STONE MOUNTAIN, GEORGIA: A CREATION GEOLOGIST'S PERSPECTIVE

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Abstract

Stone Mountain is an exposed granitic pluton, located in Northeast Georgia. Uniformitarian estimates suggest that the granite was intruded into overlying metamorphic rocks during the last stages of the Alleghenian Orogeny. Later the mountain became exposed at the earth's surface. The uniformitarian model for the formation of Stone Mountain remains unresolved. This paper presents an interpretation, using the young earth Flood model, for the origin of Stone Mountain which would predict its formation and exposure during the Flood event.

Introduction

The Appalachian Mountains form a belt stretching from northeast Alabama to Newfoundland. The mountains are usually separated into northern and southern arcs. It has been proposed that the Southern Appalachian mountain arc has undergone several orogenic events resulting in the complicated folding and faulting of the associated rocks (Cook, Brown and Oliver, 1980, pp. 152-153; Dallmeyer, 1978, 124; Windley, 1977, pp. 183-192). The core of the Southern Appalachian Inner Piedmont is composed of a high-grade migmatitic assemblage of biotite gneiss, granites and granitic gneiss, and minor but widespread amphibolite (Dallmeyer, 1978, p. 127). The Inner Piedmont granitic rock types are associated with an intrusive magma, a molten rock generated deep within the earth's crust. The molten granite rises toward the earth's surface but fails to erupt due to a variety of causes (e.g., heat loss, orogenic activity ends, loss of fluids, etc.). The magma then cooled in the subsurface and solidified into large masses of intrusive granitic rock, called plutons.

Stone Mountain is one such pluton and it is exposed at the earth's surface. The current uniformitarian model for the emplacement and exposure of Stone Mountain remains in question. The uniformitarian model will be presented to the reader in an effort to show how some of this data can be used to support the young earth Flood modeler in reconstructing events in earth's past relating to the formation and exposure of Stone Mountain. Specifically, this paper will discuss the formation of Stone Mountain within the context of the Flood model, which this author believes offers a better model for the emplacement and exposure of Stone Mountain. Age dates used in this paper will reflect those presented within the uniformitarian literature. However, the author does not accept the uniformitarian assumptions or dates as presented and will suggest a chronology within the young earth Flood model. A glossary of terms is provided to aid the reader in understanding some of the geologic terminology used in this article.

Stone Mountain

Stone Mountain is one of many granitic plutons exposed in Georgia (Figure 1). Stone Mountain, located approximately 16 miles east of Atlanta, Georgia, rises approximately 780 feet above the generally flat to slightly rolling land surface, forming a geomorphic feature called a monadnock (Figure 2). The mountain

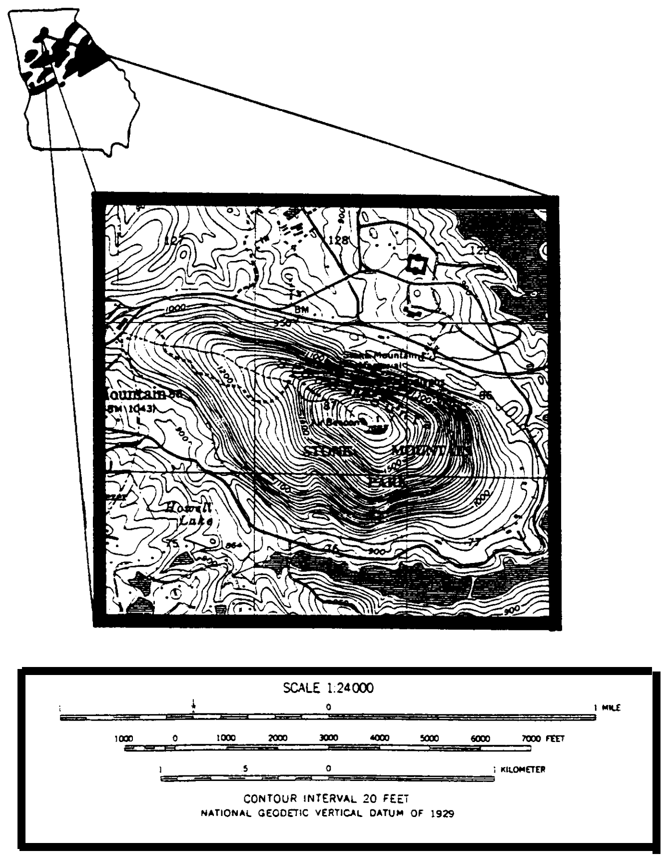

Figure 1. State of Georgia with shaded areas of igneous outcrop and U.S. Geological Survey topographic map showing elevation and features of the Stone Mountain pluton.

is observable from tens of miles away and is surrounded, at ground level, by metamorphic rocks and "Stone Mountain Granite." The highest point of the mountain is 1683 feet above sea-level. Questions remain as to how much overlying rock (termed overburden) once covered the mountain. The overburden thickness has been estimated as 2 to 10 miles (Anonymous, 1987; Grant, 1986, p. 285; Whitney, Jones and Walker, 1976, p. 1067; Atkins and Joyce, 1980, p. 1). The removal of the overburden is a very important point in the reconstruction for the exposure of Stone Mountain. It is proposed to have been removed through slow uniformitarian weathering processes and uplift. These points are key points of separation between the two models.

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Figure 2. Stone Mountain rises approximately 780 feet above the surrounding land surface. One building on top of the mountain, seen in this picture, is six stories high.

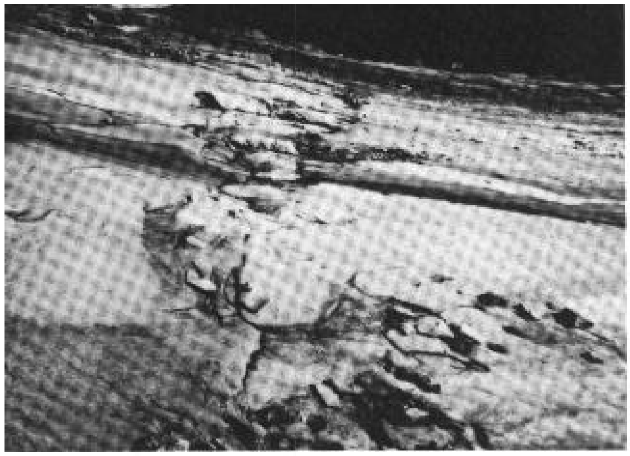

Figure 3. Flow structures seen on east end of the mountain. These structures suggest that the granite might have been intruded in pulses, as opposed to one event. However, the author suggests these structures indicate compression of the granite in a semi-solid state.

