LUNAR METEORITES: SHOCK EFFECTS VS. ^{40}AR-^{39}AR AGES. V. A. S. M. Fernandes[1,2], J. P. Fritz[3], K. Wünnemann[3], U. Hornemann[4]; [1]CREMINER/LA-ISR, Univ. Lisbon , Portugal, veraafernandes@yahoo.com; [2]Univ. Manchester, Manchester, UK; [3]Museum für Naturkunde, Leibniz Institut an der HU-Berlin; [4]Ernst Mach Institut für Kurzzeitdynamik, Fraunhofer Institut, Germany.

Introduction: The moon recorded the impact flux since the early history of the solar system, and allows to deduce the lunar crater production rates; the most important chonological standart for dating planetary surfaces in the inner solar sytem. Lunar impact events can be dated by measuring different isotopic systems in rocks. In contrast to Sm-Nd and Rb-Sr ages which date the solidification of the rock (e.g. impact melt), the Ar-Ar dating technique can also determine the resetting ages of thermal events induced by impacts. These thermal/impact events can in some cases cause partial Ar-loss (affect only the low temperature steps of the Ar-release patterns). Therefore this dating technique can be applied to a broad range of rock types (not only impact melts). This is particularly relevant to the large number of lunar meteorites considered as more representative of the average lunar crust, compared to the Apollo and Luna mission samples which were limited to equatorial and nearside localities. Here we investigate on the influence of shock pressure and temperature on the Ar budget of lunar meteorites.

Methods: Shock reverberation experiments on calcium rich plagioclase (An_{94}) shocked to 20, 24, 28 and 36 GPa, respectively, were conducted at the Ernst Mach Institute in Freiburg [1]. The recovered samples were studied macroscopically, by optical microscopy, and Raman spectroscopy.

Results: Shock recovery experiments showed that calcium rich plagioclase (An_{94}) transformes into maskeynite at shock pressures >24 GPa. Using calcium rich plagioclase as an experimentally calibrated pressure barometer allows to determine the shock pressures recorded in lunar meteorites. As a preliminary result we present the optical properties of plagioclase in lunar meteorites and the deduced shock pressures in Table 1.

Partial and complete resetting of Ar-ages were determined by 1) measuring Ar-release during step heating experiments, and 2) compare the derived ages with literature data on crystallization ages obtained by other isotopic chonometers, including Sm/Nd, Pb/Pb Th/Pb, U-Pb. (Tab. 1) [2-14].

Discussion: Preliminary investigation show that 1) formation of maskelynite, e.g. in Asuka 881757 is not leading to a loss of Ar, and even impact melt bearing samples (EET 96008) are not completely reset. In co-trast partial or complet resetting of Ar ages were ob-served in some meteorites shocked to relatively low pressures of 22-25 GPa. This indicates that Ar loss is not a result of weak to moderate shock pressures. It appears that rock need to kept at elevated temperatures for extended times allowing for the diffusion of Ar. Different radiogenic ages in rock can be explained by a two stage cooling history, e.g exhumation by mega-impacts of hot deep seated crustual rocks onto the cool lunar surface, or reheating by a later emplacement of cool rocks into a hot ejecta blanket.

Table 1. Investigated lunar meteorites, including information on pertological type, shock metamorphic features, deduced shock pressures, and completely or partially reset Ar-ages.

Name	type	plag	shock pressure [GPa]	melt veins	reset Ar-age	partial loss
Asuka 881757	b	C	>25	Yes	No	No
Yamato 793169	b	B	22-25	Yes	No	Yes
MIL 05035	b	B	>25		No	Yes
LAP 02205	b	C	21-25	Yes	No	No
NWA 032/479	b				No	No
Dhofar 287-A	b	C	>25	Yes	Yes	-
NWA 2977	b	B	21–25	Yes		
EET 96008	bb				? (No)	

Type b = basalt, bb = basaltic breccia; shock features in plagioclase are A = birefringent, B = partially isotropic, and C = completely isotropic maskelynite.

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References: **[1]**Müller W. F and Hornemann U. (1969) Earth Planet. Sci. Lett., 1969; 3: 251-264; **[2]**Misawa et al. (1993) GCA, 57, 4687–4702; **[3]**Fernandes et al. (2009) MaPS 44, 805-821; **[4]** Torigoye-Kita el al. (1995) GCA,59, 2621–2632; **[5]**Nyquist et al. (2007) XXXVIII LPSC, abst. #1702; **[6]**Rankenburg et al. (2007) GCA, 71, 2120–2135; **[7]**Nyquist et al. (2005) XXXVI LPSC, abst.# 1702; **[8]**Anand et al. (2006) GCA, 70, 246–264; **[9]**Nyquist et al (2009) 72nd MetSoc, abst.# 5347; **[10]**Burgess et al (2007) XXXVIII LPSC, abst.# 1603; **[11]**Borg et al (2009) GCA, 73, 3963-3980; **[12]**Fernandes et al. (2003) MaPS, 58, 555-564; **[13]** Fernandes et al 2008, Goldschmidt abst.# A264; **[14]**Anand et al (2003) MAPS 38, 485-499.