

**ASU-NWA-187 (K478)**

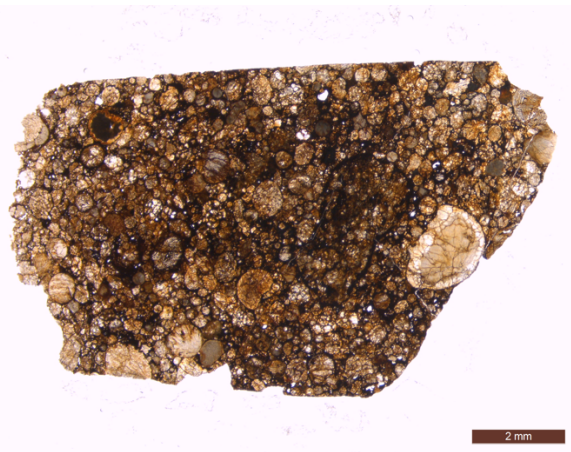
**Fabien Kuntz**

**TKW 730g**

**History:** Fabien Kuntz purchased the 730g sample in Errachidia, Kingdom of Morocco from a meteorite prospector in 2020.

**Physical Characteristics:** Sample in brownish-yellow in color, has a rounded, irregular shape and displays a heavily sand-blasted interior which shows chondrules up to cm in size. Abundant chondrules and clasts are visible on the cut face showing the interior of the sample.

**Petrography:** Description and classification (A. Love, App) Sample is a breccia composed of more equilibrated type 3 clasts in a host type 3 material. Clasts are set within a host of distinct, close-packed chondrules (average apparent diameter  $805\mu\text{m}$ ,  $n=103$ ) and opaque matrix. Within host chondrules, isotropic glass is present, however, devitrified glass is dominant. Some chondrules contain relict grains. Clinostatite is dominant. Chondrules are commonly rimmed sulfide and fine-grained rims containing  $\sim 2\text{-}10\mu\text{m}$  microchondrules. Clast A (see Fig. 3) shows distinct equilibrated chondrules set in a recrystallized transparent matrix. Clast B shows indistinct unequilibrated chondrules and fragments set within a brecciated matrix.



Figs. 1 & 2. Overview photograph (F. Kuntz) showing main mass with cm-sized chondrule on the surface (left); plane polarized light overview showing chondritic texture (right).

**Shock:** Olivine contains irregular and planar fractures and displays weak undulatory extinction. Sample contains mixed FeNi+FeS assemblages, troilite is polycrystalline.

**Weathering:** Some FeNi metal preserved. Most FeS unaltered FeOH veins crosscut sample and stain interior. Calcite veins crosscut portions of the sample. Weathering effects have taken advantage in the brecciated clast so that all sulfides and FeNi metals are completely altered.

