

THE MINERAL COMPOSITION OF ROCKS AT THE LANDING SITES OF VENERA 13 AND VENERA 14 DESCENDING MODULES: THERMODYNAMIC CALCULATIONS. V.L. Barsukov 1), I.L. Khodakovskiy 1), V.P. Volkov 1), Yu.I. Sidorov 1), M.V. Borisov 2). 1) Vernadsky Institute of Geochemistry and Analytical Chemistry, USSR Academy of Sciences, Moscow, 2) Moscow State University, USSR.

The space probes Venera 13 and 14 successfully landed on the Venus' surface in March 1982 and performed a vast program of atmospheric and planetary surface exploration. The elemental chemical composition of Venusian soil was firstly obtained by the X-ray fluorescent device on Venera 13 and 14 descending modules [1].

Thus, the theoretical calculation of mineral composition at the landing sites was carried out. The phase composition in the 16-component global system (atmosphere - surface rock) open with respect to H_2O , CO_2 , CO , SO_2 , HCl , HF , with the gas contents corresponding to the known instrumental data [2-6]. It was found that such constraints led to the incorporation of sulfur and chlorine in Venus' minerals, in the concentrations several times higher than in real soil [7]. This could be interpreted as the disequilibrium of the calculated global system with respect to SO_2 and HCl . Thus, the estimation of mineral composition of Venus' soil was performed according to the assumption of inert behavior of SO_2 and HCl : the sulfur content of rock was taken as 0.65 wt% (Venera 13) and 0.30 wt% (Venera 14). The system was considered open with respect to other volatiles. According to the calculations in question the rock at the landing site of V 14 and corresponds to the altered alkaline basalt while that of Venera 14 - to the altered tholeiitic basalt. The secondary minerals are represented by magnetite, anhydrite, marialite and sylvine. Some fraction of magnetite may be of primary origin. The calculated equilibrium compositions at different hypsometric levels (0, 5, 10 km) supported our previous conclusions on the formation of pyrite instead of anhydrite at lower P and T values depending on the datum level i.e. in the highlands [8].

The equilibrium composition of the rock in the interaction with the oxygen-bearing atmosphere in accordance with the 18 ppm O_2 determination in Venera 13 and 14 experiment [3] was found to be similar to the first calculation set excluding the complete substitution of magnetite for hematite.

Thus, the atmospheric-lithospheric interaction on Venus could be considered as the agent of a number of exogenic geochemical processes: the oxidation of Fe-silicates with the formation of magnetite or even hematite; the formation of secondary sulfates (anhydrite) or sulfides (pyrite); the chlorine is predicted to form marialite and sylvine; the fluorine could be bound in F-apatite. The presence of Fe-oxides is suggested as the result of chemical interaction of the atmospheric water vapor and crustal rocks in geological past. Thus, the Venus' crust could be considered as the sink of oxygen while the deliberated hydrogen is dissipated from the upper atmosphere. The current estimates of D/H ratio in the Venus' atmosphere [9, 10] conform to the above assumption. The hydration of surface rocks under the conditions of low water vapor content ($x_{H_2O} \approx 10^{-5}$) is not revealed as well as the carbonatization of primary rocks.

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In [11] the bulk planetary Fe-content was estimated as two orders of magnitude lower than the terrestrial value. All iron was predicted in divalent form, calcite and wollastonite being the typomorphic minerals. After Venera 13 and 14 experiments this prognosis is evidently to be reconsidered.

Our thermodynamic calculations lead to the alternative conclusion: the global system atmosphere - Venus' rocks is considered in disequilibrium with respect to SO₂ and HCl or - the SO₂ content in the nearsurface tropospheric layer is lower than measured by Venera 11 and 12 [2].

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