Dhofar 733

Anorthositic granulitic breccia

98 g

Figure 1: Dhofar 733 as found in the Dhofar region of Oman in 2002 (photo from Classen). Scale at right is in cm.

Introduction

Dhofar 733 (Fig. 1) was found in the Dhofar region of Oman in November 2002 (Figs. 2 and 3). The meteorite is a brownish grey stone without fusion crust, and exhibits moderate weathering with gypsum, smectite and Fe hydroxides present on the outside and along fractures (Russell et al., 2003).

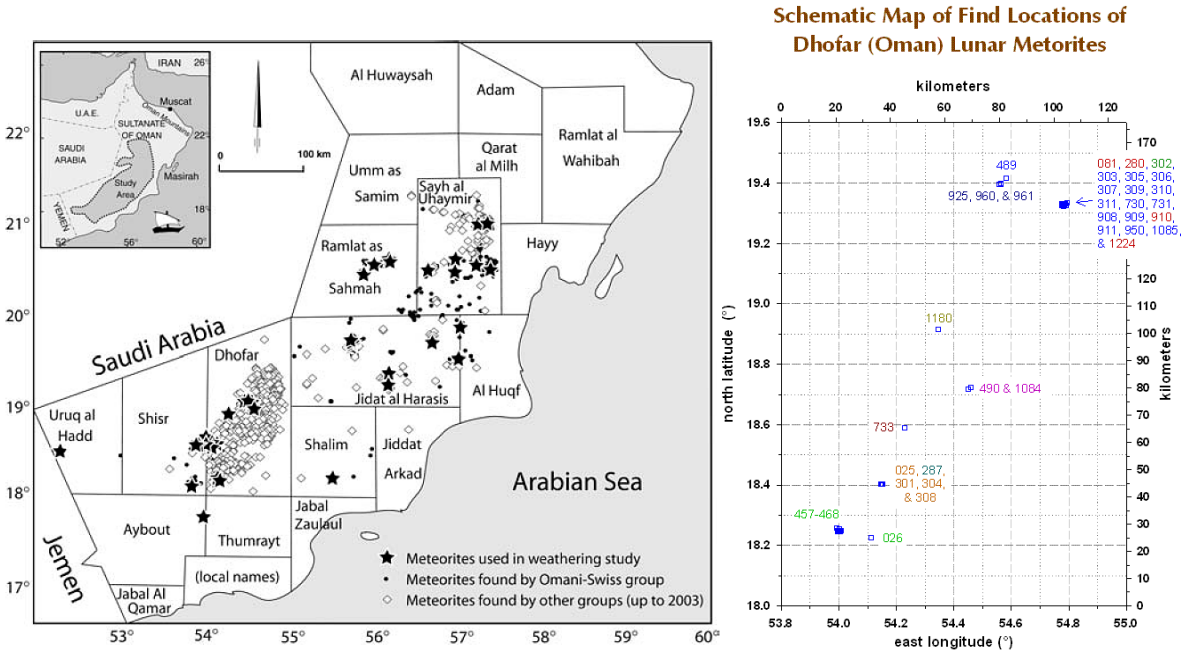

Figure 2 and 3: Location maps of the Dhofar region in Oman (from Al-Kathiri et al., 2005) and the specific coordinates for Dhofar 733 (purple just below center).

Petrography, mineralogy, and chemistry

This sample is fine grained and exhibits a granoblastic or poikiloblastic texture (Fig. 4) that includes lithologies such as anorthosite, troctolite, and gabbro-norite. Accessory phases include armalcolite, ilmenite, Al chromite, Ca phosphate, troilite and FeNi metal.

Its high Al_2O_3 and low FeO and Th contents (R. Korotev, Lunar Meteorite website) indicate that Dhofar 733 is a feldspathic highlands breccia without basaltic or KREEP components as also indicated by its feldspathic mineralogy. A distinctive feature of this meteorite is it's ~2x higher Na and Eu than normal feldspathic meteorites (Korotev, 2007; Foreman et al., 2008), consistent with its more albitic feldspar (An_{92}). Dhofar 733 does not derive from alkali anorthosites such as those of the Apollo 12 and 14 sites, which crystallized from a liquid rich in incompatible elements (Shervais and McGee, 1999) as products of the Procellarum KREEP Terrane (Foreman et al., 2008). Instead, Dhofar 733 is likely a product of the Feldspathic Highlands Terrane, and like Dhofar 489 and pairs, derives from a magnesian (troctolitic) anorthosite. But Dho 733 is more sodic than any observed before, and thus should provide another constraint for models of formation of the feldspathic crust of the Moon.

