Reference List

NWA5789 – 49 grams
Depleted Olivine-phyric Shergottite

"NWA5789 will help elucidate the igneous geology and geochemistry of Mars" Juliane Gross 2011

Figure 1: *Photo of a piece of NWA 5789 taken by S. Ralew. Cube is 1 cm.*

Introduction

NWA5789 is a fresh olivine basalt with a very fresh fusion crust (figure 1). Three pieces that fit together are known to exist. NWA5789 is ultramafic and has high Mg/Fe ratio in early-formed olivine and pyroxene. The initial Nd isotopes and the REE pattern group this sample with the depleted shergottites. Ages have not been reported.

Petrography

Irving et al. (2010) and Gross et al. (2010, 2011) have reported on the petrography of NWA5789. They report it has a porphyritic texture with numerous olivine megacrysts and smaller pyroxene, olivine phenocrysts set in a fine-grained crystalline mesostasis (figures 5, 6, 7). The interior of the rock appears very fresh (figures 2, 3, 4). The mesostasis consists of radiating sprays of plagioclase and pyroxene laths with minor silica, chromite, Fe-sulfide and merrillite (figure 7). Of the 19 % modal olivine, 14 % occurs as megacrysts (figure 4) with 5 % as phenocrysts (figure 3).

Mineralogical Mode of NWA5789

	Gross et al. 2011
Olivine	19 vol. %
Pyroxene	38
Oxides	1-2
Mesostasis	41

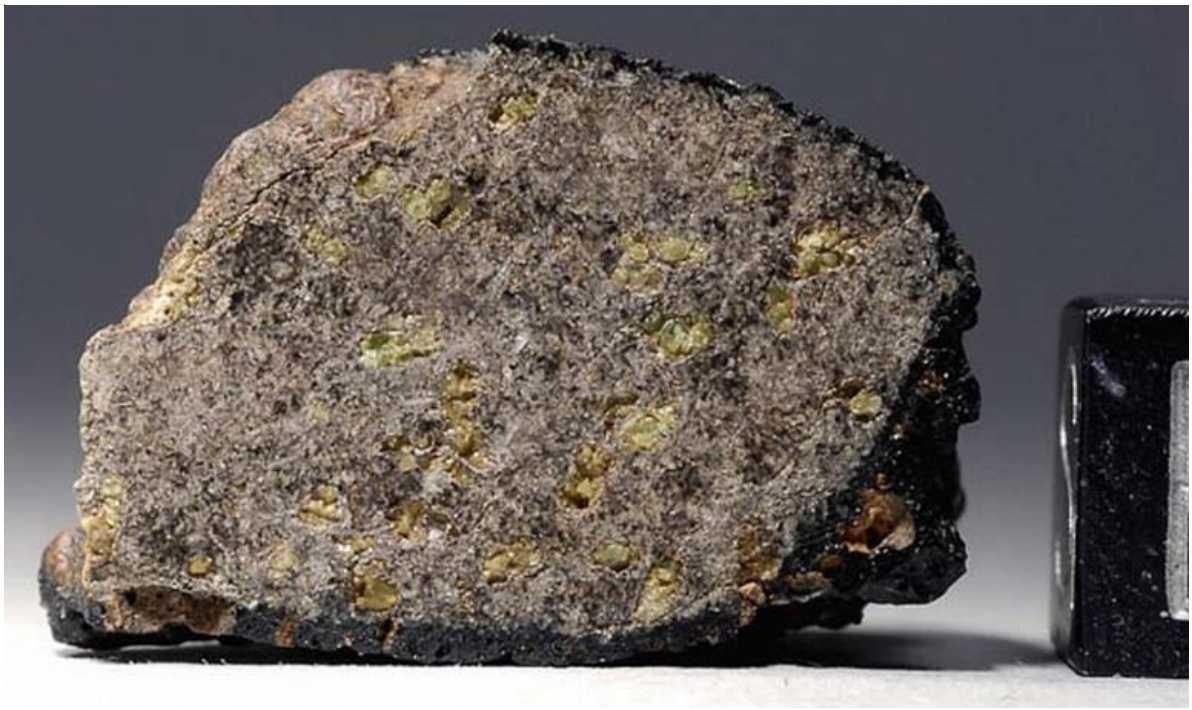

Figure 2: *Sawn surface of NWA 5789 (photo by S. Ralew).*

Figure 3: *Photo of cm sized piece of interior of NWA5789 (photo by G. Hupe).*

Figure 4: *1.6 g slab of NWA 5789 (photo by S. Ralew)*

Somehow, NWA5789 was launched from Mars without converting the plagioclase to maskelynite. Likewise, no shock-melt glass was observed.

