ABUNDANCES AND COMPOSITIONS OF PRESOLAR GRAINS IN CR2 CHONDRITE EET 92042. I. Koch[1, 2] and C. Floss[2] [1]Department of Earth and Planetary Sciences, Washington University, St. Louis, MO 63130 (ikoch@wustl.edu). [2]Laboratory for Space Sciences and Physics Department, Washington University, St. Louis, MO 63130.

Introduction: Presolar silicate grains are highly susceptible to both thermal and aqueous alteration, which makes them an important tool in studying the nature of secondary processing that happened early in the grain's life. Understanding these processes can elucidate the conditions within the early planetary disk and the ISM [1].

CR chondrites are among the most primitive meteorites, hosting relatively large abundances of presolar grains. The CR2 chondrite EET 92042 contains a significant amount of N anomalous organic matter, which likely originated in the cold outer regions of the solar protoplanetary disk [2]. Despite its primitive characteristics, no studies thus far have identified presolar grains within it. Determining the abundances and compositions of the presolar grains present within this meteorite can improve our understanding of the secondary alteration it experienced and how it relates to other CR chondrites.

Using a combination of analytical techniques, this study make comparisons between previously reported presolar grain abundances and compositions in similar meteorites to those found within three regions of a thin section of EET 92042.

Experimental Methods: Fine-grained matrix areas were identified in a thin section of the CR2 chondrite EET 92042 using an optical microscope. Presolar grains were identified using the Washington University NanoSIMS 50 by rastering a focused Cs^+ beam over 10x10 μm^2 areas in the previously identified matrix areas of the thin section. Multicollection mode was utilized to detect carbon and oxygen anomalous grains within these areas by the simultaneous collection of secondary ions of $^{12,13}C^-$ and $^{16, 17, 18}O^-$, along with secondary electrons. The grains were relocated using the PHI Auger Nanoprobe to obtain both high-resolution secondary electron images of the grains and elemental spectra.

Presolar Grain Abundances: Three separate areas of the thin section were analyzed for their presolar grain content, for a total area of 14400 μm^2. Thirty-one oxygen anomalous grains were detected: 10 grains in Area A, 9 grains in Area D, and 12 grains in Area F. Area A has an abundance of 27 ppm, Area D has 30 ppm, and Area F has 36 ppm of oxygen anomalous grains present. The overall average for EET 92042 is 31 ppm.

Eleven SiC grain anomalous in carbon were found. Five grains were found in Area A, five in Area D, and one in Area F. Area A has an abundance of 13 ppm, Area D has 17 ppm, and Area F has 1 ppm. The overall average for EET 92042 is 10 ppm.

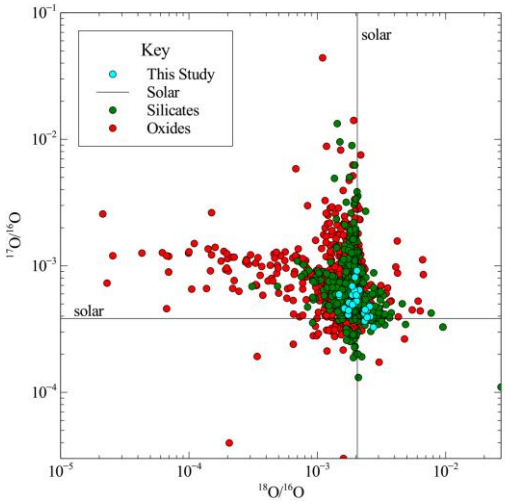

Figure 1: Oxygen three-isotope plot comparing the grains found in this study with those from the literature [3] .

Oxygen Isotopic Compositions: Eight of the thirty-one presolar grains identified were anomalous in both ^{17}O and ^{18}O relative to solar ratios, all but one of which show an enrichment in ^{17}O and a depletion in ^{18}O. Of the remaining grains seventeen were enriched in ^{17}O alone, seven were enriched in ^{18}O alone.

Elemental Compositions: All of the grains identified by this study showed high levels of Fe and Si in their spectra. Ten of the grains contained some degree of sulfur in their spectra and six showed Ca. The Fe+Mg+Ca/Si ratio was determined for the 25 grains for which Auger spectra were obtained. Nine of the grains showed olivine-like ratios (1.6-2.4), two showed pyroxene-like (0.6-1.3), and five showed ratios intermediate between the two. The remaining nine grains had ratios larger than 2.4. Of these grains, two showed both sulfur components to the spectra and relatively low amounts of silica present. This suggests that they may in fact be oxide grains where the surrounding matrix material contaminated the spectra. Three of the remaining high ratioed grains show a significant amount of sulfur present, as well as silica. It is possible that these grains are GEMS. Elemental maps of the grains are needed to confirm this.

