Geophysical Research Abstracts
Vol. 14, EGU2012-9013-1, 2012
EGU General Assembly 2012

P-T-t-constrainst on subduction and exhumation of the Liverpool Land Eclogite Terrane (LLET), East Greenland Caledonides

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Ultra-high pressure (UHP) and high pressure (HP) metamorphism have been reported from eclogite and garnet peridotite within migmatitic granitic gneisses (Liverpool Land Eclogite Terrane) in the footwall of an N-dipping shear zone (Gubbedalen Shear Zone) in southern Liverpool Land, East Greenland Caledonides. The hanging wall is dominated by a Silurian (c. 430 Ma) intrusive complex, not present in the footwall. Appearance of ultramafic rocks, including garnet peridotite, eclogite and country rock migmatite with a protolith age of ˜ 1640 Ma and eclogite facies metamorphism at ˜ 400Ma make a correlation with the Western Gneiss Region in Norway likely. LLET is thus considered to be an exotic terrane relative to the surrounding rocks of Laurentian affinity. Widespread(?) eclogite bodies show compositional variations, with omphacite in the range <Jd20 to Jd45. Small polycrystalline quartz inclusions in garnet, possibly representing pseudomorphs after coesite(?) indicate P>∼2.7 GPa at 700-750 °C, but more rigorous P-T estimates are excluded due to the lack of proper mineral assemblages. Thermobarometry (Nimis & Grütter, 2010) on garnet-peridotites gives maximum pressures of 3.5-4.5 GPa at c. 730-740 °C (Precambrian equilibration?), and with probable requilibration at pressures of 2.2-3.0 GPa around 423 Ma (Nd-Sm).

Over most of LLET, however, primary omphacite is much less sodic (max Jd20) and “low-pressure” (LP) eclogite facies conditions must have existed for part of the P-T history. U-Pb ID-TIMS dating of zircon from eclogites gives a minimum age of 400Ma for the UHP/HP/LP metamorphism. Symplectite textures in retrograde eclogites reflect changing P-T conditions during exhumation. Earliest symplectites at garnet-omphacite grain boundaries in mafic eclogites are represented by Opx+Pl and Cpx+Pl mineral assemblages, followed by Hbl+Pl, then pervasive recrystallization of Opx+Pl to Cpx+Pl pseudomorphs. Complete retrogression of mafic assemblages to Hb+Pl+Bt+Cpx is common at margins of large eclogite bodies. Retrogression is pervasive in smaller bodies entrained in gneiss. A series of 385Ma granite dikes, emplaced while LLET was still under amphibolite grade conditions, are cross-cutting the retrogressed eclogite/metaeclogite and their host gneisses. Final exhumation to closure temperatures for retention of Ar in muscovite was reached at 380 Ma.