# Geometry and Evolution of the Sulaiman Fold Belt and Hydrocarbon Prospects*

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## Abstract

The lobate Sulaiman fold belt covering about 200,000 square kilometer along the western terminus of the Indian subcontinent is considered to be the most prolific hydrocarbon province of Pakistan. Integrated surface geology and subsurface seismic data has allowed recognizing the geometry and evolution of the Sulaiman fold belt as a passive-roof duplex, with the absence of a thrust fault at the mountain front and presence of surface monoclines with exposure of progressively older strata towards the internal parts of the system.

A key balanced cross-section across the Sulaiman fold belt exhibits fold-and-thrust structures in the form of two detachment folds (Sui and Loti gas fields) with about 10 km depth of the detachment in the Triassic or older strata at the mountain front. They are transformed into a passive-roof duplex geometry further north. The duplex structures are characterized by the fault-bend folds and anticlinal stacks, as prospects, with an overlap of a considerably long roof sequence. The roof-sequence is devoid of any thrust for about 60 km north of the tip of the first duplex. It is, however, breached by the foreland and hinterland verging reverse faults bounding tight anticlines of Cretaceous and younger strata in the central Sulaiman fold belt. These reverse faults of limited lateral extent and displacement are recognized not to qualify the definition of a nappe structure. They are interpreted to be related to the active evolution of a passive-roof duplex, with abundance of seismic activity in the central Sulaiman fold belt. Some of these faults are observed to show a dominant component of dextral strike-slip displacement, suggesting imprints of transpression and rotation along the western edge of the Indian plate.

## References

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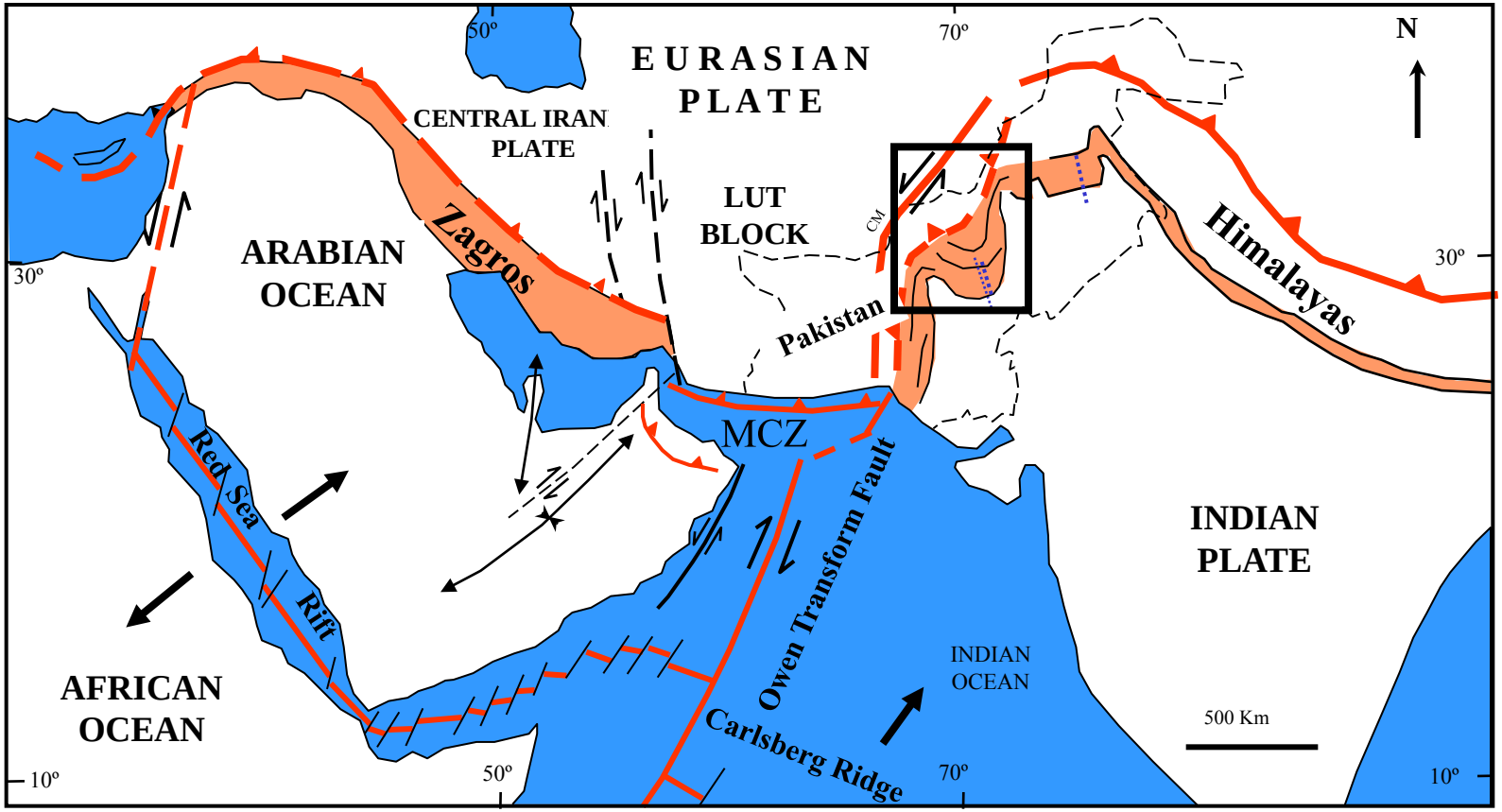
# GEOMETRY AND EVOLUTION OF THE SULAIMAN FOLD BELT AND HYDROCARBON PROSPECTS

