Impact of pervasive migration and crystallisation of anatectic magmas in Opinaca metasediments, Québec.

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Summary

High-grade metasediments from Opinaca sub-province (Québec) show two types of partial melting and have also been pervasively injected by felsic anatectic melts. The main partial melting occurred through prograde dehydration of biotite in granulitic conditions while the second set of melting reactions occurred as a result of injection and crystallisation of the magmas.

Abstract

The metasedimentary Opinaca Sub-province (Québec) is believed to contain an injection complex; anatectic magmas from a deeper source also of metasedimentary composition were injected pervasively. Felsic magmas were emplaced in innumerable small dykes and sills in the metasediments. Although a large part of felsic magma was injected, the Opinaca metasediments had partially melted. Petrological studies reveal that two types of partial melting conditions occurred.

The main partial melting occurred through dehydration of biotite and is characterized by residual assemblages that contain orthopyroxene with garnet and/or cordierite; it seems to be the most productive episode of melting of Opinaca sediments. Mineral assemblages are typical of partial melting in anhydrous granulitic conditions, estimated at 820±25°C and pressures between 4 and 5kbar.

Some metasediments contain evidence of further partial melting, characterised by assemblages with cordierite and tourmaline and the presence of a small amount of interstitial melt. These melts appear to have formed in hydrous conditions by reactions such as Qtz + Pl + Kfs + H2O = Liq and by consuming biotite through Bt + Qtz + Pl + H2O ± Kfs = Liq + Crd. Metamorphic conditions for these reactions are estimated at 720°C and 3kbar.

Tourmaline is commonly present in rocks containing the second set of partial melting reactions and is taken as evidence for hydrating fluids. Within bodies, various felsic magmas injected and crystallising in Opinaca, tourmaline is common in pegmatites and at the contact with the host metasediments. Tourmaline is thus a tracer of the fluids evolved during late-stage crystallisation of the felsic melts injected in the Opinaca. Whole rock δO^{18} results also show that Opinaca metasediments equilibrated with fluids of crustal magmatic origin.

This secondary partial melting appears to be an important process around injection complexes in host rocks and may be responsible for the widespread retrogressive relationship observed between granulite and amphibolites facies and many high grade metamorphic terrains around the world.