Partitioning of chlorine and fluorine between apatite and felsic silicate melts at subduction zone conditions

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The chemistry of subduction zone fluids has been a primary focus of geological studies in recent years. While the broader nature of the fluid phases remains a matter of debate, the specific role of ligands such as F and Cl are also pooly constrained, even though both elements can exert important controls on fluid chemistry due to their effects on H2O activity, mineral solubility and trace element partitioning, etc.

In this study, piston-cylinder experiments have been conducted to investigate chlorine and fluorine partitioning behaviour in felsic silicate systems at subduction zones conditions. A pelitic starting composition was synthesized with 6-7 wt% H_2O. Initial experiments were conducted over a pressure and temperature range of 25-45 kbar and 650-850°C, with 800 ppm Cl in the starting composition. Apatite was found to be the major mineral carrier of chlorine, with Cl concentrations ranging from ~0.1% at 750°C, 45kbar to 1.2% at 800°C, 25kbar. While an increasing Cl concentration in apatite correlates with increasing temperature, a decrease in Cl occurs with increasing pressure. Chlorine content in the coexisting melt was determined by both analysis and mass balance calculations. Partition coefficients between apatite and melt, $D^{Cl}_{ap\text{-}melt}$, vary from ~1 (e.g. at 750°C, 35kbar, and 800°C, 45kbar) to ~11 (at 800°C, 25kbar), with values rising with increasing temperature and falling with increasing pressure. The preliminary partition coefficient values for aqueous fluids, based on mass balance estimations, are found to be less than 1 at subsolidus conditions.

A further series of experiments was performed at 25 kbar and 800°C with various Cl (~0, 500, 1000, 2000, or 4000 ppm) and F (~0, 1000, or 2000 ppm) fractions in the starting compositions. $D^{Cl}_{ap\text{-}melt}$ values were found to remain relatively constant between experiments with identical F concentrations in the system. Linear regressions show the $D^{Cl}_{ap\text{-}melt}$, to be around 10.6 at 0 ppm F, ~3.5 at 1000 ppm F and ~1.9 at 2000 ppm F. The preliminary $D^{F}_{ap\text{-}melt}$ values range from 15 to 50, with the dominant influence being the F concentration in the system. The obtained results are the first ever reported in the literature, and will provide useful constraints on F and Cl contents in subduction zone fluids.

Geological evolution of Paleotethys: Constraints from Ar-Ar, U-Pb ages of gabbro in Jinshajiang Suture Zone

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Jinshajiang suture zone located in the northern and eastern of Qinghai-Tibet plateau, considered as the boundary of west-north Paleotethys. Therefore it is of significant in the research of the geological evolution of Paleotethys. We collected gabbro samples from ophiolitic melange in the area of Yushu, middle-west of the suture zone, and achieved a number of high-precision Ar-Ar and SHRIMP U-Pb age which with range of 295Ma-233Ma. According to these ages, the gabbro can be divided into three groups: (1) Late Carboniferous gabbro: Outcropped in the middle of Jinshajiang suture zone, with zircon SHRIMP U-Pb age of 295.3±5.2Ma. (2) Middle-late Permian gabbro: Distributing in central and north of the suture zone, with age ranges from 268 to 258Ma. (3) Mid-Triassic gabbro: Distributed in central and south parts of suture zone, the age is about 233Ma.

From above isotope ages of gabbro, we could extract some information for the geological evolution of Paleotethys: (1) The Jinshajiang ocean expansion lasted 60Ma. (2) Along Jinshajiang suture zone, the age of ophiolite from southeast to northwest reduce gradually, which indicate the Paleotethys Ocean opening is earlier in southern part than in northern part, from southeast to northwest, the Ocean basin opened in sharp of shear-like. (3) Considering the existence 362Ma of ophiolite in the south of Jinshajiang suture zone [1], Paleotethys existed more than 130Ma.

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[1] Jian *et al*. (1998) *Acta Petrologica Sinica* **14**(2), 207-211.