Origin

The original sediments which, through heat and pressure, altered into a granitic magma, and which now form Stone Mountain are believed to have been derived from clastic (i.e., sandy to argillaceous) sediments possibly combined with volcanic flows or ash deposits (Grant, 1962, p. 5: Herrmann, 1954, pp. 78-79). Tectonic and orogenic events associated with the formation of the Southern Appalachians resulted in the transformation of the original clastics into metamorphic rocks. The formation of the metamorphic rocks, which account for much of what is believed to have been overburden, date to Precambrian time (Herrmann, 1954, p. XV).

Stone Mountain is believed to have been intruded in the last orogenic event (Alleghenian Orogeny) associated with the Southern Appalachians. For a suggested uniformitarian chronology of events associated with the formation of Stone Mountain, see Appendix I.

According to Whitney et al. (1976, p. 1073), the Stone Mountain Granite was intruded into the Lithonia Gneiss and the overlying metamorphic rocks during the Late Pennsylvanian Period. This age date correlates directly with a belt of intrusives in South and North Carolina identified as the “300 Ma old group” (Fullagar, 1971, pp. 2856-2857; McSween, Speer and Fullagar, 1991, pp. 121-125).

Stone Mountain Granite may represent an anatectic granite which was possibly derived from the surrounding metamorphic rock. However, serious questions remain and the source rock for the Stone Mountain pluton and surrounding granitic rock mass remains an unresolved mystery (Grant et al., 1980, p. 52).

Flow structures developed during the intrusion of the pluton which include flowage foliation, mica fluctuation about an axis of rotation, and parallel orientation of micaceous autoliths (Herrmann, 1954, p. XV). These flow structures are also believed to show that the mountain was not intruded in one event, but rather in several pulses, reflected by the occurrence of flow-banded autoliths which represent an earlier cooling period [Figure 3] (Grant 1962, p. 6; Grant et al., 1980, p. 47; Grant 1986, p. 286).

According to Grant et al. (1980, p. 48), the magma intruded from the east into previously folded metamorphic rocks, as indicated by fold structures. However, it is also possible that the granite was intruded upward through northwest trending dikes (Grant, 1986, p. 286). The intrusion possibly started with the formation of a small, probably basally flattened ellipsoidal mass of magma (Grant et al., 1980, p. 48). The magma expanded parting the country rock into thin sheets. With further intrusion and expansion the country rock would be broken into xenoliths (Figure 4), which were carried outward and away from the initial point of intrusion (Grant et al., 1980, p. 48). The magma is believed to have cooled from west to east as indicated by mica growth in xenoliths found on the east end of the mountain, but not on the west end.

Questions remain regarding the rates of both uplift and erosion. An evaluation of the data shows confusing emplacement depths and uplift and erosional rates. For example, uplift is believed to have played a role in the exposure of Stone Mountain. Erosion alone could only have removed 6 to 8 km (3.7 to 5 miles) of overburden (Dallmeyer, 1978, pp. 142-143; Whitney et al., 1976, p. 1076). The remaining 10 to 15 km (6.2 to 9.3 miles) of overburden is believed to have been

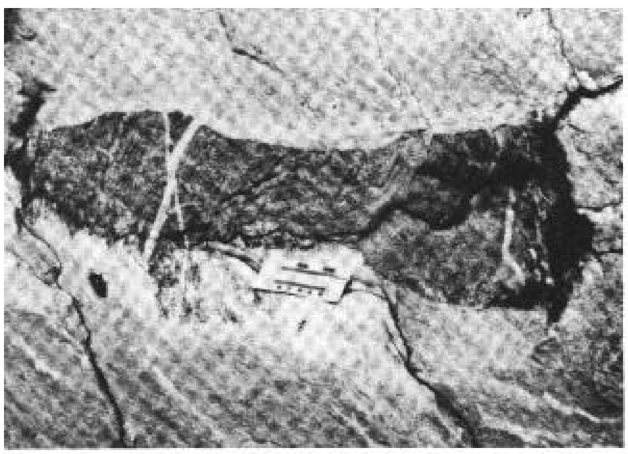

Figure 4. Xenolith of banded biotite gneiss cross-cut by quartz-felspar dikes. Scale in inches and centimeters.

removed by subsequent uplift, but this remains unproven. These numbers do not add up and this reflects just one point of weakness in the uniformitarian model for the formation of Stone Mountain.

As previously mentioned, the rate of uplift remains unresolved. According to Dallmeyer (1978, p. 142), the Stone Mountain pluton was uplifted 37,729 feet (7.1 miles) over 71 Ma. Debate exists as to when Stone Mountain became exposed at earth's surface. Dallmeyer (1979, pp. 141-143) has proposed that Stone Mountain became exposed around 220 Ma ago and offers the Late Triassic unconformity between the crystalline rocks and nonmarine elastic rock within the Dan River Basin of North Carolina as evidence. Atkins and Joyce (1980, p. 1) suggest that the mountain became exposed only 15 Ma ago.

Granitic Composition

Stone Mountain, a leucocratic admellite or quartz monzonite (Herrmann, 1958, p. 29; Whitney et al., 1976, p. 1067), ranges in compositional variation between a granite (nearly equal amounts of quartz, alkali feldspar and plagioclase) to granodiorite (containing equal amounts of quartz and plagioclase with 10% to 25% alkali feldspar) [Grant, Size and O'Connor, 1980, p. 43].

Two divergent opinions exist for the formation of Stone Mountain Granite. According to Whitney et al. (1976, p. 1071), in terms of mineralogy and major and minor-element chemistry, Stone Mountain Granite has a highly differentiated composition brought about by fractional crystallization and fractional melting. This has resulted in a granite of homogenous peraluminous composition, lacking chemically related mafic lithologies. However, according to Grant et al. (1980, p. 44), the wide range in silica composition for the Stone Mountain Granite is believed to represent repeated periods of anatectic granite-melt emplacement rather than indicating a trend in magma differentiation. These conflicting models for the granitic magma source reveal to the reader that serious questions remain regarding a suitable source material.

The minerals which compose the Stone Mountain Granite are described as fine to medium-grained. The granite is composed of quartz, plagioclase feldspar, microcline and muscovite with a minor amount of brown biotite and small tourmaline clusters (Herrmann, 1954, p. 30; Grant et al., 1980, p. 43). The grain size of those minerals, which compose the granitic rock, is believed to be a function of the amount of time that magma has to cool. The faster that magma cools the smaller the grain size of the minerals which form. Stone Mountain granitic rock mineral grain size ranges from 1 to 4 mm (Grant et al., 1980, p. 43). An interesting feature of Stone Mountain Granite is that the grain size is equigranular across the entire mountain. This suggests that the mountain cooled quickly and uniformly. Additionally, the granite exhibits flow banding at several areas across the mountain (Grant, 1986, p. 287). This implies that as the magma was flowing as it was cooling and forming minerals. This movement would serve to expose greater surface area to cooling by the surrounding country rock. Yet with cooling occurring across the granitic mass, the granite retained its uniform granular size and composition.

