FRIABLE MICROMETEORITES FROM CENTRAL ANTARCTICA SNOW. J. Duprat[1], C. Engrand[1], M. Maurette[1], M. Gounelle[1], G. Kurat[2], H. Leroux[3] [1]CSNSM, Bat 104, 91405 Orsay, France, duprat@csnsm.in2p3.fr, [2]Inst. f. Geolog. Wissensch., Universität Wien, Althanstrasse 14 , A-1090 Wien, Austria. [3]LSPES, Université de Lille1, 59655 Villeneuve d'Ascq, France.

Introduction: We carried on the collection of micrometeorites (MMs) from central Antarctica snow. The MMs were recovered by melting and sieving snow samples from the vicinity of the French-Italian station CONCORDIA (Dome C, 75°S-123°E). Located on the east Antarctic plateau, 1100 kms inland, and at 3200 m altitude, the Dome C snow is well protected from terrestrial dust contamination. The results presented so far [1] included 40 particles extracted from about 1 ton of melted snow during the January 2000 expedition (DC00). We report here on complementary results from the collection performed in January 2002 (DC02) in which 3.6 tons of snow were processed. These micrometeorites constitute the CONCORDIA-Collection. The sorting of the particles is still ongoing and this is thus a progress report.

Experimental procedure: Snow samples were manually extracted from a clean trench at depth ranging from 3 m down to 5 m, in order to get snow layers from years prior the arrival of the polar logistics on site. The snow was shovelled into 30 liters cans which were sealed and taken back to CONCORDIA station on sledges. We avoided using any engine in the vicinity of the extraction point. For the DC02 expedition, we designed a new stainless steel double tank snow smelter, working with a 35 kW propane gas boiler. The snow was melted and the dust gravitationally sieved on filters with a 30 µm opening to recover the particles. Twelve successive melts with volumes ranging from 200 to 600 liters were performed. The maximum exposure time of the particles to liquid water during each melting/sieving procedure ranged from 1 h to 20 h. During the entire sieving process, the water flow was kept low and did not involve any mechanical pumping. A preliminary inspection of each filter was performed on the field to check for possible contamination.

Results: The cleanliness of Dome C snow allowed to use generous pre-sorting criteria when extracting the micrometeorite candidates from the filters: only obvious contamination particles (textile fibres, plastic and metallic debris) were left out in the filters. So far, we have identified 412 particles of extraterrestrial origin, based on their textures and their chondritic composition on the EDXS spectra. The particles have been classified into 4 categories, ranging from completely melted spherules to largely unmelted grains [2]. Stony cosmic spherules (CSs) represent 34 % of the population, glassy CSs (19 %), crystalline micrometeorites (13 %), scoriaceous particles (15 %) and fine-grained micrometeorites (19 %). Only one iron cosmic spherule of extraterrestrial origin has been identified. A large population of small (~ 50 µm) shiny iron oxide spherules was identified but their extraterrestrial origin is doubtful [3]. The cumulative size distributions of each population are reported on Figure 1. For non-spherical micrometeorites, the particle was fitted to an ellipsoid and the size reported in Figure 1 represents the diameter of a sphere that would have the same volume as this ellipsoid. The relative proportion of unmelted micrometeorites is expected to decrease with increasing size due to increasing frictional heating at atmospheric entry [2]. Within the statistical uncertainties, such effect is not visible in this data set. For sizes greater than 100 µm, the distributions can be approximated to a power law, for the cosmic spherules (stony+glass) one gets a tail index of 5.2 in agreement with the data from the South-Pole collection [4].

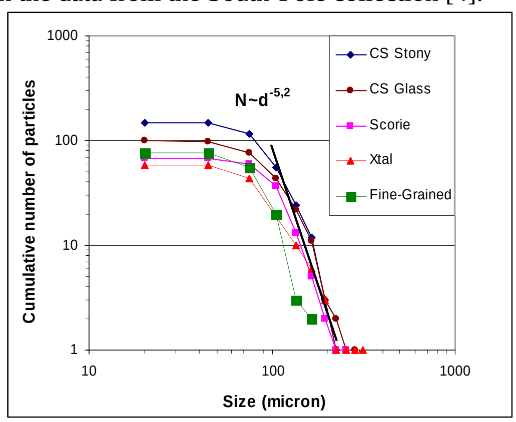

Figure 1 : Size distribution (per 30µm size bin) of the different populations of CONCORDIA-Collection micrometeorites (see text).

