PARTIAL MELTING OF GRANITE: THE IMPORTANCE OF REGIONAL SHEAR ZONES AND THE INFLUX OF H_2O

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Migmatites in the centre of the Opatica Subprovince (Superior Province) in Canada developed from leucotrondhjemite and leucogranodiorite protoliths during late Archaean, low-temperature (680 to 740°C) medium pressure (5 to 6 kbar) anatexis. Partial melting occurred in a part of the Opatica where back thrusts are common and which corresponds to a retro wedge tectonic position. The morphology of the migmatites correlates strongly with their structural position. Schollen diatexites occur in the back thrusts and metatexite migmatites occur between the thrusts. Water-fluxed melting of quartz, plagioclase and microcline is inferred from the microstructure because these minerals, but not biotite, have corroded boundaries. Between 25 and 30 % partial melting occurred, and terminated when all the K-feldspar was consumed. Distinctive microstructures in the plagioclase-rich residual rocks enable them to be distinguished from rocks that were plagioclase cumulates; residual rocks contain crystal shapes that indicate the former presence of thin films of melt. Whole rock delta 18 oxygen of the protolith (average 8.2 per mil) and migmatites (average 8.3 per mil) are the same, but melt-rich rocks are 0.6 per mil higher than residual ones. The H_2O-fluid that infiltrated and caused melting was probably a metamorphic one. Lithoprobe seismic reflection profile 48 crosses the migmatites and reveals a series of south-dipping structures (the back thrusts) in the migmatites extending to a present-day depth of 20 km. These are interpreted to have been the pathways along which aqueous fluids liberated by the breakdown of amphibole in the middle crust, and perhaps anatectic melt, migrated to higher crustal levels where they enhanced the fertility of the leucogranodiorite there and enabled them to melt. Schollen diatexites contain flow structures and have compositions indicating that they were melt-rich, and melt migrated within and possibly along, the shear zones. A new type of *in situ* neosome found in the adjacent metatexite migmatites is interpreted to have formed along fractures through which aqueous fluid entered the protolith; it entered via a network of fractures rather than pervasively along the grain boundaries. The position of the metatexites relative to diatexite-bearing back thrusts indicates that the new neosome is preserved at the periphery of the zone of fluid migration. Evidence for the pathway of the fluid followed in the shear zones is not found in the diatexites because of overprinting by syn-melting deformation and crystallisation of the melt.