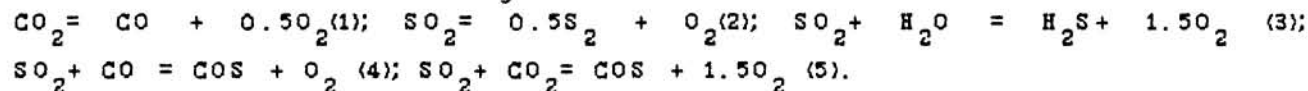


REDOX CONDITIONS OF THE NEARSURFACE ATMOSPHERE OF VENUS. I. Some reevaluations. M. Yu. Zolotov, Vernadsky Institute USSR Academy of Sciences, Moscow, USSR.

The atmospheric redox conditions as a critical parameter for the investigation of the chemical processes on the surface of Venus could be estimated from surface mineralogy as well as from atmospheric chemistry, the later seemingly being more reliable. The partial pressures of molecular oxygen $P(O_2)$ have been previously estimated from CO_2 -CO pair taking into account the assumption of chemical equilibrium between gases near the surface (e.g. 1-4). Others measured gases also should effect on oxidation state of the atmosphere. This report is presented as a modified and corrected version of [5]. The contents of measured atmospheric gases have been used as indicators of redox conditions. This approach is not based on the assumption on the chemical equilibrium between all atmospheric gases as well as atmosphere - surface equilibrium.

The partial pressures of molecular oxygen which are governed by separated groups of gases were estimated for 675-750 K temperature range providing the chemical equilibrium between various gases within each group. Mixing ratios for the gases were obtained from the most reliable instrumental data (see Fig.1 capture) making an assumption about constant chemical composition below the level of measurements down to the surface. The equilibrium redox conditions were calculated for the following set of chemical reactions:



The resulting data are plotted at the $\log P(O_2)$ - T diagram (Fig.1). The evaluation of the redox conditions for the hypsometric level near to mean planetary radius (e.g. for 735 K, 91.8 bar; 6052.05 km, $-22.67 < \log P(O_2) < -20.89$) is not in contradiction with previous data. That redox range is wide enough and overlaps the lines which are governed by magnetite-hematite (6) and pyrite-magnetite (7) equilibria: $3Fe_2O_3 = 2Fe_3O_4 + 0.5O_2$ (6); $Fe_3O_4 + 6SO_2 = 3FeS_2 + 8O_2$ (7), (see Fig.1). The lower limit of this interval is corresponding to equilibrium (3), (curve 3a on Fig.1) providing the minimal mixing ratio of H_2O measured near the surface [9] and maximal H_2S content [10]. The upper limit was calculated from the reaction (2) at minimal S_2 content [8]. The estimations of the $\log P(O_2)$ value on the base of measured upper limit of COS content are not in strong contradiction with the others estimations. But if COS content is essentially lower than 2-3ppm it could be corresponding only with more oxidizing conditions. On the other hand the high COS content measured at 29-37km (4E-5, Venera-13,14; [13]) is correlated with moderately reduced conditions: $\log P(O_2) = (-21.56) - (-21.37)$ for the 735-745 K in the case of extrapolation of Venera-13,14 data down to the surface.

Some uncertainties of $\log P(O_2)$ value for the lowlands should arrive also from the uncertainty of hypsometric level position of suggested equilibrium between some gases. For example, for 745 K (99.2 bar; 6050.75 km) the estimated lower and upper limits of $\log P(O_2)$ values are -22.33 and -20.53 respectively.

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The estimation of the redox conditions from the atmospheric data results in very low partial pressure of molecular oxygen, actually lack of oxygen in the atmosphere. In this case the molecular oxygen should be excluded as an oxidizer. The real redox conditions seems to be governed by really existing, predominantly chemically active gases.

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Fig.1 The estimation of redox conditions for the nearsurface atmosphere of Venus. Oxygen partial pressures are determined by the equilibrium conditions for the reactions 1-7 (see text, eq. 1-7). Used mixing ratios for the gases: 1 - CO₂ - 0.965 [6], CO - 1.7E-5,[7]; 2 - SO₂ - 1.5E-4 [6], S₂ - 2E-8 [8]; 3a - H₂O - 2E-5 [9], H₂S - 5E-6 [10], SO₂ - 1.5E-4; 3b - H₂O - 1E-4 [6], H₂S - 1E-6 [10], SO₂ - 1.5E-4; 4 - CO - 1.7E-5, COS < 3E-6 [10], SO₂ - 1.5E-4; 5 - CO₂ - 0.965, COS < 3E-6, SO₂ - 1.5E-4; 7 - SO₂ - 1.5E-4. 'Contrast' shows the results of of the Venera-13 color indicator [11]. P-T profile is from [12].

