THE HIGHLY UNEQUILIBRATED EH CHONDRITE, SAHARA 97072, MAY BE A PRIMITIVE BRECCIA. S. W. Lehner[1] and P. R. Buseck[1], [1]Arizona State University, 1404 (School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287, slehner@asu.edu, pbuseck@asu.edu).

Introduction: Breccias are common among ordinary and enstatite chondrites [1]. Some type-3 ordinary chondrites have been described as primitive breccias because they contain fragments of types-3 to -6 chondrites, carbonaceous, and impact-melted material [2]. Sahara 97072, one of the most primitive ECs [3], contains fragments of chondrules, shock-melt veins of Fe metal and troilite in eutectoid intergrowths, and lumps that appear to be impact-melted. We investigated several spheroidal shocked lumps containing fragments of metal, sulfide, and silicates. The lumps are similar in size to the chondrules and metal-sulfide nodules. (Fig. 1). Our goal is to describe one of these spheroidal lumps and to interpret the implications of their occurrence for the formation of Sahara 97072.

Methods: Element maps and high-resolution images of a 500-µm lump were made with two field-emission-source scanning electron microscopes (SEMs) equipped with energy-dispersive spectrometers. Quantitative analysis was performed with a JEOL JXA-8600 electron microprobe using wavelength-dispersive spectrometry.

Results: The spheroidal lump consists of fragments ranging from 5 to 40 µm in diameter set in fine-grained matrix that is crosscut by thin melt veins of Fe metal and sulfide (Fig. 1, 2). Minerals composing the fragments are Fe-Ni metal with perryite inclusions, troilite, oldhamite, niningerite, pyroxene, SiO_2, albite, and sparse schreibersite. The mineralogy reflects bulk Sahara 97072, although differences exist. Most pyroxene in the lump is low in Ca. The Fe contents of silicates inside the lump are higher than the surrounding chondrules (Fig. 3). High-magnification SEM images of the lump reveal 10-µm intergrown Fe metal and troilite blebs similar to the large eutectoid melt veins in other regions of the meteorite, as well as micron-sized veins and spherules of metal and sulfide within and between the silicates. Many of the silicate fragments are angular and appear to be fractured (Fig. 3).

Discussion: Pyroxene in chondrules surrounding the lump and near the edge has low FeO (ferrosilite = 1 to 2 wt %). Some of the pyroxene in the lump has high FeO content (ferrosilite 10 to 20 wt %; Fig. 3). Melt veins, metal spherules and the eutectic melt texture of mixed Fe metal and troilite fragments suggest this lump was formed in an impact episode. Shock heating may explain the Fe enrichment in the silicates perhaps through formation of Fe-filled fractures too fine to be excluded from the electron microprobe analyses (3 µm spot). The breccia lump appears to have been shocked prior to its emplacement in Sahara 97072 because of its position among unshocked material.

Shock-melted breccia lumps may record multiple episodes of asteroid disaggregation and reassembly [4]. It is possible the object formed from impact on another EH parent body. Alternatively, an impact on the Sahara 97072 parent body could have formed the lump, which was then recaptured by gravity as in regolith gardening. This hypothesis is supported by the occurrence of Fe metal and troilite eutectoid melt veins elsewhere in the meteorite. Sahara 97072 could thus be a primitive breccia. Such breccias have been proposed to represent immature regolith [2].

Conclusions: The breccia lump consists of fragments much smaller than the average chondrules and metal-sulfide nodules of Sahara 97072. The fragments are cemented by formerly molten metal and sulfide. The formation of the lump is evidence of a shock-heating event that occurred prior to the final accretion or lithification of the meteorite. We interpret Sahara 97072 to be a primitive breccia.

References: [1] Bunch, T.E. and R.S. Rajan, *Meteoritic Regolith Breccias*, in *Meteorites and the Early Solar System*, J.F. Kerridge and M.S. Matthews, Editors. 1988, University of Arizona Press: Tucson. p. 144-164. [2] Scott, E.R.D. and G.J. Taylor, *Primitive breccias among type 3 ordinary chondrites: Origin and relation to regolith breccias*, in *Workshop on Lunar Breccias and Soils and Their Meteoritic Analogs*, G.J. Taylor and L.L. Wilkening, Editors. 1982, Lunar and Planetary Institute: Houston. p. 130-134. [3] Weisberg, M.K., et al., *Sulfide-metal nodules in EH3 chondrites.* Meteoritics & Planetary Science, 2006. **41**(8): p. A186-A186. [4] Stoffler, D., et al., *Shock effects in meteorites*, in *Meteorites and the Early Solar System*, J.F. Kerridge and M.S. Mathews, Editors. 1988, University of Arizona Press: Tucson. p. 165-202.