Mineralogy

Olivine: Olivine megacrysts are up to 3 mm in size and have homogeneous cores (Fo_{84})(Gross et al. 2011). They include chromite and magmatic melt inclusions. Smaller, phenocrysts of olivine are zoned (figure 6).

Pyroxene: Phenocrysts of mafic orthopyroxene zone outward to pigeonite, then augite and finally Fe-rich pigeonite (figure 8).

Plagioclase: Plagioclase in NWA5789 occurs only as tiny radiating laths in the mesostasis (figure 7).

Chromite: Gross et al. (2011) reported analyses of chromite

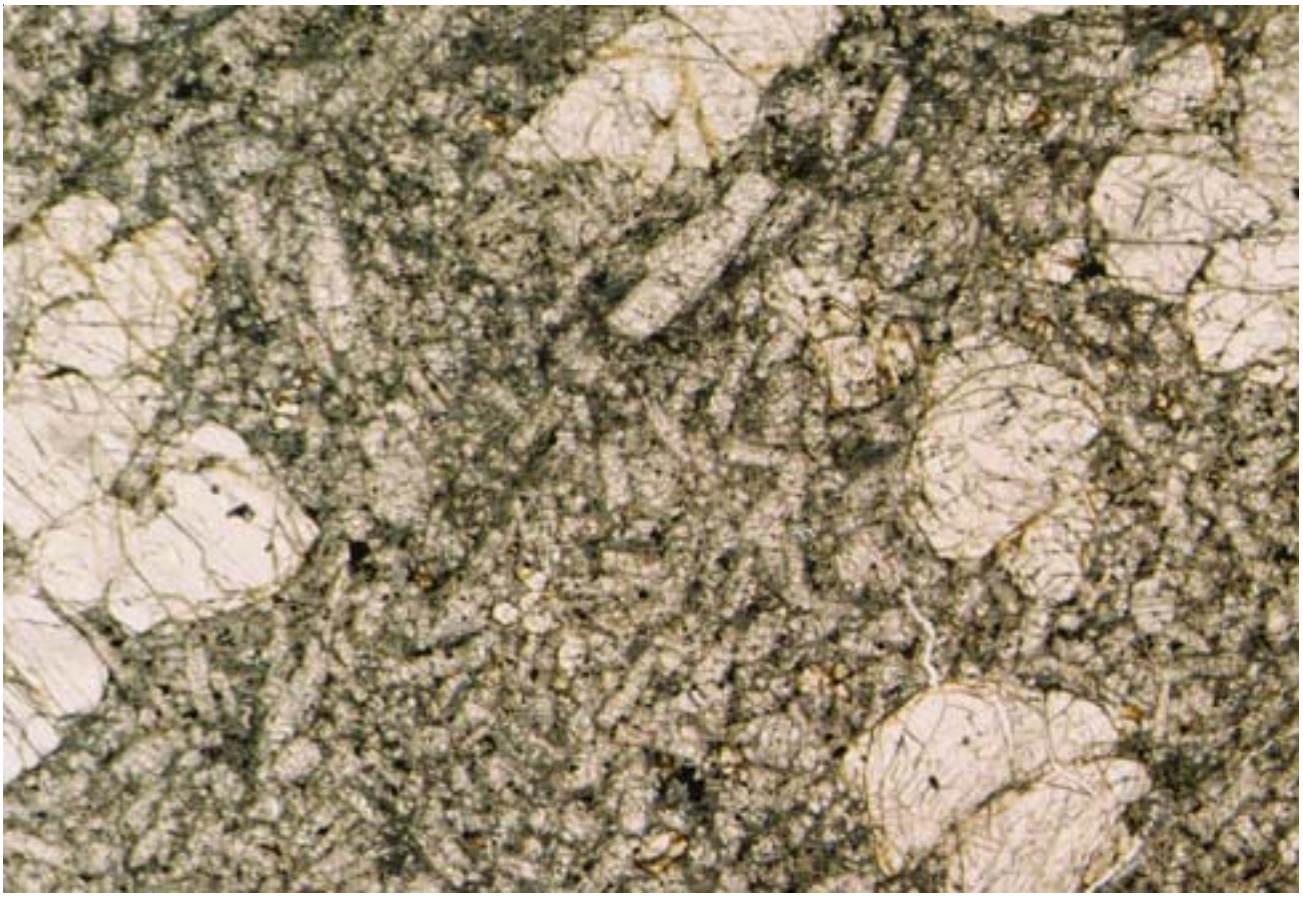

Figure 5: *Photomicrograph of thin section of NWA5789 (from Irving et al. 2010). Section is 9 mm across.*

