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# Deciphering mantle vs magma degassing in 3 Ga-old lunar basalts using halogen (F, Cl, Br and I) contents and Cl isotopes

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Phosphates are relatively common in lunar basaltic rocks and their halogen contents and Cl stable isotopes (expressed as $d^{37}Cl$: $d^{37}Cl = [(^{37}Cl/^{35}Cl)_{Sample}/(^{37}Cl/^{35}Cl)_{SMOC} - 1]*1000$) have been the focus of many investigations aiming to assess the volatile inventory in the lunar interior [1,2]. High $d^{37}Cl$ values determined in lunar phosphates have been interpreted in terms of mantle source composition as the contribution in the chemical characteristics of lunar basalts of a KREEP component with particularly high $d^{37}Cl$ values [3, 4]. Nevertheless, there are no $d^{37}Cl$ values measured in the 3 Ga-old lunar basalts which are potentially not contaminated by KREEP material. Therefore, the hypothesis of a KREEP component with high $d^{37}Cl$ values involved in the mantle sources of the lunar basalts is not fully established. Furthermore, other processes including, magmatic or impact-related degassing could produce high $d^{37}Cl$ values [5, 6, 7]. To tackle this issue, we have determined the halogen (F, Cl, Br, I) contents and $d^{37}Cl$ in phosphates from the 3 Ga-old lunar meteorite Northwest Africa (NWA) 4734. Our new data determined in situ by SIMS show a first order trend (decreasing I/Cl an Br/Cl with increasing $d^{37}Cl$) interpreted as evidence of heavy halogen (Br and I) degassing while apatite was crystallising in a magma body. A second order trend with increasing F/Cl correlated with increasing $d^{37}Cl$, is observed between the data field of the depleted low-μ basalts and the data field of the NWA 4734 apatites. Such a trend cannot be explained by a mixing between a KREEP-like mantle component and a low-μ (depleted-like) mantle component but is rather interpreted as a degassing trend affecting the mantle while exposed to vacuum.

**References:**

[1] Barnes et al. (2016), *EPSL* 447, 84–94.
[2] McCubbin et al. (2011). *GCA* 75, 5073–5093.
[3] Boyce et al. (2018). *EPSL* 500, 205–214.
[4] Potts et al. (2018). *GCA* 230, 46–59.
[5] Barnes et al. (2019). *GCA* 266, 144–162.
[6] Gargano et al. (2020) *PNAS* 117, 23418–23425.
[7] Gargano et al. (2022). *Am. Min.* 107, 1985–1994.