NORTH WEST AFRICA 032 (NWA032): EVIDENCE FOR LUNAR VOLCANISM AT 2.80 GA

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Introduction: The recognition that some of the meteorites are lunar has significantly increased the opportunities for lunar research. Lunar meteorites may provide a more varied and less biased selection of lunar material. Thus far, a total of 28 lunar meteorites have been discovered. North West Africa 032 (NWA032) was found in the Sahara Desert on October 1999 (300 g). It is an unbrecciated mare basalt, and its mineralogy consists of phenocrysts of olivine (up to 12% vol.), pyroxene (up tp 5% vol.), and chromite in a groundmass of radiating pyroxene and feldspar crystals, and ubiquitous shock veins [1 and 2].

Samples and method: The ^{40}Ar-^{39}Ar dating technique has been applied to two different fragments (G and E) of NWA032 in an attempt to determine the crystallisation age and timing of any shock events experience by the meteorite. Samples G3 (14.073 mg), G4 (11.730 mg) and E2 (8.803 mg) were analysed by conventional furnace step-heating. Sample G2 was crushed into 20 subfragments for IR-laser single-shot gas extractions. By analysing smaller fragments (<0.1 mg), it was hoped that it would be possible to include fragments not containing shock glass.

Results: The ^{38}Ar/^{36}Ar ratios in all but the lowest and highest temperature steps, are very close to that expected for cosmogenic argon (1.54) and both samples contain negligible amounts of solar Ar. NWA032 is an unbrecciated interior sample of basalt and was therefore not exposed directly to solar wind Ar. The age spectra for samples of NWA032 are show in Fig.1. There is evidence for a small amount of ^{40}Ar loss at low temperature thereafter the apparent ages rise to a maximum of 3.3-3.5 Ga at 400-500°C accounting for 10-14% of the ^{39}Ar release. Apparent ages decline steadily to 2.4-2.8 Ga at intermediate release (30-60% ^{39}Ar release) before finally falling again at high temperature. The high ages at low temperature may result from: (1) recoil of ^{39}Ar from fine-grained K-rich plagioclase into K-poor pyroxene, which releases Ar at high temperature; (2) preferential retention of radiogenic argon in shock produced melt glass that is rapidly quenched [3]. Total Ar release ages for E and G are indistinguishable and give an average of 2.78±0.02 Ga. This is also consistent with the bulk K-Ar age of 2.9 Ga calculated using Ar and K abundances [4].

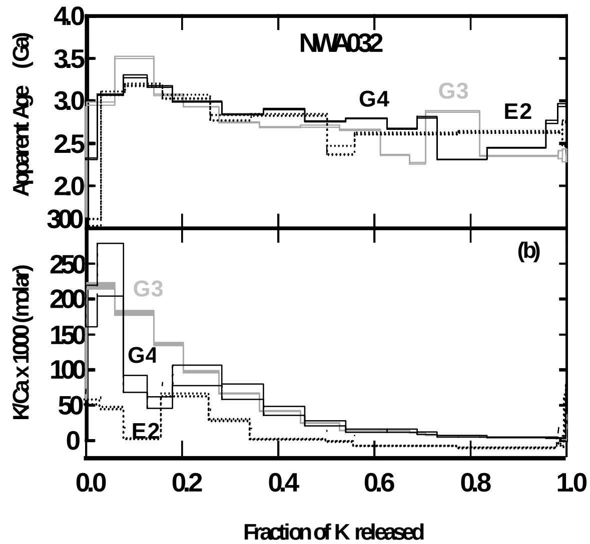

Fig.1 Ar-Ar step-heating results for samples G3, G4 and E2 of NWA 032: (a) Apparent ages and (b) K/Ca molar, vs Fraction K released.

The laser Ar-Ar results of the 20 sub-fragments of G2 show and age range of 2.45-2.86 Ga and an average age of 2.75±0.01 Ga, similar to the intermediate temperature steps of G3 and G4. Despite the smallness of the sub-fragments, the age determined is corresponding to bulk sample. Total ages of E and G fragments indicate an age of ~2.80 Ga which if interpreted as a crystallization age, would make NWA032 one of the youngest lunar basalt analysed thus far.

CRE-ages: Using the method of [5], we calculated a production rate of ^{38}Ar from calcium of 0.905 * 10-8 cm3STP/g/Ma, corresponding to exposure ages of 226 ± 12 Ma and 227 ± 13 Ma for G3 and G4 respectively, where errors are analytical precision and do not account for uncertainties in production rate.

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Refs.: [1] Fagan et al, 2000, MAPS 35 supp, A51; [2] Korotev, 2001, LPSC XXXII, abst# 1451; [3] McConville et al. 1988, GCA 52, 2487-2499.; [4] Fagan et al., 2001, in press. [5] Eugster and Michel, 1995, GCA 58, 177-199.