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Mineralogical and chemical changes during seafloor alteration in the Archaean

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Hydrothermal circulation of seawater through the oceanic crust results in alteration and recrystallisation of primary magmatic minerals and redistribution of chemical elements. Many chemical elements removed from the ocean crust during alteration are added to seawater and therefore a systematic study of the consequences of seafloor alteration in the Archaean provides insight into the composition of Archaean seawater. In addition, the alteration affects the compositions of the volcanic rocks and complicates interpretation of their magmatic histories. Finally, the types and distribution of alteration zones leaves a record of the circulation of hydrothermal fluids and thus provides information about the scale and vigour of circulation of seawater through the Archaean oceanic crust.

We present here a mineralogical and geochemical study of alteration of basalts and komatiites from the 2.7 Ga Abitibi belt in Canada and the 3.5-3.2 Ga Barberton greenstone belt in South Africa. These belts have undergone multiple stages of alteration and a major focus of the study is to isolate the mineralogical and chemical changes that occurred during seafloor alteration from those that occurred later during the metamorphism that accompanied accretion, granite intrusion and uplift. Previous studies compared whole rock analyses of altered with unaltered rocks. This study attempts to isolate the specific mineral reactions that occurred during seafloor alteration for a more detailed account of chemical changes during seafloor alteration. Methodology used includes SEM, EMPA, and microfluorescence spectroscopy. The first stage of alteration was devitrification of glassy basaltic pillow margins which included growth

of chlorite and clinozoisite, followed by replacement of primary clinopyroxene with tremolite, and plagioclase with sericite, and a later phase of carbonate veining. Preliminary results show that Abitibi belt pillow margins are depleted in Si, Fe, Mg, Ca, Na, and Mn and enriched in Al, K, and Ti. Comparison of the Barberton and Abitibi samples with modern day analogues will allow us to observe how this process has changed through time.