Experimental study of the Ultra High T metamorphism of a restitic metapelitic granulite: role of a previous partial melting event on the UHT metamorphism and influence of the redox state.

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The origin of UHT metamorphism prevailing in the continental crust is still matter of debate. Partial melting probably plays a key role. UHT metamorphism occurs at temperatures above the fluid-absent melting of most crustal rocks. Partial melting is an endothermic process that consumes heat and buffers the temperature at around 750-850°C. Thus, partial melting prevents a fertile crust to attain UHT. Conversely, UHT conditions can be more easily reached upon refractory / restitic rocks and occur preferentially in terranes that underwent previous partial melting event and melt loss.

The Gruf complex (Lepontine Alps) is a field area that confirms this scenario; it is one of the rare occurrences of Eocene UHT metamorphism in the world. This complex previously suffered the post Hercynian high-thermal regime responsible for the widespread formation of granulites in the Austro-alpine domain and Southern Alps. We propose that the typical UHT parageneses of the Gruf complex crystallized from refractory/restitic lithologies. The refractory character was acquired through fluid-absent melting reactions during the post Hercynian metamorphic event, while UHT conditions were reached during the Alpine cycle.

The typical mineral assemblage diagnostic of UHT metamorphism Spr + Qtz is sometimes replaced by the Spl + Qz assemblage under similar P-T conditions. The reason for this dichotomy is not yet understood.

In order to bring new elements to this discussion, we conducted experiments in an internally-heated pressure vessel on a metapelitic granulite from the Ivrea zone composed of Q-Grt-Sil-Kf±Pl±Bt±Rt. This rock is representative of a component of the lower crust after melt extraction. It would represent a restite associated with the process of differentiation of the crust.

The P and T intervals considered during these experiments were 0.3-0.8GPa and 950-1050°C; their duration lasted 7 or 13 days. Between 0.8-0.6 GPa, the paragenesis is Spr-Opx-Sil-Qz-TiMag-Melt (and Grt at T < 950°C) for the long-time experiments. For the short-duration experiments (same, P, T, and X), the paragenesis is Spl-Qz-Sil-TiMag-Melt. We interpret the change of paragenesis to a change from reducing (short-duration) to more oxydizing conditions (long-duration) due to progressive loss of hydrogen during the experiments at very high temperatures. At 0.3GPa, the stable assemblage is Spl-Qz-**Sil**-TiMag-Ilm-Melt-Crd and/or Osm and Grt at T>900°C, whatever the duration of the experiment.

In conclusion, our experiments show that UHT conditions applied to a restite from the lower crust produce typical parageneses of UHT metamorphism. They also suggest that Spl-Qz assemblages are indicative of reducing conditions while Spr-Qz assemblages prevail under more oxidised conditions.