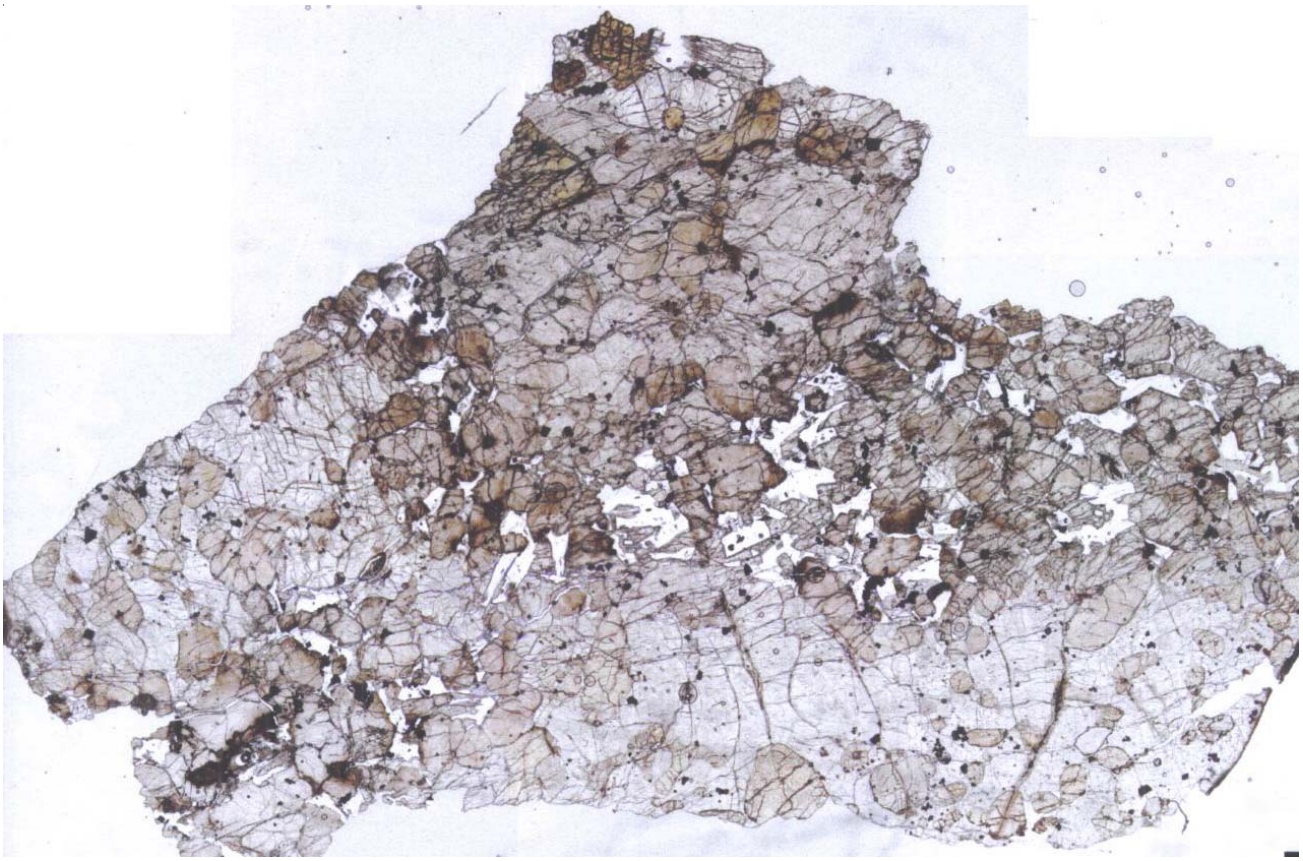
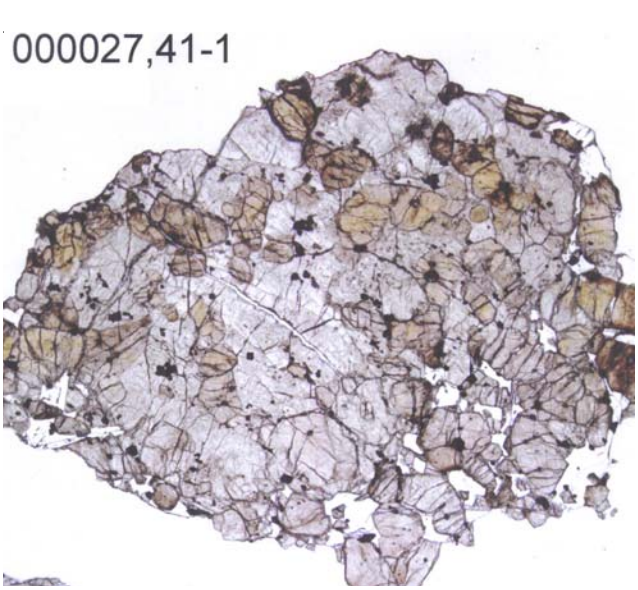
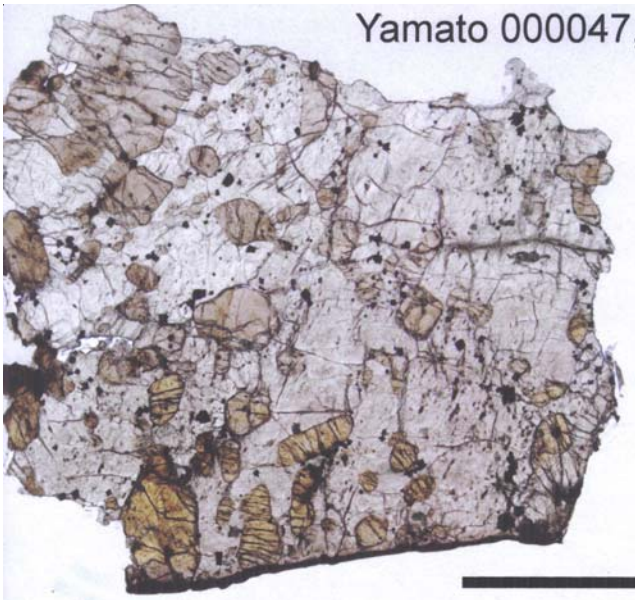
Reference List

