C CHONDRITE CLASTS IN H CHONDRITE REGOLITH BRECCIAS: SOMETHING DIFFERENT

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Introduction: Zag (H3-6) and Monahans (1998) (H5) are regolith breccias that contain 4.5 GY old halite crystals which in turn contain abundant inclusions of aqueous fluids, solids and organics [1-4]. We have previously proposed that these halites originated on a hydro-volcanically-active C-class asteroid, probably Ceres [3-7]. We have begun a detailed analysis of the included solids and organics and are re-examining the related carbonaceous (C)) chondrite clast we previously reported in Zag [5-7]. These new investigations will potentially reveal the mineralogy of asteroid Ceres. We report here on potentially identical C chondrite clasts in the H chondrite regolith breccias Tsukuba (H5-6) and Carancas (H4-5). The clast in Tsukuba was known before [8], but the Carancas clast is newly recognized.

Zag Clast: As we have previously reported, the Zag clast is predominantly a fine-grained mixture of serpentine, saponite, magnetite, Ca-phosphates, organic-dominated grains, pyrrhotite, Ca-Mn-Mg-Na carbonates, and minor olivine. The carbonates have Mn-rich cores, mantles of Ca-carbonate, and very thin Na-Mg-rich rims. These carbonates are now the target of a study of the Mn-Cr systematics. As we reported previously, the bulk oxygen isotopic composition of this clast plots above the TFL, and away from the field of the mineralogically-similar CI chondrites - at a ^{16}O poorer composition ($d^{17}O = 13.13‰$, $d^{18}O = 23.38‰$). It has a rather high $\Delta^{17}O$ value of +1.41 - 1.49 [earlier value from 5], as we have now verified. The Na-rich rims of carbonates suggested a link between this clast and the halite in Zag, and in fact this clast does contain scattered halite crystals. We have searched for additional Zag clasts, thus far in vain. Results of a study of the H, C, O and N isotopic and molecular composition of the abundant organic-rich grains (including a nanoglubule) from the Zag clast are also reported at this meeting [10].

Tsukuba Clast: The C chondrite clast in Tsukuba has been well described before [8]. Its mineralogy is very similar to the Zag clast, except it may lack carbonates and halite. There is evidence that it has been heated, plausibly during incorporation into the H chondrite parent asteroid. We are currently seeking additional clasts in Tsukuba in order to measure the bulk O isotope composition, and to make analyses of organics.

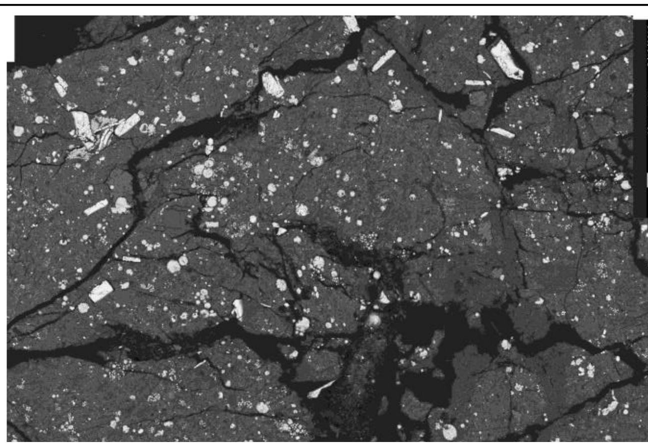

Fig. 1. BSE Image of Carancas clast. View measures 0.5 mm across. Magnetite and sulfides are white, most of the remainder is phyllosilicates and carbonates.

Carancas Clast: The clast in Carancas appears to be mineralogically identical to that in Zag, except that we have not yet observed halite. Figure 1 is a BSE image of this clast

Discussion: The three clasts we have been examining, all from H chondrite regolith breccias, appear sufficiently similar to propose a common origin, although we need oxygen isotope analyses of the latter clasts to further this proposal. The O isotope composition of the Zag clast lies along a projection of the field of CI chondrites, suggesting a possible genetic relationship. In fact we do see mineralogically identical clasts in CI chondrites (excepting the halite). This lithology appears to be distinct from the CI/CR clasts we have observed in HEDS [11].

References: [1] Zolensky et al. (1999) *Science* **285**, 1377-9; [2] Rubin et al. (2002) *MAPS* **37**, 125-142; [3] Fries et al. (2013) *MAPS* **48**, A80*;* [4] Zolensky et al. (2013) *MAPS* **48**, A394; [5] Zolensky et al. (2003) *66th MetSoc Meeting*; [6] Fries et al. (2011) *MAPS* **46**, A70; [7] Zolensky et al. (2015) *78th MetSoc Meeting;* [8] Nakashima et al. (2003), EPSL **212**, 321-336; [10] Kebukawa et al. (2016) *78th MetSoc Meeting*;[11] Zolensky et al. (1996) *MAPS* **31**, 518-537.