P-T-t PATH FOR THE ARCHEAN PIKWITONEI GRANULITE DOMAIN AND CROSS LAKE SUBPROVINCE, MANITOBA, CANADA;

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Pressure-temperature-time (P-T-t) paths for metamorphic terranes coupled with thermal modelling should allow a quantitative reconstruction of the thermobarometric history of ancient mobile belts and may permit recognition of the style of tectonism. The accurate reconstruction of the evolution of a metamorphic terrane requires the determination of a quantitative pressure-temperature-time history, where actual pressures and temperatures can be combined with the absolute time they were reached in the rocks.

High precision ages for upper amphibolite to granulite grade gneisses were obtained by U-Pb dating of garnets. These ages, combined with pressures and temperatures obtained from different geobarometers and geothermometers, as well as mineral reactions observed in the gneisses, can be used to construct quantitative P-T-t paths (Fig. 1).

Based on textural evidence the following prograde reactions very likely have occurred in the rocks:

andalusite = sillimanite
staurolite + quartz = garnet + sillimanite + V
staurolite + quartz = cordierite + sillimanite + V
staurolite = garnet + spinel + sillimanite + V

and the following retrograde reactions:

hercynite + quartz = cordierite
garnet + sillimanite + quartz = cordierite
cordierite + hercynite = sillimanite + garnet

These retrograde reactions indicate that the terrane cooled isobarically or near-isobarically which is consistent with the garnet zoning in samples which contain the GRAIL assemblage (Mezger et al., 1986).

The prograde path at Cauchon Lake is defined by reactions at 2700-2687 Ma and then later at 2645-2637 Ma. The metamorphic event at 2700-2687 Ma locally led to the formation of partial melts and conditions above the stability of staurolite + quartz. The thermal event at 2645-2637 Ma caused extensive partial melting and probably the highest grade metamorphic conditions, as indicated by mineral assemblages containing the youngest generation of metamorphic garnets. All the high temperatures obtained from the two-feldspar thermometer and most of the pressures determined from the various mineral equilibria are interpreted to represent the "peak" conditions reached during this metamorphic event.

The retrograde part of the P-T path corresponds to the cooling following the metamorphism at 2645-2637 Ma. At about 2600 Ma the terrane may have cooled to temperatures near the minimum melting point of granite. The introduction of fluids, together with the granitic melts at that time, locally caused extensive retrogression of the rocks to amphibolite grade and the resetting of the feldspar temperatures. The calculated cooling rate from 2637 Ma to 2600 Ma is ca. 3 ^{o}C/Ma.

Based on the anti-clockwise pressure-temperature path for the Pikwitonei granulite domain, the near-isobaric cooling path, the slow cooling rate and the multiple thermal events within about 150 Ma (Mezger et al., in prep.) we suggest that these granulites may have formed in a long-lived Andean-type continental margin rather than in a fold-and-thrust-belt.

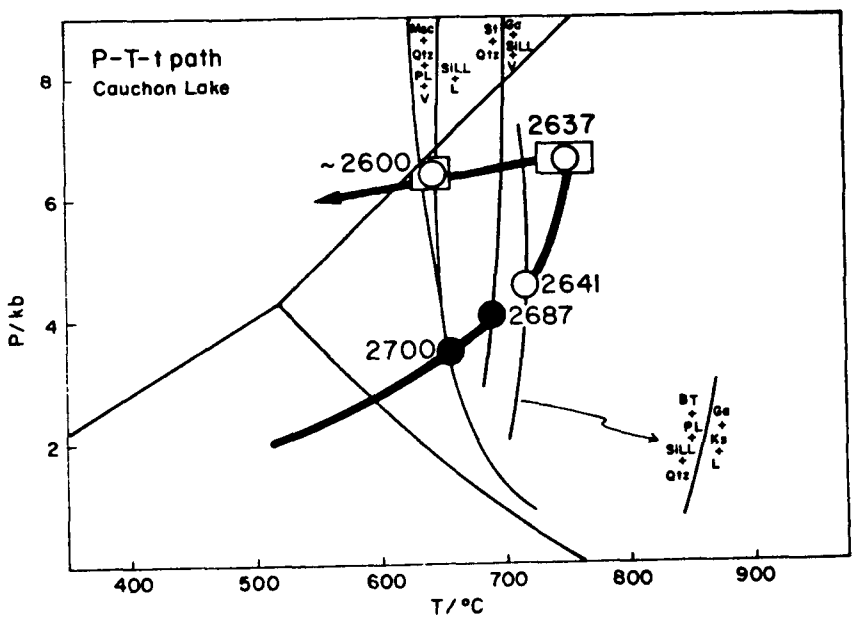

Fig. 1: P-T-t path for the Cauchon Lake are, Pikwitonei granulite domain - Cross Lake subprovince, Manitoba, Canada.

Mezger, K. et al., 1986; EOS 67, p. 407.