SERICHO: A NEW MAIN GROUP PALLASITE WITH TWO TYPES OF CHROMITE. J. S. Boesenberg[1], M. Humayun[2], R. Windmill[3], R. C. Greenwood[3] and I. A. Franchi[3]. [1]Dept of Earth, Environmental and Planetary Sciences, Brown University, 324 Brook Street, Providence, RI 02920 (joseph_boesenberg@brown.edu). [2]National High Magnetic Field Laboratory and Dept. of Earth, Ocean & Atmospheric Science, Florida State University, Tallahassee, FL 32310. [3]The Open University, Walton Hall, Milton Keynes, MK7 6AA, United Kingdom.

Introduction: Sericho is a new Main Group (MG) pallasite discovered in Kenya in 2017. We have analyzed this pallasite to determine its petrological, chemical and oxygen isotopic history, and its relationship with the other members of MG pallasites.

Analysis: Two rectangular slabs of Sericho were purchased from meteorite dealers. Due to practical size limitations for analysis, the first sample (~1x3 inches) was split in half and mounted (JSB-58A and -58B). A second sample (JSB-60), which contains large chromites, was purchased subsequently after realizing the original -58 contained only one small chromite. Microprobe analysis and sample characterization was performed at Brown Univ., trace element metal data was gathered by laser ablation ICP-MS at Florida State Univ., and laser fluorination oxygen isotopic analysis was carried out at The Open University.

Results: Modal abundances for Sericho have been reported as ~70% olivine; 29% metal, schreibersite, and sulfide; and <1% chromite (by area) [1]. No phosphates have yet to be reported in Sericho and none were found in this study.

Texturally, Sericho looks much like Brenham or Springwater [2]. The olivine grains are predominantly rounded. There are also occasional polyhedral olivines. The grains vary in color from green to orange depending on their weathering. The olivines range in size from a few hundred microns up about 1 cm across. The few polyhedral olivines observed were no larger than the rounded forms. A few olivines, reported by [1], range up to 4 cm in diameter, but it is suspected these are clusters of polyhedral olivine, such as observed in Esquel and Seymchan [3], not individual olivines. Chromites are rare in Sericho, but when found tend to be quite large. Only one small (~60 micron diameter) chromite grain was found in the 4.5 square inches studied here. The large chromites in slab JSB-60 vary in size. Most tend to be in the millimeter to 5 millimeter range, are very round and not equidimensional, and form rods or blobs between olivines or olivine and metal. [1] reports finding a 5 cm cruciform-shaped chromite, however none of this type were found in this study. Swathing kamacite is prominent around the olivine, and plessite dominates the interior metal regions. No large taenite plates have been observed.

Compositionally, Sericho is a typical MG pallasite, but it contains some uncommon features. Olivine compositions in Sericho ($Fa_{12.6}$) are very homogeneous. Olivine Fe/Mn ratios are 55.6 (n=63, traverses across seven grains) with very low Cr (0.03 wt% Cr_2O_3) and Ca below detection. There are at least two different compositions of chromite in Sericho. The small, 60 micron diameter chromite (Fig. 1) measured in sample JSB-58A contains very low aluminum (below the detection limit of the microprobe) approximately 1 wt% V_2O_5, and is reversely-zoned from core [100*Fe/(Fe+Mg) = 92.1 and Fe/Mn = 48.7] to rim [FFM = 83.0 and Fe/Mn = 36.1] (Fig. 2). This is the first recorded reversely-zoned chromite in a pallasite. The large chromites however are mildly normally-zoned, but contain between 2.3 to 1.7 wt% Al_2O_3 from core to rim, about 0.65 wt% V_2O_5, and have very different core [FFM=~59] to rim [FFM= ~63] compositions (Fig. 2). There are virtually no Fe/Mn variations from core to rim on the large chromites, with a range of 34-37.

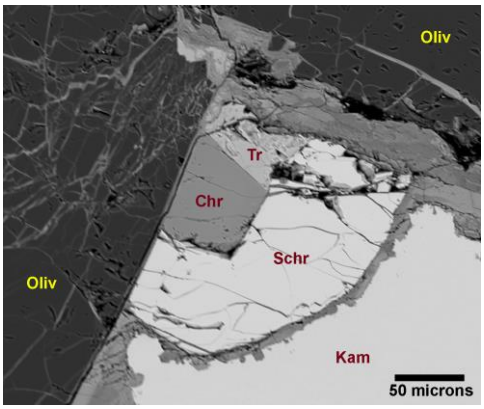

Figure 1. Reversely-zoned chromite in Sericho.

Analysis of three troilites shows compositions are homogeneous with trace levels of Cr (0.15 wt%), Co (0.03 wt%) and Ni (0.05 wt%). However, analysis of two schreibersite regions shows significant heterogeneity. Both schreibersites are zoned and have different compositions. The first, which is 300 microns in diameter, shows low Ni (range of 33.4-35.1 wt%), but higher Co (range 0.14-0.19 wt%), while the second, 200 micron diameter one, has high Ni (range 44.4-45.4 wt%) and lower Co (range 0.08-0.11 wt%).

Trace element metal analysis by LA-ICP-MS shows that the metal from Sericho is consistent with that of the MG pallasites (Fig. 3). The bulk metal composition

is 733 µg/g P, 904 mg/g Fe, 5.34 mg/g Co, 90 mg/g Ni, 124 µg/g Cu, 20.2 µg/g Ga, 50.2 µg/g Ge, 22.4 µg/g As, 7.30 µg/g Mo, 2.30 µg/g Ru, 1.02 µg/g Rh, 5.83 µg/g Pd, 0.49 µg/g Sn, 0.20 µg/g Sb, 0.26 µg/g W, 0.060 µg/g Re, 0.47 µg/g Os, 0.47 µg/g Ir, 2.62 µg/g Pt and 2.52 µg/g Au.

