SIMS ANALYSIS OF OH AND D/H OF APATITES FROM EUCRITES.

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Introduction: Eucrites, a member of the howardite-eucrite-diogenite (HED) group, are basaltic meteorites that are believed to come from the asteroid Vesta [e.g., 1]. A recent study of water concentration and hydrogen isotope of eucrite apatite [2] suggested an early accretion of water from a carbonaceous chondrite–like source on Earth, Vesta and other planetary bodies in the inner solar system. In this study, we present results of OH and D/H analyses of apatites from more eucrite samples.

Samples and Analytical Methods: Apatites were identified and measured with a scanning electron microscope and an electron microprobe analyzer in four non-cumulative eucrite samples: Millbillillie, Camel Donga, NWA 1109, and NWA 6594. All the apatites found so far are fluorine apatite. The sizes of the apatites range from a few to tens microns. Water concentration and hydrogen isotope of the apatites were measured with secondary ion mass spectrometry (SIMS), using similar techniques as described in [3].

Results and Discussion: Eleven apatite grains from Camel Donga (3), NWA 1109 (3) and NWA 6594 (5) have been measured for their OH and D/H values with SIMS. Because of extremely heavily cracked, no apatite from the Millbillillie sample is suitable for similar measurements.

The water concentrations of the apatites from the three eucrite samples vary from ~50 ppm to ~3500 ppm. The apatites from NWA 1109 contain the least water, whereas the apatites from Camel Donga the most. The δD values of the apatites range from 50 (±40) ‰ to -210 (±40) ‰. There is no correlation between water contents and δD values.

The water concentration and hydrogen isotope of the eucrite apatites obtained in this study are consistent with the results reported in [2]. The observations indicate that significant amounts of water was involved in the early evolution of planetary bodies, such as Vesta, in the asteroid belts. Variations in OH and D/H of apatites are not consistent with a single igneous process on the eucrite parent body. Instead, the results suggest possible later processing of the apatites or different water sources.

References: [1] McCord, T.B. et al (1970) Science, 168, 1445–1447. [2] Sarafian, A. R. et al (2014) Science, 346, 623-626. [3] Boyce, J. W. et al (2010) Nature, 466, 466–469.