EVIDENCE FOR A TWO-LAYER STRUCTURE OF THE ACAPULCOITE/LODRANITE PARENT ASTEROID AND 5 MA CRE AGE OF 4 NEW ACAPULCOITES

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Introduction: A group of meteorites with achondritic textures and chondritic element composition, the acapulcoites and the lodranites (A/L), appear to originate from a parent body that shows the mineralogical features of the S-class asteroids. These meteorites sample a lithologically diverse asteroid, which includes rocks that are broadly chondritic in chemical composition and samples of partial melts [1]. There is strong evidence that the A/L have a common parent body: they have identical O-isotopic composition [2] and their cosmic-ray exposure (CRE) ages are in a narrow range of 4-7 Ma [3]. Only one acapulcoite, TIL 99002, shows a CRE age of 14.8 Ma [4].

Results: In this work we determined the He, Ne, and Ar isotopic abundances in the four acapulcoites, DHO 125, DHO 290, DHO 312, and GRA 98028. CRE ages were calculated based on the concentrations of cosmogenic ^{3}He and ^{21}Ne and appropriate production rates [3]. The CRE ages of the four acapulcoites are 5-6 Ma, within the typical range of this type of meteorites.

Discussion: The evidences from mineralogical, chemical, and oxygen isotopic characteristics clearly show that the A/L come from the same parent body. Furthermore, the CRE ages indicate that almost all A/L were ejected by one or two break-up events 4-7 Ma ago. By analogy to the onion-shell structure of the H-chondrite parent body [5] we propose that the A/L parent asteroid also had a layered structure. We suggest that the acapulcoites, like the H3/4 chondrites, originate from the outer layer of the parent body as they are fine grained, the temperature was never high enough for silicate partial melting, the peak temperature was 950-1050°C, and the ^{39}Ar-^{40}Ar ages are in the range of 4503-4556 Ma. The lodranites, like the H5/6 chondrites, represent the inner shells of their parent asteroid, are coarse grained, show silicate partial melting and were heated to ~1100-1250°C, and the only two ^{39}Ar-^{40}Ar ages are at the later end of the range for the acapulcoite ages, 4519 Ma for EET 84302 [6] and 4490 Ma for Gibson [7].

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