# Sulaiman Fold Belt

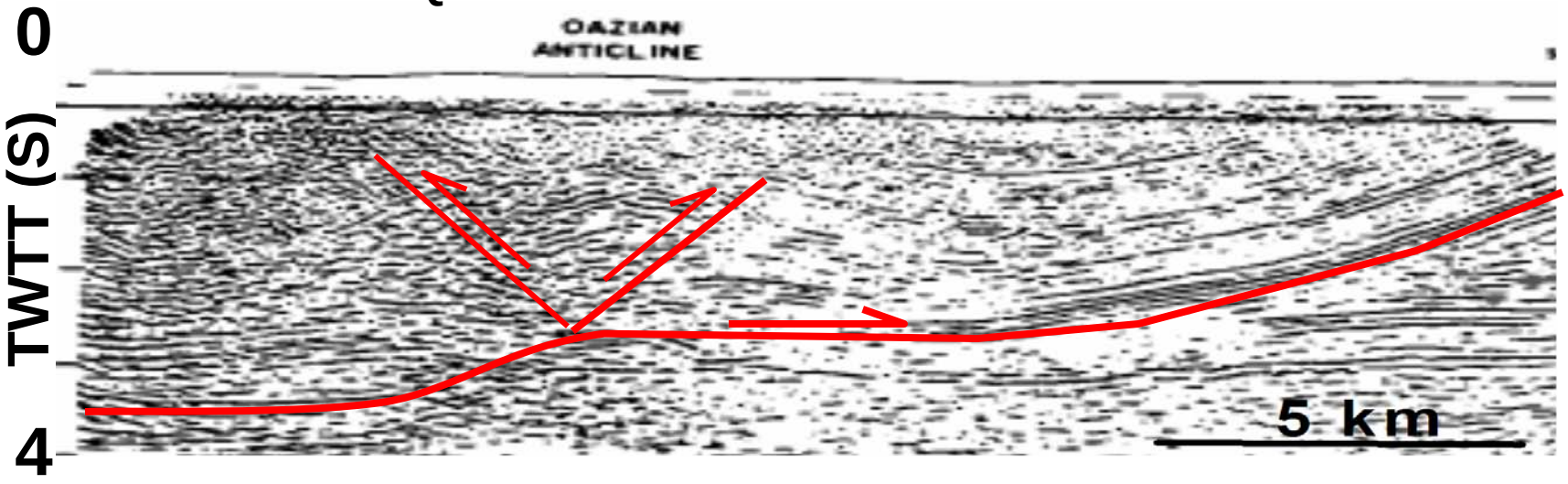



Modified from Marzouk & Sattar (1994), Jadoon et al. (1997)

# Mechanics of Foreland Deformation

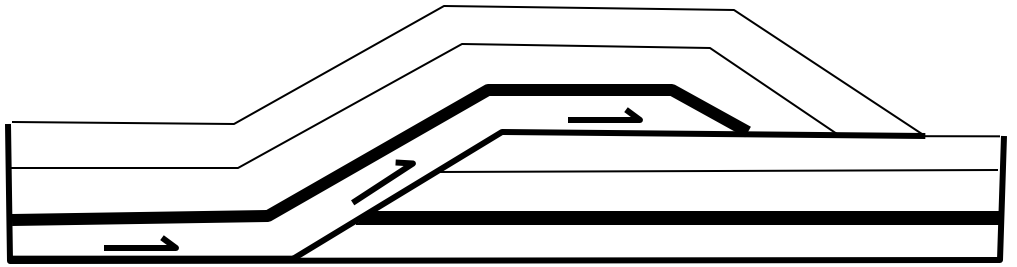


**QAZIAN ANTICLINE**

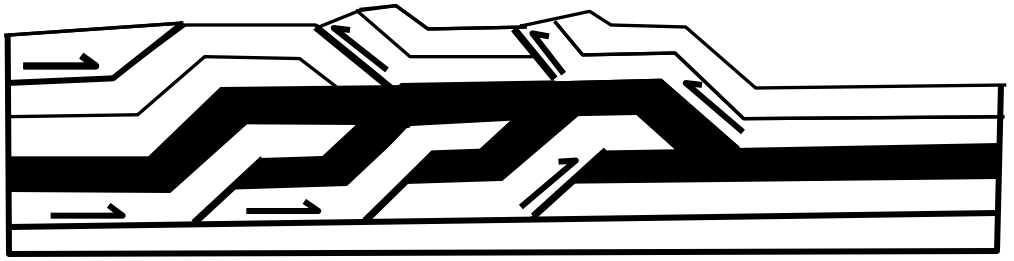


# Structural Model

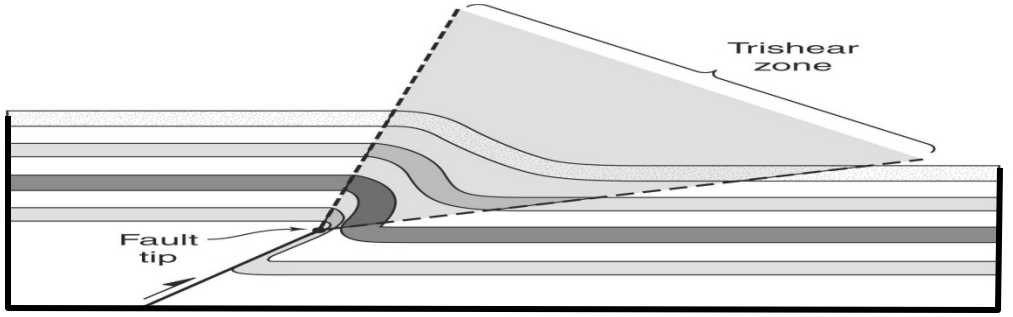
1. Imbricate Structures
   (Bannert et al., 1992)



2. Duplex Structures
   (Jadoon et al., 1994)



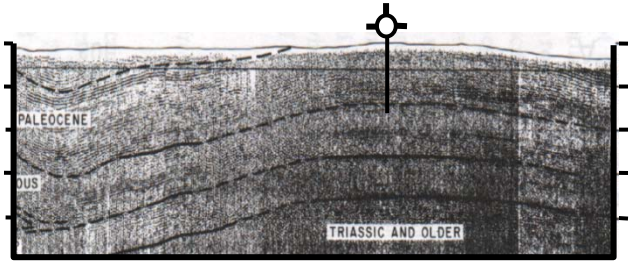
3. Basement Inversion
   (Coward, 1994)



