

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

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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 CH₄ and N₂ and having $\delta^{13}\text{C} < -60\text{‰}$, 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.

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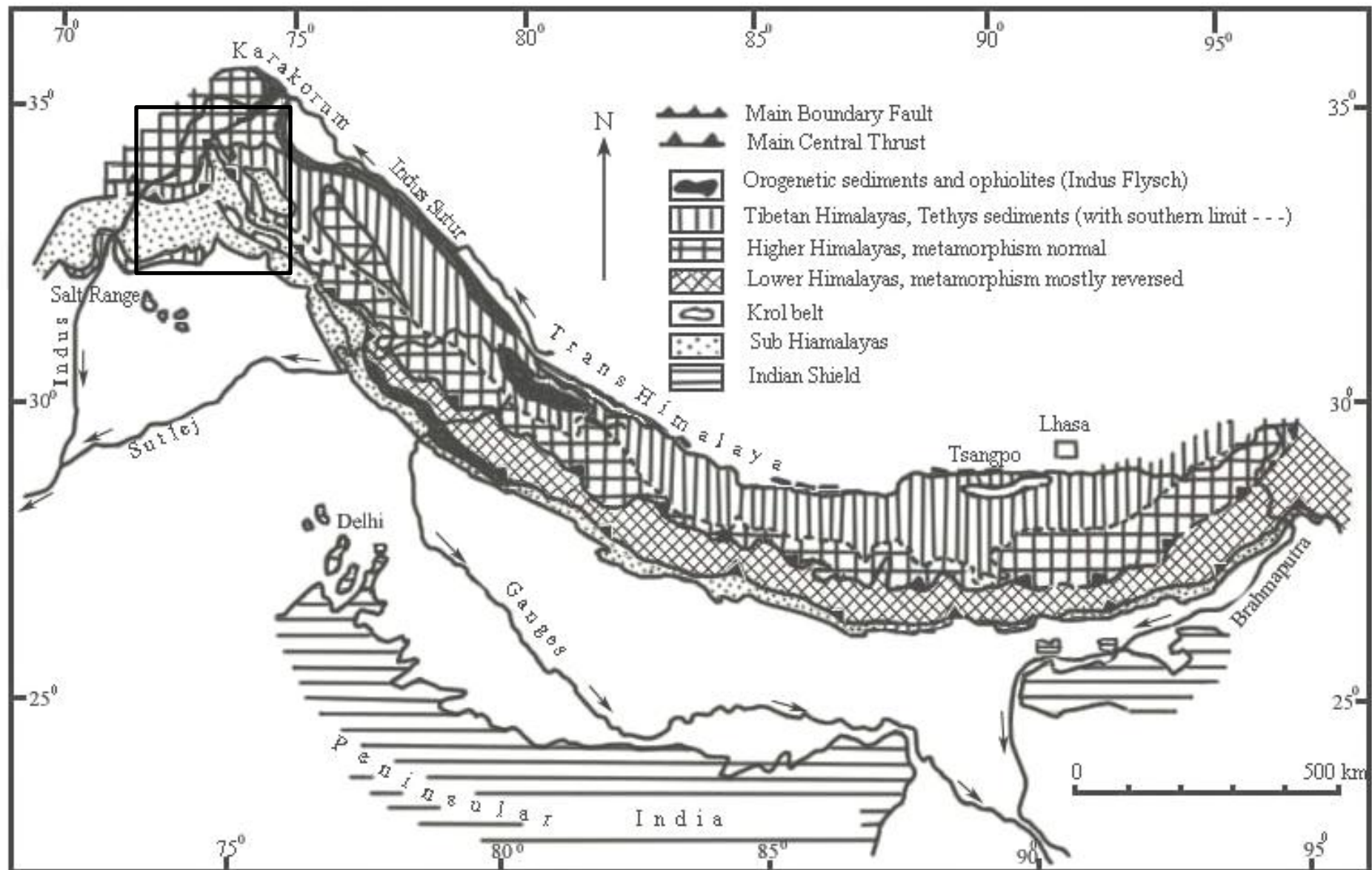
3. MPRG, Department of Earth Sciences, University College London



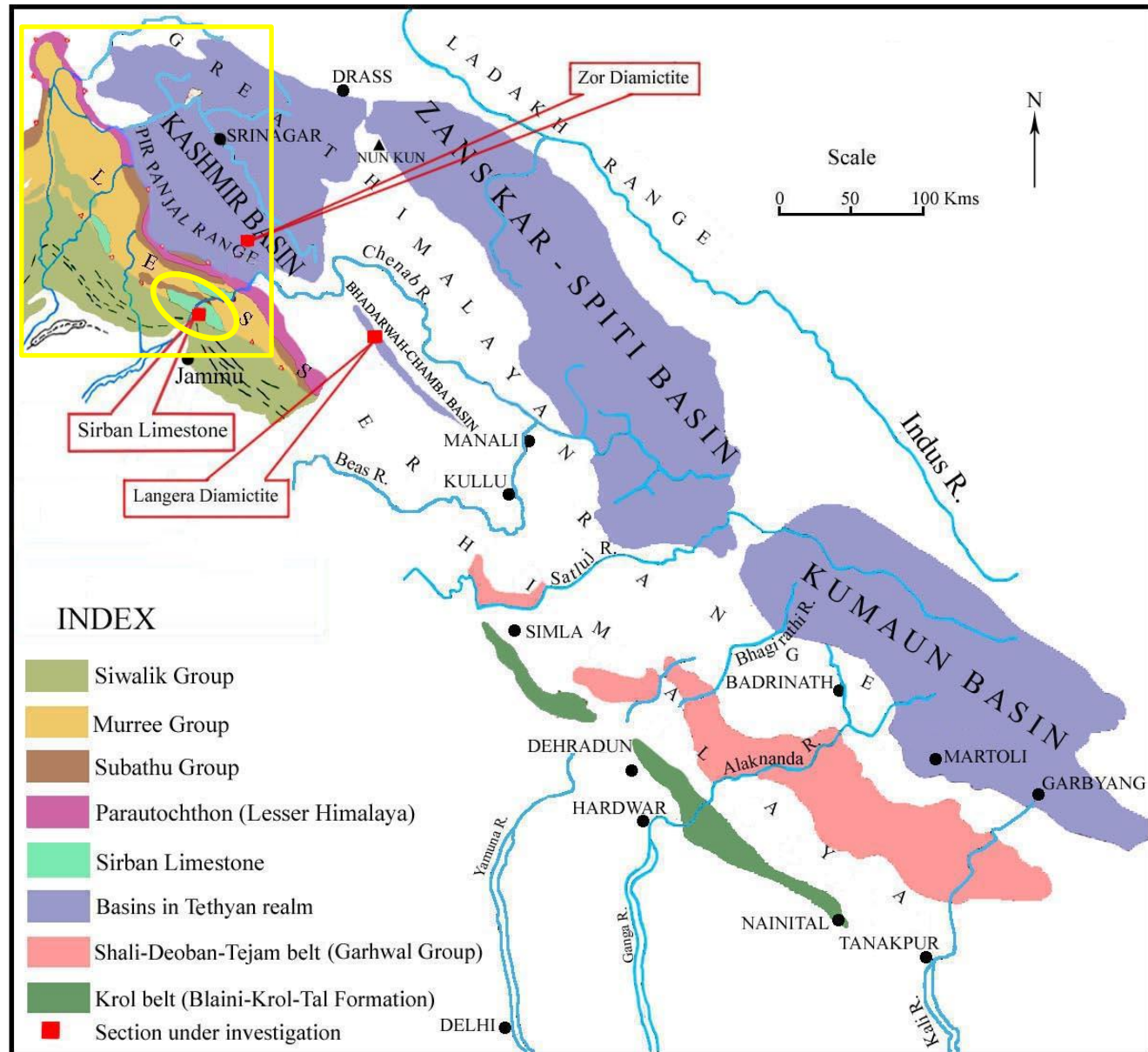
Institute of Energy Research & Training
IERT
University of Jammu

