Fault/Fracture Related Dolomitisation of the Eocene Thebes Formation, Hammam Fauran Fault Block, Gulf of Suez*

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Abstract

It is recognised that post-depositional processes, such as faulting, dolomitisation, dissolution, and cementation, usually strongly influence the architecture of carbonate reservoirs. It is often difficult, however, to reconstruct patterns of diagenetic modification from subsurface datasets, and as such confidence in permeability models may be compromised. Nevertheless, interpretations can be informed by quantitative, spatial data extracted from robust, high quality outcrop studies. In this context, this study focuses upon reconstruction of fault-controlled dolomitisation within the Suez Rift in order to map the spatial distribution of dolomite geobodies and determine the tectono-stratigraphic controls on their distribution.

The Hammam Fauran Fault Block, NW Sinai, provides excellent pseudo-3D exposure of differentially dolomitised, pre-rift Cretaceous-Eocene carbonates, deposited in a deep marine slope environment. Field mapping reveals massive, non-fabric selective dolomitisation, with common zebra dolomite, associated with two main structural trends a) NW-SE, parallel to the Suez Rift and b) NE-SW, parallel to Aqaba transform zone. Baryte, gypsum/anhydrite, goethite, and haematite are found within these fault zones. Stratabound dolomitisation is also observed within debris flows, grain flows that intersect the faults, and at the top of upward-coarsening beds, continuing laterally for several hundred metres in some cases. A third, subordinate, fault/fracture system trends north-south and is not associated with dolomitisation; these fractures are either open or quartz cemented.

These preliminary data indicate that fluid flux on the platform was controlled by the geometry of the normal faults and fratures associated with the development of the Suez Rift. Flow away from the faults appears to have focused upon the coarsest, cleanest facies. Zebra dolomite fabrics within the fault-related dolomite bodies imply high temperature/high pressure fluid emplacement, whilst the mineralogical assemblage suggests fluid interaction with both syn-rift volcanic and evaporite beds. It is clear, therefore, that a relationship exists between facies

architecture, tectonic evolution, and dolomitisation. Future data collection will evolve this model and move towards a quantitative framework by which the length scales of key flow-controlling layers, for calibration of subsurface models, can be derived.

Reference

Land, L.S., 1985, The origin of massive dolomite: Journal Geological Education, v. 33, p. 112-125.

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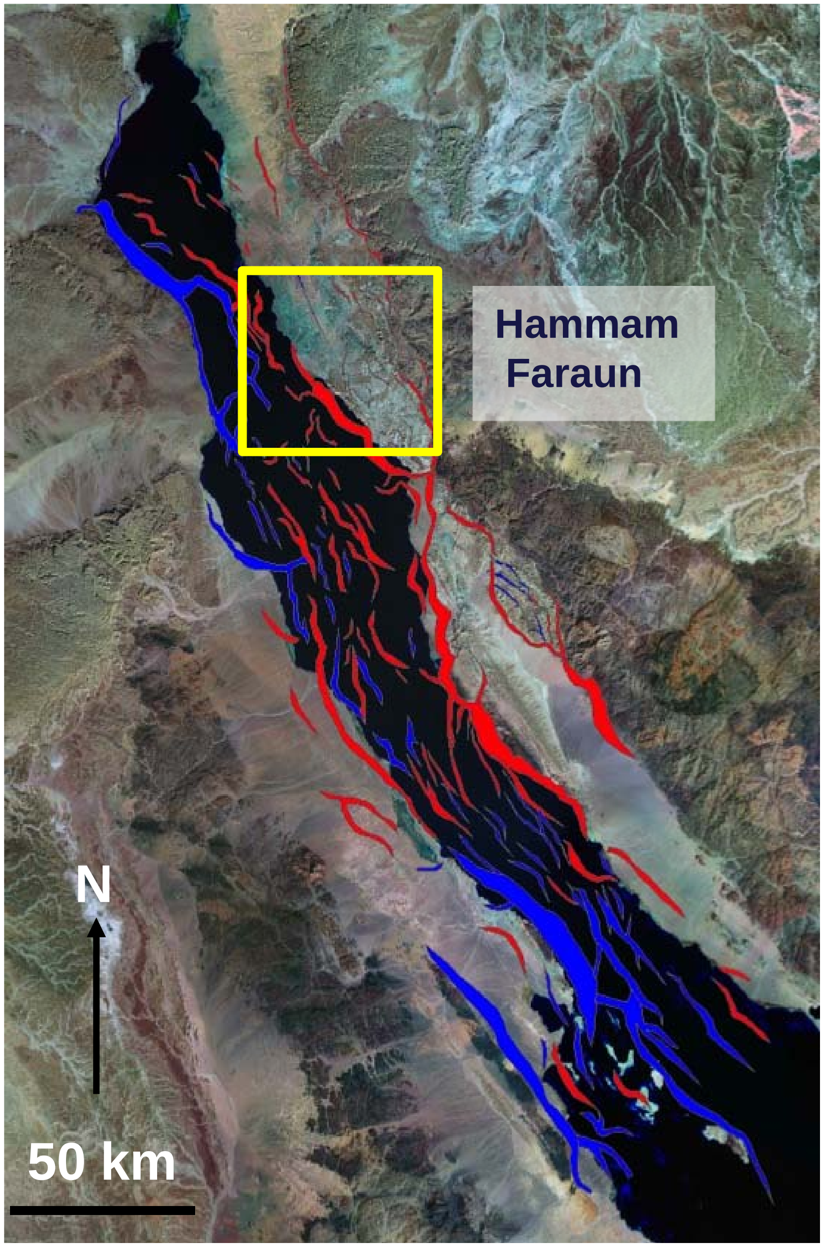
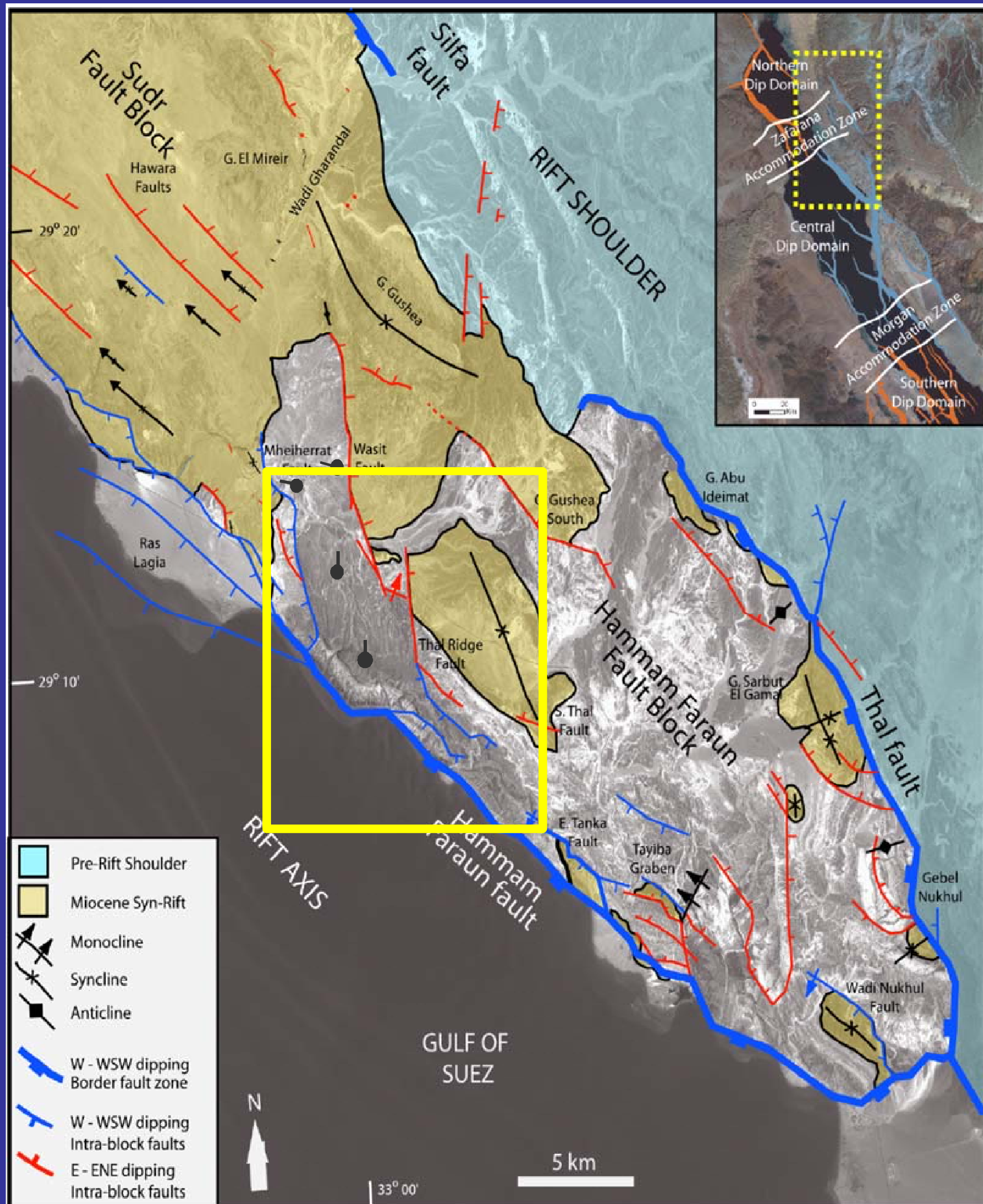
University of Bergen