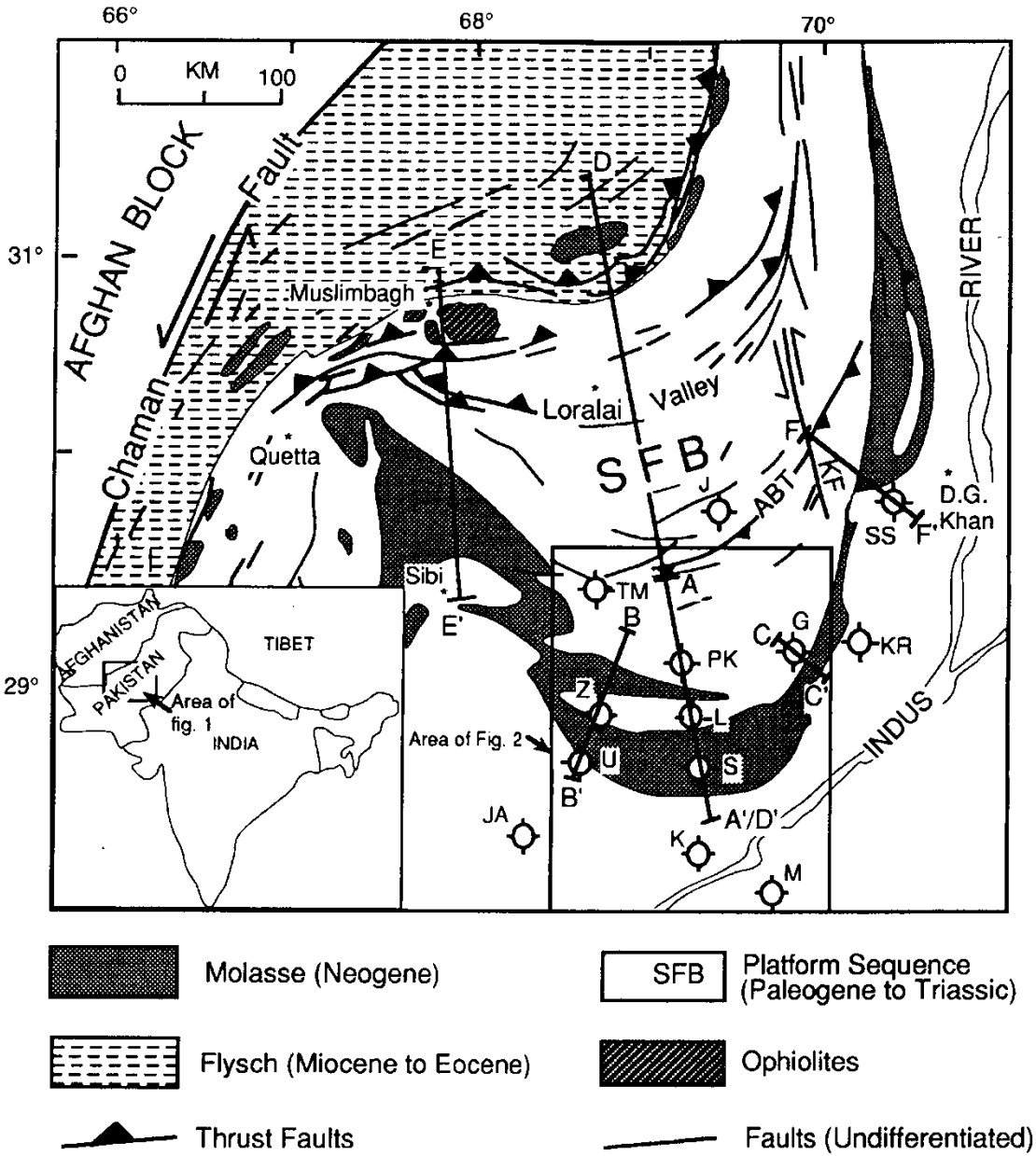
# Data & Methodology

- **Surface geology**
- **Landsat / Spot Images**
- **Borehole data**
- **Seismic reflection profiles**
- **Gravity data**

