Extrapolating investigations of ion and molecular adsorption at the muscovite (001)-water interface to systems in Earth, environmental, and materials science

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Over ten years ago, we began investigating adsorption processes at the muscovite (001)-water interface using *in situ* X-ray reflectivity to understand the reactivity of this unique representative charged surface, which occurs in soils and sediments in the form of detrital micas and clays. Advances in experimental design and measurement along with implementation of resonant anomalous X-ray reflectivity have led to acquisition of data for monovalent cation, divalent cation, and dissolved organic matter systems over a range of pH at ambient conditions. From the data, which provide bulk and element-specific electron density in layers parallel to the (001) surface with Ångstrom-scale resolution, a new detailed picture of the distributions of and interactions among ions, water, and organic molecules has emerged. We are developing quantitative expressions for the energetic balance between hydration and electrostatic attraction in the interfacial region that enhance models of the electrical double layer. We show how the results apply to the disposition of toxic metals and nutrients in soils and sediments, the mobility of cations in natural waters, the formation of mineral and organic colloidal aggregates in natural waters, and the general behavior of charged surfaces in materials science.

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Stable chlorine isotope study of standard rocks and Allende meteorite by TIMS

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Current chlorine isotope studies on planetary materials are controversial among IRMS (gas source mass spectrometry) and/or TIMS (Thermal Ionization Mass Spectrometry) groups [e.g. 1-3]. We have initiated development of the TIMS technique at NASA JSC in order to analyze small amounts of meteoritic and planetary materials.

For silicates, we use an HF-leaching method similar to that of Musashi *et al.* [4]. Cl is analyzed as Cs_2Cl^+. The composition of our laboratory standard was well established in previous work; $\delta^{37}Cl_{SMOC} = -2.49 \pm 0.21‰$ [5].

We report TIMS results for two standard rocks, JB2 and JB3, that have been analysed by the IRMS technique [1, 4]. Values of $\delta^{37}Cl$ $(‰)_{SMOC}$ obtained were 0.32±0.07 for JB2 and 0.53±0.20 (1 σ), for JB3, resp. (Fig. 1). The JB3 value is in agreement with [4] (0.55 ±0.10) within 1σ error. The JB2 value is ~0.8 ‰ higher than that of [1]. Preliminary analyses of Allende give $\delta^{37}Cl_{SMOC} = -1.41 \pm 0.15‰$ similar to -1.90 reported by Bonifacie *et al.*[2].

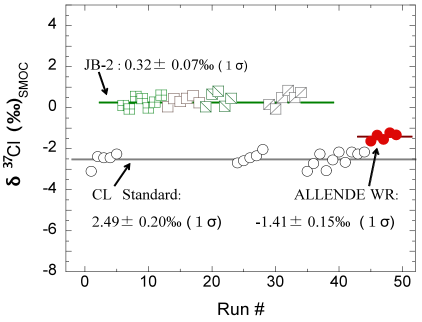

Figure 1: Preliminary results for JB2 and Cl laboratory standard (Nakalai tesque CsCl reagent) and Allende whole rock (WR). Individual data points represent the mean of 300 ratios/run. The $\delta^{37}Cl$ $(‰)_{SMOC}$ shows permil deviation from seawater.

[1] Bonifacie *et al.* (2007) *Chem Geol,* **242**, 187–201. [2] Bonifacie *et al.* (2008) *Science* **319**, 1518–1520. [3] Sharp *et al.* (2007) *Nature* **446**, 1062–1614. [4] Musashi *et al.* (1998) *Anal. Chim. Acta* **362** 261–269. [5] Numata *et al.* (2001) *Geochem. J.* **35**, 89–100.