Geophysical Research Abstracts
Vol. 20, EGU2018-16374, 2018
EGU General Assembly 2018

2-Pyroxene thermometry on single crystals of the Lewisian Complex, Scotland

Phillip Gopon (1), Jacob Forshaw (2,1), David Waters (1,3), and Jonathan Wade (1)

(1) University of Oxford, Dept. of Earth Science, United Kingdom (phillip.gopon@earth.ox.ac.uk), (2) University of Calgary, Dept. of Geoscience, Alberta, Canada, (3) Oxford University Museum of Natural History, United Kingdom

The Archaean Lewisian Complex of northwest Scotland is composed primarily of tonalite-trondhjemite-granodiorite orthogneiss, with comparatively lesser amounts of metamorphosed mafic and ultramafic rocks (Rollinson, 1996; Johnson and White, 2011). Despite a tremendous amount of research into the tectono-thermal evolution of this terrane, peak pressure and temperature (P-T) conditions of the complex remain somewhat unconstrained. Previous P-T estimates span a vast range from 8 to 15 kbar and 800 to 1000 [U+2103] (Sills and Rollinson, 1987).

Using the relatively new technique of low keV EPMA (Gopon et al., 2013) this study aims to constrain retrograde and peak metamorphic conditions achieved in granulite facies mafic rocks from the Central Region of the mainland Lewisian at Scouriemore by examining sub-micron exsolution lamellae within pyroxene crystals. Traditional electron microanalysis uses accelerating voltage of 15 or 20 keV, which prohibits analysis of features less than 1-2 microns in size. Comparatively, newer instruments and techniques provide spatial resolution down to ∼0.5 microns but require careful execution of the procedure due to the associated analytical difficulties (Heikinheimo et al., 2016).

Pyroxene grains provide a fertile territory for thermometry due to the maturity of the technique, the extent of experimental research within the discipline (Lindsley and Frost, 1992; Bertrand and Mercier, 1985), and the complex intergrowths that can develop within individual crystals. This complexity can potentially reveal details about exhumation rate, retrograde P-T conditions along discrete steps in the path, and peak P-T conditions. For the Lewisian, the aim is to estimate the peak metamorphic conditions using a regression through two or more points on the retrograde path.

References:

Bertrand, P., and Mercier, J.C.C., 1985, The mutual solubility of coexisting ortho- and clinopyroxene: toward an absolute geothermometer for the natural system? Earth and Planetary Science Letters, v. 76, p. 109–122

Gopon, P., Fournelle, J., Sobol, P.E., and Llovet, X., 2013, Low-Voltage Electron-Probe Microanalysis of Fe – Si Compounds Using Soft X-Rays: Microscopy and Microanalysis, v. 19, p. 1–11.

Heikinheimo, E., Pinard, P.T., Richter, S., Llovet, X., and Louhenkilpi, S., 2016, Electron probe microanalysis of Ni-silicides at low voltage: difficulties and possibilities: IOP Conference Series: Materials Science and Engineering, v. 109, p. 12005

Johnson, T.E., and White, R.W., 2011, Phase equilibrium constraints on conditions of granulite-facies metamorphism at Scourie, NW Scotland: Journal of the Geological Society, v. 168, p. 147–158

Lindsley, D.H., and Frost, B.R., 1992, Equilibria among Fe-Ti oxides, pyroxenes, olivine, and quartz: Part I. Theory: American Mineralogist, v. 77, p. 987–1003.

Rollinson, H.R., 1996, Tonalite-trondhjemite-granodiorite magmatism and the genesis of Lewisian crust during the Archaean: Geological Society Special Publication, p. 25–42

Sills, J.D., and Rollinson, H.R., 1987, Metamorphic evolution of the mainland Lewisian comple. In Evolution of the Lewisian and Comparable Precambrian High Grade Terrains: Geological Society Special Publication, No. 27 p. 81–92.