The Venera-15, 16 and Magellan data show reliable evidences of volcanic processes on Venus (e.g., 1). It is reasonable to suppose that a certain fraction of volcanic volatiles was degassed into the atmosphere at least during the last billion years. The present work is an attempt to estimate the effect of volcanic degassing on the evolution of the physico-chemical conditions of the Venus' atmosphere.

**METHOD and CONSTRAINTS.** For the first approximation the atmosphere of Venus was presented as a physico-chemical system (H-C-N-O-S) which is open in respect to mass (input of the volcanic gaseous carbon dioxide) and energy (solar light). The atmospheric evolution was modeled by using the special computer program GEVA which involved the following main calculation blocks: 1. Equilibrium block (Gibbs free energy minimization method), 2. Pressure control, 3. Redox conditions control, 4. Greenhouse block (i.e. temperature control). For each time step the program runs by the iteration scheme. The mentioned above blocks run respectively up to coincidence with the previous results. After that the next portion of the volcanic gas is added to the system and the calculations are continued. The input data are as following: initial time, temperature (T), pressure (P), atmospheric composition, redox buffer, CO2 mass input. The output data for the current time step are as following: T, P, mass and molecular mass of the atmosphere, concentrations and partial pressures of the 12 gases (CO2, H2O, SO2, CO, H2S, COS, CH4, NH3, N2, O2, H2, S2), masses of H, C, N, O, S in the atmosphere, current redox buffer and log(P(O2)) value. The atmospheric redox conditions were assumed as buffered by surface mineral assemblages as have been predicted for the present atmosphere (e.g. (3-5)). The chemical interaction between gases and minerals as well as hydrogen escape were not taken into account in our model. The degassing rate of CO2, solar luminosity and masses of N, H, and S in the atmosphere were considered as constant values. The evolution was modeled for the possible Earth-based range of the CO2 degassing rate (Q from 5E+17 to 1.1E+19 mol/Ma (e.g. (6))). The assumed value of the CO2 degassing rate for Venus (about 1.3E+18 mol/Ma) was estimated using the volcanic productivity value of 2 cubic km. of lava per year (7) and about 1% of CO2 solubility in terrestrial tholeiites (8). All calculations were carried out from the present time point.

**RESULTS.** The calculations within the limited range of that model show that degassing of CO2 should result in the increase of temperature and pressure of the atmosphere. The variations of T and P for the hypsometric level of 6051.4 km are plotted on Fig. 1, 2 as a function of CO2 degassing rate for the various time steps in the past and future. The variations of T and P for the minimal and maximal terrestrial estimations of degassing are considered as unreal for Venus. At the same time the T,P changes corresponding to Venusian degassing rate (log(Q) = 18.1) are found as not so dramatic during the last billion years. For example, 500 Ma ago T and P were found to not differ from the present values more than 12K and 6 bar respectively. Temporal variations of the T, P and atmospheric chemistry should result in changes of the mineral stability of minerals on the surface. The changes of the critical hypsometric level which determines the possibility of magnesite (MgCO3) formation as a function of degassing rate are plotted on Fig. 3. If at present magnesite could be formed above about 7 km (9) in ancient period that mineral could be formed at lower elevations. For the Venussian degassing rate it was predicted that magnesite could be stable at the level corresponding to mean radius within the time interval up to about 2.3 billion years ago.

Redox conditions of the present nearsurfase atmosphere can be determined by hematite-magnetite (Hem-Mt) or pyrite-magnetite (Py-Mt) buffers (5). It is assumed that the redox conditions on the ancient Venus were buffered by some other buffer possibly by pyrite-hematite (Py-Hem) buffer. The assumed value of the CO2 degassing rate for Venus (about 1.3E+18 mol/Ma) was estimated using the volcanic productivity value of 2 cubic km. of lava per year (7) and about 1% of CO2 solubility in terrestrial tholeiites (8). All calculations were carried out from the present time point.

**CONCLUSIONS.** 1. At the CO2-degassing rate estimates for Venus (1.3E+18 mol/Ma) temperature and pressure was not found to increase dramatically during the last billion years. 2. The magnesium carbonate formation could not be excluded on the ancient Venus for the mean radius level. An existence of carbonate deposits should not be excluded. This result show that at the future modeling it will be necessary to take into account the possibility of CO2 exchange between atmosphere and crust as a result of carbonate formation and destruction. 4. The atmospheric redox conditions earlier could be buffered by pyrite-hematite assemblage. More reliable conclusions would be obtained if the chemical weathering and resurfacing as well as the presence of H and S in the volcanic gas composition are taken into account.

VENUS ATMOSPHERE EVOLUTION
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FIG. 1
MEAN AIRCRAFT TEMPERATURE OF THE VENUS' ATMOSPHERE AS A FUNCTION OF CO2 (e) DENSITIES (kg/m³) FOR THE VARIOUS TIME STEPS

FIG. 2
MEAN AIRCRAFT PRESSURE OF THE VENUS' ATMOSPHERE AS A FUNCTION OF CO2 (e) DENSITIES (kg/m³) FOR THE VARIOUS TIME STEPS

FIG. 3
MINERAL ASSEMBLAGES IN THE SYSTEM Fe-5-0 AS A FUNCTION OF TEMPERATURE AND PRESSURE CONDITIONS

FIG. 4
MEAN AIRCRAFT TEMPERATURE OF THE VENUS' ATMOSPHERE AS A FUNCTION OF CO2 (e) DENSITIES (kg/m³) FOR THE VARIOUS TIME STEPS

FIG. 5
Magnetite + Hematite or Magnetite + Pyrite
Hematite + Pyrite

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