Geophysical Research Abstracts
Vol. 21, EGU2019-4027, 2019
EGU General Assembly 2019

Geothermobarometric constraints on the Neoarchean metamorphic overprint in the Nuvvuagittuq supracrustal belt (NSB), northern Québec, Canada

Peter Tropper (1) and Stephen Mojzsis (2)

(1) University of Innsbruck, Institute of Mineralogy and Petrography, Innsbruck, Austria (peter.tropper@uibk.ac.at), (2) Department of Geological Sciences, University of Colorado, Boulder, CO 80309-0399, USA

The Nuvvuagittuq supracrustal belt (NSB) in northwestern Québec ranks as one of the oldest granitoid gneiss complexes thus far discovered on Earth. U-Pb zircon emplacement ages for discordant intrusive trondhjemitic dikes of the NSB cluster at 3.75 Ga. As with all other pre-3.7 Ga terranes the NSB has been metamorphosed and multiply deformed. An Eoarchean metamorphic episode has been deduced from a zircon depth-profile, recorded at 3.62 Ga. A Neoarchean event was discerned based on dating of metamorphic zircon, garnet rutile and monazite and yielded 207Pb/206Pb and Sm/Nd ages ranging from 2.8 Ga to 2.5 Ga. Concerning geothermometric constraints of this Neoarchean metamorphic event Cates & Mojzsis (2009) coupled conventional garnet-biotite- and hornblende-plagioclase geothermometry with zircon U-Th-Pb depth profiles, REE partitioning and Ti-in-zircon thermometry and showed that Neoarchean metamorphism reached upper amphibolite-facies conditions ($\sim$640°C) but P constraints were still lacking.

The aim of this study was to provide a more precise geothermobarometric constraint on this Neoarchean metamorphic event by applying multi-equilibrium geothermobarometry (average PT approach), pseudosection modelling (DOMINO-Theriak) and Zr-in-rutile geothermometry (Tomkins et al., 2007) to three samples from Cates & Mojzsis (2009). Samples IN05037 and IN05042 are quartz-biotite schists with the mineral assemblage garnet + biotite + muscovite + rutile + quartz $\pm$ plagioclase $\pm$ staurolite. Sample IN05020 is an amphibolite with the mineral assemblage cummingtonite + hornblende + K-feldspar + plagioclase + biotite + rutile. All samples show extensive retrogression under greenschist-facies metamorphic conditions (complete pinitisation of possibly cordierite, chloritisation of staurolite, amphiboles). The average PT calculations (H_2O-free calculations only) of the metapelitic sample IN05037 yielded P-T conditions of 590 $\pm$ 95°C and 0.5 $\pm$ 0.1 GPa. The mafic sample IN05020 yielded P-T conditions of 610 $\pm$ 70°C and 0.56 $\pm$ 0.2 GPa. Pseudosection modelling of sample IN05037 yielded similar P-T conditions based on the occurrence of garnet + cordierite + biotite and the absence of kyanite. Modelling the metamafic sample IN05020 yielded a large stability field of the assemblage 2 amphiboles + K-feldspar + plagioclase + biotite but limiting P of 0.5-0.7 GPa could be calculated over the T range of 600-650°C. Zr-in rutile geothermometry yielded the following temperatures (2σ): 600 $\pm$ 30°C (IN05037); 600 $\pm$ 25°C (IN05042) and 590 $\pm$ 20°C (IN05020). The resulting T is in very good agreement with the results of Cates & Mojzsis (2009) as well as the stability of relict staurolite in sample IN05042.

Although T deviations in the average PT calculations are large due to the nature of mineral reactions involved in this approach, the data nonetheless provide the first precise P constraints. These data help to better constrain the P-T conditions of the Neoarchean metamorphic overprint in the Northeast Superior Province, which in turn is a prerequesite for further modelling of Archean geodynamic processes.

Cates, N.L., & Mojzsis, S.J. (2009). Chemical Geology, 261, 99-114.
Tomkins, H. S., Powell, R., & Ellis, D. J. (2007). Journal of Metamorphic Geology, 25(6), 703-713.