# Cl incorporation in amphibole and biotite from granulite-facies iron formations: interplay among crystallography and fluids

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Cl-rich calcic amphibole (cam) and biotite (bt) are found in Archean iron-formations of the Beartooth Mtns, Montana, USA. These rocks, typified by mineral assemblages of quartz + magnetite + orthopyroxene + garnet ± clinopyroxene, equilibrated at granulite facies conditions of ~775–800°C and 6–8 kbar. The Fe-rich cam (mostly Cl-rich potassic-hastingsite and magnesio-ferri-hornblende) and bt contain Cl concentrations up to 2.9 wt% and 3.4 wt%, respectively. Threshold values of the $X_{Fe2+}$, $^{A}K$ (cam) and $^{T}Al$ must be attained before significant amounts of Cl are incorporated. The high Cl content suggests a coexisting brine (~25 wt% NaCl and $f_{H2O}/f_{HCl}$ ~0.75). There is evidence for brine-$CO_2$ immiscibility during peak metamorphism. $Fe^{2+}$-Mg partitioning of cam and the coexisting mafic silicates changes such that cam preferentially partitions $Fe^{2+}$. A feedback mechanism can be generated such that the more Cl available from a fluid the more $Fe^{2+}$-rich the cam can become, and this produces a crystal structure that can accommodate more Cl and the Fe-Cl enrichment cycle continues until depleted.