

COSMIC SPHERULE DENSITY IN SOIL AND SURFACE EXPOSURE AGE IN THE ATACAMA DESERT, CHILE.

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We have sampled various surfaces in the Atacama desert during our meteorite search expeditions (e.g. Gattacceca et al., 2009) and determined cosmic spherule (CS) density within these surfaces. Soil was sampled down to 10 cm depth on a surface varying from 0.1 to 1 m². Raw soil was sieved in the 200-800 μm fraction and subjected to magnetic extraction either on site (for larger samples) or back to the laboratory. CS larger than 200 μm were picked under the binocular and their extraterrestrial nature confirmed by SEM imaging and micro-chemical analysis using μXRF. CS >200 μm density varies in the eight sites sampled from 100 to 2500 CS/m². Repeated sampling on the same surface for three sites (within a km distance) yield consistent CS densities. For the richest samples logarithmic cumulative size distribution slope around -5 indicates minor size distortion with respect to Antarctic collections, suggesting little horizontal (by wind or water) or vertical (by percolation below the sampled surface) transport. In those sites the proportion of Iron CS (ICS) is about 4%, again in agreement with Antarctic collections, taking into account the lack of glass CS due to magnetic extraction. However, in less rich samples, the size distribution slope (up to -3) and the ICS% (from 15 to 60%) indicate some density and size sorting. Assuming that ICS>200μm is the least mobile fraction of the CS flux, due to size, resistance to weathering and density, we propose that their density may be a proxy of surface age.

To test this hypothesis, surface exposure ages have been determined using in situ produced ¹⁰Be content in large quartz pebbles sampled on the same surfaces. Measurements were performed on ASTER, the 5MV AMS located at CEREGE (Arnold et al.2010). Surface exposure ages calculated assuming no erosion vary from 0.15 to 6 Myr. Correlation between ICS density and exposure ages appears good in all sites except one, from a different climatic zone. Silicate CS density is much less well correlated with exposure age, comforting our hypothesis of higher reliability of ICS density. Drawback is that larger samples are needed to recover a significant ICS number.

References: Gattacceca et al. (2009) Met.Soc. Meeting, abstract #5083. Arnold M. et al. (2010) Nucl. Instr. and Meth. in Phys. Res. B, 268 1954–1959. Doi:10.1016/j.nimb.2010.02.107.