PETROLOGY AND OXYGEN ISOTOPES IN NEW ENSTATITE CHONDRITE FRAGMENTS FROM THE ALMAHATA SITTA FALL

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Introduction: **The Almahata Sitta (AhS) polymict meteorite fall in 2008 contains chondritic fragments that may represent parts of their parent bodies not otherwise be found in our meteorite collections [1]. We have investigated 5 new enstatite chondrite (EC) fragments from the University of Khartoum collection of AhS [2] for texture, mineralogy, mineral compositions, and oxygen isotopes. Their pristine nature (low terrestrial weathering grade) enables us to constrain the range of oxygen isotopes shown by the enstatite chondrite parent body/ies, and the origin(s) of metal assemblages [e.g., 3].**

Petrography and Mineralogy: Figs 1 and 2 (right) show BSE images and X-ray maps of two of the new EC samples. All are fractured but nearly unweathered (except for oldhamite, CaS, that shows evidence of weathering). All contain enstatite-rich chondrules in a matrix of enstatite, metal and sulfides. In all samples, enstatite (En_{99}) is the dominant mineral. Albitic feldspars are subhedral to anhedral and up to 50 µm in length. Feldspar is almost pure albite. It is commonly associated with the enstatite and cristobalite, which occurs as interstitial anhedral grains up to 40 µm in size. Olivine (Fo_{99}) occurs in some chondrules.

The samples contain ubiquitous metals and sulfides which are distributed evenly through the sections, except for AhS 1002 in which they are concentrated in a metal-rich vein with sulfides, and are less abundant in a region of finer-grained metal-poor material that is rich in oldhamite (Fig. 2). Metals and sulfides often occur in association with each other, although larger grains of kamacite occur separately. Si is found in the metal in all samples. All samples contain sulfides including troilite and oldhamite. Niningerite is common, and keilite is present in AhS 1002 and AhS 41 (Fig. 3). Graphite laths are also found sporadically.

