Abstract

The Sirban Limestone of Proterozoic age occurs in detached inliers of Jammu region in India and extends westwards to the oil producing Potwar Basin in Northeast Pakistan. The Reasi Inlier, 40 km long and 12 km wide, is the largest inlier in Jammu region. This sequence comprises of reservoir quality, dark-grey dolomite, limestone with seal horizons of chert and argillites and organic rich shale intervals. The limestones possess vuggy, inter- and intragranular, fracture, inter- and intralayer porosities. The shales with organic matter content of 10% have oil/gas generating potential. Some of these carbonate and shale horizons yield Neoproterozoic microflora, comparable with those reported in North African Neoproterozoic sandstones and Late Proterozoic carbonates of the giant oil and gas fields of the Baikit Anticline of the Siberian Platform.

The sequence is juxtaposed against the Tertiary sedimentary sequence in the north of the Reasi Inlier and the contact between the two has conventionally been considered as a major regional unconformity but recent study reveals this contact as a back thrust. The inlier along with the Tertiary sedimentary sequence is also involved in the north directed re-entrant and furthermore, within the Reasi Inlier a “Triangle Zone” occurs in the Anji valley east of the Reasi town. These rocks also exhibit multiple generation folds in the area. North of the Reasi Inlier, Chenab River veers its course from west to south, forming a loop - a drainage anomaly. This drainage anomaly seems to be an expression of a subsurface structure and considered potential target for hydrocarbon exploration.

Along the back thrust at Kanthan village, gas seep samples from the Chenab River bed, analysed for bulk chemical and isotopic composition reveal the presence of dry gas rich in CH\textsubscript{4} and N\textsubscript{2} and having $\delta^{13}$C $< -60\%$o, indicating possible shallow source of biogenic origin.

The association of reservoir quality limestones with seal horizons and organic rich shales, together with the presence of gas seeps and the observed “Triangle Zones” and drainage anomaly supports the existence of a potential petroleum play in the Sirban Limestone.
References


Oil and Gas Development Corporation (OGDC), 1996, Pakistan petroleum prospects—An overview: Oil & Gas Development Corporation, Islamabad, Pakistan, 22 p.


Potential Proterozoic Petroleum System: Northwest Himalayan Thrust Belt, Jammu (India)

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REGIONAL GEOLOGICAL SETUP OF HIMALAYA
Siwalik Group (Mio-Pliocene)
Murree Group (Lr. Miocene)
Subathu Formation (Eocene)
Volcanic Rocks & Slates
Cambro-Triassic and Panjal Traps

Inliers of Sirban Formation in the Jammu area
1. Dandili - Devigarh Inlier
2. Kalakot - Mahogala Inlier
3. Reasi Inlier
4. Dhansal - Sawalkot (Lopri) Inlier

LEGEND
- Siwalik Group (Mio-Pliocene)
- Murree Group (Lr. Miocene)
- Subathu Formation (Eocene)
- Volcanic Rocks & Slates
- Cambro-Triassic and Panjal Traps
- Sirban Formation (Proterozoic)

Regional geological map with location of the Sirban Formation Inliers and generalized stratigraphy
(Map modified after Gansser, 1964)
Geological map of the Reasi Inlier and adjoining areas showing key localities and thrust contacts.

General Stratigraphic Succession Of The Area:

- **Siwalik Group**: Miocene-Pliocene-Pleistocene
- **Murree Group**: Upper Eocene-Lower Miocene
- **Subathu Group**: Eocene

**L E G E N D**
- Yellow: Siwalik Group
- Blue: Sirban Fm.
- Brown: Murree Group
- Green: Subathu Fm.
- Dashed line: Biostrome
- Section Line
- Alluvium & terrace deposits
- Recent & Subrecent

**Back thrust** (Marked by Brecciated unit & Bauxite beds)

**Sirban Limestone Fm.**: Neoproterozoic

**Base not exposed**
Satellite imagery of the study area
Satellite imagery of the southern contact of the Riasi Inlier, a subsidiary of MBT (Riasi Thrust=Vaishnov Devi Thrust)
Traditionally the contact between Subathu Group and Riasi inlier has been recognized as a major unconformity.
Extension of Kohat-Potwar Basin

C.J. Wandrey, B.E. Law, and Haider Ali Shah
U.S. Geological Survey Bulletin 2208-B
Posted online February 2004
General Stratigraphy of Potwar Area
(modified from ODGC, 1996; Quadri, 1996; Kemal, 1992; Iqbal and Shah, 1980; Shah and others, 1977)
Our study reveals the contact is a Back thrust (Bhat et al. 2009)
Detailed Relationships within Thrust Complexes

Locality: Muthal
Tectono-stratigraphic Relationships

Relationship within Thrust Complex, Muthal
Schematic Cross-Section Through The Terminal Portions Of The Reasi Inlier, Near Jammu
Jammu and Kashmir, India
Observed “Triangle Zone” in the Anji valley east of the Reasi town
Observed drainage anomaly and gas seeps at Kanthan (circled in yellow)
General geology around gas seep site

- DISCONTINUOUS EXPOSURES (SLIVERS) OF SUBATHU
- BRECCIATED UNIT
- PISOLITIC BAUXITE
- SIRBAN LIMESTONE
- MURREE

Satellite Image of The Kanthan & Salal Area in Reasi Inlier
Gas seep samples collected from Kanthan village were analyzed for bulk chemical and isotopic composition.

Preliminary results indicate that the gas mainly consists of CH₄, is very dry and has δ¹³C < -60‰.

This suggests a possible shallow source with biogenic origin.

A potential Source Horizon with TOC 2.5%
Neoproterozoic Microflora recovered from the carbonate and shale horizons of the Sirban Fm., Reasi Inlier

- Filamentous Algae
- Indet.
- Cyanoceterial trichomes
- Leiosphaeridia sp.
- Leiosphaeridia sp.
- Filamentous Algae
- Leiosphaeridia sp.
- Filamentous Algae
- Tasmanite sp.
- Indet.
- Branching Filament
- Small Spheroid
- Synsphaeridium sp.
- Indet.
Neoproterozoic Microflora recovered from the carbonate and shale horizons of the Sirban Fm., Reasi Inlier
Amorphous Organic Matter recovered from the shale horizons of Sirban Fm., Reasi Inlier

Anji Nala Section

Muthal Section, TAI 8

Muthal Section

Anji Nala Section
Micro Scale Algal Laminae in Sirban Limestone
Micro-scale porosity observed in the Sirban Limestone:

- Fenestral Porosity
- Fracture Porosity
- Intra-granular Porosity
Macro-scale porosity observed in the Sirban Limestone

- Breccia Porosity
- Cavern Porosity
- Drape Stones
- Vuggy Porosity

Coin diameter 2.45 cm
Seal Horizons of Argillite and Chert Bed/ Lenses in Sirban Limestone Fm.
Conclusion

The association of reservoir quality limestones with seal horizons and organic rich shales, together with the presence of gas seeps and the observed “Triangle Zones” and drainage anomaly supports the existence of a potential petroleum play in the Sirban Limestone.
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