Abiotic hydrocarbon production: the role of mineral catalysts

K. KULARATNE[1,2*], I. MARTINEZ[2], O. SISSMANN[1], M. CHARDIN[1], J. CARLUT[2] AND F. GUYOT[3]

[1] IFP Energies Nouvelles, 92852 Rueil-Malmaison, France
[2] Institut de Physique du Globe de Paris, 75005 Paris, France
[3] IMPMC, MNHN, 75005 Paris, France
(*correspondence:kanchana.kularatne@ifpen.fr)

Fischer-Tropsch Type (FTT) reactions have been proposed to account for the formation of abiotic hydrocarbons in natural geological environments. It is coupled with the serpentinization reaction, which produces large amounts of hydrogen creating highly reducing conditions; for example in mid-oceanic ridge hydrothermal systems. It has been shown that certain minerals associated in such environments have the ability to catalyze the FTT synthesis. In addition, the formation of simple hydrocarbons by FTT reactions are considered to proceed via several reaction intermediates. Nevertheless, the mechanism of FTT synthesis of abiotic hydrocarbons still remains unclear.

Here we report the results of an experimental study conducted at 300 °C and 30 MPa in sealed gold capsules to investigate the catalytic potential of sphalerite (ZnS) and marcasite (FeS_2). We used several Fe(II)-bearing minerals (forsterite (Fo90), fayalite and Fe-rich chlorite) to produce H_2 *in-situ*. Carbon was introduced as 0.64 M $NaHCO_3$(aq) solution. After 20 days of reaction, we observed alkanes (C1-C4) in the gas phase of those experiments which conducted in the presence of catalysts. However, the rates of conversion of inorganic carbon to organic carbon were <1%. In addition, carbon and hydrogen mass balance calculations imply large fraction of organic molecules could exist in the dissolved or condensed form. Recent work by [1] suggests that CO_2 should be at equilibrium with condensed carbon rather than dissolved phases. We expect to obtain both the qualitative and quantitative data on liquid phase composition (i.e. to identify neo-formed dissolved organic compounds) and mineralogical analysis on solid products to understand the intermediate steps of the reaction mechanism and to determine catalytic efficiency.

[1] Milesi et al. (2015) GCA **154**: 201-211.