Multi-stage corona development during early Tertiary, high-temperature exhumation of the Grand Forks Complex, British Columbia

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Summary

Metasedimentary gneisses of the Proterozoic Grand Forks Group experienced rapid high-temperature, ~2.5kbar exhumation in the late Paleocene to early Eocene, coincident with orogenic collapse in the hinterland of the Canadian Cordillera. The migmatitic paragneisses were metamorphosed to upper amphibolite facies, Sil+Kfs zone (abbreviations after Kretz, 1983) at *c.* 84±3 Ma (Laberge and Pattison, 2007), and experienced near isothermal decompression at 750-725°C (Cubley and Pattison, 2009), leading to the development of two independent corona textures. Sillimanite in mesosome layers is rimmed by a Crd+Spl+Ilm decompression assemblage, whereas garnet is rimmed by a spinel and ilmenite-absent, Crd+Kfs+Qtz corona. Past research on these coronae (Laberge and Pattison, 2007) suggested both corona structures were the result of a single "whole rock" KFMASH reaction, Grt+Sil+melt = Crd+Spl+Qtz+Kfs. New reaction modeling in the MnNCKFMASHT system using the program Theriak-Domino and the Holland and Powell (1998) database suggests a sequence of two separate reactions. For Crd+Spl+Ilm coronae around sillimanite, phase equilibrium modeling using the entire bulk rock composition does not yield stable cordierite+spinel. This suggests a reduced effective bulk composition (EBC) involving the interaction of a quartz-deficient, Sil+Bt mesosome with a reduced proportion of the quartzofeldspathic leucosome. An EBC with an alumnosilicate:biotite:matrix ratio of 4:2:2 produces the observed decompression assemblage at ~725°C, 3.4kbar, consistent with thermobarometry and petrogenetic grid constraints (Cubley and Pattison, 2009). The low-variance reaction Sil+Bt+Pl+Qtz = Crd+Spl+Ilm+Kfs+melt is proposed. This decompression reaction occurs earlier, and at higher pressure than, the second higher-variance garnet replacement reaction, Grt+Kfs = Crd+Bt+melt, which can be can be modeled using the entire bulk rock composition.

Thermodynamic modeling of this exhumation event suggests a near-isothermal decompression path with limited melt production, consistent with stromatic migmatite textures that suggest *in situ* melting and lack evidence for significant melt injection or extraction. A new SHRIMP U-Pb zircon date from syn-tectonic anatectic leucogranite in the Grand Forks Group suggests this latest anatexis occurred at 51.2±0.6 Ma, within error of U-Pb monazite rim ages of 51.5±2Ma from Laberge and Pattison (2007). High-temperature ductile exhumation predates the emplacement of ~50 Ma post-tectonic granitoid bodies, which are in turn brittlely deformed by late movement along the Kettle River and Granby normal faults.

References

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