Goldschmidt2020 Abstract

Thermodynamic Model for Borate in Elevated Temperature and High Ionic Strength Environments

YONGLIANG XIONG[1*], YIFENG WANG[1], PHOLOPATER FALTAS[1]

[1] Department of Nuclear Waste Disposal Research & Analysis, Sandia National Laboratories (SNL), 1515 Eubank Boulevard SE, Albuquerque, NM 87123, USA
***Corresponding author email**: yxiong@sandia.gov*

In geological disposal of high level nuclear waste (HLW), borate is present in the associated groundwaters. First, there may be relatively high concentrations of borate in natural groundwaters such as brines associated with salt formations [1]. Second, when borosilicate glass for HLW is corroded in geological repositories, borate is also released into the groundwater [2]. Therefore, borate can impact nuclear waste management in two aspects. First of all, borate can form an aqueous complexes with actinides in +III oxidation state, such as Am(III) [3]. Consequently, borate could become a potential transport agent for actinides if the Am(III)-borate complex contributes significantly to the total Am(III) concentrations. In the second aspect, numerous actinide-bearing borate solid phases have been recently successfully synthesized in the literature, implying that actinides in waste could be transformed into, or be sequestrated as, actinide borates, if their solubility limits are reached. Hence the accurate knowledge of borate geochemistry under the conditions of various disposal concepts is important to the performance assessment (PA).

In this study, we deleop a thermodynamic model for borate chemistry valid to high temperatures and high ionic strengths, with the Pitzer equations for activity coefficient calculations. It is expected that the model can be applied to various disposal concepts.

Sandia National Laboratories is a multi-mission laboratory operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA-0003525. SAND2020-1319A. This research is funded by the SFWST programs administered by the Office of Nuclear Energy (NE) of the U.S. Department of Energy.

References

[1] A.Vengosh, A. Starinsky, Y. Kolodny, and A.R. Chivas, Geochimica et Cosmochimica Acta 55, 1689 (1991); Y. Xiong, and A.S. Lord, Applied Geochemistry 23, 1634 (2008).

[2] T. Advocat, P. Jollivet, J.L. Crovisier, M. del Nero, Journal of Nuclear Materials 298, 55 (2001); E. Curti, R. Dahn, F. Farges, and M. Vespa, Geochimica et Cosmochimica Acta 73, 2283 (2009).

[3] M. Borkowski, M. Richmann, D.T. Reed, and Y.-L. Xiong, Y.-L., Radiochimica Acta 98, 577 (2010).