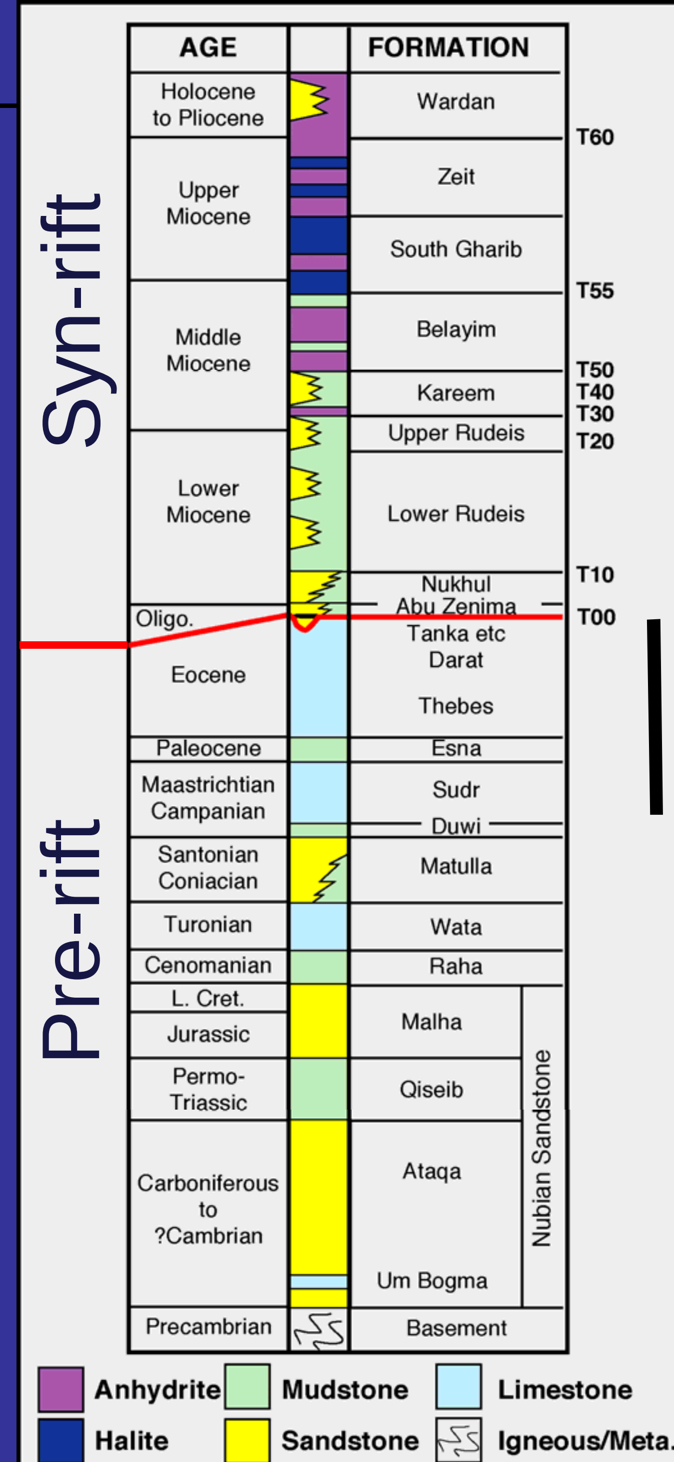
Hammam Fauran Fault Block

Gulf of Suez

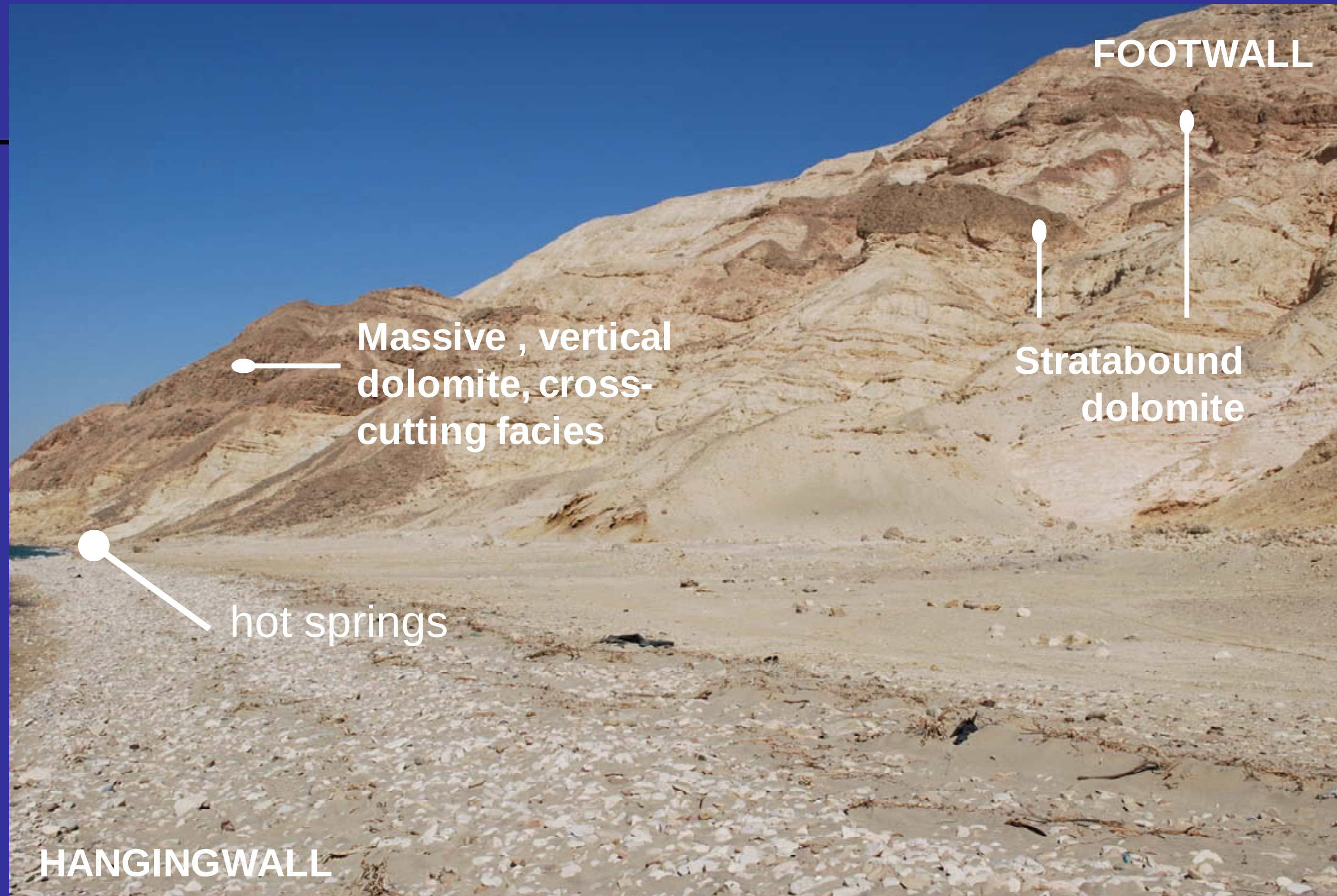


Tectono-stratigraphic framework





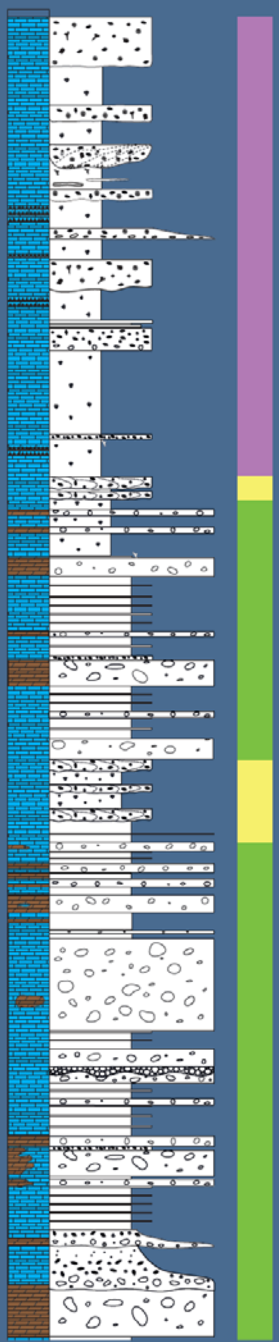
Aims and objectives

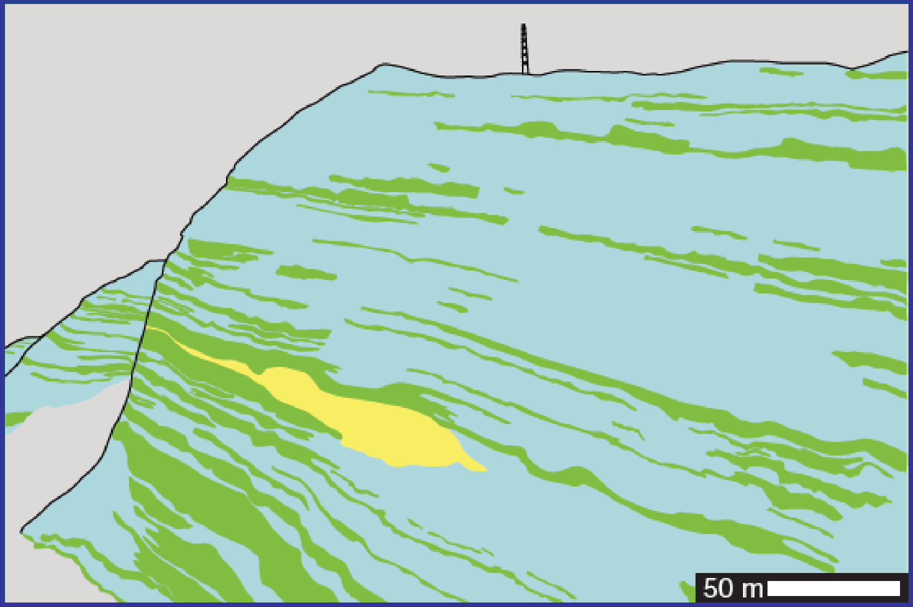


- Textural, compositional and structural control on dolomite body geometry
- Estimation of timing of dolomitisation in relation to structural evolution of the Sinai Rift
- Determination of fluid composition, and potential fluid flow pathways and circulation mechanisms
- Quantification of dolomite body geometry

