

## Geology and evaluation of hydrocarbon prospects of Tethyan sediments in Spiti Valley, Spiti and Zaskar, Himanchal Pradesh

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The Tethyan sediments in the Spiti Basin stretch from Pir Panjal in the south to the Zaskar Range in the north. The Tethyan sediments lie within the Higher Himalayan Physiographic Zone. Since such huge thicknesses of sediments are deposited in this area, it is anticipated by the geologists that favourable conditions might have prevailed for the generation and accumulation of hydrocarbon in the Tethyan sediments. It has been continuous endeavour of ONGC to explore and enhance hydrocarbon reserves from all Indian sedimentary basins including the category IV and frontier basins. Seismic data acquisition and geological modelling have been carried out for Lesser Himalayas and even parametric, structural, or wild cat wells have been drilled and one such well is under drilling at Sundernagar. The Tethyan part being inaccessible has not been subjected to detailed geological modelling.

Mesozoic sequences from Kibber Gate Tashegang and Lidang Domal traverses have been subjected to sedimentological, Palaeontological, Palynological and source rock investigations to reconstruct microfacies, biochronostratigraphy, depositional environment, and organic matter maturation. The petrographic study of the Mesozoic Tethyan sediments exposed along the selected traverses shows occurrence of Kioto Limestone, Spiti Shale, Giumal Sandstone, Tashegang Limestone and Chikkim Limestone formations. The Kioto Limestone is highly sparitised and has poor porosity. The Giumal Sandstone consists of glauconitic sands which are well indurated and have very poor intergranular porosity. The porosity is further reduced by calcite cementation. Similarly, the Tashegang Limestone is also highly sparitised and has poor porosity. Spiti shale is dark grey, black, carbonaceous, occasionally oxidised in nature.

Brachiopod fauna supportive of Lower Carboniferous age has been recorded from Lipak Formation and Ordovician - Silurian fauna from Takche Formation. Cephalopods supportive of Oxfordian - Callovian age have been recovered from Spiti Shale. Lilang Group has yielded rare Cephalopods of Triassic - Jurassic age. On the basis of FAD of *Riguadella filamentosa* and *Egmontodinium torynum* Late Bathonian to Late Tithonian age has been suggested to Spiti Formation. On the basis of FAD of *E. cinctum* and *Batioladinium micropodum*, Late Tithonian to Early Valanginian age has been suggested to Tashegang Formation. On the basis of FAD of *B. micropodum* the base of Giumal Formation is dated as Early Valanginian. The absolute pollen frequency (APF) value of the palynofloral assemblage from Spiti Formation suggests inner neritic to marginal marine environment of deposition, while palynoflora from Tashegang Formation indicate marginal marine to lagoonal environment and Giumal Formation was laid under marginal marine conditions. The Organic matter recorded from the studied samples shows Humic-Wood (H-W) to Humic-Sapropelic-Wood (HS-W) to Humic-Sapropelic-Charcoal (HS-C) facies.

The organic matter studies have indicated TAI value from 3 to 3.5 which is suggestive of thermally matured sediments. In general geochemical studies on all the samples have indicated poor hydrocarbon generation potential with very low TOC except for carbonaceous shales having indicated >1% TOC. S<sub>2</sub> is very low in many organic rich samples probably due to weathering affects. So an entirely different picture can be anticipated in the subsurface. T max data is not reliable as S<sub>2</sub> is low hence no maturity estimate could be made.