Petrogenetic Significance of Pyroxene in the Marathon Deposit, Ontario: Petrography and Chemical Variation

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Abstract

The Marathon deposit is hosted within the Two Duck Lake Gabbro (TDLG) of the Mesoproterozoic Coldwell alkaline complex. The TDLG is coarse-grained to pegmatitic, comprising dominantly plagioclase with variable amounts of interstitial clinopyroxene, olivine, and magnetite. TDLG clinopyroxene and orthopyroxene textures include lamellar texture (Opx in Cpx, and Cpx in Opx), resorption, and patchy zoning. Orthopyroxene either postdates or predates clinopyroxene and occurs as reaction rims surrounding olivine. Clinopyroxene without lamellae have been resorbed and overgrown by lamellar Cpx, and vice versa. The thickness and spacing of the exsolution lamellae vary between crystals and even within a single crystal. Thick lamellae are always more widely spaced than thin lamellae. Closely spaced thin lamellae are more common in altered samples. Individual Opx lamellae are sometimes completely, but most frequently partially, altered. Orthopyroxene has a depleted light-REE pattern and a negative Eu anomaly, which is consistent with REE partition coefficients for basaltic melts, whereas Cpx shows an enriched light-REE pattern that is contrary to REE partition coefficients. Magmatic sulfides occur as either blebs or inclusions within unaltered and altered pyroxene suggesting that sulfides are cogenetic with pyroxene. However, sulfides (mostly chalcopyrite) also replaced exsolution lamellae within altered pyroxene that represents metal re-distribution by volatiles. Thermobarometric calculation of pyroxene indicated that different lamellar generations formed in different P-T conditions (approximately 8.1-15.8 kbar, and 1047-929°C). The variety of texture and thickness of lamellae in pyroxene suggests progressive exsolution during cooling and crystallization. The high equilibrium pressure indicates crystallization at deep crustal level (approximately 30-40 km) that is in contrast with the shallow postulated emplacement depth for the TDLG. Therefore, crystallization may have taken place at depth, followed by intrusion as a crystal mush. Furthermore, textural and geochemical studies support a mineralization model that involved repeated throughput of new magma during crystallization.