Integrated geochemical studies of hydrocarbon in Proterozoic basins

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There are number of unexplored Proterozoic basins for hydrocarbon in India. These basins are characterized by varied geology, age, tectonics and depositional environments. Hydrocarbons generated and trapped beneath the sub-surface seeps to the surface in varying but detectable quantities. Diffusion, effusion, and buoyancy allow these hydrocarbons to escape from reservoirs and migrate to the surface where they are retained in the sediments, diffuse to atmosphere or water columns. Based on these assumptions, surface geochemical prospecting lab has been developed to identify the surface or near surface occurrences of hydrocarbons. The facility includes adsorbed soil gas surveys in light hydrocarbon (C_1-C_4), $^{13}C/^{12}C$ measurement on C_1-C_4 and microbial techniques. Surface geochemical research for hydrocarbon was carried out in various in parts of Vindhyan basin, Cuddapah basin, Kaladgi basin, Kutch basin and Jamnagar sub-basin.

Soil samples from Vindhyan, Cuddapah and Kaladgi basins were analysed for light hydrocarbon, Carbon isotopic ratio and microbial analyses. Cross plot between C1-C2, C1-C3, C2-C3 show linear correlation which indicates that light hydrocarbon migrated from thermogenic source. Pixler plot (C1/C2 and C1/C3) plot distinguish the non productive zone from oil/gas producing zone. $\delta^{13}C$ analyses of C1-C4 suggest thermogenic source for these hydrocarbon. Microbial analyses for MOB and POB also show anomalous concentrations in some of the samples. Integrated geochemical studies in these Proterozoic basins suggest warm area for hydrocarbon exploration.

Lu-Hf and Sm-Nd isotopic study of Martian meteorites: Implications for early differentiation on Mars

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We present a new study of ^{176}Lu-^{176}Hf and ^{147}Sm-^{143}Nd isotope systematics in 12 SNC meteorites including 3 nakhlites (Nakhla, MIL03346, Yamato000593), 3 depleted shergottites (SaU008, SaU094, DaG476), 1 intermediate composition shergottite (EETA79001), 4 enriched shergottites (Shergotty, Zagami, Los Angeles, NWA856) and the orthopyroxenite (ALHA84001). The objective is to provide constraints on processes occurring during the early differentiation of Mars and the subsequent crystallization from a magma ocean, resulting in compositionally distinct cumulates.

All the shergottites define a mixing trend between a depleted end-member, likely represented by depleted shergottites, and an enriched end-member. Shergottites also plot to the right of a 1:1 line for their calculated time-integrated mantle sources $^{147}Sm/^{144}Nd$ vs. measured ratios in lavas. This can be explained by two successive partial melting events that are close in time in the depleted shergottite source. This results in an increased Sm/Nd in the source and in turn produces magmas with Sm/Nd ratios that are greater than time-integrated Sm/Nd ratio inferred from $^{143}Nd/^{144}Nd$. This implies that all the shergottites share a common depleted source and that the enriched shergottites are not corresponding to the enriched end-member of the mixing trend. Shergottites plot to the left of the 1:1 line in a similar diagram using $^{176}Lu/^{177}Hf$. Because ilmenite is unlikely significant in the Martian mantle, the only other prevalent mantle mineral able to efficiently fractionate these Lu/Hf and Sm/Nd ratios is magnesio-perovskite. This would place the depleted shergottites source in the lowermost Martian mantle, close of the core-mantle boundary. This source may be early cumulates crystallizing from a magma ocean. Acquisition of $^{142}Nd/^{144}Nd$ data should give a clearer answer to this problem.

Nakhlites are characterized by low $\varepsilon_{Hf}/\varepsilon_{Nd}$ ratios, consistent with a source having experienced ancient garnet segregation.

Finally, Lu-Hf and Sm-Nd systematics of the orthopyroxenite ALHA84001 require a reassessment of the crystallization age of this sample, because a 4.5 Gy crystallization age produces an unrealistically depleted source $^{147}Sm/^{144}Nd$ of 0.66 and $^{176}Lu/^{177}Hf$ of 0.23. A crystallization age of 3.9 Gy gives more consistent results and is therefore preferred.