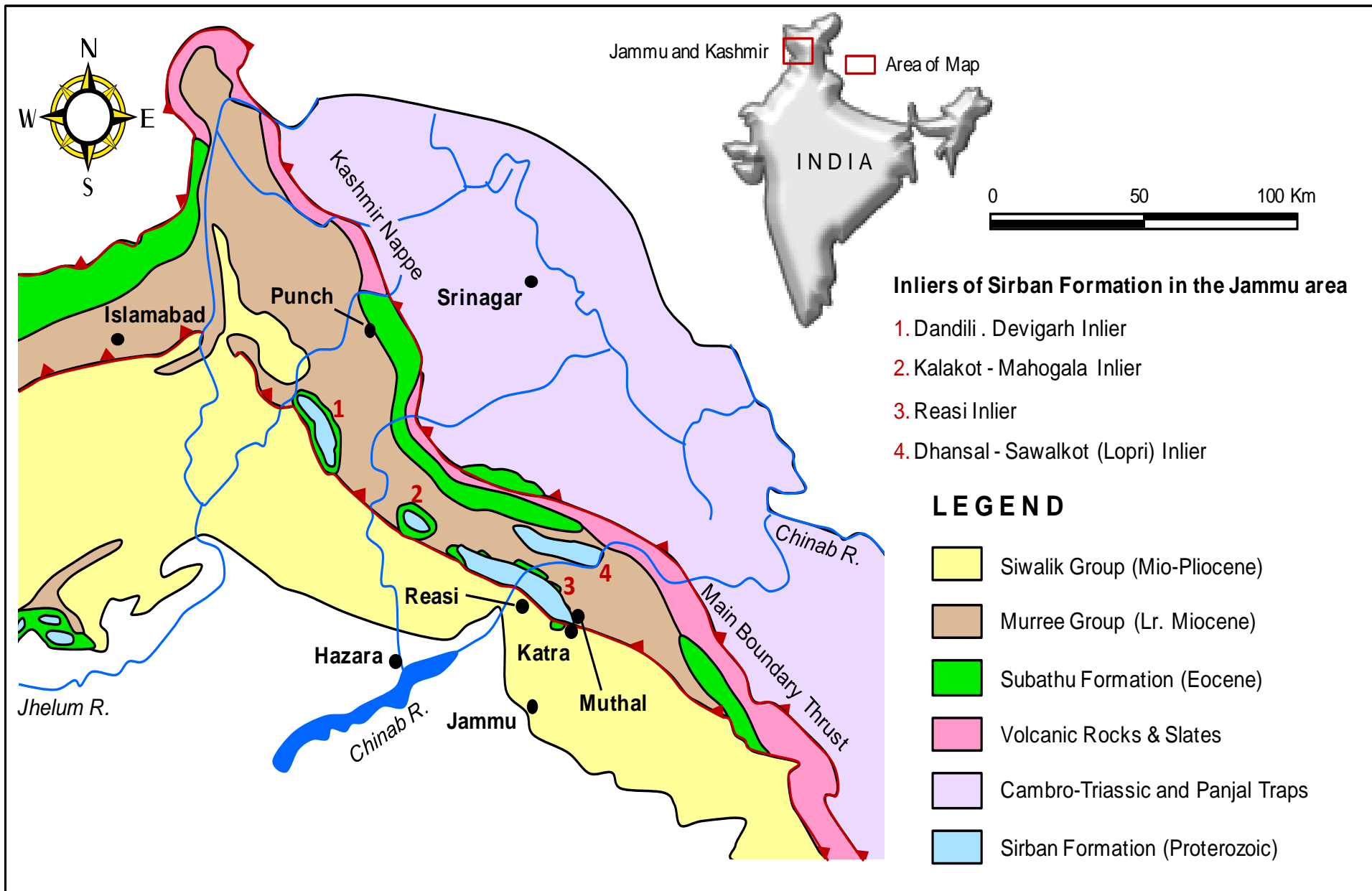


REGIONAL GEOLOGICAL SETUP OF HIMALAYA

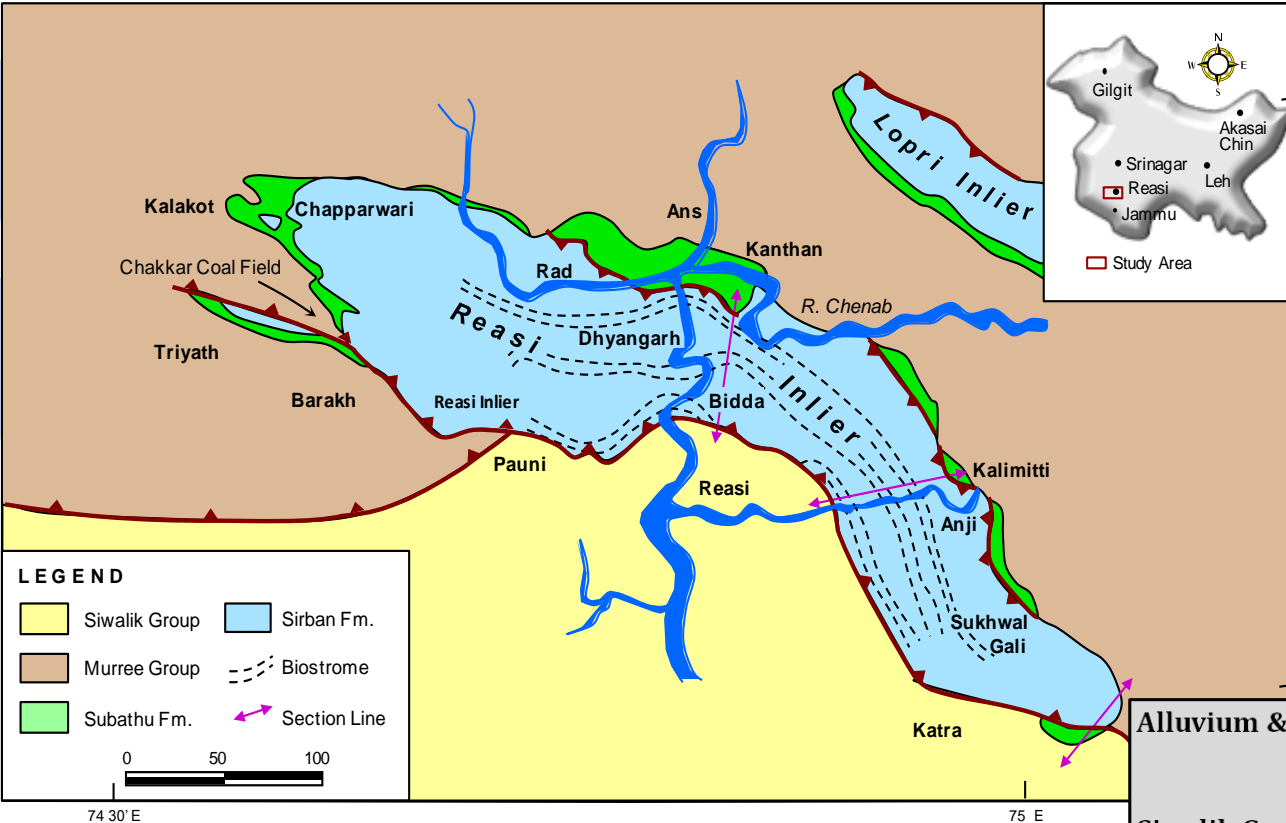


PROTEROZOIC-PHANEROZOIC BASINS IN NORTHWEST HIMALAYA





Regional geological map with location of the Sirban Formation Inliers and generalized stratigraphy
(Map modified after Gansser, 1964)



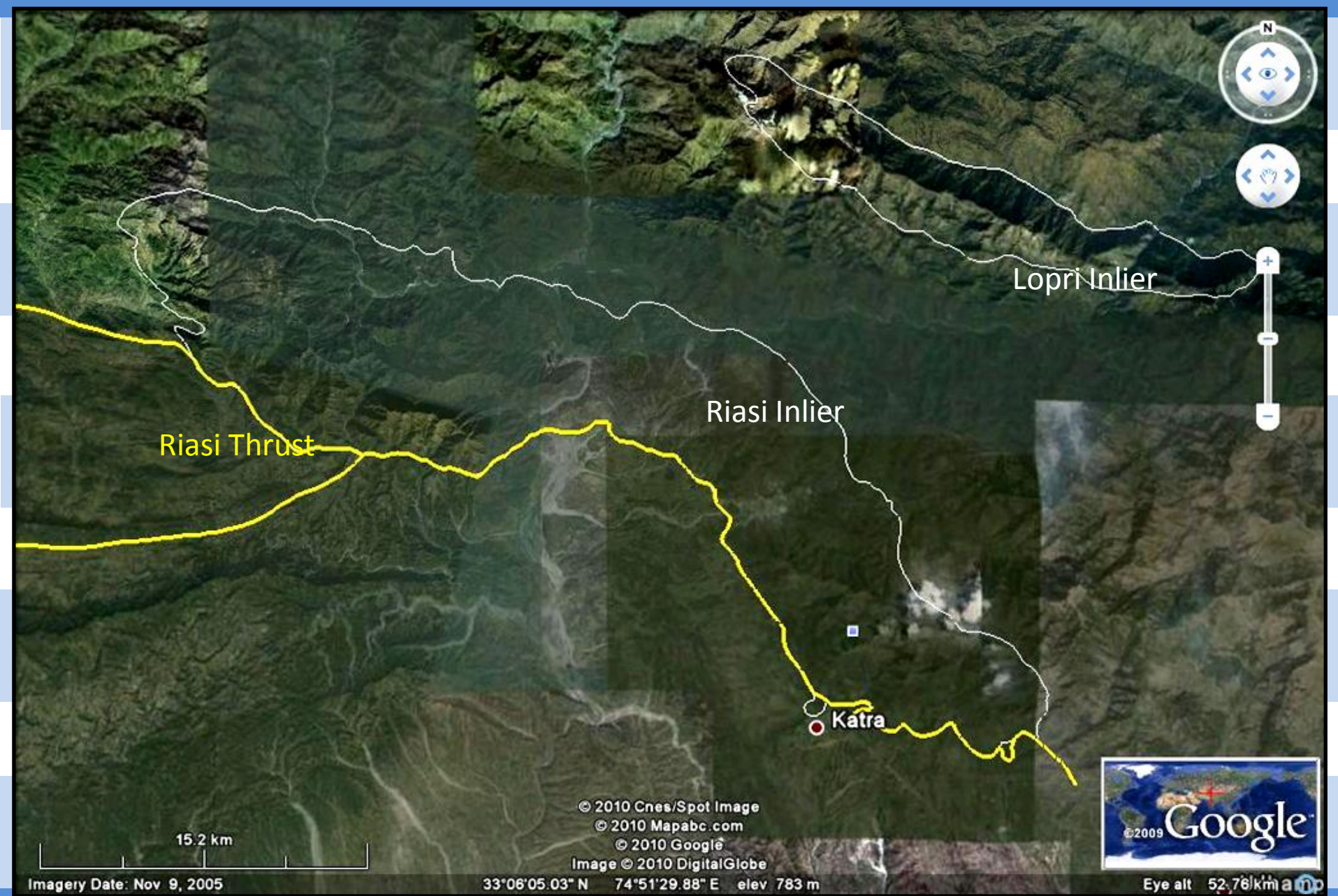
Geological map of the Reasi Inlier and adjoining areas showing key localities and thrust contacts

General Stratigraphic Succession Of The Area

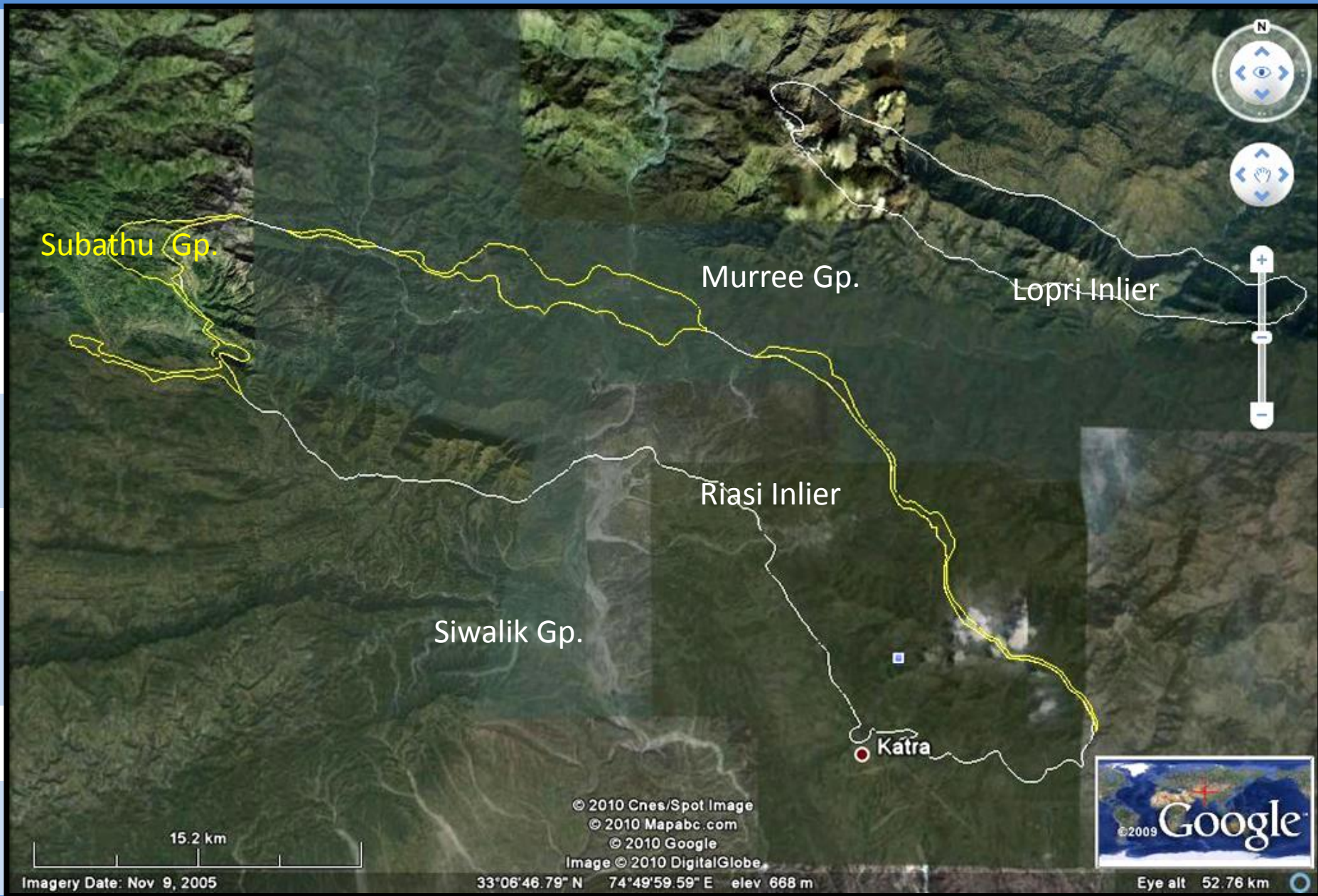
Alluvium & terrace deposits	Recent & Sub recent
Siwalik Group	Mio- Plio- Pleistocene
Murree Group	Up. Eocene- Lr. Miocene
Subathu Group	Eocene
-----Back thrust----- (Marked by Brecciated unit & Bauxite beds)	
Sirban Limestone Fm.	Neoproterozoic
-----Base not exposed-----	



