Studying the Fe-Ti oxide composition to understand the PGE fractionation in the Jurassic Dufek Intrusion, Antarctica

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The Jurassic layered mafic Dufek Intrusion, Antarctica, is characterised by enrichment of platinum-group elements (PGE) in the evolved upper part of the 8 – 9 km thick intrusion. PGE enrichment (up to ~ 800 ppb) occurs in gabbroic cumulates rich in Fe-Ti oxides and in thin Fe-Ti oxide layers. It is most prominent in the lower 300 m of the upper third of the intrusion. However, the PGE enrichment is highly variable even in samples of similar mineralogy; elevated PGE concentrations are not evident macroscopically since sulphides are very rare or absent.

To better understand the PGE fractionation that is interpreted to be related to the late-stage formation of oxide-rich cumulates, we intend to investigate the trace elemental composition of Fe-Ti oxides by LA-ICP-MS. The results of our preliminary electron microprobe study of Ti-magnetite from cumulates of the upper third of the intrusion indicate positive correlations among Ti, V, Cr, Ni, Mg and Al that mainly follow fractionation trends with upward decreasing element abundances. An obvious reversal in Ti-magnetite composition occurs at about 1000 m below the top of the intrusion that approximately correlates with reversals shown by the variation trends of the associated pyroxenes. Above this reversal, a further peak of PGE enrichment is indicated.

The observed compositional variations in Ti-magnetite underline that fractional crystallisation under mainly S-undersaturated conditions and related changes in magma composition due to extensive oxide crystallisation as well as repeated magma influx into the crustal Dufek magma reservoir have to be discussed as major processes governing the PGE fractionation in the Dufek Intrusion.

Deviations from the general variation trends shown by Ti-magnetite of individual cumulates from the Stephens Anorthosite Member, the cyclic succession of anorthosites, gabbros, and magnetitites showing the highest PGE contents of the intrusion so far, as well as compositional differences observed for Ti-magnetite from thin oxide layers and their hosting gabbros have to be further evaluated by more detailed data.