THE STARDUST INVENTORIES OF GRAVES NUNATAKS 95229 AND RENAZZO: IMPLICATIONS FOR THE DISTRIBUTION OF PRESOLAR GRAINS IN CR CHONDRITES. J. Leitner[1], P. Hoppe[1], and J. Zipfel[2], [1]Max Planck Institute for Chemistry, 55128 Mainz, Germany (jan.leitner@mpic.de), [2]Forschungsinstitut und Naturmuseum Senckenberg, 60325 Frankfurt, Germany.

Introduction: Primitive meteorites, interplanetary dust particles (IDPs) and cometary matter contain small amounts of circumstellar dust [e.g.,1]. These so-called presolar grains formed in the winds of evolved stars or in the ejecta of stellar explosions and were incorporated in the molecular cloud from which our Solar System formed. They are distinguished from Solar System material by their highly anomalous isotopic compositions. Presolar grain abundances vary among different materials and even among individual meteorites of the same class. Refractory silicates and oxides are among the most abundant presolar phases.

CR chondrites have petrologic types 1–3 and are among the most primitive meteorites. Their mineralogy has been affected by aqueous alteration to various degrees [2]. Previous studies of individual CRs revealed a wide spread of presolar silicate and oxide grain abundances [3–8], possibly linked to the degree of aqueous alteration [e.g.,5] Earlier analyses of a fine-grained fraction in the Antarctic CR chondrite Graves Nunataks (GRA) 95229 yielded 2 presolar silicate grains, corresponding to an abundance of ~19 ppm [9]. In a previous study of Renazzo, which is among the most aqueously altered CR chondrites, no presolar silicates were observed [3]. Therefore, investigating the occurence, systematics and variations in the presolar grain abundances in CR chondrites can give new insights on parent body processes and possible heterogeneities in the protosolar nebula.

We report here the discovery of 7 new presolar silicate grains and one presolar oxide in GRA 95229 and the first 2 presolar silicate grains in Renazzo, as well as 4 and 3 presolar silicon carbide (SiC) grains, respectively, by NanoSIMS ion imaging. In both meteorites, the chemistry and mineralogy of the presolar grain-bearing areas were documented in detail in order to explore a relationship with presolar grain abundances.

Samples and Experimental: Fine-grained material was identified by optical microscopy in thin sections of the CR chondrites GRA 95229 and Renazzo. Element maps of Mg, Si, S, Ca and Fe were acquired with a JEOL Superprobe 8200 Electron Microprobe.

For the oxygen isotope measurements a ~100 nm primary Cs^+ beam was rastered over 10×10 µm²-sized sample areas (256×256 px) with a total integration time of ~55 minutes in the NanoSIMS 50. $^{16,17,18}O^-$, $^{28}Si^-$, and $^{27}Al^{16}O^-$ ion images were acquired in multicollection mode. O-anomalous grains are considered as presolar if the anomaly is more than 4σ away from the average value of the surrounding matrix and visible in at least two subsequent image planes. $^{12}C^-$, $^{13}C^-$, and $^{28,29,30}Si^-$ were measured on a subset of matrix areas to identify presolar SiC grains, as well as $^{28,29,30}Si^-$ of one presolar silicate grain (GR95_13_29).

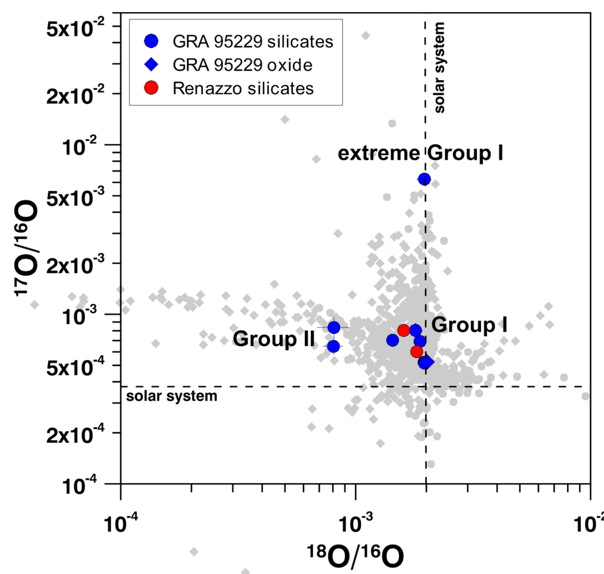

***Fig.1.** Oxygen-3-isotope plot for the O-anomalous grains in GRA 95229 and Renazzo. Reference data (gray) are from [10].*

