Origin and evolution of ultrapotassic plutonic rocks (Durbachite series, Třebíč Massif, Czech Republic): An experimental approach

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To address the question of the origin of K-rich magmatism at the end of major orogenic episodes, an experimental study was conducted to constrain the crystallization conditions of mafic durbachite from the Třebíč Massif in the Bohemian Massif, Czech Republic. Durbachites are coarse-grained, porphyric plutonic rocks, typically containing large phenocrysts of K-feldspar, with high amounts of biotite, plus plagioclase, amphibole, augite and orthopyroxene. The durbachite series are abnormally K- and Mg-rich volcanic rocks and evolve from mafic to felsic end-members (SiO_2=52-70 wt.%, K_2O=7.3-5.5 wt.%, MgO=10-2.5 wt.%). Crystallization experiments were performed in internally heated argon pressure vessels at 200 MPa, 900-1100°C, $\log fO_2$=NNO and NNO+3.6, and various water activities (XH_2O of the coexisting fluid=0.3 to 1), using the most mafic natural durbachite as starting material. At 1100°C, only olivine crystallized (close to liquidus for XH_2O=1), whereas olivine + biotite + augite crystallized at 1000°C. At 900°C, only biotite and augite (+apatite, zircon and magnetite) are stable phases in the investigated range of XH_2O and fO_2. K-feldspar, plagioclase, amphibole and opx are absent in all experimental products even at subsolidus conditions (~900°C and low XH_2O). Thus, the natural mineral assemblage was not reproduced for the investigated range of T, fO_2 and XH_2O. Only biotite (Ti-rich: TiO_2=3-5 wt.%, mg#=75-80) and augite ($Wo_{44}En_{42}$), present in natural sample, could be reproduced.

Our results indicate that the mineral assemblage of the mafic durbachite may not be the product of the crystallization of a melt with the investigated bulk composition at 200 MPa. If we consider that partial melting of enriched, heterogeneous subcontinental lithospheric mantle beneath the Variscan Orogen lead to the formation of the mafic durbachite (Holub, 1997; Gerdes *et al.*, 2000), the observed mineral assemblage may indicate that (1) crystallization occurred at pressures or volatile activities significantly different from those investigated in this study (200 MPa; XH_2O in the range 0.3 to 1) and/or that (2) incongruent reactions involving olivine, biotite and augite as reactants occurred at hypersolidus and subsolidus conditions. This hypothesis is supported by the presence of scattered clots of fine-grained actinolite mantled by biotite ("pilite") that may be interpreted as pseudomorphs of olivine (Holub, 1997) and by the presence of augite as relics in amphibole. Another explanation is that the investigated mafic sample is not an end-member composition but a hybrid composition, contaminated by crustal material.

Holub (1997) *J. Geol. Science* 31(5-26); Gerdes *et al.* (2000) *Geol. Soc. Special Publication* 179 (415-431).

Interaction of copper with humic-coated gibbsite

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Both humic substances and mineral oxides exert important effects on chemical speciation and the transport of nutrients and contaminants in soils and sediments. Although most of the studies regarding chemical speciation in natural systems have been developed for individual reactive surfaces (mineral oxides, humic substances, clays), a better understanding on the subject could be achieved with mixtures of these components. The aim of this study was to compare the copper adsorption on gibbsite and HA-coated gibbsite.

First, the interaction of copper with the single systems humic acid (HA) and gibbsite was studied at different HA concentrations and pH. In order to explain the experimental results, the NICA-Donnan and the CD-MUSIC models were applied for Cu-HA and Cu-Gibbsite interaction, respectively.

The gibbsite was covered with different HA concentrations to study the copper interaction in a system that resemble more to the reactive surfaces present in natural systems. The adsorption of copper on the HA-gibbsite was higher than the adsorption on the single systems individually at the different pH values studied. This result was interpreted in a linear aditivity model basis. The copper adsorption on the HA-coated gibbsite was also compared with a system consisting of HA, gibbsite and copper simultaneously added into the reaction vessel.