CLASSIFICATION OF COSMIC SPHERULES FROM WIDERØFJELLET (SØR RONDANE MOUNTAINS, EAST ANTARCTICA). C. Ventura Bordenca[1], M. S. Huber[1], S. Goderis[1,2], V. Debaille[3], and Ph. Claeys[1]. [1]Vrije Universiteit Brussel, Earth System Science, Dept. of Chemistry, BE-1050 Brussels, Belgium (cventura@vub.ac.be), [2]Ghent University, Dept. of Analytical Chemistry, Krijgslaan 281-S12, BE-9000 Gent, Belgium, [3]Laboratoire G-Time, Université Libre de Bruxelles, Brussels, Belgium.

Introduction: We report the classification of a large number of well-preserved cosmic spherules (melted micrometeorites) extracted from the fine-grained granitic-gneissic detritus collected in December 2012 at the top of the Widerøefjellet Mountain (2750 m a.s.l.) in East Antarctica (Fig.1). This material was recently reported to derive from a new micrometeorite accumulation trap [1].

Samples: A total of 1.6 kg of sediment was defrosted at the Belgian Antarctic research Station during the field expedition. It was then processed by washing and sieving to separate the following six size fractions: *< 125 µm, 125-200 µm, 200-400 µm, 400-800 µm, 800-2000 µm, and > 2000 µm*. A total of 1361 cosmic spherules with excellent preservation (< 10 % show surface alteration products such us *jarosite*) were handpicked using a Stereo Microscope. All of the subtypes described by [2] have been identified amongst the cosmic spherules recovered so far (Fig.2).

Bulk chemistry: The cosmic origin of the spherules was confirmed and these were classified on the basis of their surface chemical composition. Standardless analyses of scanned areas of variable sizes were performed on the surfaces of the cosmic spherules with an Analytical SEM JEOL JSM-300 or a FE-SEM JEOL JSM-7000F both equipped with an Electron Dispersive System (EDS) (Table 1).

Results: In total, 406 melted micrometeorites were identified in the 125-200 µm size fraction, 828 in the 200-400 µm fraction, and 127 in the 400-800 µm fraction. No cosmic spherules were found in the 800-2000 µm and > 2000 µm fractions. This observation is in contradiction with the results of [3]. The smallest size fraction (< 125 µm) will additionally be separated magnetically as the extremely small size of the grains does not easily permit the identification of micrometeorites under the stereo microscope. Preliminary study of this magnetic fraction has revealed the presence of potential unmelted micrometeorites although their identification is made difficult due to abundant black, angular, Fe-rich terrestrial grains of the metatonalitic host rock (mainly biotite). Our results (Fig.3) indicate that 39% of the extracted cosmic spherules are barred-olivine (BO-type), 28% crypto-crystalline (C-type), 17% glassy (V-type), 10% porphyritic-olivine (PO-type), 5% iron (I-Type), and finally 1% G-Type cosmic spherules. An interesting feature emphasized by SEM imaging is that a small proportion of the spherules exhibits a Fe-Ni metal bead at one end almost exiting the spherule, whilst other spherules show one or more sub-spherical void(s) likely due to the loss of the metal bead during atmospheric entry. The metal beads for the spherules characterized so far are usually 50-100µm in size. Statistically, 7% of the BO-type spherules contain a metal bead, 18% for C-type, 8% for V-type, and 6% for PO-type. No metal beads were observed in G-type spherules.

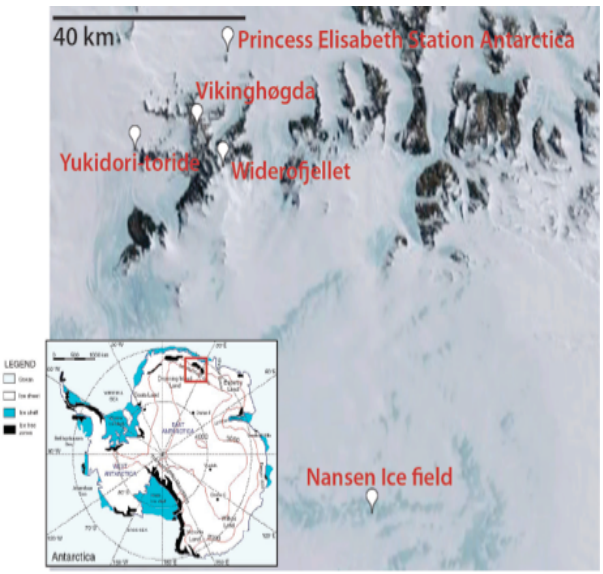

Fig. 1. *Map of the Sør Rondane Mountains of Antarctica (S72°8'41", E23°16'41"), showing the location of the sampled outcrops with respect to the Belgian Station "Princess Elisabeth".*

A new micrometeorite collection: The finding of such a high abundance of cosmic spherules at the Widerøefjellet site places it together with other well-documented Antarctic accumulation traps such as the Transantarctic Mountains (TAM; [3]), the Cap Prudhomme (CP; [4]), the South Pole Water Well (SPWW; [5]), and the CONCORDIA [6] collection.

