A MICROMETEORITE "SPECTRUM" FOR THE MASS DISTRIBUTION OF WELL PRESERVED GREENLAND COSMIC DUST GRAINS. E.Robin[1,2], C.Jéhanno[1], M.Maurette[2], C.Hammer[3]. [1]Centre des Faibles Radioactivités, Laboratoire Mixte CEA/CNRS, 91190 Gif-sur-Yvette; [2]Laboratoire René Bernas, 91406 Orsay; [3]Institut of Geophysics, University of Copenhagen, DK-2200 Copenhagen.

We extracted cosmic dust grains from 75g-samples of dark sediments ("cryoconite"), collected in 6 distinct deposits found at three distant collecting sites on the melt zone of the west Greenland ice cap (latitudes of Sondrestromfjord and Jakobson). Their extraterrestrial origin was determined, first by preselecting the grains with a scanning electron microscope equipped with an energy dispersive X-Ray spectrometer (on the basis of either a chondritic or a Fe/Ni composition) and further measuring their iridium concentration by Instrumental Neutron activation Analyses (1).

At a given collecting site, the concentration of cosmic dust grains is independent of the type of deposits. In particular, at the Sondrestromfjord site, where we conducted a few field studies of the ~10cm-deep cryoconite holes that constitute an essential part of the melt zone surface, this concentration (~4,000 grains with a size >50μm per kg of wet sediments) is already in its final state in the thin layers of sediments deposited on the bottom of these holes.

We classified most of the cosmic dust grains in the 4 following major families, according to textural features and optical and magnetic properties: chondritic stony spherules (abundance ~50%; tarnished gray to opaque; magnetic); chondritic glassy spherules (abundance ~15-20%; transparent; very weakly (or not) magnetic); "unmelted" chondritic grains with irregular habits (abundance ~25-30%; opaque to transparent; generally weakly magnetic); Fe/Ni spherules (abundance ~2%; opaque; strongly magnetic).

From SEM measurements we directly inferred the size distribution of the most abundant grains (chondritic stony spherules), by using about 2,000 grains in the size range 50-300μm (line 1, table I). We verified (on a smaller number of grains) that the other families of grains did show similar size distributions (2). From both the size distribution of the chondritic stony spherules and the relative abundance of the other families of grains we inferred the "composite" mass spectrum of the Greenland cosmic dust grains. To extend this mass spectrum to smaller grains of the <50μm-residue, first we measure the total mass of iridium (corresponding to 1.75×10^{-9}g of Ir per kg of wet sediments) in the magnetic separate from this residue (that is heavily contaminated with terrestrial grains). We used the average concentration of iridium (670 ppb) of the cosmic dust component, deduced from individual Ir measurements in the larger cosmic dust grains to determine the total mass (~2.6mg) of the <50μm-size cosmic dust grains per Kg of sediments.

The initial mass spectrum (line 2, table I) was expressed in terms of g per kg of sediment roughly captured over a time scale of 3,000y (see ref.2) in cryoconite holes at the Sondrestromfjord site. As field studies indicate that the maximum mass of sediments retained per m^2 of ice surface is about 2kg, the Greenland mass spectrum (lower histogram in fig.1) could be given in units of $g/m^2/y$. This spectrum is then directly comparable to the micrometeorite mass spectrum (upper histogram in fig.1) of Grün et al (3). The most striking features of these spectra is the amazing similarity of their shapes (see slopes and peak positions). This shows that a very large proportion of cosmic dust grains of all sizes accreted by the Earth, and not only the >0.5 mm-size fraction in which high concentrations of ^{10}Be and ^{26}Al have been measured (4), are indeed micrometeorite debris and not ablation products of meteorites.

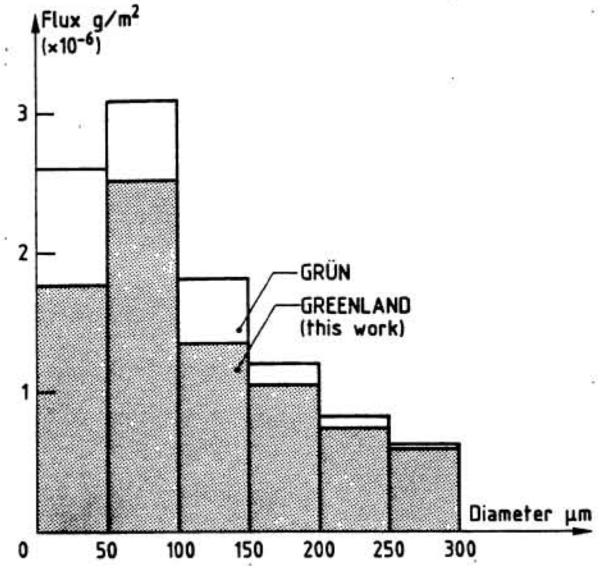
MICROMETEORITE MASS SPECTRUM

Robin, E. et al.

size: µm	< 50	50-100	100-150	150-200	200-250	250-300
number of stony per kg of wet sediment	-	1500	300	120	60	20
total mass mg/kg	2.6	3.8	2.0	1.6	1.2	1.0
total mass 10^{-6} g/m²/y	1.8	2.5	1.4	1.0	0.8	0.6

Table 1

Fig.1



These results allow the following additional inferences: (I) Micrometeorites survive amazingly well upon ablation in the atmosphere, losing a constant mass fraction, which is probably smaller than <50% over the whole mass range investigated in our work ($<10^{-4}$ g). This last conclusion, that can be directly inferred from both the small vertical shift between the two mass spectra and the similar position of the peaks at $\sim10^{-6}$ g, is also compatible with our observation of an unexpectedly high abundance of "unmelted" grains; (II) Neither the placer type mechanism responsible for the formation of the massive deposits of cryoconite, nor our extraction procedure has produced a marked fractionation of the major families of cosmic dust grains; (III) The countless ~10cm-deep cryoconite holes of the melt zone surface act as very efficient collectors of a relatively unbiased population of micrometeorites.

In July 1987 we shall return on the west Greenland ice cap at the latitude of Sondrestromfjord to: improve the determination of the cosmic dust mass spectrum (measuring in particular the amount of sediments trapped in cryoconite holes, per m^2 of ice surface, as a function of the surface age); and hopefully to find a sufficient number of <u>unmelted mm-size</u> grains (that might be identified as micrometeorites from ^{10}Be and ^{26}Al measurements) for the determination of important isotopic ratios related to their early solar system history (for this last objective we plan to extract these very rare grains by disaggregating ~1 ton of sediments while still in the field).

<u>REFERENCES</u>. (1) Bonté Ph. et al.(1986), <u>Proc. Lunar Planet. Sci. Conf.</u> <u>17</u>, in press; (2) Maurette M., Bonté Ph., Jéhanno C., Robin E. and Hammer C. (1987) submitted to Nature; (3) Grün E. et al.(1985) <u>Icarus</u> <u>62</u>, 244; (4) Raisbeck et al.(1986) <u>Proc. 49th. Annual Meteoritical Society Meeting</u>, paper M-8.