USING CHLORINE ISOTOPES TO TRACK THE COMPOSTITION OF ICE INCORPORATED INTO CHONDRITE PARENT BODIES

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Introduction: The $\delta^{37}Cl$ values of chondrites have a large range, -2 to +1‰ with one outlier, Parnallee, -4.1‰[1][2] which is in the same isotopic range as the primitive martian mantle [3,4,5]. This spread in $\delta^{37}Cl$ values could represent contributions from different volatile reserviors in the solar nebula or may be the product of secondary alteration on the parent body. To address this issue, this study will report the $\delta^{37}Cl$ of 3.00 chondrites, as classified by [3]. These samples should be affected less by secondary, parent-body processing. However, some of these ordinary chondrites, including Parnallee and Semarkona have been shown to be aqeously altered [4,5] but the nature of these fluids is not well understood.

Results: All 4 classified 3.00 ordinary chondrites (Semarkona, NWA 7731, NWA 8276 and NWA 10061) were processed using the methods described by [1,2]. Thus far, only NWA 7731 and NWA 8276 were analyzed and the $\delta^{37}Cl$ values are -0.75‰ and -4.52‰ respectively.

Discussion: The isotopically light $\delta^{37}Cl$ of NWA 7731 ($\delta^{37}Cl$ =-4.5‰) is similar to Parnallee ($\delta^{37}Cl$ =-4.1‰) and primitive olivine phyric shergottites (-4 to -3‰)[6,7,8], while NWA 8276 lies within the field of previously measured chondrites[3,4].

At 140 to 160 K, near the H_2O ice line, a solid HCl-clathrate ($HCl \bullet 3H_2O$) becomes stable as shown by [1]. The formation of this ice has been suggested to cause a $\delta^{37}Cl$ fractionation on the order of 3-6‰ [9]. In addition, [10] proposed the incorporation of an HCl-clathrate to explain acidic reactions seen in some chondrites. Parnallee and NWA 7731 may have escaped late incorporation of this HCl-clathrate, and therefore escaped secondary Cl isotope alteration. These samples represent a Cl isotope composition most similar to the primitive solar nebula. All bodies istopically heavier than -4‰ reflect different degrees of secondary HCl-clathrate incorporation [10]. Further, the concentration of Cl should increase by this HCl-clatherate incorporation, which would explain the low Cl/Na in most ordinary chondrites relative to other classes.

The Martian mantle and some ordinary chondrites may reflect parent bodies which were not in a region of HCl-clatherate stability. Analysis of Semarkona and NWA 10061 are pending and may give further insight into this hypothesis. Further, all 3.00 chondrites will be analyzed by SEM, EPMA and TEM to determine Cl concentration, distribution, and host phases.

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