Xenoliths

Xenoliths are chunks of the original country rock in the granitic rock. The xenoliths found at Stone Mountain consist of biotite gneiss and amphibolite which are believed to be characteristic of the older metamorphic rocks which at one time covered the mountain [Figure 4] (Atkins and Joyce, 1980, p. 11). The lithology of the xenoliths varies and includes biotite and a muscovite-biotite with garnet mica schist (Grant et al., 1980, p. 47). Distribution of the xenoliths is irregular, with concentrations predominantly on the east and west ends of the mountain. Structures in xenoliths include schistosity and gneissic banding (Grant et al., 1980, p. 47).

Sheeting Structure

Sheeting structure is displayed over the entire surface of Stone Mountain. Individual sheets range from a fraction of an inch up to several feet or possibly even tens of feet in thickness (Hopson, 1958, p. 65). Sheet formation has been attributed to the release of overburden confining pressure, which has resulted in the expansion (dilation) of the granitic rock. Dale (1923, p. 30) found that newly quarried blocks of Stone Mountain granite expanded 0.1 percent in the direction of greatest confinement. Hopson (1958, p. 65) has reported sheets of Stone Mountain granite as thick as 12 feet. Sheet thickness has been found to increase with depth. The sheeting of the Stone Mountain Granite will vary due to uplift, warping, release of confining overburden, etc., and will contribute to the breakup and erosion of the mountain.

Jointing, Fracturing and Faulting

Jointing on Stone Mountain is generally poorly developed. Joint attitude measurements collected from different areas of the mountain show no preferential orientation for development [Figure 5] (Grant et al., 1980, p. 47). Joints and joint sets are believed to be caused by two different mechanisms. The first is due to stress during folding and the second is due to contraction of the cooling magma (Atkins and Joyce, 1980, p. 5). Some joints remain as unfilled cracks in the rock, while other joints have been filled with magma intruded later, forming dikes. The mineral composition of the dike is believed to reflect the rate at which they cooled. Aplite dikes form where fast cooling conditions existed (smaller rock crystal sizes), while pegmatite dikes (Figure 6) formed under more slow cooling conditions (larger rock crystal sizes). Additionally, a third type of dike exists at Stone Mountain. These dikes show no real zone of contact, rather these dikes blend into the surrounding granitic rock (Figure 7). These blended contacts suggest that the dike was intruded into the granite while the granite was still molten (Lahee, 1931, pp. 128-129). Also associated with the jointing are biotite schlieren, which appear to be the result of sheared xenoliths rather than magmatically formed concentrations of biotite (Figure 8). Both Mount Arabia, a migmatite dome to the south, and Stone Mountain show minor, late brittle faulting and mineralization along joints which is believed to be in association with intrusion of Triassic diabase dikes (Grant, et al., 1980, p. 41). Much like what was previously stated regarding sheeting, the jointing, fracturing and faulting will occur at various rates due to uplift, warping, breaking of

Figure 5. Jointing and weathering of granite has resulted in widening the joints and eroding the jointed rock into blocks.

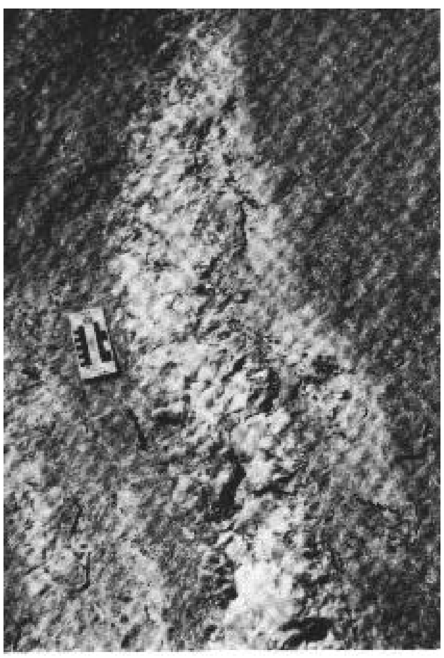

Figure 6. A mineralized fracture (i.e., dike) pegmatite. This pegmatite contains crystals of quartz, feldspar, muscovite and tourmaline. Scale in inches and centimeters.

Figure 7. Blended pegmatite dike. This dike does not show sharp contact with the surrounding granite, rather the contact grains blend together.

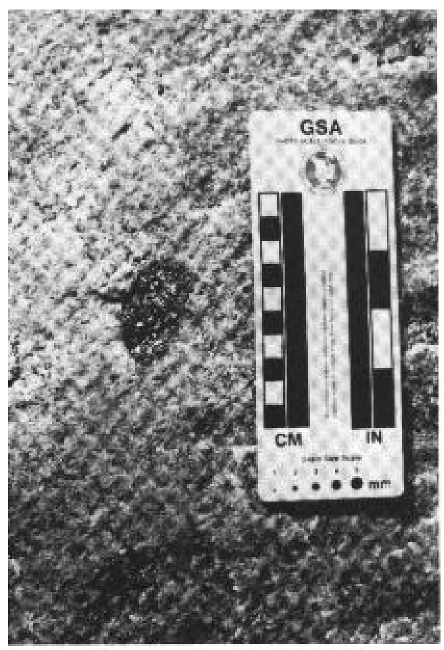

Figure 8. Biotite Schlieren. Heat and pressure are believed to have modified the original xenolith rock pieces into these biotite schlieren.

granitic sheets, release of confining overburden, etc., and will contribute to the erosion to the mountain.

Fractures are created by both physical (e.g. dilation, expansion and contraction due to temperature changes, freezing and thawing of the water within the fractures and exfoliation) and chemical (rainwater and plant acid dissolution of the minerals) processes (Figure 9). Fractures also serve as conduits or water movement and several areas of the park have natural flowing springs immediately following precipitation events (Figure 10).

