Oxide mineralogy as a record of postmagmatic processes in the Eastern Gabbro, Coldwell Complex, NW Ontario: Significance of textures

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Magnetite is a minor to major mineral in the mafic and ultramafic rocks of the Eastern Gabbro (EG) suite, a complicated sequence of crosscutting sills and dykes, including metabasalts, a Layered Series, and the mineralized Marathon Series [1]. Magnetite in these units exhibits a continuum of exsolution textures from cloth to trellis types. Cloth-textured magnetite consists of a box-like network of ulvöspinel (<1μm wide) ± thick trellis lamellae of ilmenite (5-20 μm wide) ± bladed spinel (1-5 μm wide), all hosted by magnetite. Trellis-textured magnetite consists of both fine (1-5 μm wide) and thick trellis lamellae, and always contains spinel hosted by both the magnetite and ilmenite lamellae. Experimental evidence indicates that ilmenite cannot exsolve from magnetite, but rather must form by oxidation of ulvöspinel mediated by fluid-mineral reaction [2]. The Layered Series is distinct from the Marathon Series because it lacks magnetite with fine trellis lamellae. The presence of these different textural variants throughout the EG, as well as within individual samples and within individual grains is consistent with subsolidus, fluid-induced oxidation. Textural and chemical evidence, including trellis-like intergrowths radiating outwards from Cu-bearing fractures in magnetite, and alteration of many host rocks suggests that the trellis exsolution textures resulted from reaction of cloth-textured magnetite with late, Cu-rich fluids. The trace element chemistry of the magnetite textural types are indistinguishable on the sample scale, with the exception of W, Ta, Nb, Mo, and Sn, which have higher concentrations in trellis-textured magnetite. These elemental variations, in part, can be explained by reaction of cloth-textured magnetite with an oxidized fluid to form trellis-textured magnetite, whereby the oxidized forms of Sn, W, and Mo, which are more compatible in magnetite than their reduced forms, were available during transformation of the magnetite-ulvöspinel assemblage. This suggests that within a given gabbroic series, the various magnetite types represent initial crystallization of the same high-temperature magnetite-ulvöspinel solid solution, but have developed different textures and trace-element chemistry due to varying degrees of oxidation. High-resolution textural characterization prior to laser ablation analysis is thus critical for interpreting variations in W, Ta, Nb, Mo, and Sn. These results suggest that the suite of rocks making up the EG crystallized under relatively reducing conditions, capable of stabilizing ulvöspinel. In the Marathon Series, the fO_2 conditions of the local environment were later modified by the flux of Cu-rich fluids, which caused oxidation of cloth-textured ulvöspinel to trellis-textured ilmenite.

[1] Good *et al*. (2015) *Econ Geol* **110**, 983-1008. [2] Buddington and Lindsley (1964) *J Petrol* **5**, 310-357.