# 3D X-RAY MICRO-CT INTERNAL TEXTURE OF I-TYPE COSMIC SPHERULES.

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**Introduction:** Micrometeorites (MMs) are microscopic particles, collected at the Earth's surface and mainly produced by collisions among solid bodies and by surface evaporation of icy bodies in the Solar System [1]. As such, they provide important information on the compositon of their parent bodies including those that are not sampled by meteorites.

I-type cosmic spherules (CS) are dark, opaque, melted micrometeorites dominated by magnetite ($Fe_3O_4$) and wüstite (FeO) crystals. I-type CS frequently contain µm-sized Ni-rich Fe,Ni metal beads [2] as well as µm- and nm-sized platinum-group element (PGE) nuggets [3].

The aim of this work is twofold: 1) to study the internal textural and structural components (i.e. iron oxides domains, metal beads, PGE nuggets, cavities) of the I-type CS, 2) to characterize the distribution of the metal beads and PGE nuggets and estimate their relative volume/mass.

**Samples:** I-type CS have been collected in loose sediments sampled on the tops of the Transantarctic Mountains [4] during the 2012-13 and 2014-15 Italian Programma Nazionale di Ricerche in Antartide (PNRA) campaign. In Antarctic MMs collections the abundance of I-type spherules is typically less than 2% [5]. Our collection consists of over 3000 MMs. Among these 107 (3.2% of the total) are I-type CS. For this study we have selected 52 I-type CS, ranging from 200 to 800 µm in diameter and 2 with diameters <150 µm. They look fresh (unweathered) under the stereomicroscope-SEM and provide excellent material for our study.

**Methods:** The external morphology of CS has been described by SEM analyses. Subsequently, non-destructive mapping of I-type CS has been carried out by X-ray microcomputed tomography (micro-CT) using a Zeiss Xradia 520 Versa 3D X-ray microscope, at the Electrochemical Innovation Lab, part of the Department of Chemical Engineering of University College London. The microscope was operated at 140 kV with a high energy filter in place (HE1) and an optical magnification of 20X.

**Results and Discussion:** So far 3D tomographic reconstructions on 7 CS have been performed. They allowed: 1) Distinction of four components, i.e. the cavities, the iron oxide domains, the metal beads and the PGE nuggets; 2) Estimation of the true 3D Bead-Volume/Total-Volume ratio and its relationship with the size of the spherules. This allow to obtain atmospheric flight parameters of the spherules. For instance, numerical modeling indicates that metal survival in particles with radius ≥100 µm occur at steep entry angle (>40°) and high entry velocity (>16 km $s^{-1}$) [6].

3) Characterization of void distribution. Irregular cavities are frequently observed in I-type CS. They are interpreted as: (i) the result of contraction due to quenching after atmospheric heating [7]; (ii) the product of gaseous exsolution (e.g. $O_2$, $SO_2$) during cooling of iron oxide liquids. 4) Speculate on the origin of the peculiar web-structure of the oxide phases resulting from wüstite domains surrounded by magnetite.

More samples are being analyzed in the next weeks. Results will be discussed at the Meeting.

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**References:** [1] Folco L. and Cordier C. 2015. *EMU Notes in Mineralogy - Planetary Mineralogy Volume 15,* M.R. Lee and H. Leroux eds., London, 253-297. [2] Rudraswami, N.G. et al. 2014. *Geochimica and Cosmochimica Acta* 145:139-158. [3] Rudraswami, N.G. et al. 2011. *Meteoritics & Planetary Science* 46:470-491. [4] Rochette P. et al. 2008. *Proceedings of the National Academy of Sciences USA* 105:18206-18211. [5] Taylor S. et al. 2000. *Meteoritics & Planetary Science* 55:651-666. [6] Genge M. J. 2016. *Metoritics & Planetary Science* doi: 10.1111/maps.12645. [7] Feng H. et al. 2005. *Metoritics & Planetary Science* 40:195-206.