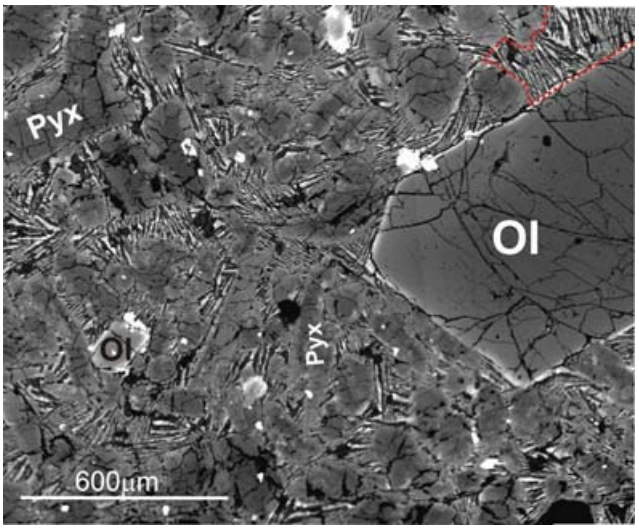

Figure 6: *BSE image of NWA5789 (Gross et al. 2010).*

Chemistry

The bulk composition of NWA5789 was reported by Irving et al. (2010) and has been confirmed by analyses of the fusion crust (Gross et al. 2011). Figure 9 compares the REE pattern for NWA5789 with other depleted shergottites.

