Northwest Africa 3136

Anorthosite-bearing basaltic (polymict) regolith breccia

95.1 g

Figure 1: Northwest Africa (NWA) 3136; approximately 5 cm wide (photo by G. Hupe).

Introduction

Northwest Africa (NWA) 3136 was found in Algeria or Morocco and purchased in April 2004 (Fig. 1). It is partially covered with a thin pale brown fusion crust, and a thin dark weathering varnish (Russell et al., 2005). The interior is dark and vitreous with white or yellowish clasts up to 0.5 cm in size (Fig. 2).

Figure 2: Slab cut of NWA 3136 illustrating the feldspathic nature of the sample (photo from R. Korotev).

Petrography, mineralogy, and chemistry

Lithic clasts in this breccia are comprised of mare basalt, mare micro-gabbro, and some norite and anorthosite clasts of highlands affinity (Russell et al., 2005; Kuehner et al., 2005; O'Donnell et al., 2008). Mineral clasts include plagioclase feldspar, pyroxenes, olivine, ilmenite, FeNi metal, troilite, and Cr-bearing ulvöspinel (Fig. 3). There are rare occurrences of pentlandite, baddeleyite, and zirconalite. Pyroxenes from many of the clasts follow the general trend exhibited by pyroxenes from low Ti or very low Ti basalts (Fig. 4), but there are a few clasts that follow a high Ti pyroxene trend, somewhat rare for lunar basaltic meteorites (Kuehner et al., 2005). Pyroxenes in general are more ferroan in composition (Fig. 4 and 5), with only one or two clasts from the study of Kuehner et al. (2005) showing compositions like highlands lithologies (Fig. 5).

The composition of NWA 3136 is clearly intermediate between basaltic and feldspathic lunar meteorites, with ~ 16 wt% FeO, 12.5 wt% CaO (Fig. 6). Thorium and Sc contents are similar to EET 87521/96006 (Fig. 7), but its Cr contents are significantly higher. Overall its composition is distinct from any other of the "mingled" lunar meteorites such as EET's or MET 01210 (Korotev and Irving, 2005). The meteorite is a heterogeneous, polymict breccia, that represents a regolith different from any in the Apollo collection (Korotev et al., 2009b). The non-mare component is mafic and feldspathic material is rare.