Y000027 – 9.68 grams
Y000047 – 5.34 grams
Y000097 – 24.48 grams
Y984028 – 12.3 grams
Intermediate lherzolitic shergottite







Figures 1 a, b, c: Photomicrographs of thin sections of Y000097 (top), and Y000027 and Y000047 (all to different scale, but 97 is about 1 cm across). From Misawa and Kojima.

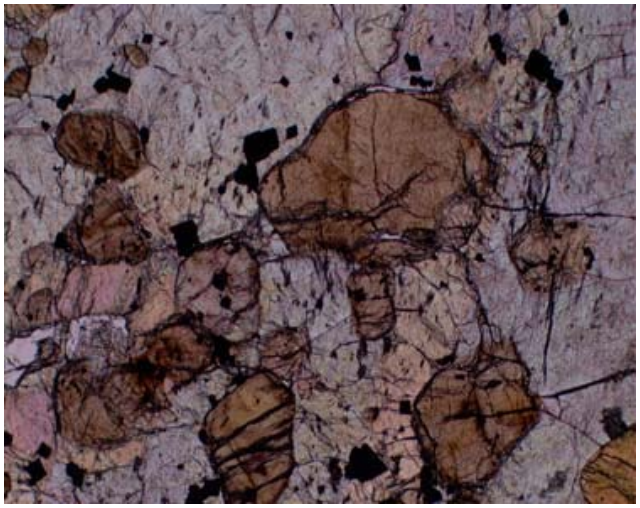


Figure 2: *Close-up of olivine phenocrysts in Y000027 (from Newsletter 14).*

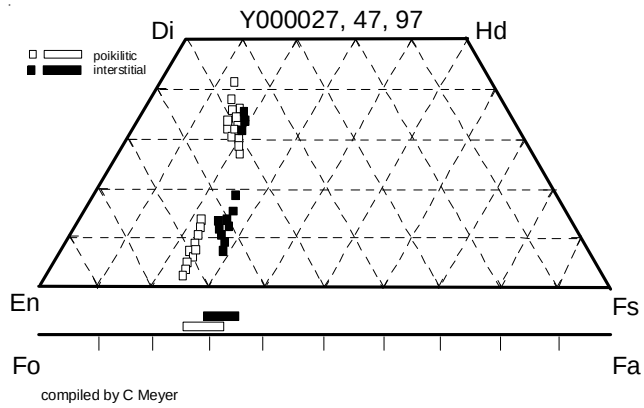


Figure 3: *Summary olivine and pyroxene composition diagram for poikilitic and non-poikilitic areas of Y000027, 47 ,97 (compiled from data by Mikouchi and Kurihara 2008 and Imae and Ikeda 2008, with appologies).*

Introduction

Yamato 000027, Y000047 and Y000097 were found in November 2000 on bare ice a few km north of the northern end of the JARE IV nunataks (Kojima 2006; Misawa et al. 2006). Mikouchi et al. (2009) found another piece. These small samples are considered "paired" because they have similar texture and were found in the sample place. Their distinctive poikilitic texture, rare gas signatures and oxygen isotopic composition prove they are Martian in origin. Their age is 189 m.y. and they spent about ~ 5 m.y. in space.

