

REDOX INDICATOR "CONTRAST" ON THE SURFACE ON VENUS.

C.P.Florensky, O.V.Nikolaeva, V.P.Volkov, A.F.Kudryashova, A.A.Pronin, Yu.M.Gektin, E.A.Tchaikina and A.S.Bashkirova, Vernadsky Institute, Moscow, II7334 USSR

There is a strong oxidizer H_2SO_4 in the upper troposphere of Venus. Below, the measured contents of O_2 and CO /1,2/ support a suggestion on disequilibrium state or local equilibria with spatial-temporal variability /3/. The results of the only in situ measurements on the surface, LNMS Pioneer-Venus data, on S-bearing species were considered as an artifact /4,5/. Thus now there is no direct information on the redox state on the surface of Venus. The high temperatures are favorable for equilibration. Taking into account the C_2H_6 LNMS data /4/, the calculated oxygen mixing ratio (x_{O_2}) is about 10^{-30} , but the O_2 Venera I3, I4 GC data above 3,5 km /6/ show ~ 25 orders of magnitude higher ($x_{O_2} \approx 10^{-5}$) (Fig.1).

To estimate the redox conditions on the surface assuming the equilibrium state the redox indicator "Contrast" was fitted on the supporting rings of Venera I3 and I4 probes (Fig.2). The indicator consists of the metallic frame holding an asbestos paper impregnated by sodium pyrovanadate (albedo, $A \sim 80\%$). If x_{O_2} corresponds to white field on Fig.1, the pyrovanadate remains white, while if x_{O_2} corresponds to dark field, the pyrovanadate darkens ($A < 30\%$) by the reduction to V_2O_4 (blue) and/or to V_2O_3 (black): $Na_4V_2O_7 + CO_2 + 3CO = V_2O_4 + V_2O_3 + 4Na_2CO_3$. The transition rate is ~ 15 min as laboratory tests have shown. The transition region is hatched on Fig.1. Because of the inaccuracy of the thermodynamic values as well as the possibility of the incomplete equilibration the magnetite stability field is carefully considered as the region of uncertainty.

During the descent in the atmosphere the asbestos paper was protected from aerosols by a metallic plaque with melted rivets, which were fused at ~ 12 km ($\sim 380^\circ C$), and the plaque was thrown away by aerodynamic flow. Some dust is to be seen both on the indicator and another details (Fig.2). The comparison of the measured albedos of the different features permits to infer albedo of the paper without dust ranged from 2 to $< 30\%$ (Venera I3 and I4). Thus the sodium pyrovanadate on the surface of Venus was subject to darken.

Hence at thermodynamic equilibrium on the surface (Fig.1) $CO > 10$ ppm, $O_2 < 10^{-23}$, $SO_3 \ll SO_2$, CO_2 ; the stable Fe-bearing phases are Fe-silicates (\pm Fe-oxides) or magnetite rather than hematite. This redox state is compatible with the CO -content but drastically incompatible with the O_2 -content both measured by Venera GC above 3,5 km /1,6/. This implies either (i) a distinct nonequilibrium down to the surface, or (ii) unreliability of the O_2 peak attribution in Venera GC data, or (iii) transition to the thermochemical equilibrium zone at the level 3,5 ($\pm 2-3$) km. A possibility of (i) seems to be supported by kinetic estimations /7/; then a reducing gas (apparently CO) reacted with V^{5+} as well as high O_2 -content could coexist on the surface. For (ii) the constancy of O_2 -content at altitudes ranged from 58 km (H_2SO_4 , $-10^\circ C$) to 3,5 km (gas medium, $+450^\circ C$) is questionable. As an evidence for (iii) it would be useful to revise the LNMS data on the S-bearing species relation from 20 to 0 km without an assumption on the constant mixing ratio of these in the atmosphere /5/; this assumption may

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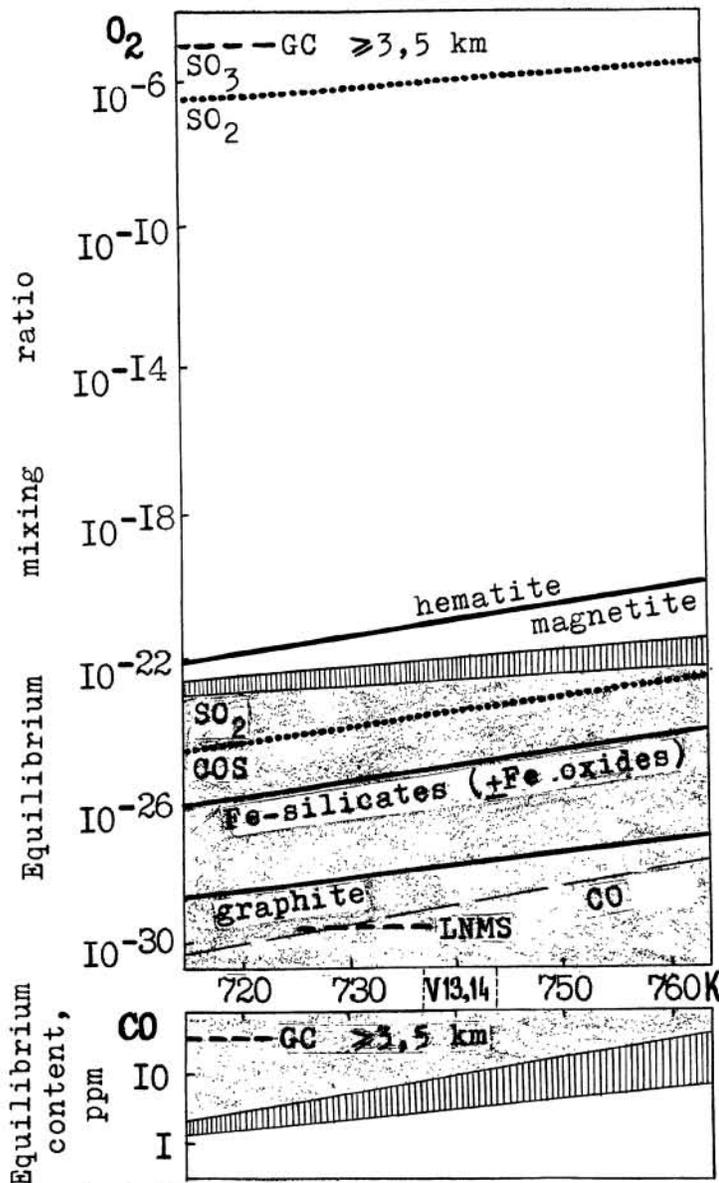


Fig.1

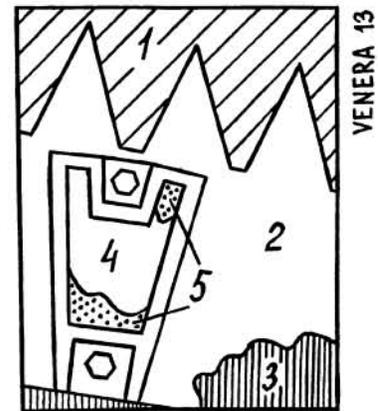


Fig.2

1 - soil; 2 - supporting ring; 3 - shadow; 4 - asbestos paper; 5 - dust

be not fully correct. For now some approach to the equilibrium on the surface is necessary for the chemical weathering variations as a function of altitude, as it has been proposed by /8,9, 10/ and supported later by /11/.

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