COSMOGENIC AND SOLAR NOBLE GASES IN 470 MA FOSSIL METEORITES AND MICROMETEORITES FROM THE L-CHONDRITE PARENT-BODY BREAK-UP.
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Introduction: Schmitz et al. [1] discovered about 50 fossilized meteorites in the Thorsberg quarry of mid-Ordovician marine limestone in southern Sweden, reflecting a ~two orders of magnitude enhanced flux of extraterrestrial material ~470 Ma ago, caused by the L-chondrite parent body break-up. The meteorites are accompanied by abundant extraterrestrial chromite grains (~80-100 microns) dispersed in the same and adjacent limestone strata as the meteorites throughout southern Sweden [2]. Chromite grains from the sediments and the fossil meteorites preserve their original chemical [1,2] and oxygen isotope [3] composition, allowing classification as L-chondrites.

Cosmic ray exposure ages: Chromites extracted from a suite of fossil meteorites in a stratigraphic sequence from Thorsberg extending over 1-2 Ma yield ^{21}Ne cosmic ray exposure ages of ~0.1-1.1 Ma, increasing with decreasing stratigraphic age [4]. This is additional evidence that the fossil meteorites were created in a single very large collision in the asteroid belt and shows that some meteorites from this event arrived on Earth very quickly, by direct injection into a strong resonance in the main belt. A fossil meteorite from the mid-Ordovician Gullhögen quarry in Southern Sweden (Gullhögen 001) also has a low exposure age of 0.9 Ma, in agreement with the ages of Thorsberg meteorites from the corresponding sediment beds Tredje Karten and Sextummen. Exposure ages were calculated with a ^{21}Ne production rate of $(7.04\pm0.65)*10^{-10}$ cc/g determined with chromites from five modern meteorite falls with long exposure ages.

Solar He and Ne in dispersed chromite grains: Each one of 8 batches of 4-6 chromites dispersed in sediment beds contains He and Ne with ~solar isotopic composition. This means that a sizeable fraction – if not most – of the grains were brought to Earth as sub-mm-sized interplanetary dust particles, being irradiated by the solar wind in space. The alternative, that at least one grain in each batch was irradiated on a L-chondritic regolith (3% of all L-chondrites), is highly unlikely. The solar noble gases inhibited detection of cosmogenic ^{3}He or ^{21}Ne and hence exposure ages. This goal will require analysis of strongly etched chromites.

Transfer times of dispersed chromites: The concentration of dispersed chromites increases in the same layer (Arkeologen) where the oldest meteorites were found [2]. These grains were brought to Earth probably by the same fast track as the meteorites, through an orbital resonance. Dispersed chromites are also found in sediments at least 2 Ma younger than Arkeologen, however. This is longer than estimated Poynting-Robertson lifetimes of 0.6-1 Ma for 100 micron-sized particles. Such chromites may have been parts of slightly larger IDPs in space or may stem from second- or higher generation collisions some time after the main event leading to the L-chondrite parent body break-up.

References: [1] Schmitz B. et al. 2001. *Earth Planet. Sci. Lett.* 194:1. [2] Schmitz B. and Häggström T. 2006. *Meteoritics Planet. Sci.* 41:455. [3] Greenwood R. C. et al. 2007. *Earth Planet. Sci. Lett.* in press. [4] Heck P. R. et al. 2004. *Nature* 430:323.