

MAC88136 -- THE FIRST EL3 CHONDRITE; Y.T. Lin¹, H-J. Nagel¹, L. L. Lundberg² and A. El Goresy¹, (1) Max-Planck-Institut für Kernphysik, 6900 Heidelberg 1, FRG. (2) McDonnell Center for the Space Sciences, Washington University, St. Louis, MO 63119, USA.

The Antarctic meteorite MAC88136 was reported as a new member of the enstatite chondrite clan, tentatively an E3, by Brian Mason [1]. We studied a section that contains several opaque minerals characteristic of the E-clan in addition to glass-bearing chondrules and silicate fragments. A monolithic clast (0.64 x 0.30 cm) and a coarse-grained silicate fragment (0.38 x 0.22 cm) are also found in the section. Thus, the meteorite is probably an E-chondrite breccia. Major phases are enstatite, troilite, kamacite and ferromagnesian alabandite. Less abundant are schreibersite, zincian daubreelite and sphalerite. Accessory phases are taenite, perryite, oldhamite, pentlandite, djerfisherite, diopside, forsterite, albite, anorthite, silica, Cl-rich glass (in chondrules) and FeO-bearing pyroxene. One chondrule with abundant spinel was also found.

Mineral chemistry: Alabandite compositions are comparable to those in EL chondrites and aubrites but the MnS-contents are higher (Fig. 1). Microprobe profiles of alabandite grains show zoning of FeS with higher contents in the core (18.8-20.3 mole%) than at the rims toward neighboring troilite (10.2-9.3 mole%). The low FeS-concentration in the alabandite core implies equilibration of the alabandite-troilite assemblage at temperatures below 600°C [2]. Thus, the alabandite probably had a complex history before incorporation into the meteorite. The descending FeS profile to troilite is suggestive of further equilibration with the coexisting troilite. Sphalerite compositions are unique in comparison to those previously reported in meteorites (Fig. 2). The MnS-content is the highest found in meteoritic sphalerites (16.2-20.1 mole%). FeS-contents are usually lower than those in sphalerites from EH chondrites (42.7-46.2 mole%). In addition, microprobe profiles show zoning with a decreasing FeS-content toward neighboring troilite. Unlike grains in EH chondrites, no Ga, Cu or Mg was detected in the sphalerites in MAC88136. The low FeS-content of the sphalerites suggests equilibration at low temperatures before accretion in the meteorite. The composition of kamacite (0.12-1.1 wt% Si, 3.7-7.1 wt% Ni, <0.27 wt% P) is typical for the EL group. The low concentration of Si in kamacite is consistent with the low amount of perryite found in MAC88136. The perryite is also markedly lower in Si than in EH chondrites (10.3-11.3 vs 11.7-13.8 wt%). Schreibersite is a common accessory mineral and its high Ni-content (19.2-49.0 wt%) places it in the EL group. Some kamacite grains contain lamellae of taenite (18.6-48.8wt% Ni, 0.2-1.5 wt% Si, <0.27 wt% Cu, <0.40 wt% Co) exhibiting M-shaped Ni concentration profiles with values ranging from 18.6-28.0 wt% in their cores to 36.8-48.8 wt% at their rims. Daubreelites in MAC88136

have high MnS-contents similar to those in the EL6 subgroup but many grains have high Zn-contents (up to 5.7 wt%), a feature not found before in the EL6 subgroup. The Ti-content of troilite is low (0.09-0.52 wt%), below the levels for EL chondrites [3]. A unique feature of MAC88136 among the E-clan is the presence of pentlandite (16.1-16.7 wt% Ni, 47.4-48.4 wt% Fe, 0.66-1.11 wt% Mn). This is the first report of Mn in natural pentlandite. A few grains of djerfisherite occur with daubreelite, alabandite and/or sphalerite. One djerfisherite is significantly enriched in Cu (5.17 wt%) and has a low Na/Na+K ratio (0.053) compared to djerfisherites in EH chondrites[4].

Conclusions: (1) Our detailed petrological and mineral-chemical investigation of MAC88136 supports an EL3 classification for this meteorite. (2) Comparison of MAC88136, EL6 and EH chondrites suggests that (a) the high Mn-content of daubreelite and sphalerite in EL6 chondrites is a result of chemical fractionation in the solar nebula, probably reflecting a considerably lower oxygen fugacity in the EL formation region, (b) the occurrence of djerfisherite in MAC88136 extends its presence to EL chondrites and (c) the absence of Ti-rich troilite in MAC88136 argues against Ti-bearing troilite as a genetic marker for EL chondrites. However, MAC88136 is unique among the ELs.

References: [1] M.M. Lindstrom, ed. (1990) *Antarctic Meteorite Newsletter* 13, 22. [2] B.J. Skinner and F.D. Luce (1971) *Amer. Miner.* 56, 1269-1296. [3] K. Keil (1968) *J. Geophys. Res.* 73, 6945-6975. [4] M. Kimura and A. El Goresy (1988) *Meteoritics* 23, 279-280. [5] K. Ehlers and A. El Goresy (1988) *Geochim. Cosmochim. Acta* 52, 877-887. [6] T.R. Watters and M. Prinz (1979) *Lunar Planet. Sci. Conf. 10th*, 1073-1093.

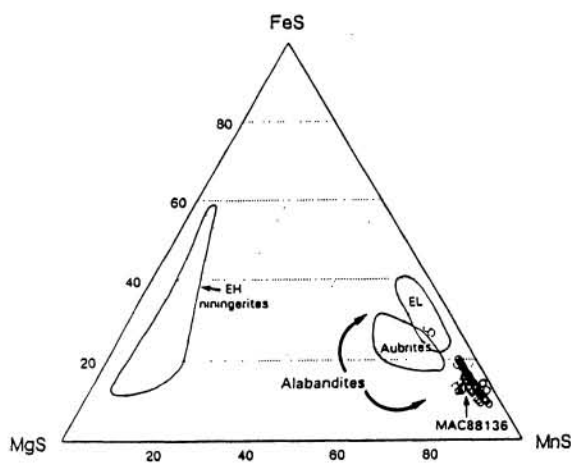


Fig. 1 Atomic ratio of FeS, MgS, MnS in EH miningerites [5] and aubrite [6], EL6 [3] and MAC88136 (this work) alabandites.

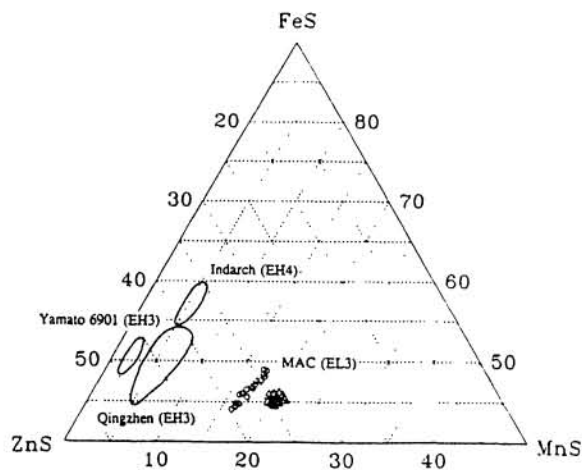


Fig. 2 Atomic ratio of FeS, ZnS, MnS in different meteoritic sphalerites ○ in contact with troilite, Δ in contact with alabandite.