

Determination of fluid/melt partition coefficients by LA-ICPMS analysis of co-existing fluid and silicate melt inclusions

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We analyzed co-existing primary silicate melt (MI) and fluid inclusions (FI) in quartz crystals by Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICPMS) to quantify distribution of several major and trace elements between a volatile saturated silicate melt and the exsolving fluid phase. The samples were collected from graphic intergrowth of quartz and feldspar and freegrown quartz crystals in miarolitic cavities of the Baveno, Carona (Northern-Italy) and the La Cabrera (Spain) granitic intrusions, and alkaline-pegmatites of Mt. Malosa (Malawi). Textural evidence for the co-existence of FI and MI was their occurrence in the same assemblages (i.e. the same trails or growth zones). High density aqueous fluid inclusions were entrapped in the Baveno and La Cabrera granite, while at Mt. Malosa and Carona two fluids (liquid and vapor) exsolved from the melt. The entrapment pressure was estimated using microthermometric data on the FIs and is between 210 and 350 MPa for Baveno, 200 and 250 MPa for La Cabrera, approx. 130 MPa for Mt. Malosa and 100 MPa for Carona. After LA-ICPMS analyses of some FIs and MIs we rehomogenized the remaining MIs from the same assemblages in cold seal pressure vessel at 180 MPa. The homogenization temperatures were around 730 °C for each location. We determined the major element composition and the water content of the homogenized melt inclusions by electron microprobe and Raman spectroscopy (Zajacz et al., 2005), respectively. The latter indicated water contents between 10-12 wt% for MIs from Baveno, 5-7 wt% for MIs from La Cabrera and 5-5.5 wt% for MIs from Mt. Malosa.

The fluid/melt partition coefficients (D) for trace elements vary significantly between locations. Most chlorine complexed elements in the aqueous fluid show strongly increasing preference for the fluid phase with increasing salinity from 5 to 55 wt% (D_{Zn} : 2→130, D_{Pb} : 1→85, D_{Mn} : 0.2→25, D_{Li} : 2→50, D_{Fe} : 1→13, D_{Rb} : 0.1→0.8) while the hydroxy-complexed Mo (D_{Mo} : 20→2) and W (D_W : 3→3) show an opposite behaviour. At similar salinity (or Cl content), K, Na, Fe, Mn, Pb, Zn partition coefficients are nearly identical between different locations showing no significant influence of the melt composition or of complexes formed by components other than Cl in the fluid phase. In contrast, Ba, Sr, Li, Sn, W, Mo shows significant differences in the brine/melt partition coefficients between samples from Mt. Malosa and Carona. The partition coefficients determined in these natural systems have a higher variability than those determined experimentally, but for most elements investigated, they overlap with the experimental data. However, the behaviour of some elements of economic significance (Cu, W, Sn) differs remarkably from that predicted experimentally.

REFERENCES

Zajacz Z., Halter WE., Malfait W. et al. (2005): A composition independent quantitative determination of water content in silicate glasses and melt inclusions by Raman spectroscopy. *Contrib Mineral Petrol* **150**: 631-642.