Lower Thebes Formation

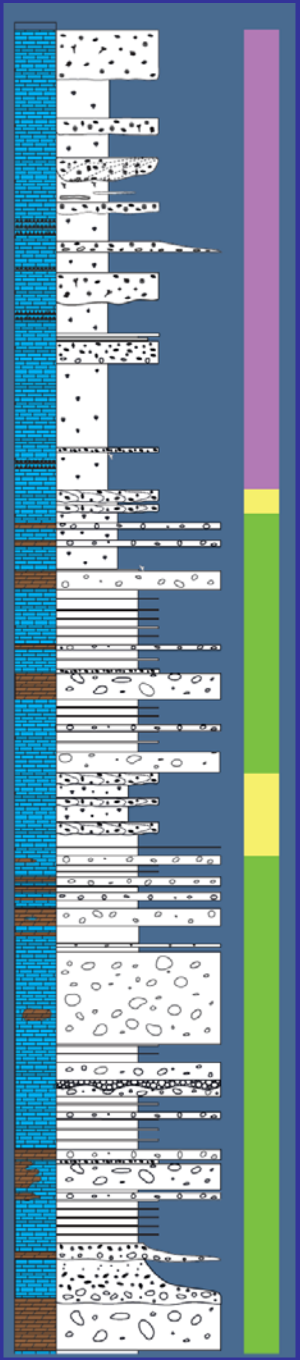
Remobilised facies: debris flows





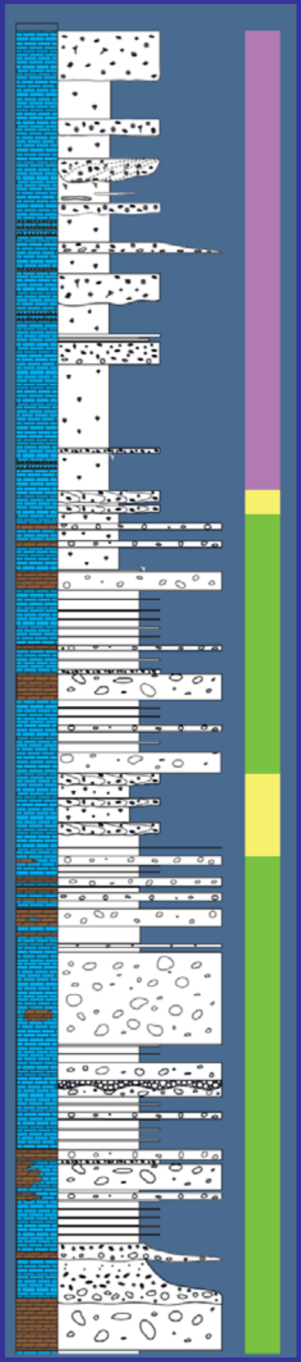
Upper Thebes Formation

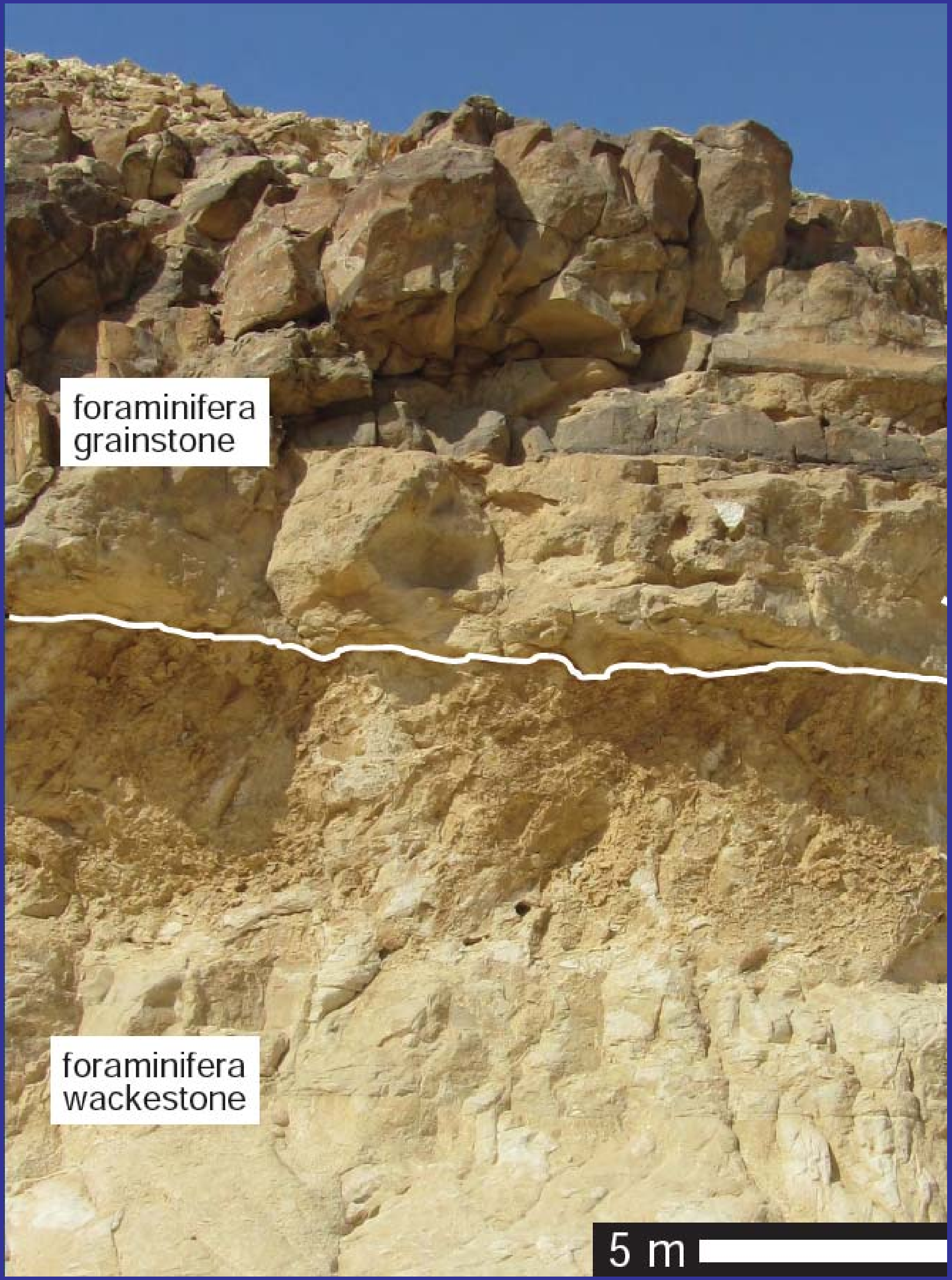
Grainflows and pelagic skeletal wackestone



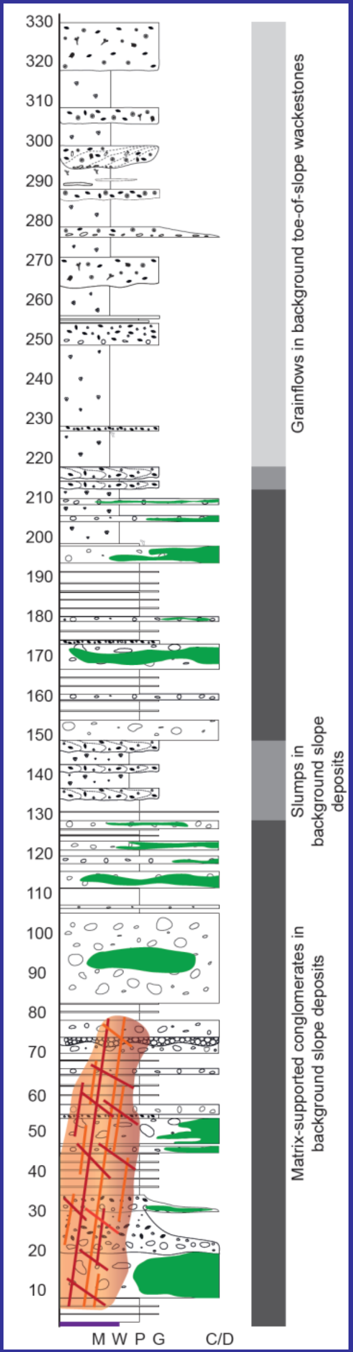
Upper Thebes Formation

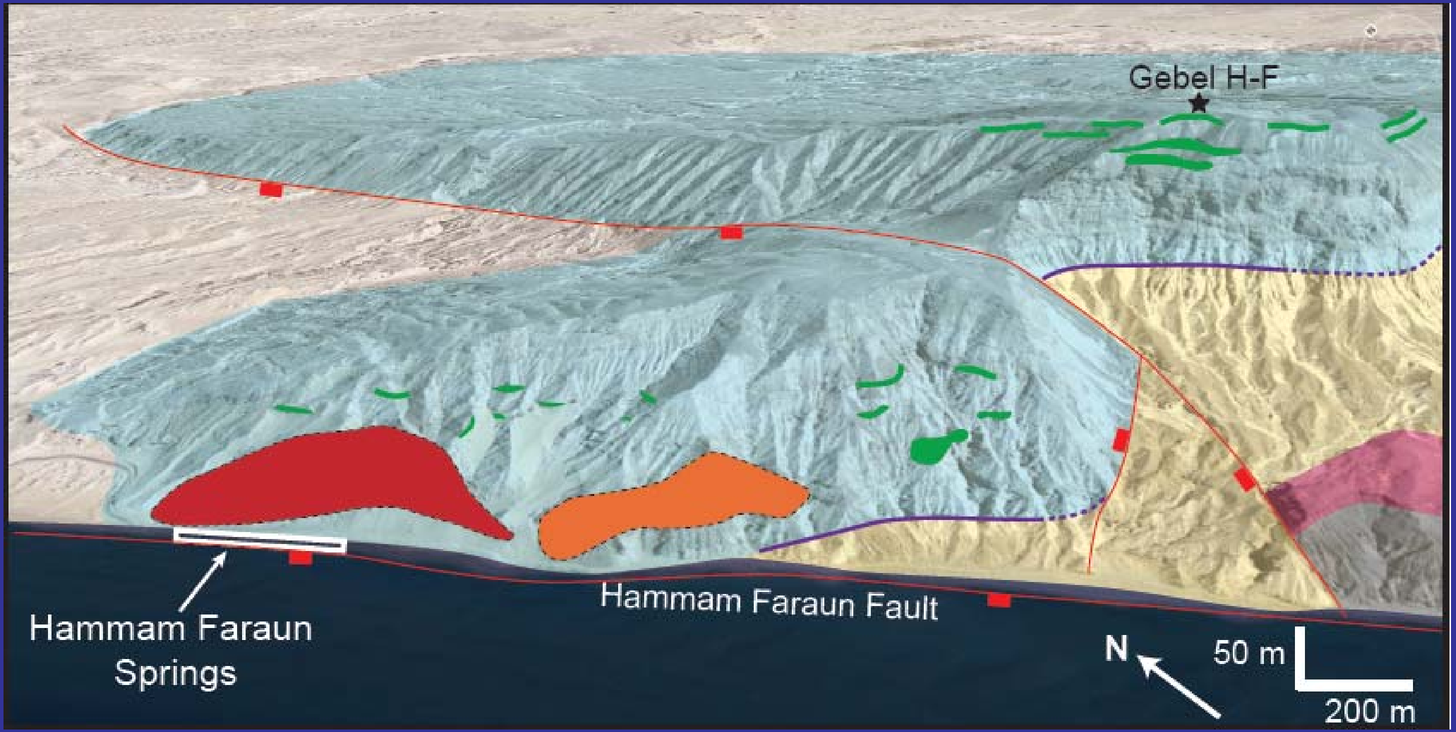
Grainflows and pelagic skeletal wackestone