Diabase Dikes

Sometime following the intrusion or intrusions of the granitic pluton into the surrounding country rock, another intrusive event occurred quite different from the previous ones. This intrusion was composed of diabase, a rock of basaltic composition (Figure 11). It is unknown

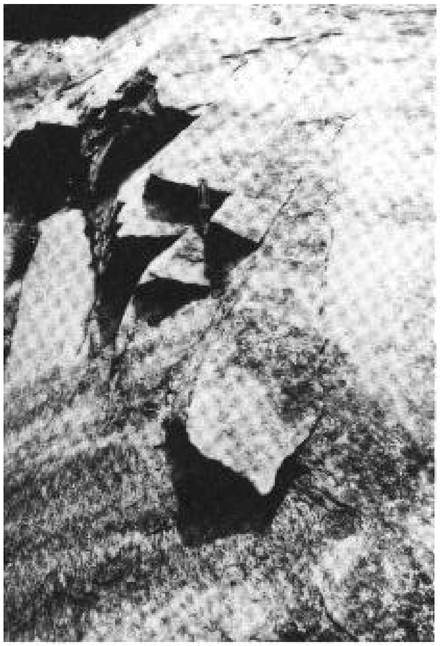

Figure 9. Joints, Fractures and sheeting are all represented in this figure. Scale in center of photo is 6.5 inches.

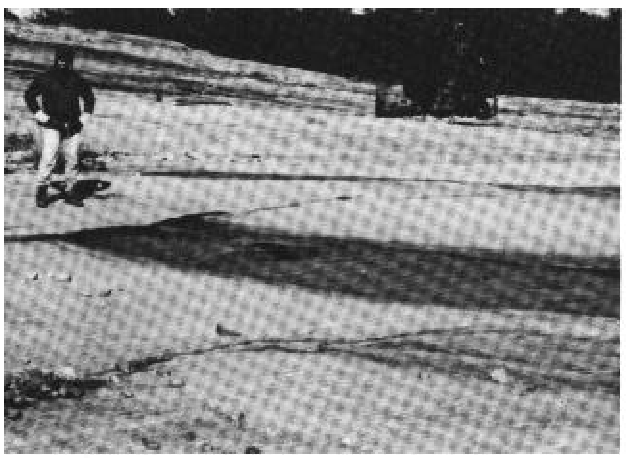

Figure 10. A spring flows from a fracture in the granite. Several areas in the Park exhibit fracture flowing springs following precipitation events.

whether this rock was derived from melted crustal rock or from deeper rock derived from the earth's mantle. The diabase dikes appear to trend in a northwest-southeast direction (Atkins and Joyce, 1980, pp. 12-13). These diabase dikes are associated with a Triassic age rift which occurred along the eastern side of the Appalachian mountains and are believed to have formed as a result of the breakup of the Pangaean supercontinent (Olsen, Froelich, Daniels, Smoot, and Gore, 1991, p. 142). A chronological reconstruction of the intrusive events associated with dikes is given in Appendix II.

Geomorphic Processes

Today the surface of the mountain is exposed to atmospheric erosional processes. Weathering begins with meteoric water percolating downward through vertical joints of tectonic origin and horizontally along sheet joints which are of dilation origin (Grant, 1963, p. 70). The jointing and fracturing aids in the exfoliation (thin sheets of rock which break off parallel to the surface of the exposed rock-like the skin of an onion) process of erosion, by breaking the rocks into blocks (Figure 12). Weathering enhances the exfoliation of the rock resulting in some cases, in the complete detachment of the block from the mountain (Figure 13). This exfoliation process was exploited by quarry workers when the mountain was a source of granite (Figure 14). Stone Mountain is now a Confederate Memorial Park and is no longer quarried for granite.

Today the mountain continues to exfoliate layers of granite from its surface (Figure 15). Additionally, many spall layers lie at the base of the mountain and reflect the fact that they were at one time a part of the mountain (Figure 16). Exfoliation is likely the greatest single

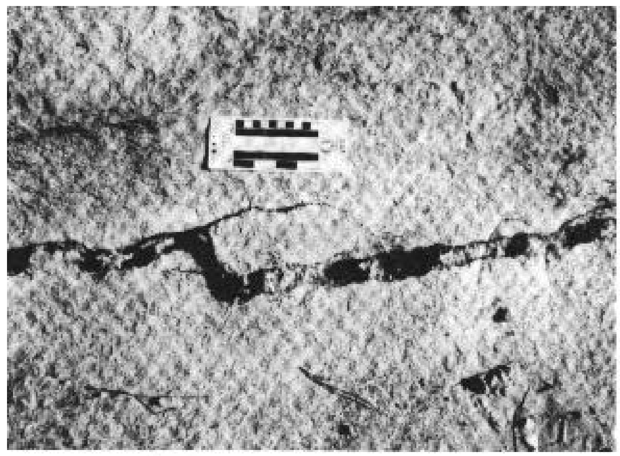

Figure 11. A diabase dike cuts through the granitic mass. Scale is in inches and centimeters.

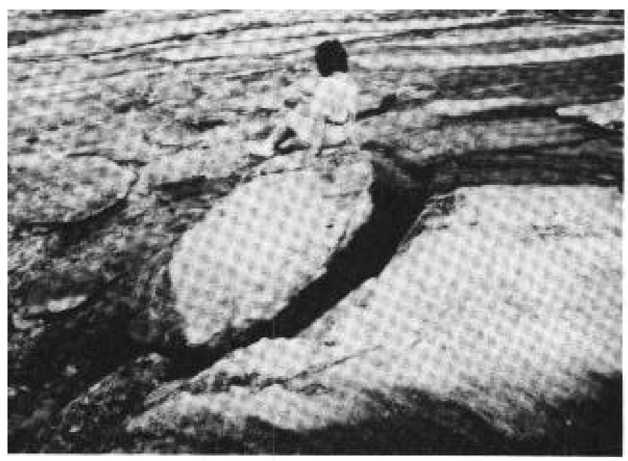

Figure 12. An exfoliated sheet of granite eventually breaks into blocks due to internal jointing and/or fracturing.

process controlling the dome shape of Stone Mountain (Grant et al., 1980, p. 43; Hopson, 1958, p. 73).

A weathering pattern particularly associated with the granite pavement is the pit and dome structure [Figure 17] (Grant, 1986, pp. 296-287). Domes form as

Figure 13. Blocks of granite lie on the mountain surface. These blocks, each weighing several tons, are completely detached from the mountain. At one time these blocks formed another layer of granite over the mountain. Perhaps this outer layer was removed by the Flood? The spall lying at the base of the mountain does not calculate to what is necessary to cover the mountain with another layer.

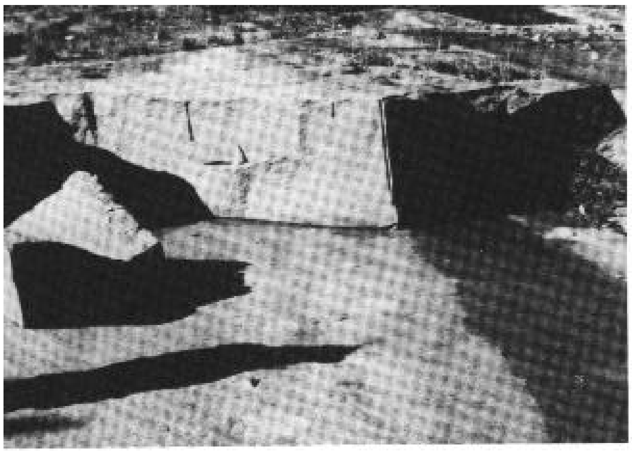

Figure 14. Drill holes mark the joint which the quarry workers used to break the granite for use as ornamental stone. Rock hammer rests on ledge in center of block, for scale. Note also the flowing water issuing from lower sheet surface.

