Lunar degassing and basalt effusions

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Degassing of cosmic bodies starts with their warming up. Moving in keplerian non round orbits with alternating accelerations body warms up itself. Ancient thick anorthosite lunar crust and underlying mantle degas in planetary scale. Its traces remain in thin lunar atmosphere and composition of the anorthosite crust. Highly hydroxyl apatite, phosphorus in composition of apatite and some olivines (upto 0.5% P_2O_5 in olivine and 0.3-2.0% P_2O_5 in KREEP basalts) witness this process. Highland rocks anorthosite-norite-troctolite series unreached with incompatible elements could be related to assimilation of KREEP-rocks or with superposed metasomatic processes [1]. Anorthosite regions with enriched alkali metals also witness about their treatment by warm fluxes with alkalis. Ancient regions with the KREEP-basalts also witness this (K, P,TR). The main mass of basalts in the Marea was emplaced later. Thus, the question of origin of volatiles and water in the Moon (impacts or degassing) remains open. We prefer to consider their main origin as degassing products in course of constant slow body warming. The basalt flows have the same origin but appear later when temperature was enough for melting.

It is interesting that in Earth in limits of ancient cratons occurrence of alkali massives is typical (the Kola Peninsula, Norway, Greenland, the southern Africa) with Proterozoic-Paleozoic ages. This age is older than age of oceanic and cover basalts. This speaks about volatiles and alkalis emplacement from the mantle before origin of Mesozoic basalt melts. In some respect, one could compare this Earth's process with origin of lunar ancient KREEPs and enriched with K and P anorthosite –troctolite rocks.

Planetary degassing of Moon and Earth precedes massive melts and effusions of basalts. Earth that is more massive overall warms later than less massive Moon. Mass difference of them is about 82. This corresponds to difference in time of warming [2]

References**:** [1] Демидова С.И., Аносова М.О., Кононкова .Н.Н. и др. Фосфорсодержащие оливины лунных пород: источники и их локализация в лунной коре //Геохимия, том 64, №8 (2019),стр. 803-825 (In Russian) [2] Kochemasov G.G. Regular wave tectonics of the Moon// B.Cudnic (ed.) Encyclopedia of Lunar Science, Springer International Publishing AG, part of Springer Nature 2018. https://doi.org/10.1007.978-3-319-05546-6_121-1