Geochemistry, Pressure-Temperature conditions and tectonic setting of the amphibolite from the southern part of Motloutse Complex, eastern Botswana

*Thembiso Otladisang Basupi[1], Toshiaki Tsunogae

1. Graduate of Life and Environmental Sciences, University of Tsukuba

Amphibolites constitute prominent rock types in Archean high-grade terranes in eastern Botswana and these include the Motloutse and Phikwe Complex terranes (Aldiss, 1991; Carney et al., 1994). Phikwe Complex is considered part of the larger Limpopo Complex high-grade terrane between the Archean Kaapvaal and Zimbabwe cratons. Available studies indicate polymetamorphic amphibolite- to granulite-facies conditions from metasedimentary rocks of the Phikwe Complex (McCourt et al., 2004). Unlike the Phikwe Complex, no granulite-facies conditions or polymetamorphism has been reported so far from the Motloutse Complex, which occurs to the SW of the Zimbabwe Craton (Smith and Phofuetsile, 1985; Aldiss, 1991). In spite of this, there has been no study in modern literature on the amphibolite rocks belonging to Motloutse complex. This study is to focus on the geochemistry, pressure-temperature (*P-T)* condition and tectonic setting of mafic rocks (amphibolites) of the Motloutse Complex and amphibolites from Phikwe Complex are introduced for comparison.
The field survey conducted indicated amphibolites occupying prominent hills in the respective areas surrounded by granitoids. Available geochronological data indicate that the granitoids in both areas are Neoarchean (ca 2.65 Ga). Therefore, the mafic rocks must be older than ca 2.65 Ga. Overprint events (e.g., partial melting) were observed in amphibolites.
The field description shows that the amphibolites are made up of plagioclase, hornblende, biotite and quartz. Petrographic images of the amphibolites shows slight alteration of plagioclase to sericite and triple junction texture of the hornblende-plagioclase (plagioclase as an indication of deformation). Alignment of minerals is a common feature. Hornblende + plagioclase + quartz + sericite + ilmenite + magnetite dominates the composition.
Metamorphic temperature estimates for amphibolites from Maope area using hornblende-plagioclase geothermometry of Holland and Blundy (1994) ranges from 650 to 780 ˚C. The geothermobarometry *P-T* condition estimates using the hornblende-plagioclase of Schmidt (1992) and Anderson and Smith (1995) recorded 572 to 670˚C at 3.5 to 7 kbar and 450 to 670˚C at 3.7 to 7.3 kbar. These results estimate bracket the Maope amphibolites on the upper amphibolite to lower granulite facies metamorphic condition.
Whole-rock geochemical analysis indicates that the amphibolites are characterised by high SiO_2 (45.40–54.82 wt.%) and MgO (4.40–10.25 wt.%) contents, some are comparable with boninites. The TAS plot characterise the amphibolites of Maope area and Phikwe area as basaltic to basaltic andesite composition. The primitive mantle elements normalised and chondrite-normalised REE pattern indicate that they are likely to have been derived from the same parental magma. The positive Pb, Sr, and Eu anomalies reflect plagioclase accumulation on the magma during fractionation. The tectonic setting plots show volcanic arc basalts in an oceanic arc environment. The results also show hydrated magma of tholeiitic composition due to subduction that lead to boninites like mafic rocks. We therefore suggest that the protolith of the Maope amphibolites formed by subduction as boninites like mafic rocks in an oceanic arc environment. Based on field evidence and results of geothermobarometry, we suggest that the amphibolites were later exposed to peak metamorphism due to partial melting that is believed to have been the only Paleoprotezoic (2.06 Ga) overprint in Motloutse Complex (Zeh eta al., 2009). The source of

the overprint remains unknown.

Keywords: Amphibolites, amphibolite facies, granulite facies, boninites, plagioclase accumulation.