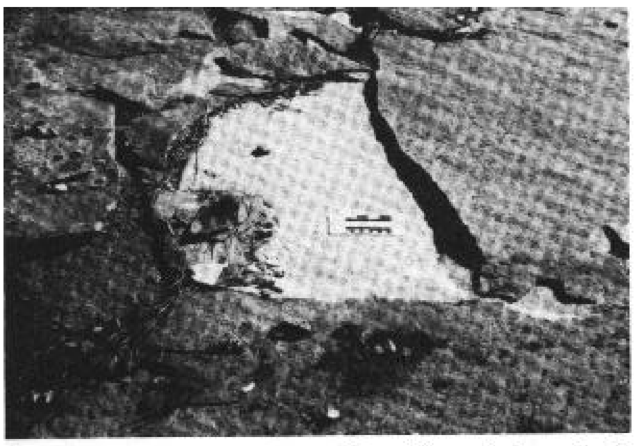

Figure 15. Exfoliation continues on Stone Mountain. Large sheets break from the granitic rock mass due to dilation, jointing and fracturing.

Figure 16. Large sheets of exfoliated granite lie at base of mountain. These sheets of rock, some weighing several tons, are post-Flood deposits.

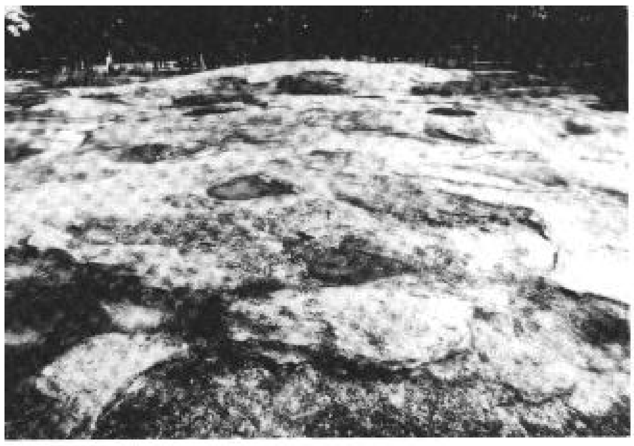

Figure 17. Pit and dome structure. Granite pavement weathers into pits and domes due to exfoliation and dilation.

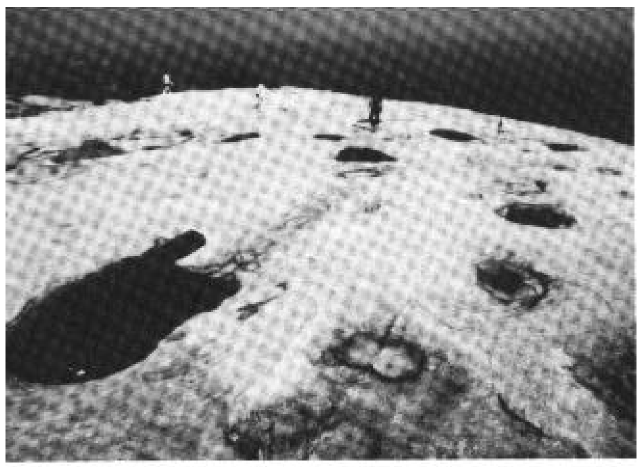

Figure 18. Vernal pools atop Stone Mountain. These pools are home to unique forms of plant and animal life.

areas around them erode into pits. They are believed to be formed by dilation and associated weathering (Grant, 1986, p. 285). The pits or depressions fill with water following precipitation events, turning them into vernal pools (Figure 18). Lammerts (1978) discusses the unique flora and fauna associated with vernal pools occurring in the western U.S. and their possible time of formation within the context of the Flood model. The vernal pools at Stone Mountain range in size from 6 inches to a few tens of feet in diameter and are also home to unique (but surprisingly similar to those discussed by Lammerts) forms of plant and animal life. Two different types of shrimp (i.e., clam and fairy) live in the clear freshwater pools during the rainy season (Anonymous, 1987). Smith (1941, pp. 117-127) found that the standing water in the depressions were acidic (Ph 5.0-5.4) due to plant activity. He further speculated that the acids contributed to the chemical weathering of the granite. Additionally, it is now recognized that acid rain exists, due to air pollution, at a Ph around the previously stated range and also contributes to the chemical weathering of the granite.

A second type of weathering pit has developed on Stone Mountain. These pits are small, elliptically shaped depressions which aligned parallel to the flow structure of the granite [Figure 19] (Herrmann, 1954, p. 6: Hopson, 1958, pp. 72-73). This author believes that these secondary elliptical pits also weather to form vernal pools seen on the mountain.

Rocks exposed at the top of the mountain are subject to freezing and thawing (winter months) and heating and cooling (summer months). The freezing and thawing weathering process is believed to have created a weathering pattern similar to what is seen on the Antarctic continent (Figure 20). Differential erosion occurs where there is a variation in rock composition. This has occurred where the granite has weathered away around the harder tourmaline crystals, creating a pimple like surface (Figure 21). Additionally, wind blown sand contributes in a minor way to the erosion of the mountain by abrasion.

According to Hopson (1958, pp. 75-79), intergranular wedging by crystallizing salts and expansion of mineral grains accompanying hydration are probably the two most effective weathering mechanisms working to break down the granite. According to Hopson (1958, pp. 75-79), Stone Mountain granite is no longer considered of sufficient grade or quality for use as monumental stone due to its low resistance to weathering. The granite has been shown to weather rapidly in a moist environment. The granite weathers into sheets and / or blocks, which further weathers to form a saprolite (i.e., soil).

Saprolite develops as a result of weathering of the granitic or basaltic rock. Weathering of the granite produces a saprolite composed predominately of kaolinite, with minor amounts of endellite, quartz, muscovite and microcline (Grant, 1963, p. 70). The saprolite is usually white and structureless, containing disseminated muscovite flakes [Figure 22] (Herrmann, 1954, p. 5). where diabase dikes (i.e., basalt) are present the saprolite develops a deep red color, due to the iron content of diabase, which oxidizes.

