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CO_2, CH_4, CxHy and H_2O behavior at high and low pressure conditions in silicate system: from degassing to storage of CO_2 and production of H_2

ROMMULO VIEIRA CONCEICAO[1], CAROLINE D K TOLLOTI[1], TIAGO DE ABREU SIQUEIRA[2], JOAO BERNARDO VARGAS[1] AND VINICIUS H MARCON[1]

[1]UFRGS-PPGGEO-LAGEPE

[2]Universidade Federal do Rio Grande do Sul

Presenting Author: rommulo.conceicao@ufrgs.br

The presence of volatile C-H-O elements in silicate systems play an important role in the genesis of magmas on the Earth's mantle, but also contribute to the atmosphere and supergenic process due to their speciation diversity that depends on the fO_2 of the environment. Among those elements, carbon can change its valence according to the oxygen fugacity (fO2) of the environment, resulting in different speciation, as: CO_3^{-2}, CO_2, $C_{graphite/diamond}$, CH_4 or heavier hydrocarbons (C_xH_y). Hydrogen can be found in H_2O and OH^- forms as (-1) valence, but also in the zero valence as H_2 molecular gas. Our group has been experimentally testing the CO_2 and H_2O mantle degassing and the abiotic generation of hydrocarbon in mantle conditions under high pressure and fO_2 between CCO and IW; and the storage of CO_2 concomitant to H_2 production in peridotite and basalt, under low pressure conditions. The high-pressure experimental results suggest that: a) CO_2 is firstly released, related to water, before mantle melting in expanded tectonically environment during the breakup of the lithosphere, b) longer and complex abiotic hydrocarbon genesis can be facilitated with pressure, as far as the low fO_2 is present in the mantle, and c) these previous reactions can generate CO_2, C_xH_y and H_2 gases that can flow from the mantle to the surface and play supergenic processes. Low-pressure experiments suggest that: d) peridotite can easily store CO_2 as magnesite and also generate H_2, via redox reactions involving olivine and orthopyroxene minerals; and e) the production of H_2 is facilitated if SO_4^{-2} is added to the environment, in expense of lower storage of CO_2. All these experiments will help to understand the role of volatile in expanded tectonic environment before and after the lithosphere breakdown. The results will also help to understand the production of H_2 and storage of CO_2 that can be stimulated via fluid/rock reactions.