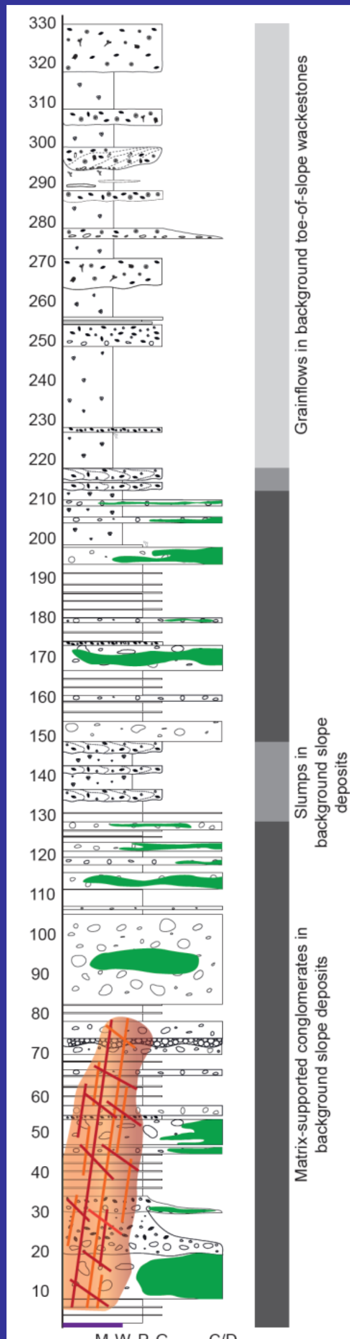


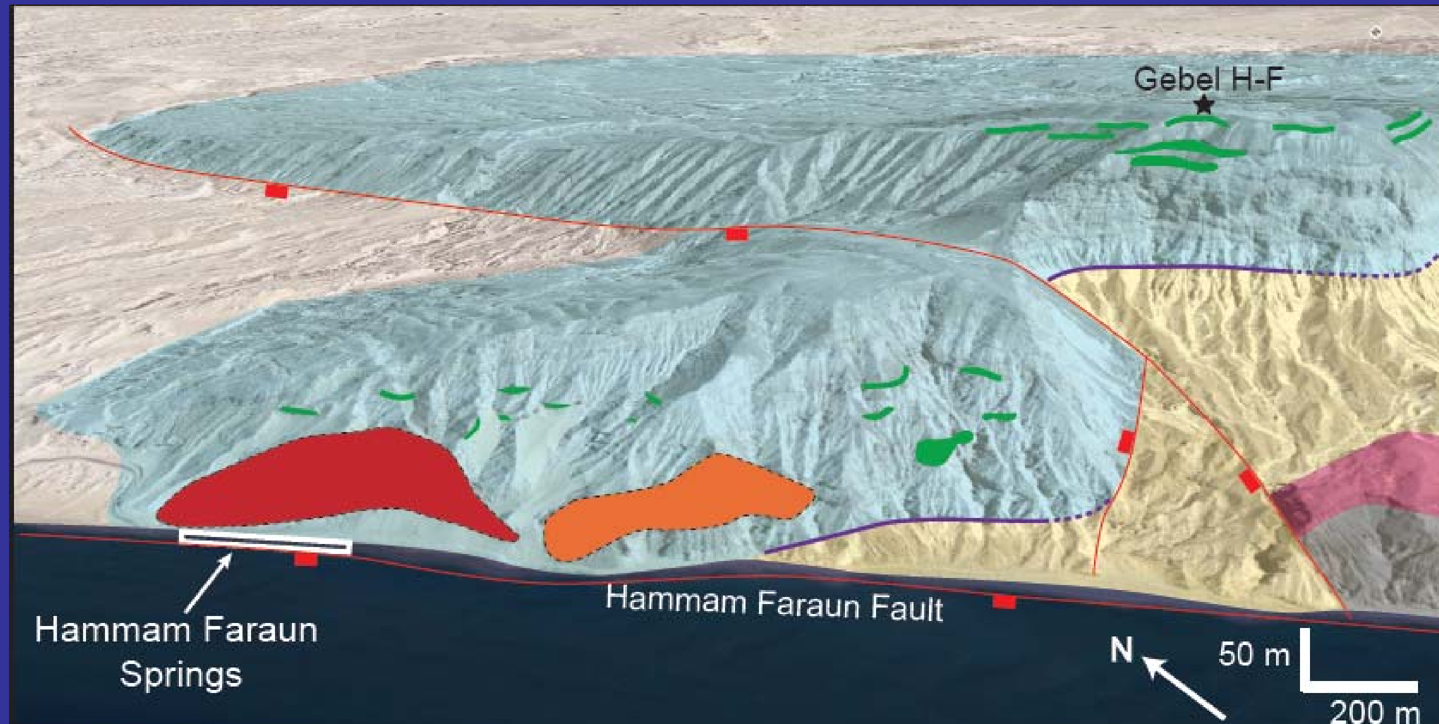
Spatial distribution of dolomitisation

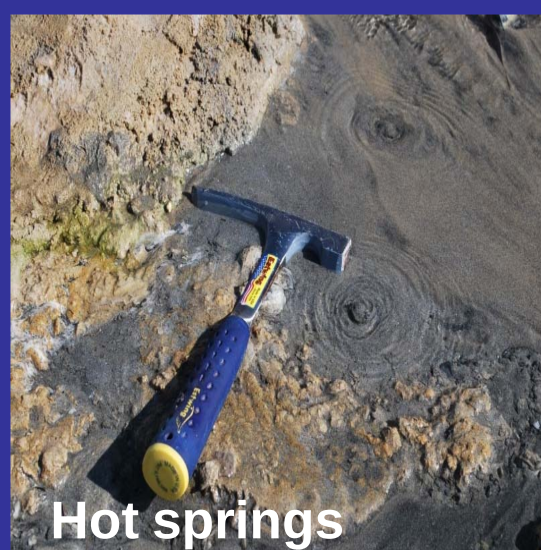




Spatial distribution of dolomitisation







Massive dolomite

Thickness: ±70m   Length: 250-500m

Massive dolomite

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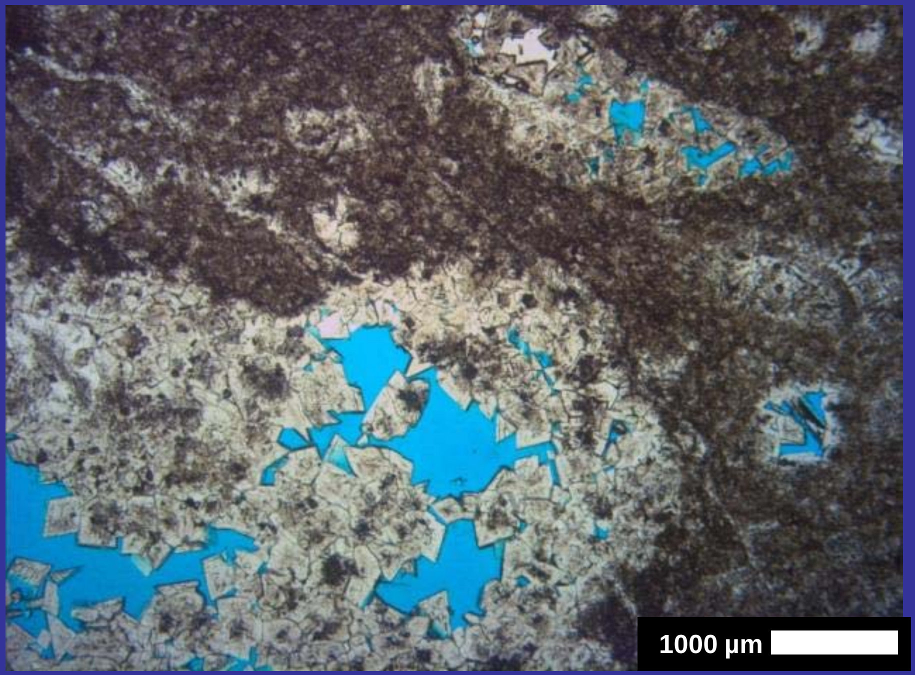
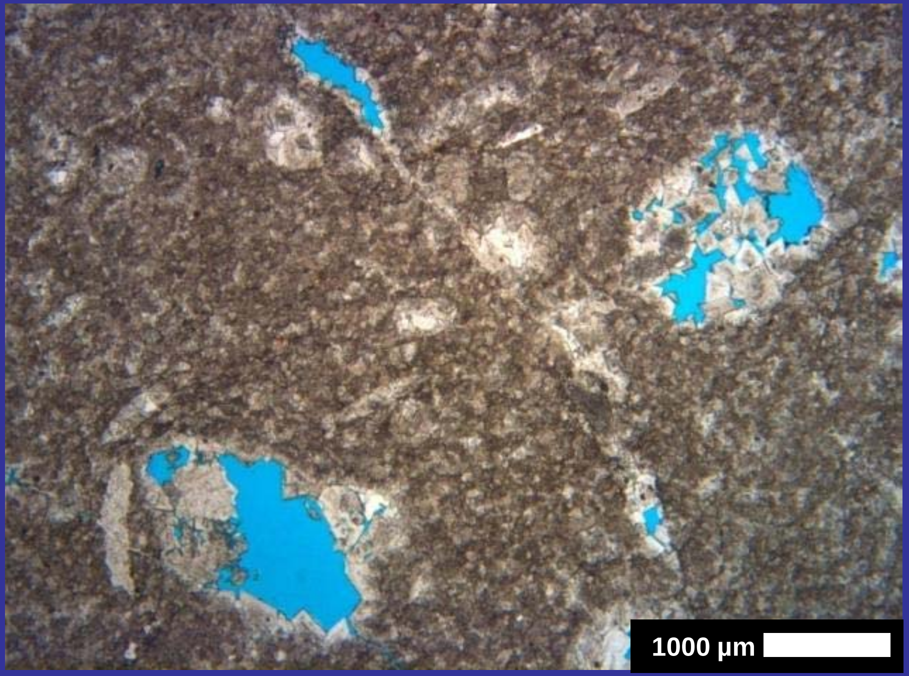
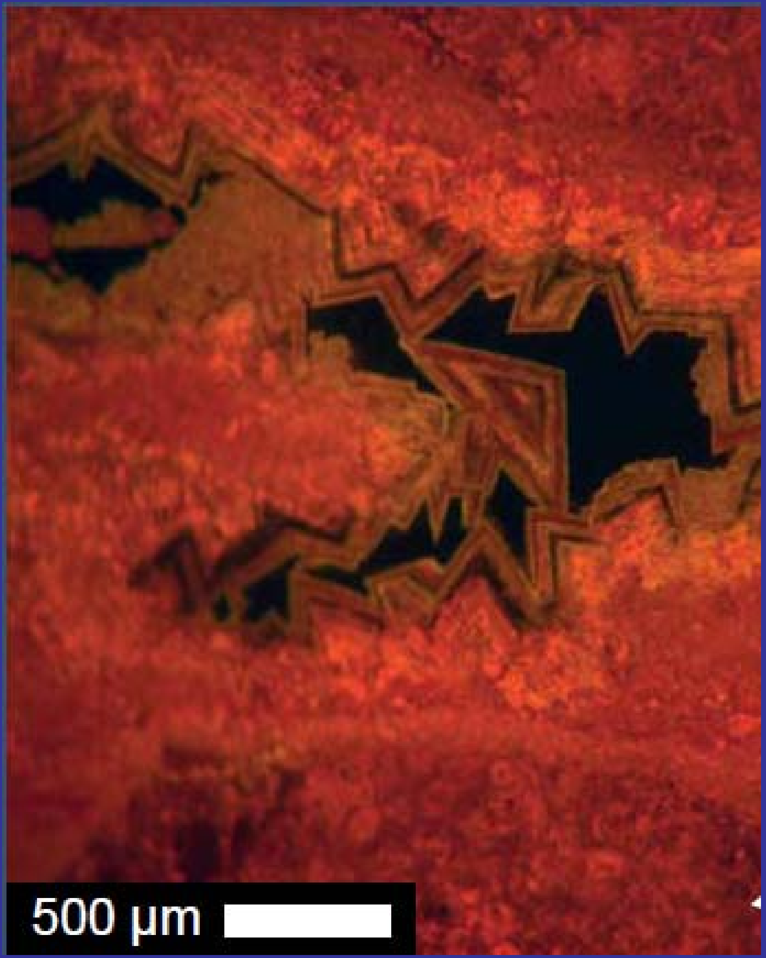
Massive dolomite