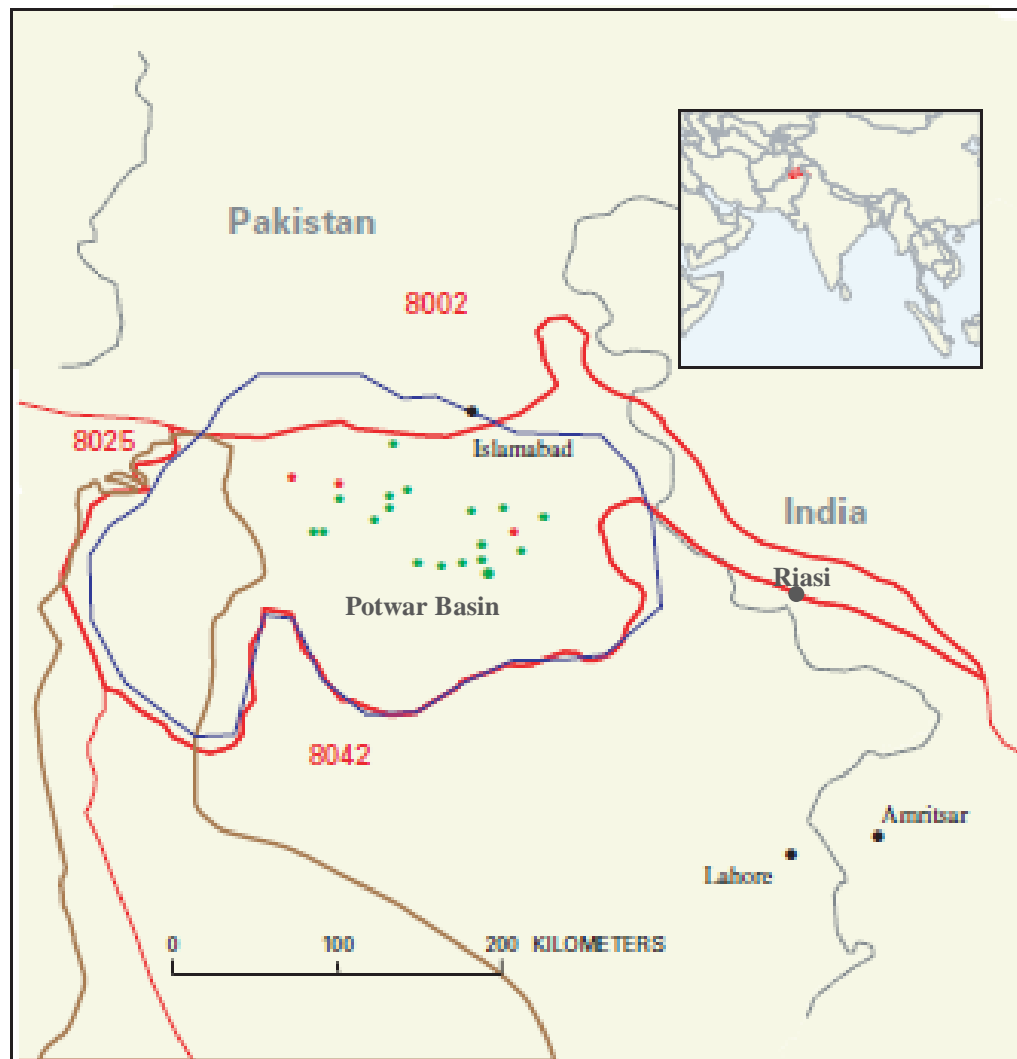
Satellite imagery of the study area



Satellite imagery of the southern contact of the Riasi Inlier, a subsidiary of MBT(Riasi Thrust=Vaishnov Devi Thrust)



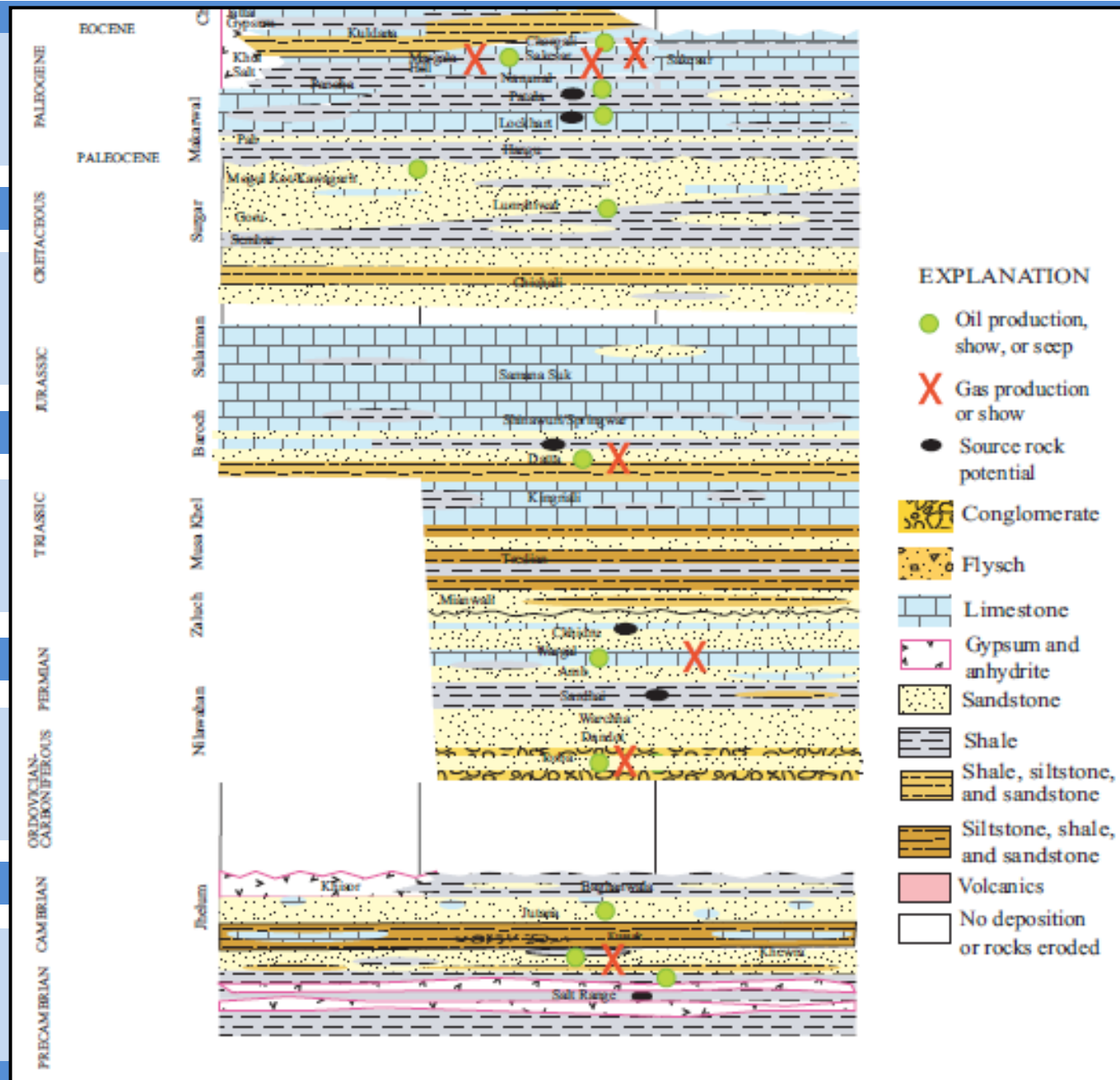
Traditionally the contact between Subathu Group and Riiasi inlier has been recognized as a major unconformity



- Patala-Nammal Total Petroleum System 802601 and Kohat-Potwar Intrathrust Basin (80260101)
- Sembar-Goru/Ghazij Total Petroleum System 804201
- Kohat-Potwar geologic province 8026
- Other geologic province boundary
- Country boundary
- Oil fields
- Gas fields

