

MINERALOGICAL AND PETROLOGICAL COMPARISONS OF DUAL-LITHOLOGY

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Introduction: EETA79001 is a dual-lithology shergottite discovered near Reckling Peak, Victoria Land, Antarctica during the 1979 ANSMET expedition [1]. It is composed of two main lithologies (termed A and B) separated by a linear, gradational, geologic contact [2]. Lithology A is an olivine-phyric shergottite, the first known sample of this subgroup, while lithology B is classified as a basaltic shergottite [3].

We report the major petrographic and mineral compositional differences between the two lithologies, using analyses of polished thin-and thick-sections. Thin-and thick-sections were cut from lithology A (79001, 616; ,439), lithology B (79001, 457; ,392), and at the boundary between A and B (79001, 615).

Table 1. Differences between the two Lithologies		
	Lithology A	Lithology B
Grain Size	finer grained	coarser grained
Texture	Porphyritic	non-porphyritic
Olivine	present as phenocrysts	no olivine
Chromite	present	no chromite
Pyx phenocrysts	Low-Ca cores (typically opx) and rimmed by pigeonite or augite.	no phenocrysts
Pyx groundmass	Ranges from low Ca-pigeonite to augite	Pigeonite cores zoned to augite or opx with some having Fe-rich pyx rims. New! Opx crystals found in 79001, 457
Maskelynite	Smaller Zonations	Larger Zonations
Modes	higher abundance of pigeonite	higher abundance of augite and maskelynite

General Differences: The major differences between the lithologies, based on petrography, are outlined in Table 1. *Lithology A is finer-grained than B and contains megacrysts of olivine, low-Ca pyroxene (typically opx), and phenocrysts of chromite.* In contrast, *lithology B is coarse-grained, non-porphyritic, and lacks olivine and chromite.* Each lithology also differs slightly in mineral chemistry.

Mineral Chemistry:

Pyroxenes

Pyroxene phenocrysts in lithology A typically have orthopyroxene cores rimmed by pigeonite or augite. The megacrysts range in composition between $Wo_{2-13}En_{50-79}$ and are similar in composition to those analyzed previously [5,6]; $Wo_{2-12}En_{58-82}$ and $Wo_{6-13}En_{42-73}$, respectively. Pyroxenes in the matrix of lithology A range in composition between pigeonite and augite ($Wo_{6-33}En_{40-69}$) and are also similar in composition to those previously analyzed ($Wo_{6-30}En_{50-73}$ [6]).

Pyroxenes within lithology B have Mg-rich pigeonite cores ($Wo_{6-13}En_{4-69}$), and are commonly mantled by augite and rimmed by Fe-rich pyroxene. Large pigeonite laths (up to 2 mm in length) occur in both lithologies. There is a greater affinity toward low-Ca pigeonite in the groundmass than reported by Steele and Smith [5] and Mikouchi et al. [6]. Orthopyroxene crystals of up to 1.2 mm in diameter have also been found in section 79001,457 (Lith B), a characteristic not reported previously.

Maskelynite

The maskelynites in both lithologies are zoned with Ca-content decreasing from core to rim, with a smaller range of Ca- zonation in lithology A than in B, e.g., $An_{48-63}Or_{0.7-1.7}$ and $An_{45-66}Or_{2.1-4.0}$, respectively. The data are similar to [5,6], however, the analyzed sections have a slightly larger range of An content.

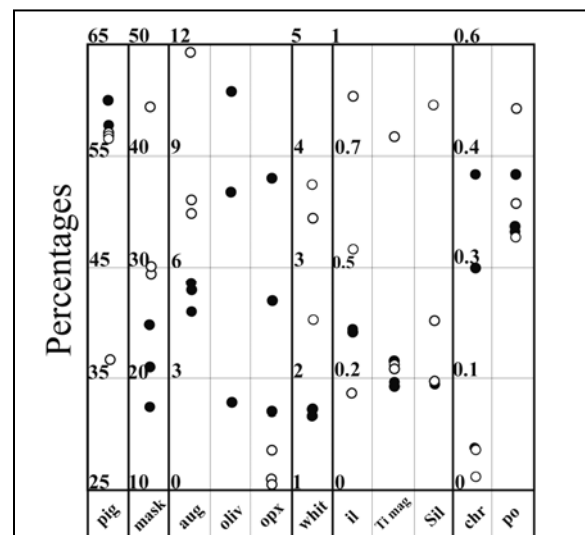


Figure 1. Modal abundances (vol %) of lithology A (solid circles) and B (open circles)

Modal analyses: Mineral modes of both lithologies are listed in Table 2. Maskelynite and augite increase in modal abundance from A to B, while pigeonite decreases (Figure 1), consistent with [2].

