Geophysical Research Abstracts
Vol. 14, EGU2012-7585, 2012
EGU General Assembly 2012

Chemical, petrological and structural analysis of syn-kinematic migmatites: insights from the Western Gneiss Region, Norway.

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Migmatites in the inner part of collisional orogens are markers of past partial melting during burial and/or exhumation of their crustal root. If melt production has a softening effect as soon as the very first percents of melt are produced, as suggested by experimental data, then the exact timing of partial melting initiation and the complete duration of the melting event need to be estimated. The Western Gneiss Region (WGR), a basement window within the Norwegian Caledonides, presents excellent exposures of migmatites associated with (ultra)-high pressure (UHP) eclogites and amphibolitic gneisses, appropriate for a field study on the relationships between partial melting, (U)HP metamorphism and subsequent retrogression.

Chemical analyses of natural leucosomes in the WGR define a trend from trondhjemitic to granitic compositions. Their relative chronology allows correlation between trondhjemitic compositions and early melting stages in one hand, and granitic compositions and late melting stages in the other hand (Labrousse et al., 2011). A broader sampling of leucosomes in the WGR and their systematic chemical analysis allows an expansion of the observed trend in space and time. The natural trondhjemitic to granitic trend of the leucosome compositions is comparable to experimental results obtained in vapor present partial melting experiments in piston-cylinder (Labrousse et al., 2011), implying that water-present partial melting may have occurred at depth in the Caledonides.

While bulk compositions of leucosomes relate to the partial melting conditions and the beginning of partial melting episode, their petrography is relevant for the determination of their retrograde equilibration stage and the termination of the partial melting. The petrography of the leucosomes displays a great diversity in terms of mineral assemblages and compositions. However, early and late leucosomes have different mineral compositions, implying different retrograde PT paths.

First results of syn-kinematic partial melting experiments on a natural gneiss from the low temperature realm of the WGR in a Paterson apparatus at ISTO Orléans indicate that partial melting does not occur at temperature below 850°C (i.e. maximum temperature estimate for the peak conditions in the WGR) without free water. Higher temperature and/or fluid present deformation experiments show partial melting textures with melts segregated in a vein network parallel to uniaxial stress.

Both piston-cylinder and Paterson experiments suggest that the Caledonian syn-kinematic partial melting event in the WGR is due to vapor present melting reactions. Even if such a reaction is known and expected for the late stages of melting at amphibolite facies conditions, its relevance at higher pressures has strong implications on the hydration state of the continental crust at depth.

Keywords: migmatite, leucosome, partial melting, Paterson experiments, Western Gneiss Region, (U)HP.

Labrousse L., Prouteau G. and Ganzhorn A.-C., 2011, Continental exhumation triggered by partial melting at ultrahigh pressure: Geology, v. 39, n°12, p. 1171-1174, doi: 10.1130/G32316.1.