Geophysical Research Abstracts
Vol. 20, EGU2018-10878, 2018
EGU General Assembly 2018

Fluid-mediated, metamorphic densification of subducted felsic continental crust from the Norwegian Caledonides: implications for buoyancy and rheology

Simon Cuthbert
The University of the West of Scotland, School of Science, Paisley, United Kingdom (simon.cuthbert@uws.ac.uk)

Geodynamic models for continental collision require information on rock density and rheology as they evolve during the subduction-eduction cycle. The Western Gneiss Complex (WGC) in the Scandinavian Caledonides is a giant HP/UHP terrane representing a continental margin that underwent transient subduction during the Scandian collision. Preservation of peak eclogite facies metamorphic parageneses in the predominant granitoid gneisses is very rare due to amphibolite-facies overprinting and partial melting. In the Dalsfjord area of the southern WGC the gneisses escaped the migmatisation prevalent in the higher-T, UHP, northern WGC. Grey bt+pl+qz+ep±grt±Ca-amp orthogneisses enclose areas of green, omphacite-bearing granitoid gneiss. These evolved from a Mesoproterozoic anhydrous charnockitic precursor to omp+grt+phe+ky+qz+rt±czo (omp extensively altered to amp+pl symplectite). They are L>S tectonites with a strong omphacite-aggregate shape fabric. Peak P-T was $\sim$650^{o}C at 2.3GPa, based on conventional thermobarometry on a well-preserved adjacent eclogite. Density of the omphacite gneiss at peak P&T has been estimated at $\sim$3.15 g.cm^{-3} based upon the estimated mineral mode and isochemical phase diagram sections. This would have been neutrally or slightly positively buoyant relative to anhydrous lithospheric mantle but negatively buoyant relative to an overlying serpentinised mantle wedge. Phase diagram analysis shows that the HP assemblage of the less calcic, more potassic grey gneisses would have been richer in phengite and poorer in cpx (which would have been much more jadeitic) and slightly less dense than the omphacite gneiss. Phengite would have spontaneously decomposed on decompression, while the omphacite gneiss assemblage required addition of an aqueous fluid. Hence the grey gneiss remained reactive, so the HP paragenesis was lost. In contrast, the reactivity of the omphacite gneiss was constrained by the availability of a source of water so the HP paragenesis was (partially) preserved. The evolution of density and rheology during the subduction cycle depended on an initial ingress of water followed by its differential consumption and release by different bulk compositions. The tectonite fabric indicates that transformation from charnockite resulted in a major change in rheology. However, the localised survival of pristine protolith shows that the transformation was limited in its efficiency, hence also limiting the extent of densification. The original source of the aqueous fluid remains uncertain but flux over distances of at least hundreds of metres is likely.