The solubility and speciation of scandium in fluoride-bearing aqueous solutions at elevated temperatures

JIAXIN WANG*[123], A.E. WILLIAMS-JONES[2], A. TIMOFEEV[2], SHUNDA YUAN[12], JIAJUN LIU[3]

[1] MLR Key Laboratory of Metallogeny and Mineral Assessment, Institute of Mineral Resources, Chinese Academy of Geological Sciences, Beijing 100037, China

[2] Department of Earth and Planetary Sciences, McGill University, 3450 University Street, Montreal, Canada, H3A 0E8

[3] State Key Laboratory of Geological Processes and Mineral Resources and School of Earth Sciences and Resources, China University of Geosciences, Beijing 100083, China

*jiaxin.wang@cags.ac.cn

Scandium, a scatter rare metal, is considered as one of the critical elements. Approximately 90% of global scandium production has been supplied by Bayan Obo deposit in China, where scandium is hosted mostly by aegirine. The next important scandium deposit is Zhovti Vody deposit (in Russia) containing aegirine as its main scandium-bearing mineral. Finally, the most important scandium deposit is Kumir deposit (in Russia) which approximately 64% scandium is hosted in thortveitite containing scandium as an essential component. All of these deposit case the hydrothermodynamic solution. The increased demand and the imminence requirement of independent giant scandium deposit exploration have created a strong need to improve our understanding the genesis of scandium ores. Unfortunately, the lack of reliable high-temperature the thermodynamic data for the aqueous scandium species precludes modeling their transport in hydrothermal fluids. In this study, we report the results of a series of experiments (pH:1.2 – 4; HF: 10^{-3} – 10^{0} mol/kg) conducted at 100, 150, 200 and 250°C, and vapor-saturated water pressure designed to determine the solubility of $ScF_{3(s)}$ in fluoride bearing solution.

At these experimental conditions, the results of the experiments show that ScF_2^+ and ScF_3^o are the dominant species in solution. The logarithms of the formation constant for ScF_2^+ ($Sc^{3+} + 2F^- \rightleftharpoons ScF_2^+$) range from 12.09 ± 0.02 to 14.76 ± 0.01 at 100 to 250°C, and from 17.24 to 19.81 for ScF_3^o ($Sc^{3+} + 3F^- \rightleftharpoons ScF_3^o$) between the same temperatures.