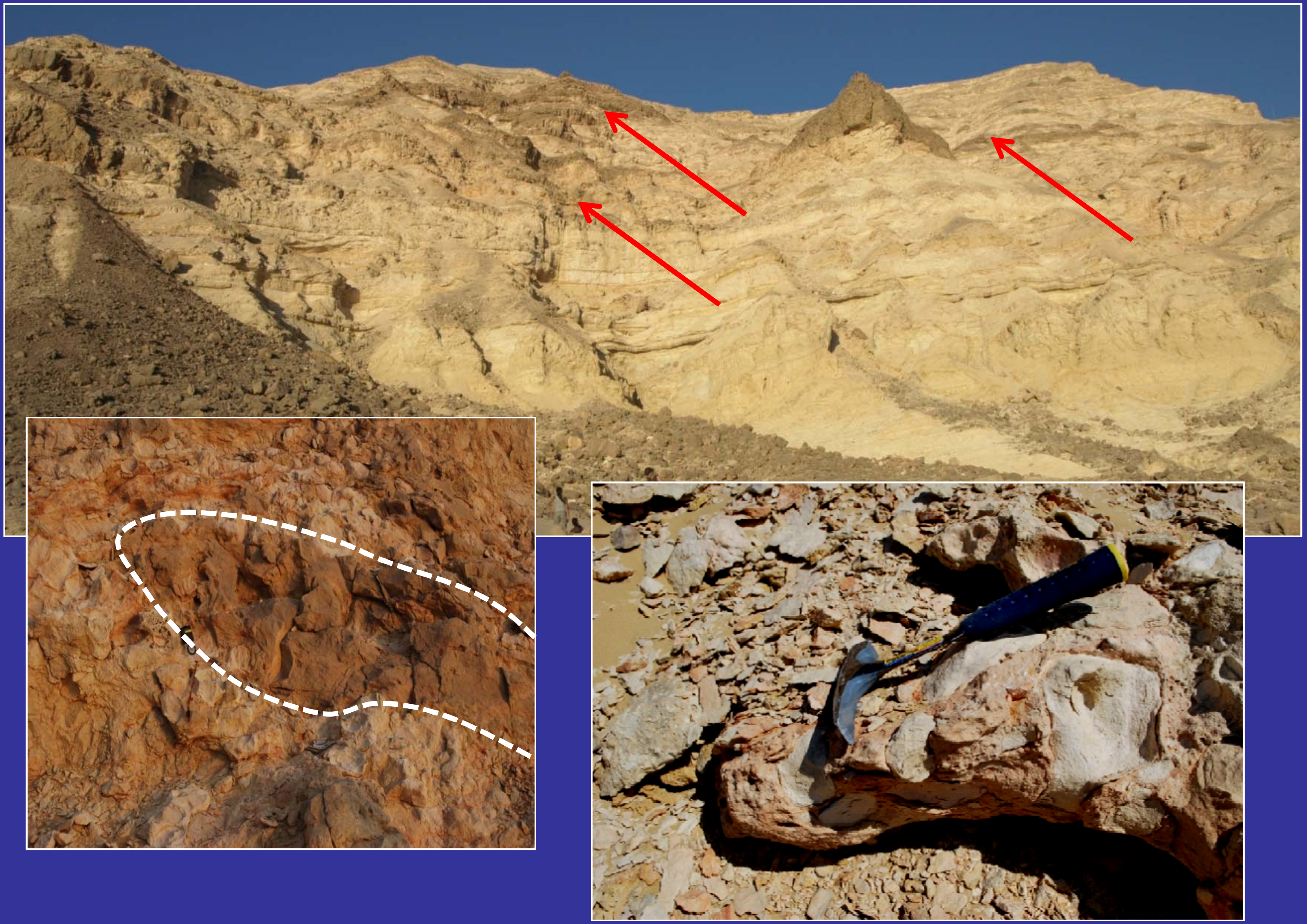






- Xenotopic replacive dolomite
- Pore filling dolomite, occasionally zoned

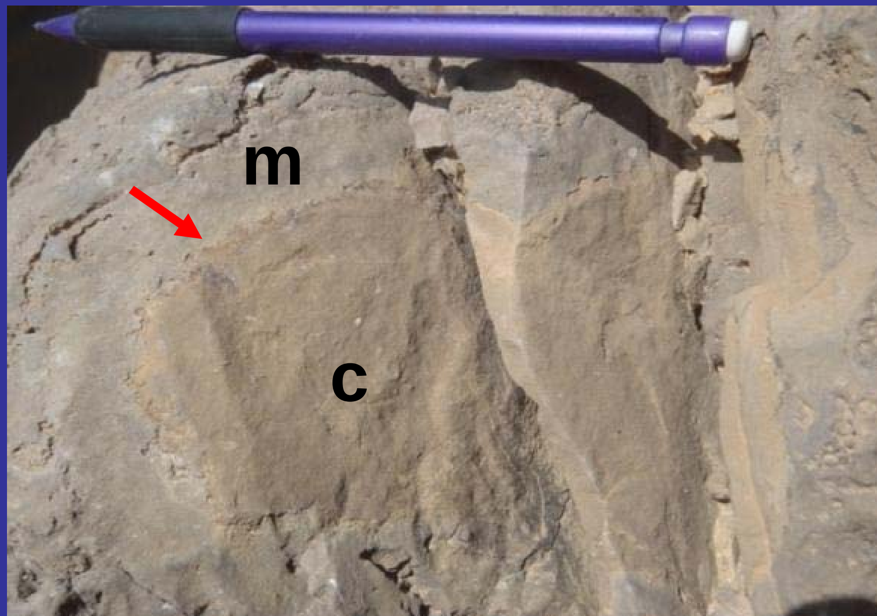
Stratabound dolomite

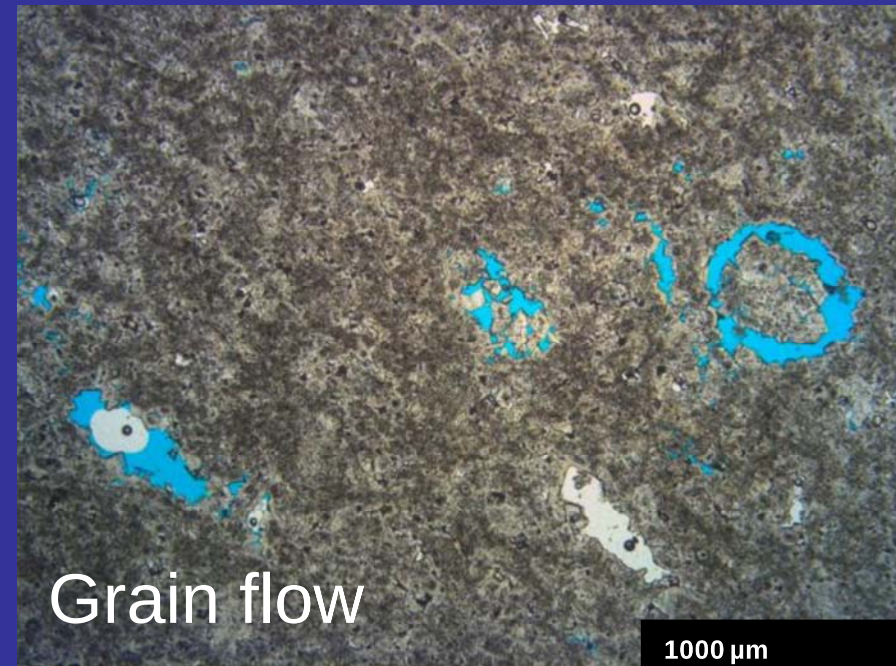


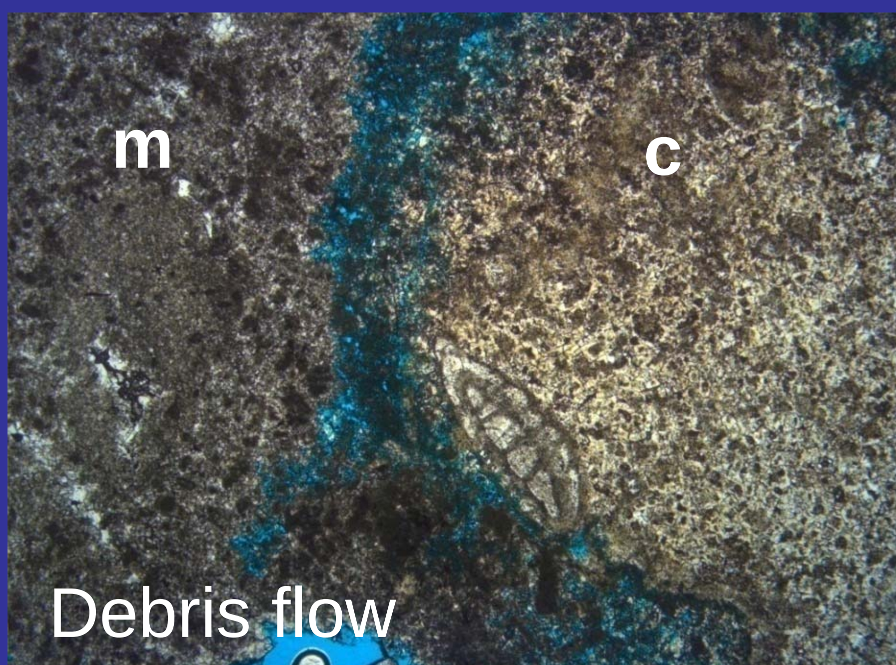
Thickness: 0.25 – 15m Length: 1-300m

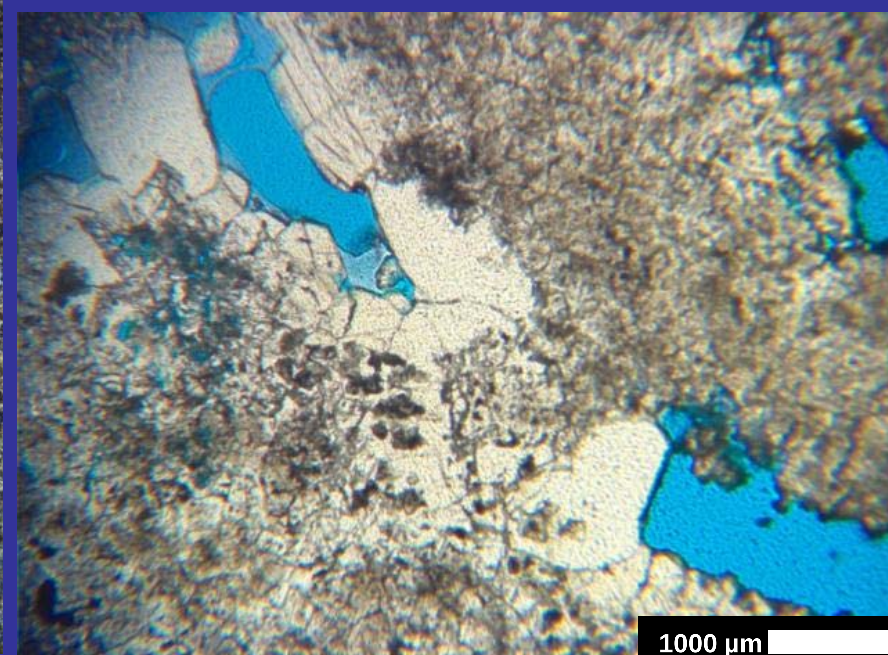
Penetration for up to 2km from Hammam Fauran Fault

