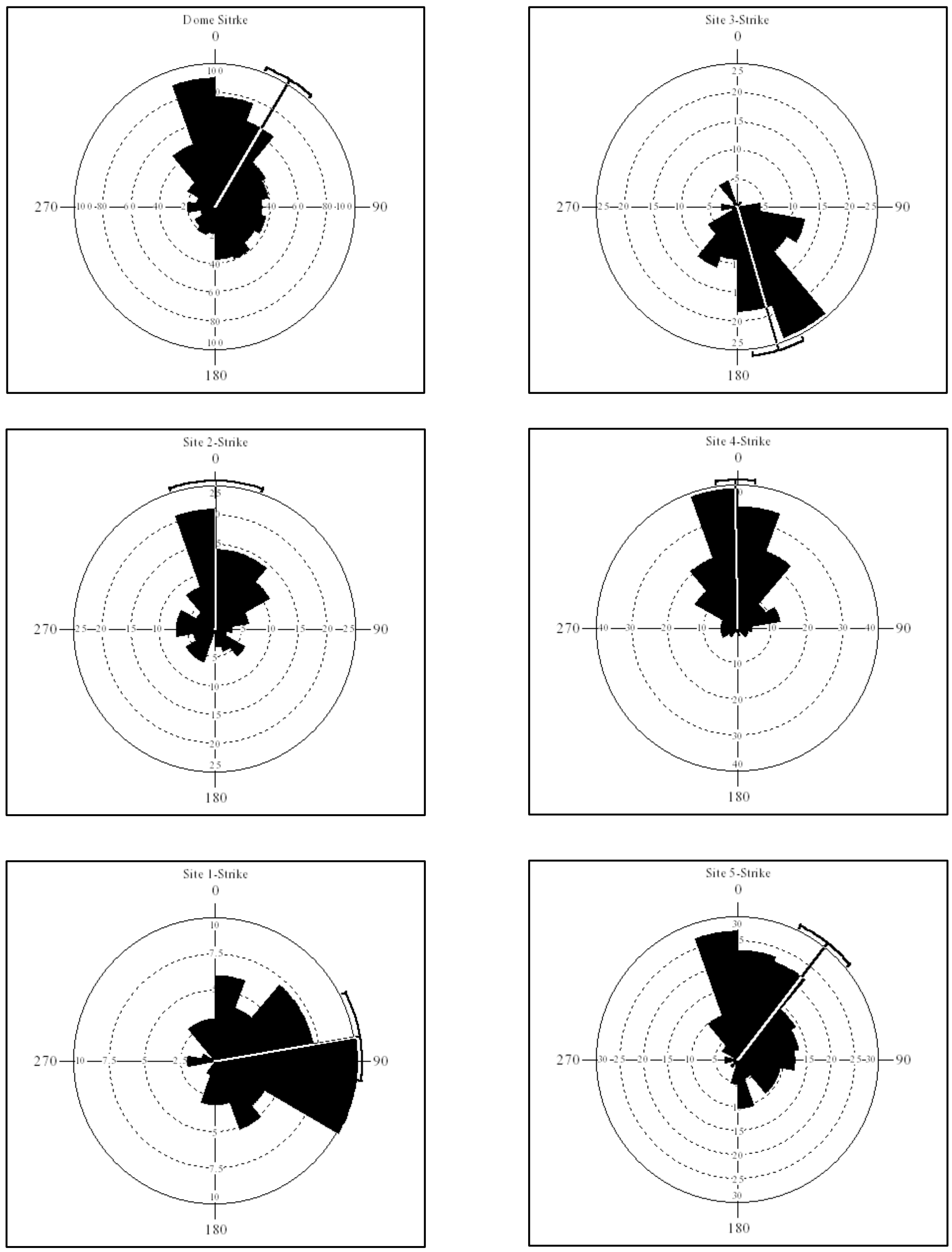

Figure 43. *Rose diagrams for strike at Forty Acre Rock dome and sites.*

FORTY ACRE ROCK- DIP

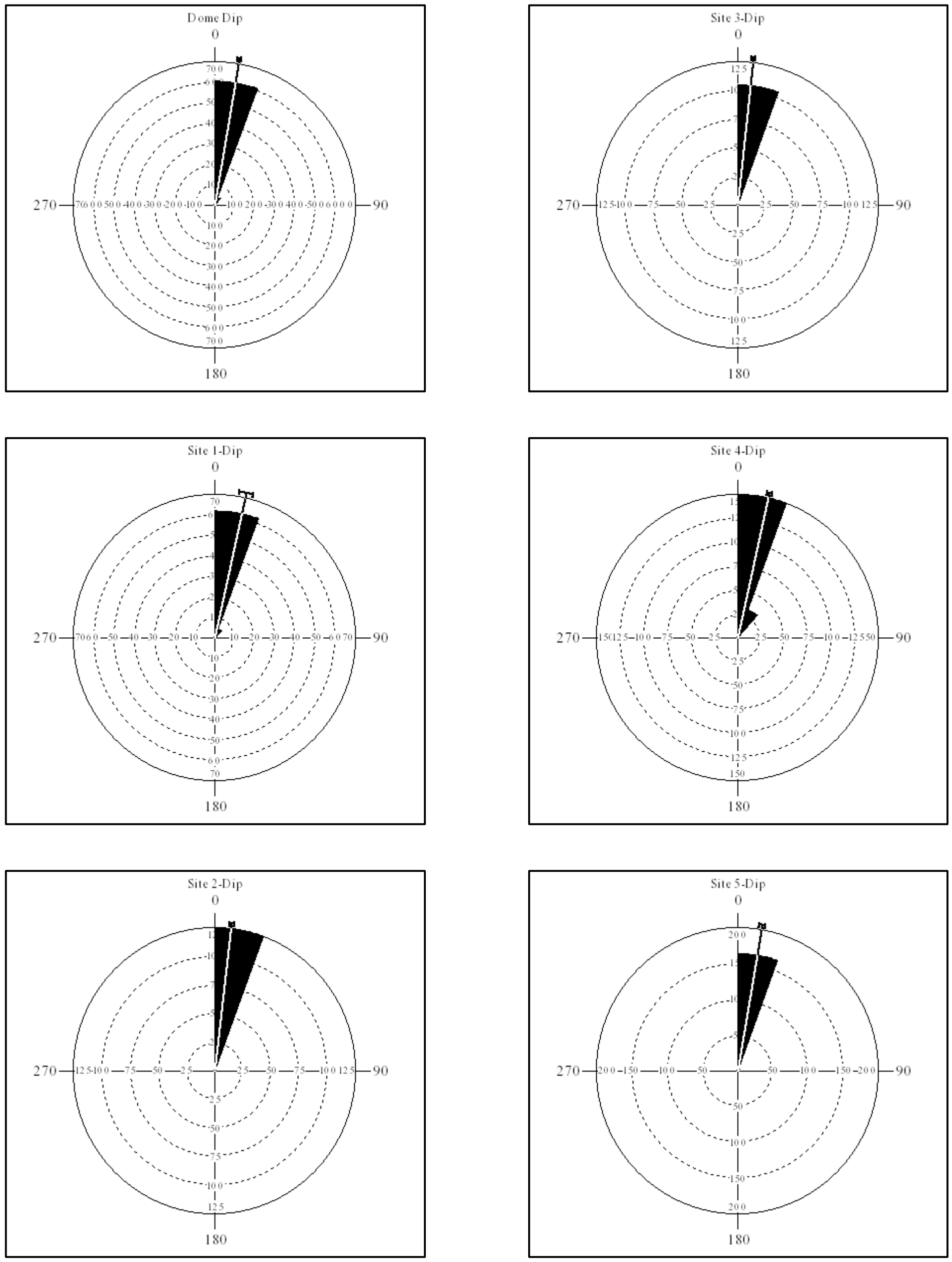

Figure 44. *Rose diagrams for dip at Forty Acre Rock dome and sites.*

TABLE 21: ROSE DIAGRAM STATISTICS- ROCKY FACE

Variable	Dome-Strike	Dome-Dip	Site1-Strike	Site1-Dip	Site2-Strike	Site2-Dip	Site3-Strike	Site3-Dip	Site4-Strike	Site4-Dip	Site5-Strike	Site5-Dip
Number of Observations	672	668	74	74	126	127	105	105	187	187	171	171
Mean Vector (μ)	28.822°	9.454°	72.058°	11.507°	0.254°	6.689°	163.502°	6.218°	358.968°	12.571°	37.005°	9.497°
Length of Mean Vector (r)	0.305	0.987	0.485	0.981	0.366	0.997	0.655	0.998	0.644	0.978	0.469	0.991
Concentration	0.64	39.674	1.107	26.166	0.786	145.445	1.757	239.84	1.705	23.147	1.059	53.119
Circular Variance	0.695	0.013	0.515	0.019	0.634	0.003	0.345	0.002	0.356	0.022	0.531	0.009
