ORIGIN OF ENSTATITE CHONDRITE FRAGMENTS IN ALMAHATA SITTA: IMPLICATIONS FOR THE ENSTATITE CHONDRITE PARENT BODY. H. Downes[1], C.A. Goodrich[2] , R. C. Greenwood[3] and F. J. Abernethy[3]. [1]Dept. of Earth and Planetary Sciences, Birkbeck University of London, Malet Street, London WC1E 7HX, UK (h.downes@ucl.ac.uk); [2]Lunar and Planetary Institute, USRA, Houston, TX 77058 (goodrich@lpi.usra.edu); [3]School of Physical Sciences, Open University, Milton Keynes, UK

Introduction: Enstatite chondritic fragments are common within the Almahata Sitta (AhS) polymict ureilite meteorite fall [1, 2]. We have investigated 5 new enstatite chondrite (EC) fragments from the University of Khartoum AhS collection [3,4] for texture, mineralogy, mineral compositions, and oxygen, carbon and nitrogen isotopes. The results constrain the ranges of stable isotopes in the enstatite chondrite parent body/ies, and may have implications for the nature of the parent body or bodies

Results: The new AhS samples are fractured but unweathered (except for some grains of oldhamite CaS that show incipient weathering). The samples contain enstatite-rich chondrules ~1mm in diameter, in various states of thermal metamorphism. A few chondrules contain olivine of Fo_{99} composition. The matrix consists of enstatite (En_{99}), metal and sulfides, typical of ECs. Rare albite, cristobalite and graphite are also present. The sulfides include oldhamite and troilite, and a series of minerals that range in composition from keilite to niningerite. Using the concentrations of Si and Ni in metal and Cr in troilite [5], the samples are classified as one EH_a3, two EH_b4-5, one EH_b6 and one EL_b4-5. This contrasts with a previous analysis of a different suite of EC fragments from Almahata Sitta [5], in which most of the samples were of EL_b type, with only small proportions of EH_b, EL_a and EH_a types. This suggests that different groups of ECs may be located in different parts of the strewn field, reflecting different parts of the impacting asteroid 2008 TC_3 that was parental to Almahata Sitta.

Oxygen isotopes obtained at the Open University using an infrared laser fluorination system show that four of the five samples have $\Delta^{17}O$ values in the range -0.005 to 0.029 ‰. These results are typical of E chondrites and fall within the established fields of EL and EH chondrites [6]. One AhS sample has a lower $\Delta^{17}O$ value of -0.29 ‰ but still plots within the envelope of data from EH chondrites. Peak N release occurs at temperatures of 750-1400°C, whereas peak C release tends to be lower by ~200°C, suggesting that different components host these two elements. Peak values of $\delta^{15}N$ fall within the known range of ECs but divide into two groups, one with $\delta^{15}N$ around -28‰ and the other at -41‰. Peak $\delta^{13}C$ values range from -37 to -0.8‰. This wide variation is in agreement with earlier carbon isotope data for ECs [7]. No correlations were found between petrology and stable isotope compositions of the EC fragments.

Origin of enstatite chondrite fragments: A recent study [5] suggested that representatives of 8 different EC parent bodies have fallen on Earth as meteorites in recent times. The immediate parent body of AhS (which undoubtedly had a much smaller cross-sectional area than the Earth) also accreted material representing the four most common EC groups, in agreement with the observations by [8]. Goodrich et al [9] suggested that this accretion of EC and other types of xenolithic material to the parent body of AhS (as well as other polymict ureilites) occurred approximately 50-60 Myr after formation of the Solar System, during a period of enhanced dynamical activity when many planetesimals in the asteroid belt were disrupted.

We find it a remarkable coincidence that the same wide range of EC material has arrived on two different sized planetary bodies at very different times in Solar System history. This implies that the parent body of AhS was in the vicinity of the EC parent body/ies at this time, in order to accrete material from it/them. The simplest explanation for this observation is that, at the time when the immediate parent body of AhS was accreting EC material, there was at least one mega-breccia EC parent body, composed of all the different geochemical and petrological types of ECs. This single EC body may have been formed when a series of separate EC bodies, (formed in the same region of the solar nebula and all in similar orbits, but with slightly different compositions), were catastrophically disrupted and reassembled into jumbled rubble pile bodies [10]. These same mega-breccias are now the source of all ECs arriving on Earth.

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