Application of geochemistry in shale gas exploration: A case study from Cambay Basin, Gujarat, India

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Shale gas is an unconventional hydrocarbon resource as the shale acts both as a source and reservoir for the gas. Gas can be stored in the shale either in the pore spaces or as adsorbed gas on to the organic matter. Characterization and evaluation of the source potential of a rock is made by using parameters like (1) Total Organic Carbon (2) Rock-Eval Pyrolysis (3) Elemental analysis of C, H, N, O and S (4) Vitrinite Reflectance (5) Visual Kerogen Analysis (6) Extract SARA Analysis (7) Gas Chromatograph of extracted bitumen (8) Pyrolysis Gas-Chromatography (9) Gas Chromatograph-Mass Spectrometry of extracted bitumen and (10) Isotope composition of carbon and hydrogen. For commercial shale gas exploration TOC content of the shale should be more than 2%, mature to post mature zone i.e. oil window to gas window (Ro > 0.7%, Tmax >445°C). The kerogen in the shale must be gas prone. At higher temperature zone gas can be generated by insitu cracking of oil. In this study, total 15 shale samples were collected from Broach and Jambusar areas of Cambay Basin, Gujarat, India. The analytical findings reveal that the Shales are found rich in organic matter (1- 5%), maturity (0.7- 1.2VRo), kerogen type II, III marine, hydrogen index <100, thickness is more than 500m and area extent is more than 53000square km. The organic richness attains the oil window at the depth of 2000m and below this depth gas window starts. Finally the laboratory findings highlight the positive prospects for shale gas exploration and exploitation in Cambay Basin.

Keywords: Shale Gas, Geochemical, Exploration.

Quantification of the magma fluxes feeding the growth of a shallow magma reservoir (Soufrière Hills, Montserrat)

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Shallow andesite intrusions in arcs participate to the formation of new continental crust. The SEA-CALIPSO experiment revealed a low-seismic-velocity volume beneath Soufrière Hills (Montserrat) extending vertically from 4 to at least 7.5 km depth and attributed to the presence of melt [1]. By simulating the growth of a magma body by accretion of andesitic intrusions we calculated spatial distributions of temperature and melt fraction and the corresponding seismic wave velocities, which were smoothed to be comparable with tomography results.

The size and intensity of the synthetic velocity anomaly are controlled by the diameter of intrusions, the rate at which they are emplaced, i.e. the total duration of the intrusive episode, and the intruded magma initial heat content (including latent heat). We were able to reproduce the tomographically determined velocity anomaly with a relatively wide range of intrusion diameters (4 to 10 km) and magmatic episode durations (6,000 to 150,000 yrs), but, because of a trade off between these two parameters, the corresponding magma fluxes are restricted to 0.7 - 5 x 10^{-3} km^3/yr.

The velocity anomaly can be reproduced with a chamber containing high melt-fraction magma or with a mush of crystals and melts. The range of magma ages in the modelled magma chambers is much wider than the crystal residence time of the erupted andesite [2]. This suggests that eruptions tap small pockets of recently assembled magma and that the velocity anomaly might be mostly due to a non-eruptible mush.

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