EXTRATERRESTRIAL OLIVINES BROUGHT BACK FROM SPACE. G. E. Blanford[1], F. J. M. Rietmeijer[2], L. S. Schramm[2], D. S. McKay[3]. [1]University of Houston-Clear Lake, Houston, TX 77058; [2]Lockheed/EMSCO, 2400 Nasa Rd. 1, Houston, TX 77058; [3]NASA/Johnson Space Center, Houston, TX 77058.

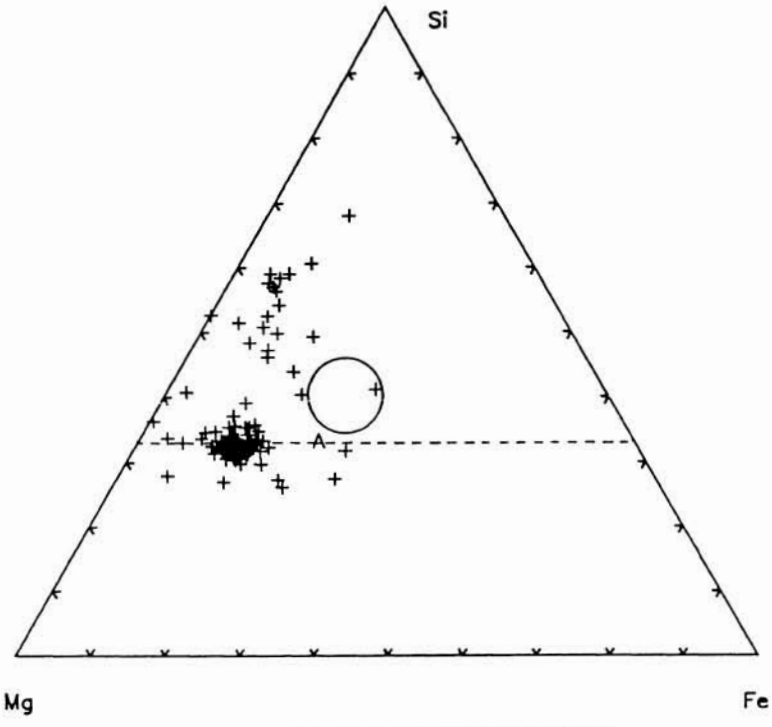
We have reported some likely extraterrestial particles from two impact features found in the thermal blanket on the main electronics box of the Solar Maximum satellite [1,2]. The majority of particles associated with impact feature M-19-280 have an olivine composition. These particles have been analyzed by energy dispersive spectroscopy (EDS) and the data reduced by the DUST2 program [3] (modified by D. Anderson, NASA/JSC, personal communication) which not only makes fluorescence and absorption corrections but also takes particle size and shape into account. Analyses of these particles are summarized in Table I and Figure 1.

Some of these particles have been transferred to beryllium TEM grids for more extensive analysis using a JEOL 100CX Analytical Electron Microscope. So far selected area electron diffraction (SAED) for four out of five particles with EDS spectra typical of olivine show that they are crystalline phases. The particle shown in Figure 2 consists of two olivine single crystals (Fo76, Fo78) of nearly the same orientation but of slightly different unit cells. The crystal of larger unit cell contains 0.5 wt% MnO. The SAED patterns show no evidence of shock metamorphism or thermal alteration. The angular shape and composition of the olivine single crystals suggests that they survived capture without melting. This may not be true for rounded silicate particles in the same impact feature. The bumps/inclusions (Fig. 2) contain iron-nickel in the range Ni/Fe = 0-0.14 ($\pm$0.04).

SOURCE OF SOLAR MAX OLIVINES. Olivine is commonly present in carbonaceous chondrites and unequilibrated ordinary chondrites (UOC). In general, olivine in the matrix of carbonaceous chondrites is more iron rich (Fo48-52) compared to chondrule olivine (Fo50-100) in these meteorites [4]. Euhedral olivines and angular clasts up to 100 μm in maximum dimensions are present in carbonaceous chondrites [5,6]. For UOC's, olivine compositions vary between individual meteorites and between matrix and chondrule olivines within a meteorite. In general, matrix olivine is more iron-rich compared to chondrule olivine [7]. The range of olivine compositions is from about Fo10 to Fo100; with increased metamorphism the compositions for both matrix and chondrule olivine peak at about Fo70-80 [7]. Olivines in the Murchison carbonaceous chondrite and UOC's often contain Fe-metal inclusions of variable Ni-content [8,9].

Clearly the particle shown in Fig. 2 has a composition and texture that are similar to olivines found in primitive meteorites. We feel confident that this particle is a chemically unaltered, unshocked meteoritic specimen. It is the first such particle to be so identified that has been collected in space and brought back to Earth for analysis.