The averaged augite abundances (Fig. 1) for lithology B and whitlockite abundances of all the analyzed sections differ from those found in [2]. This may be due to the difference in modal analysis techniques. McSween and Jarosewich [2] used the optical point counting technique. Modes in our study were acquired using an Energy Dispersive Spectrometer coupled with an Electron Microprobe, the Feature Scan software developed by Oxford Instruments, and the procedure outlined by Taylor et al. [4]. Variations in modal abundances of the analyzed slides are summarized in Figure 1.

Grain Size: Grain-size measurements were determined optically by averaging up to twenty randomly selected crystals per mineral phase. The average of two perpendicular measurements per crystal was recorded. Grain-size results are reported in Table 3 along with

referenced values from [2]. Lithology B maskelynites and pyroxenes have a larger grain size than A. Chromites in the analyzed lithology A sections are smaller than published results by [2]. Also, the lithology A pyroxene groundmass has a smaller crystal size than lithology B pyroxene crystals.

Conclusion: **Lithologies A and B of EETA79001 show many differences in mineral chemistry, mineral modes, and crystal size. The five analyzed sections show similarities to previous work, however there are slight differences in mineral chemistry, modal variations and the presence of orthopyroxene crystals in lithology B, slide 79001, 457.**

References: [1] Meyer C. (2003) *The Mars Meteorite Compendium*. JSC #27672, IX1-IX26; [2] McSween H.Y. & Jarosewich (1983) *GCA* 47, No. 8, 1501-1513; [3] Goodrich C.A. (2003) *GCA* 67, No. 19, 3735-3771; [4] Taylor L.A., Taylor D., Chambers J. McKay D.S. (1996) *Icarus*, 124, 500-512; [5] Steele I.M. and Smith J.V. (1982) *JGR*, 87, A375-A384; [6] Mikouchi *et al.* (1999) *EPSL* 173, 235-256.

Table 2. Average Modal Abundances of Analyzed Sections

	pig	aug	opx	mask	oliv	whit	po	chr	sil	il	Ti-mag	opq
<u>Lithology A</u>												
This study	58.5	5.1	5.2	21.2	7.0	1.7	0.4	0.3	0.1	0.3	0.3	--
McSween and Jarosewich [2]	59.3	6.1	5.5	17.1	8.9	0.40	--	--	--	--	--	3.1
<u>Lithology B</u>												
This study	50.7	9.0	0.5	34.6	0.0	3.2	0.4	<0.1	0.5	0.5	0.5	--
McSween and Jarosewich [2]	39.5	20.0	0.00	29.1	0.00	0.37	--	--	--	--	--	3.5
Mineral Abbreviations: pig - pigeonite, aug - augite, opx - orthopyroxene, mask - maskelynite, oliv - olivine, whit - whitlockite, po - pyrrhotite, chr - chromite, sil - silica, il - ilmenite, Ti-mag - titaniferous magnetite, opq - opaques												

Table 3. Average Crystal Size Measurements

Mean Crystal Size (mm)	<u>Lithology A</u>				McSween and Jarosewich [2]		
	616 (A)	439 (A)	39 (A)	615 (A)	,75 (A)	,68 (A)	,79(A), 80(A)
Oliv pheno	1.16	1.18	0.91	0.69			
Opx pheno	0.77	0.77	0.50	0.52			
Pig pheno	0.58	0.96	0.69	0.95			
Pyx groundmass	0.25	0.27	0.31	0.32			
Mask	0.19	0.14	0.29	0.27			
Chromite	0.17	0.10	0.15	0.12	0.32	0.34	0.42
Oliv/Opx	1.51	1.52	1.83	1.32	2.70	3.30	3.60
Groundmass	0.24	0.24	0.36	0.36	0.14	0.15	0.15
*Sections 615, 79, and 80 contain both A and B lithologies							
Mean Crystal Size (mm)	<u>Lithology B</u>				McSween and Jarosewich [2]		
	39 (B)	615 (B)	457 (B)	392 (B)	,69 (B)	,71 (B)	,79 (B), 80 (B)
Mask	0.61	0.33	0.49	0.62			
Pyx	0.42	0.37	0.58	0.46			
Groundmass	0.62	0.40	0.71	0.46	0.37	0.30	0.28
*Sections 615, 79, and 80 contain both A and B lithologies							