**BALANCED SECTIONS**

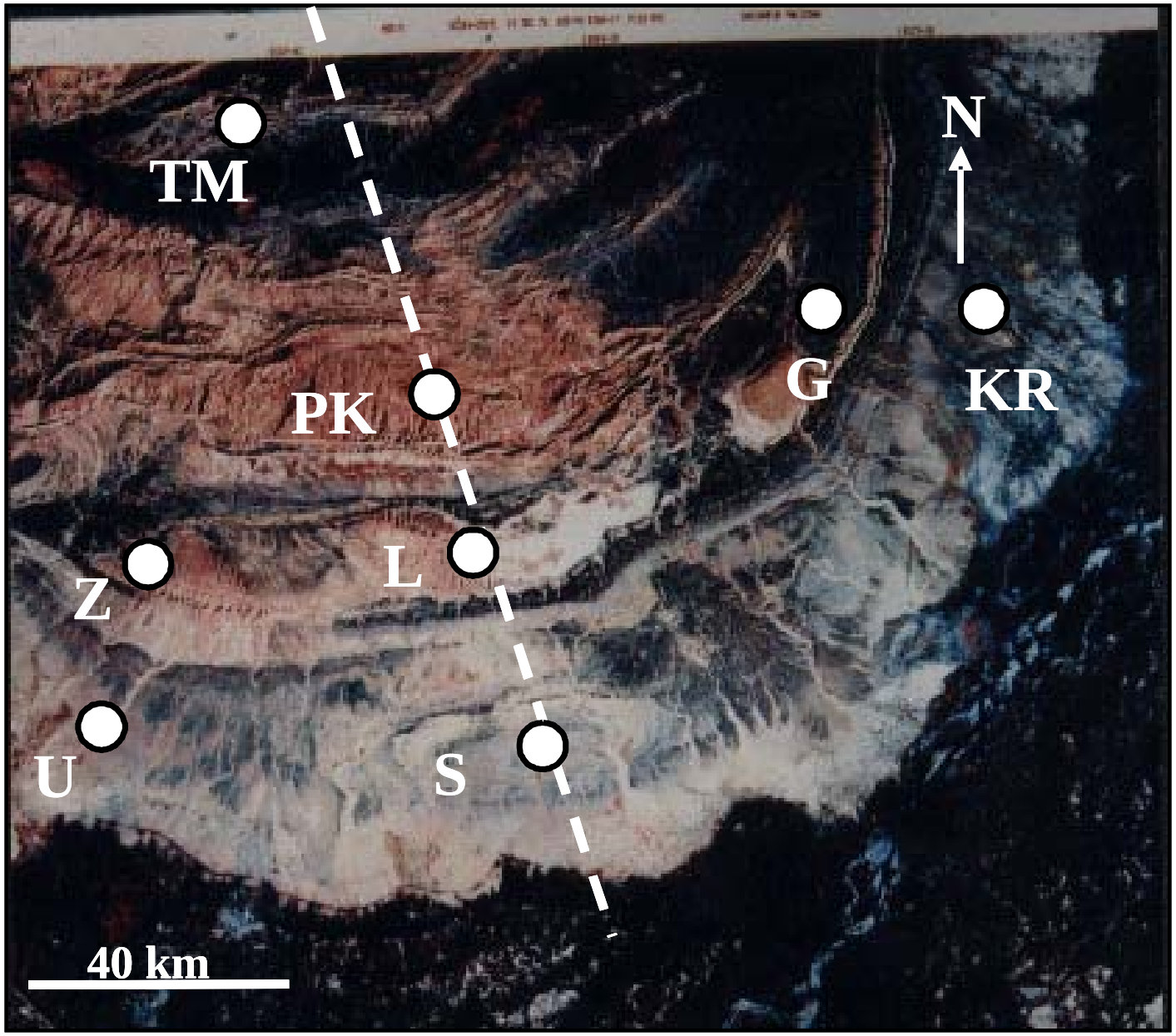


# Sulaiman Fold Belt

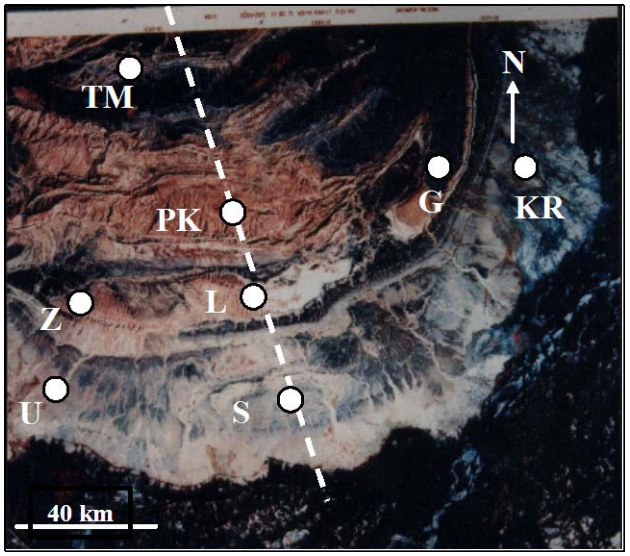


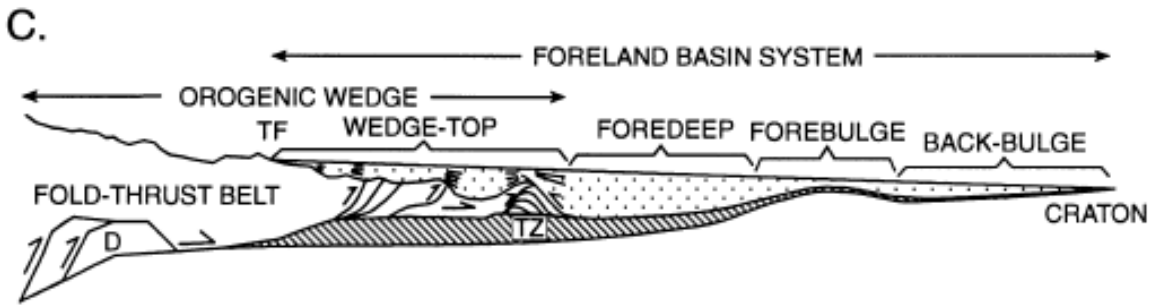
| KM | AGE | FORMATION | LITHOLOGY and SEIS. VEL. (app) | SYM-BOLS | TECTONOSTRATIGRAPHIC UNIT | DECOLLEMENT | |
|---|---|---|---|---|---|---|---|
| | NEOGENE | SIWALIK | 2500 m/s | Tm | Molasse synorogenic deposits | | ROOF SEQUENCE |
| | PALEOGENE | KIRTHAR | 2800 m/s | T (e+p) | Initial collision sequence of shallow marine rocks | | |
| | | GHAZIJ | | | | | |
| | | DUNGAN | | | | | |
| | | RANIKOT | | | | | |
| | CRETACEOUS | PAB | | K | Post-rift deposits | | |
| | | MUGHALKOT | | | | Main Roof Thrust | |
| | | PARH | 3800 m/s | | | | |
| | | GORU | | | | | |
| | | SEMBAR | | | | | |
| 5 | JURASSIC | CHILTAN | 4500 m/s | J | | | DUPLEX SEQUENCE |
| | | LORALAI | | | | | |
| | TRIASSIC | ALOZAI | 5000 m/s | Tr | | | |
| | PALEOZOIC | | Not exposed or drilled | Pal | Syn- and pre-rift deposits ? | Main Floor Thrust | FLOOR SEQUENCE |
| 10 | PRECAMBRIAN | | | | | | |

