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Orthopyroxene-kyanite-quartz as an indicator of high-pressure UHT metamorphism in magnesian pelites from South Harris, Scotland

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Orthopyroxene-kyanite-quartz is an extremely rare assemblage in nature – moreso than its lower pressure counterpart, orthopyroxene-sillimanite-quartz. Modelling of this assemblage from equilibrated textures in quartzitic magnesian pelites from the Leverburgh Belt (South Harris, Scotland) reveals that its stability is extremely compositionally restricted in pelitic rocks and occurs only under high-pressure UHT metamorphic conditions.

The Proterozoic Leverburgh Belt (1-2 km wide) and the adjacent South Harris Igneous Complex underwent granulite facies metamorphism at $c.$ 1.83 Ga. Orthopyroxene, kyanite, and quartz occur in rare, thin layers in a psammitic unit comprised of quartz, K-feldpar, kyanite, minor garnet, orthopyroxene, biotite and cordierite.

Orthopyroxene ion exchange thermobarometry has yielded pressures for these rocks that are inconsistent with the stable occurrence of kyanite (eg. Baba, 1999), indicative that retrograde ion exchange has influenced preserved mineral compositions. Here we have quantitatively modelled preserved mineral assemblages using THERMOCALC. By using real bulk rock compositions, we are able to circumvent some of the problems of mineral chemical disequilibrium.

Bulk rock compositions of two samples from a garnet-kyanite-K-feldspar-biotite-quartz gneiss (XMg = 37) and an orthopyroxene-kyanite-garnet-K-feldspar-biotite-

quartz gneiss (XMg = 89) are modelled in the system NCKFMASH. The modelling reveals that mineral assemblages, textures and mineral chemical zonation from the two rock types record different stages of a mutually consistent metamorphic history involving high pressure UHT metamorphism at $c.$ 900˚C and $c.$ 12.5–14 kbar.

The garnet-kyanite gneiss preserves a prograde history: mineral chemical zonation and inclusion and matrix assemblages indicate early moderate pressure amphibolite facies conditions followed by a high pressure event, which produced calcic garnet overgrowths and a garnet, kyanite, K-feldspar, quartz assemblage. The orthopyroxene-kyanite gneiss preserves the peak and retrograde history: equilibrated orthopyroxene ($c.$ 9 wt% Al_2O_3) kyanite, K-feldspar, and quartz are consistent with conditions of 12.3-14 kbar at c. 900˚C. Subsequently developed orthopyroxene-cordierite symplectites record evidence for decompression.