

## The Solubility and Speciation of Niobium in Fluoride-Bearing Aqueous Solutions

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Although niobium is generally considered to be highly immobile in hydrothermal fluids, there is evidence for appreciable hydrothermal mobility of this metal in alkaline igneous complexes. There are, however, almost no data on the solubility and speciation of niobium in aqueous solutions at elevated temperature. From geological and hard acid-soft base (HSAB) considerations [1], fluoride is the ligand most likely to form stable complexes that will facilitate the development of significant concentrations of niobium in hydrothermal fluids. Significantly, hydrofluoric acid is used to extract niobium from ores in industrial settings and experimental data on the solubility of tantalum, “niobium’s twin”, in an aqueous fluid at elevated temperature and pressure suggest that fluoride species are responsible for the hydrothermal transport of tantalum [2]. In this study, we determined the solubility of niobium oxide in aqueous solutions at elevated temperature (150-250 °C), variable fluoride activity ( $\sim 10^{-5}$ - $10^{-2}$  mF), and variable pH (2.1 and 2.4).

Our experiments involved determining the solubility of Nb oxide in F-bearing aqueous solutions at temperatures up to 250 °C and saturated water vapour pressure. The experiments were performed using the autoclave solubility method and employed a technique involving teflon tubes, which was developed previously for determining the solubility of REE fluorides in F-bearing solutions [3].

Preliminary results indicate that the speciation and solubility of niobium are dependent on the activity of fluoride in the aqueous solution. At low fluoride activity ( $\sim <10^{-3.5}$  mF), niobium solubility is low and pH dependent, suggesting that simple niobium fluoride complexes are responsible for its solubility. By contrast, at higher fluoride activity ( $\sim >10^{-3.5}$  mF), the solubility of niobium is considerably higher and independent of the pH of the aqueous solution. In this range of fluoride activity, the solubility of niobium is best explained as being due to the formation of hydroxyfluoride species.

[1] Pearson (1963) *Journal of the American Chemical Society* **85**, 3533-3543. [2] Zraisky *et al* (2008) *Mineralogy and Petrology* **99**, 287-300. [3] Migdisov *et al* (2009) *Geochimica et Cosmochimica Acta* **73**, 7087-7109.