Melting in the deep crust: Message from melt inclusions in peritectic garnet from migmatites

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S-type granites and leucosomes in migmatites provide information on the composition of crustal anatectic melts. However, their reliability as witnesses of primary anatectic melts has been questioned by several lines of evidence. Previously, the composition of the melt produced during crustal anatexis has been assumed from glass obtained in equilibrium melting experiments of crustal rocks. However, Cesare *et al*. [1, 2] have shown that peritectic minerals in migmatites can trap droplets of melt, that were formed by incongruent melting reactions during crustal anatexis.

We performed for the first time an experimental and analytical study of melt inclusions (MI) within peritectic garnets, using the metasedimentary migmatites from Ronda (S Spain). These garnets contain primary 2-10 μm MI that range from totally glassy to fully crystallized (*nanogranite*, [1]). Raman spectroscopy has documented the presence of liquid H_2O-filled micro-pores in nanogranites. Piston cylinder remelting experiments led to the rehomogenization of crystalline MI at conditions (700 °C, 500 MPa) close to those inferred for anatexis. Remelted MI have a peraluminous, granitic composition with high (up to 7.5 wt %) H_2O content; they overlap the composition of glassy MI, but differ from the composition of leucosomes in the host rock. Some CO_2 bubbles are present after remelting experiments, suggesting fluid present, $a_{H_2O} < 1$ conditions, in agreement with graphite occurrence in the protolith. Our study identifies the natural anatectic melt composition and fluid regime at the onset of crustal melting, otherwise unknown. Hence, MI in migmatites represent a unique tool for the *in situ* characterization of anatexis in its early stages, and provide the only means of determining the volatile fluid content of anatectic melts.

[1] Cesare *et al*. (2009) *Geology*, **37**, 627-630. [2] Cesare *et al*. (2011) *JVirtExpl*, **40**, paper 2.

Lime lumps in gothic joint mortars from Kruszwica (Central Poland): An insight into the lime production

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In this study we present the complete characterization of joint mortars from the 'Mouse Tower'. The tower is a remnant of a gothic castle, erected in mid-14th century by King Casimir the Great.

All mortars comprise a calcitic binder (micrite) and a fine- to medium-grained inert aggregate, dominated by a detrital quartz. Smaller or larger binder-related particles, so called 'lime lumps' could be found in the micritic matrix. The inner part of these lime lumps is typically composed mainly of calcite crystal and aggregates of minerals rich in CaO and/or SiO_2, identified by means of SEM-EDX as wollastonite, silica (identified as cristobalite by means of XRD), belite (C_2S), minerals with a composition close to the melilite group (gehlenite-åkermanite) and less common rankinite. The core of lime lump is rimmed by a thin zone composed of micrite and unidentified amorphous silicates.

As suggested by different authors, the presence of lime lumps is attributed to low water/quick lime ratios for slaking, rapid slaking, slaking with excess of water, or technologies based on the nonseasoning of lime. However, in our particular case the lime lumps should be considered as overburnt lumps, formed due to local increase of the temperature above mean in the kiln.

The chemical analysis revealed that the percentages of acid soluble SiO_2, which indicates the existence of hydraulicity, reach very low values. The cementation index (C.I. <0.13) classifies the joint mortars as non-hydraulic. The volume of hydraulic phases (i.e. belite) is very small, they are enclosed in the almost impermable structure, thus their presence had no impact on the hydraulic properties of whole mortar.

On the basis of our studies, we conclude the joint mortar was poorly homogenized, non-hydraulic lime, derived presumably from the calcination of impure limestone rich in clay and silt, possibly the lacustrine chalk. Deposits of this material, very common in post-glacial lakes of northern Poland, occur in the Gopło Lake, situated in the nearest vicinity of the tower.