Stratabound discontinuous dolomite texture

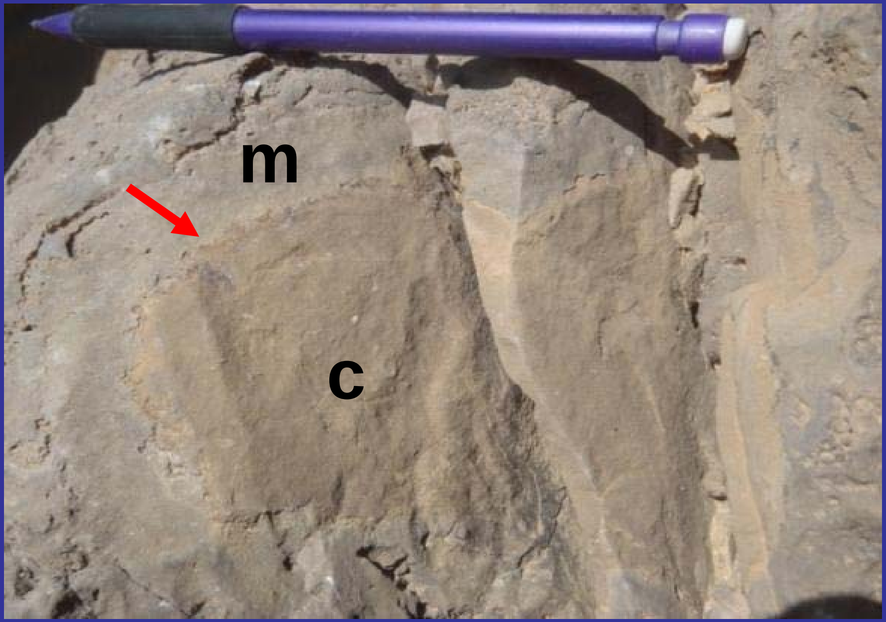


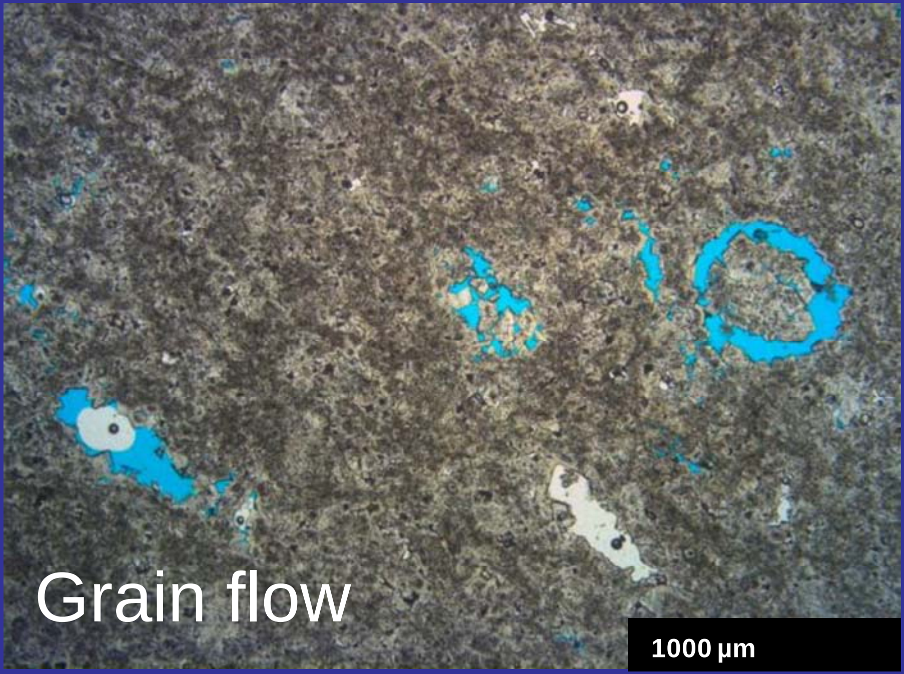


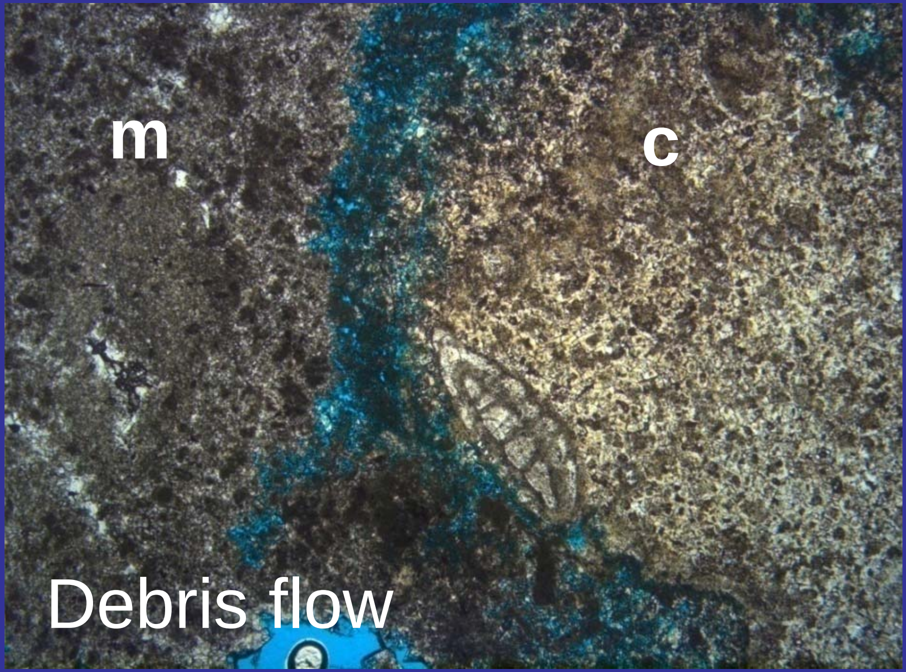


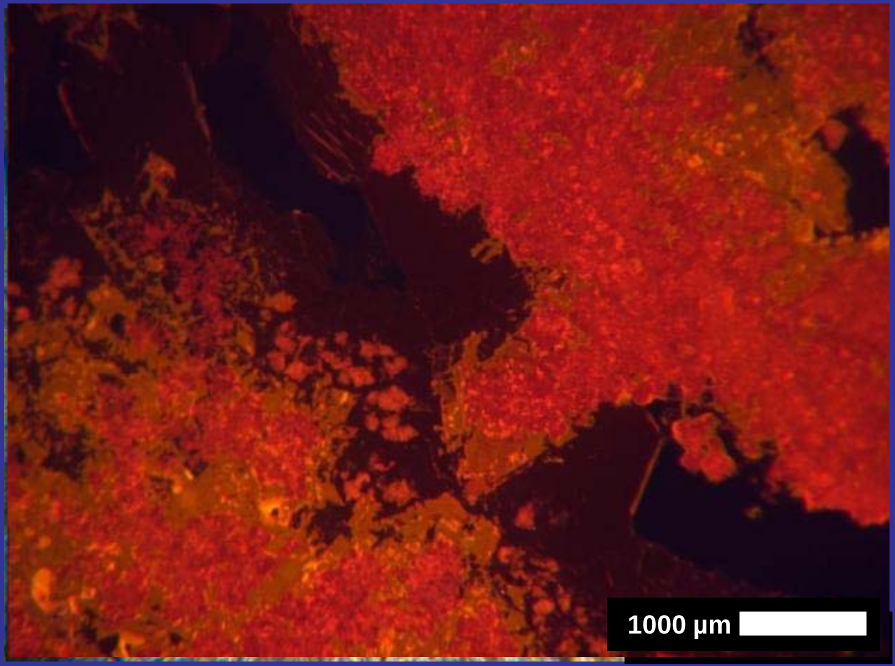


Stratabound discontinuous dolomite texture









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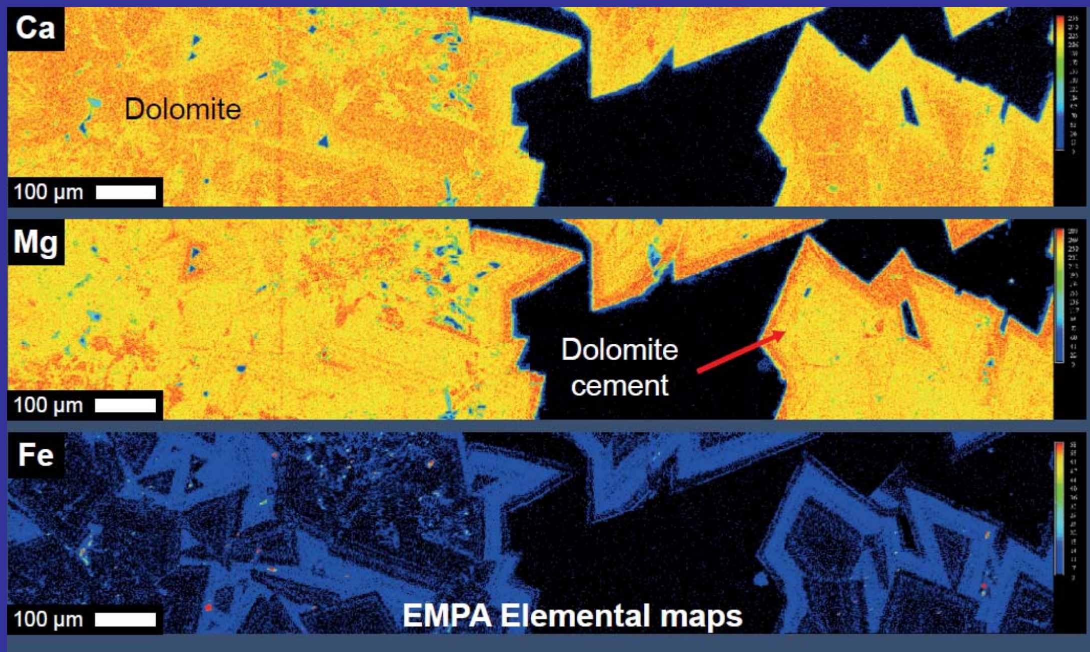
The University of Manchester

