EVIDENCE FOR AQUEOUS ALTERATION PRIOR TO PARENT BODY FORMATION; PETROGRAPHIC OBSERVATIONS IN CM-CHONDRITES; K. Metzler and A. Bischoff, Institut für Planetologie, Wilhelm-Klemm-Str. 10, 4400 Münster, F.R.G.

Many meteorites belonging to the CM-chondrite class seem to be much more primitive than has been previously thought. We have investigated 14 CM-chondrites in great detail (ALH 83100, Bells, Cold Bokkeveld, Essebi, Haripura, Kivesvaara, Mighei, Murchison, Murray, Nogoya, Pollen, Y-74662, Y-791198, Y-793321) and found that all but two (Essebi, Bells) of these meteorites seem to be mostly uneffected by secondary aqueous alteration on their final parent body. All but one (Y-791198) of these chondrites represent either regolith or fragmental breccias. With the exception of Essebi and Bells all samples contain rock fragments with typical accretionary fabrics. These fabrics can be characterized by the existence of accretionary dust mantles surrounding all coarse grained components like chondrules, CAIs and isolated minerals (1). It has been widely accepted that dust mantles must have been formed within the solar nebula by adhesion of dusty material onto the surfaces of chondrules and other components (e.g. 1-4). These dust mantles are usefull markers "that have been formed chronologically between completion of major element condensation and agglomeration of the chondritic meteorites" (4). Due to our investigations of dust mantles in CM-chondrites we conclude that aqueous alteration of chondritic components has basically been taken place prior to the formation of the dust mantles, i.e. within the solar nebula or on small preexisting planetesimals. There are four lines of evidence for this conclusion:

1) Figure 1 demonstrates a porphyritic olivine chondrule fragment in Haripura surrounded by an accretionary dust mantle (ADM). Due to the influence of water the olivine grains are partly altered to serpentine. Some of the smaller grains are totally altered (arrow 1) whereas the large olivine grain (ol) shows alteration features exclusively at its edges and on cracks *within* the chondrule fragment (arrow 2). The contact face between the dust mantle and the large olivine crystal (arrow 3) is absolutely fresh and free of any serpentinisation. The aqueous alteration of the olivines must have taken place prior to the break-up of the chondrule and prior to the formation of the accretionary dust mantle. The in situ aqueous alteration of the whole mantled object seems to be implausible, because of the unaffected contact face between the large olivine and the dust mantle. For this reason the water-bearing minerals of the dust mantles (serpentines, tochilinite) also must have been present within the solar nebula prior to the parent body accretion.

2) The CM-chondrite Y-791198 is the only unbrecciated meteorite in our thin section collection. Within the dust mantles of this meteorite we found tiny metal grains and beads with Ni contents of 4.5 to 6.5 wt%. These metals (m) are usually free of magnetite rims (Fig. 2a), but in one case we found a metal grain (m) enclosed by a thick magnetite (mag) shell (Fig. 2b). The metals in Figs. 2a and 2b were found in the same dust mantle in a distance of not more than 50 microns, embedded in hydrous minerals. An in situ formation of these hydrous minerals within the dust mantles without influencing the tiny metals seems to be impossible. The hydrous dust mantle minerals and the metal grains (partly surrounded by magnetite) must have come in contact during the dust mantle formation.

3) In the CM-chondrite Murray we found a porphyritic olivine chondrule fragment with a glassy mesostasis, surrounded by accretionary dust. The clear isotropic glass is directly in contact to the hydrous minerals of the dust mantle, but there is no evidence for any aqueous alteration of this thermodynamically instable glassy material. The dust must have consisted primarily of hydrous minerals, prior to the adhesion onto the chondrule fragment.

4) The PCP-rich objects that consist entirely of hydrous minerals (serpentines, tochilinite) are mantled by accretionary dust (ADM), like chondrules and other chondritic components (Fig 3a). There is no evidence for an in situ alteration of this abundant component (26-38 vol%, (1)) of CM-chondrites. In Cold Bokkeveld an isolated calcite crystal (cal) has been observed, that is entirely mantled by accretionary dust (Fig. 3b). This calcite crystal as well as the PCP-rich objects must have had an independent history as isolated units within the solar nebula until their contact with the dusty hydrous material, that led to the formation of the accretionary dust mantles.

References: (1) Metzler, K. and Bischoff, A. (1989), LPS XX, 689-690; (2) MacPherson, G.J. et al. (1985), GCA 49, 2267-2279; (3) Bunch, T.E. and Chang, S. (1984), LPS XV, 100-101; (4) Allen, J.S. et al. (1980), GCA 44, 1161-1175.