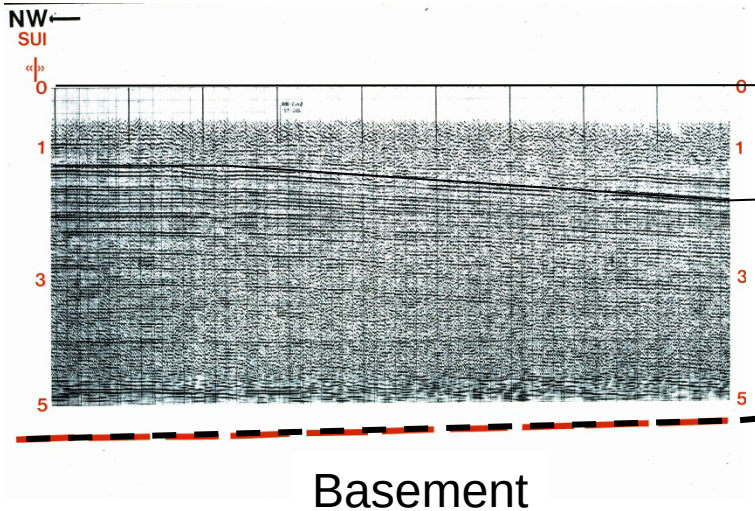
# Sulaiman Foreland



# Sulaiman Foredeep



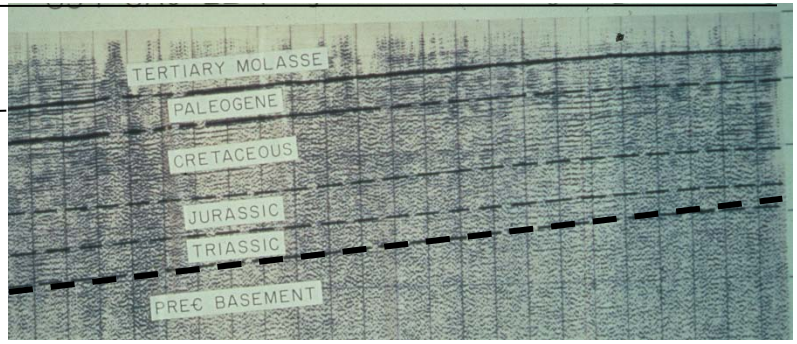

Basement

**Tertiary Molasse**

**Eocene to Paleozoic Platform Seq.**

**834-SA-22 (Migrated)**

4 km



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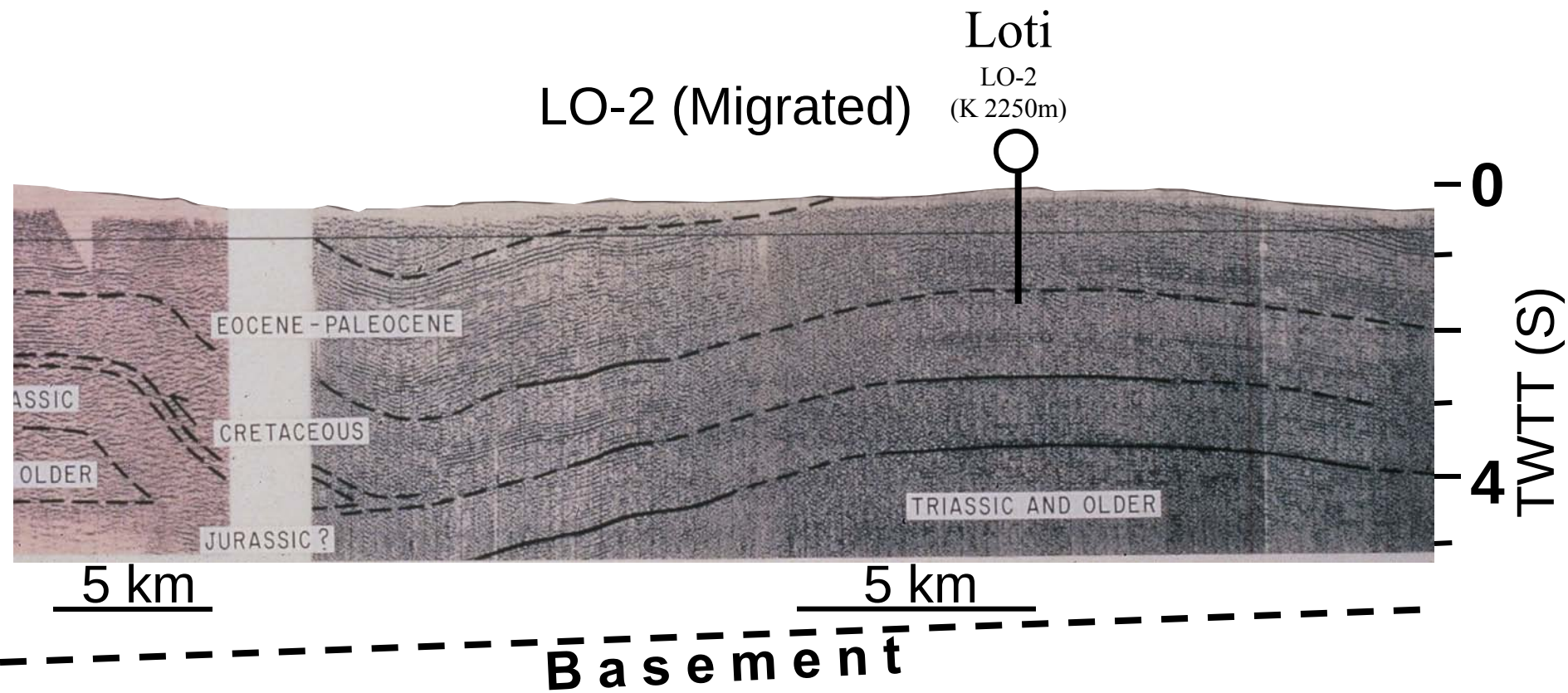

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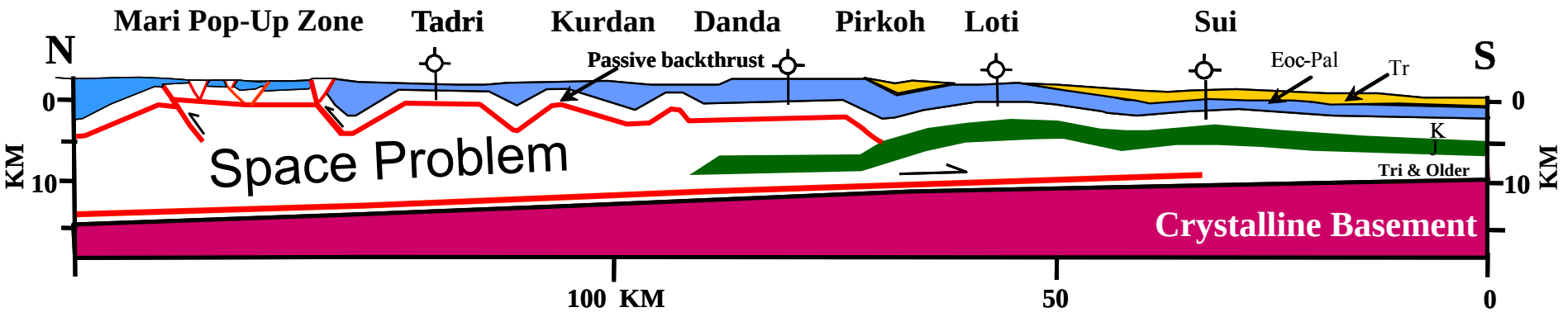
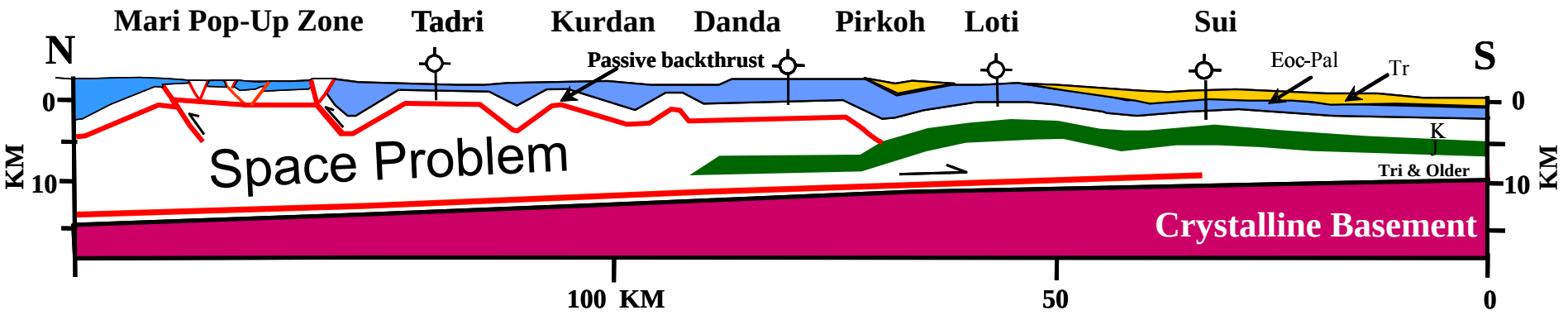


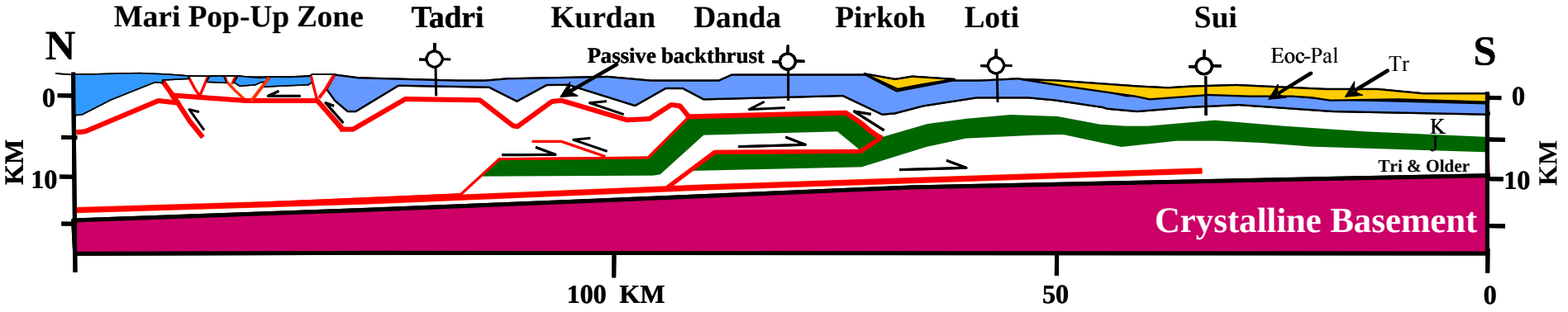

Eocene
(Kohlu)

