Transformation of Fe–Ti gabbro to coronite, eclogite, and amphibolite in the Baie du Nord segment, Manicouagan Imbricate zone, eastern Grenville province: evidence for high heat flow in the lower crust during orogenesis

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Fe–Ti gabbro from the Baie du Nord Segment of the Manicouagan Imbricate zone, metamorphosed under high-P-T conditions during the Grenvillian orogeny, has been the focus of a detailed micropetrological study. Textures and mineral chemistry suggest that the mineral assemblages represent progressive stages of metamorphic transformation resulting in the formation of coronas, pseudomorphs after igneous phases (transitional), and true granoblastic eclogite. The transitional and eclogitic samples also have coronas developed locally around igneous xenocrysts of plagioclase and olivine. Coronitic Fe–Ti gabbro is transformed to amphibolite at deformed margins and contains clinopyroxene-bearing leucosomes with garnet poikiloblasts that are indicative of high-PT dehydration melting. Interpretation of garnet zoning and thermobarometry suggest that the highest-P-T conditions are recorded by coronas around xenocrysts (ca. 720-800°C at 14-17 kbar) and garnet-clinopyroxene cores in granoblastic assemblages (ca. 740-820°C at 13-17 kbar) in the eclogitic samples. Re-equilibration during the early stages of exhumation at high-T conditions (>700°C) affected all samples, and is indicated by the widespread development of pargasite-bearing plagioclase collars in the coronitic and transitional metagabbro and by widespread re-equilibration of the eclogite giving lower P-T estimates at grain boundaries. However, the difference in calculated P conditions between coronite and eclogite samples is consistent with increasing pressure (depth) from the coronite (11-13 kbar) to the eclogite (13-17 kbar). The P-T conditions recorded by these rocks define an apparent isothermal P-T path. In fact, this is a steep metamorphic field gradient, indicating that all the samples experienced temperatures in excess of 800°C both during and shortly after peak metamorphism over a range of depths (ca. 65-35 km). This is turn suggests high heat flow through this segment of the lower crust during the Grenvillian orogeny.