When the Continental Crust Melts

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The *Elements* issue entitled "When the Continental Crust Melts" (vol. 7(4), 2011) covered a selection of topics of relevance to the anatexis of the continental crust during orogenesis and the origin of granites: microstructures, rheology, thermal models, comparison between experiments and thermodynamic modelling and melt segregation and ascent. The issue was more recently complemented by the one on "Continental Crust at Mantle Depths".

This contribution will focus on the microstructural and microchemical aspects of the issue, describing the advances brought to the study of crustal melting by the discovery of tiny (rarely exceeding 15 μm) glassy or crystallized melt inclusions in migmatites and granulites ("*nanogranites*"). Unlike in igneous rocks, melt inclusions (MI) in migmatites are trapped during incongruent melting, generally along the up-temperature path followed by the rock. Therefore, they can provide key information on anatexis.

Microstructurally, the occurrence of primary MI in peritectic phases (e.g., Grt, Crd, Spl, Ilm) demonstrates the growth of the host minerals in the presence of melt. Therefore MI are among the most reliable microstructural criteria for recognizing anatexis in a rock, particularly where other textures have been erased by deformation or recrystallization. In addition MI add constraints to the mineral(s) (or parts of minerals) which coexisted with the melt. When in zircon or monazite, MI allow anatectic events to be dated with unprecedented confidence.

Chemically, as the composition of anatectic MI is representative of that of the bulk melt in the system during anatexis, MI represent the embryos of anatectic granites. With an appropriate characterization and analytical strategy they can provide missing information on the primary composition of natural crustal melts before these undergo modifications by processes such as fractional crystallization, which generates cumulate and enriched granites, mixing of melts from different sources or entrainment of exotic material. So far, MI have been analysed for major and trace elements, as well as for H, allowing the nature of the fluid regime during anatexis to be discussed on the basis of measured data. The next step will be their isotopic characterization.