Cretaceous
(Tadri)

Eocene
(Pirkoh)

# Sulaiman Foreland



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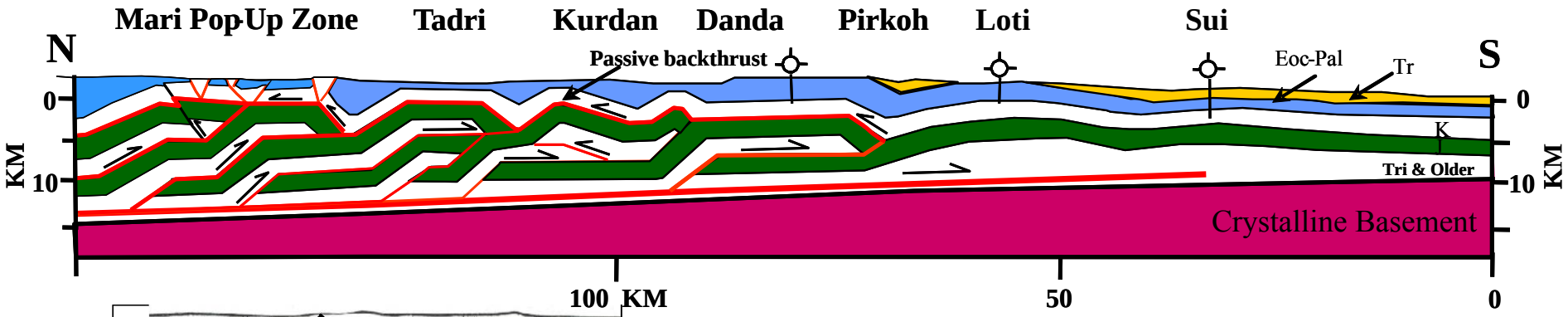
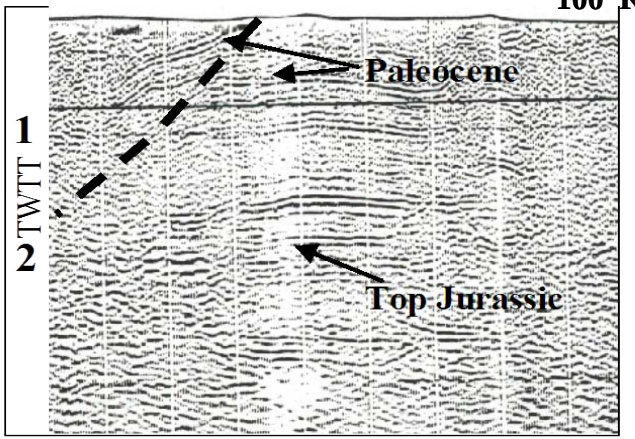
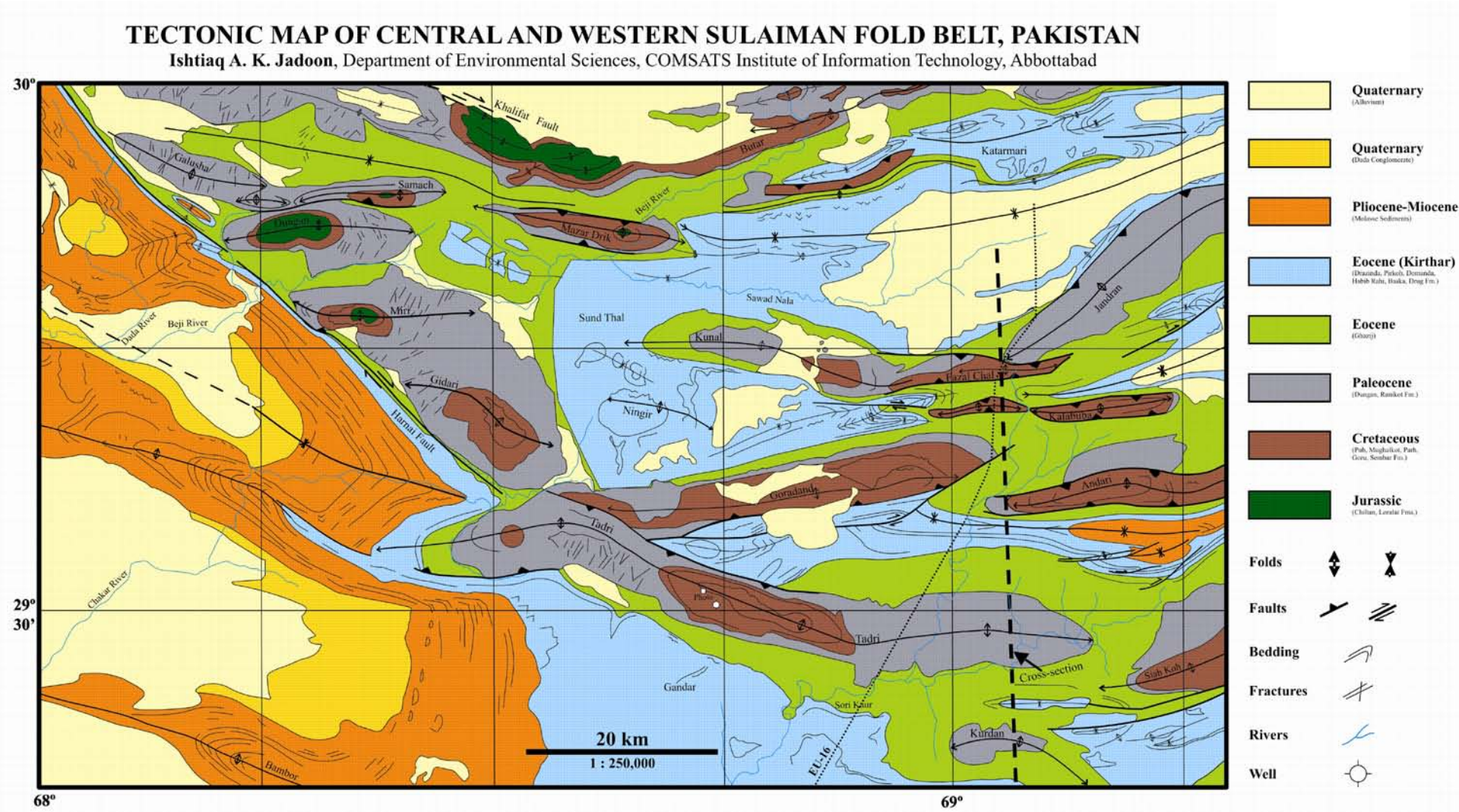


