CO CHONDRITE PARENT BODY PROCESSING AS RECORDED BY NOBLE GASES

L. M. Eckart[1], C. A. K. Mertens[1], H. Busemann[1], C. Maden[1], K. Righter[2] and C. M. O'D. Alexander[3] [1]Institute of Geochemistry and Petrology, ETH Zürich, Switzerland (lisa.eckart@erdw.ethz.ch), [2] NASA Johnson Space Center Houston, TX, USA, [3] Earth and Planets Laboratory, Carnegie Institution of Washington, DC, USA.

Introduction: CO carbonaceous chondrites are among the most primitive meteorites, of which some experienced mild degrees of thermal alteration (up to 500 °C, e.g., [1]) in their parent asteroid. Previous studies on aqueously altered CM, CY and CR chondrites [2-4] have shown that the noble gases preserved in those meteorites can be used to assess the extent of parent body processing. This is mostly due to an Ar-rich carrier phase being susceptible to aqueous alteration. In this study, we follow up on these findings by investigating the effects of mild thermal alteration on the noble gas content of CO chondrites. They are subclassified from petrologic subtype 3.0 (e.g., Yamato-81025) to 3.8 (e.g., Isna) according to the degree of thermal alteration experienced (e.g., [5]). Understanding these effects does not only help to distinguish the most primitive samples from the severely altered ones, but also adds to the picture of the primordial volatile composition and distribution, as preserved in the most primitive material which accreted from the solar nebula at different heliocentric distances. Additionally, we search for pairing among samples, as part of an ongoing survey of Antarctic CO chondrites (e.g., [6]).

Experimental: Noble gas measurements were conducted on aliquots of ~20-25 mg from 16 different samples of varying petrologic subtype from 3.0 to 3.8. The gas extraction occurred in one temperature step at ~1700 °C, followed by separation into three fractions, He-Ne, Ar, and Kr-Xe, measured successively in a custom-built mass spectrometer. For each sample, complete gas extraction was verified by a re-extraction step at ~1750 °C. Details on the sample preparation and measurement protocols can be found in [7].

Results and Discussion: In most cases, the gas concentrations for all five noble gases decrease with increasing petrologic subtype, and the trend is most pronounced for Ne (Fig. 1). An exception is e.g. CO3.0 Colony, which is strongly terrestrially weathered [8]. CO3.8 Isna shows an unusually short exposure time to cosmic rays (~0.15 Ma [9]), which may be explained by a direct injection into a mean orbital resonance shortly after collision. The currently ill-defined Ar-rich carrier phase, found only in the least aqueously altered CM and CR samples, is still abundantly present in the predominately anhydrous CO chondrites, indicating that this component is less susceptible to moderately elevated temperatures. No CO chondrites examined so far contain solar wind, supporting the hypothesis that CO chondrites originate from the asteroidal interior (e.g., [10]). It thus remains enigmatic which material could account for the surface layer.

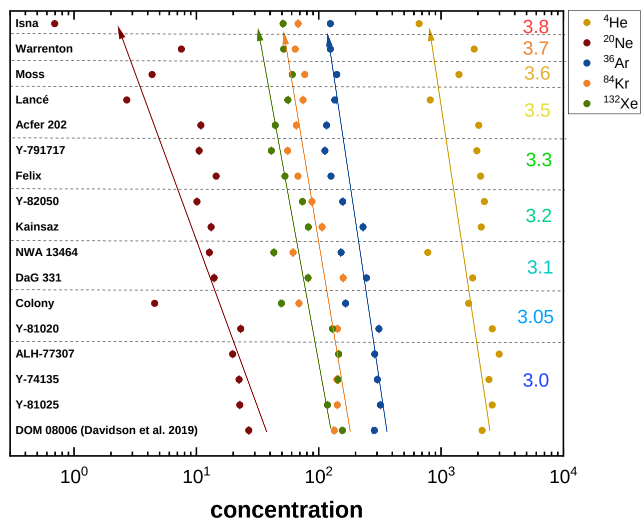

Fig. 1: *Preliminary noble gas concentrations of CO chondrites analyzed in this study. Values are given in 10^{-8} (He, Ne) or 10^{-10} (Ar, Kr, Xe) g/cm^3 STP.*

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