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Thermal modification of hematite-ilmenite intergrowths in the Ecstall pluton, British Columbia, Canada

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Abstract

In this study, we examine the effects of reheating on finely exsolved hematite-ilmenite intergrowths from the ~91 Ma Ecstall pluton using reflected light microscopy, scanning electron microscopy (SEM), and transmission electron microscopy (TEM). As a result of the emplacement of the younger adjacent ~52 Ma Quottoon pluton, samples closer to a thermal boundary have experienced greater degrees of thermal alteration. Five main microstructural features characterize hematite-ilmenite intergrowths from the Ecstall: (I) exsolution lamellae of hematite and ilmenite; (II) oxidation of ilmenite to form hematite, rutile, and other Ti-rich phases; (III) 20–50 nm magnetite precipitates in hematite; (IV) rutile blitz texture; and (V) exsolution of hematite in rutile. Based on spatial relationships, textures II through V appear to be related to reheating of the Ecstall by the Quottoon, and samples up to ~14 km from the thermal boundary intrusive contact have been affected. We propose a mechanism, similar to that of Kontny and Dietl (2001), in which reheating has driven T-f_{O_2} conditions across the hematite-magnetite buffer to lower f_{O_2} resulting in the reduction of hematite. Higher temperatures also enhanced oxidation in ilmenite. The formation of magnetite altered the bulk magnetic properties of these samples, increasing NRM intensity. This study underscores the need to consider a pluton's post-emplacement thermal history before making tectonic interpretations based on paleomagnetic data.

Keywords: Electron microscopy, hematite-ilmenite, magnetite, mineral intergrowths, Ecstall pluton