REFERENCES: 1. Schramm LS et al. (1985) LPS 16, 736; 2. Schramm, LS et al. (1986), this volume; 3. Amstrong JT & Buseck PR (1975) Anal. Chem. 47, 2178; 4. McSween HY (1979) Rev. Geophys. Space Physics 17, 1059; 5. Reid AM et al. (1970) GCA 34, 1253; 6. Kerridge JF & Macdougall JD (1976) EPSL 29, 341; 7. Huss GR et al. (1981) GCA 45, 33; 8. Richardson SM & McSween HY (1978) EPSL 37, 485; 9. Rambaldi ER and JT (1982) GCA 46, 929; 10. Brownlee et al. (1984) LPS 15, 94.



Oxide	Cluster	Fo80 Olivine
MgO	42.12±2.31	42.08
SiO2	38.08±1.95	39.21
CaO	0.45±0.55	–
FeO	18.40±3.06	18.71
NiO	0.08±0.10	–
S	0.59±0.87	–
	99.72	100.00

TABLE 1: Average chemical composition of 75 Solar Max Mg-Fe-silicate particles in M-19-280 [1] compared with Fo80 olivine.

FIGURE 1: Mg-Si-Fe atomic ratio distribution for Solar Max Mg-Fe-silicate particles in M-19-280 compared with stratospheric meteorite SP56A [10] (circle). Seventy-five out of 108 particles within M-19-280 cluster at Fo80. We analysed a bulk sample of the Allende meteorite for comparison (labelled A).

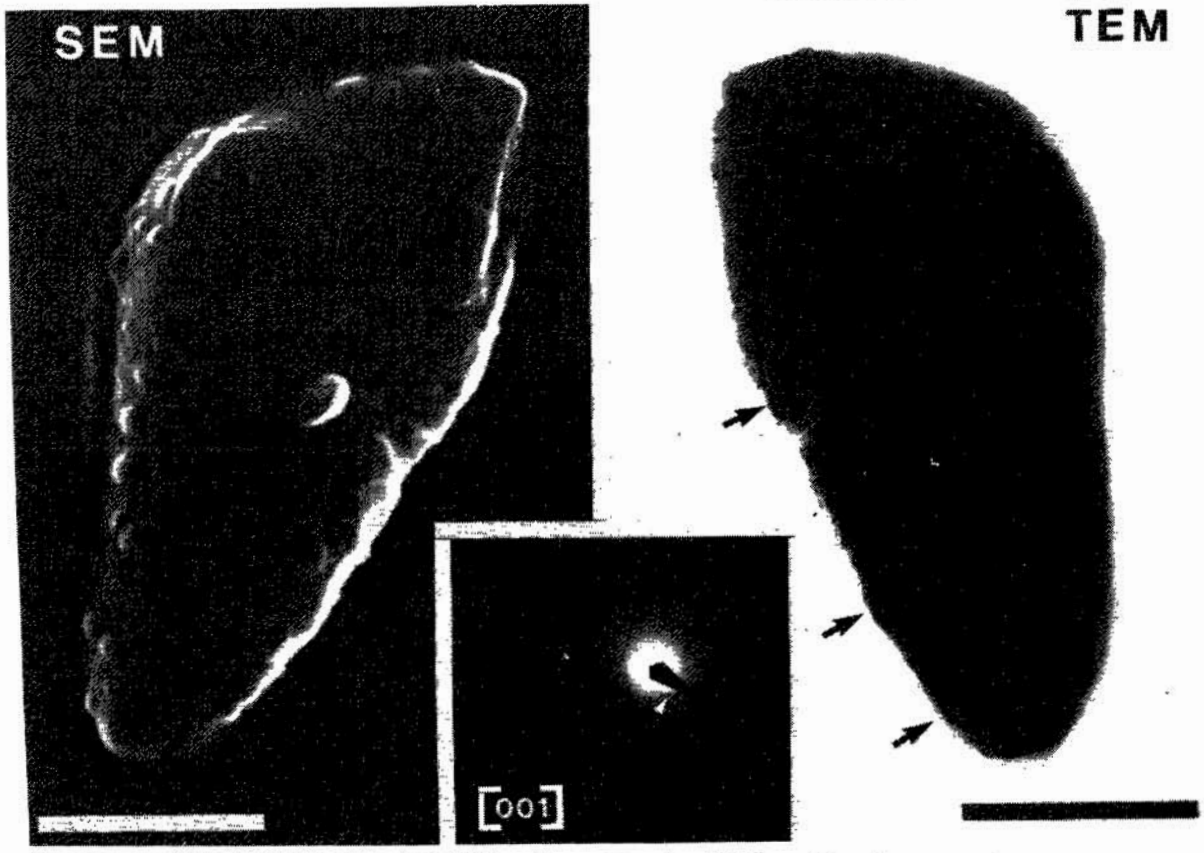


FIGURE 2: SEM and TEM images and SAED pattern [inset; d(010) = 10.29Å; arrowed] of a Solar Max olivine particle. Bumps (SEM image) and inclusions (TEM image; arrowed) are an Fe-Ni phase. (NOTE: central bright spot in SEM image results from electron beam contamination).