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Light Noble Gases Delivered to Earth by Interplanetary Dust Particles

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About 4×10^7 kg/yr of cosmic dust is currently accreted by Earth, carrying implanted solar wind noble gases to the surface mostly in fine particles under 35 μm diameter [1]. This process may have brought a primordial solar component to proto-Earth, contributing to the terrestrial volatile budget [2]. However, existing noble gas studies of cosmic dust (interplanetary dust particles, IDPs) have important limitations. Individual IDPs captured in the stratosphere are likely biased, for example, towards larger grains [3], and magnetic fines from modern seafloor represent only a subset of the IDP population [4]. Looking deeper in time, analyses of ancient IDPs preserved in pelagic sediments are often very sensitive to the relatively uncertain proportion and composition of terrigenous components [5].

We have undertaken new He and Ne measurements of deep-sea sediments from Shatsky Rise to assess variability in the mean composition of cosmic-dust-sourced He and Ne in the geologic record. These ~80-Ma-old carbonate oozes were deposited during the K1 ^{3}He enhancement event, likely produced by an asteroid collision or comet shower [6]. Very high concentrations of helium with ^{3}He/^{4}He ratios as high as 200 R_A (R_A: ^{3}He/^{4}He of atmosphere; 1.4×10^{-6}) were measured in decarbonated residue. The high concentrations indicate existence of abundant IDPs. The ratios are comparable to stratospheric particles [7], indicating minimal He contamination from terrigenous sediments.

These samples offer a new opportunity to study noble gases in IDPs and potentially offer new insights to: noble gas contents in ancient IDPs; noble gas elemental and isotopic signatures of implanted solar wind; volatile flux changes induced by an IDP-producing event; and retention of He and Ne in IDPs under deep-sea conditions over geologic time periods.

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