Circular Standard Deviation	88.349°	9.155°	68.922°	11.311°	81.261°	4.759°	52.703°	3.704°	53.721°	12.042°	70.553°	7.899°
Standard Error of Mean	5.008°	0.354°	9.091°	1.315°	9.52°	0.422°	5.212°	0.361°	3.998°	0.881°	6.221°	0.604°
95% Confidence Interval (-/+) for μ	19.004°	8.759°	54.236°	8.929°	341.591°	5.861°	153.284°	5.509°	351.131°	10.845°	24.809°	8.313°
	38.639°	10.148°	89.881°	14.085°	18.917°	7.517°	173.719°	6.926°	6.806°	14.297°	49.2°	10.681°
99% Confidence Interval (-/+) for μ	15.921°	8.541°	48.638°	8.12°	335.729°	5.601°	150.075°	5.286°	348.669°	10.303°	20.978°	7.941°
	41.723°	10.366°	95.479°	14.894°	24.779°	7.777°	176.929°	7.149°	9.268°	14.84°	53.031°	11.053°
Second Order Statistics												
Grand Mean Vector (GM)	16.086°											
Length of Grand Mean Vector (r)	0.609											
Number of Means	12											
95% Confidence Interval (-/+) for GM	4.664°											
	53.608°											
99% Confidence Interval (-/+) for GM	1.722°											
	91.636°											