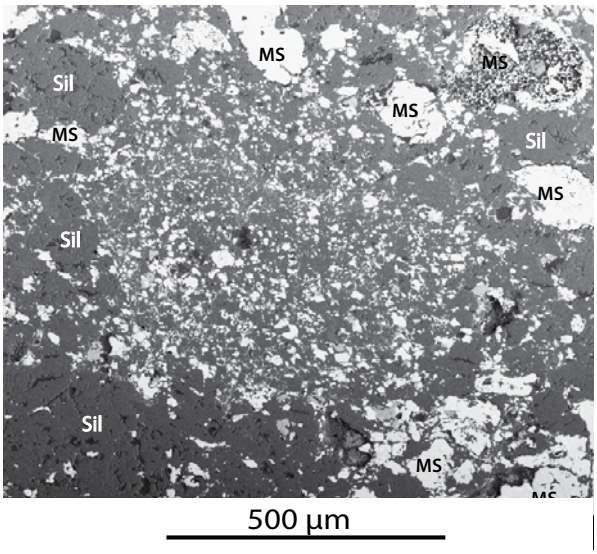

Fig. 1. *Backscattered-electron image of the breccia lump amid chondrules and metal- sulfide nodules. MS - metal and sulfide, Sil - silicate*

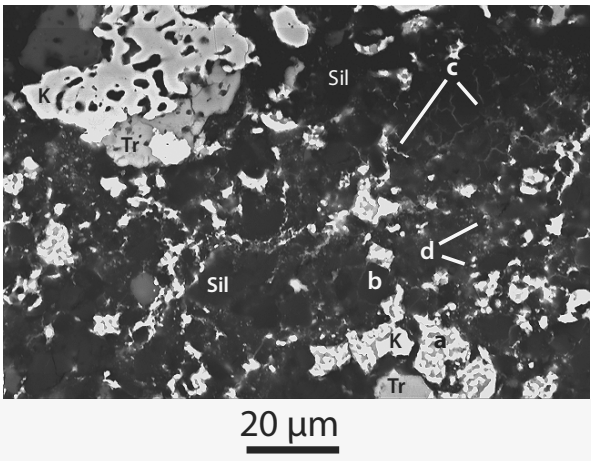

Fig. 2. *BSE image of matrix lump showing shock features such as: (a) Fe-Ni metal/FeS eutectic texture, (b) angular silicate fragments, (c) melt-filled fractures and (d) metal-sulfide blebs. K-kamacite, Tr-troilite, Sil-silicates*

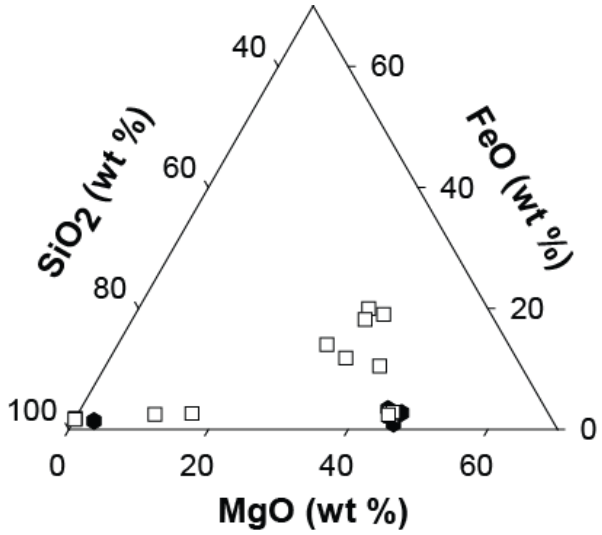

Fig. 3. *SiO_2-MgO-FeO plot of silicate composition measured outside the breccia lump (black octagons and inside the breccia lump (open squares)*