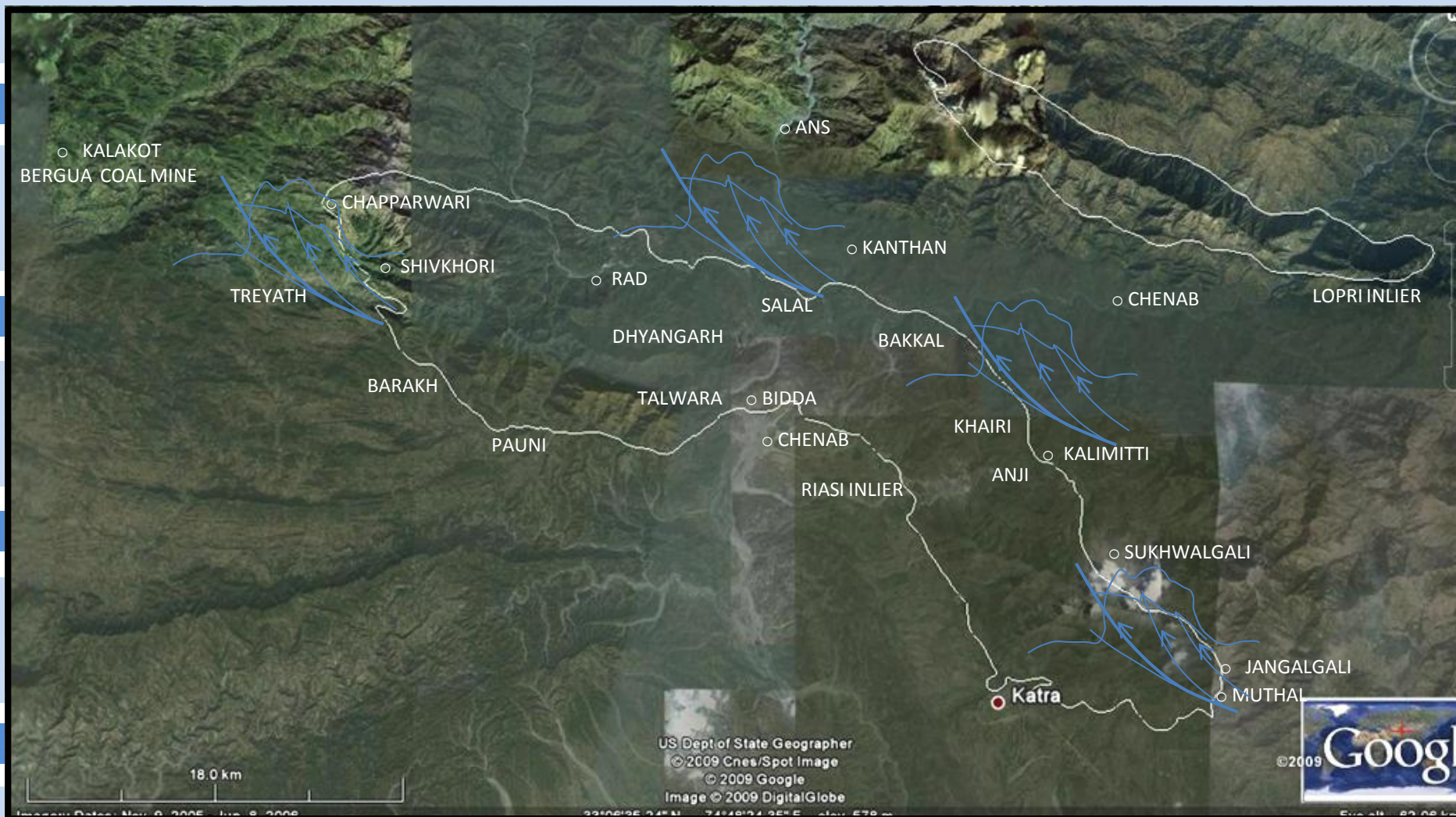
C.J. Wandrey, B.E. Law, and Haider Ali Shah
 U.S. Geological Survey Bulletin 2208-B
 Posted online February 2004

Extension of Kohat-Potwar Basin

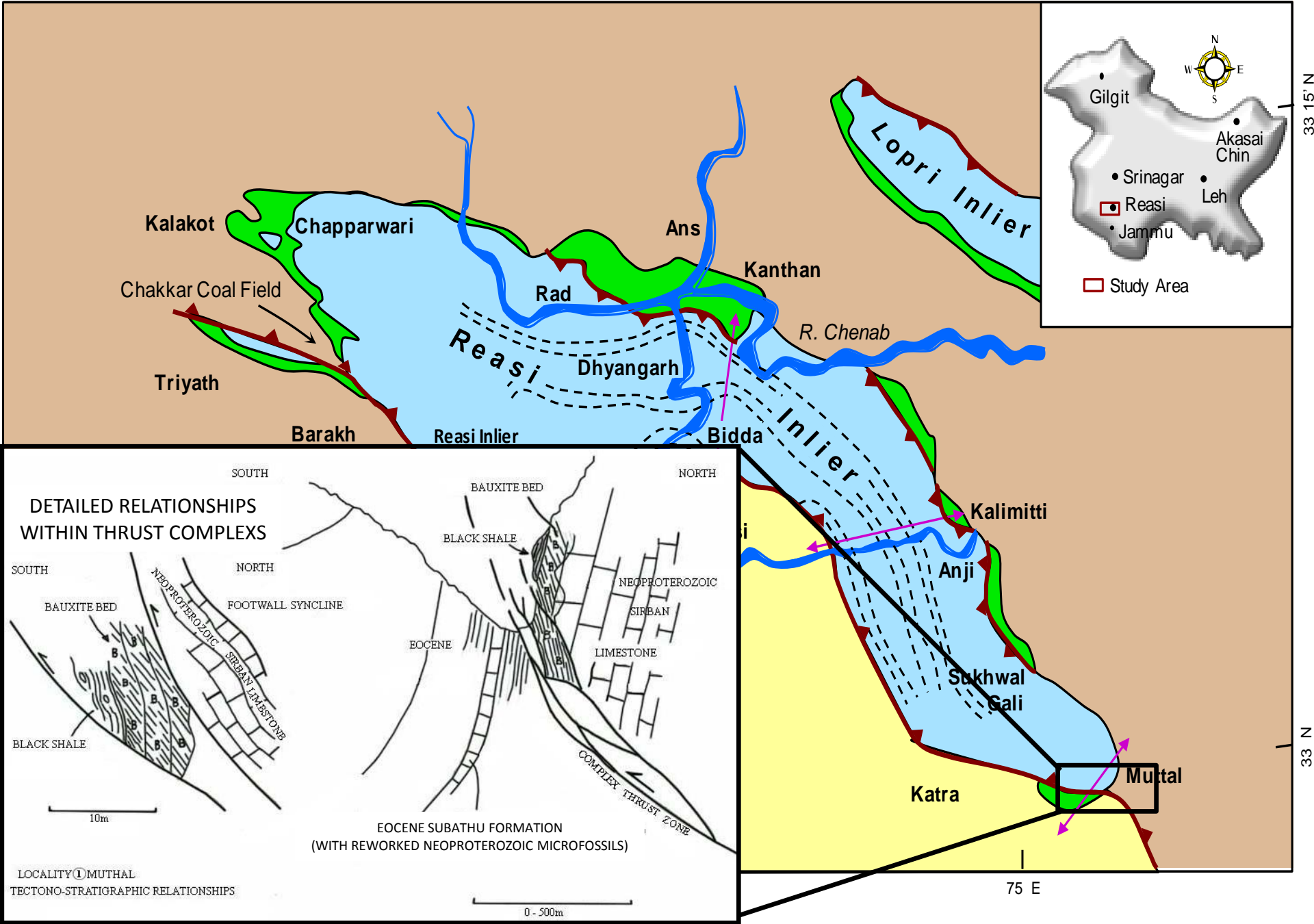


General Stratigraphy of Potwar Area

(modified from ODGC, 1996; Quadri, 1996; Kemal, 1992; Iqbal and Shah, 1980; Shah and others, 1977)

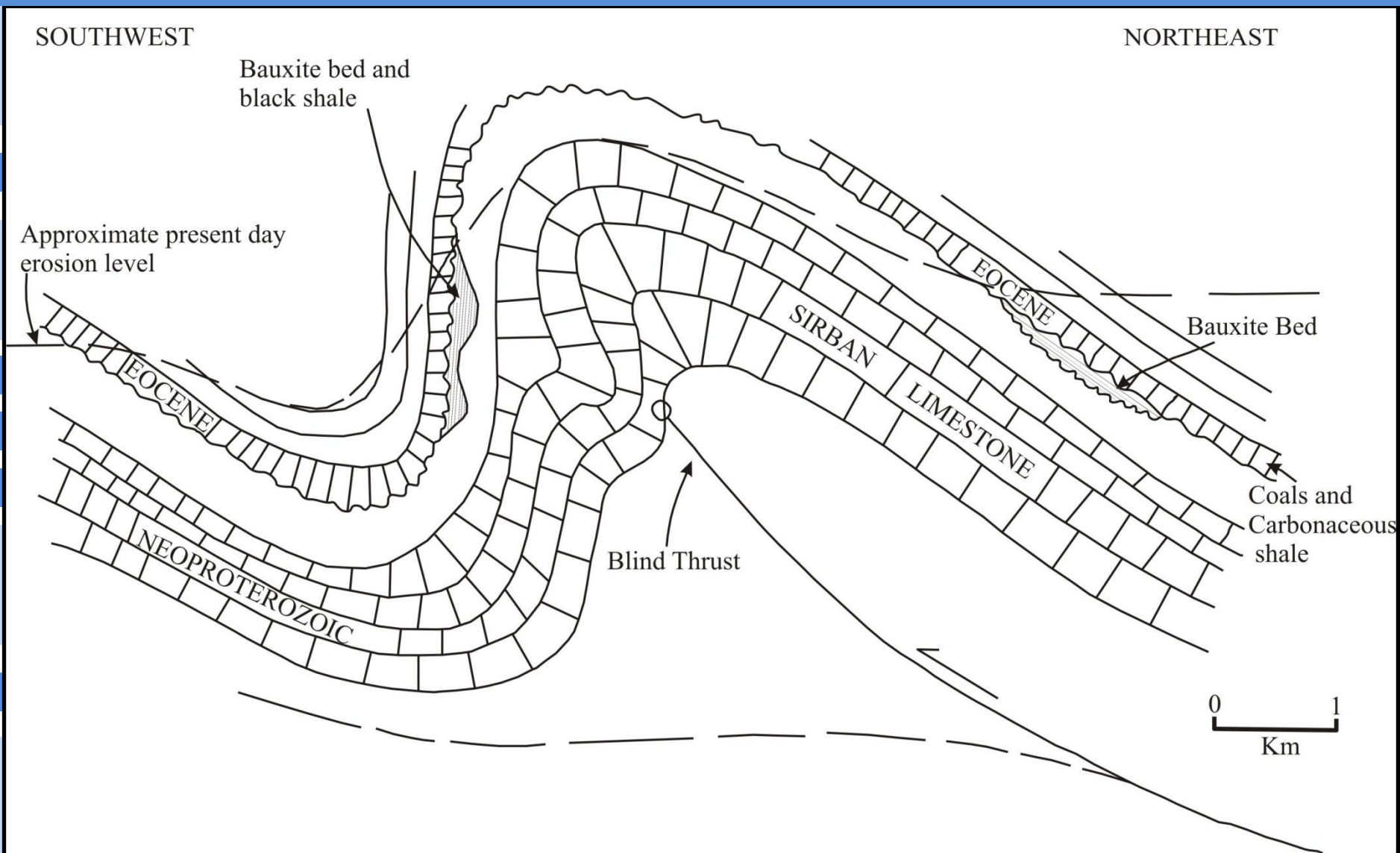


Our study reveals the contact is a Back thrust (Bhat *et al.* 2009)

