INTEGRATED STRUCTURAL AND LANDSAT STUDIES OF THE BETSIMISARAKA SUTURE, EAST MADAGASCAR

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Abstract

Investigation of the proposed Betsimisaraka suture or B.S. in eastern Madagascar has been completed using remote sensing and field investigations. Digital image processing of Landsat ETM+ data has been mainly used as a basis for the analysis, but due to the vegetation cover, Synthetic Aperture Radar (SAR) imagery has been also explored and combined with Landsat ETM+ bands. Field study is based on field petrography and structural geology. Band ratio composites including 5/3-5/1-7/3 and 5/7-5/1- 5/4x3/4 assigned successively to red, green and blue are used to enhance the lithologic contrast and to reduce the effect of topography. In addition, false color composite and single Landsat bands, such as 7-4-2 and 4-2-3, are also used in some places. Single bands and band ratios are chosen according to their characteristics to maximize the rock discrimination and their spectral reflectance signatures. The B.S. is divided in two domains, domain 1 for the northeastern part of the B.S., and domain 2 for the central southeastern part. Both domains divide the Precambrian basement rocks of Madagascar in two parts. The western part is characterized by Proterozoic rocks represented by the Graphite System and the eastern part which is an Archean block, characterized by the Antongil block in domain 1 and the Masora block in domain 2. These later two blocks are associated with the Vohibory System. The B.S. was defined to bound the western side of the Antongil block, in which it is represented by high grade metamorphic rocks, recording strong deformation and mineral assemblages characteristic of oceanic material that is compatible with a suture zone, including chromite and nickel.

The B.S. has a complex deformation history. Large scale structural features viewed on Landsat enhanced images indicate ductile deformation including three

generations of folding (F1, F2, and F3) associated with dextral shearing. The first folding event (F1) shows a succession of folds with NE striking axial planes. The second folding event (F2) mainly has a north-south striking axial plane, and the last event (F3) is represented by mega folds that have ENE-WSW axial plane directions indicating NNW and SSE contractional strain patterns.

Three types of shearing were delineated, one is NW-SE shearing including strike slip faults in the Andilamena and northern Befandriana region, as well as the NW-SE shearing recorded in sigmoidal bodies in Mandritsara, Ankijanalava-Maronantoandro regions which have sinistral movements. Another shear zone strikes N-S and forms sigmoidal bodies in Mahanoro. Finally, a the NE-SW striking dextral shear recorded in the Mananjary-Vohilava region was delineated with the L-band radar mixed with the Landsat bands for the region around Alaotra Lake that is confirmed by the S shaped bodies.

Several faults, joints and fractures represent brittle deformation events. A lineament study of the B.S. showed that the brittle deformations can be divided in two groups; lineaments which have N-S strikes and may correlate with the collision events of west and east Gondwana, and the NE and NW trending lineaments which are much younger and are mainly found in the central plateau. Those young faults may represent an active tectonic event in the central plateau that bounds the western part of the B.S.