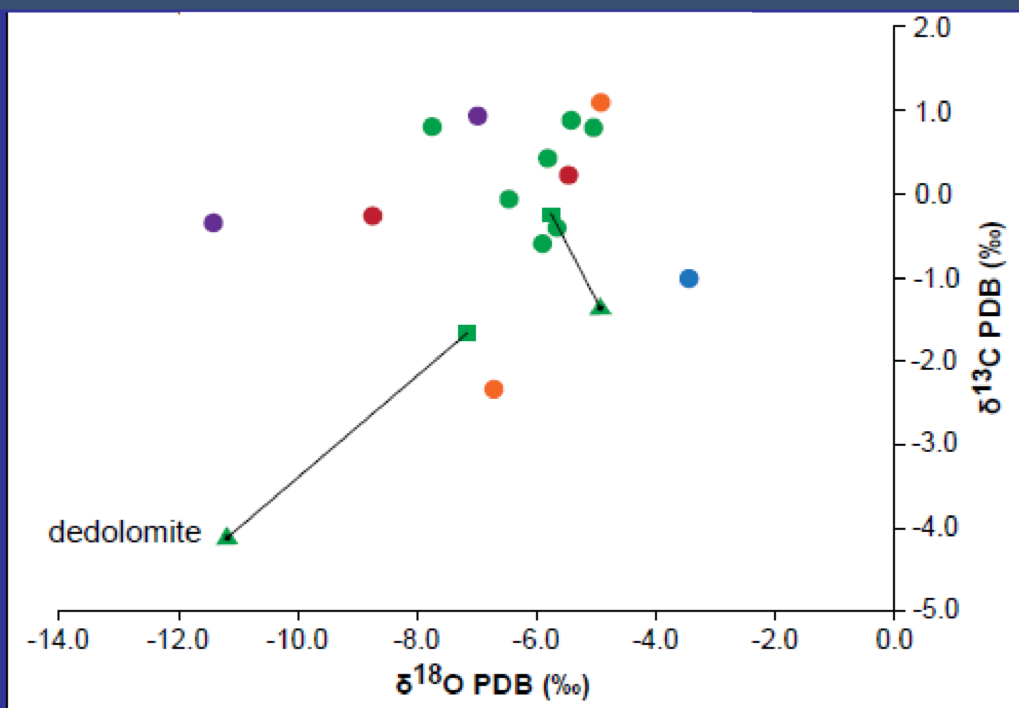
Geochemical characterisation



Massive dolomite

Relative conc.

- Very High
- High
- Medium
- Low
- Very low



- Limestone
- Massive dolomite (North body)
- Massive dolomite (South body)
- Stratabound discontinuous dolomite
- Clast to Matrix
- Stratabound continuous dolomite

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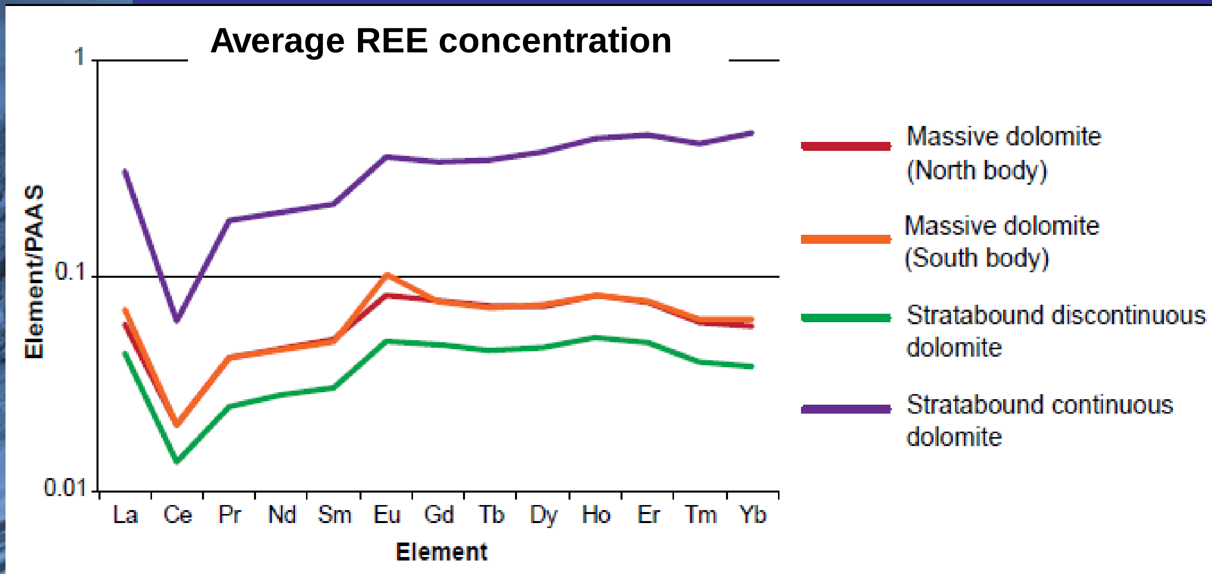
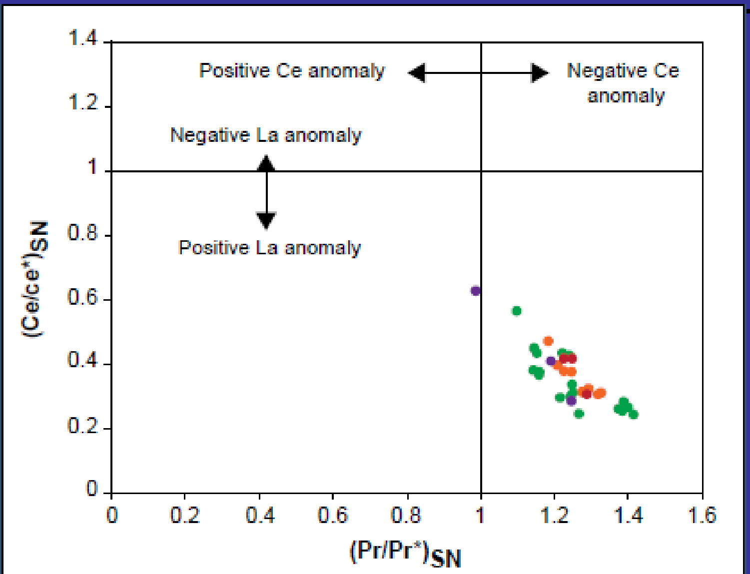
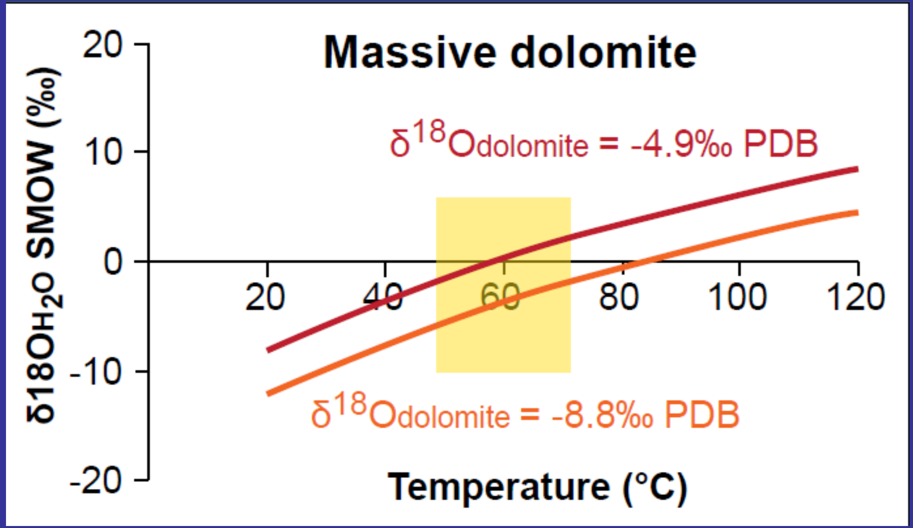
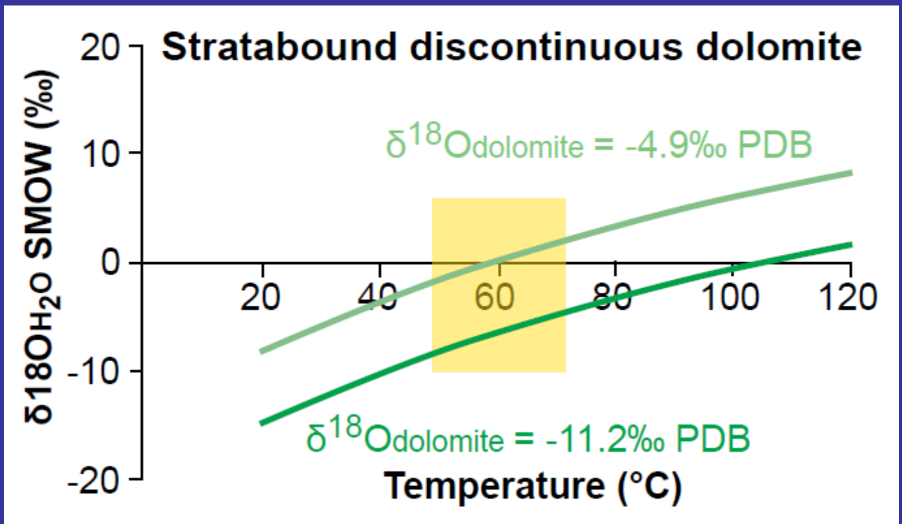
Basin studies