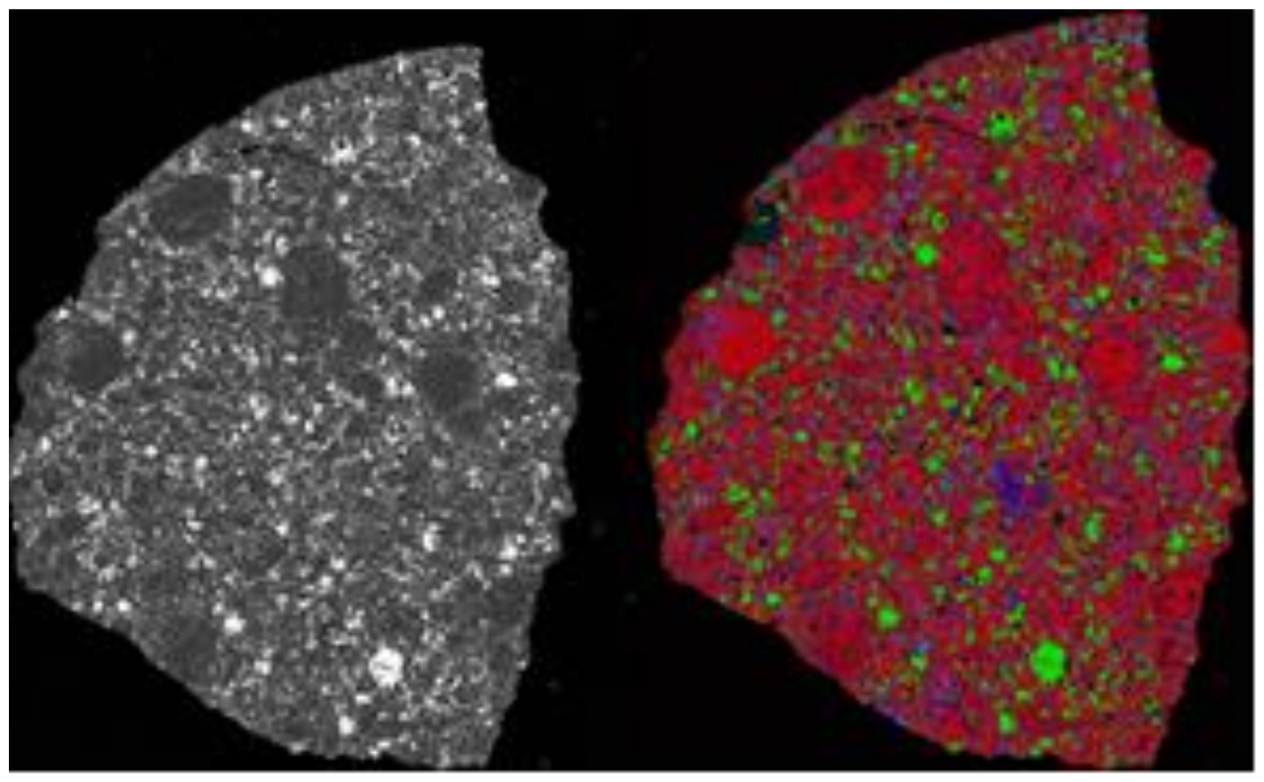

Figure 1. BSE (left) and X-Ray map (right) of EH4-5 sample AhS 2012 (Mg=red; Fe=green; S=blue)

