COMPOSITE MICROMETEORITES RECOVERED FROM ANTARCTICA D. Fernandes[1,2], N.G. Rudraswami[1], and M. Pandey[1,2], [1]National Institute of Oceanography, Geological Oceanography Department, Goa, India, [2]Goa University, School of Earth, Ocean and Atmospheric Sciences, Goa, India.

Introduction: Extraterrestrial material that enters the Earth's atmosphere have sampled wide variety of asteroidal and cometary bodies [1,2,3]. Majority of this extraterrestrial material get ablated during atmospheric entry due to subsequent frictional heating with air molecules, however, small quantity that survives can be retrieved as micrometeorites from Antarctica and deep-sea sediments on Earth's surface [4]. The heating and ablation process obliterates the original characteristics of the extraterrestrial material and their initial chemical compositions are altered, making it difficult to relate it to their precursors [5]. Some of the relict and refractory phases remain unaltered found in micrometeorite have improved our understanding about the nature of the micrometeorites parent bodies but to limited extend [6,7]. Here we report two composite micrometeorites that appears to contain objects known and found in larger chondrites.

Experimental Methods: MS-I8-P245 and MS-I26-P38 were recovered from Antarctica Indian Maitri station, Schirmacher Oasis obtained by melting ice recovered using magnetic separation method [8]. Both particles were mounted in epoxy, polished, carbon coated. Further, they were petrographically examined in scanning electron microscope (SEM-JEOL JSM-IT300LV) and chemically analysed using electron microprobe (Cameca SX5) housed at National Institute of Oceanography, Goa.

Results: MS-I8-P245 is a fine grained partially melted micrometeorite 190 x 150μm in size and consist of a small micro-chondrule (MC) inside (Fig. 1a). The MC inside is 40μm in diameter and emerges as dislodged from background porous fine grained matrix. The peripheral edge of the MC contains micro bubbles and desiccation cracks in the centermost part. The chemical composition of the MC represents a glass which is similar to those MC found in ordinary chondrites (OC) (Table 1). The background matrix is occupied by fine grained anhydrous silicate that is enrich in Na_2O ~1.3 wt% (Table 1).

MS-I26-P38 is a rough spherule 116μm in diameter and shows unique texture composed of three parts, substantial portion made up of fine grained matrix occupied by large round vesicles and small mineral grains along with excess metal (Fig. 1b). In contrast the other parts includes sub spherical domains of radial pyroxene (RP) 57μm in diameter, and granular porphyritic olivine (PO) 110μm in diameter as equal half's and both in volume corresponds to 50% of the entire spherule. A thin metal rim (MR) envelops the entire spherule. The chemical composition of the matrix in particle MS-I26-P38 is volatile poor Na_2O ~0.0 wt% and Cr_2O_3 ~0.4 wt% (Table 1). The RP has a chemical composition that show similarity with radial pyroxene chondrules abundant in OC (Table 1). The PO contains zoned olivines much enriched in FeO upto 29.8 wt% (Table 1).

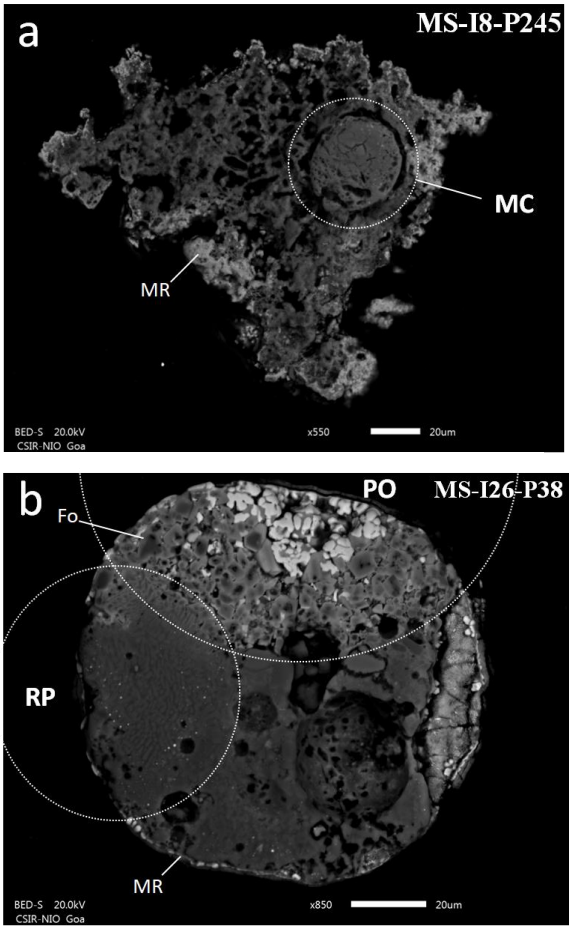

Fig. 1. SEM images of composite micrometeorites a) Scoriaceous micrometeorite containing a single MC b) Spherule containing domains of RP and PO and metal cellular dendrites.

Table 1. EPMA analysis of composite micrometeorites.

	MS-I8-P245		MS-I26-P38		
	MC	Matrix	RP	PO	Matrix
Na_2O	1.9	1.3	0.1	0.1	0.0
MgO	20.4	20.7	31.3	32.1	37.8
Al_2O_3	4.4	3.6	3.2	1.8	0.7
SiO_2	44.6	37.1	48.3	34.4	35.9
P_2O_5	0.2	0.1	0.3	0.6	0.1
SO_2	1.2	0.6	0.3	0.0	0.1
K_2O	0.3	0.3	0.1	0.0	0.0
CaO	0.1	1.2	2.6	0.3	0.4
TiO_2	0.1	0.1	0.0	0.0	0.0
Cr_2O_3	3.2	0.7	0.6	0.4	0.4
MnO	0.1	0.3	0.5	0.2	0.9
FeO	22.1	30.2	10.9	29.8	21.1
CoO	0.1	0.2	0.0	0.0	0.1
NiO	0.2	0.1	0.0	0.1	0.0
Total	98.8	96.4	98.3	99.8	97.4

Discussion: The MR on both composite micrometeorites indicate they have experienced heating and the presence of round vesicles in their matrix suggest temperature not exceeding >1300°C [9] during their atmospheric entry. Their internal framework appears to have shielded internal silicates from external frictional heat. The MC in MS-I8-P245 in particular have undergone least thermal decomposition due to partial melting and has a chemical composition similar to MC found in OC. The matrix however has a texture and chemical composition with chondritic abundances similar to carbonaceous (CC) CI and CM chondrites.

The textural characteristics of MS-I26-P38 appears to be two detached closely packed chondrule fragments and their chemical composition are closely affiliated to OC. The size of the chondrule fragments in MS-I26-P38 is much smaller, and such small chondrules are commonly found in CC CM, CO chondrites [10]. This could suggest smaller size chondrule probably stand better chance to survive with least alteration compared to larger chondrules that can undergo breakdown and fragmentation during their atmospheric entry due to their larger size. The matrix in this case however show considerable melting that has turned into glass. The metal inside spherule shows primary cellular dendrites that form due to melting and rapid cooling [11]. The petrologic features and chemical composition in both these composite micrometeorites are found to be similar to CC and OC and suggest that micrometeorites may have contributed from larger known chondrites.

References:

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