THE HISTORY OF VOLATILE ELEMENTS IN THE SOLAR SYSTEM: MERCURY ISOTOPE SYSTEMATICS IN CHONDRITES AND EUCRITES.

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Introduction: Terrestrial planets and meteorites show variable degrees of volatile element loss compared to average solar system material and CI chondrites. This is most expressed in the noble gases, but is also evident in moderately volatile elements such as Cd and Ag. The origin and the physical processes that lead to these depletions in planetary bodies are debated. They include (i) incomplete condensation in the solar nebula, (ii) losses through chondrule formation or (iii) losses during the violent process of accretion and (iv) during parent body processes (shock heating and thermal metamorphism) on small asteroidal bodies. To address the topic of volatile depletion, we determined the Hg content and the Hg isotope compositions of various chondrites and eucrites. Mercury is highly volatile with a condensation temperature between ices/gases and moderately volatile elements such as Tl. Moreover, Hg has seven stable isotopes that are produced by different nucleosynthetic processes (p, s and r) and can thus be used to assess the nucleosynthetic heterogeneity in the solar system.

Analytical Techniques: The analytical procedure is described in [1] and references therein. The Hg concentrations were measured by combustion Atomic Absorption Spectrometry (LECO AMA 254), while the determination of the Hg isotope compositions used a two-stage tube combustion oven coupled with an oxidizing liquid trap for the pre-enrichment of Hg prior to isotope analysis [2]. The isotopic measurements were performed on a Nu Plasma MC-ICPMS using a cold vapor sample introduction system.

Results and Discussion: The Hg concentrations were determined for various chondrites (CI, CM, CV, CR, CO, H, E and R), a lodranite, an acapulcoite and four eucrites. They yielded a wide range of concentrations from 2.8 ng g^{-1} (NWA 2714, lodranite) to 88420 ng g^{-1} (Orgueil, CI) with no clear trend within or between specific meteorite classes. Isotopic compositions were determined for a subset of the samples and mass-dependent (MDF) and mass-independent variations (MIF) were identified. The data reveals a range of δ^{202}Hg values (MDF) from -3.55‰ (Orgueil) to +0.14‰ (Bouvante). Isotopic compositions and Hg concentrations are not correlated. This suggests a multistage evolution for Hg in the analyzed meteorites. Diverse local processes (aqueous alteration, condensation, sulfidation) affect the occurrence of HgS in meteorites [3, 4, 5] and thus likely the Hg isotope composition. Small correlated MIF effects in Δ^{199}Hg and Δ^{201}Hg were observed (Δ^{199}Hg range: -0.11 to 0.15‰, ±0.06‰, 2SD). They are consistent in sign and magnitude with the nuclear volume effect predicted alongside the observed MDF. Our data show no evidence for the presence of nucleosynthetic anomalies and demonstrate that Hg is heterogeneously distributed in bulk meteorites.

References: [1] Wiederhold J. G. and Schönbächler M. Abstract #1841. 46th Lunar & Planetary Science Conference. [2] Jiskra M. et al. 2015. *Environ. Sci. Technol.* doi: 10.1021/acs.est.5b00742. [3] Caillet Komorowski C. et al. 2012. *EPSL* 349-350:261-271. [4] Kurat G. et al. 1989. *Z. Naturforsch.* 44a:988-1004. [5] Lauretta D. S. et al. 1999. *EPSL* 171:35-47.