ASSESSMENT OF BIASES IN COLLECTIONS OF GREENLAND MICROMETEORITES: THE "BLUE ICE I" PROJECT OF JANUARY 1988 IN ANTARCTICA.

M. de Angélis[1], M.Maurette[2], M.Pourchet[1]. [1]Laboratoire de Glaciologie du CNRS, Domaine Universitaire, 38402 St Martin d'Hérès; [2]Laboratoire René Bernas, 91406 - Orsay.

We first outline several effects that might prevent the direct extrapolation of the characteristics of the most interesting unmelted micrometeorites collected on the west Greenland ice cap (1,2) to their parent bodies in space. We next describe our "Blue Ice I" expedition in Antarctica (January 1988), that should allow us to assess the importance of such effects, leading to various "biases" in collections of Greenland micrometeorites.

SOME EXPECTED BIASES: (a) Contrarily to previous thoughts, the modeling exercises presented by Bonny et al (3) suggest that "compact-inert" micrometeorites (such as chunk of chondritic and iron meteorites) would be preferentially melted and/or destroyed upon ablation in the atmosphere, while those with a porous aggregate structure loaded with a pyrolisable organic component, which are much more friable, should show a higher survival probability. On the other hand such friable micrometeorites can be fragmented during the mechanical disaggregation of their host sediments ("cryoconite"); (b) Density fractionation might be effective during the placer type mechanism leading to the accumulation of such "Greenland Cryoconite MicroMeteorite" (GCMM); (c) Callot et al (4) showed that cryoconite is composed of cocoons of filamentary siderobacteria, in which GCMM are tightly encapsulated. They also discovered a powerful process of biocorrosion induced by siderofungis on both crystalline and amorphous silicate. Thus the most interesting "carbon-sulfur-iron-rich" unmelted GCMM might be "biocorroded" to some extend by Greenland siderobacteria; (d) Bonny et al (4) report evidence suggesting that the connected pore structure observed in most unmelted GCMM ends up after ablation being partially coated with some organic-rich residues, that might act as "ion exchange resin" for adsorbing various trace elements in cryoconite interstitial water.

THE "BLUE ICE I" PROJECT NEAR DUMONT-D'URVILLE IN ANTARCTICA. In 1985 we decided to investigate such biases in the GCMM collections, launching the "Blue Ice I" project, that was finally accepted and funded in 1987. In January 1986 M.Pourchet explored the site of our expedition, right on a blue ice clift of the margin of the Antarctica ice cap, at about 5km from the french station of Dumont-d'Urville. We also prepared this project, analyzing a 60-kg chunk of blue ice, that was collected with a chain saw by Barnola at the same site in January 1987. Our final project is to melt in the field, in january 1988, about 100 tons of old blue ice, relying on a powerful generator of pressurized steam. The melt ice water will "gently" pass though a series of stainless steel sieves, preserving the integrity of the most friable grains, and allowing the direct collection of grains with sizes > 50µm initially trapped in the ice. Moreover, as the grains were constantly kept "deep frozen" and isolated from microorganisms, all bias quoted hereabove for the GCMM collections should be considerably reduced.

SEARCH FOR COSMIC SPHERULES IN 40 KG OF "BLUE ICE I". Five chondritic cosmic spherules were extracted from the sample returned by Barnola, relying on a simple extraction procedure that was specifically developped to minimize grain losses, and which was run in the ultraclean facilities at Grenoble. We first clean 5kg-chunk of ice, melting their external surface with a jet of bidistilled water. Each residual chunk is placed in a specific dust collecting decanter, and melted in a microwave owen. After about 15 minutes of decantation most of the melt water is removed by a gentle siphoning directed onto a