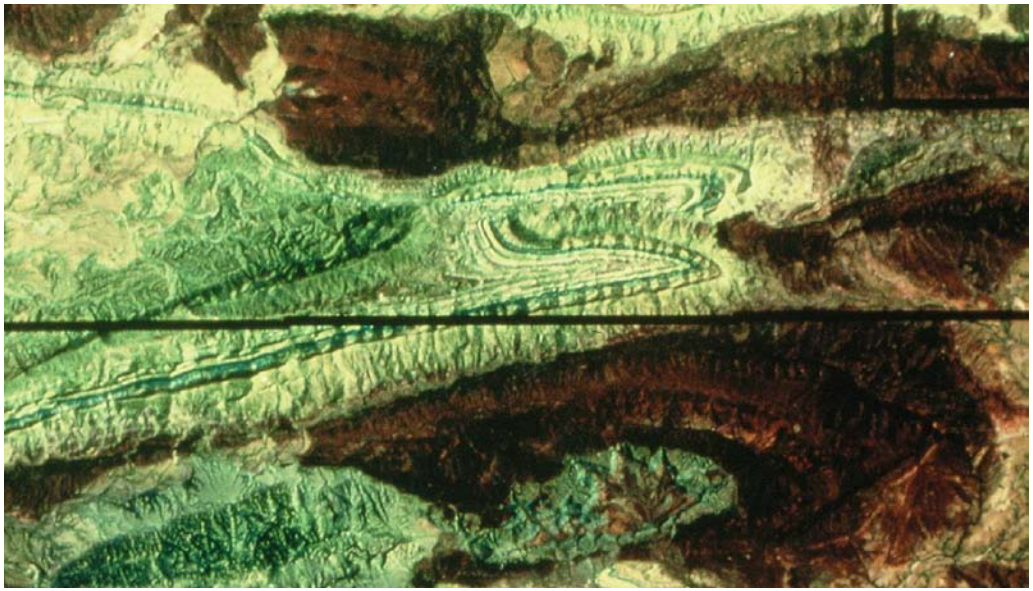


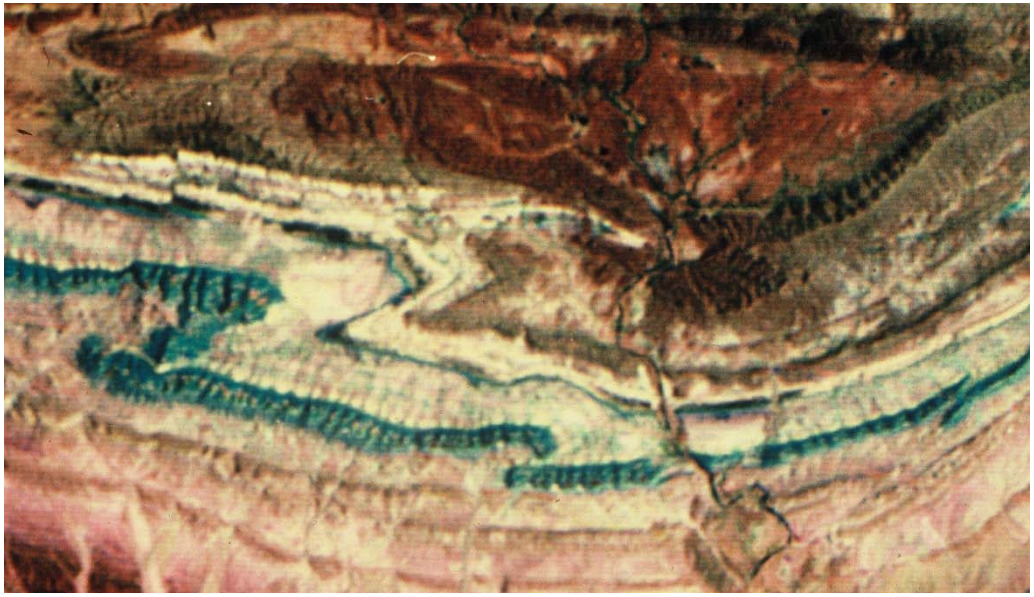
# Western Sulaiman Fold Belt

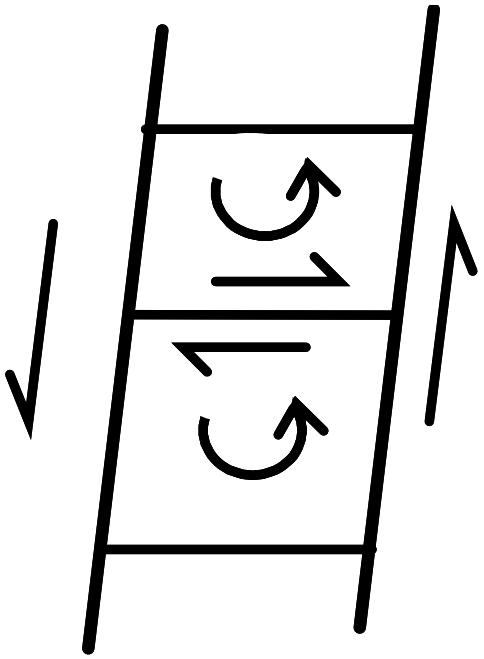
# Central Sulaiman Fold belt



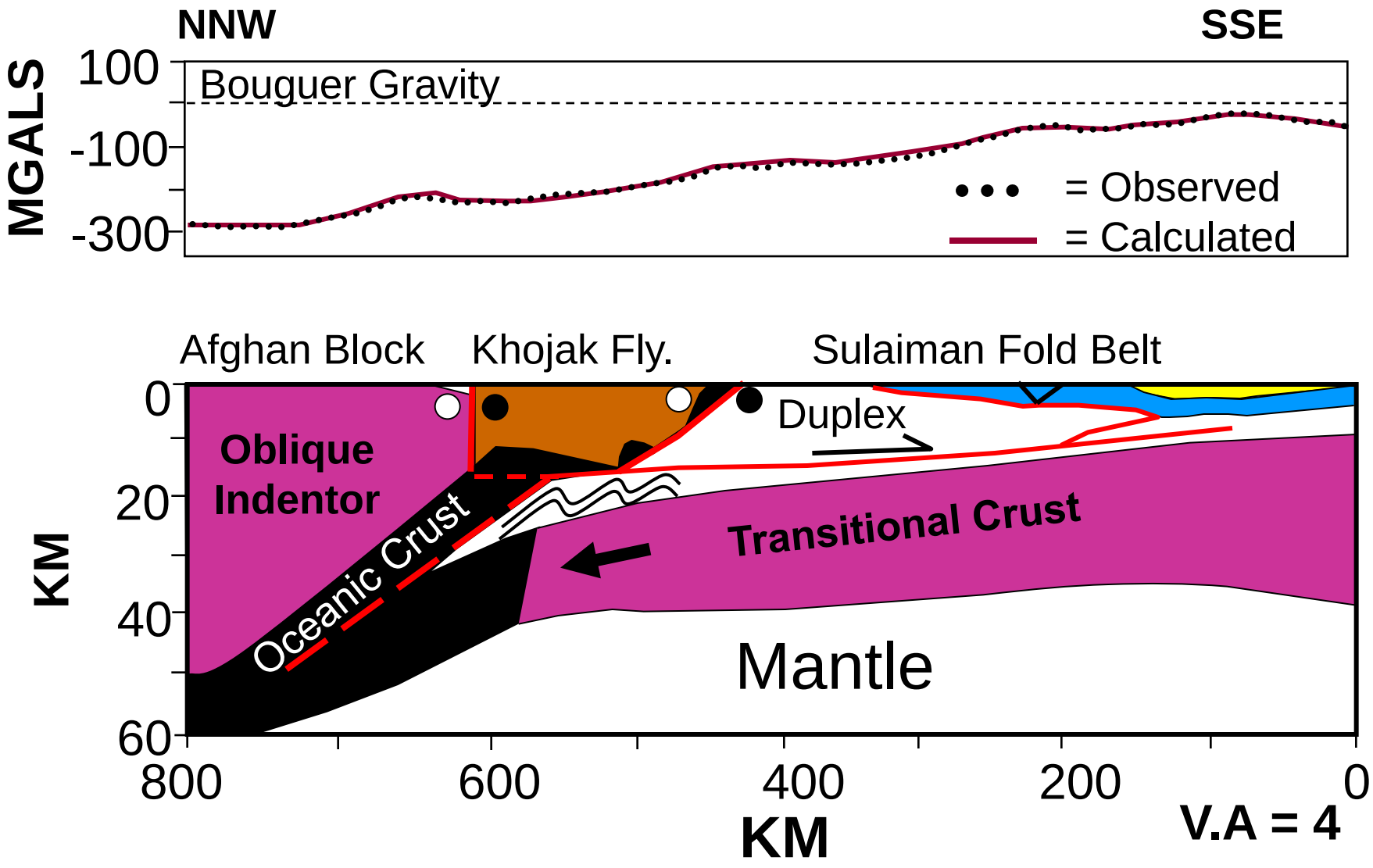
# Strike-Slip Deformation



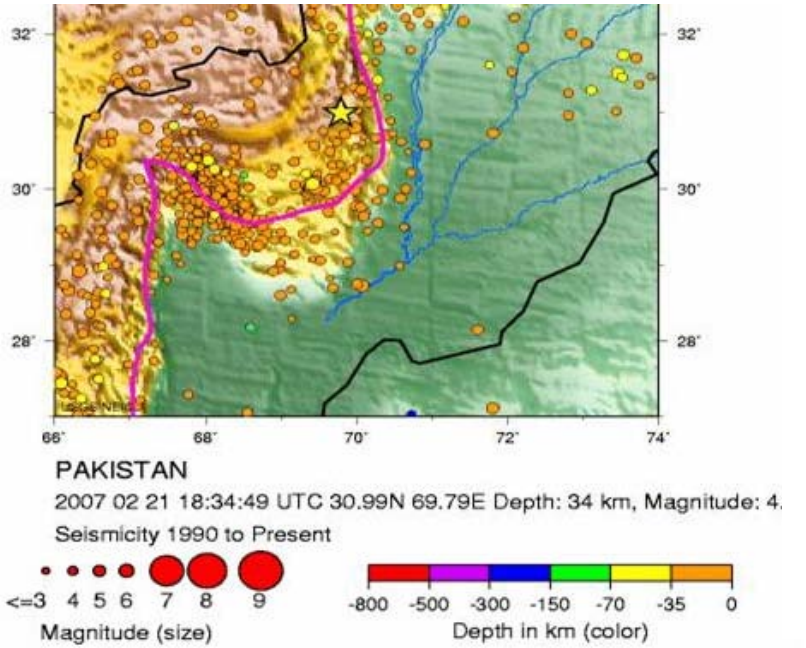