In the DC00 collection the ratio between extraterrestrial and terrestrial particles (ET/T) was ~ 0.1, while improvement in the collection procedure in DC02 yielded a ratio close to 1. The one order of magnitude improvement on this ratio indicates that most of the terrestrial particles are coming from contamination introduced during the fieldwork itself. It is probable that in the close future even higher ET/T ratio could be achieved at Dome C. In most previous collections of micrometeorites, when reported, the ET/T ratios are found ~ 2 orders of magnitude lower than that of DC02. The collections from Adélie Land [5] contain a large proportion of light-coloured morainic debris coming from the bedrock. The two other collections from central Antarctica snow (South-Pole [4] and Dome Fuji [6]) exhibit larger contamination levels compared to the CONCORDIA data. A key difference with the work presented here is that both were obtained using the functional water supply of their polar stations. The work done so far at Dome C indicates the necessity to perform the collection in a dedicated smelter and to follow a rigorous snow extraction procedure to reach the intrinsic high signal to background ratio of central Antarctic snow. The results obtained with the CONCORDIA Collection clearly confirm that, within the micrometeorite size range (>30 µm), the intrinsic dust in Central Antarctic snow is essentially of extraterrestrial origin.

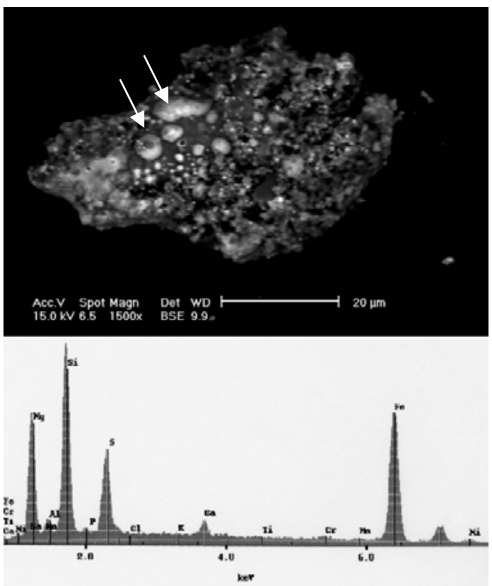

Figure 2 : (top) Micrometeorite from the CONCORDIA-Collection, at the surface, iron-sulphide inclusions (pyrrhotite) (arrows). (bottom) bulk composition EDXS spectrum.

We confirm that the CONCORDIA micrometeorites are characterized by a high proportion of Fe sulphides [1]. These Fe sulphides (mainly pyrrhotite) are found on the surface and/or inside of most unmelted or partially melted MMs (see Figure 2). We have reported on the discovery of a large (350 x 150 µm) friable particle recovered from DC00 Collection [1]. We further looked for such particles in the DC02 collection and found several new ones (see Figure 3). All the friable particles found in DC02 collection are within 30-50 µm, a size range which is comparable to the largest size range of the Interplanetary Dust Particles (IDPs) collected in the stratosphere by NASA [7]. Mineralogical and in-situ isotopic analyses are in progress to compare these new particles to IDPs. The observation of such particles in Dome C snow strongly suggests that the differences observed between the stratospheric IDPs and the polar MMs collections could be due to collection biases [8].

These observations confirm that both the unique conditions of preservations of the samples in Dome C snow and the collection technique itself provide the opportunity to collect particles that have undergone a minimal terrestrial weathering. In the collection presented here the particles did not suffered of mechanical stress, neither in their host snow nor during the collection procedure. The central regions of Antarctica represent a unique collector for large unmelted pristine interplanetary dust.

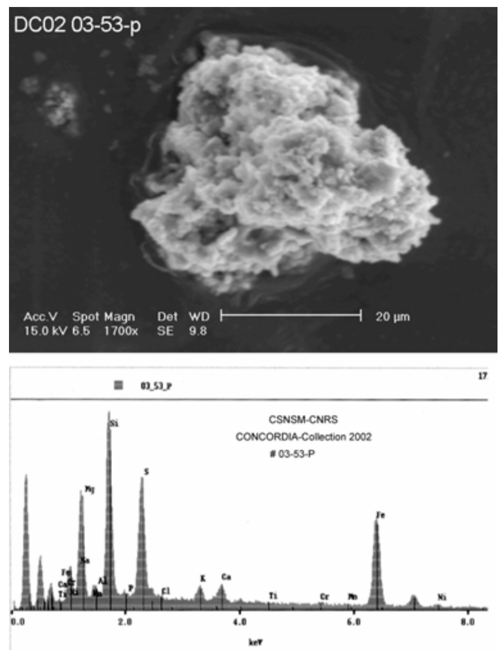

Figure 3 : (top) Friable fine-grained micrometeorite from the CONCORDIA-Collection. (bottom) bulk composition EDXS spectrum.

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