The low concentrations of siderophile elements on the other hand (Korotev, 2006) indicate that it formed at depth and did not inherit the high siderophile element concentrations expected if from shallower and in the regolith.

Figure 4: Cut slab face of Dhofar 733 illustrating its fine grained texture. Image from R. Korotev. Scale divisions are 1 mm.

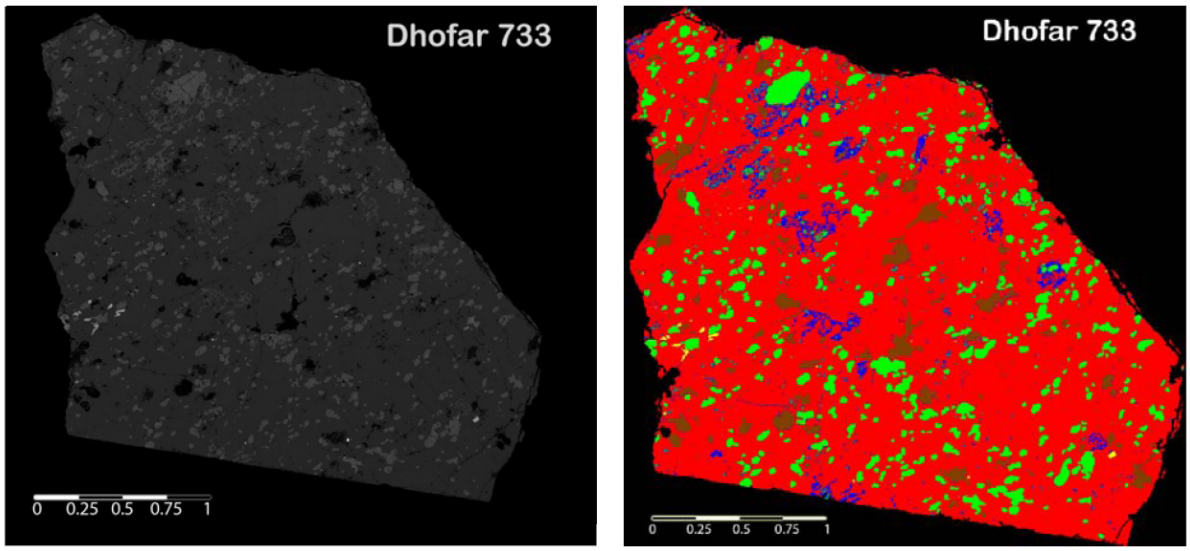

Figure 5: Back-scattered electron (BSE) mosaic of Dhofar 733 (from Foreman et al., 2008). Scale in mm. (b) False-color image of Dhofar 733. Red = Plagio-clase/Maskelynite, Green = Olivine, Blue = Pyroxenes, Yellow = Oxides, Brown = Fractures. Scale in mm.

Radiometric age dating

There are no known studies.

Cosmogenic exposure ages

There are no known studies.

Table 1: Chemical composition of Dho 733

reference	1	1	2
weight	32 mg	32 mg	1000
method	d	e	a,e,h
SiO_2 %	44.3		45.5
TiO_2	0.27		0.33
Al_2O_3	29.5		28.5
FeO	3.27		3.08
MnO	0.05		0.05
MgO	5.37		5.47
CaO	16.2		16.2
Na_2O	0.7		0.71
K_2O	0.04		0.03
P_2O_5	0.02		
S %			
sum	99.77		
Sc ppm		3.89	6
V			
Cr		171	300
Co		9.9	12.2
Ni		35	47
Cu			
Zn			
Ga			
Ge			
As			
Se			
Rb			
Sr		410	212
Y			
Zr		10	20
Nb			
Mo			
Ru			
Rh			
Pd ppb			
Ag ppb			
Cd ppb			
In ppb			
Sn ppb			
Sb ppb			
Te ppb			
Cs ppm			

Ba	90	297
La	1.58	1.2
Ce	3.66	3
Pr		
Nd	2.3	2.6
Sm	0.58	0.97
Eu	1.63	2.5
Gd		
Tb	0.109	0.17
Dy		
Ho		
Er		
Tm		
Yb	0.36	0.42
Lu	0.05	0.065
Hf	0.34	0.77
Ta	0.06	0.28
W ppb		
Re ppb		
Os ppb		
Ir ppb	1.3	1.3
Pt ppb		
Au ppb	5	43
Th ppm	0.104	0.6
U ppm	0.14	0.72

technique (a) ICP-AES, (b) ICP-MS, (c) IDMS, (d) FB-EMPA, (e) INAA, (f) RNAA, (g) PGA, (h) XRF

Table 1b. Light and/or volatile elements for Dho 733

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

References: 1) Foreman et al. (2008); 2) Demidova et al. (2007)