

## Abstract

Transport of volatiles, including halogens, into the lower crust and upper-mantle has been of great interest because of their control on magma formation and ore-genesis associated with collisional orogenic zones. The relative stability of OH-bearing minerals (amphibole = amph, biotite=biot) in mafic and ultramafic rock compositions has been studied experimentally before, but no such studies have involved Cl-rich phases. Results are presented here for a study involving Cl-rich amph and biot aimed at determining their relative stabilities with pressure and, therefore, their ability to store and transport Cl deep into the Earth.

Nominally anhydrous experiments were made using the mafic bulk composition  $\text{KCa}_2(\text{Fe}_4\text{Fe}^{3+})(\text{Al}_2\text{Si}_6)\text{O}_{22}(\text{Cl}_2)$  prepared from reagent oxides and  $\text{FeCl}_2$ . Experiments in the range of 2 – 8 GPa at 800°C were done in a multi-anvil press using  $\text{Ag}_{50}\text{Pd}_{50}$  capsules but without any control of  $f\text{O}_2$ . One experiment was done at 700°C and 0.4 GPa at an  $f\text{O}_2$  of about  $-2 \Delta\text{NiNiO}$ . Although these experiments, like previous studies, involve synthesis rather than reaction reversals, the results are systematic and give an indication of the nucleation stability limits of amph and biot in this chemical system.

The results indicate that amph (~potassic-chloro-hastingsite) is stable from 0.4 to 2.0 GPa, where biot (chloro-annite) begins to form. From 2 – 3 GPa amphibole is gradually replaced by biot and garnet (gar, andradite-rich). From 3-7 GPa amph is no longer stable and the assemblage is biot, gar, and clinopyroxene (cpx, hedenbergite). Finally at 8 GPa biot is no longer stable and breaks down to an assemblage rich in gar + cpx with minor coesite, ahrensite ( $\text{Fe}_2\text{SiO}_4$ , spinel), sylvite, and  $\text{FeCl}_2$ . Chemical analysis shows amph has 4 – 6 wt% Cl and biot has 7 – 12 wt% Cl, with Cl possibly increasing in both phases with increasing pressure. From this study we see the relative stability of Cl-amph and Cl-biot is like that of OH-phases in ultramafic rocks, with the pressure stability of biot  $\gg$  amph. Second, in the Mg-free and dry system studied here, amph and biot have nearly the maximum possible Cl contents, with the biot having higher Cl than amph ( $D^{\text{Cl}}_{\text{Biot/Amph}} = 1.5$ ). Assuming 10 wt% amph or biot in Fe-rich and Cl-saturated rocks, it is possible to transport 0.5 - 1.0 wt% Cl in silicate minerals to ~240 km before being released as sylvite and  $\text{FeCl}_2$ .

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