ROCKY FACE- STRIKE

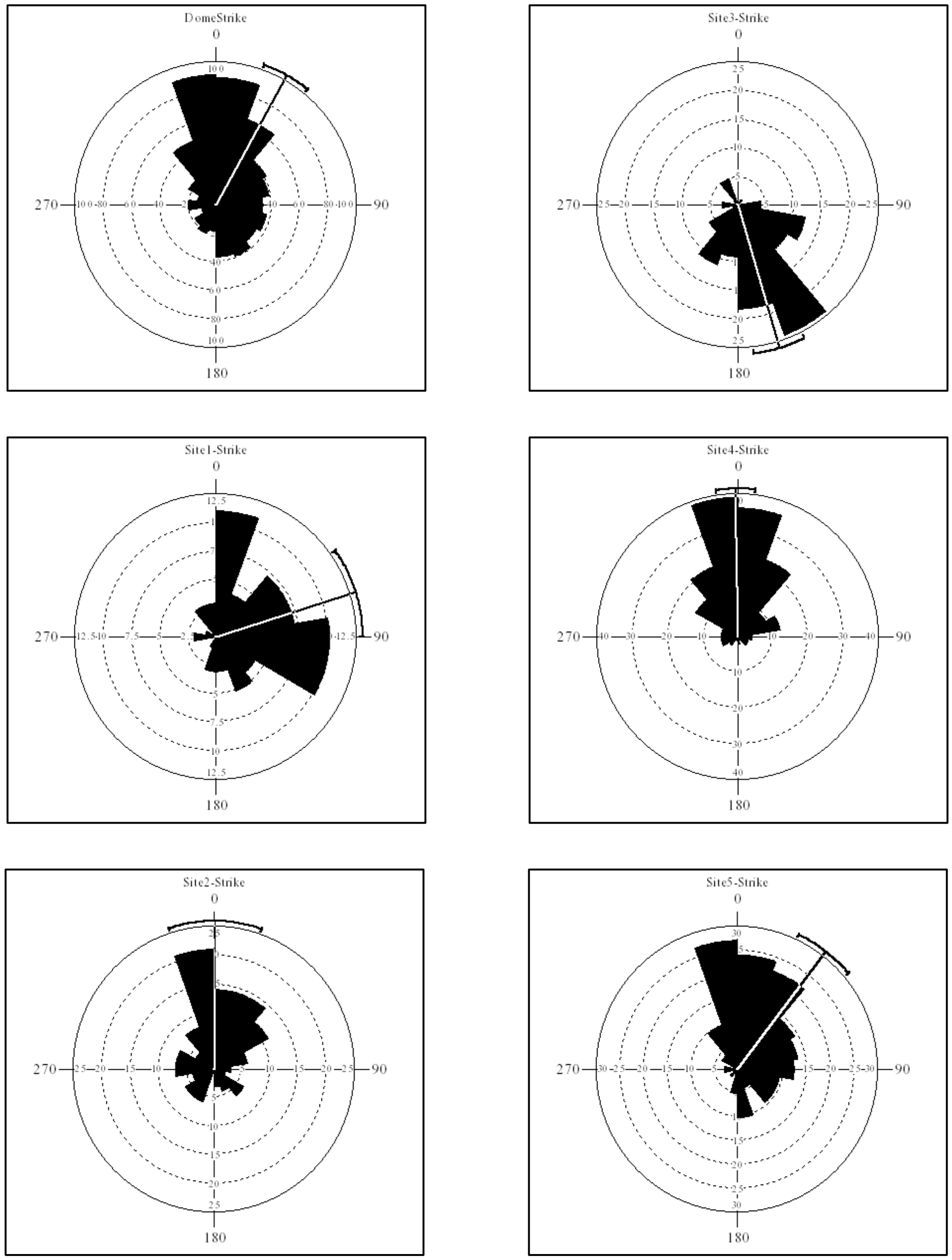

Figure 45. *Rose diagrams for strike at Rocky Face dome and sites.*

ROCKY FACE- DIP

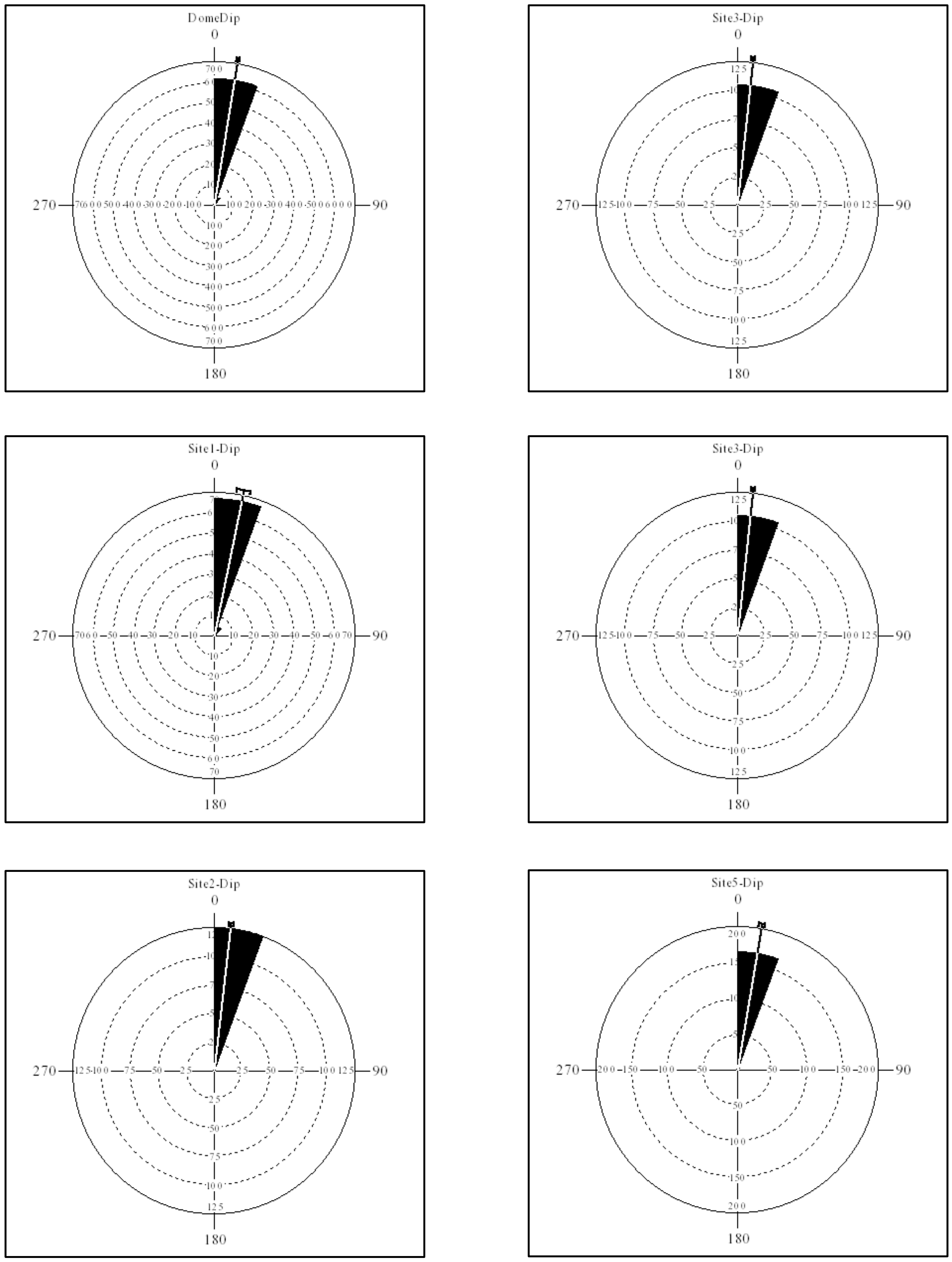

Figure 46. *Rose diagrams for dip at Rocky Face dome and sites.*

TABLE 22: ROSE DIAGRAM STATISTICS- STONE MOUNTAIN

Variable	Dome-Strike	Dome-Dip	Site1-Strike	Site1-Dip	Site2-Strike	Site2-Dip	Site3-Strike	Site3-Dip	Site4-Strike	Site4-Dip	Site5-Strike	Site5-Dip
Mean Vector (μ)	260.303°	18.474°	107.096°	21.874°	18.989°	19.127°	273.04°	16.972°	149.665°	14.575°	237.555°	20.381°
Length of Mean Vector (r)	0.045	0.989	0.61	0.986	0.773	0.993	0.664	0.995	0.263	0.991	0.414	0.984
Concentration	0.09	45.402	1.552	36.481	2.573	70.441	1.803	96.022	0.546	58.673	0.91	31.07
Circular Variance	0.955	0.011	0.39	0.014	0.227	0.007	0.336	0.005	0.737	0.009	0.586	0.016
Circular Standard Deviation	142.765°	8.551°	56.942°	9.553°	41.067°	6.851°	51.85°	5.862°	93.618°	7.512°	76.044°	10.364°
Standard Error of Mean	41.465°	0.393°	5.859°	0.946°	4.889°	0.825°	4.781°	0.535°	15.431°	0.767°	10°	1.111°
95% Confidence Interval (-/+) for μ	179.014°	17.704°	95.611°	20.02°	9.405°	17.51°	263.668°	15.923°	119.414°	13.072°	217.951°	18.203°
	341.592°	19.244°	118.581°	23.728°	28.574°	20.744°	282.411°	18.022°	179.916°	16.079°	257.16°	22.56°
99% Confidence Interval (-/+) for μ	153.48°	17.462°	92.003°	19.438°	6.394°	17.002°	260.724°	15.594°	109.912°	12.6°	211.792°	17.519°
	7.126°	19.485°	122.189°	24.311°	31.584°	21.252°	285.355°	18.351°	189.419°	16.551°	263.318°	23.244°
One Sample Tests												
Second Order Statistics												
Grand Mean Vector (GM)	17.365°											
Length of Grand Mean Vector (r)	0.502											
Number of Means	12											
95% Confidence Interval (-/+) for GM	295.268°											
	68.993°											
99% Confidence Interval (-/+) for GM	*****											

