NORTH WEST AFRICA 773 (NWA773): AR-AR STUDIES OF BRECCIA AND CUMULATE LITHOLOGIES

V. A. Fernandes, R. Burgess and G. Turner, Dept. Earth Sciences, Univ. of Manchester, Oxford Rd., Manchester, M13 9PL, UK (e-mail: vfernandes@fs1.ge.man.ac.uk)

Lunar meteorites may provide a more varied and less biased selection of lunar material. At present there are relatively few detailed age data available for the 26 lunar meteorites that have so far been discovered. As part of a wider study of Ar-Ar age determinations of lunar meteorites, we present data for North West Africa 773 (NWA773) a 633g lunar meteorite found in the Dchira, Western Sahara in 2000 [1]. It was initially defined as a regolith breccia with a cumulate olivine gabbro [2], however more recently [3] described it has having two distinct lithologies: a VLT basaltic composition and clastic components; and a Mg-rich, olivine-rich cumulate clast lithology with trace-elements and signature similar to KREEP.

Samples and method: The ^{40}Ar-^{39}Ar dating technique has been applied to two different fragments in an attempt to determine the crystallisation age and timing of any shock events experience by the meteorite. Sample NWA773-1 (3.203 mg) is comprised of only olivine-rich cumulate, while NWA773-5 (10.876 mg) has two lithologies: olivine-rich cumulate; and a dark clast (e.g. impact breccia component) containing small cumulate fragments. Both samples were analysed by conventional furnace step-heating over the temperature range 300-1600°C

Ar-Ar ages: The two fragments have different contents of non-radiogenic ^{40}Ar: NWA773-1 has a negligible content, while NWA773-5 has a relatively high trapped component with $^{40}Ar/^{36}Ar_t$ value of ~1.3. Age spectra for NWA773 are shown in Fig.1a. In NWA773-1 the apparent ages rise to a maximum of 2.9 Ga at 500°C but accounting for only 5% of the ^{39}Ar release. Apparent ages decline steadily to 2.1 Ga at intermediate release (12% ^{39}Ar release), before rising again to a maximum of 2.9 Ga at higher temperature (50% of K release). The total age obtained by summing data over all the temperature steps is 2.66 ± 0.03 Ga. Because NWA773-5 showed the presence of trapped ^{36}Ar/^{40}Ar, both uncorrected (solid) and corrected (open) apparent age spectra are shown in Fig. 1a. The corrected age spectrum of NWA773-5 shows a similar pattern to NWA773-1; initially apparent ages increase from 2.6 Ga to 3.1 Ga at 500°C corresponding to 20% of the K release. The intermediate steps show a decrease in apparent age to 2.5 Ga, followed by an increase to a maximum of 3.1 Ga at high temperature. The total age for NWA773-5 is 2.94 ± 0.04 Ga, broadly consistent with the age obtained for the breccia.

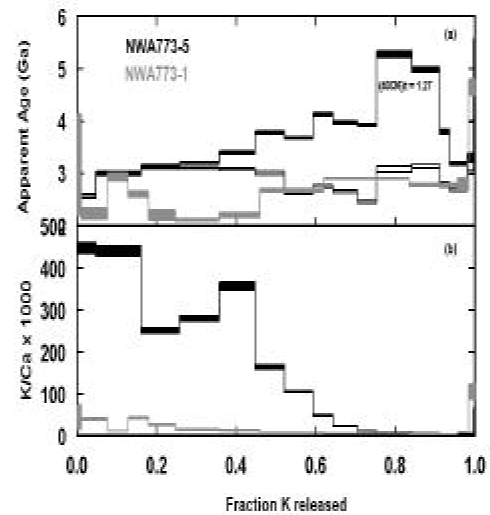

Fig.1 Ar-Ar step-heating results for samples NWA773-1 and NWA773-5: (a) Apparent ages and (b) K/Ca molar, vs Fraction K released.

There is a marked difference in K content between the samples with the cumulate fragment having a K content (404 ppm) three times lower than that of the breccia (1214 ppm) this is also reflected in the different K/Ca release patterns (Fig. 1b). The Ca content of the two samples are similar NWA773-1=5.1wt%; NWA773-5=7.4wt%.

CRE-ages: Using the method of [4], we calculate cosmic-ray exposure ages of 91±2 Ma and 177±3 Ma for NWA773-1 and NWA773-5 respectively, where errors are analytical precision and do not account for uncertainties in production rate. The lower CRE age of NWA773-1 suggests a deeper burial history of this component and is consistent with it containing negligible trapped Ar.

Summary. The Ar-Ar age of the cumulate lithology in NWA-773 is ~2.7Ga; the breccia component age is slightly higher, but this may not be significant because of the uncertainties introduced by correction for trapped Ar in this sample. It is noted that the age of NWA773 is similar to the Ar-Ar age of NWA032 (a mare basalt lunar meteorite) of 2.8 Ga [5].

Acknowledgements: This work was supported by the European Commission via a TMR fellowship to VAF and Fundação para a Ciência e a Tecnologia, Portugal.

[1] Grossman and Zipfel (2001) MAPS, 36, A293-322; [2] Fagan et al., (2001), MAPS 35, A55; [3] Korotev et al. (2002) MAPS 37, asbt# 5145; [4] Eugster and Michel (1995), GCA 58, 177-199; [5] Fagan et al. (2002) MAPS 37, 371-394