Halogen geochemistry of planetary building blocks

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Understanding how the Earth obtained its volatiles is important for our overall understanding of large scale planetary evolution. Many models exist to explain the heterogeneous accretion of volatiles to early Earth, yet it is difficult to account for all elements through simple accretion of possible planetary building blocks (e.g., CI chondrites). The moderately-volatile heavy halogens (Cl, Br and I) provide an opportunity to investigate such questions as they are sensitive tracers of dynamic planetary processing (e.g., differentiation, crust formation, addition of a 'late veneer', etc.) largely due to their incompatibility, low abundance and hydrophilic (e.g., Cl) nature. Utilizing neutron-irradiation noble gas mass spectrometry, an evaluation of the baseline halogen composition of the primitive meteorites as 'building blocks' was undertaken. The results of carbonaceous (CI, CM, CR, CV), ordinary (H, L, LL), and enstatite chondrites (EH, EL) are reported.

The ordinary chondrites show variable halogen concentrations (5–600 ppm Cl, 1–1650 ppb Br and 2–390 ppb I) and very low molar I/Cl (~10^{-6}) and Br/Cl (~10^{-4}) ratios, comparable to those measured in some terrestrial hydrothermal fluids[1]. Carbonaceous chondrites are fairly homogeneous in their halogen concentrations and ratios (Br/Cl, I/Cl ~10^{-4}), suggesting effective closed-system behavior. The EH chondrites show relative enrichments in the heavy halogens (up to 330 ppm Cl, 2290 ppb Br and 180 ppb I) and have high I/Cl (~10^{-3}) and Br/Cl (~10^{-3}) ratios. Halogen concentrations in the ECs are up to ~ 8 times higher for Cl, up to ~ 40 times higher for Br and up to ~ 50 times higher for I, compared to estimates of halogen concentrations in the primitive terrestrial mantle[2]. These results provide insight into the accretion of moderately volatile element rich material under reducing conditions, such as may have existed on early Earth. Results of Rumuruti chondrites and mineral, chondrule and metal separates will be presented to further inform on the distribution of halogens in primitive solar system materials.

[1] Böhlke & Irwin (1992) *EPSL*, **110**: 51-66 [2] Newsom, H.E., (1995) Global Earth Physics, A Handbook of Physical Constants, AGU Ref.Shelf, v. 1