EGU22-10734
https://doi.org/10.5194/egusphere-egu22-10734
EGU General Assembly 2022

Using garnet to the fullest: The tectono-metamorphic evolution of the Eoarchean Isua supracrustal belt

Anthony Ramírez-Salazar[1], Thomas Müller[2], Sandra Piazolo[1], Dominik Sorger[2], Jiawei Zuo[3], A. Alexander G. Webb[3], Joyjit Dey[1], and Peter J. Haproff[4]

[1]University of Leeds, Institute of Geophysics and Tectonics, Leeds, United Kingdom of Great Britain – England, Scotland, Wales (eears@leeds.ac.uk)

[2]Geoscience Center, Department of Minerology/Petrology, Georg-August-Universität Göttingen, Göttingen, Germany

[3]Department of Earth Sciences and Laboratory for Space Research, University of Hong Kong, Hong Kong, China

[4]Department of Earth and Ocean Sciences, University of North Carolina Wilmington, 601 South College Road

The Eoarchean Isua supracrustal belt (ISB) represents a key supracrustal portion of one of the oldest km-scale regions of Archean crust exposed today. Microstructures and compositional zoning of garnets from the ISB have previously been interpreted to reflect either three or two main metamorphic events. The former interpretation supports the operation of plate tectonics in the early Archean, while the latter suggests Eoarchean non-uniformitarian tectonics. Thus, an in-depth understanding of the evolution of garnet through time is necessary to evaluate these tectonic models.

A quantitative microstructural and chemical analysis of the garnet porphyroblasts in the ISB and their host rocks shows that variability in garnet characteristics is largely a product of differing degrees of transport-controlled growth mechanisms operating in medium-grade rocks. Sluggish elemental transport is common in samples with low contents of garnet-forming phases and elements, and high abundance of quartz and/or carbonates. Such rocks will develop garnets with high proportions of inclusions, irregular internal morphologies, and localized equilibrium features like patchy zoning. Faster elemental transport in rocks with higher concentration of garnet-forming materials and lower content of non-reactant phases are characterized by higher garnet-to-inclusion ratios and the development of concentric zoning patterns.

The observed diversity of the porphyroblast characteristics across the ISB is thus readily interpreted as a consequence of changes in local bulk compositions, whereas the rocks experienced the same tectonometamorphic evolution. We use garnets showing larger-equilibrium features from two metapelitic rocks from the centre of the belt to decipher the metamorphic evolution of the belt. Here, petrographic observations, garnet trace element compositions, quartz-in-garnet barometry, and geologically-based timing constraints are used to model different P-T-t paths and test the competing models proposed for the belt. Preliminary results suggest that a two-stage garnet growth history can successfully reproduce the observed garnet record. These results highlight that a plate tectonic interpretation of the ISB is not unique and that simple non-uniformitarianism interpretations are viable.