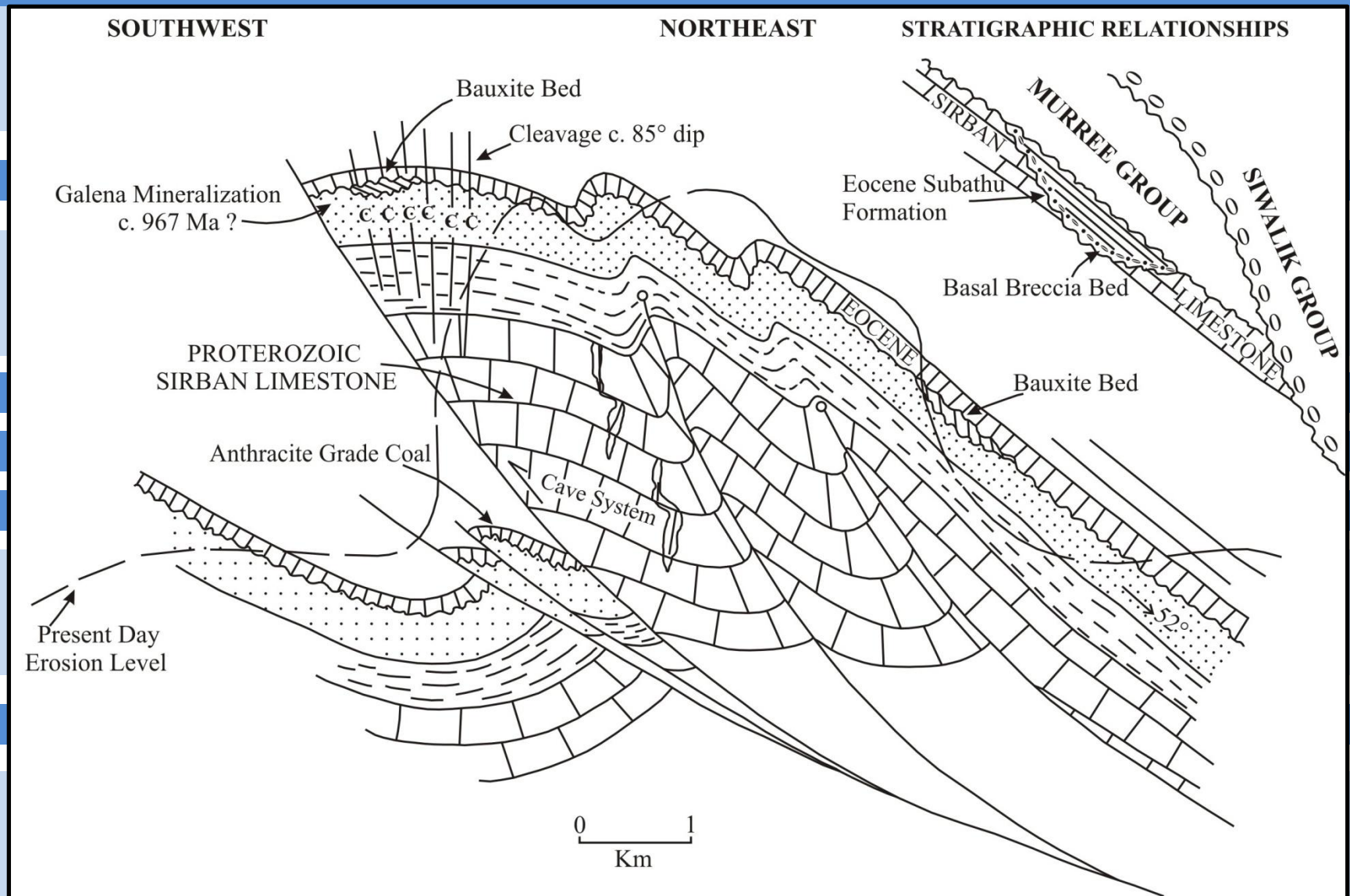


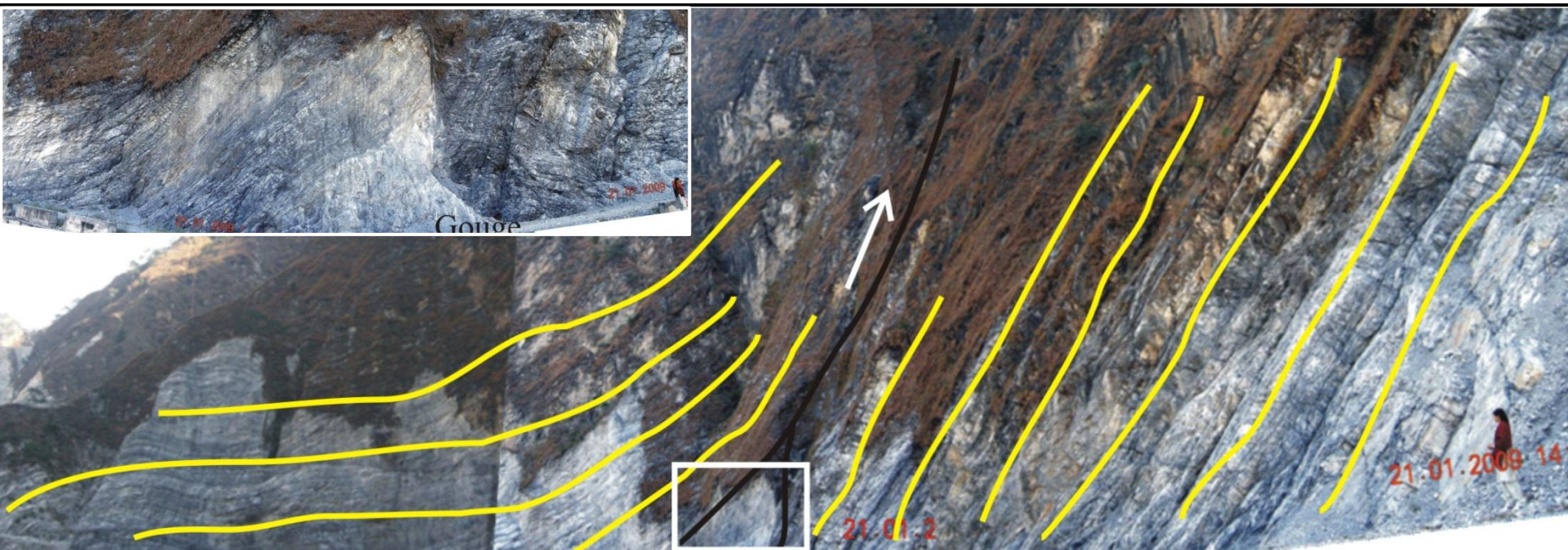
RELATIONSHIP WITHIN THRUST COMPLEX, MUTHAL

Schematic Cross-Section Through The Terminal Portions Of The Reasi Inlier, Near Jammu Jammu and Kashmir, India



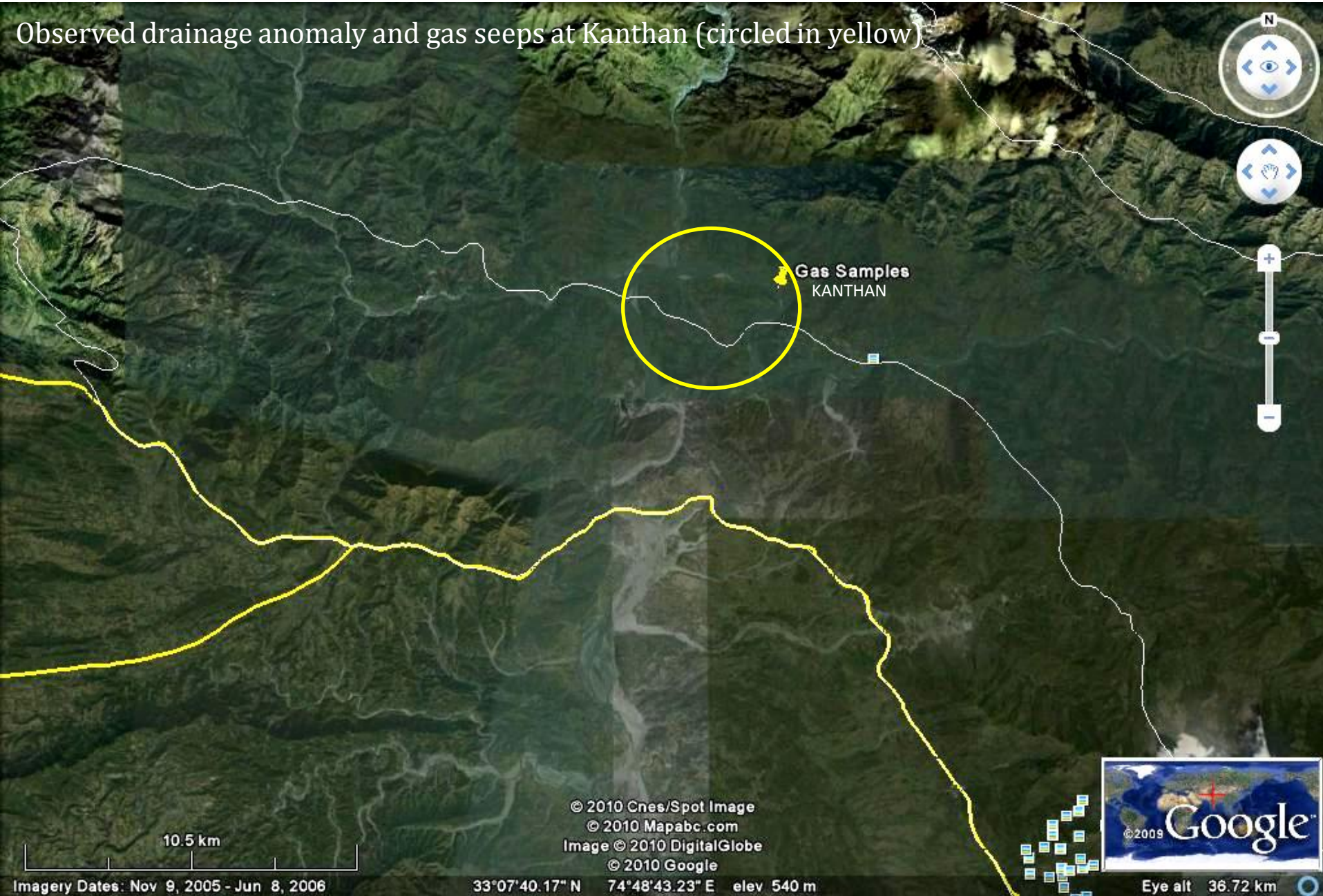
Schematic Cross-Section Through The Central Portion Of the Riasi Inlier, Near Jammu Jammu and Kashmir State, India





