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SEDIMENTOLOGICAL AND STRATIGRAPHIC EVOLUTION OF THE SOUTHERN PART OF THE BARBERTON GREENSTONE BELT: A CASE OF CHANGING PROVENANCE AND STABILITY; Donald R. Lowe and Gary R. Byerly, Department of Geology, Louisiana State University, Baton Rouge, Louisiana 70803 USA

The sedimentological and stratigraphic evolution of the 3.5 to 3.3 Ga Barberton Greenstone Belt can be divided into three principal stages: (1) the volcanic platform stage during which at least 8 km of mafic and ultramafic volcanic rocks, minor felsic volcanic units, and thin sedimentary layers (Onverwacht Group) accumulated under generally anorogenic conditions, (2) a transitional stage of developing instability during which widespread dacitic volcanism and associated pyroclastic and volcaniclastic sedimentation was punctuated by the deposition of terrigenous debris derived by uplift and shallow erosion of the belt itself (Fig Tree Group), (3) an orogenic stage involving cessation of active volcanism, extensive thrust faulting, and widespread deposition of clastic sediments representing deep erosion of the greenstone belt sequence as well as sources outside of the belt (Moodies Group).

I. The platform stage of Barberton Greenstone Belt development is represented by rocks of the predominantly volcanic Onverwacht Group. Sediments deposited during this stage included (a) dacitic breccias, conglomerate, and coarse sands deposited as part of and adjacent to felsic volcanic centers and, less abundantly, proximal mafic lapillistones and tuffs; (b) distal felsic volcaniclastic and pyroclastic layers consisting mainly of fine ash, dust, and accretionary lapilli, (c) biogenic deposits such as carbonaceous oozes, carbonaceous muds, bacterial mats, and locally, stromatolites, and (d) orthochemical sediments including evaporites, barite, carbonate, and possibly siliceous deposits. The bulk of these sedimentary units show clear evidence of having been deposited under shallow-water conditions. The regional stratigraphic continuity and sedimentological integrity of sedimentary layers within this sequence, the predominantly shallow-water depositional setting, and the paucity of debris derived from the uplift and erosion of older rock sequences indicate that the overall depositional and tectonic setting was a broad, low-relief, shallow-water anorogenic platform (1).

II. Rocks traditionally assigned to the Fig Tree Group were deposited during a transitional phase of greenstone belt evolution. These are exposed in a complex succession of thrust sheets that provide numerous exposures of each part of the stratigraphic sequence (2). The lowest part of the Fig Tree is characterized by distal volcaniclastic units and carbonaceous cherts resembling those in the Onverwacht but showing rapid lateral facies changes. In particular, 40 to 50 m of predominantly carbonaceous chert in some structural belts can be correlated with a sequence of interbedded ultramafic lavas, banded cherts, carbonaceous cherts, stromatolites, and volcaniclastic units at least 500 m thick in other areas (2).

The overlying 200 to 500 m of rocks includes two principal components. By far the greatest thicknesses of Fig Tree strata consist of heavily altered dacitic pyroclastic and volcaniclastic detritus (3). This succession includes three main lithofacies: (a) plagioclase-phyric intrusive rocks that may locally grade into extrusive flows, (b) proximal, plagioclase-phyric breccias and conglomerates, probably developed as lava domes and surrounding coarse epiclastic units, and (c) regionally extensive ash deposits, tuffs, and their current-worked equivalents, volcaniclastic sandstone and siltstone. The bulk of the finely laminated cherty ferriginous sediments characterizing Fig Tree rocks throughout much of the Mountain Land represent altered fine-grained dacitic volcaniclastic deposits. In contrast to previous interpretations, we consider the Fig Tree to represent a predominantly volcanic interval, perhaps more closely related petrogenetically to the Onverwacht Group than to the suprajacent orogenic Moodies succession.

Interbedded with these volcanic and volcaniclastic strata are thin, lenticular units of chert-pebble conglomerate and chert-grit sandstone showing rapid lateral facies changes and apparently representing debris derived from local uplifts within the greenstone belt. Most of the debris can be identified with underlying silicified rocks of the Fig Tree Group; there is little evidence for major uplift or deep erosion of the greenstone belt at this time.

III. Rocks which have traditionally been included within the Moodies Group represent three main clastic lithofacies: (a) a sequence of quartz-poor, highly altered sands and fine gravels derived by erosion of the subjacent dacitic rocks; (b) thick, coarse, chert-clast conglomerate and chert-grit sandstone derived by weathering and erosion of uplifted parts of the greenstone belt, and (c) quartzose and locally K-spar-rich sandstone representing the erosion of sources outside of the greenstone belt, possibly but not necessarily including the intrusive granitoid rocks and/or the Ancient Gneiss Complex or its equivalents.

Although the stratigraphic sections in most structural belts can be correlated with one another, there is as yet no satisfactory reconstruction of their original relative depositional positions. So-called northern facies rocks in the Mountain Land also belong to allochthonous terranes and their present location relative to units to the south is clearly of tectonic rather than depositional origin.

The overall sequence includes numerous minor unconformities and at least one major break. Within the Onverwacht Group, pauses in effusive activity are marked locally by weathering and erosion of flow surfaces, but no significant formation or accumulation of clastic debris. The inception of felsic volcanism both in the upper Hooggenoeg formation and the Fig Tree Group was accompanied by minor instability and local erosion of underlying rocks. Also, the formation of large, high-relief subaerial felsic volcanic edifices in Hooggenoeg and Fig Tree times was followed by extensive erosion and truncation of these complexes. The major structural unconformity within the Barberton sequence occurs locally at the base of the Moodies Group. Although a number of apparently conformable Fig Tree-Moodies transitions occur, over wide areas, the Moodies was deposited with angular unconformity on rocks as old as the Hooggenoeg Formation. This contact has additionally been complicated by structural movement.

The sedimentological development of the Barberton Greenstone Belt reflects three principal tectonic stages involving three contrasting sources of clastic sediment. The volcanic platform stage, represented by rocks of the Onverwacht and Fig Tree Groups, was primarily an interval of rapid effusion of lavas, subsidence, but little differential tectonic movement. The main sources of clastic detritus were first cycle, active, high-relief, felsic and, to a lesser extent, mafic volcanic centers. The second stage, represented by rocks of the Fig Tree Group, was one characterized by continuing, regionally extensive volcanism and developing tectonic instability reflected by the presence of extensive lateral facies changes and small intra-platform uplifts that supplied shallow-level intraformational debris to local sedimentary systems. Latest Fig Tree and Moodies deposition was influenced by concurrent thrusting and orogenesis. Sediments were derived initially from both shallow and deep levels within the greenstone belt and, later, from distant quartz and K-spar rich sources outside of the belt.

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