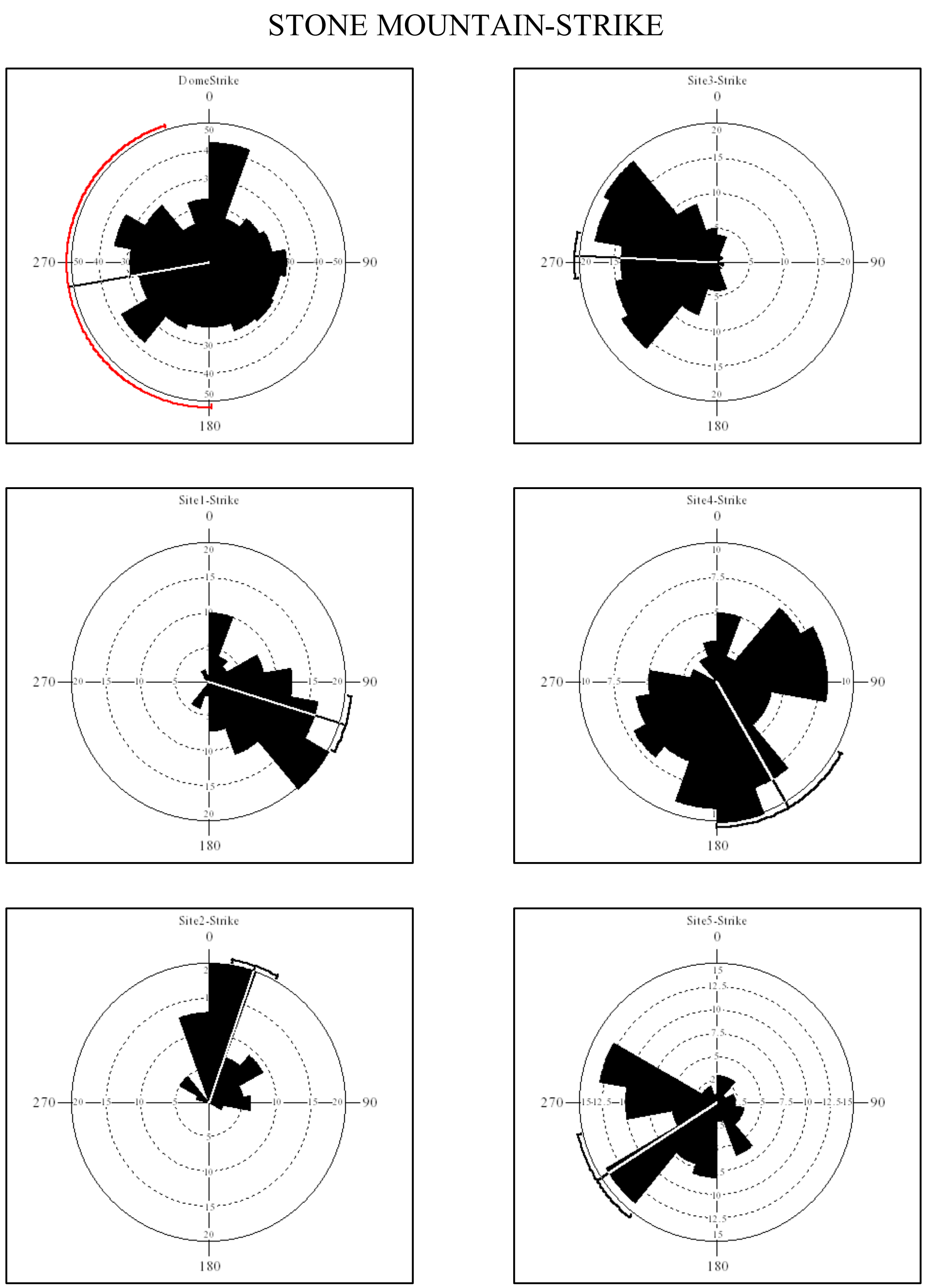

Figure 47. *Rose diagrams for strike at Stone Mountain dome and sites.*

STONE MOUNTAIN- DIP

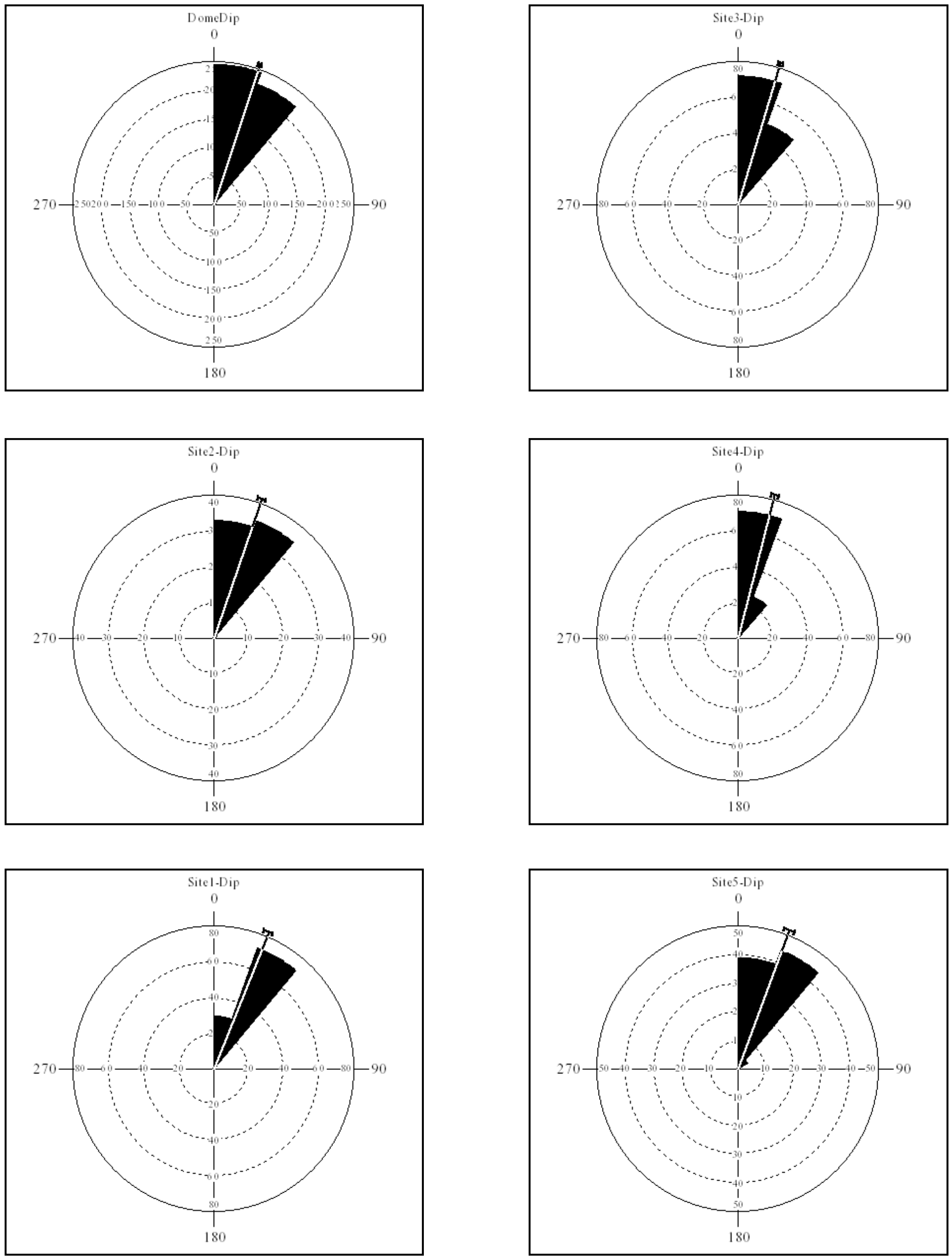

Figure 48. *Rose diagrams for dip at Stone Mountain dome and sites.*

TABLE 23: : COMPRESSIVE STRENGTH-NINE SCHMIDT MEASUREMENTS TAKEN PER BOX ALONG TRANSECT

Location	Orientation	Average (Q)	STDEV	Location	Orientation	Average (Q)	STDEV	Location	Orientation	Average (Q)	STDEV
FA	n/a	38.66	12.39	**RF**	n/a	40.64	7.60	**SM**	n/a	44.63	9.48
FA:S1	n/a	27.29	54.23	**RF:S1**	n/a	39.91	8.30	**SM:S1**	n/a	49.44	5.99
FA:S2	n/a	23.23	26.60	**RF:S2**	n/a	37.56	7.80	**SM:S2**	n/a	42.41	9.85
FA:S3	n/a	13.99	13.45	**RF:S3**	n/a	37.90	6.09	**SM:S3**	n/a	41.39	10.18
FA:S4	n/a	20.74	6.30	**n/a**	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a
FA-4	NE	38.16	12.88	**n/a**	n/a	n/a	n/a	**SM-3**	NE	46.46	6.89
FA-2	SE	34.69	13.17	**RF-1**	SE	41.03	9.05	**SM-2**	SE	39.77	11.53
n/a	n/a	n/a	n/a	**RF-5**	SE	40.64	5.76	**n/a**	n/a	n/a	n/a
FA-1	SW	35.19	12.85	**RF-3**	SW	43.93	6.04	**SM-1**	SE	48.10	6.38
FA-3	SW	39.28	10.87	**n/a**	n/a	n/a	n/a	**SM-4**	SW	37.84	8.28
FA-5	SW	45.03	8.63	**n/a**	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a
n/a	n/a	n/a	n/a	**RF-2**	NW	38.57	9.55	**SM-5**	NW	49.36	8.71
n/a	n/a	n/a	n/a	**RF-4**	NW	38.33	7.48	**n/a**	n/a	n/a	n/a

TABLE 24: STUDENT T.TESTS- AVERAGE SLAB THICKNESS

Location	T.Test	Location	T.Test	Location	T.Test
FA vs RF	0.000				
FA vs. SM	0.077				
RF vs SM	0.000				
All N:S2 vs All S:S2	0.264				
All N:S3 vs All S:S3	0.008				
All E:S2 vs All W:S2	0.471				
All E:S3 vs All W:S3	0.146				
FA:S2 vs FA:S3	0.001	**RF:S2 vs RF:S3**	0.000	**SM:S2 vs SM:S3**	0.009
FA:S2 vs FA:S4	0.003	**n/a**	n/a	**n/a**	n/a
FA:S3 vs FA:S4	0.376	**n/a**	n/a	**n/a**	n/a
FA North Sites vs South Sites	0.404	**RF North Sites vs South Sites**	0.000	**SM North Sites vs South Sites**	0.244
FA East Sites vs West Sites	0.317	**RF East Sites vs West Sites**	0.000	**SM East Sites vs West Sites**	0.061