Results and Discussion: *GRA 95229.* 14,000 µm² of fine-grained material have been analyzed. A total of 10 presolar O-anomalous grains have been identified (9 silicates, 1 oxide, Fig. 1), together with 4 presolar SiC grains. Six silicates and the oxide grain are enriched in ^{17}O and belong to the O-isotopic Group I, originating from 1.2–2.2 $M_\odot$ AGB stars [11,12]. Two silicates are significantly depleted in ^{18}O and enriched in ^{17}O and fall into Group II, and one silicate grain, with $^{17}O/^{16}O=(6.25\pm0.25)\times10^{-3}$ and $^{18}O/^{16}O=(1.96\pm0.14)\times10^{-3}$, belongs to the rare extreme Group I grains, which are possible nova condensates or come from other binary systems. The Si isotopic composition of this grain (GR95_13_29) is $\delta^{29}Si=62\pm20$ ‰, and $\delta^{30}Si=169\pm26$‰. This is the first potential nova silicate with a significant enrichment in ^{30}Si, which strongly supports an origin from a ONe nova. Three SiC grains have $^{12}C/^{13}C$-ratios of 56– 96 and are mainstream grains, while the fourth is a SiC Z-grain. These grains correspond to matrix-normalized abundances of 46 ppm for silicates, 2 ppm for oxides, and 57 ppm for SiC, respectively. Eight O-anomalous grains were discovered in a S-rich fine-grained rim around a chondrule and in a S-rich patch of fine-grained material ("S-rich" meaning a higher S-content than in the typical interchondrule matrix). For these S-rich regions, we calculate grain abundances of 62 ppm (silicates), 5 ppm (oxides), and 111 ppm (SiC), while the typical interchondrule matrix contains only ~24 ppm presolar silicates. No oxides or SiC were found here.

Renazzo. 10,100 µm² of fine-grained material have been investigated so far. Two presolar silicate grains were identified (Fig.1). Both are enriched in ^{17}O and have subsolar ^{18}O/^{16}O-ratios, belonging to Group I of presolar silicates and oxides. They represent a presolar silicate abundance of ~18 ppm. We also found three presolar SiC grains (corresponding to 55 ppm): two MS grains with ^{12}C/^{13}C-ratios of 61 and 84, respectively, and one SiC Y-grain with ^{12}C/^{13}C=108. All are located in S-rich fine-grained chondrule rims.

When studying the fine-grained fraction of CR chondrites, we distinguishued different types of occurrences: interchondrule matrix, fine-grained rims around chondrules, and fine-grained material in lithic clasts. GRA 95229 has a moderate degree of aqueous alteration, between the pristine CR3 chondrites Queen Alexandra Range (QUE) 99177 and Meteorite Hills (MET) 00426, and more severely altered CR chondrites like Renazzo [13]. Wasson and Rubin [14] reported evidence for chemical heterogeneity of the interchondrule matrix in the Antarctic CR2 chondrite LaPaz Icefield (LAP) 02342, which they attributed to surviving compositional heterogeneities among the fine-grained particles derived from the protosolar cloud. Such heterogeneities should also affect the distribution and preservation of presolar material in the solar nebula. There is evidence for clustering of grains on small scales [15], but effects on larger intra-meteoritic scales have not been reported to date. The fact that 80% of the presolar grains in GRA 95229 and the two silicates in Renazzo are located in S-rich fine-grained chondrule rims and matrix patches instead of typical interchondrule matrix (Fig. 2) may indicate the existence such larger-scale heterogeneities.

Conclusions: Presolar grains are present in the moderately to highly altered CR chondrites GRA 95229 and Renazzo. Their preferred occurrence in fine-grained chondrule rims in comparison with typical interchondrule matrix hints towards larger-scale heterogeneities in the distribution of presolar grains. The presence of presolar silicates in fine-grained chondrule rims rules out that such rims formed by aqueous alteration or disaggregation of chondrule material. Our finding of presolar grains in these rims support the idea that fine-grained material was accreted from the solar nebula on chondrule surfaces prior to parent body formation, as was suggested by Metzler et al. for the formation of accretionary dust rims in CM chondrites [16]. These observations show the importance of thorough pre-selection of sample areas for the search for presolar grains, and demonstrate moreover that fine-grained chondrule rims are another promising site for finding presolar materials.

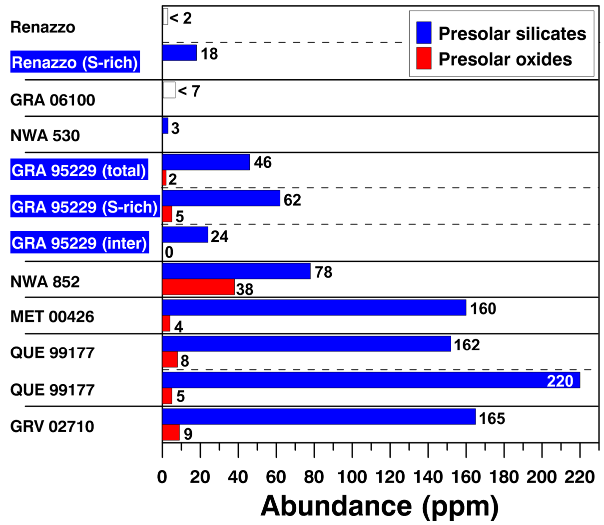

Fig.2. *Matrix-normalized abundances of presolar silicates and oxides in CR chondrites. Data from this study are marked in blue on the left side. Additional data were taken from [3–9].*

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