GAS-RICH ASTEROIDAL REGOLITH BRECCIA DHOFAR 018

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Dhofar 018 is a typical howardite mainly composed of eucritic and diogenitic lithologies. This meteorite contains a wide variety of foreign components, some of which were not known to occur in howardites so far, e.g., LL-chondrite and aubrite clasts [1]. Howardites (as HED meteorites in general) are potentially informative of impact cratering events, in particular the late heavy bombardment ~4 Ga ago [2-4], and frequently preserve records of exposure to solar corpuscular radiation [5,6]. Here we report the first results of ^{40}Ar-^{39}Ar analyses of Dhofar 018 mineral separates and whole rock sample.

Dhofar 018 whole rock (WR) has the highest concentrations of ^{36}Ar and ^{38}Ar (485 and 94 $\times 10^{-8}$ cm^{3}STP/g, respectively) found so far in howardites [cf. 7]. ^{36}Ar/^{38}Ar ratios in individual temperature extractions are generally >5, with a maximum ^{36}Ar/^{38}Ar value of 5.35±0.04 at 760°C. This ratio likely implies a higher ^{36}Ar/^{38}Ar value of the trapped endmember composition, as Dhofar 018 experienced a significant exposure history and ^{37}Ar derived from Ca – the main target element for ^{38}Ar production – is released at this temperature. Evidently, this breccia contains solar wind implanted Ar similar to other howardites [5-8]. The cosmic ray exposure age of Dhofar 018 (WR) crucially depends on the uncertainty of the solar wind argon isotopic composition [8]. Assuming the solar wind ^{36}Ar/^{38}Ar value as high as 5.8 [6] the cosmic ray exposure age would be ~100 Ma, while a ^{36}Ar/^{38}Ar ratio of 5.35 would imply ~31 Ma. Meanwhile our data indicate that Dhofar 018 had a pre-compaction exposure: The cosmic ray exposure age of a coarse-grained plagioclase separate is only ~13 Ma and independent on different possible $(^{36}Ar/^{38}Ar)_{trapped}$ values due to the high fraction of ~90 % of $^{38}Ar_{cos}$. Hence, this rock resided for a long time on the surface of its parent body, acquiring solar wind and cosmogenic gases, allowing incorporation of projectile matter ranging from reduced (enstatite type) to oxidized (carbonaceous type) material.

As the coarse-grained plagioclase separate released only negligible amounts of solar argon, an isochron analyses could be applied and revealed the presence of a trapped argon component at >660°C with a ^{40}Ar/^{36}Ar ratio of ~400. Correcting the age spectrum for this non-solar extraterrestrial component results in a partial age plateau of 2.3 Ga, indicating a relatively young impact event. On the other hand, the whole rock sample yielded two partial isochrons >790°C with low ^{40}Ar/^{36}Ar ratios ranging between 1 and 2, much closer to the solar value, and apparent ages close to 3 Ga. This outlines a scenario of a complex impact, degassing, compaction and irradiation history.

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