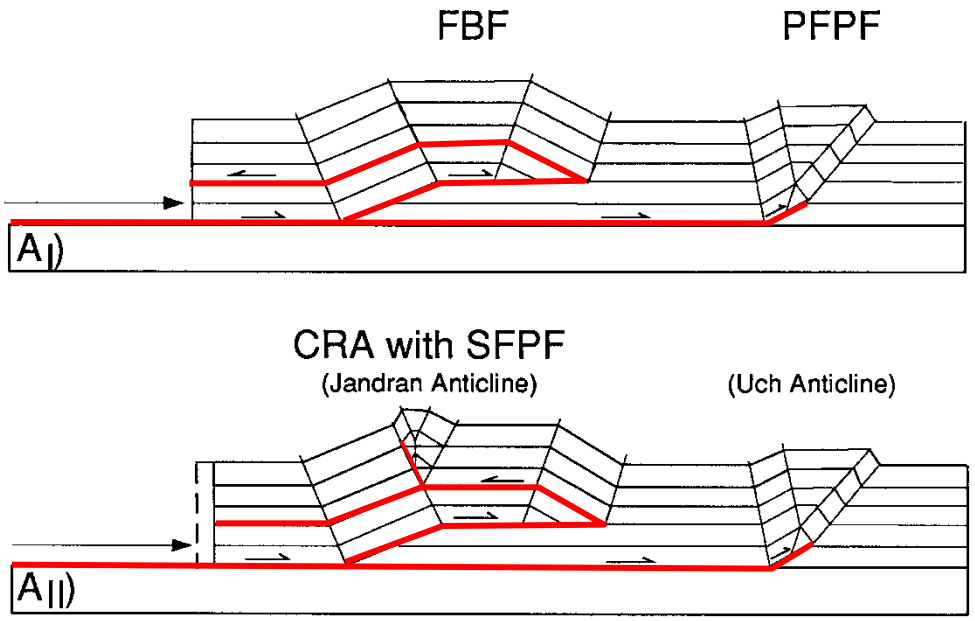


# BOUGUER GRAVITY & TECTONIC MODEL



# Geometry and Evolution




- **Passive Roof Duplex Geometry**
- **In-and-Out of Sequence Deformation**
- **Post-collision Strike-Slip Deformation**


Thank You