PETROLOGY AND COMPOSITION OF LUNAR TROCTOLITIC GRANULITE NORTHWEST AFRICA 5744: A UNIQUE RECRYSTALLIZED, MAGNESIAN CRUSTAL SAMPLE. S. M. Kuehner[1], A. J. Irving[1], M. Gellissen[2] and R. L. Korotev[3] [1]Dept. of Earth & Space Sciences, University of Washington, Seattle, WA 98195 (kuehner@ess.washington.edu), [2]Institut für Geologie, Mineralogie und Geophysik, Ruhr-Universität Bochum, Germany, [3]Dept. of Earth & Planetary Sciences, Washington University, St. Louis, MO 63130.

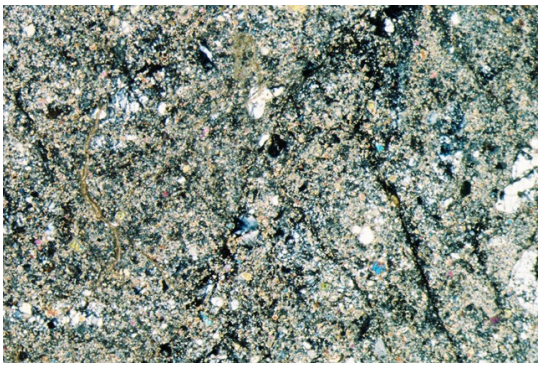
A broken, rounded 170 gram stone lacking fusion crust found in Mali in 2009 is a rare type of lunar magnesian feldspathic granulitic rock.

Figure 1. *Whole Northwest Africa 5744 stone.*

Figure 2. *Endcut portion (width 3.5 cm), showing light gray, very fine grained interior with larger white plagioclase clasts. Image © T. Bunch.*

Petrography: The specimen is a heterogeneous recrystallized breccia composed mainly of anorthitic plagioclase (grainsize up to 100 mm, $An_{97.9}Or_{0.1}$, partially transformed to maskelynite) and olivine (mostly <50 mm, $Fa_{20.7}$, FeO/MnO = 76.9-94.5) accessory finer grained pigeonite ($Fs_{16.6}Wo_{9.7}$, FeO/MnO = 50), orthopyroxene, Ti-chromite and Ni-bearing troilite. Metal appears to be absent. Although this specimen seems to be a monomict breccia, the texture is heterogeneous, with some larger clasts (see Figures 3 and 4).

Figure 3. **(above)** *Plane polarized light image showing plagioclase clasts (white) in a very fine grained matrix* **(below)** *Partially cross-polarized light image of a different area. Both images 9 mm wide © T. Bunch.*



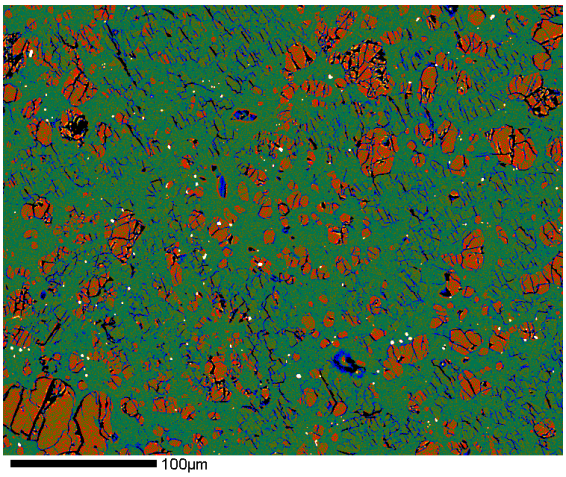
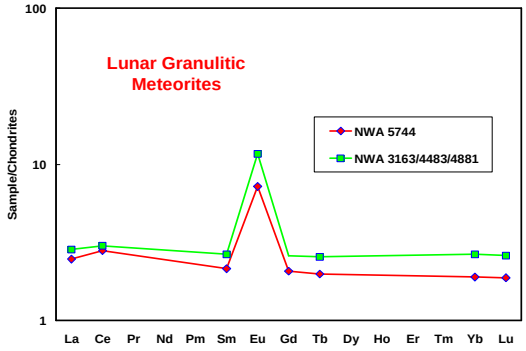


Figure 4. *BSE image showing recrystallized olivine grains (red-brown) in a matrix of mostly anorthitic plagioclase (blue-green) with Ti-chromite (white).*

Bulk Elemental Composition: Nine interior subsamples were analyzed by INAA (weighted mean given below). Major element analyses were conducted by electron microprobe (FB) on a fused 185 mg fragment, and by XRF on clean dust (totaling 2.1 grams, obtained during cutting of the type specimen):