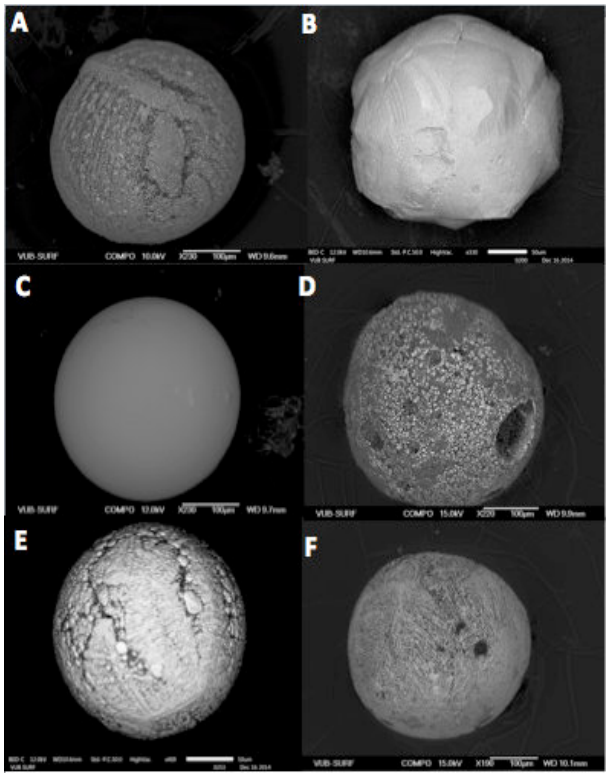

Fig. 2. *BSE images of cosmic spherules found within the Widerøefjellet sediment. (A) Barred-olivine cosmic spherule dominated by parallel olivine striations and dendritic magnetite. (B) Crypto-crystalline cosmic spherule with characteristic turtle-back texture. (C) Glass cosmic spherule with smooth surface. (D) Porphyritic cosmic spherule showing magnetie microphenocrysts (white) within the dark-gray external texture. Void where a metal bead exited the spherule during atmospheric entry can be recognized. (E) Iron-type cosmic spherule consisting almost entirely of Fe. (F) G-type cosmic spherule consisting of magnetite dendrites in silicate glass.*

Our research goals are to keep on extracting microparticles from the remainder of the sediment to implement the Sør Rondane Mountains collection and to chemically investigate the internal structure of selected polished cosmic spherules in order to obtain useful insights about their formation. Moreover, chemical investigation of the metal beads is also planned.

References: [1] Huber M. S. et al. (2014) *LPSC XLV #2108*. [2] Genge et al. (2008) *Meteoritics and Planet. Sci., 43*, 497-515. [3] Rochette et al. (2008) *PNAS, 105*, 18206-18211. [4] Maurette M. et al. (1991) *Nature*, *351*, 44-47. [5] Taylor et al. (2000) *Meteoritics and Planet. Sci., 35*, 651-666. [6] Duprat et al. (2007) *Adv. in Space Res., 39*, 605-611.

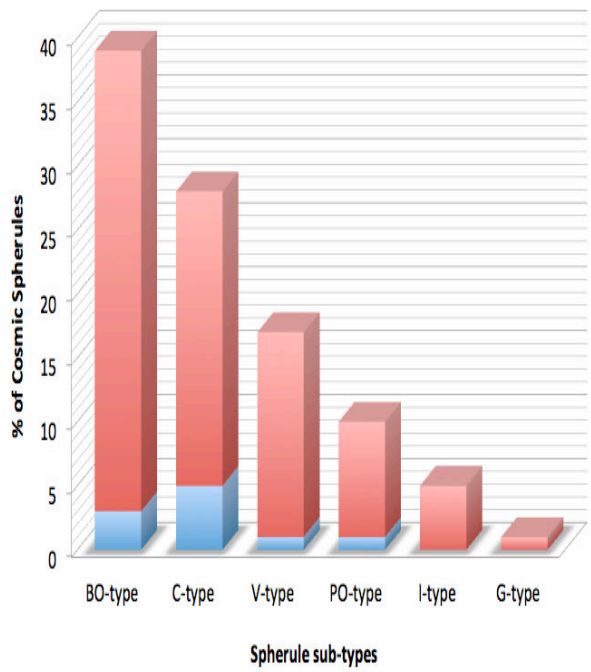

Fig. 3. *Stacked histogram showing the percentages of different cosmic spherule sub-type extracted from the Widerøefjellet site. The blue areas in the bars represent percent of those spherules containing metal bead.*

Sub-type	BO	C	V	Po	I	G
	n = 76	n = 48	n = 23	n = 16	n = 8	n = 4
wt.% oxide						
Na_2O	0.49	0.26	0.25	0.56	0.38	0.42
MgO	21.94	24.61	23.33	14.19	1.45	5.48
Al_2O_3	5.18	4.43	4.32	7.3	0.96	3.98
SiO_2	36.44	39.8	47.46	38.27	3.38	11.99
K_2O	0.26	0.13	0.11	0.21	0.04	0.14
CaO	2.23	2.55	2.81	3.39	0.41	1.13
Cr_2O_3	0.49	0.33	0.11	0.78	0.09	2.85
MnO	0.63	0.45	0.5	0.99	1.26	0.85
FeO	31.33	26.59	20.97	33.67	89.67	70.38
NiO	0.63	0.37	0.03	0.47	1.98	2.43

Table 1 – Average major-element composition (wt. % oxide) of representative cosmic spherules from Widerøefjellet site. All those spherules characterized by voids, cavities and alteration products on the surfaces were intentionally excluded. SEM accelerating voltage: 12 kV for BO-, C-, V-, and Po-type cosmic spherules; 15 kV for I- and G-type cosmic spherules; ZAF correction. n: number of analyses included in the average. The sum of the oxides is normalized to 100%.