

Discovery of hydrocarbon in Proterozoic Vindhyan Basin, East India, using geochemical signatures

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The Vindhyan basin is a Proterozoic intercontinental basin in the central part of the Indian shield with maximum thickness of 3 km. The occurrence of stromatolitic limestone in the basin proves the abundance of organic life in the Vindhyan sediments.

A total of 637 samples were collected for adsorbed soil gas analysis. The concentration of C₁, C₂, C₃, iC₄ and nC₄ desorbed from the soils vary from 0-186 ppb, 0 – 4 ppb, 0-5 ppb, 0 ppb and 0-1 ppb, respectively. Excellent correlations exist among methane, ethane, propane and C₂₊. Such correlations indicate that these hydrocarbons most probably share a single source. The cross-plots for C₁-C₂, C₁ - C₃, C₁ - ΣC₂₊ and C₂ - ΣC₂₊, C₃ - ΣC₂₊ and ΣC₂₊ - C₄ show excellent correlation and indicate that these hydrocarbons are genetically related and not effected by secondary alteration during their migration from subsurface to subsequent adsorption on to the surface soil and might have been generated from a thermogenic source because of the presence of C₂ & C₃ components.

The compositional signature displayed by methane to ethane, methane to propane ratios, as defined by Pixler plot suggest the samples fall in three zones: oil, oil/gas and gas zones.

The carbon isotope values varies between -62.2‰ and -25.239 ‰ (PDB) for methane (δ¹³C₁), and -35.3‰ and -20.069‰ for Ethane. Based on Bernard diagram, the relationship between δ¹³C₁ and gas wetness C₁/(C₂+C₃) indicates that all samples fall within the thermogenic field.

An experimental investigation of olivine–fluid interaction as a function of pH and surface area

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The rate of olivine dissolution under ambient conditions (T=25°C, P=1atm) resulting from the interaction of olivine powders with low pH solutions has been previously determined by numerous researchers [1]. Though it has been shown that one effect of this interaction is the protonation of the olivine surface (i. e. solution pH increases), many of these rate-determining experiments are performed under pH-stat conditions with solution composition maintained at a constant pH.

In our experiments, we started with solutions of known pH (HCl, H₂SO₄ at pH=2) and then allowed pH to change as reaction with olivine powders proceeded. San Carlos olivine (Fo90) was crushed and sieved to a range of particle sizes (1000, 500, 250, 125 μm) and elutriated and dried to remove any superfine, potentially highly reactive material. Olivine powder was then mixed with the solution at a fluid to rock mass ratio (F:R) of 1:1, 3:2, or 2:1. Solution pH increased non-linearly until reaching a steady value of about pH=10 (Fig. 1). The time to reach this value varied systematically with powder size and F:R, indicating that both surface area and solution concentration affect the rate of protonation and pH increase.

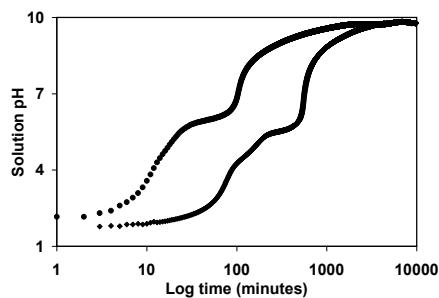


Figure 1: Solution pH vs. log time (min) for 250 & 1000 μm olivine powders with H₂SO₄ (starting pH=2) at F:R=1:1

[1] Brantley (2008) 'Kinetics of mineral dissolution' in: *Kinetics of Water-Rock Interaction*, pp.151-210.