NEW PB-ISOTOPIC CONSTRAINTS ON THE AGE OF THE MOON.

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Introduction: The lunar magma ocean (LMO) model remains the canonically accepted explanation for the magmatic differentiation of the Moon and the origin of the major suites of lunar rocks identified [1]. However, the formation age of Moon and the timing of LMO crystallisation remain unclear. A wide range of ages have previously been determined for rocks interpreted either as remnants of the primary anorthositic crust (Ferroan Anorthosites; FAN) or as products of early plutonic magmatism (the Mg- and Alkali Suite rocks). These ages, and the uncertainties associated with them, have led to the traditional LMO model being challenged in a number of recent studies [2-4]. We address this emerging controversy with a new set of Pb isotope data for a range of lunar basalts.

Analytical Techniques: The samples analysed included four mare basalts from the Apollo 11 and 12 missions (10044, 12038, 12039 and 12063) and two KREEP-rich basalts from the Apollo 14 and 15 missions (14072 and 15386). Initial characterisation of the samples included the acquisition of backscatter electron (BSE) images and energy dispersive spectroscopy (EDS) element. The Pb isotopic compositions of the phases (e.g. plagioclase, K-feldspar, K-rich glass, etc.) were determined with a CAMECA IMS 1280 ion microprobe at the NordSIM facility in the Swedish Museum of Natural History, Stockholm, using a methodology similar to that outlined in previous studies [5,6].

Results and Discussion: The data have been used to determine the following $^{207}Pb/^{206}Pb$ vs. $^{204}Pb/^{206}Pb$ isochron ages for each of the samples: 10044 – 3687±4 Ma; 12038 – 3242±12 Ma; 12039 – 3132±9 Ma; 12063 – 3194±10 Ma; 14072 – 3904±7 Ma; 15386 – 3885±73 Ma (all errors are stated at the 95% confidence limit). Furthermore, the range of Pb isotopic compositions measured has enabled us to calculate initial Pb compositions for the basalts. These values have been used to generate a two-stage model Pb isotope evolution for the Moon. Based on this model, the Moon could not be any younger than ~4475 Ma, and the Pb isotopic composition of the lunar interior would have begun evolving with a μ-value ($^{238}U/^{204}Pb$) of <400. This first stage of evolution finished at around 4400 Ma, potentially as a result of a significant magmatic event and/or the final stages of LMO crystallisation. After this, the evolution of the mare basalt and KREEP reservoirs diverged, and continued to evolve with μ-values of between 400-650 and 2500-3600, respectively.

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