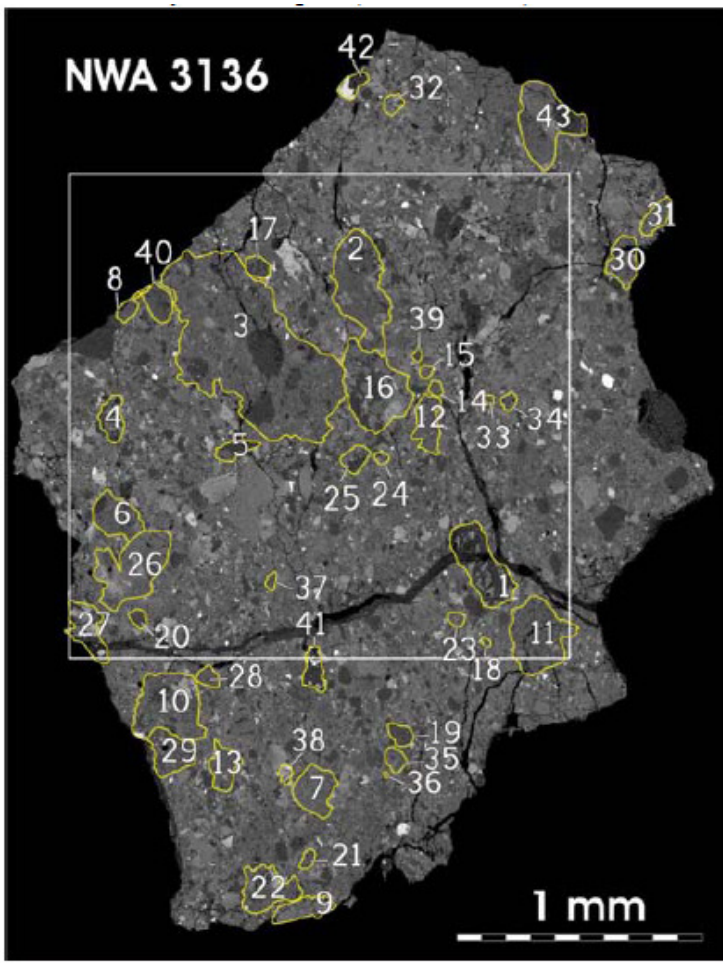

Figure 3: Back-scattered electron (BSE) mosaic of NWA 3136 showing diversity of clast types and sizes. (from O'Donnell et al., 2008).

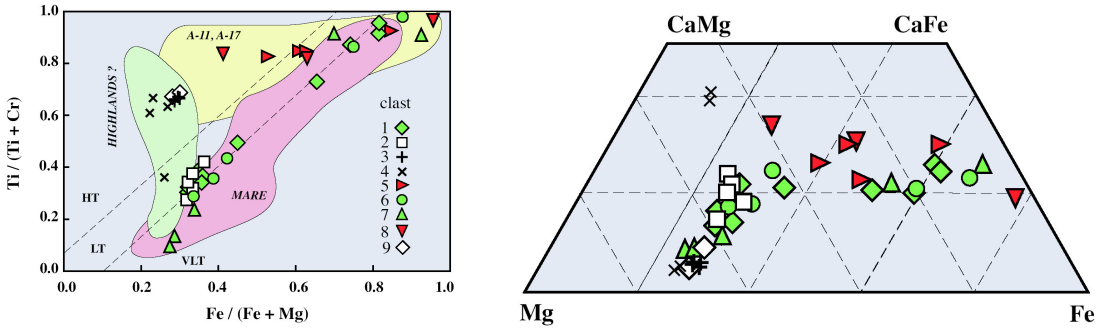

Figure 4: Pyroxenes from clasts 5 and 8 with Apollo 11 and 17 like trends (from Kuehner et al. (2005).

Figure 5: Pyroxene quadrilateral diagram for NWA 3136 (from Kuehner et al., 2005).