FA-1 vs FA-2	0.001	**RF-1 vs RF-2**	0.000	**SM-1 vs SM-2**	0.001
FA-1 vs FA-3	0.475	**RF-1 vs RF-3**	0.003	**SM-1 vs SM-3**	0.011
FA-1 vs FA-4	0.164	**RF-1 vs RF-4**	0.000	**SM-1 vs SM-4**	0.196
FA-1 vs FA-5	0.002	**RF-1 vs RF-5**	0.000	**SM-1 vs SM-5**	0.125
FA-2 vs FA-3	0.000	**RF-2 vs RF-3**	0.000	**SM-2 vs SM-3**	0.065
FA-2 vs FA-4	0.000	**RF-2 vs RF-4**	0.114	**SM-2 vs SM-4**	0.000
FA-2 vs FA-5	0.220	**RF-2 vs RF-5**	0.157	**SM-2 vs SM-5**	0.000
FA-3 vs FA-4	0.101	**RF-3 vs RF-4**	0.000	**SM-3 vs SM-4**	0.000
FA-3 vs FA-5	0.000	**RF-3 vs RF-5**	0.000	**SM-3 vs SM-5**	0.030
FA-4 vs FA-5	0.000	**RF-4 vs RF-5**	0.010	**SM-4 vs SM-5**	0.011

TABLE 25: STUDENT T.TESTS- MAXIMUM SLAB THICKNESS

Location	T.Test	Location	T.Test	Location	T.Test
FA vs RF	0.193				
FA vs. SM	0.239				
RF vs SM	0.062				
All N:S2 vs All S:S2	0.468				
All N:S3 vs All S:S3	0.016				
All E:S2 vs All W:S2	0.460				
All E:S3 vs All W:S3	0.154				
FA:S2 vs FA:S3	0.122	**RF:S2 vs RF:S3**	0.060	**SM:S2 vs SM:S3**	0.238
FA:S2 vs FA:S4	0.206	**n/a**	0.000	**n/a**	0.000
FA:S3 vs FA:S4	0.454	**n/a**	0.000	**n/a**	0.000
FA North Sites vs South Sites	0.491	**RF North Sites vs South Sites**	0.000	**SM North Sites vs South Sites**	0.190
FA East Sites vs West Sites	0.290	**RF East Sites vs West Sites**	0.000	**SM East Sites vs West Sites**	0.021
FA-1 vs FA-2	0.194	**RF-1 vs RF-2**	0.070	**SM-1 vs SM-2**	0.100
FA-1 vs FA-3	0.368	**RF-1 vs RF-3**	0.186	**SM-1 vs SM-3**	0.144
FA-1 vs FA-4	0.311	**RF-1 vs RF-4**	0.089	**SM-1 vs SM-4**	0.401
FA-1 vs FA-5	0.205	**RF-1 vs RF-5**	0.113	**SM-1 vs SM-5**	0.332
FA-2 vs FA-3	0.164	**RF-2 vs RF-3**	0.005	**SM-2 vs SM-3**	0.356
FA-2 vs FA-4	0.191	**RF-2 vs RF-4**	0.427	**SM-2 vs SM-4**	0.107
FA-2 vs FA-5	0.433	**RF-2 vs RF-5**	0.079	**SM-2 vs SM-5**	0.083
FA-3 vs FA-4	0.386	**RF-3 vs RF-4**	0.000	**SM-3 vs SM-4**	0.111
FA-3 vs FA-5	0.153	**RF-3 vs RF-5**	0.173	**SM-3 vs SM-5**	0.165
FA-4 vs FA-5	0.135	**RF-4 vs RF-5**	0.042	**SM-4 vs SM-5**	0.238