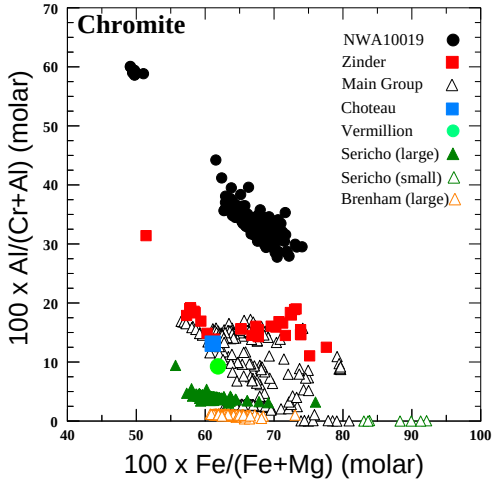

Figure 2. Comparison of the Fe/(Fe+Mg) versus Al/(Cr+Al) ratios in chromite from Sericho and other pallasites.

Oxygen isotopes performed on Sericho show it to have a composition of $\delta^{18}O$ = 3.136, $\delta^{17}O$ = 1.454 and $\Delta^{17}O$ = -0.189, indicating it is a typical MG pallasite.

Discussion: Sericho is a MG pallasite similar in texture to other rounded olivine pallasites. The oxygen isotope data, as well as the metal abundances for Ga and Ge in metal (which are excellent indicators for differentiating between different parent bodies), all overlap those of MG. Abundances for Ir and Au in metal indicate that Sericho metal is a moderately fractionated member of MG.

Given the limited mineralogy of most pallasites, chromites show the greatest chemical variation within the oxide and silicates, and best track the crystallization history of pallasites. Sericho is unusual as it contains two generations of chromites. Certain regions of Sericho contain very large, rounded chromites that tend to be clustered together, while vast portions of the pallasite contain nearly no chromite. This also occurs in Brenham [4]. Given their shape, composition and only mild zoning (Fig. 2), these chromites likely formed contemporaneously with olivine and subsequently ripened, aided by Cr chemical transport through S- and P-rich melts. The other type of chromite present is a small euhedral chromite that contains reverse zoning. Reverse zoning in igneous rocks is typically the result of a relatively rapid increase in temperature, usually caused by the introduction of a new fluid or melt moving into the crystallizing rock [5]. In a pallasite, the most likely fluids/melts are S- or P-rich melts. Given the extreme Fe-rich composition of the small chromite, the lack of aluminum detected within it, and the presence of both troilite and schreibersite in contact with this chromite, it seems likely that 1) this chromite formed very late, after much of the metal had already crystallized. 2) a S- and/or P-rich melt intruded into at least a portion of Sericho late in the fractional crystallization sequence.

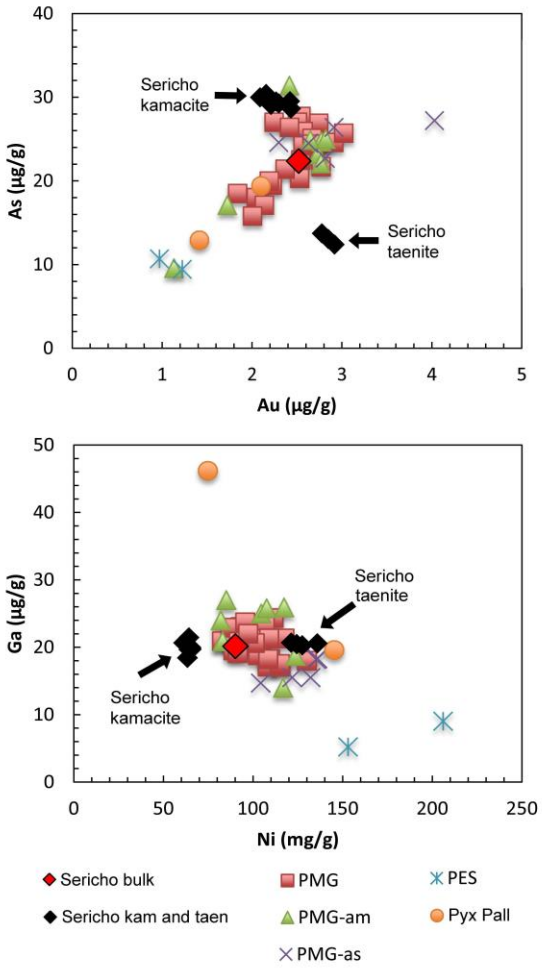

Figure 3. Trace element metal data from Sericho compared to Main Group, Eagle Station and two pyroxene pallasites.

Acknowledgements: Thanks to Mike Farmer for locating the slab of Sericho with large chromites used in this study.

References: [1] Meteoritical Bulletin 106 (2018) *Meteoritics & Planet. Sci., 53*, in prep. [2] Scott E. R. D. (1977) *GCA 41*, 693–710. [3] Boesenberg J. S. et al. (2012) *GCA 89*, 134-158. [4] Wasson J. T. et al. (1999) *GCA 63*, 1219–1232. [5] Lofgren G. (1980) *Physics of Magmatic Processes*, ed. R. B. Hargraves, p. 488-551.