

Early fluid channelization in the Pikwitonei granulite Domain, Manitoba, Canada

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The results of field mapping, carbon isotope and phase equilibria studies show that two different, locally controlled fluid regimes existed during at least the early phases of high-grade metamorphism in the north Cauchon Lake region, Pikwitonei granulite domain, Manitoba, Canada. During the prograde phases of high-grade anti-clockwise regional metamorphism (heating before nearly isobaric early cooling), rocks already metamorphosed to at least sillimanite grade were thermally metamorphosed at temperatures near 900° C by the intrusion of a charnockitic magma. It is likely that this magma released an oxidizing, CO₂-bearing, probably CO₂-rich fluid phase while the region was still at relatively shallow depths. Fluid migration was channelized along the intrusive contact, and local fluid buffering characterized many of the country rocks. Large-scale, pervasive CO₂ infiltration, by contrast, would have reset and homogenized both carbon isotope and fO₂ values, and led to the precipitation of graphite in lithologies buffered to low oxygen fugacities. The light carbon isotope values of graphites and cordierites in pelitic lithologies ($\delta^{13}\text{C}$ graphite = -41.8 to -30.4; $\delta^{13}\text{C}$ cordierite = -31.8 to 34.9), and the low oxygen fugacities in many samples rule out infiltration of these units by large amounts of an externally derived CO₂-rich fluid phase.

Texturally early CO₂-rich fluid inclusions occur in the cores of garnets in a variety of rock types along the intrusive contact. These fluid inclusions were probably trapped during early garnet growth at high temperatures but at relatively low pressures, and appear to have undergone only limited or possibly no subsequent re-equilibration. They do not appear to provide direct information about the highest metamorphic temperature and pressure conditions to have affected the region (750° C and 7 kbars) (Mezger *et al.* 1990), but may, instead, retain evidence of the prograde metamorphic path.

The results of these studies show the importance of local controls on the sources, compositions, timing and transport of metamorphic fluids in the north Cauchon Lake region. The data are consistent with the view that overall, high-grade regional metamorphism should be associated with low fluid/rock ratios, and that fluid migration will be channelized and probably episodic. In high-grade terrains where local controls predominate, assessments of the conditions during metamorphism will depend upon the sampling pattern and sampling scale selected.

REFERENCE

Mezger, K., Bohlen, S.R., and Hanson, G.N., 1990. *Journal of Petrology* 31, 483-517.