

FORSTERITE COMPOSITIONS IN ANTARCTIC MICROMETEORITES COMPARED WITH OTHER EXTRATERRESTRIAL SAMPLES: Ian M. Steele, Dept. of the Geophysical Sciences, University of Chicago, 5734 S. Ellis Ave., Chicago, IL, 60637.

INTRODUCTION: There are several sources of extraterrestrial material including Antarctic and non-Antarctic meteorites, deep sea particles (DSP), interplanetary dust particles (IDP), Greenland Lake sediment, and Antarctic micrometeorites. There is controversy over the equivalence of meteorites from the two sources (1) and there are indications that interplanetary dust (2,3) and deep sea particles (4) are not representative of all meteorites. Below olivine compositions for recently recovered Antarctic micrometeorites (5,6) are compared with similar data for other extraterrestrial samples. This comparison suggests significant differences among the extraterrestrial samples precluding a common origin for the refractory olivine.

SAMPLES: The recovery and general description of the Antarctic micrometeorites can be found in (5,6). Samples are recovered by melting ice and filtering to recover particles. Unmelted micrometeorites greater than 50 μ m as well as melted samples are obtained. Two prepared polished sections (labeled 8GL and AS3A) of such particles were obtained courtesy of Dr. M. Maurette (Laboratoire Rene Bernas, Universite de Paris, Paris, France) and together included over 200 particles. The largest particles were about 200 μ m in the plane of the section while an average maximum dimension is about 100 μ m. While some particles are unmelted as indicated by silicate grains included within a fine-grained matrix, others are spherical with a typical quench or vesicular texture indicating partial to complete melting. Each particle was visually characterized by BSE imaging and those containing discrete grains of olivine and/or pyroxene noted. The analyzed silicate grains were usually larger than 5 μ m but only rarely were grains larger than 20 μ m. Analyses were made at 20kV, 50nA for Na, Mg, Al, Ca, Sc, Ti, V, Cr, Mn, Fe, and Ni with counting times sufficient to give detection limits near 50ppmw for all except Ni.

RESULTS: The FeO content of analyzed olivines ranges from 0.58 to values greater than 20% in the melted particles. Only one particle, however, has a FeO value less than 1.0%. Using a large library of analyses for olivine from other classes of extraterrestrial material, simple graphical comparisons are possible for sets of elements to determine apparent similarities or differences among olivines. Fig. 1 illustrates the ranges of Cr vs Fe data for C1, C3 and the Antarctic micrometeorites reported here. It is clear in this figure that data from the Antarctic micrometeorites show almost no correspondence with data for the 3 C3 meteorites while they do show a very similar range to the C1 olivines of Orgueil and Alais (3). The lack of Fe-rich olivines in the two C1 meteorites probably is due to the lack of melted particles which are present in the Antarctic micrometeorites. Fig. 2 illustrates data for two refractory elements, Ca and Al, and the high values of CaO characteristic of the most Mg-rich olivines in C3 meteorites are not present in the Antarctic micrometeorites; the only match is with the low-Ca, low-Al C3 data which would correspond to Fe-rich olivines. Although not obvious on Fig. 2, the C1 data correspond closely to the Antarctic micrometeorite range.

A similar comparison is shown for C2 (Murchison, Mighei, Boriskino, Belgica 7904) and DSP data in Fig 3 for Fe vs Cr. The C2 data show a very simple linear trend which has been previously shown to match data for DSP ((4), and Fig. 3). Likewise, many data for the Antarctic micrometeorites correspond closely with the C2 trend although a greater fraction of the Antarctic data show high FeO probably due to common melted particles.

DISCUSSION: These graphical comparisons show clearly that there is a close correspondence between the olivine compositions of C2 meteorites, DSP, C1 meteorites and the Antarctic micrometeorites. The olivine compositions present in C3 (and UOC meteorites; data not shown) are not represented in any of the other sample types. Especially lacking are the refractory-rich forsterites characteristic of the C3 meteorites and rare in C2 meteorites. Based on these olivine compositions, the fine particles represented in the Antarctic micrometeorites and DSP as well as the olivine in C1 meteorites are chemically related. This is not necessarily true when oxygen isotopic compositions are considered but the known isotopic compositions represent 'anhydrous' material which may include material other than olivine. The Antarctic micrometeorites and DSP are unlikely to be simple ablation products of C3 or UOC meteorites. For further characterization, isotopic measurements are required for individual olivine grains to complement these chemical data.

FORSTERITE COMPOSITIONS... Steele, I.M.

REFERENCES: (1) Dennison et al. (1986) *Nature* 319, 390-393; (2) Klöck et al. (1989) *Nature* 339, 126-128; (3) Steele, I. (1991) *Meteoritics*, in press; (4) Steele et al. (1985) *Nature* 313, 297-299; (5) Maurette et al. (1989) *LPSC XX*, 644-645; (6) Maurette, M. and Brownlee, D. (1989) *LPSC XX*, 636-637.

