ELECTRON PETROGRAPHY OF LAMELLAR Ca, Cr-SYMPLECTITES IN OLIVINE FROM THE 'LUNA-24' REGOLITH

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Optical observartion showed [1] that individual olivine grains from the Luna-24 regolith contain Cr- and Ca-rich lamellae of 0.5-1 μm thick oriented parallel to the (100) of the host olivine (fig. 1).

Fig.1. Optical image of Ca,Cr-lamellae in the olivine grain from the "Luna-24" regolith

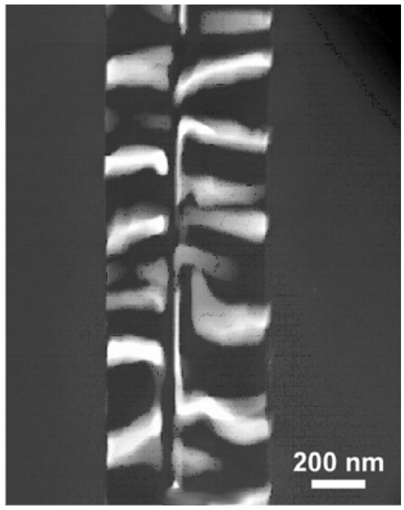

Fig.2. Dark-field TEM image of Ca,Cr-lamellae. Black and white platelets are diopside and chromite, correspondingly

Alternating platelets of diopside and chromite ~40 nm and ~130 nm thick, respectively, are oriented normal to the (100) olivine/lamellae boundary, with $(100)_{Ol}$ // $(111)_{Sp}$ //$(100)_{Cpx}$; $[001]_{Ol}$ // $[011]_{Sp}$ // $[010]_{Cpx.}$ The bulk mineral composition of the lamellae is close to $FeCr_2O_4 + 2CaMgSi_2O_6$. Lamellar symplectites are rare to occur. They were described in olivine from some terrestrial rocks [2, 3] and a Martian meteorite [4]. No detailed investigation of Cr,Ca-rich lamellar symplectites in lunar olivines has ever been done. The study shows that (i) the symplectitic lamellae in olivine have been formed by a solid-state reaction; (ii) subsolidus $Cr^{2+} \rightarrow Cr^{3+}$ oxidation and 2Mg = Cr + Ca cation exchange reaction were related to the symplectite formation (fig. 3).

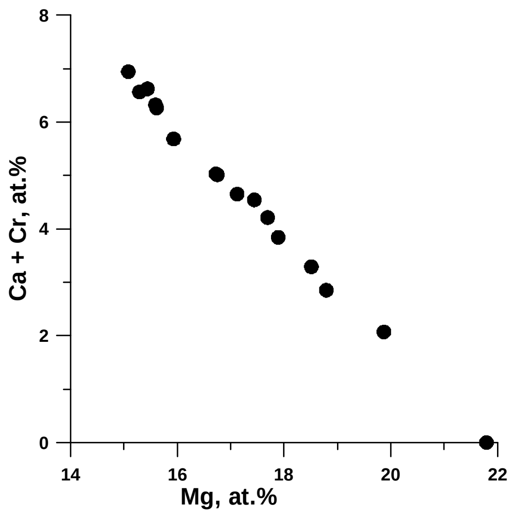

Fig.3. The correlation of Mg versus (Ca + Cr). EMPA data for olivine + lamellae. The point at (Ca + Cr) =0 corresponds to the host olivine composition

Chromite and diopside are probably the breakdown products of some pre-existing phase of $Ca_2\square_{Fe}Mg_2Fe(Cr^{3+})_2Si_4O_{16}$ composition inferred from the bulk chemistry of the symplectites. A model of a deprotonation-oxidation process associated with a $\{\square_{Fe}, 2H^-\} \rightarrow \{\square_{Fe}, 2Cr^{3+}\}$ point defect transformation is suggested to explain the origin of the pre-existing phase of the symplectites. The model seems to be a convincing explanation for the occurrence of lamellar spinel + pyroxene symplectites in terrestrial olivines, because the latter contain commonly $n \cdot 10^1 - n \cdot 10^2$ ppm of H_2O. Both $\{\square_{Fe}, 2H^-\}$ point defects and (100)-oriented lamellar precipitates of hydrous olivine $[Mg\square FeH_2SiO_4]*n[(Mg,Fe)_2SiO_4]$ were found in terrestrial mantle olivine [6]. A similar mechanism has been suggested to explain the origin of oxide precipitates in olivine from a terrestrial garnet peridotite [5]. How can this model be applied to lunar rocks, because the rocks are believed to be almost free of water? Recently, some arguments suggesting an H_2O presence in the lunar mantle has come from a SIMS study of lunar volcanic glasses [7, 8].

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