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System

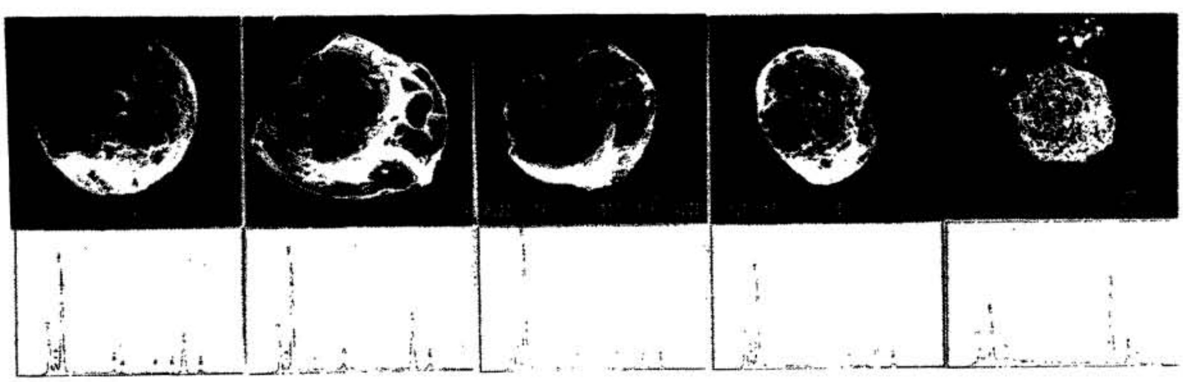
stainless steel sieve with an opening of 36µm. This set of operations was repeated for about 10 chunks of ice (total residual mass ~40kg), leading to a "gentle" deposition of most of the grains on the bottom of the decanter. All magnetic grains were finally collected under a binocular with a magnetized needle, and analyzed by Patrice Siry with a SEM equiped with an EDX system. We thus identified the 5 magnetic chondritic spheres reported in figure 1, that also shows high Mg contents in their EDX spectra.

FAVORABLE CONDITIONS FOR COLLECTING MICROMETEORITES AT THE "BLUE ICE I" SITE. E.Robin (5) recently found 5 chondritic spheres in the size range 50-150µm in a family of about 30-40 spherules collected by F.Yiou on a stack of millipore filters used for filtering ~110kg of ice shavings, probably obtained during the drilling of an ice core at South Pole, where the ice accumulate at a rate, $V_a \sim$ 8cm/y. From ice flow models we deduce that "Blue Ice I" was initially formed at ~200km from the ice margin, where $V_a \sim$ 20cm/y. From both the data of Robin and the ratio of the ice accumulation rate at both sites, we should have collected about "0.7" chondritic sphere from ~40kg of ice. Our finding of 5 spheres illustrates probably the loss of particles during the handling of the South Pole Ice. If both the value $V_a \sim$ 20cm/y, and the ratio (~1) of unmelted micrometeorites to cosmic spheres measured by Robin in the ~50-150µm-size fraction of the Greenland collection, still hold true at the "Blue Ice I" site, our results would indicate that the micrometeorite flux at 1 au in the size range, was about 5 times higher in the past than the corresponding value deduced from the data of Grün et al (6). The value of V_a for "blue ice I" might also be smaller, but it can hardly reach the South Pole value. Nevertheless our measurements indicate very favorable conditions that loaded "Blue Ice I" with a high concentration of cosmic dust grains. This should allow us: to extract around 10,000 micrometeorites with sizes >50µm (from 100 tons of ice), that have not been weathered to any measurable extend; to discover very fragile grains not found in the Greenland collection yet (see the last "sphere" on the right in figure 1; the very high Fe-content reported for the large beam analysis of this sphere is probably associated to rusty iron dust just observed above the sphere; Ni was also detected).

References: (1) Maurette et al., Science 233, 869 (1986); (2) Maurette et al., this Conf.Proc.; (3) Bonny et al., ibid; (4) Callot et al., Nature 328, 147 (1987); (5) Robin et al., this Conf.Proc.; (6) Grün et al., Icarus 62, 244 (1985).

Acknowledgments. We warmly thank P.Galle and P.Siry for SEM measurements at "Laboratoire de Biophysique de la Faculté de Médecine de Créteil", and "Terres Australes et Antarctiques Française for funding the "Blue Ice I" project.

FIGURE I: Chondritic spheres and their EDX spectra



© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System