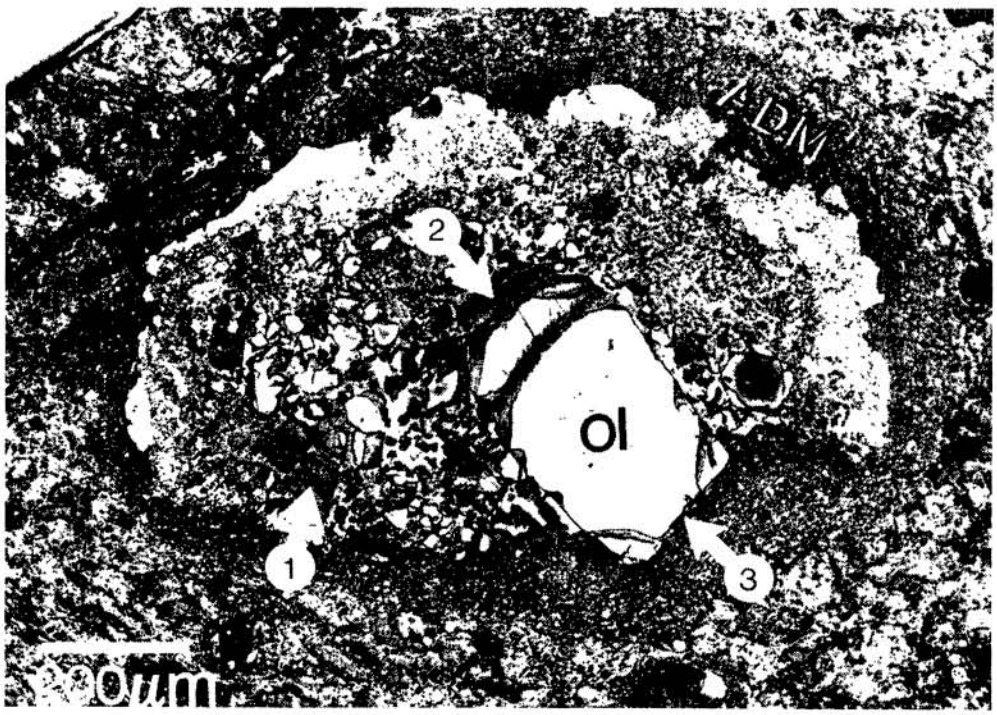
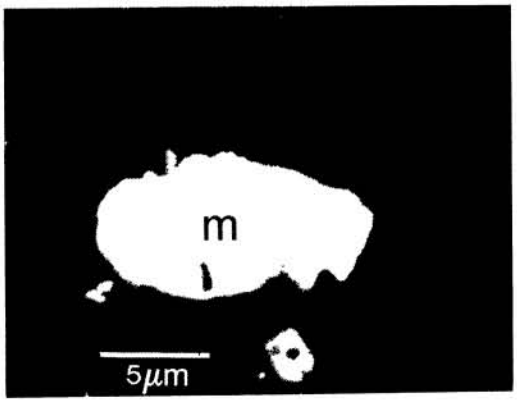


Fig.1



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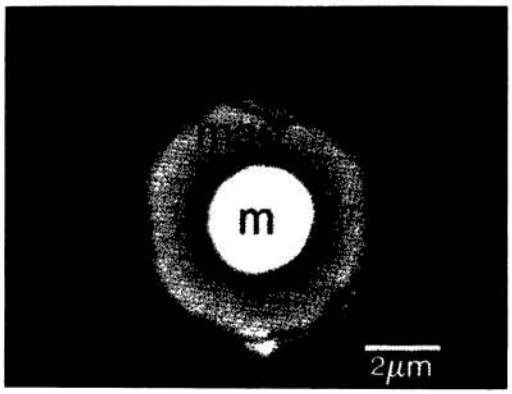

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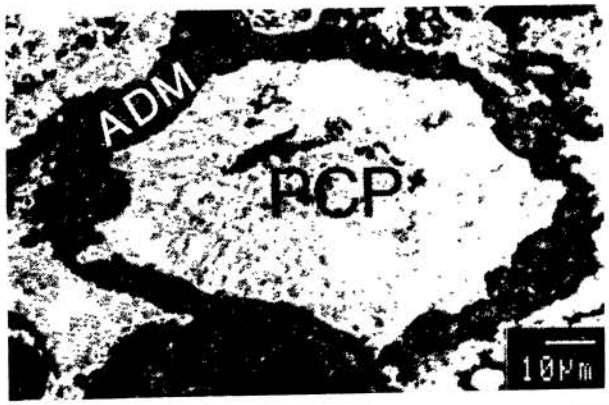
Fig. 2



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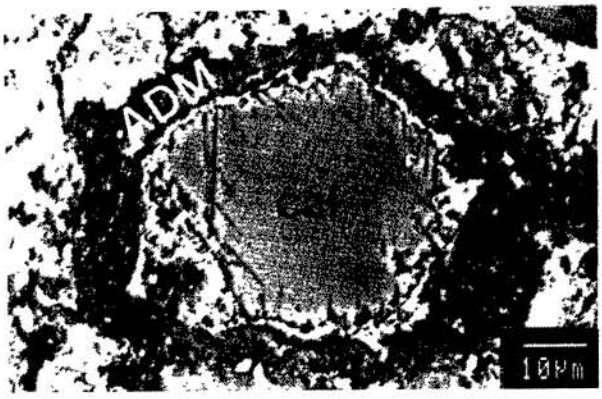

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Fig.3