Radiogenic age dating

Not yet

Cosmogenic isotopes and exposure ages

Not yet

References for NWA5789

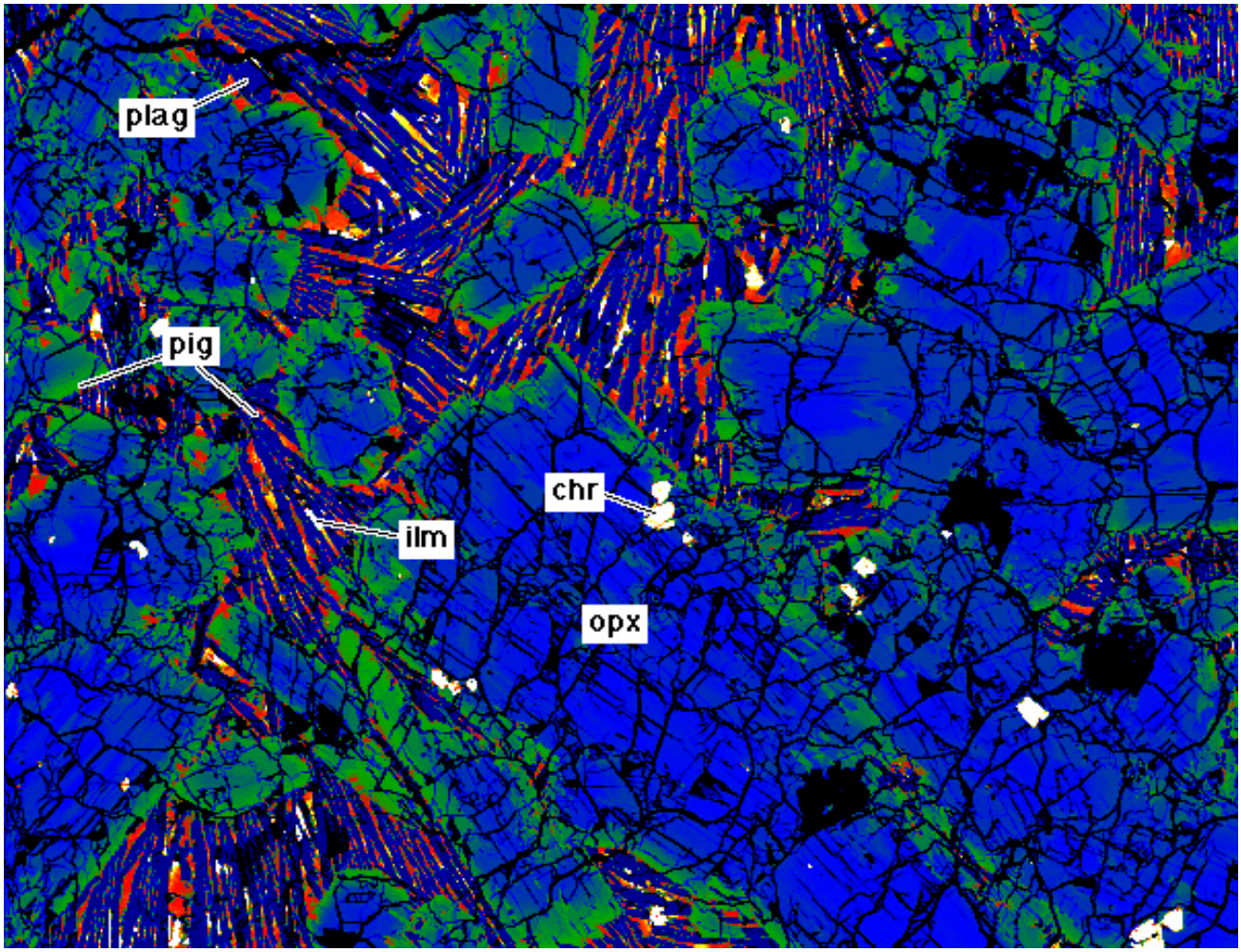

Figure 7: *Back-scatter-electron image of pyroxene phenocrysts in fine-grained groundmass of NWA5789 (from Irving et al. 2010).*

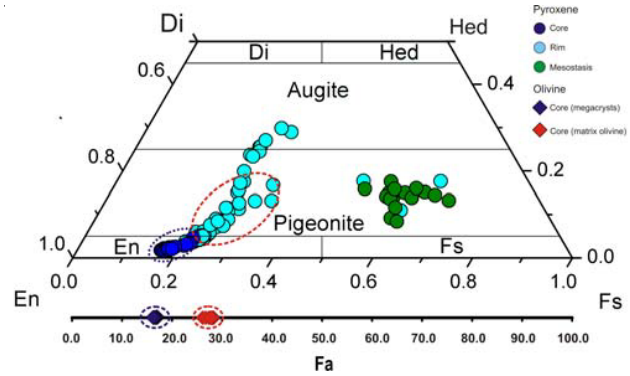

Figure 8: *Pyroxene composition of NWA5789 (Gross et al. 2010).*

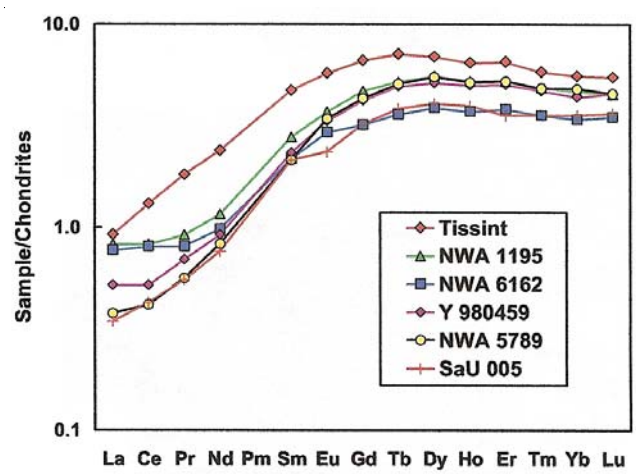

Figure 9: *Normalized rare-earth-element diagram for NWA5789 compared with other "depleted" shergottites (Irving et al. 2012).*

Table 1. Chemical composition of NWA 5789.

reference	Irving10		Gross11	
weight			fusion crust	
SiO2 %	48.57	(a)	49.24	(c)
TiO2	0.45	(a)	0.48	(c)
Al2O3	5.33	(a)	5.65	(c)
FeO	17.56	(a)	16.61	(c)
MnO	0.45	(a)	0.47	(c)
MgO	19.15	(a)	17.74	(c)
CaO	6.53	(a)	6.48	(c)
Na2O	0.69	(a)	0.43	(c)
K2O	0.02	(a)	0.02	(c)
P2O5	0.34	(a)	0.38	(c)
S %				
sum				
Sc ppm	35.1	(b)		
V	210	(b)		
Cr	5000	(a)		
Co	52.6	(b)		
Ni	210	(b)		
Cu				
Zn				
Ga				
Ge ppb				
As				
Se				
Rb	0.33	(b)		
Sr	24.9	(b)		
Y				
Zr				
Nb				
Mo				
Ru				
Rh				
Pd ppb				
Ag ppb				
Cd ppb				
In ppb				
Sn ppb				
Sb ppb				
Te ppb				
Cs ppm				
Ba				
La	0.12	(b)		
Ce	0.34	(b)		
Pr	0.068	(b)		
Nd	0.51	(b)		
Sm	0.43	(b)		
Eu	0.26	(b)		
Gd	1.15	(b)		
Tb	0.25	(b)		
Dy	1.81	(b)		
Ho	0.39	(b)		
Er	1.13	(b)		
Tm	0.159	(b)		
Yb	1.06	(b)		
Lu	0.15	(b)		
Hf	0.49	(b)		
Ta				
W ppb				
Re ppb				
Os ppb	5.4			
Ir ppb				
Pt ppb	1.6			
Au ppb				
Th ppm				
U ppm				

technique: (a) XRF, (b) ICP-MS, (c) emp