APPARENT VOLCANIC CYCLES IN THE ARCHEAN SWAZILAND SUPERGROUP, BARBERTON MOUNTAIN LAND, SOUTH AFRICA: A RESULT OF NON-MAGMATIC PROCESSES, Gary R. Byerly, Donald R. Lowe, Bruce W. Nocita, and Barbara L. Ransom, Department of Geology, Louisiana State University, Baton Rouge, Louisiana 70803 USA

Rocks of the 3.5 to 3.1 billion year old Swaziland Supergroup are perhaps the oldest well preserved supracrustal sequence available for studies of the early evolution of the earth. The lower 8 km of the sequence is made up of ultramafic to mafic lavas, minor intrusives, and rare felsic lavas. The middle 8 km, the Hooggenoeg and Kromberg Formations, has previously been described as mafic to felsic volcanic cycles with minor sedimentary units. About 2 km of argillaceous Fig Tree Group sediments lie on top of these volcanic units. The Fig Tree Group includes minor repetitions of ultramafic to felsic cycles throughout. The Fig Tree sediments are overlain by a 500 m or more thick unit composed of intermediate volcaniclastic sands and breccias. This upper volcanic unit appears to grade into the uppermost 3 km of the sequence which is the arenaceous Moodies Group.

Geological studies currently underway at LSU suggest that the apparent cyclic repetition of ultramafic to felsic lavas in this sequence requires an alternative explanation to those only involving magmatic factionation. Many of the ultramafic to felsic cycles in the Hooggenoeg and Kromberg are due to diagenetic silicification of the uppermost parts of the ultramafic volcanic rocks during periods of volcanic inactivity. Thus each "cycle" includes a thick sequence of ultramafic lavas (the ultramafic unit), an overlying zone of silificied ultramafic lava (the felsic unit), and a chert representing sedimentation during a period of volcanic quiescence. In the Fig Tree the ultramafic to felsic cycles are also produced by diagenetic silicification but these units have been faulted into place from the underlying formations.

Field, petrographic, and compositional evidence all support the hypothesis that many of the trends toward silica-enrichment found in these lavas are diagenetic rather that magmatic. Individual lava flows with no evidence for significant crystal settling have fine-grained ultramafic bases and silicified tops. Spinifex textures are commonly preserved in both silicified and nonsilicified parts of the flows. Sedimentary units commonly lie on top of the silicified flows suggesting some hiatus in volcanic activity. Sediments often have dropped down into cracks and fissures formed in the underlying flow during this diagenesis. This further suggests that the diagenesis occurred at the surface and not during burial or metamorphism. Petrographic features confirm that the textures of these silicified rocks are ultramafic. Through now nearly totally replaced by silica, ghosts of spinifex olivine or pyroxene crystals are clearly visible. Often the only primary mineral preserved is chrome-spinel. These euhedral crystals have the same composition in silicified and nonsilicified flows. Their compositions are similar to those reported from ultramafic lavas in younger, less altered, greenstone belts. Whole rock compositions of silicified ultramafic rocks retain the very high chromium and nickel contents that characterize the nonsilicified rocks.

From the base to the top the volcanism in the Swaziland sequence becomes less ultramafic. True felsic lavas do occur but only at a few stratigraphic positions within the sequence. They are most easily distinguished from silicified ultramafic lavas when they contain small phenocrysts of beta-quartz. Unlike the ultramafic lavas the true felsic units generally occur as debris flows, airfall and current-worked deposits. Where true felsic lavas do occur they are most often separated from the underlying ultramafic rocks by thick zones of silicification and thin sedimentary units. Two conclusions seem justified from the above observations:

1) the concept of ultramafic to felsic volcanic cycles in greenstone belts, first proposed based on this sequence, must be rejected or at least greatly modified; and

2) the origin of felsic lavas in this greenstone belt is not the end product of shallow-level magmatic fractionation sequences but is more likely related to partial melting of the base of a thick pile of ultramafic lavas.