EQUILIBRIUM RELATIONS AMONG PHASES OCCURRING IN LUNAR ROCKS

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ABSTRACT

Liquidus and solidus temperatures and sequences of appearance of the various crystalline phases under equilibrium conditions have been determined for Apollo 12 samples as well as for synthesized mixtures of similar compositions. The equilibrations were carried out in iron crucibles sealed into silica glass capsules under vacuum, in order to simulate lunar conditions. Olivine and spinel are usually the primary crystalline phases, appearing in the temperature range of approximately 1300 to 1200°C, followed by pyroxene and plagioclase in the temperature range of approximately 1180 to 1130°C. The solidus temperatures are approximately 1100 to 1070°C.

The nature of individual crystalline phases appearing, and the distribution of cations between coexisting pairs of solid-solution phases, are elucidated by consideration of subsolidus equilibria in the system MgO-"FeO"-TiO_2, where armalcolite appears as a phase. Similar studies at subsolidus temperatures in systems obtained by combination of MgO or FeO with TiO_2 and Cr_2O_3 or Al_2O_3 are shedding light on equilibrium relations of spinel phases occurring in the lunar rocks. Two spinel phases coexist in equilibrium when the sesquioxide is Al_2O_3, whereas only one spinel phase is present when the sesquioxide is Cr_2O_3.

Inasmuch as the extent of the solubility gap in these spinels

is a function of temperature and composition, the data may be useful in estimating the cooling history of lunar rocks.