	XRF	*FB*		*INAA*
SiO_2	42.90	43.9	Sc	8.5 ppm
TiO_2	0.17	0.17	Co	22.6
Cr_2O_3	0.15	0.14	Ni	100
Al_2O_3	21.56	22.83	La	0.91
FeO_T	6.46	5.71	Ce	2.4
MnO	0.09	0.08	Nd	1.7
MgO	12.98	12.68	Sm	0.45
CaO	12.95	14.03	Eu	0.56
Na_2O	0.24	0.25	Tb	0.10
K_2O		0.04	Yb	0.42
P_2O_5		0.03	Lu	0.062
SUM	97.50	99.86	Hf	0.28
Mg/(Mg+Fe)	0.782	0.798	Th	0.12
V	70 ppm		Ir	1.4 ppb



Discussion and Comparisons With Other Lunar Granulitic Rocks: Northwest Africa 5744 is distinctive not only because of its fine grained, granulitic texture but because of its very magnesian bulk composition (Mg/(Mg+Fe) ~ 0.79) – see Figure 6. Unlike most lunar highlands breccias of anorthositic to noritic or gabbroic compositions, NWA 5744 is much more olivine-rich (troctolitic). The low concentrations of Ni and Ir are consistent with the absence of metal. Recrystallized granulitic breccias are rare in the Apollo collection [1, 2], and are otherwise represented as meteorites only by Dhofar 026 [3] and the paired stones Northwest Africa 3163/4483/4881 [4, 5, 6].

Our preferred explanation of the petrogenesis of NWA 5744 is that an ancient troctolitic protolith was repeatedly comminuted by impacts to produce a thick ejecta sheet, which was subsequently recrystallized within the lunar regolith or megaregolith. The mechanism for this metamorphic transformation may have been subsurface selenothermal heat at several kilometers depth in the lunar crust, or else a long-lived post-impact thermal pulse in a very thick ejecta blanket.

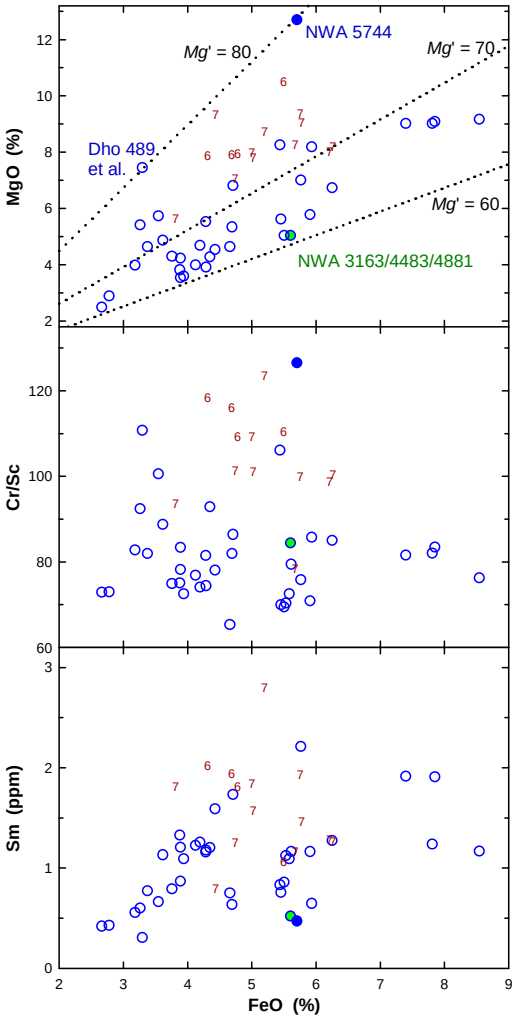


Figure 6. *NWA 5744 and Dhofar 489 et al. have the greatest MgO/FeO among feldspathic lunar meteorites (circles), but NWA 5744 is more mafic. Some granulitic breccias from Apollo 16 (6) and 17 (7) are magnesian, but less so than NWA 5744. Apollo granulites also tend to be richer in incompatible elements.*

Irrespective of these thermal models, the importance of NWA 5744 is that it reveals the existence of a new type of magnesian highlands lithology, which has important implications for lunar crustal evolution.

References: [1] Cushing J. et al. (2009) *MAPS* **34**, 185-195 [2] Hudgins J. et al. (2008) *GCA* **72**, 5781-5798 [3] Cohen B. et al. (2003) *MAPS* **39**, 1419-1447 [4] Irving A. et al. (2006) *Lunar Planet. Sci.* **XXXIX**, #1365 [5] Fernandes V. et al. (2009) *Lunar Planet. Sci.* **XL**, #2009 [6] Hudgins J. and Spray J. (2009) *72nd Met. Soc. Mtg.*, #5157.

Educational Website: A comprehensive website with information about lunar meteorites can be found at: http://meteorites.wustl.edu/lunar/moon_meterorites.htm.