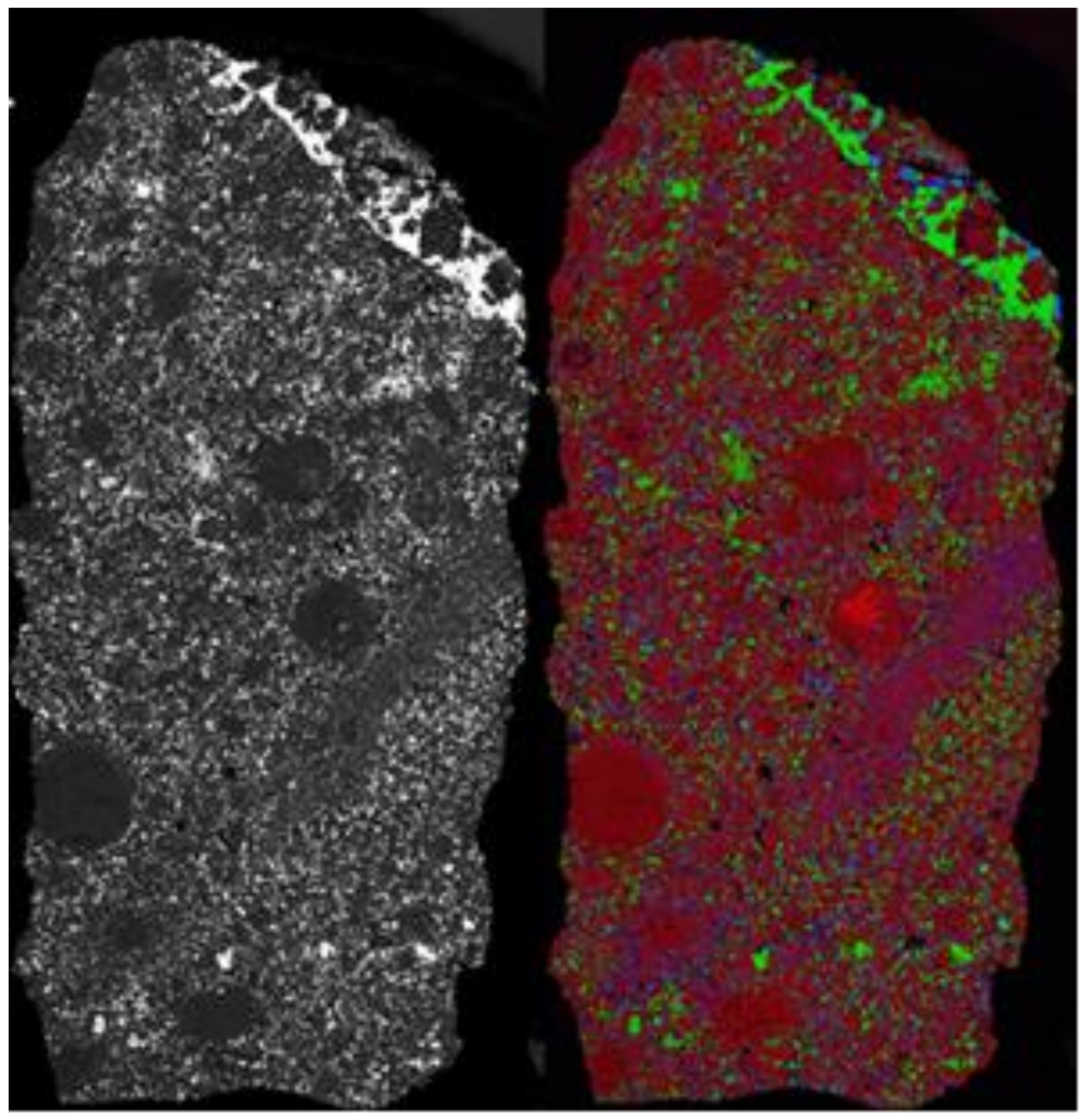

Figure 2. BSE (left) and X-Ray map (right) of EL4-5 sample AhS 1002 showing metal-rich vein (top right) and metal-poor region running from bottom left to middle right of the slide (Mg=red; Fe=green; S=blue)