The relatively thin layer of saprolite overburden on and around Stone Mountain (ranging from 0 to 8 feet)

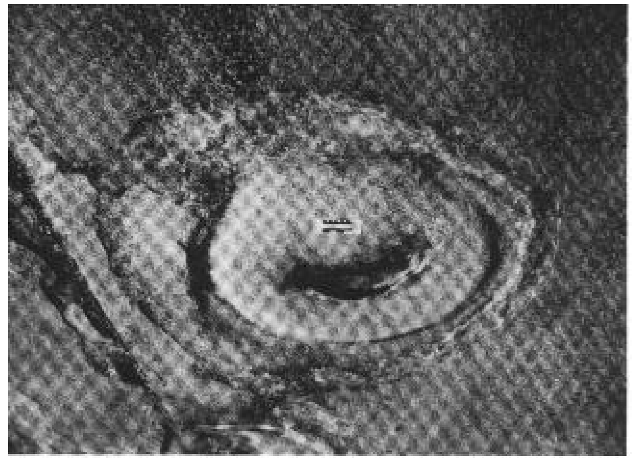

Figure 19. Secondary weathering feature. Scale is in inches and centimeters.

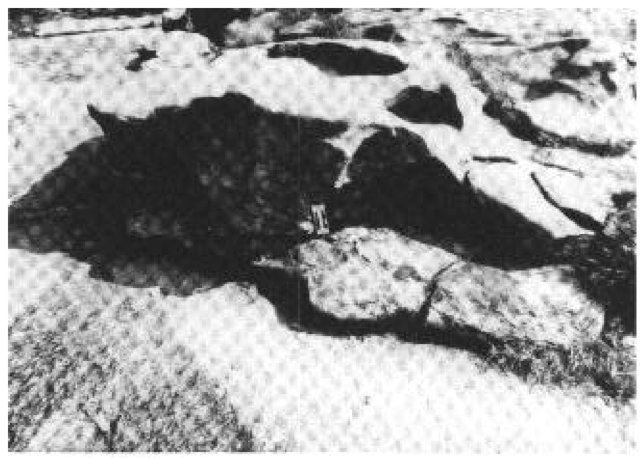

Figure 20. Weathering not only occurs along top and bottom of rock but also along the sides of the granite. This same weathering feature is seen in granitic rock on the Antarctic continent and is called case hardened or core softened granitic weathering. It is believed to be caused by the freeze/thaw cycle.

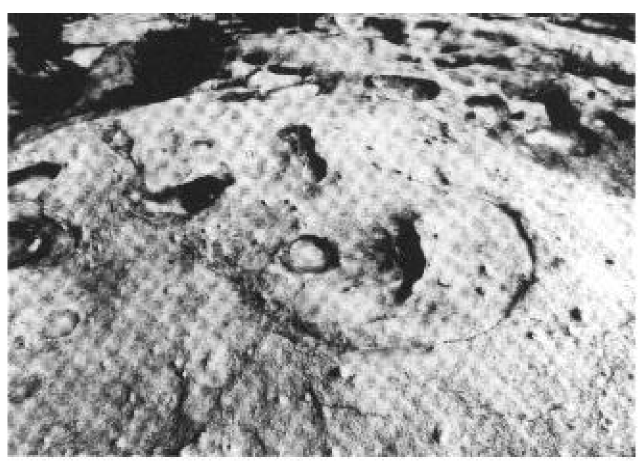

Figure 21. Tourmaline crystals are harder than the surrounding granitic rock and as a result they weather more slowly and create raised bumps on the granite pavement. Also note secondary weathering patterns and dry pits.

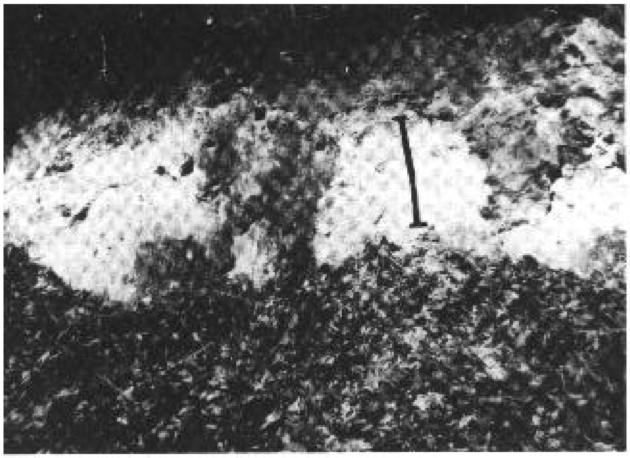

Figure 22. White saprolite which is derived from weathered Stone Mountain Granite. Scale is 3.5 feet (The rod in the photograph has been retouched for clarity). Saprolite at this locale was approximately 6.5 feet thick. The top 2 feet of saprolite has a light brown color due to organic activity.

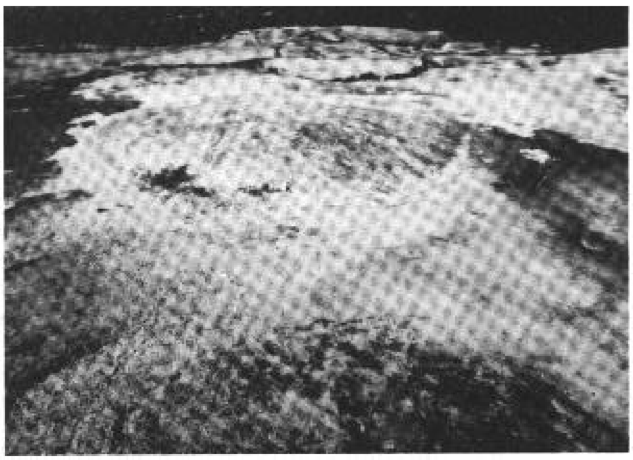

Figure 23. Sand dome atop Stone Mountain. Saprolite has accumulated in a depression on top of Stone Mountain forming a dome approximately 12 feet in diameter by 2 feet high.

Figure 24. Pit and dome structure showing a sand filled vernal pool in the foreground and a plant community in the adjacent vernal pool in the background.

reflect, in the author's opinion, the short amount of time that has been available for soil to develop. The author believes that greater saprolite development should have occurred if the 15 Ma exposure time is used, and especially if the 220 Ma date is correct.

On the mountain pavement, the eroded sand size particles accumulate in areas of low relief behind large objects which block the wind (Figure 23). With a sufficient buildup of this soil, plant life is able to establish itself and grow (Figure 24). Due to the increase in organic content in the soil, the white saprolite changes to a gray and/or black color (Herrmann, 1954, p. 5). Studies of the soils show an increase in clay mineral content with soil thickness (Grant, 1986, p. 287).

