Production of chromium isotopes by galactic cosmic rays in lunar samples: Characterisation of exposure dependence using noble gases

P. MORINO[1], M. SCHÖNBÄCHLER[1], H. BUSEMANN[1]

[1]Institute of Geochemistry and Petrology, ETH Zürich, Switzerland (*correspondence: precillia.morino@erdw.ethz.ch)

Nucleosynthetic isotope variations are powerful tools to track genetic relationships between solar system objects. Variations of Cr isotopes in solar system materials are widespread and well-characterized. Thus, measuring Cr isotope compositions of lunar samples and comparing them to terrestrial and meteorite data might be key to determine the origin of the impactor that caused the formation of the moon [1].

However, most lunar samples were exposed to galactic cosmic rays (GCR), which can alter the initital Cr isotope composition. Consequently, the measured Cr isotope data might need correction for these effects [2]. While the GCR contribution to Cr was previously attributed mostly to spallation of Fe [2], a recent study [3] proposed that the Cr isotope composition is strongly modified by neutron capture reactions. Hence, Cr isotope ratios in lunar rocks are likely modified by a complex combination of both, depending on their Fe/Cr ratio, shielding conditions and exposure age. Distinct cosmogenic contributions can be determined through noble gas analyses, because ^{3}He, ^{21}Ne, and ^{38}Ar are products of spallation, while ^{80,82}Kr and ^{128}Xe variations are also produced by neutron capture on ^{79,81}Br and ^{128}I [4,5]. To assess the cosmogenic Cr production, we have been obtaining a combined dataset of ultra-high precision Cr isotope data (< 5 and 7 ppm for ε^{53}Cr and ε^{54}Cr, respectively), and noble gas compositions for 18 lunar samples (14 basalts, 2 anorthosites, 1 norite and 1 soil sample). All noble gas compositions were already measured at ETH Zürich. The Cr isotope measurements are being carried out on the same lunar sample aliquots to allow robust GCR corrections. Results and implications will be presented at the conference.

[1] Akram & Schönbächler (2016), *EPSL* 449, 302–310. [2] Leya et al. (2003), *GCA* 67, 529–541. [3] Mougel et al. (2018), *EPSL* 481, 1–8. [4] Marti et al. (1966), *ZNA* 21, 398-426. [5] Hohenberg et al. (1978), *LPSC* 2, 2311-2344.