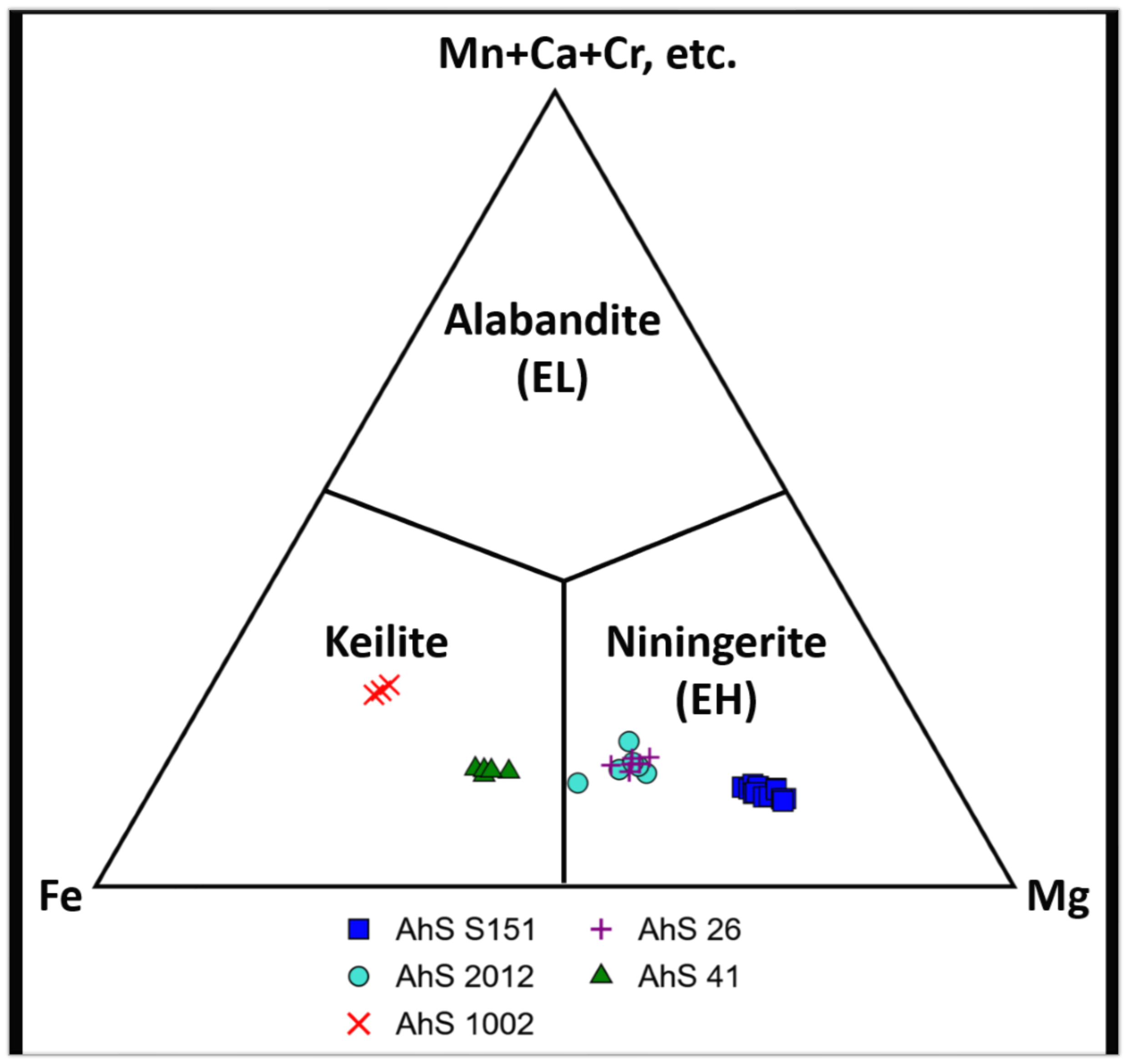

Fig 3 Ternary plot of sulfides from AhS Enstatite Chondrite samples.

