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

Ganzhorn Anne-Céline (1,2), Labrousse Loic (1,2), Prouteau Gaëlle (3,4,5), Leroy Clémence (6,7), Vrijmoed Johannes (8), Andersen Torgeir B. (9), Arbaret Laurent (3,4,5)

(1) Univ. Pierre et Marie Curie Paris 06, UMR 7193, ISTeP, F-75005 Paris (anne-celine.ganzhorn@upmc.fr), (2) CNRS, UMR 7193, ISTeP, F-75005 Paris, (3) Univ. d'Orléans, UMR 7327, ISTO, F-45071 Orléans, (4) CNRS/INSU, UMR 7327, ISTO, F-45071 Orléans, (5) BRGM, ISTO, UMR 7327, F-45071 Orléans, (6) Univ. Pierre et Marie Curie Paris 06, UMR 7590, IMPMC, F-75005 Paris, (7) CNRS, UMR 7590, 75005 Paris, France, (8) Univ. Lausanne, Institut des Sciences de la Terre, CH-1015 Lausanne, (9) Univ. Oslo, CEED, N-0316 Oslo

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.
Based on structural studies in the WGR, melt products were classified in three populations: zoned veins trapped in (U)HP (ultra)mafic bodies, deformed leucosomes present in the amphibolite gneiss foliation and undeformed leucosomes secant to Caledonian structures. The structural positions of leucosomes or veins and their relative chronology are correlated to eclogite facies metamorphism and amphibolite retrogression.
Chemical analyses of natural leucosomes and veins in the WGR define two trends correlated to the mafic or gneiss nature of samples hosts. The first trend from Na rich to K rich compositions correlates with leucosomes hosted in gneiss whereas the second group from Na to Ca rich compositions corresponds to veins and leucosomes hosted in (ultra)mafic rocks. The natural Na to K trend is comparable to experimental results obtained in vapor-present partial melting experiments of metapelites, whereas the natural Na to Ca trend is comparable to experimental results obtained in vapor-present partial melting experiments of metabasite. The chemistry of the zoned trapped veins suggests a more complex origin, involving interaction between melt and (ultra)mafic solids.
The observation of both natural chemical trends in the WGR suggests vapor present partial melting of two distinct sources: the gneiss and their mafic eclogites. Even if vapor present melting reactions are known and expected for the late stages of melting at amphibolite facies conditions, their evidence at higher pressures has strong implications on the water budget of the continental crust at depth.

Keywords: migmatite, leucosome, partial melting, metapelites, metabasites, Western Gneiss Region, (U)HP.