Geophysical Research Abstracts
Vol. 21, EGU2019-9285, 2019
EGU General Assembly 2019

Not all kyanite is created equal – Determining kyanite provenance in migmatites

Stacy Phillips (1), Tom Argles (1), Nigel Harris (1), Clare Warren (1), and Nick Roberts (2)

(1) The Open University, Milton Keynes, United Kingdom (stacy.phillips@open.ac.uk), (2) NERC Isotope Geosciences Laboratory, British Geological Survey, Nottingham, UK

Aluminosilicate minerals are commonly used to constrain P-T conditions in a wide range of metamorphic rocks and peraluminous granites. In granites, however, these minerals could be xenocrysts, peritectic phases or have directly crystallised from melt: each of these occurrences provides different implications for the formation of their host. The presence of kyanite in Himalayan leucogranites is commonly interpreted as a sign of early (Oligocene) melting during prograde burial; by contrast, sillimanite-bearing leucogranites are interpreted as forming during later (Miocene) decompression melting. The petrogenesis of these aluminosilicate-bearing melts therefore carries implications for the timing of mid-crustal weakening and overall Himalayan tectonics.

The provenance of kyanite in small-scale (cm-dm), in situ leucogranites from eastern Bhutan and their host schists was investigated using cathodoluminescence imaging (CL), LA-ICP-MS trace element spot analysis and LA-ICP-MS trace element (V, Cr, Ge) mapping. Kyanite grains vary in morphology, internal CL zonation and geochemistry. Kyanite in the schist is commonly tabular with complex internal CL zonation. Kyanite in the leucosome immediately adjacent to the schist shows similarly complex internal textures, but is corroded, skeletal and rimmed by coarse muscovite. Both the complexly-zoned kyanite in the schist and in the leucosome show similar V, Cr, Ge and Fe concentrations. Within the leucosome, but further from the schist margin, kyanite crystals are distinctly different: thin and bladed, with little to no internal CL zonation and higher Ge content (>7.5 ppm).

We interpret the corroded kyanite crystals in the leucosome to be xenocrysts from the schist that retained the complex CL patterns and chemical composition of metamorphic kyanite. The thin, bladed kyanite crystals are thought to represent "igneous" kyanite that formed either peritectically or by crystallisation from the melt. Inter-sample differences in kyanite Cr and Fe content appear to represent differences in protolith composition. Both types of kyanite, and evidence for both prograde and retrograde mineral reactions, can be found in close proximity on the thin-section scale, demonstrating very localised control of composition over mineralogy.

LA-ICP-MS trace element mapping is able to resolve the features visible in greyscale CL images, with the best resolution apparent in V and Cr concentrations. High V/Cr ratios correspond to dark CL areas and low V/Cr ratios correspond to brighter CL areas. Understanding the significance of these variations in terms of reaction history and the genesis of kyanite is important for constraining future P-T-t modelling of the leucogranites, and is crucial for the tectonic interpretation of these melts as drivers for the exhumation of the orogenic mid-crust.