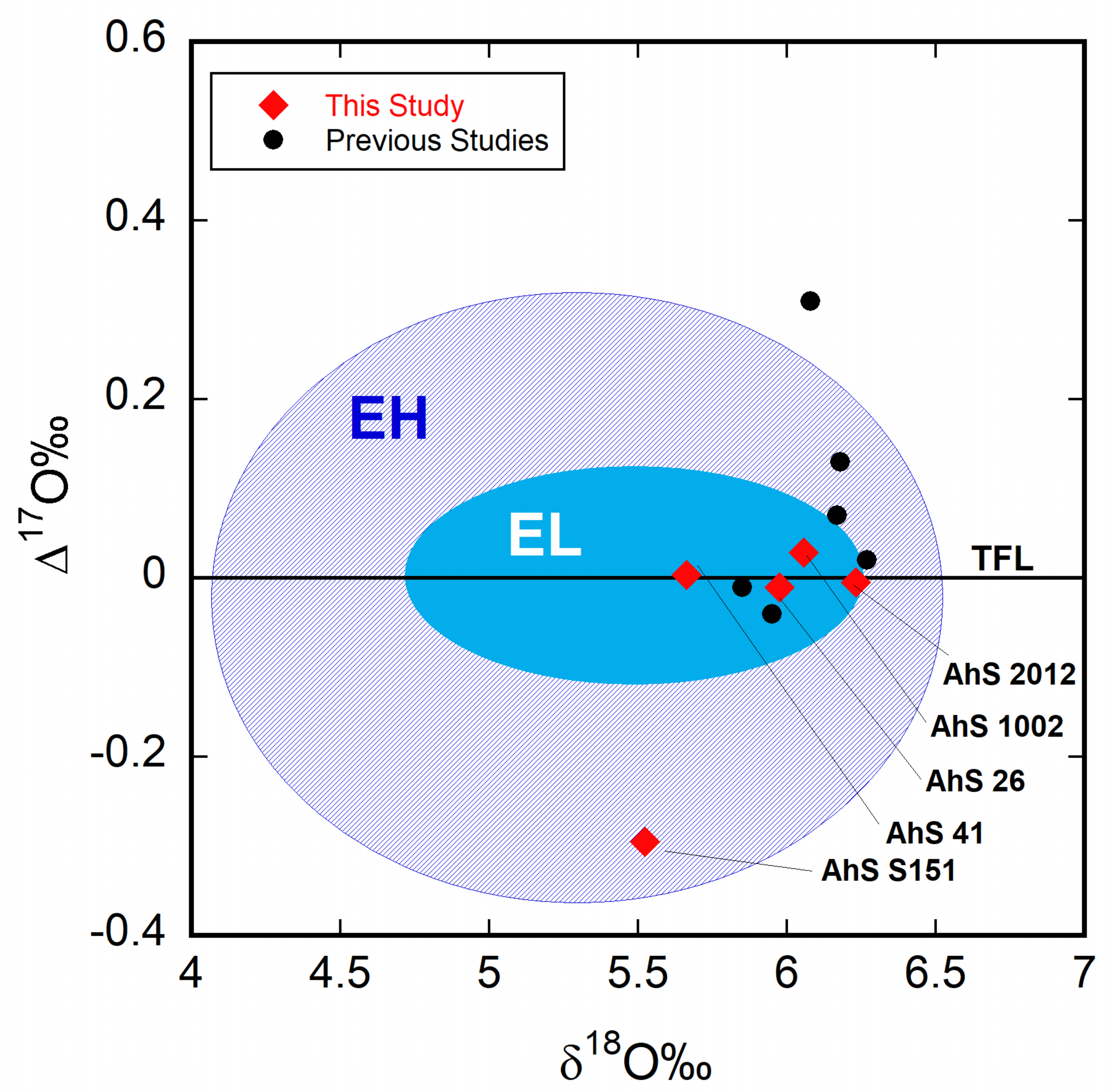

Figure 4. Oxygen isotope data for enstatite chondrite samples from Almahata Sitta analyzed in this study and by [5], compared with fields for ECs [6].

Classification and conclusions: From the petrography and mineralogy, the new samples include one EL4-5 type (AhS 1002), three EH4-5 (AhS S151, AhS 26, AhS 2012) and an EH6 impact melt rock (AhS 41). The samples appear to be typical Enstatite Chondrites but are clearly derived from different parts of the EC parent body/ies. The sulfide mineralogy is slightly unusual, as EL sample AhS 1002 contains keilite instead of alabandite. The question of why the parent body of AhS contained so much debris from the EC parent body/ies remains open for discussion.

Oxygen isotopes: Oxygen isotopes (Fig. 4) were obtained at the Open University using an infrared laser fluorination system. AhS 41 has a $\Delta^{17}O$ value of 0.004 ‰, (using the linear method of [4]), so that the sample lies exactly on the Terrestrial Fractionation Line. Three other samples have $\Delta^{17}O$ values in the range -0.005 to 0.029 ‰. These results are typical of Enstatite Chondrites and fall within the fields of EL and EH chondrites [6]. Sample AhS S151 has a $\Delta^{17}O$ value of -0.29 ‰ which is lower than the others but still plots within the envelope of data from EH chondrites in agreement with its petrography. Oxygen isotopes show a remarkably tight field around the $\Delta^{17}O$ = 0‰ line, except for AhS S151 which confirms that the halo of isotopic data on either side of this line is a genuine feature of the Enstatite Chondrite parent body/ies.

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References: [1] Fioretti A M et al. (2017). 48th LPSC Abst #1846. [2] Shaddad M et al., (2010). *Meteoritics & Planetary Science* 45, 1557-1589. [3] Horstmann M et al. (2014). *Geochimica et Cosmochimica Acta* 140 720-744. [4] Miller M. F. (2002). *Geochimica et Cosmochimica Acta* 66, 1881-1889; [5] Horstmann M and Bischoff A (2014). *Chemie der Erde*, 74, 149-183. [6] Newton J et al. (2000). *Meteoritics & Planetary Science* 35, 689-698.