

Provenance of Garnet in the Neoproterozoic Verbaard granitoid gneiss: A case study from Beit Bridge Complex, Central Zone, Southern Africa

T.O. Basupi^{a,b*}, T. Tsunogae^{a,c}

^a*Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan*

^b*Department of Earth and Environmental Sciences, BIUST, Botswana*

^c*Department of Geology, University of Johannesburg, South Africa*

**email:basupit@biust.ac.bw*

Neoproterozoic granitoids are commonly exposed along Archean high-grade metamorphic terranes, where they occur as granitoid gneisses. A number of issues, including the effect of overprint event(s), can complicate the characterization of these granitoids in Archean terranes. A case study is presented here highlighting the complexity of characterizing Neoproterozoic granitoid magmatism from the Limpopo Complex high-grade terrane in southern Africa. Neoproterozoic granitoids occurring within the Central Zone of the Limpopo Complex include the ~2.73-2.64 Ga biotite±amphibole-bearing Alldays granitoid, the ~2.68-2.62 Ga garnet-bearing Singelele leucogranite, the ~2.65-2.63 Ga Avoca granitoid with pyroxene-bearing and pyroxene-absent variants, the ~2.65-2.62 Ga biotite-bearing Verbaard granitoid and the ~2.61-2.58 Ga Bulai granitoid with pyroxene-bearing and pyroxene-absent variants. Of the different granitoids, the Singelele leucogranite and Verbaard granitoids exhibit evidence for anatectic overprint. This study focuses on characterizing the nature of overprint in the Verbaard granitoid. Exposures in the Verbaard area show a conspicuous network of garnet-bearing leucocratic veins overprinting the light greyish biotite-bearing Verbaard granitoid. These leucocratic veins, with more or less straight line outline, do not have any biotite-bearing melanocratic margins, indicating that they formed elsewhere. On the other hand, the garnet-bearing irregular outline leucosomes associated with surrounding metapelites have biotite-bearing melanocratic margins indicating *in situ* formation by partial melting. Detailed mineral chemical characteristics of garnet occurring in the metapelite, associated leucosome, and the Verbaard granitoid, indicate comparable composition, suggesting common origin. It is argued that the garnet in leucocratic veins overprinting the Verbaard granitoid represent relics from the metapelites, with the leucocratic veins representing segregated melt away from the source region. Of the two types of metapelites found in the study area – high-Al and low-Al metapelites – the distinction between the two is suggested as an artifact of the extent of partial melting, with the high-Al metapelite preserving more of the restitic domains, while the low-Al metapelite preserving more of the leucosomic material. Using rim-core-rim garnet mineral chemical profiles, the leucosomes are suggested as sites of preservation of different stages of garnet formation in the associated metapelites. Whole-rock geochemical characteristics of carefully sampled garnet-free domains of the Verbaard granitoid indicate that they are similar to low-HREE Archean TTGs. Comparison with experimental melts from a variety of source rocks indicates that the Verbaard granitoid was likely derived from the melting of metabasalts. A comparative exercise with other Neoproterozoic granitoids from the Central Zone indicates that the compositional characteristics of the Verbaard granitoid are closely comparable to those of the Alldays granitoid. It is suggested that the Verbaard granitoid represents the manifestation of the Alldays granitoid magmatism in the Verbaard area.

Keywords: Neoproterozoic granitoid, Archean high-grade, Limpopo Complex, Verbaard granitoid, Anatectic overprint, Garnet.