Observed “Triangle Zone” in the Anji valley east of the Reasi town

Satellite Image of The Reasi Inlier



Satellite Image of The Kanthan & Salal Area in Reasi Inlier

General geology around gas seep site

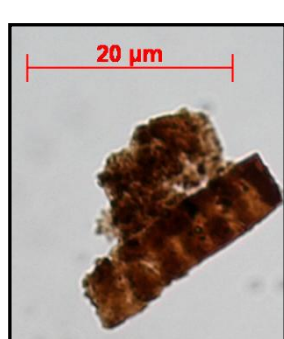


Geochemical Characterization

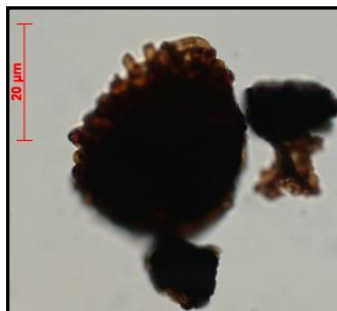
Sample	%CH ₄	%CO ₂	%N ₂	δ ¹³ C CH ₄	δ D CH ₄	δ ¹³ C CO ₂
Kanthan 1	16.2	0.6	83.2	-62.40	-182.0	-24.9

- 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%

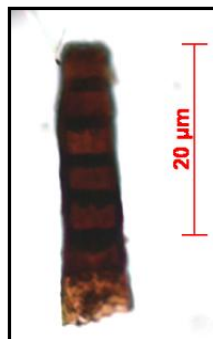
Neoproterozoic Microflora recovered from the carbonate and shale horizons of the Sirban Fm., Reasi Inlier



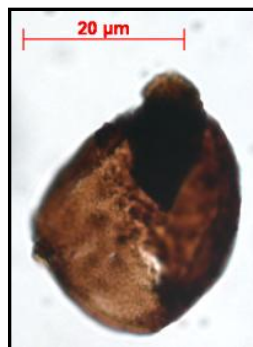
Filamentous Algae



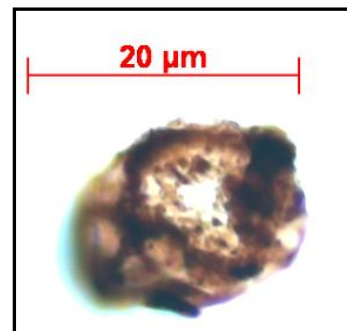
Indet.



Cyanobacterial trichomes



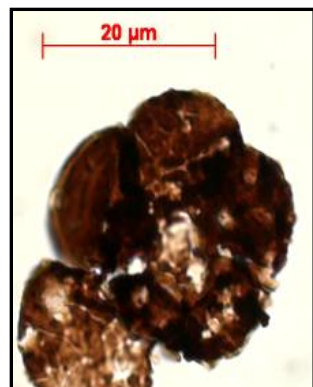
Leiosphaeridia sp.



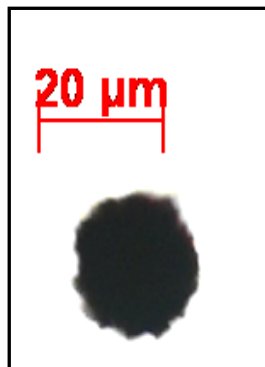
Leiosphaeridia sp.



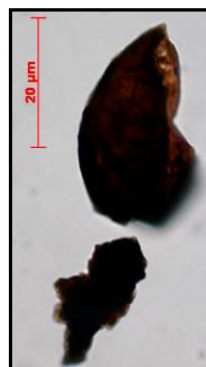
Leiosphaeridia sp.



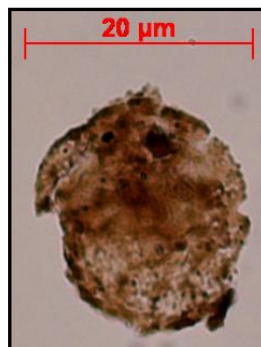
Leiosphaeridia sp.
In clusters?



Indet.



Leiosphaeridia sp.



Leiosphaeridia sp.



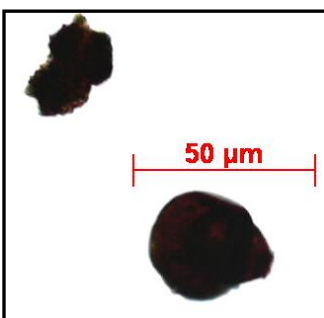
Leiosphaeridia sp.



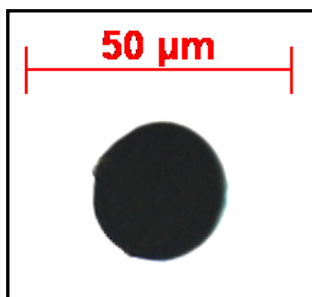
Filamentous Algae



Filamentous Algae



Tasmanite sp.



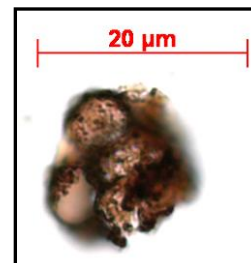
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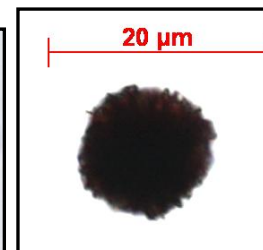
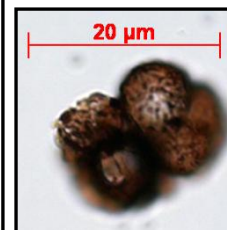
Branching Filament



Small Spheroid

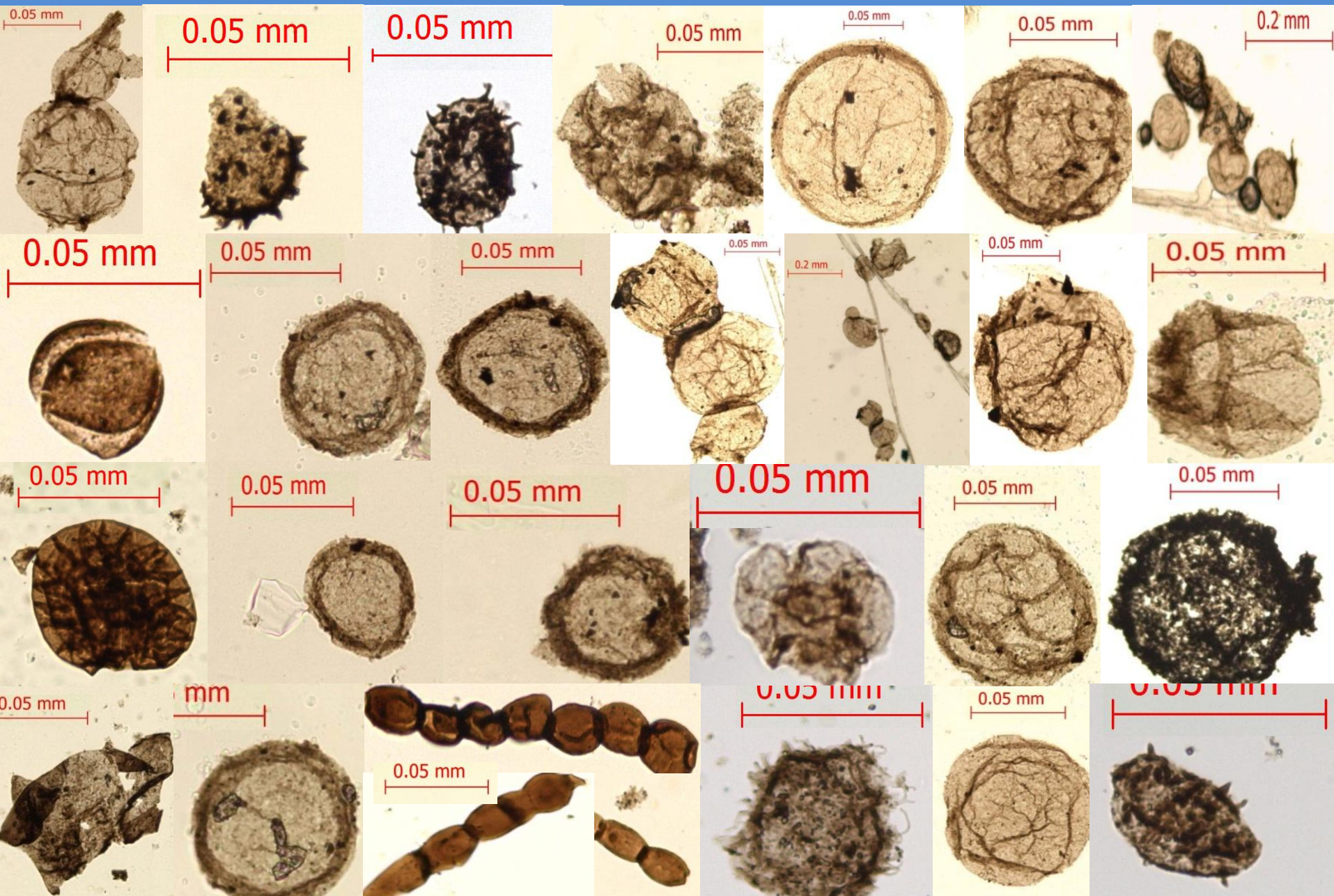


Synsphaeridium sp.