The average Fe content for the grains identified was 17%, with a range from 3 % - 31% This average is similar to other CR chondrites, but the range is larger than in other CRs. EET 92042 is, however, similar in both range and average is Acfer 094 [1].

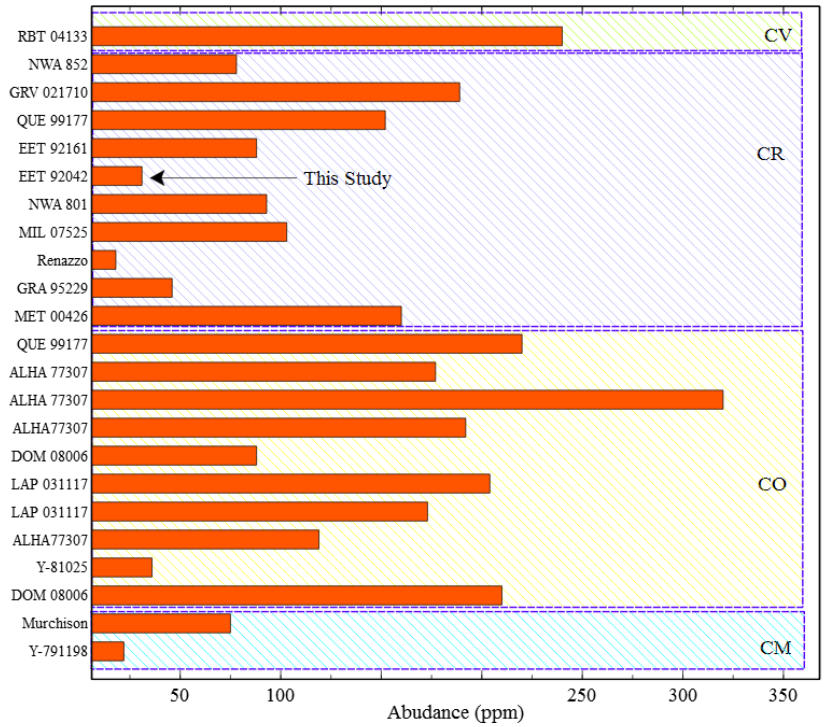

Figure 2: Presolar silicate grain abundances in carbonecous meterorites. [1 and references therein]

Discussion:

Abundances: Compared to other CR chondrites, the abundances of oxygen anomalous grains in EET 92042 is on the lower end of the spectrum (Fig. 2). The highest abundance of anomalous silicate grains in a CR Chondrite is in QUE 99177 with an abundance of 220 ppm [1]. It is somewhat similar to Renazzo which has ~18 ppm silicate grains. GRA 95229 is also somewhat similar, having an abundance of ~46 ppm [4]. EET 92042, GRA 95229, and Renazzo are all petrographic type CR 2.5 [5]. The similar abundances of silicate grains is thus likely due to similar levels of aqueous alteration.

EET 92042 has an overall average of 10 ppm SiC based on this study. This number within error of the abundances found the 18 ppm abundance found for EET92042, but slightly lower than the 30 ppm abundance also reported by Davidson et al. 2014 [6].

Isotopic Compositions: Of the grains analyzed, 23 fall into isotopic Group 1 and 8 fall into Group 4 (Fig. 1) [7]. Group 1 grains originate in oxygen-rich low-mass red giant and AGB stars, during the CNO cycles in the inner layers of the stars. This material is then dredged up to the stellar envelope, allowing the ^{17}O enrichment to form. Group 4 grains are thought to form in the ejecta of type II supernovae [7]. EET 92042 has a significant number of Group 4 grains, 25% by grain number and 9 ppm based on abundance. This is fairly typical for carbonaceous chondrites. GRV 021710 has abundance of 19 ppm and 19% , QUE 99177 has an abundance of 10 ppm and 8%, MET 00426 has 11pm abundance and 11%, NWA 852 has and abundance of 8ppm and 13% [8 and references therein]. Within reasonable error our abundance agrees well with these values.

Elemental Compositions: The majority of the grains found in this study are of olivine-like composition, with very few intermediate or pyroxene-like grains. There are also a large number of grains with ratios higher than olivine. The CR chondrites QUE 99177 and MET 00426 show nearly the opposite abundances with pyroxene-like being the most common and a large number of intermediate composition grains [9]. It is much more similar to Adelaide which had more grains consistent with olivine than pyroxene and a large number of grains with ratios higher than olivine. However, Adelaide has experienced thermal metamorphism, while EET 92042 has only experienced aqueous alteration [10].

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