LAMELLAR SPINEL-PYROXENE SYMPLECTITES IN LUNAR OLIVINE: EVIDENCE FOR H_2O TRACES IN LUNAR MAGMAS?

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Introduction: 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. These lamellae were investigated with EMPA, SEM and TEM.

Results. The lamellae consist of diopside - chromite intergrowths. 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 $FeCr_2O_4 + 2CaMgSi_2O_6$.

Discussion. Lamellar symplectites are rare to occur. They were described in olivine from some terrestrial rocks [1, 2] and a Martian meteorite [3]. 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; (iii) chromite and diopside are probably the breakdown products of some pre-existing phase of $Ca_2\ _{Fe}Mg_2Fe(Cr^{3+})_2Si_4O_{16}$ composition inferred from the bulk chemistry of the symplectites. A model of a deprotonation-oxidation process associated with a $\{\ _{Fe}, 2H^-\} \rightarrow \{\ _{Fe}, 2Cr^{3+}\}$ 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 $\{\ _{Fe}, 2H^-\}$ point defects and (100)-oriented lamellar precipitates of hydrous olivine $[Mg\ FeH_2SiO_4]*n[(Mg,Fe)_2SiO_4]$ were found in terrestrial mantle olivine [4]. 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 [6, 7].

Conclusion. The formation of the chromite-diopside symplectites in lunar olivines could be due to deprotonation-oxidation processes. If this model is correct, then the occurrence of the symplectites should be considered as additional evidence for an H_2O presence in some lunar rocks.

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