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Geochemistry of a paleoweathering profile on the "bostonite" mafic intrusives of Avontuur Deposit, Northern Cape

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Paleoweathering studies contribute to paleogeographic reconstruction and global stratigraphic correlation by directly recording paleoclimate through petrography, mineralogy and geochemistry of weathered products [1]. Precambrian weathering profiles can potentially reflect evolving atmospheric composition and variations in paleoclimates. A paleoweathering profile on the mafic intrusive rocks (so-called "Bostonite") was intersected during the exploration drilling of the Avontuur Deposit, and provides an opportunity to describe the behaviour of major, trace and REE in weathered rock relative to the unweathered parent rock. This weathering profile developed below an unconformity overlying the iron formation (IF) and manganese ore beds of the Hotazel Formation. This weathering profile developed an unconformity known as the basal Mapedi/Gamagara and marks the base of Olifantshoek group. The Gamagara Formation refers to the red beds succession that outcrops along the Gamagara ridge on the western side of the Maremane Dome, whereas in other areas it is referred to as the Mapedi [2]. These two formations display comparable lithostratigraphy and are hence referred to as the Mapedi/Gamagara Formation [2]. The Mapedi/Gamagara unconformity is responsible for the high grade ore deposit like Sishen [2].

Comparisons of the sampled intrusions were made in order to note if the intrusions are magmatically related, and to observe the effect of paleoweathering on the geochemistry of these intrusions, as well as the paleogeographic reconstruction thereof. Major and rare earth element (REE), as well as redox sensitive element mobility was evaluated through the profile. Based on the geochemistry, the samples are characterised by low Mg# indicating an evolved nature of the magma, as well as low Cr, Co and Sc signifying fractionation of the mafic minerals within the magma chamber. These mafic intrusives are characterized by a negative Nb and Ta anomaly, which is a characteristic feature of the Kaapvaal Craton, suggesting crustal contamination. Based on the weathering profile with an increase in weathering, a slight loss of silica and an intense decrease in alkali and alkali earth elements (Mg, Ca and Na) is noted. Potassium behaves differently from other alkali and alkali earth metals as it increases dramatically reaching a maximum of 245 %. The chemical indexes of alteration (CIA) values are typical of a warm and humid climate with chemical weathering, and the Ce anomalies suggest oxidative weathering.

References

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