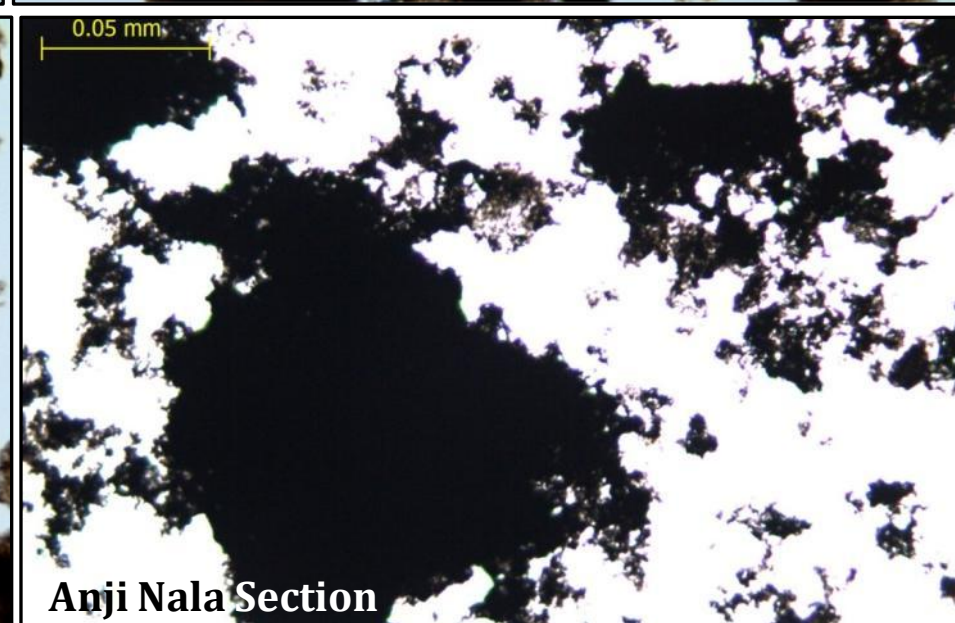
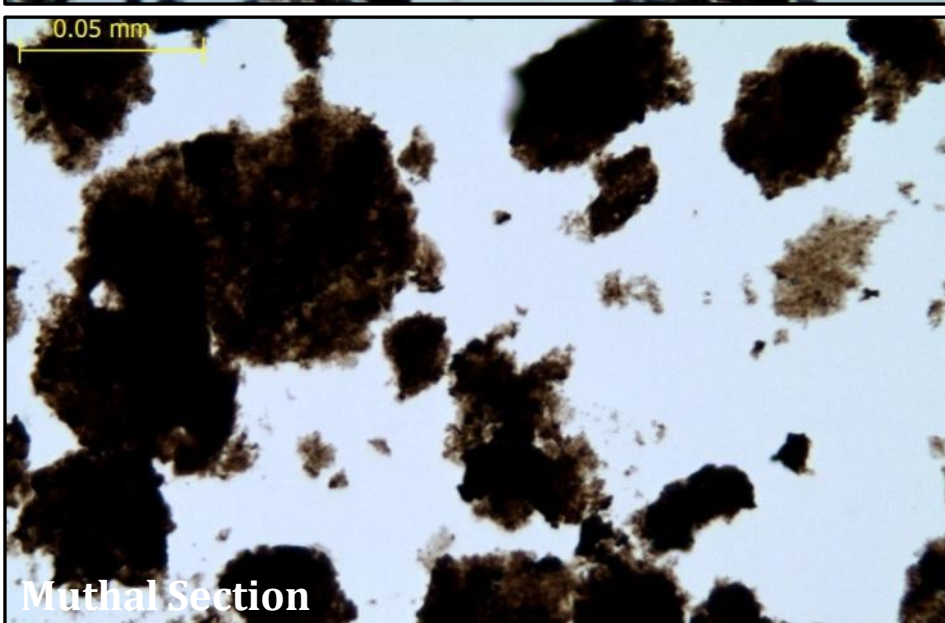
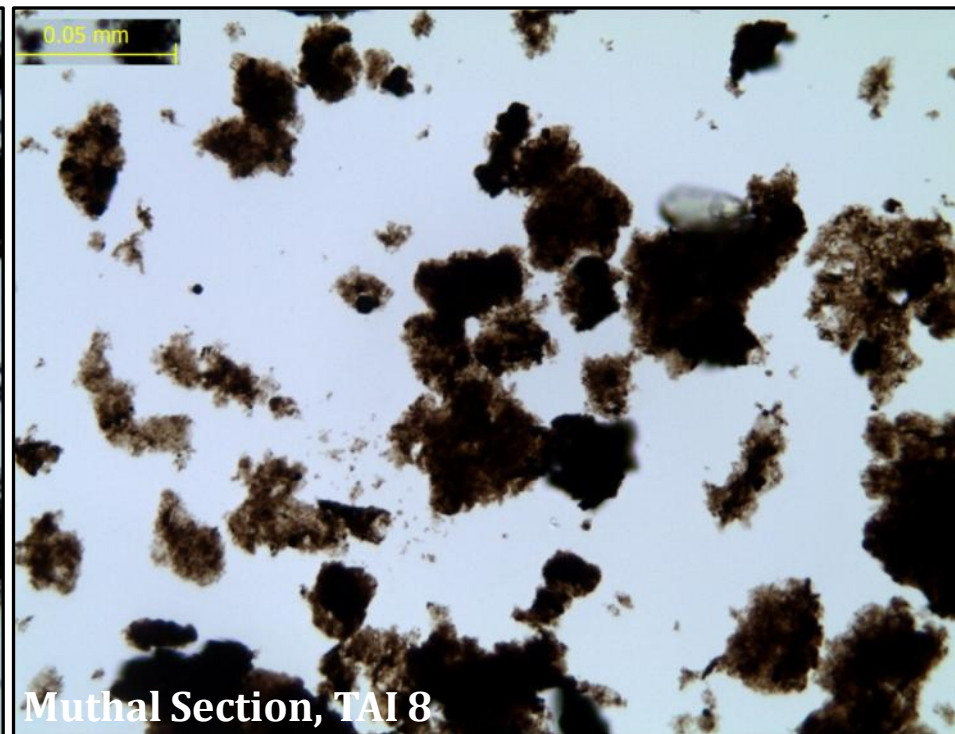
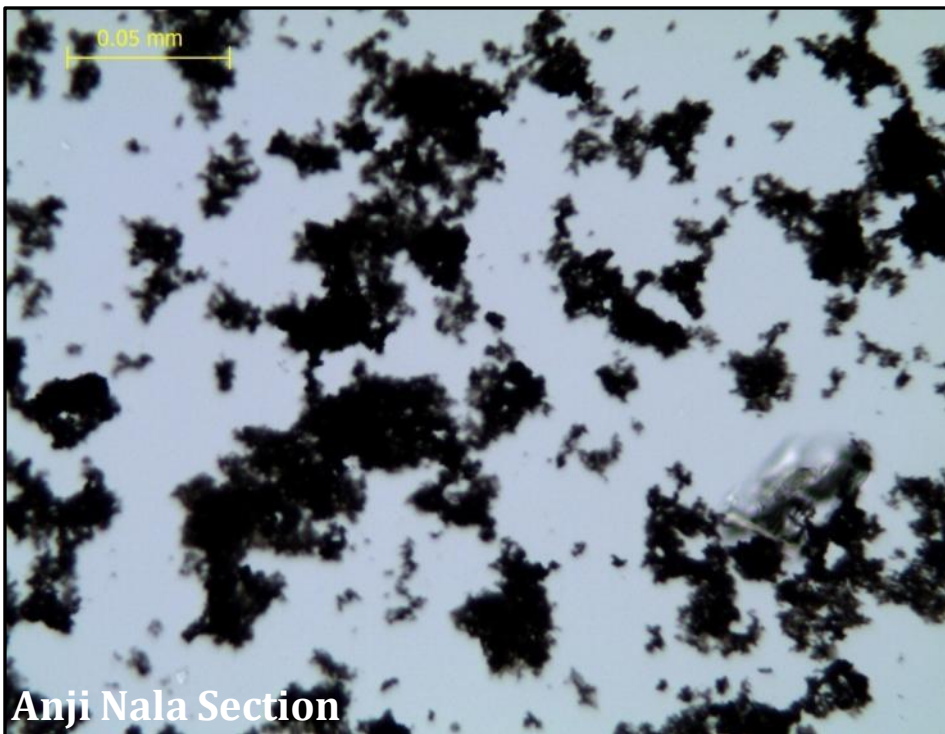


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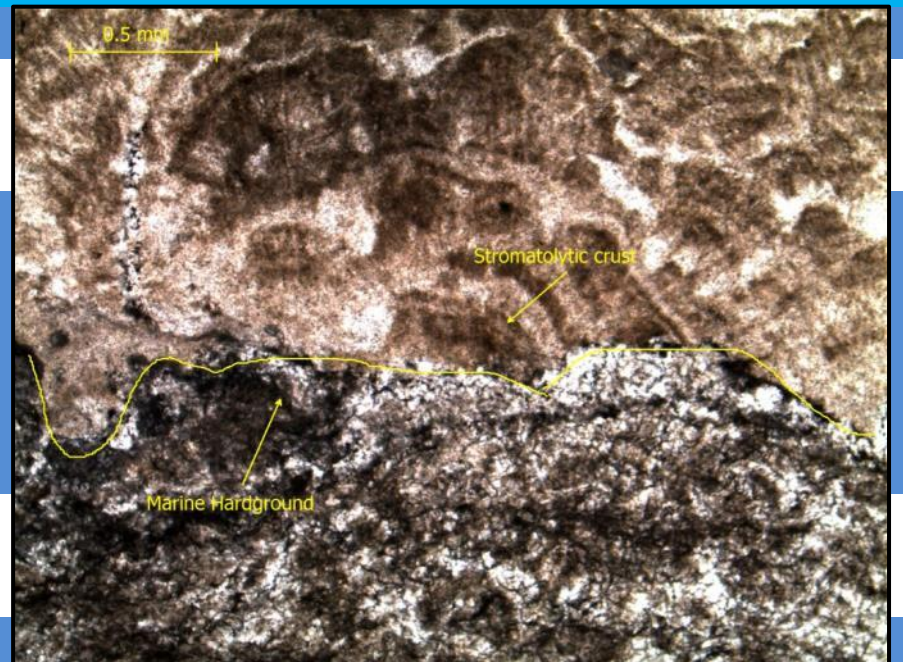
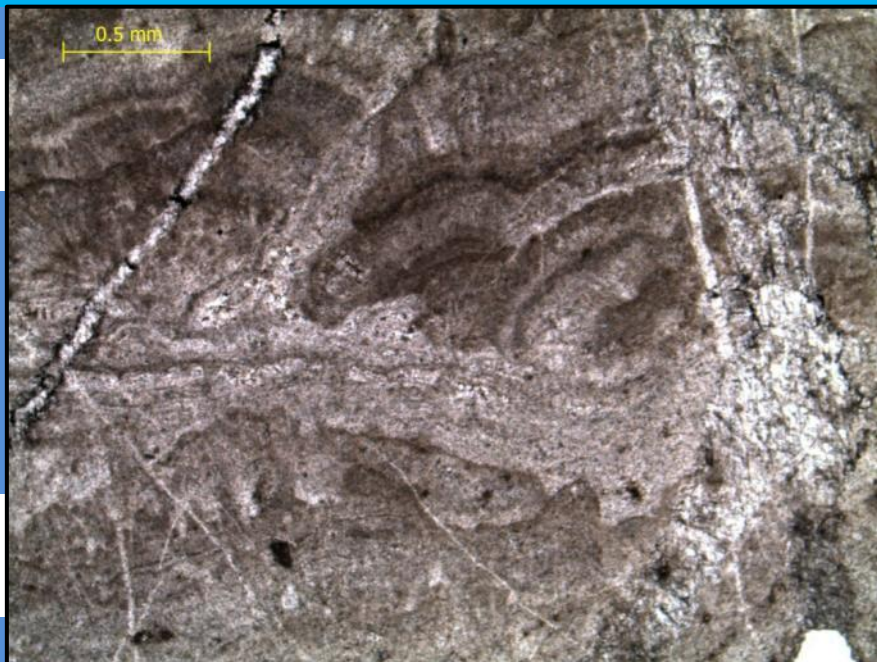
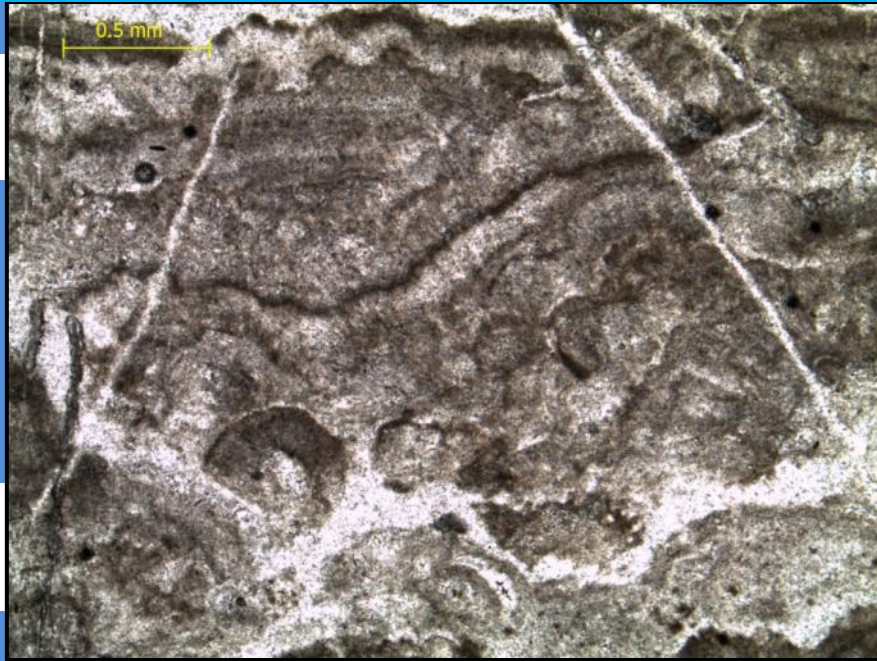
Neoproterozoic Microflora recovered from the carbonate and shale horizons of the Sirban Fm., Reasi Inlier