Petrography

Mikouchi and Kurihara (2007) and Imae and Ikeda (2007) describe Y000027, 47, 97 as poikilitic, lherzolitic shergottites. Regions of large poikilitic pyroxene (up to 8 mm) with smaller rounded olivine and chromite chadocrysts are separated by interstitial pyroxene and plagioclase (figure 1). Pyroxene crystals zone continuously from the poikilitic regions extending into the interstitial regions. The nonpoikilitic interstitial regions also contain ilmenite, merrillite, ulvospinel, Cl-apatite and sulfide. Apparently, there is a complete paper on the subject by Riches et al. (2011), *but this paper is inaccessible.*

Ikeda and Imae (2007) studied the magmatic inclusions found in olivine, pyroxene, chromite and ilmenite grains. Glasses found in these inclusions show a wide range of chemical composition. Kurihara et al. (2008) determined the reason why the olivine is "brown".

Mineralogical Mode of Y000027

	Poikilitic	Interstitial
Olivine	27 %	35
Pyroxene	69	55
Plagioclase		9
Chromite	tr.	9
Ilmenite		tr.
Pyrrhotite		tr.
Merrillite		tr.
Cl-apatite		tr.
Baddelyite		tr.

A 2 mm thick vein of shock melt penetrates Y000027. Imae and Ikeda (2007) identified high-pressure phases including "akimotoite".

Chemistry

Shirai and Ebihara (2007) found that the composition of Y000097 was similar to that of ALHA77005 and LEW88516. The light REE are depleted compared with the heavy REE (figure 4). These shergottites appear to be "intermediate" between enriched and depleted shergottites.

Radiogenic age dating

Misawa et al. (2008) and Shih et al. (2009) have dated the time of crystallization as 189 ± 18 m.y. by the Rb/Sr technique (figure 5). Park et al. (2010) found excess Ar.

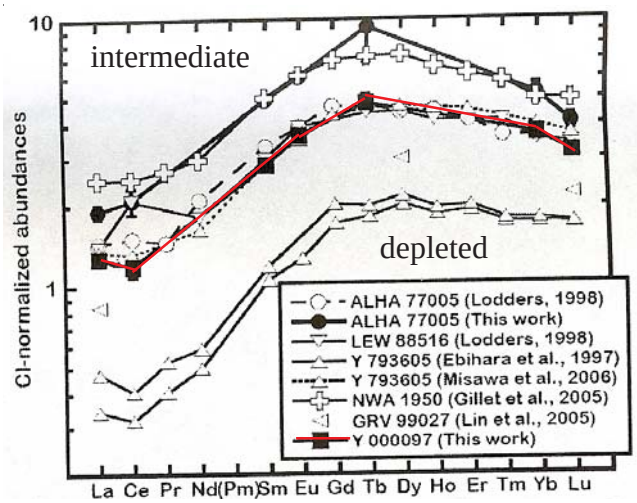


Figure 4: *Normalized REE patterns for Martian basalts with Y000097 in red (Shirai and Ebiharaa (2007).*

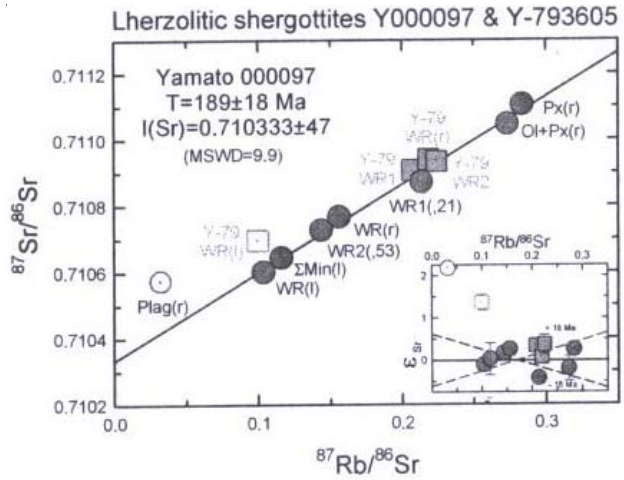


Figure 5: *Rb-Sr iscochron diagram for Y000097 (from Misawa et al. 2007).*

Cosmogenic isotopes and exposure ages

Nagao et al. (2007), Schwenzer et al. (2008) and Park et al. (2010) determined the composition and isotopic ratios of rare gases from Y000027 and 97 and determined an exposure to cosmic rays of 4.9 m.y.

Other Studies

Oxygen isotopes were reported by Misawa et al. (2006) and can be found in the Meteoritical Bulletin. Boctor et al. (2010) reported on H isotopes.

Hoffmann et al. (2007, 2008) studied the magnetic properties of Y000097.

Dyar et al. (2009) measured spectroscopic properties.

References for Y000027 etc.