Creationist Interpretation

The author supports Gentry's (1988, p. 133; pp. 194-195) position regarding the formation of granites during the creation week (e.g., granite cores of the proto-Southern Appalachians) and again during the Flood event (e.g. Stone Mountain Granite). From a creation geologist's perspective the Appalachian mountains might have had their beginnings when land was first separated from the waters during the creation week (Genesis 1:9). Uniformitarian geoscientists have classified the Appalachian granites in Georgia into either older or younger intrusives, with the Stone Mountain Granite falling into the younger category (Crickmay, 1952, p. 34). It is further believed that Stone Mountain was intruded at or near the end of the regional deformation (Alleghenian Orogeny) associated with the Southern Appalachians (Grant, 1962, p. 6; Grant et al., 1980, p. 41).

According to McQueen (1987, p. 247), the orogenic activity associated with the formation of the Appalachian mountains took place over a six month timeframe towards the end of the Flood event; he defines this time interval as Phase III. McQueen did not differentiate between the uniformitarian orogenic events associated with the deformation of the Southern Appalachian mountains (i.e., Late Precambrian/Cambrian, Taconic, Acadian and Alleghenian orogenies). The author believes that one or more of the above referenced orogenies could be associated with the Creation week and the remaining orogenies could be associated with the Flood event. According to Whitcomb and Morris (1961, p. 9), the Flood waters began to recede beginning on the 150th day. The decrease in water level could directly relate to tectonism via seafloor spreading, continental collisions and tensional lateral plate movements. The author supports McQueen's position for the formation of the Stone Mountain pluton towards the end of the Alleghenian Orogeny (defined by this author as a late Flood orogenic event) in association with the latter stages of the Flood event. Additionally, this author believes that the Stone Mountain granitic magma formed as a result of the mixing of some remelted original primordial granite with melted surrounding rocks and sediments (Gentry, 1988, pp. 184-185). This could explain why the Stone Mountain Granite is compositionally different from all of the other granites in the area.

The author suggests that possibly the source magma of Stone Mountain was derived from deep within the crust during the tectonic event identified as the Alleghenian Orogeny (a Flood generated orogenic event). Tremendous heat and pressure were generated during this event and the author believes that two separate magmas were created, one being the crustal felsic or granitic magma (of which Stone Mountain is composed) and the other being the mantle mafic or basaltic magma (of which the basalt dikes are composed). Initially the lighter and larger felsic magma would rise quickly being intruded into the metamorphic overburden. The smaller slower rising mafic magma would be later intruded into the cooling semi-solid granitic rock mass and any metamorphic country rock not eroded by Flood waters, thus providing both granitic rock and basaltic dikes. Support for my suggestion comes from the fact that the Southern Appalachian Mountains and all of the orogenic events associated with their formation are viewed (by uniformitarian research) as having occurred as a result of stacking and shuffling of relatively thin sheets of crustal material and all basaltic rock is viewed as being derived from the earth's mantle (Cook et al., 1980, pp. 139-155). The diabase intrusions into the Stone Mountain Granite are believed to have occurred during a rifting period in the Triassic (also a Flood generated orogenic event). Additional research and field work is necessary to reconstruct how this event occurred and the diabase was emplaced.

The formation of granitic rock remains a mystery for geologists. Gentry (1988, p. 131) has pointed out that with all of the volcanic activity across the earth, geologists have yet to show how granites crystallize from a granite melt. Even today there is no way of recreating in the laboratory how granite forms in the subsurface. So the question of how and why granites form coarse grained structures as opposed to fine grained structures remains an enigma.

Granitic rock is commonly characterized by grain size and composition and the Stone Mountain Granite is no exception. What is interesting is in the fact that Stone Mountain Granite is the same, both in grain size and mineral composition, from the east end to the west end of the mountain (a distance of approximately 1.9 miles). Normally magmatic masses are said to cool over millions of years and vary in composition due to differentiation of the cooling magma. Stone Mountain does not show any differentiation in granitic composition. The author believes that the homogeneity of the granite reflects rapid emplacement. At a later time additional intrusive events occurred resulting in pegmatite and aplite dikes and later still the diabase dikes which cross-cut the granite.

The amount of time suggested by the previously cited authors for the cooling and exposure of the Stone Mountain granite (i.e., 71 Ma) is quite rapid considering the timeframe for its emplacement and subsequent exposure. The overburden and surrounding rocks, which at one time covered the pluton, are gone (Figure 2). Today, when looking at Stone Mountain, two obvious questions come to mind: Where did all the overlying and surrounding sediments go and when did it happen?

Once again, from the creationist perspective, the Flood event was a time of intensive tectonic (orogenic) activity. Magma, created as a result of plate tectonic collisions and associated heat and pressure, would have been squeezed into the overlying rocks, causing them to be uplifted. The author believes that Flood waters eroded away both the overlying and surrounding sediments and rock from the quickly cooling granitic pluton. Eventually, due to the rapid erosion which was occurring, the cooled mountain surface would be exposed to the Flood waters which would further erode the granitic mass. With the release of the overburden weight (which served to compress the cooling magma mass) the mountain would expand, resulting in exfoliation. The Flood waters might even have eroded away the outer exfoliated layers of the exposed granitic surface. The end of the Flood event and subsequent draining of the waters to the ocean basins would place the mountain and surrounding land surface at close to present conditions. The ensuing ice age would contribute increased precipitation to the mountain and surrounding metamorphic rock surface, resulting in the formation of saprolite (i e., soils) on which plant life would reestablish itself. An oak hickory forest climax could have developed around the base of the mountain in as little as 150 years following the Flood, provided that sufficient soil developed rapidly enough to support such a forest [Figure 25] (Odum, 1971, p. 261). The reader must realize that this is a "catastrophic" interpretation as to events which happen during the Flood event. Many questions and issues remain to be resolved, however, this model is a starting point.

Conclusion

Stone Mountain provides witness to orogenic events of monumental proportion which have occurred in earth's past. I believe that Stone Mountain formed and was exposed as a result of the events associated with the Flood event described in Genesis. The mountain we see today has not been exposed due to peneplaination, but rather has been exposed due to erosion during and following the Flood event. The forest which grows on and around the mountain has adapted to the shallow nature of the saprolite or soils which have formed above the underlying rocks from the Ice Age to present timeframe.