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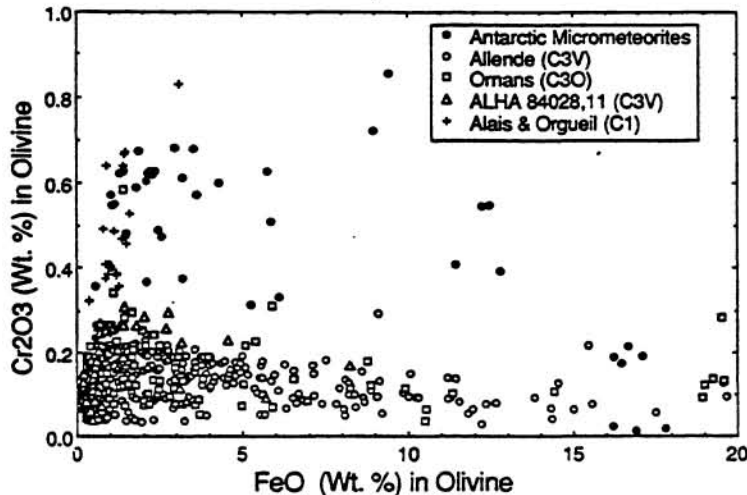


Fig. 1. Cr_2O_3 vs FeO for olivines of Antarctic micrometeorites (solid circles) compared with data from C3 (open symbols) and C1 (crosses) olivines. In general, the olivine of Antarctic micrometeorites shows a range similar to olivine of C1 meteorites and both show little or no overlap with the range of C3 olivine compositions.

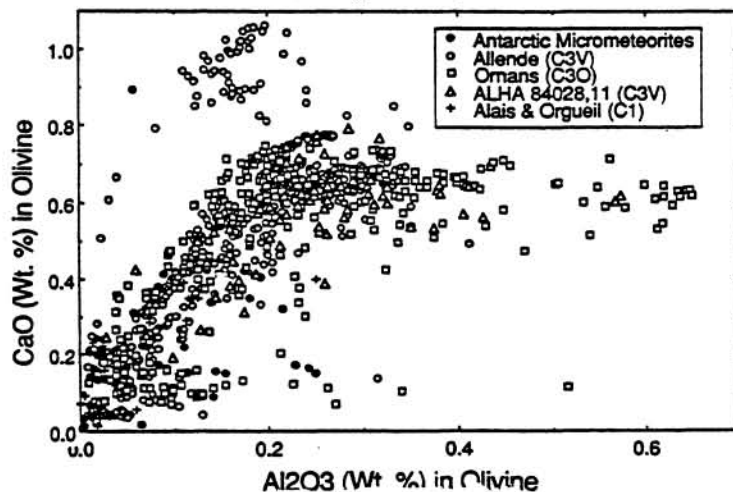


Fig. 2. CaO vs Al_2O_3 for olivines of Antarctic micrometeorites (solid circles) compared with data from C3 (open symbols) and C1 (crosses) olivines. Data for the Antarctic micrometeorites and C1 meteorites lie at the extreme of the C3 data which in fact have high FeO . Data with high Ca and Al which are common among C3 olivines are not present in the C1 and Antarctic micrometeorite analyses.

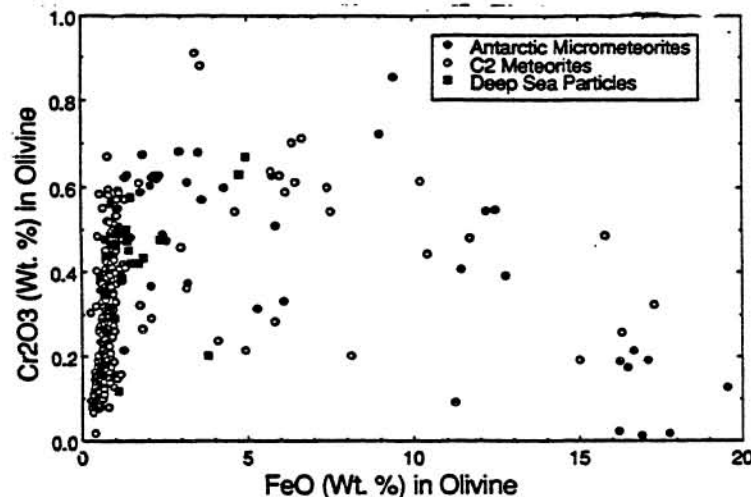


Fig. 3. Cr_2O_3 vs FeO for Antarctic micrometeorites compared with data for C2 and deep sea particles. In general all three sets of data overlap and show a strong similarity as opposed to C3 data in Fig. 1 above.