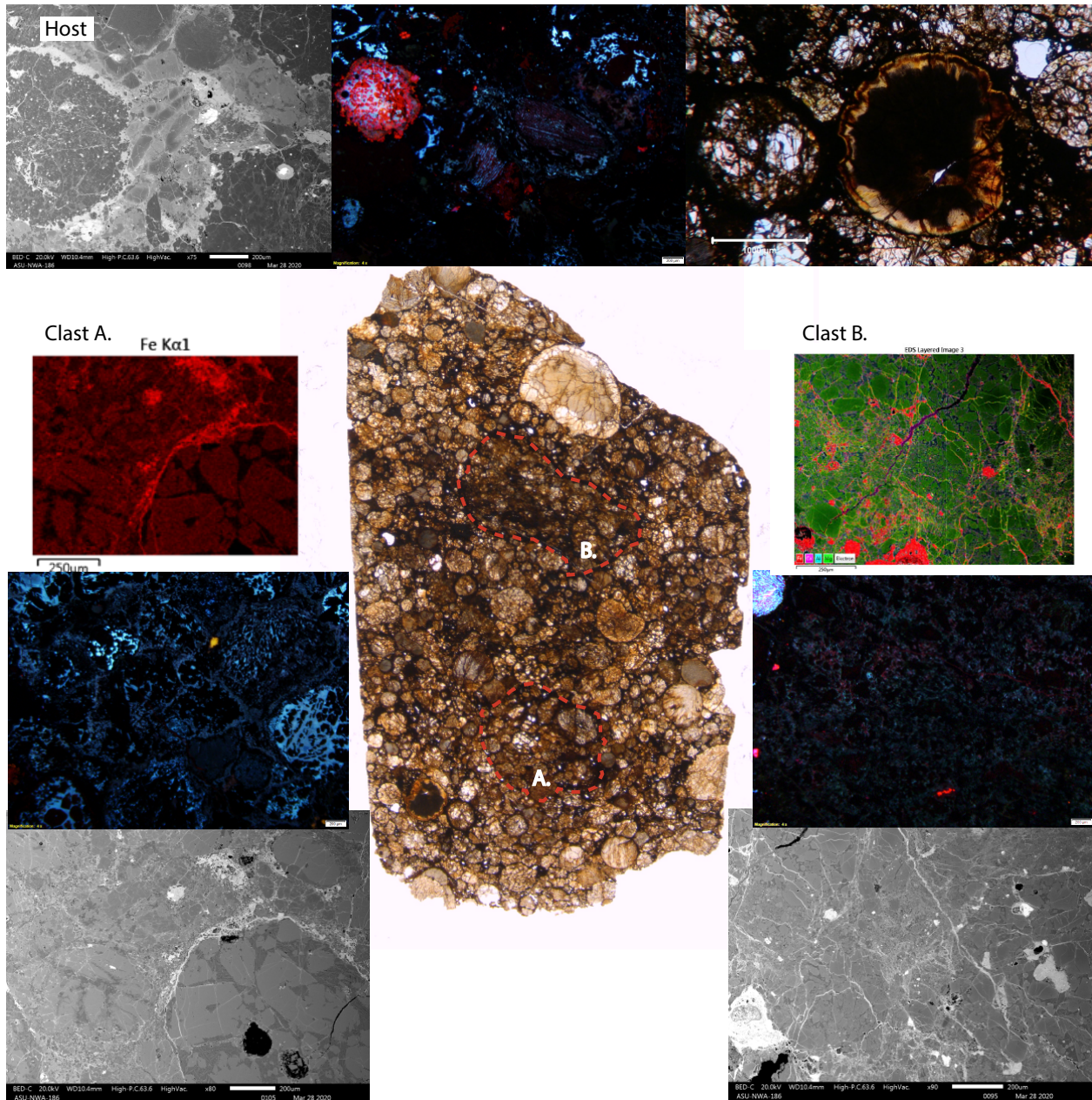


Fig. 3 Image mosaic showing petrographic and chemical differences between host and clasts (outline with red dashed lines). Host is composed of unequilibrated chondrules (w/ chemical zonation) in opaque matrix. The unequilibrated composition can be seen in the backscattered electron image at the top showing a range in greyscale shades for silicates, within the CL photo showing some red luminescence of olivines and blue luminescence of mesostasis in adjacent FeO-rich chondrules (>5 wt% FeO quenches CL). Clast A (left) appears to be chemically homogenized (based on the even shades of red in the Fe K-alpha map-top left), the lack of red CL and dominance of mesostasis CL (middle left) and finally within backscattered electron images (bottom left). The brecciated clast (Clast B.) is composed of a variety of grainsizes, but chemically-zoned grains are common (as seen in the False-color X-ray map (top right)). The CL signature is extremely weak as silicates lack prominent CL (blue chondrule in upper left falls

outside of this clast). The backscattered electron image shows the brecciated nature and the chemical zonation within this clast.

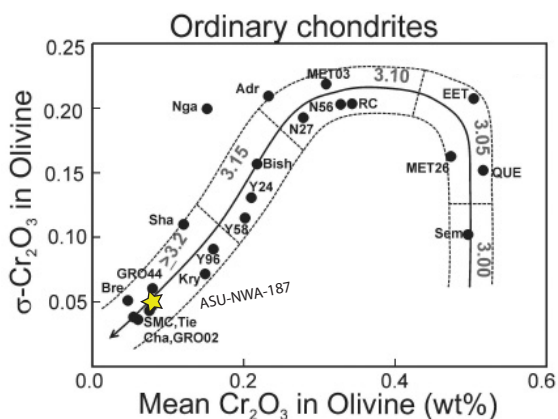
**Magnetic Susceptibility:** Quadruplicate measurements of stone produced  $\log \chi \times 10^{-9} \text{ m}^3/\text{kg} = 3.46$ . This value fits within the range for LL chondrites (Rochette et al., 2003).

**Cathodoluminescence Microscopy:** CL was observed using the CL Olympus BX-51 with a Reliotron CL control and stage housed within the Department of Geology at Appalachian State University. Observations were made at 8 KV.

Sample has distinct CL dominated by luminescent mesostasis. Within the host, chondrule olivine with bright and dark red CL are present but rare. Mesostasis CL varies from hues of blue to yellowish-green and purple. Chondrules within equilibrated clasts show no CL w/in olivine but do show dominant blue CL within mesostasis. Within the brecciated clast, chondrules with dark red CL and small bright red and magenta fragments (broken chondrule minerals) are present. The signature is dominated an anastomosing pattern of light blue mineral material (likely silica).

**Geochemistry:** (A. Love, App) Geochemistry was measured using the JEOL ITS300 SEM with EDAX EDS in the Dewel Microscopy Lab at Appalachian State University. An accelerating voltage of 20kV was used to analyze 3 spots per grain. Olivine and pyroxene are unequilibrated.

Host: Olivine (Fa16.84+/-11.88 (Fa0.72-38.72), Fe/Mn=50.26+/-22.17, n=11. Cr<sub>2</sub>O<sub>3</sub> in type II chondrules has an average of 0.08 Wt% with a standard deviation of 0.05, n=9); low Ca-pyroxene (Fs16.24+/-13.56Wo0.98+/-0.62 (Fs2.13-28.88Wo0.34-2.05), n=10. Clast A: olivine (Fa14.47+/-5.19, n=4); low Ca pyroxene (Fs15.21Wo1.26, n=1). Clast B: Olivine (Fa10.84+/-4.91, n=2); low Ca pyroxene (Fs17.86+/-0.75Wo0.5+/-0.14, n=2).



**Classification:** Ordinary chondrite (LL3 C-S3 W2) Based on texture, chondrule size and magnetic susceptibility this sample is an LL chondrite breccia. Estimated subtype for this sample is 3.5 based on unequilibrated compositions, presence of isotropic glass mesostasis (3.4-3.5), lack of yellow CL in chondrule mesostasis (>3.4) and presence of red luminescence in chondrule olivine

>3.5). Clasts A & B are type 3 (>3.5) based on unequilibrated olivine compositions and CL signatures.

**Specimens:** Fabien Kuntz holds the main mass. A thick slice and several smaller slices and fragments comprise the 36.43g type specimen. A polished thin section and mount are on deposit at App.