Noble gases in differentiated meteorites

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The goal of this paper is to investigate noble gas isotopes in differentiated meteorites. Differentiated meteorites come from parent bodies that were once molten and separated into metal cores and silicate mantles.

HED is a group of differentiated meteorite believed to be derived from asteroid Vesta and Martian meteorites derived from Mars. Howardites, eucrites and diogenites represent various sections such as interior and crustal rocks of the parent body. Noble gas study is a tool to understand the history of volatile degassing from the interior and to constrain the types of precursor materials.

Neon in meteorites can have multiple components such as trapped and cosmogenic. For this purpose we use the data set of ~153 eucrites. This study shows that, the neon in eucrites is dominated by cosmic ray effects. There is no evidence of solar wind gases. Absence of a clear signature of trapped components hints a requirement of detail study of eucrites. The measurements on the meteorites could be on near surface samples, or the meteoroid could be small enough such that the cosmogenic effects are present in whole meteorite. One reason for the absence of neon could be complete loss of volatiles from the meteorites. This needs to further study, that it has implications for the volatile budget of differentiated objects in the solar system.

Diogenites on the other hand are representative of mantle of Vesta. The three isotope plot of $^{20}Ne/^{22}Ne$ vs. $^{21}Ne/^{22}Ne$ ratios of 49 diogenites indicates that all the samples are lie in the spallation component line. Diogenites are derived from mantle part of Vesta and hence during the process of heating, melting all the neon could be escaped.

Similar study of the Martian meteorites, shergottites and nakhlite show more than one trapped component. One of them is Martian atmosphere, while the others could be interior components.

Understanding the evolution of parent body can be done by explaining through planetary models that initially the composition is same as that of chondrites and by estimating the loss component of noble gases in eucrite, diogenites and Martian meteorites. This study will be extended to differentiated objects like Earth and Moon.

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