

A LUNA 20 TROCTOLITE FRAGMENT WITH P-BEARING OLIVINE: A MISSING COMPONENT?S. I. Demidova¹, M. A. Nazarov¹, K. M. Ryazantsev¹, N. N. Kononkova¹, F. Brandstätter², and Th. Ntaflos³¹Vernadsky Institute of Geochemistry and Analytical Chemistry, Kosygin St. 19, Moscow 119991, Russia, demidova.si@yandex.ru; ²Natural History Museum, Burgring 7, 1010 Vienna, Austria; ³Department für Lithosphärenforschung, Universität Wien, Althanstrasse 14, 1090 Wien, Austria.

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 (En₅₀₋₇₃Wo₇₋₃₆). 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.

Acknowledgments: This study was supported by Russian Academy of Sciences (Program №7) and RFBR grant 16-05-00695.

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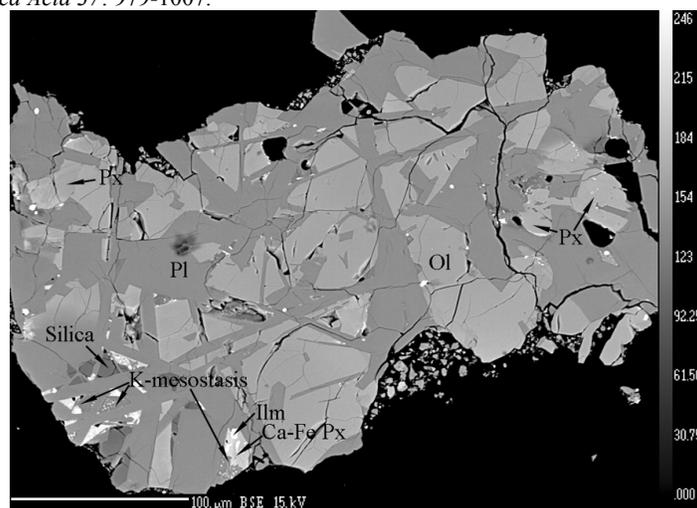


Fig.1. The pyroxene troctolite fragment of Luna 20