A LUNA 20 TROCTOLITE FRAGMENT WITH P-BEARING OLIVINE: A MISSING COMPONENT?
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Introduction: P-bearing mineral phases in lunar rocks are mainly phosphates (merrillite and apatite) and rare schreibersite as well. However, it can be suggested that P may be concentrated in lunar olivines as well because some terrestrial olivines of mafic and ultramafic rocks contain P in significant abundances [1,2]. Indeed, rare grains of P-bearing olivine were documented in the Dhofar 961 lunar meteorite [3]. Here we report on a first find of P-bearing olivine in a pyroxene troctolite fragment from the Luna 20 site.

Methods: A polished thick section containing 60 (100-600 µm in size) fragments of the Luna 20 soil was studied using optical microscopy. Chemical composition of mineral phases was measured using Cameca SX100 microprobes in Vienna and Moscow.

Results: The pyroxene troctolite fragment (200x380 µm) has a primary igneous coarse-grained ophitic texture (Fig.1). Olivine (35 %) and minor pyroxene (4%) occur between plagioclase laths (60%). Minor silica, phosphate, ilmenite, Ca-Fe pyroxene and baddeleyite are present in a late-stage K-rich mesostasis. Plagioclase is An92-95. Pyroxene varies in composition from pigeonite to augite (En50-73 Wo7-36). Olivine (Fo76-81) contains 0.2-0.3 wt.% Cr2O3 and up to 0.4 wt.% P2O5. P is unevenly distributed in the olivine grains.

Discussion: For example, it has been demonstrated [4] that olivine containing 0.3 wt.% P2O5 crystallizes from a silicate melt with bulk P2O5 content of about 1 wt.% or higher. Such P-rich melts are not common among lunar rocks. The highest P contents were reported in KREEP basalt 15386,1 and cataclastic granite 15434,10 (0.7 and 1.3 wt.% of P2O5 respectively) [5,6]. KREEP material is generally related to Mare Imbrium and it is extremely rare in the Luna 20 regolith [7]. In Luna 20 lithic fragments, the highest P contents were reported from high alumina basalts (up to 0.2 wt% P2O5) and rare ANT rocks (up to 0.4 wt% of P2O5) [8]. In our study of Luna 20 rocks we found only one impact melt fragment that has 1.3 wt% P2O5. Interestingly, olivine of the fragment does not contain any P in detectable concentrations. This finding suggests that P enrichment of lunar olivine should take place under more or less equilibrium conditions by slow cooling.

Conclusion: The investigation implies that (1) olivine fractionation could control the P content of lunar melts, and (2) in addition to KREEP basalts there could be another source rock for P in the Luna 20 landing site.

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