Ion association in hydrothermal systems: Strontium chloride, hydroxide and acetate to 350 ºC and 20 MPa

H. ARCIS,[1] G. ZIMMERMAN[2] AND P. TREMAINE[1]

[1]University of Guelph, Guelph, Ontario, Canada
[2] University of Bloomsburg, Bloomsburg, Pennsylvania, USA

The ion association constants of Sr^{2+} with common ligands under hydrothermal conditions are needed to model the geochemistry of naturally occurring radioactive materials ("NORM") [1] and the chemistry of Generation IV super-critical water nuclear reactor designs [2]. Moreover, because of its favourable solubility, Sr^{2+} is an attractive model system for predicting the thermodynamic properties of M^{2+} transition metals. This paper reports the first conductivity study of aqueous $SrCl_2$ and $Sr(OH)_2$ from 25 to 350 °C, using a novel high-precision flow-through AC electrical conductance instrument [3,4] at concentrations from $5{\cdot}10^{-5}$ to 0.2 mol·L^{-1}.

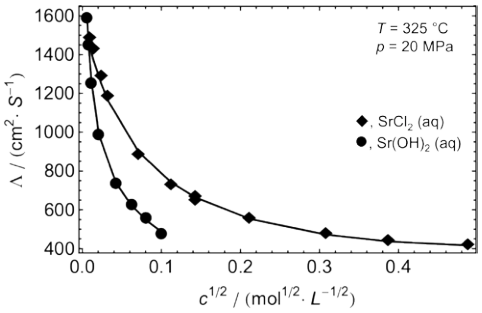

Figure 1: Molar conductivity Λ of aqueous $SrCl_2$ and $Sr(OH)_2$ *vs*. concentration *c* at 325 °C and 20 MPa.

Formation constants were determined from Λ vs *c* using the TBBK model [3,4]. The values for $Sr(OH)^+$ and $Sr(OH)_2^0$ are greater than those for $SrCl^+$ and $SrCl_2^0$ ion pairs, and both neutral species are significant above 10^{-3} mol·L^{-1} at 350 °C. Similar data have been obtained for the complexes of Sr^{2+} with acetate, $Sr(Ac)^+$ and $Sr(Ac)_2^0$ up to 275 °C at 20 MPa. The limiting molar conductivities can be used to estimate ionic mobilities and diffusion under hydrothermal conditions.

[1] Hinrichsen C. (1998) *Corrosion* **98**, Paper 98061. [2] Guzonas *et al*. (2009) *Power Plant Chem*. **11**, 284-291. [3] Hnedkovsky *et al*. (2005), *J. Phys. Chem. B* **109**, 9034-9046. [4] Mendez De Leo, *et al*. (2005) *J. Phys. Chem. B* **109**, 14243-14250.

Modes of mantle flow and He travel in the northern Lau Basin

R.J. ARCULUS*, O. NEBEL, F.E. JENNER, J.A. MAVROGENES AND N. DYRIW

Research School of Earth Sciences, ANU,Australia
(*correspondence: richard.arculus@anu.edu.au)

High $^3He/^4He$ has been documented in dredged volcanic glasses from the Rochambeau Rifts (RR) and North West Lau Spreading Centre (NWLSC) in the northwestern Lau Basin, plausibly related to southerly ingress of the Samoan Plume into the mantle wedge underlying this rapidly opening backarc basin[1]. The Central Lau Spreading Centre (CLSC), offset south of the NWLSC by the right-lateral Peggy Ridge Transform Fault, has MORB-like $^3He/^4He$, suggesting the Ridge exerts control on asthenospheric mantle as well as fracturing the lithosphere. The relative fertility of the mantle supplying the actively extending rifts and spreading centres increases from south to north (CLSC through NWLSC to RR). In terms of elevated Fe8, the RR define a new, hot, fertile, global backarc basin end-member, with strongly elevated Hf*/Hf and Dy/Yb, consistent with a garnet-bearing residue during melt generation. Both RR and NWLSC show a positive correlation between Fe8 and $^3He/^4He$. Hf-Nd isotopic covariations provide additional constraints on the nature of mantle sources involved (SOPITA, Samoan plume, Pacific) and ingress of high $^3He/^4He$ material; RR samples with high $^3He/^4He$ have low ε_{Hf} and ε_{Nd} plausibly resulting from a Samoan-SOPITA mantle mix. However, high $^3He/^4He$ samples of the NWLSC show no mixing with Samoan-type Nd and Hf. It appears plume invasion is restricted to sub-RR. The Pacific mantle signature is prominent beneath the NWLSC but disappears south of the PR towards the CLSC being replaced by SOPITA-type mantle. Decoupling of $^3He/^4He$ with Nd and Hf may indicate flow of He in a plume-derived volatile phase.

[1] Lupton, J.E. *et al*. (2009) *Geophysical Research Letters* **36**, L17313, doi:10.1029/2009GL039468.