SIMULATION OF CRYSTALLIZATION AND GEOCHEMICAL THERMOMETRY OF MARE CRISIUM MAGMATIC ROCKS

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The system of Pl, Ol, Pig and Aug geothermometers was carried out based on the available thermodynamic data on the crystallization conditions of lunar basalts and eucritic meteorites. It allows to calculate the equilibrium temperatures and compositions of these minerals with the accuracy of 10^{o}C and 1-2 mol.% correspondingly [1]. These dependences have been used to develop the LUNAMAG computer program which can simulate the sequences of equilibrium and fractional crystallization in such silicate systems as low-Ti mare basalts and basaltic achondrites [2]. Based on the procedure we performed simulation of phase relations in the melts of 8 main petrochemical types of the Mare Crisium ferrobasalts and their high magnesian and aluminous species. It was shown that most of Luna-24 basalts are undersaturated in relation to Pl but their average composion corresponds to conditions of Ol-Pl cotectic crystallization. The most magnesian basalts were found to contain Ol(Fo_{74-82}) as a liquidus phase while aluminous types are characterized by high temperature crystallization of plagioclase (up to 1280^{o}C).

In order to estimate the genetic relations and crystallization conditions of the Mare Crisium magmatic rocks the method of *geochemical thermometry* have been used [3]. It was based on the results of computer simulation of equilibrium crystallization for the melts of all studied fragments with the succeeding cotectic typization of model liquids. So the liquid phase evolution lines including 1037 compositions at 1100-1300^{o}C were calculated for 85 rocks and glasses from the Luna-24 regolith. As result of statistical analysis of these data it was found that approximately 70% of the initial compositions form a single family of cotectic lines (Pl+Ol±Pig±Aug) representing the VLT type of mare basalts. The most representive clusters of the model cotectics are revealed in the temperature interval of 1130-1170^{o}C. This could be considered as the predominant

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temperatures of the basaltic magmas in the lunar region discussed. We suppose that an additional argument in favor of this conclusion is the consistency of the model olivine compositions in this temperature interval with the "ferrobasaltic" maximum of Fo content (60-65 mol.%) in monomineralic particles from the Luna-24 regolith [4,5].

For detailing the real genetic relations between the Luna-24 ferrobasalts and green glasses the computer modeling of fractionation of corresponding magnesian liquids have been performed. Based on the model results concerning the melts with moderate MgO contents (11-12%) it was shown that the liquid lines of descent during fractionation are slightly distinguished in the range of 1300-1150^{0}C and like to "ferrobasaltic" cotectics which are lower 1200^{0}C. It is important that their Ol liquidus compositions (Fo_{76}) are near to maximal Fo contents in monomineralic Ol grains [4,5]. That could be interpreted as the right indication to reality of the fractional bonds between these different rock types in Mare Crisium.

This process however is not peculiar to the most magnesian particles containing 15-17% MgO (like to Apollo-15 green glasses). Comparison of their equilibrium and fractional crystallization trends allows to suppose that these high magnesian glasses are more probably representing some products of impact melting of the Ol-Pig cumulates or mineral aggregates.

References: *1. Ariskin A.A., Barmina G.S., Frenkel M.Ya. Geokhimiya, 1989, N 10, p. 1418. 2. Ariskin A.A., Barmina G.S., Frenkel M.Ya. Geokhimiya, 1990, N 10, p. 1476. 3. Frenkel M.Ya., Ariskin A.A., Barmina G.S. et al. Geochem. Intern., 1988, v. 25, N 6, p. 35. 4. Basu A., McKay D.S., Fruland R.M. In: Mare Crisium: the view from Luna-24, 1977, p. 321. 5. Papp H.A., Steele I.M., Smith J.V. Ibid., p. 245.*