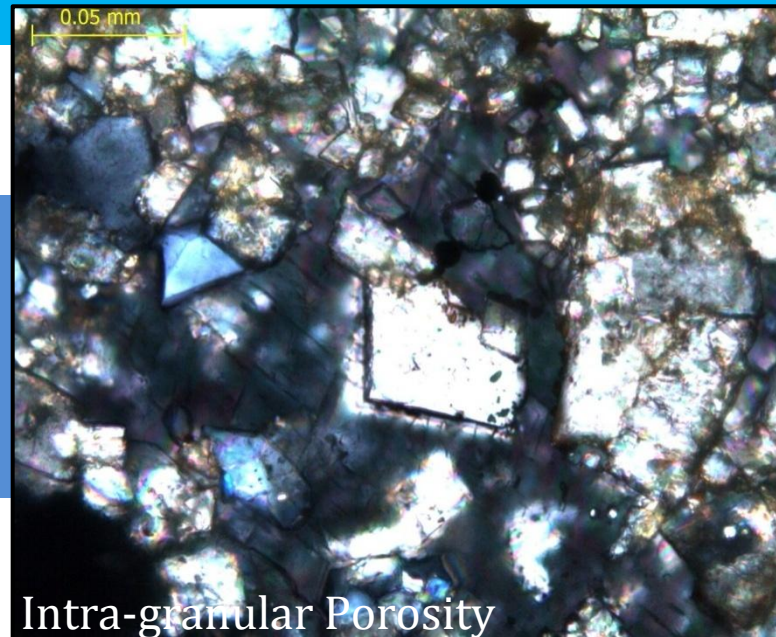
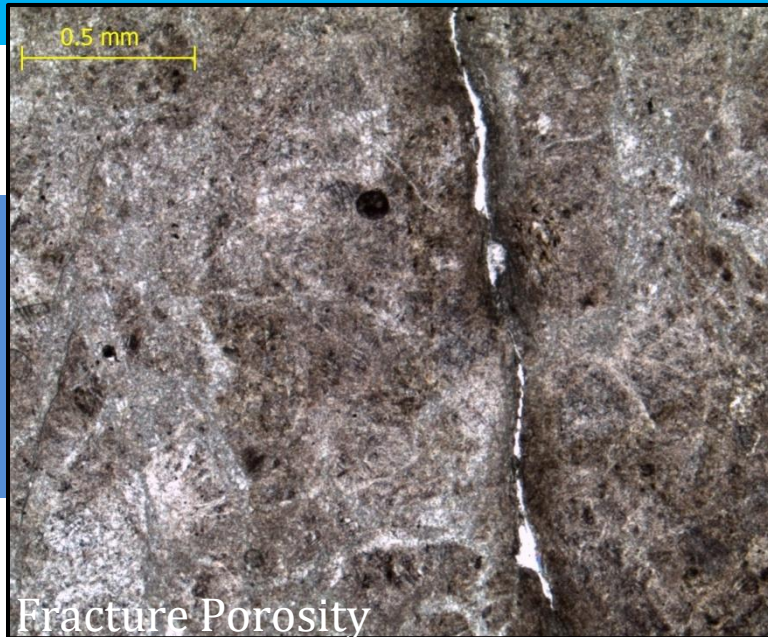
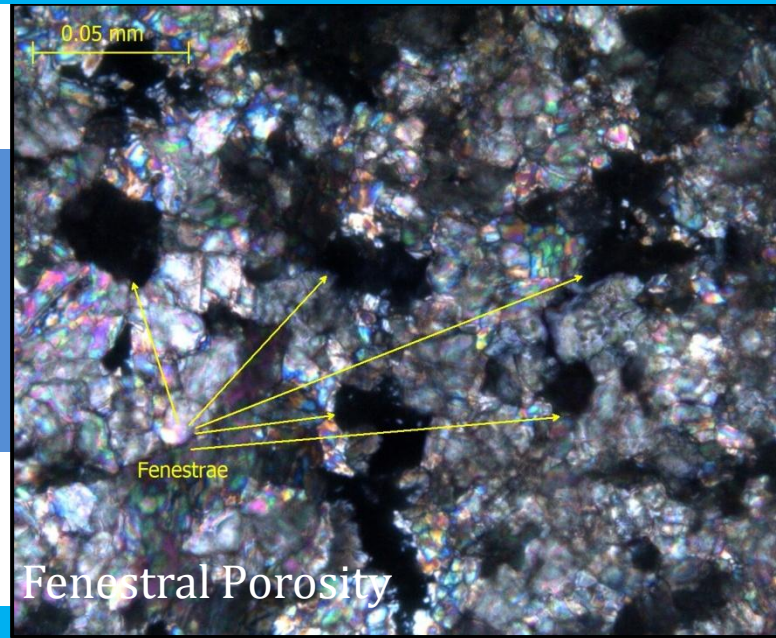
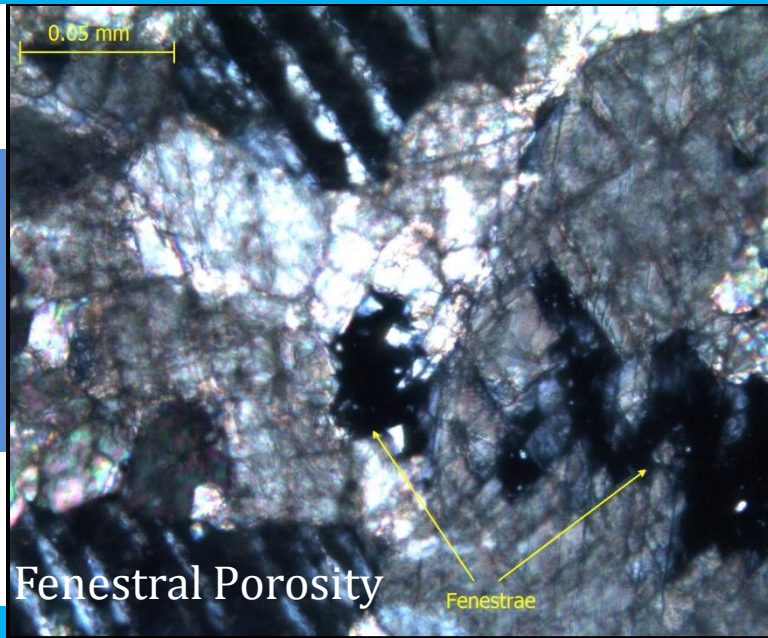
Amorphous Organic Matter recovered from the shale horizons of Sirban Fm., Reasi Inlier



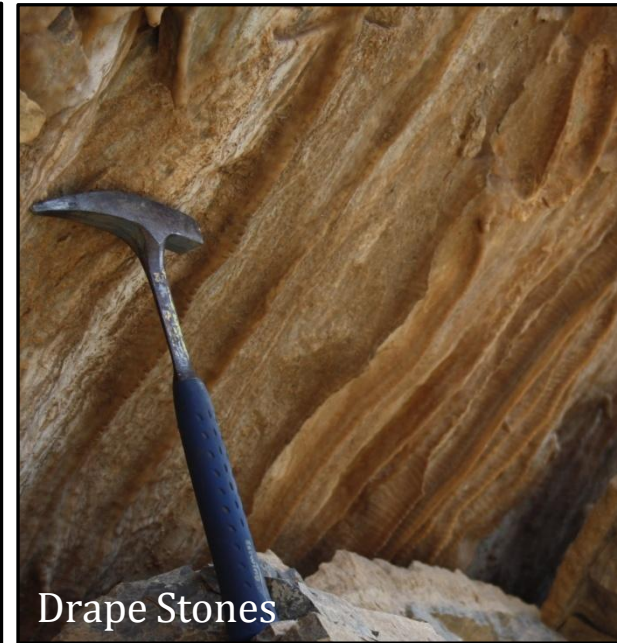
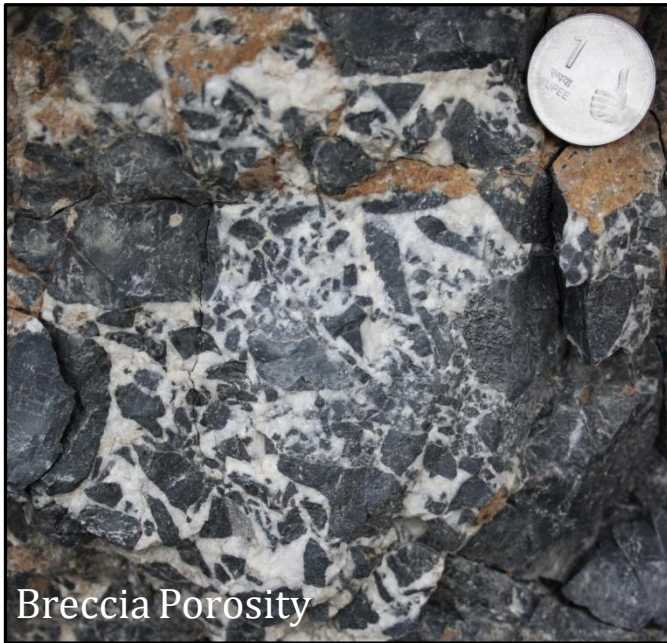
Micro Scale Algal Laminae in Sirban Limestone



Micro- scale porosity Observed In The Sirban Limestone



Macro- scale porosity Observed In The Sirban Limestone



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.

Acknowledgements

We gratefully acknowledge the support of many individuals whose efforts and encouragement have paved the way for the incremental enrichment of knowledge represented in this paper. Research funding and analytical support by eni are gratefully acknowledged.

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THANK YOU

