SOLAR NOBLE GASES IN 470 MYR OLD FOSSIL MICROMETEORITES.

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Introduction: A large abundance of fossil meteorites [1] and sediment-dispersed extraterrestrial chromite grains (SEC grains) [2] have been found in ~470 Myr old marine sediments [3] in quarries in Southern Sweden. Cosmic-ray exposure ages of the fossil meteorites are very short (~0.1–1 Myrs) and increase in younger sediments [4]. The break-up of the L chondrite parent body is thought to be responsible to have caused the high concentration of extraterrestrial matter [1–6]. Since SEC grains are less difficult to find than the fossil meteorites [2,6], our main motivation was to try to determine the exposure ages of the grains.

Samples and Experimental: The chromites were extracted from large (10-30 kg) limestone samples with acids, yielding up to a maximum of ca. 3 grains per kg of rock [2]. Grains were hand-picked and identified as extraterrestrial with SEM/EDS (L/LL chondrite composition). Batches of 4-6 chromite grains were weighted (4–8 µg ± 10%) and noble gases were extracted with an IR laser and analyzed in an ultra-high sensitivity mass-spectrometer equipped with a compressor ion-source [7].

Results and Discussion: The SEC grains contain very high concentrations (^{4}He: 1.4–9.4 10^{-3} cm^3/g; ^{22}Ne: 4.9–17 10^{-6} cm^3/g) of trapped He and Ne. Therefore, the determination of cosmic ray-exposure ages as done for the fossil meteorites [4] was not possible. However, the trapped gases provide clues about the nature of SEC grains. The He- and Ne-isotopic composition of the SEC grains is consistent with solar composition, and noble gas data from stratospheric IDPs [8] and recently fallen micrometeorites [9]. This strongly suggests that also the SEC grains were IDPs and came to Earth as micrometeorites. As we find solar noble gases in all SEC grains from different sediment beds, it is highly unlikely that the grains are fragments of regolith breccias, since only a few percent of all L and LL chondrites are regolith breccias [10]. Model calculations predict that large collisions in the asteroid belt produce so much dust, that the influx of material on Earth increases by two orders of magnitude [11]. Using a simple estimate of the dynamical lifetime (t) of dust based on P-R-drag [12] we estimate t = 0.6 to 1 Myrs for 100 µm chromite grains. This is consistent with the delivery times of the fossil meteorites in the same sediment beds [4].

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