A NUCLEAR PRODUCTION RATIO TH/U ≈ 0.96 FROM LUNAR AND TERRESTRIAL ROCKS: IMPLICATIONS FOR FUTURE LUNAR SAMPLE RETURN MISSIONS

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The nuclear rapid (r) neutron-capture process production ratio of the Actinides ^{238}U and ^{232}Th is an important parameter in nuclear physics and astronomy. Published Th-U-Pb and Re-Os data from Barberton komatiites in South Africa [1, 2] provide direct evidence for an ancient terrestrial component containing an undisturbed primordial Th/U signature, if the isotopes of ^{187}Re, ^{238}U and ^{232}Th were once produced in a singular r-process event shortly after the Big Bang 13.78 Ga ago [3, 4]. Under this reasonable assumption, which is consistent with a prevailing paradigm as to the origin of the heavy r-process elements [5, 6], the data point to more homogeneous nuclear production ratios ≈ 0.96 for ^{232}Th/^{238}U, Ir/Os and Re/Os, the ^{232}Th/^{238}U ratio varying only between 0.88 and 1.02. This agrees with results from nuclear theory for ^{244}Pu/^{238}U = 0.96 ± 0.21 [7]. If present ^{232}Th/^{238}U ≈ 4 and ^{197}Au/Ir ≈ 1 in lunar samples [8-10] were also due to the 13.78 Ga r-process event, it might be concluded that the moon and the earth are related to a common ancient r-process source reservoir. Concerning the sudden increase of heavy metals observed in terrestrial rocks between 3.5 Ga and 2.9 Ga [11], a gravitational core collapse ≈ 3.48 Ga and subsequent nucleosynthesis have been suggested as possible causes [4]. A proposed meteoritic veneer component [11] is in principle inconsistent with the robust ultra-subchondritic ^{187}Os/^{188}Os ratios known from Archaean rocks [3]. The ^{187}Os/^{188}Os evolution of the inner and outer core can be calculated using a nuclear production ratio ^{187}Re/^{188}Os = 5.873 at the time of any r-process event. There is currently no evidence that the moon has experienced a comparable (possibly Fermi-pressure controlled) core collapse or multiple r-process events. Hence, the moon could become an astrophysical reference as to pristine r-process isotope and element abundances or ratios, with far reaching consequences even for applications in astronomy, cosmology and nuclear or particle physics. Therefore and to enhance cross-correlations between different fields of science, it is suggested to consider these preliminary findings in any strategy which aims at sampling the moon in the course of future lunar sample return missions.

References: [1] Brévart O. et al. 1986. *Earth and Planetary Science Letters* 77:293-302. [2] Birck J. L. & Allègre C. J. 1994. *Earth and Planetary Science Letters* 124:139-148. [3] Roller G. 2015. *Geophysical Research Abstracts* 17: Abstract #2399. [4] Roller G. 2015. Spring Meeting AGU 2015: Abstract T34B-0407. [5] Marshall R. R. 1962. *Icarus* 1:95-111. [6] Suess, H. E. & Zeh, D. D. 1968. *Naturwissenschaften* 55:477-482. [7] Seeger P. A. & Schramm D. D. 1970. *The Astrophysical Journal* 160:L157-L160. [8] Morgan J. M. et al. 1973. *Proceedings of the 3rd Lunar Science Conference* 2:1377-1395. [9] Wänke H. et al. 1977. 8th Lunar & Planetary Science Conference. pp. 973-975. [10] Laul J. C. et al. 1978. *Proceedings of the 5th Lunar Science Conference* 2:1047-1066. [11] Maier W. D. et al. 2009. *Nature* 460:620-623.