SEBKHA EL MELAH 001: UNBRECCIATED PEGMATITIC AUBRITE. C. B. Agee, A. J. Ross, M. N. Spilde, Department of Earth and Planetary Sciences and Institute of Meteoritics, University of New Mexico, Albuquerque, NM 87131, agee@unm.edu.

Introduction: Sebkha el Melah 001 (SeM 001) is an unbrecciated aubrite meteorite with a unique pyroxenitic pegmatite texture. SeM 001 possesses single crystals that are, along with Peña Blanca Spring, among the largest ever reported in an aubrite, with some measuring over 8 cm in size. The remarkably coarse grain size and unbrecciated preservation of SeM 001 may help to give insight into igneous crystallization processes on the aubrite parent body.

Fig. 1. Photograph of the 216 gram deposit sample of Sebkha el Melah 001 at residing at UNM.

Fig. 2. Photograph of a 216 gram deposit sample of Sebkha el Melah 001 showing a patch of milky-white fusion crust on upper left portion of the specimen.

History: This meteorite was found in late March 2022 in Mali, about 10 km to the southwest from Sebkha el Melah and 245 km southeast of Taoudenni, by Sahrawi meteorite hunters. The total recovered amount was approximately 17 kg. Bachir Salek obtained 12.5 kg, including the main mass, which weighs 3550 grams. Mark Lyon holds masses of 3290 grams and 2400 grams, plus several specimens in the 100-400 gram range and numerous sub-100 gram pieces. Said Muftah holds approximately 3 kg.

Fig. 3. Photographs of the 216 gram deposit sample of Sebkha el Melah 001 showing a cluster of interlocking single crystals enstatite.

Fig. 4. Photograph (left) of a single crystal separated from one of the larger masses of Sebkha el Melah 001, residing at UNM, donated by Said Mufta. Photograph on the right shows a collection enstatite single crystals separated from one of the larger masses of Sebkha el Melah 001 (photo credit Said Mufta).

Physical Characteristics: This meteorite consists primarily of clusters of coarse, interlocking enstatite crystals with a pegmatitic texture (figures 1, 2, and 3). Individual crystals are cm-sized, many showing distinct cleavage planes and traces, with pronounced elongate crystal habits. Some enstatite crystals are milky-white in color, while a few are colorless translucent to transparent and gemmy. The enstatite crystals easily come loose and separate from the clusters, examples of these separated crystals are shown in figures 4 and 5. The single crystal on the left hand side of figure 4 weighs 19.5 grams and is approximately 7.5 cm

long and 1.5 cm wide. There are also scattered dark-colored patches on some of the crystals. Significant amounts of smooth cream-colored to white fusion crust are visible (figure 2), although some fusion crust is dark-colored. No vesicles are present. The meteorite appears to be unbrecciated.

Fig. 5. Photographs of numerous single crystal enstatites separated from one of the larger masses of Sebkha el Melah 001 (photo credits Said Mufta).

Petrology and Geochemistry: Electron microprobe analyses and reflected light microscopy show that enstatite makes up approximately 98% of this meteorite. Scattered small diopside grains were detected. A single olivine grain was found in the sample microprobe mount. Small grains of kamacite, taenite, schreibersite, Ti-troilite, troilite, and daubreélite were the only accessory opaques observed. No other sulfides were detected. No feldspar was found in the microprobe mount. This aubrite has one of the highest modal abundances of enstatite ever reported (~98%). The enstatite, diopside, and forsterite of this meteorite have some of lowest iron contents (below electron microprobe major element detection limits) ever documented in an aubrite.

Electron microprobe results:
Enstatite Fs0.0±0.0Wo0.9±0.1, n=6
Diopside Fs0.0±0.0Wo45.5±0.8, n=3
Forsterite Fa0.0, n=1
Kamacite Ni=4.3±0.8, Co=0.4±0.2 (wt%), n=5
Taenite Ni=48.7, Co=0.11 (wt%), n=1

Origin of Sebkha el Melah 001 and Comparison with other Aubrites:
Here we use the term “pyroxenitic pegmatite” as a purely textural description of SeM 001, in that it is an exceptionally coarse-grained igneous rock composed of interlocking crystals, with individual crystals greater than 1 centimeter in size. On Earth, pegmatites are thought to be formed from the last fluid fraction of a large crystallizing magma body. Whether or not SeM 001 formed in a similar fashion on the aubrite parent body remains to be tested. Another possibility is that SeM 001 is a coarse grained adcumulate igneous rock formed through crystal settling and subsequent crystal growth in a magma chamber at depth within the aubrite parent body. Typically aubrites possess very coarse grain sizes when compared with other achondrite types and this feature places constraints on possible formation scenarios [1 and references therein]. The very large enstatite grain sizes in SeM 001 are not unique among the ~84 classified aubrites, for example Peña Blanca Springs and Norton County both have comparable large grain sizes. However, theses two examples and the vast majority of other aubrites do not well-preserve their original igneous textures and are either fragmental breccias or regolith breccias [2]. Notable unbrecciated aubrites Mount Egerton and Shallowater are both anomalous. Mount Egerton being metal-rich [3] and Shallowater not thought to be from the main aubrite parent body [4]. In contrast, with discovery of unbrecciated SeM 001, we now have exceptional preservation of the original igneous texture of a very coarse-grained aubrite, which may offer new constraints on the igneous history of the aubrite parent body.

References: [1] Keil K. (2010) *Chemie der Erde* 70, 295-317. [2] Keil K. (1989) *Meteoritics* 24, 195-208. [3] Watters T. R. & Prinz M. (1980) *Lunar Planet. Sci.*11, 1225–1226. [4] Keil K. (1989) *Geochim. Cosmochim. Acta* 53, 3291–3307.