TABLE 26: STUDENT T. TESTS-MESOSCALE

Location	Crack Length	Crack Width	Sheet Height	Location	Crack Length	Crack Width	Sheet Height	Location	Crack Length	Crack Width	Sheet Height
FA vs RF	0.020	0.013	0.045								
FA vs. SM	0.036	0.083	0.011								
RF vs SM	0.294	n/a	0.384								
All N:S1 vs All S:S1	0.010	n/a	0.356								
All N:S2 vs All S:S2	0.138	0.047	0.146								
All N:S3 vs All S:S3	0.050	0.028	0.110								
All E:S1 vs All W:S1	0.022	n/a	0.002								
All E:S2 vs All W:S2	0.021	0.049	0.007								
All E:S3 vs All W:S3	0.175	0.009	0.014								
FA:S1 vs. FA:S2	0.013	n/a	0.209	RF:S1 vs. RF:S2	0.055	0.133	0.350	SM:S1 vs. SM:S2	0.041	0.064	0.002
FA:S1 vs. FA:S3	0.377	n/a	0.477	RF:S1 vs. RF:S3	0.364	0.008	0.026	SM:S1 vs. SM:S3	0.323	0.220	0.294
FA:S1 vs. FA:S4	0.019	n/a	0.012	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
FA:S2 vs. FA:S3	0.119	0.291	0.205	RF:S2 vs. RF:S3	0.027	0.023	0.008	SM:S2 vs. SM:S3	0.030	0.068	0.001
FA:S2 vs. FA:S4	0.286	0.000	0.144	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
FA:S3 vs. FA:S4	0.144	0.000	0.012	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
North Sites vs South Sites	0.003	0.025	0.184	North Sites vs South Sites	0.304	n/a	0.420	North Sites vs South Sites	0.065	0.069	0.118
East Sites vs West Sites	0.485	0.049	0.092	East Sites vs West Sites	0.304	n/a	0.420	East Sites vs West Sites	0.001	n/a	0.000
FA-1 vs FA-2	0.009	0.085	0.289	RF-1 vs RF-2	0.225	n/a	0.043	SM-1 vs SM-2	n/a	n/a	n/a
FA-1 vs FA-3	0.128	0.013	0.139	RF-1 vs RF-3	0.065	n/a	0.000	SM-1 vs SM-3	0.052	n/a	0.007
FA-1 vs FA-4	0.383	0.012	0.487	RF-1 vs RF-4	0.339	n/a	0.012	SM-1 vs SM-4	0.407	0.485	0.100
FA-1 vs FA-5	0.018	0.211	0.200	RF-1 vs RF-5	0.258	n/a	0.071	SM-1 vs SM-5	0.035	0.068	0.115
FA-2 vs FA-3	0.424	0.018	0.100	RF-2 vs RF-3	0.396	n/a	0.029	SM-2 vs SM-3	n/a	n/a	n/a
FA-2 vs FA-4	0.009	0.014	0.255	RF-2 vs RF-4	0.305	n/a	0.296	SM-2 vs SM-4	n/a	n/a	n/a
FA-2 vs FA-5	0.072	0.102	0.163	RF-2 vs RF-5	0.374	n/a	0.350	SM-2 vs SM-5	n/a	n/a	n/a
FA-3 vs FA-4	0.131	0.104	0.137	RF-3 vs RF-4	0.105	n/a	0.082	SM-3 vs SM-4	0.035	n/a	0.091
FA-3 vs FA-5	0.214	0.013	0.471	RF-3 vs RF-5	0.184	0.039	0.012	SM-3 vs SM-5	0.009	n/a	0.012
FA-4 vs FA-5	0.020	0.012	0.201	RF-4 vs RF-5	0.388	n/a	0.180	SM-4 vs SM-5	0.043	0.069	0.033

TABLE 27:
STUDENT T TESTS- MICROSCALE

Location	Crack Parallel to (ChiSquared)	Surface where crack is (ChiSquared)	Crack Width	Crack Length	Crack Length in Box	Sheet Height	Weathering Index Minimum	Weathering Index	Weathering Index Maximum
FA vs RF	0.000	0.000	0.000	0.472	0.097	0.112	0.000	0.000	0.000
FA vs. SM	0.000	0.000	0.071	0.225	0.046	0.297	0.000	0.000	0.000
RF vs SM	0.000	0.000	0.000	0.204	0.152	0.190	0.000	0.000	0.000
All N:S1 vs All S:S1	0.000	0.000	0.068	0.113	0.219	0.021	0.394	0.311	0.254
All N:S2 vs All S:S2	0.000	0.000	n/a	0.134	0.211	0.242	0.007	0.017	0.023
All N:S3 vs All S:S3	0.000	0.000	0.144	0.307	0.456	0.079	0.335	0.206	0.126
All E:S1 vs All W:S1	0.000	0.000	0.435	0.187	0.482	0.059	0.177	0.052	0.016
All E:S2 vs All W:S2	0.000	0.000	n/a	0.385	0.093	0.001	0.148	0.105	0.188
All E:S3 vs All W:S3	0.000	0.000	0.144	0.094	0.451	0.028	0.187	0.119	0.081
FA:S1 vs. FA:S2	0.000	0.000	0.023	0.418	0.103	0.220	0.002	0.000	0.000
FA:S1 vs. FA:S3	0.000	0.000	n/a	0.350	0.001	0.196	0.000	0.000	0.000
FA:S1 vs. FA:S4	0.000	0.000	0.000	0.000	0.102	0.027	0.065	0.053	0.027
FA:S2 vs. FA:S3	0.000	0.000	0.023	0.373	0.001	0.082	0.123	0.134	0.156
FA:S2 vs. FA:S4	0.000	0.000	0.000	0.000	0.096	0.029	0.058	0.186	0.133
FA:S3 vs. FA:S4	0.000	0.000	0.000	0.007	0.089	0.027	0.055	0.271	0.199
North Sites vs South Sites	0.000	0.000	n/a	0.207	0.130	0.008	0.000	0.000	0.000
East Sites vs West Sites	0.000	0.000	n/a	0.418	0.168	0.007	0.000	0.000	0.000
FA-1 vs FA-2	0.000	0.000	n/a	0.075	0.092	0.011	0.012	0.013	0.018
FA-1 vs FA-3	0.000	0.000	0.022	0.033	0.064	0.001	0.272	0.276	0.286
FA-1 vs FA-4	0.000	0.000	n/a	0.383	0.482	0.000	0.001	0.001	0.001
FA-1 vs FA-5	0.000	0.000	n/a	0.285	0.067	0.000	0.071	0.075	0.086
FA-2 vs FA-3	0.000	0.000	0.022	0.101	0.155	0.363	0.001	0.002	0.004
FA-2 vs FA-4	0.000	0.000	n/a	0.086	0.086	0.048	0.024	0.010	0.008
FA-2 vs FA-5	0.000	0.000	n/a	0.284	0.138	0.477	0.019	0.020	0.036
FA-3 vs FA-4	0.000	0.000	0.022	0.029	0.060	0.013	0.000	0.000	0.000
FA-3 vs FA-5	0.000	0.000	0.022	0.174	0.429	0.235	0.055	0.063	0.086
FA-4 vs FA-5	0.000	0.000	n/a	0.364	0.063	0.026	0.000	0.000	0.000