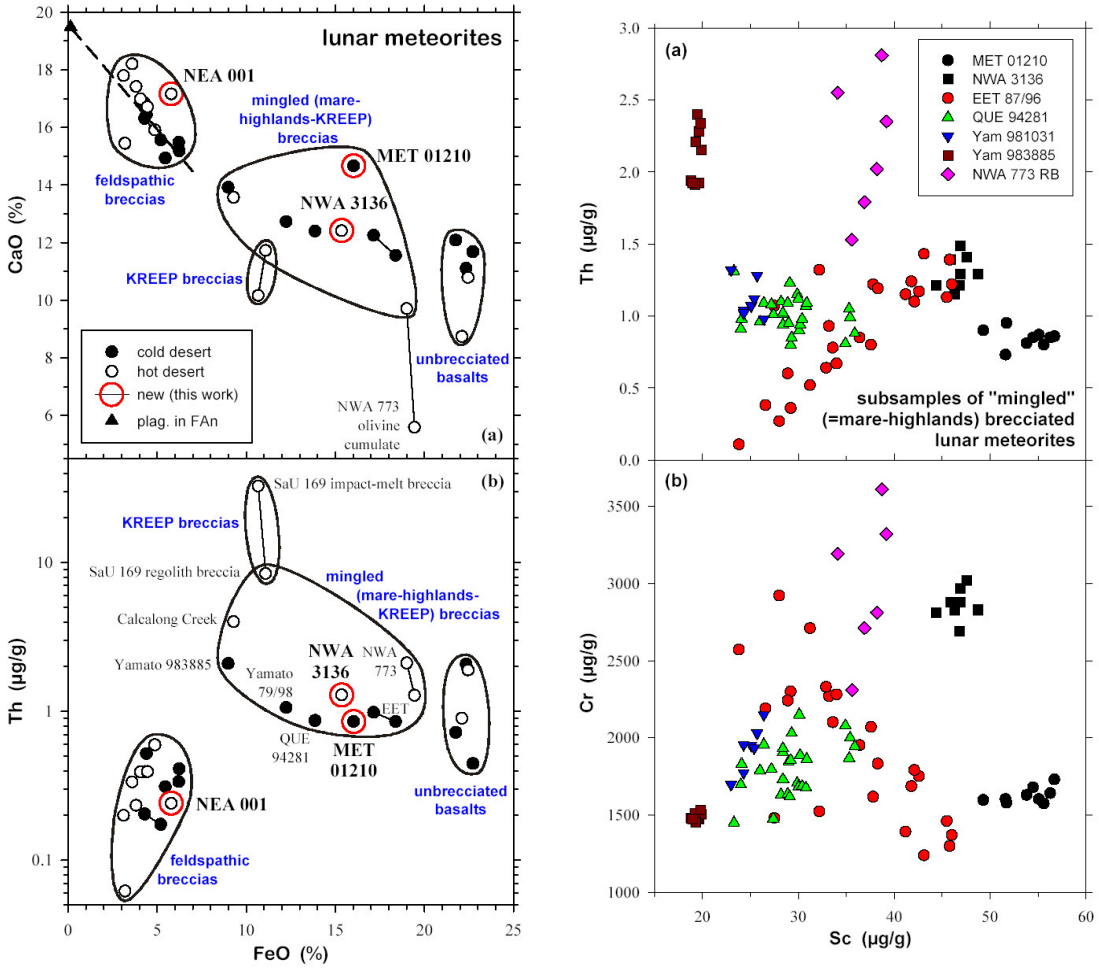

Figure 6: CaO, FeO and Th contents of several lunar meteorites including NWA 3136 (from Korotev and Irving (2005).

Figure 7: Cr, Sc, and Th contents of several lunar meteorites including NWA 3136 (from Korotev and Irving (2005).

Table 1a:Chemical composition of NWA 3136

reference	1	1
weight	20-60	230
technique	a	c
SiO_2 %	45.8	
TiO_2	1.23	
Al_2O_3	13.85	
FeO	15.36	15.36
MnO	0.25	
MgO	10.33	
CaO	11.7	12.4
Na_2O	0.3	0.295
K_2O	0.1	0.14
P_2O_5	0.06	
S %		
sum	99.5	
Sc ppm		46.6
V		
Cr		2860
Co		35.6
Ni		156
Cu		
Zn		
Ga		
Ge		
As		1.1
Se		<0.5
Rb		<6
Sr		150
Y		
Zr		100
Nb		
Mo		
Ru		
Rh		
Pd ppb		
Ag ppb		
Cd ppb		
In ppb		
Sn ppb		
Sb ppb		
Te ppb		
Cs ppm	0.13	
Ba	645	
La	7.67	
Ce	20.6	
Pr		
Nd	12.4	
Sm	3.86	
Eu	0.94	
Gd		
Tb	0.82	
Dy		
Ho		
Er		
Tm		
Yb	3.37	
Lu	0.476	
Hf	2.93	
Ta	0.343	
W ppb		
Re ppb		
Os ppb		
Ir ppb	6	
Pt ppb		
Au ppb	3.3	
Th ppm	1.29	
U ppm	0.37	

technique (a) EMPA, (b) ICP-MS, (c) INAA (d) XRF

Table 1b. Light and/or volatile elements for NWA 3136

Li ppm	
Be	
C	
S	
F ppm	
Cl	
Br	0.57
I	
Pb ppm	
Hg ppb	
Tl	
Bi	

References: 1) Korotev et al. (2009b)

Radiogenic age dating
No work has been reported yet.

Cosmogenic isotopes and exposure ages
No work has been reported yet.