

Hydrolysis of niobium and tantalum fluoride complexes: implication on Nb/Ta fractionation

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Niobium and tantalum have long been regarded as geochemical “identical twins” because of their similar geochemical behaviours. However, significant Nb/Ta fractionations often can be observed not only in a single mineral, but also during the formation of the continental crust and ore deposits[1-4]. It is still hotly debated regarding to the mechanism on Nb/Ta fractionation. Here we report discrepant hydrolysis behaviours between Nb and Ta in fluorine-bearing fluids, a new explanation on Nb/Ta fractionation in corresponsse to the environmental change.

A series of hydrolysis experiments under the conditions of 200-550°C and 1-2 kbar were conduct using synthetic $K_2NbOF_5 \cdot H_2O$ and K_2TaF_7 . In the hydrothermal conditions the Nb and Ta fluorides hydrolyze gradually to form different complex species through ion exchange between F^- in the fluorides and OH^- in the H_2O . Take K_2TaF_7 for example, it hydrolyzes firstly to form $[TaF_6(OH)]^{2-}$, $[TaF_5(OH)_2]^{2-}$, and $[TaF_4(OH)_3]^{2-}$, etc., and finally to $[Ta(OH)_7]^{2-}$, which easily reacts with H^+ to produce Ta_2O_5 deposit in the acid fluids. Our experimental results indicate that, i) the ultimate hydrolysis ratio of Nb or Ta fluoride complex, which represents the amount of deposit, is enhanced with the pressure and especially the temperature increasing and the concentration reducing; and ii) usually more Ta fluoride than Nb fluoride hydrolyzes on various temperature or pressure. Discrepant hydrolysis behaviours between Nb and Ta fluoride complexes can induce not only Nb moving more easily than Ta, but Nb/Ta self-fractionation in fluorine-bearing fluids due to the falling of temperature or pressure.

[1] Ding *et al* (2013) *J. Geol.* **121**, 255-274 [2] Xiao *et al* (2006) *Geochim. Cosmochim. Acta* **70**, 4770-4782 [3] Liang *et al* (2009) *Chemi. Geol.* **268**, 27-40 [4] Ding *et al* (2009) *Int. Geol. Rev.* **51**, 473-501