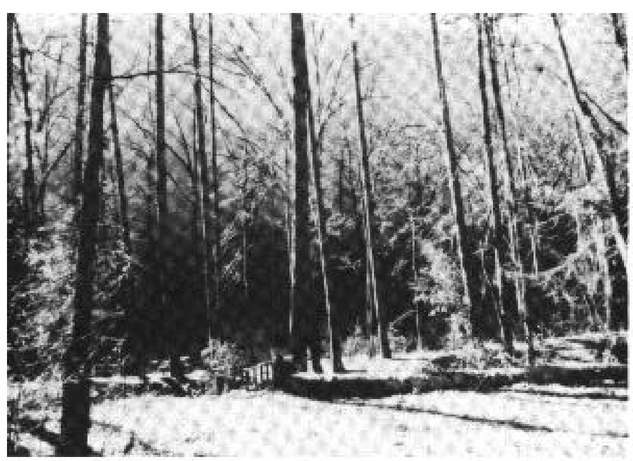

Figure 25. Climax Hardwood forest at the base of the mountain. This forest exists at the base of the mountain in no more than 2.5 feet of soil. Trees are approximately 35 to 45 feet tall. Stone Mountain is immediately in background and provides the dark backdrop.

Appendix I
Uniformitarian Chronology for the Formation and Exposure of Stone Mountain

Dallmeyer (1978, p. 142) has suggested the following chronology of events associated with the formation of Stone Mountain (parenthesis mine):

1. At ~365 Ma the present erosional level (i.e., land surface as exists today) was at a depth between 23 (14.3 miles) and 29 km (19 miles) and maintained at a metamorphic temperature of ~725°C (1337°F).
2. At ~325 Ma temperatures had dropped below those required for argon retention in hornblende (for argon dating purposes).
3. At ~300 Ma temperatures had dropped below those required for argon retention in biotite (for argon dating purposes).
4. At ~291 Ma the Stone Mountain granite was emplaced at a depth of ~12 km (7.5 miles).
5. By approximately the Late Triassic (~220 Ma) the present erosional level was nearly exhumed.

Appendix II
Cross-cutting Relationships

The Law of Cross-cutting Relationships forms the basis for the chronological reconstruction of an intrusive event into the surrounding country rock. However, this law does not give an absolute age date for the event, it only gives a "what came first" chronology, or relative date. Age dating by radioactive techniques serves to further "refine" the age of the rock. Age dating of Stone Mountain Granite has been done by Pinson, Fairburn, Hurley, Herzog and Cormier (1959, pp. 58-60) and Long, Kulp and Eckelmann (1959, pp. 595-603), using biotite and muscovite, respectively. The biotite was analyzed using the Rubidium-Strontium method and was found to be approximately 280 +/- 14 Ma old. The muscovite was analyzed using the Potassium Argon method and was approximated as 294 +/- 10 Ma old. Standard uniformitarian radioactive dating assumptions were used in both dating techniques and both reinforce the Pennsylvanian/Permian date presumed to be the time of intrusion.

This information is presented to show how the Law of Cross-cutting relationships is used, in this case, to reinforce the preexisting uniformitarian timescale. The youngest rock cross-cut by an intrusion is older than the intrusion and serves as the beginning point for an age date determination of the intrusion. The scale used in age determination is the evolutionary uniformitarian timescale. Hence any radioactive dating method used will seek to reinforce the already accepted Pennsylvanian/Permian date.

Glossary

Admellite—A variety of granite containing a calcium-bearing plagioclase, usually oligoclase and a potassium feldspar in roughly equal amounts.

Anatectic/Anatexis—A high-temperature metamorphic process by which plutonic rock in the deeper levels of the crust is dissolved and regenerated as a magma.

Aplite—A dike rock consisting essentially of quartz and alkali feldspar, with a fine-grained, sugary texture.

Autolith—An inclusion or fragment of older igneous rock that is genetically related to the rock and has partially melted and mixed with the rock.

Country Rock—A general term applied to rocks invaded by and surrounding an igneous intrusion.

Diabase—A rock of basaltic composition, consisting essentially of labradorite and pyroxene, and characterized by ophitic texture.

Dike—A tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks. Although most dikes result from the intrusion of magma, some are the result of metasomatic replacement.

Dilation—The expansion of the rock mass following the removal of the overburden confining pressure, usually resulting in exfoliation.

Exfoliation—(also known as spalling or sheeting) The breaking of sheets of rock from the surface of the same rock by the action of either physical or chemical forces.

Fault—a fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture.

Felsic—applied to light-colored rocks containing quartz, feldspars, feldspathoids and muscovite.

Gneiss—A coarse-grained rock in which bands rich in granular minerals alternate with bands in which schistose minerals predominate.

Igneous—Formed by solidifaction from a molten or partially molten state. Rocks formed in this manner have also been called plutonic rocks.

Joint—Fracture in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.

Law of Cross-cutting Relationships—A stratigraphic principle whereby relative ages of rocks can be established. An igneous rock is younger than any rock across which it cuts.

Leucocratic—A term applied to light-colored igneous rocks which contain from 0 to 30% dark minerals.

Mafic—Pertaining to or composed dominantly of the magnesian rock forming silicates. Synonymous with "dark minerals"

Metasomatism—The processes by which one mineral is replaced by another of different chemical composition due to reactions set up by the introduction of material from external sources.

Migmatite—Rock consisting of a composite of igneous or igneous looking and/or metamorphic materials.

Monadnock—A residual rock, hill or mountain standing above a peneplain.

Monzonite—A granular plutonic rock containing approximately equal amounts of orthoclase and plagioclase.

Ophitic—A term applied to a texture characteristic of diabases or dolerite in which euhedral or subhedral crystals of plagioclase are embedded in a mesostasis of pyroxene crystals, usually augite.

Orogeny—The process of forming mountains.

Overburden—Material of any nature, consolidated or unconsolidated, that overlies the geologic object of interest.

Pegmatite—Igneous rocks of coarse grain found usually as dikes associated with plutonic rock of finer grain size.

Peneplain—A land surface worn down by erosion to a nearly flat or broadly undulating plain.

Peraluminous—In the Shand classification of igneous rocks, a division embracing those rocks in which the molecular proportion of alumina exceeds that of soda, potash and lime combined.

Pluton—A body of igneous rock that has formed beneath the surface of the earth by consolidation from magma.

Saprolite—A soft, earthy, clay-rich, thoroughly decomposed rock formed in place by chemical weathering of igneous or metamorphic rocks.

Schist—A medium or coarse-grained metamorphic rock with subparallel orientation of the micaceous minerals which dominate its composition.

Schlieren—Tabular bodies, generally a few inches to tens of feet long, that occur in plutonic rocks. They have the same general mineralogy as the plutonic rocks, but because of differences in mineral ratios they are darker or lighter; the boundaries tend to be transitional.

Tectonic—Pertaining to or designating the rock structure and external forms resulting from the deformation of the earth's crust.

Xenolith—Rock fragments of surrounding country rock which are unmelted in the original intrusive rock.

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