SEARCH FOR PRESOLAR GRAINS IN FINE-GRAINED CHONDRULE RIMS: FIRST RESULTS FROM CM CHONDRITES AND ACFER 094. J. Leitner[1], K. Metzler[2], C. Vollmer[3], and P. Hoppe[1], [1]Max Planck Institute for Chemistry, P.O. Box 3060, 55020 Mainz, Germany (jan.leitner@mpic.de), [2]Institute for Planetology, University of Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany, [3]Institute for Mineralogy, University of Münster, Correnstr. 24, 48149 Münster, Germany.

Introduction: Primitive Solar System materials contain small amounts of isotopically anomalous presolar dust grains that have formed in the winds of evolved stars or in the ejecta of stellar explosions [e.g., 1]. The abundances of presolar grains vary among different materials and even among individual meteorites of the same class, apparently reflecting metamorphic processes on the parent bodies and possibly also heterogeneities in the solar nebula.

Recent studies of fine-grained chondrule rims in several CR [2,3] and CO [4,5] chondrites revealed the presence of abundant presolar material. CM chondrites often contain pronounced dust rims around chondrules and other coarse-grained constituents [e.g., 6], making them interesting objects for the search of presolar materials. The majority of the CMs are of petrologic type 2, *i.e.*, they have experienced similar degrees of aqueous alteration as the CRs studied by [2,3]. To date, two CM chondrites, Murchison and Paris, have been investigated in situ for the presence of presolar O-rich dust. For interchondrule matrix and dust rims in Murchison, [7] calculated a presolar silicate abundance of ~3 ppm. This estimate, however, is based on a comparatively low-resolution ion imaging survey and a significant fraction of presolar silicates with sizes >100 nm might have been missed. In Paris, no O-anomalous grains were found, and an upper limit of ~10 ppm is given [8].

A systematic investigation of the presolar grain content of CM chondrites and Acfer 094 allows to study the effects of aqueous alteration effects on presolar dust in the fine-grained nebular material in the CM and Acfer 094 chondrite formation region.

Samples and Experimental: We selected thin sections of the CM chondrites Yamato (Y-)791198, Maribo, Murchison, and of the ungrouped carbonaceous chondrite Acfer 094. Y-791198 is one of the least altered CM chondrites known so far [6,9]. While the majority of CMs are composed of clasts of so-called primary accretionary rocks embedded in a fine-grained clastic matrix, Y-791198 is an unbrecciated sample composed exclusively of primary accretionary rock (PAR), where almost all coarse-grained constituents are surrounded by fine-grained dust rims [6]. The dust rims in this particular meteorite still show some primitive textural characteristics. They contain abundant amorphous materials, rare, pristine phases of probable nebular origin like olivine and Fe,Ni metal [6,9], and high concentrations of primordial noble gases and presolar diamond [10].

Maribo is a recent CM fall, which has been classified as among the least altered CM chondrites, based on petrology and bulk O-isotopes [11]. Noble gas measurements indicate the presence of presolar diamond and SiC [11]. Murchison is a brecciated CM consisting of PAR embedded in a clastic matrix [6]. The only presolar silicates in CMs were found in this meteorite, and [10] measured high primordial gas and presolar diamond concentrations for its dust rims.

The ungrouped carbonaceous chondrite Acfer 094 shows affinities to both CO3 and CM2 chondrites [12]. Although having experienced some aqueous alteration, the meteorite is considered as petrologic type 3 [12,13], and is among the most primitive meteorites known to date. Its interchondrule matrix has high presolar silicate abundance [14], and some of the chondrules display fine-grained dust rims [12]. All samples were pre-characterized with a LEO 1530 field emission SEM, and rim compositions were determined by energy-dispersive X-ray spectroscopy (EDS). Oxygen isotope measurements were conducted with a NanoSIMS 50 ion probe by rastering a ~100 nm primary Cs^+ beam over 10×10 µm²-sized sample areas with a total integration time of ~55 min.

Results: *Y-791198.* 6,100 µm² of fine-grained material were investigated in one chondrule rim. No presolar silicates were detected, but several SiC grain candidates were identified. We estimate an upper limit of ~22 ppm for the presolar silicate abundance.

Maribo. 15,000 µm² of fine-grained material in 8 chondrule rims were scanned. No presolar silicates were found, but two presolar Al-oxide grains (Group 1 & 4, Fig. 1) were detected, together with 8 presolar SiC grains. These grains correspond to presolar oxide and SiC abundances of 8 ppm and 48 ppm, respectively. For presolar silicates, we calculate an upper limit of ~9 ppm in Maribo (Fig. 2).

Murchison. A total of 1,650 µm² in one fine-grained dust rim have been scanned so far. Two presolar silicates were identified. Both grains belong to Group 1 (Fig. 1) and represent a presolar silicate abundance of ~75 ppm (Fig. 2).

