Occurrence and geochemical study of the basalts, komatiites and cherts from the silica alteration zones in the Barberton greenstone belt, South Africa

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The Early Archean Barberton Greenstone Belt (BGB), South Africa, comprises three groups of the Onverwacht, Fig Tree and Moodies Groups. The Komati and Hooggenoeg formations in the Onverwacht Group contain a well-exposed volcanosedimentary sequence of komatiitic and basaltic volcanic rocks and cherts. It is known that the komatiite and basalt underwent both severe carbonation and silicification. However, the relationship of the timing, order, and geological distribution between the silicification and carbonation and the extent of the elemental movement during their events are still ambiguous. This work presents distribution of the silicified and carbonated volcanic rocks, and the petrological and geochemical sequences from unaltered though carbonated to silicified volcanic rocks.

The silicified volcanic rocks from the basalts and komatiites widely underlie the bedded cherts, whereas the carbonated rocks are sporadically and rarely distributed all over the thick volcanic sequences. Only the carbonated rocks are found within the volcanic sequences. On the other hand, the silicification is dominated, but both the silicified and carbonated volcanic rocks occur under the bedded cherts. In addition, an ultramafic komatiite flow underwent both carbonization and silicification in the middle Hooggenoeg Formation, but the silicification is limited to the upper part of the flow whereas the lower part avoids the severe silicification and preserves much carbonate minerals, suggesting the silicification postdated the carbonation.

We analyzed major and trace element contents of the carbonated, silicified and not-silicified volcanic rocks including five basalts and eleven peridotitic and basaltic komatiites and five overlying cherts. The fresh basalt has *ca.* 47% in SiO_2 contents whereas the silicified basalts range from 57 to 78% in SiO_2. Their Mg, Fe, Na, Mn and P contents progressively decrease with increasing SiO_2 contents. Their TiO_2, Al_2O_3 and K_2O contents decrease for moderately silicified basalts, and then increase for severely silicified basalts with increasing SiO_2 contents. On the other hand, their Ca contents increase for moderately silicified basalts, and then decrease for severely silicified basalts with increasing SiO_2 contents. Fresh peridotitic komatiites have *ca.* 45% in SiO_2 contents whereas the silicified komatiites range from 55 to 84% in SiO_2. A moderately silicified komatiite with *ca.* 55% in SiO_2 content has distinct compositions rather than others, and are highly enriched in Al_2O_3, MgO, and K_2O contents. However, TiO_2, Al_2O_3, FeO and MgO contents of the silicified ultramafic komatiites progressively decrease with increasing SiO_2 contents. Their MnO, CaO and Na_2O contents basically decrease but are fluctuated with increasing SiO_2 contents.

The PAAS-normalized rare earth element (REE) patterns are quite distinct between the silicified basalts and ultramafic komatiites. All of the silicified basalts and ultramafic komatiites have LREE-depleted REE patterns and large to faint positive Eu anomalies. Some ultramafic komatiites have obvious negative Ce anomalies, positive Eu and Y/Ho anomalies whereas silicified basalts have no Ce anomalies. Both positive and negative Y/Ho anomalies are found for both the silicified basalts and komatiites. The REE patterns of cherts apparently depend on the underlying silicified volcanic rocks. The cherts overlying the silicified basalts have no Ce anomalies whereas those over the silicified komatiites have obvious negative Ce anomalies. The systematic change of the REE patterns implies the elemental mobility depends on the host rocks during the silicification and carbonation.

Keywords: Silicification, Barberton greenstone belt, Hydrothermal process

