SESSION 6

Delivery of Volatiles to Terrestrial Planets

DAY 3 – Feb.15, 2017
4:30 pm – 6:40 pm

Noble Gases in Various Chondrite Classes – Clues to Parent Body Processing and the Origin of the Terrestrial Volatiles

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Background: A fundamental goal in cosmochemistry is to understand the origin of water and volatile elements in Earth-like planets and evolution of their atmospheres. Noble gas considerations can complement other evidence, e.g., from diagnostic H and N isotopes [1-3]. (Giant) impacts likely erased most signatures of a primary atmosphere but also – combined with global magma oceans – led to early degassing of mantle volatiles. Continued outgassing and the addition of some incoming, volatile-rich *chondritic* or cometary material replenished the terrestrial atmosphere [1-4].

In addition to volatiles accreted during the "late veneer", the interior contains traces of primordially trapped volatiles [5-7]. These could have been incorporated directly from the nebula gas, e.g. by ingassing from a thick atmosphere into a global magma ocean [8], or were provided by the planetary building blocks. The latter may be best represented by originally *chondritic* material that was thermally or aqueously altered to different degrees and potentially even differentiated. Hence, the *primordially trapped* noble gas concentrations of the various chondrite classes but also achondrites are important parameters. To obtain these, members of all meteorite classes must be analysed. The buildup of radiogenic and cosmogenic noble gases, solar wind incorporation in recent asteroidal regoliths and terrestrial effects must be taken into account.

New Results: A large number of R, ungrouped C, CI and CR chondrites were recently analysed at ETH Zurich [9-13, this work]. At the symposium we will discuss correlations of these results with parent body metamorphism, aqueous alteration and terrestrial processing. We will present new data for primordially trapped noble gas concentrations for many meteorite classes and combine these with literature data to define concentration ranges for these meteorites. The ranges will be compared with terrestrial noble gas observations to better understand the origin of terrestrial volatiles.

References: [1] Alexander C.M.O'D. et al. (2012) *Science* 337, 721-723. [2] Marty B. et al. (2016) *EPSL* 441, 91-102. [3] Halliday A.N. (2013) *GCA* 105, 146-171. [4] Dauphas N. (2003) *Icarus* 165, 326-339. [5] Mukhopadhyay S. (2012) *Nature* 486, 101-106. [6] Caracausi A. et al. (2016) *Nature* 533, 82-85. [7] Hallis L.J. et al. (2015) *Science* 350, 795-797. [8] Mizuno H. et al. (1980) *EPSL* 50, 202-210. [9] Busemann H. et al. (2011) *LPSC XLII*, #2793. [10] Lee M.Y.P. et al. (2013) *LPSC XLIV*, #2681. [11] Vogel N. et al. (2011) *Chem. Erde* 71, 135-142. [12] Riebe M. et al. subm. to *GCA*. [13] Busemann H. et al. (2016) Workshop "DINGUE" #4 (Nancy, April 13-15, 2016).