Acfer 094. About 2,000 µm² of fine-grained material in one chondrule rim have been investigated so far. Seven presolar silicates have been found, all of which are Group 1 grains. They represent a presolar silicate abundance of ~190 ppm (Fig. 2).

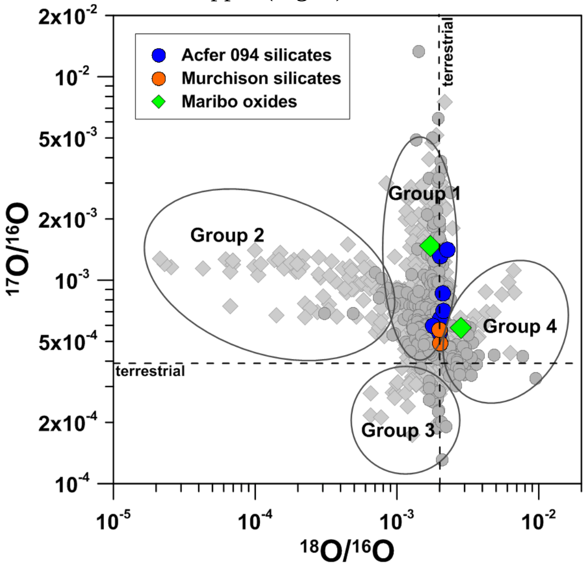

Figure 1*. Oxygen 3-isotope plot for O-anomalous grains in chondrule rims from Maribo, Murchison and Acfer 094. Ref. data (gray) are from [15].*

Discussion: For Acfer 094, the CR2 chondrites investigated by [2,3], and the CO3 chondrites studied by [4,5], the concentrations of presolar silicates are, within 2σ error limits, compatible with the abundances for the respective interchondrule matrices (Fig. 2). For an unambiguous determination whether the rim and interchondrule abundances are significantly different or comparable, better statistics are needed. For the CM chondrites, a comparison between rim and interchondrule matrix is not meaningful, since fine-grained rims are the only major reservoir of fine-grained dust [6]. The interchondrule matrix is mainly composed of debris of primary rocks; thus, presolar grains are expected in lower concentrations than in the rims, if any. For Y-791198, there is evidence that the apparent lack of presolar silicates is not due to extensive aqueous alteration. The outer rim layers contain small Fe,Ni metal grains with ~chondritic Fe/Ni-ratios Which would have been transformed into Fe-oxides by aqueous alteration. Also, the elemental composition of the rim does not differ significantly from that of the Murchison rim containing presolar silicates. The absence of presolar silicates in Maribo, and the detection of 2 presolar Al-oxides and several SiC grains can be explained by preferential destruction of the silicates by aqueous alteration. Since Maribo and Y-791198 are among the least altered CMs, the destruction occurred most likely prior to parent body accretion. Murchison is also among the more primitive CMs, and the presence of presolar silicates in its dust rims suggests differing degrees of aqueous alteration affecting the presolar grain contents of the CM precursor material.

Fine-grained rims represent a valuable reservoir of presolar dust in carbonaceous chondrites. The presence of presolar grains indicates that they were accreted in the solar nebula and escaped major alteration and modification during and after parent body formation. Further investigation of the presolar grain contents of the rims will allow insights into the degrees of aqueous alteration experienced by the precursor materials.

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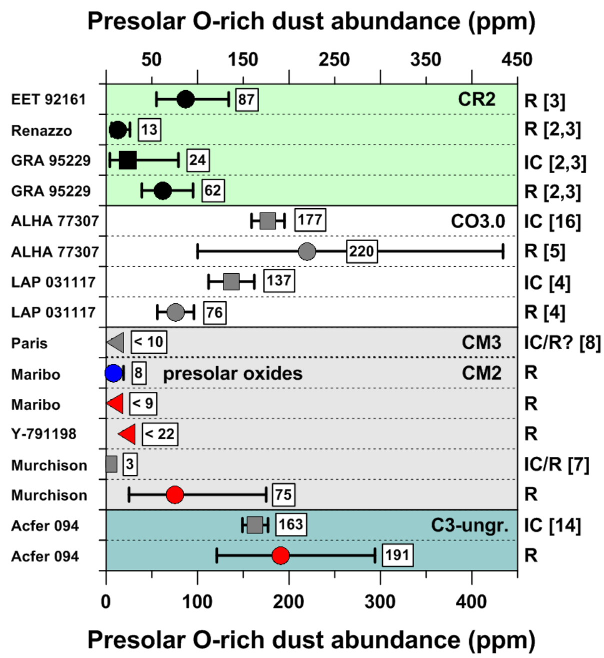

Figure 2*. Presolar silicate abundances of dust rims and interchondrule matrix for Acfer 094, CM, CO, and CR chondrites."R" and "IC" denote rims and interchondrule matrix. References are given in parentheses.*

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