TABLE 27: (CONT.): STUDENT T.TESTS- MICROSCALE

Location	Crack Parallel to (ChiSquared)	Surface where crack is (ChiSquared)	Crack Width	Crack Length	Crack Length in Box	Sheet Height	Weathering Index Minimum	Weathering Index	Weathering Index Maximum
RF:S1 vs. RF:S2	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000
RF:S1 vs. RF:S3	0.000	0.000	0.221	0.381	0.311	0.374	0.009	0.008	0.008
RF:S2 vs. RF:S3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
North Sites vs South Sites	0.000	0.000	0.054	0.395	0.017	0.140	0.427	0.394	0.369
East Sites vs West Sites	0.000	0.000	0.054	0.395	0.017	0.140	0.427	0.394	0.369
RF-1 vs RF-2	0.000	0.000	n/a	0.050	0.030	0.012	0.008	0.012	0.020
RF-1 vs RF-3	0.000	0.000	n/a	0.096	0.117	0.012	0.000	0.000	0.000
RF-1 vs RF-4	0.000	0.000	n/a	0.373	0.049	0.013	0.009	0.009	0.012
RF-1 vs RF-5	0.000	0.000	n/a	0.088	0.061	0.007	0.430	0.498	0.436
RF-2 vs RF-3	0.000	0.000	0.055	0.173	0.017	0.452	0.000	0.000	0.000
RF-2 vs RF-4	0.000	0.000	0.196	0.151	0.306	0.417	0.420	0.467	0.487
RF-2 vs RF-5	0.000	0.000	n/a	0.319	0.131	0.342	0.000	0.000	0.001
RF-3 vs RF-4	0.000	0.000	0.140	0.238	0.101	0.456	0.000	0.000	0.000
RF-3 vs RF-5	0.000	0.000	n/a	0.394	0.141	0.219	0.000	0.000	0.000
RF-4 vs RF-5	0.000	0.000	n/a	0.215	0.344	0.181	0.000	0.000	0.000

TABLE 28: STEDENT T.TEST-COMPRESSIVE STRENGTH

Location	T.Test	Location	T.Test	Location	T.Test
FA vs RF	0.000				
FA vs. SM	0.000				
RF vs SM	0.000				
All N:S1 vs All S:S1	0.000				
All N:S2 vs All S:S2	0.000				
All N:S3 vs All S:S3	0.000				
All E:S1 vs All W:S1	0.000				
All E:S2 vs All W:S2	0.343				
All E:S3 vs All W:S3	0.018				
FA:S1 vs. FA:S2	0.000	**RF:S1 vs. RF:S2**	0.017	**SM:S1 vs. SM:S2**	0.000
FA:S1 vs. FA:S3	0.000	**RF:S1 vs. RF:S3**	0.00	**SM:S1 vs. SM:S3**	0.000
FA:S1 vs. FA:S4	0.000	**n/a**	n/a	**n/a**	n/a
FA:S2 vs. FA:S3	0.000	**RF:S2 vs. RF:S3**	0.033	**SM:S2 vs. SM:S3**	0.076
FA:S2 vs. FA:S4	0.000	**n/a**	n/a	**n/a**	n/a
FA:S3 vs. FA:S4	0.000	**n/a**	n/a	**n/a**	n/a
North Sites vs South Sites	0.000	**North Sites vs South Sites**	0.000	**North Sites vs South Sites**	0.000
East Sites vs West Sites	0.000	**East Sites vs West Sites**	0.000	**East Sites vs West Sites**	0.009
FA-1 vs FA-2	0.344	**RF-1 vs RF-2**	0.014	**SM-1 vs SM-2**	0.000
FA-1 vs FA-3	0.000	**RF-1 vs RF-3**	0.001	**SM-1 vs SM-3**	0.002
FA-1 vs FA-4	0.002	**RF-1 vs RF-4**	0.002	**SM-1 vs SM-4**	0.000
FA-1 vs FA-5	0.000	**RF-1 vs RF-5**	0.328	**SM-1 vs SM-5**	0.029
FA-2 vs FA-3	0.000	**RF-2 vs RF-3**	0.000	**SM-2 vs SM-3**	0.000
FA-2 vs FA-4	0.002	**RF-2 vs RF-4**	0.393	**SM-2 vs SM-4**	0.027
FA-2 vs FA-5	0.000	**RF-2 vs RF-5**	0.008	**SM-2 vs SM-5**	0.027
FA-3 vs FA-4	0.142	**RF-3 vs RF-4**	0.000	**SM-3 vs SM-4**	0.000
FA-3 vs FA-5	0.000	**RF-3 vs RF-5**	0.000	**SM-3 vs SM-5**	0.000
FA-4 vs FA-5	0.000	**RF-4 vs RF-5**	0.000	**SM-4 vs SM-5**	0.000