Fluid source



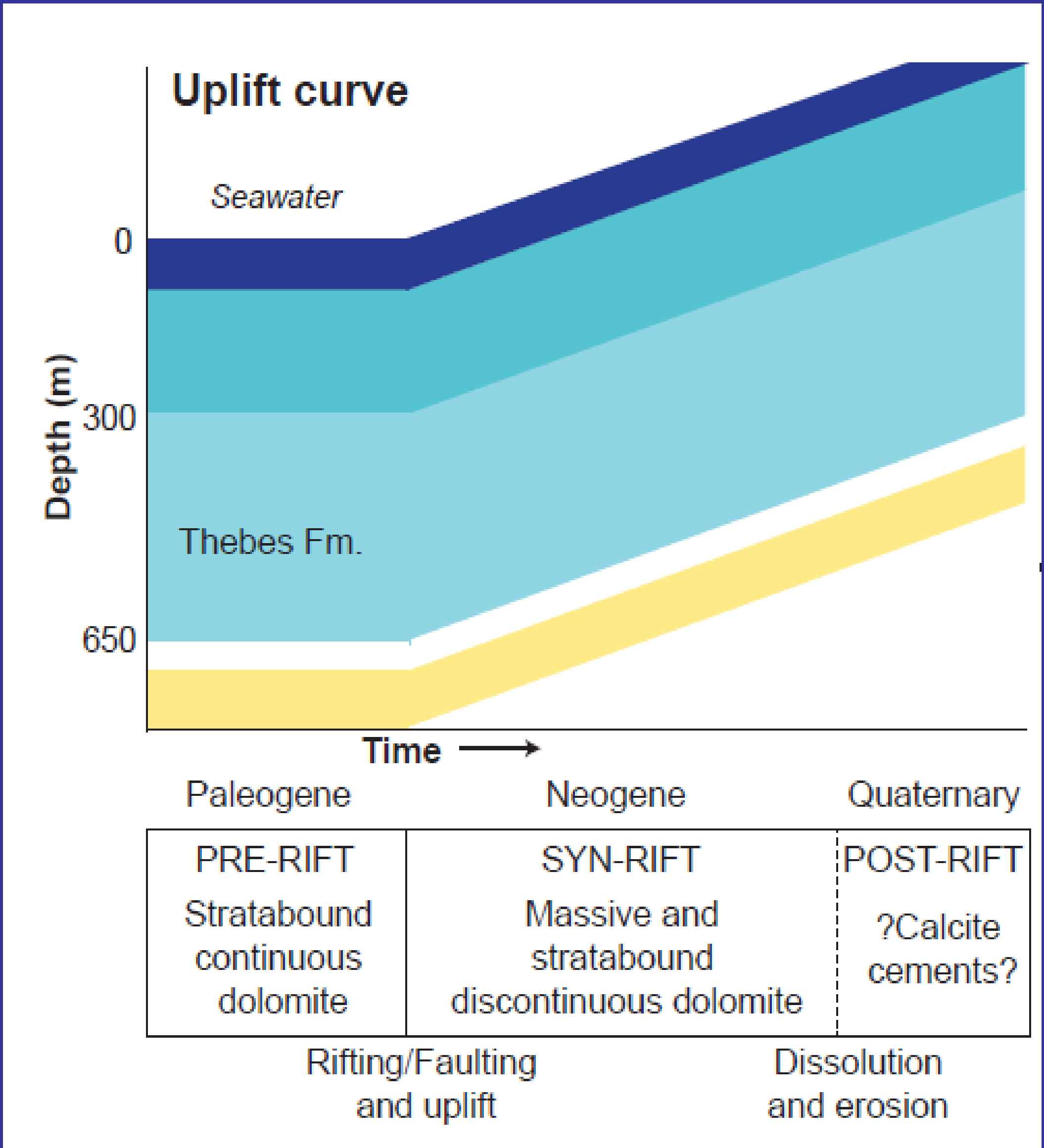






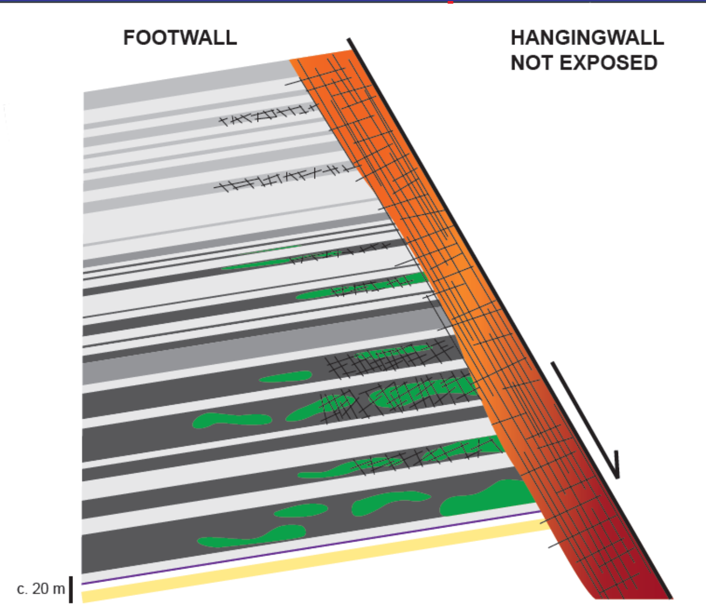
- REE data consistent with dolomitisation from seawater
- From preliminary isotope data precipitation temperatures of >60ºC for dolomitisation from seawater, based on Land (1985)

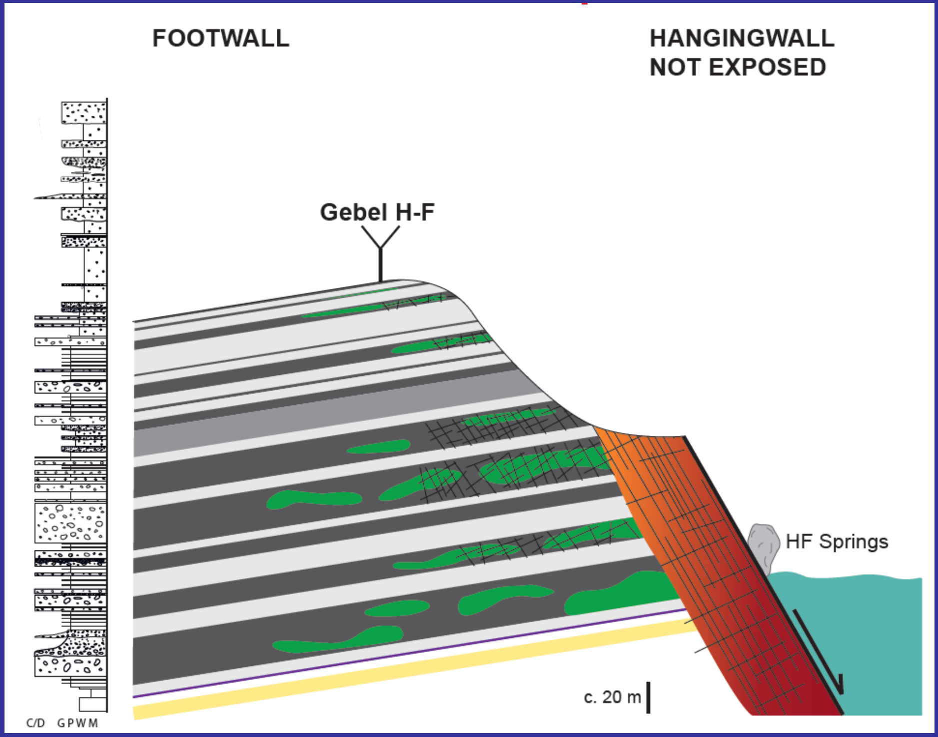
Paragenesis



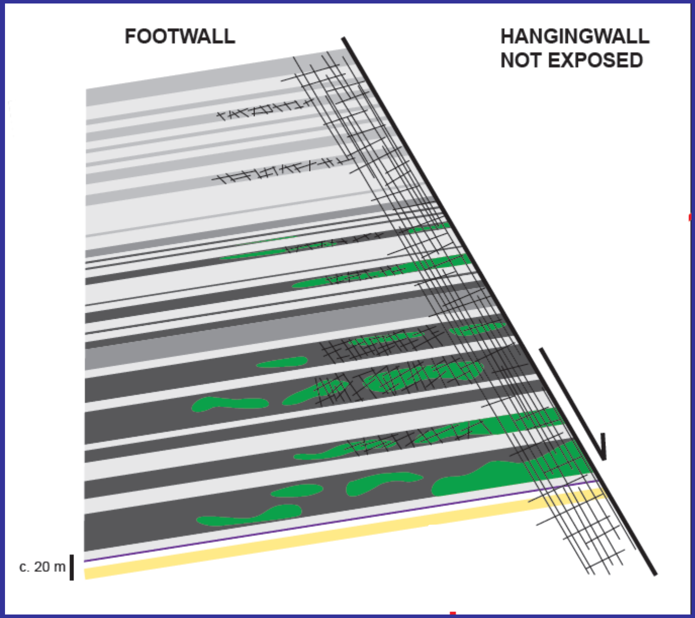
Timing of dolomitisation

1. Dolomitisation along Hammam Fauran fault formed massive dolomite
2. Massive dolomite adjacent to fault (fabric destructive, non facies selective)
3. Preferential fluid migration of dolomitising fluids along higher permeability beds to form stratabound discontinous dolomite
4. Faulting and erosion

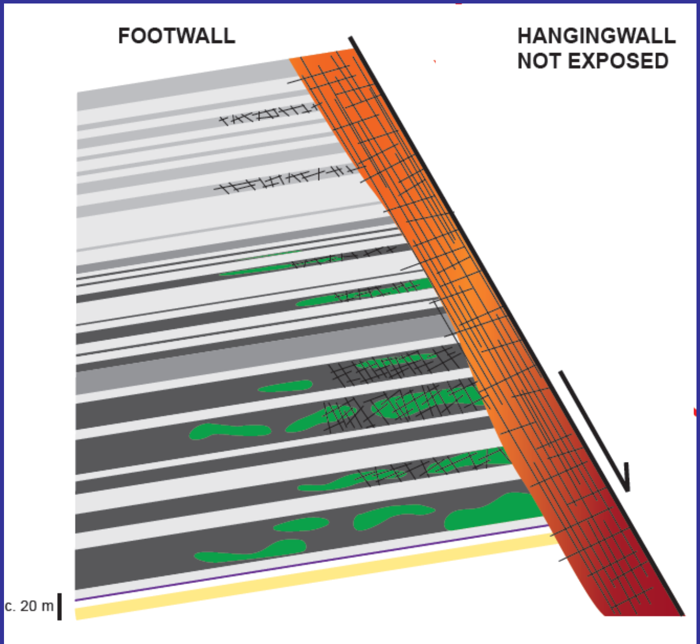


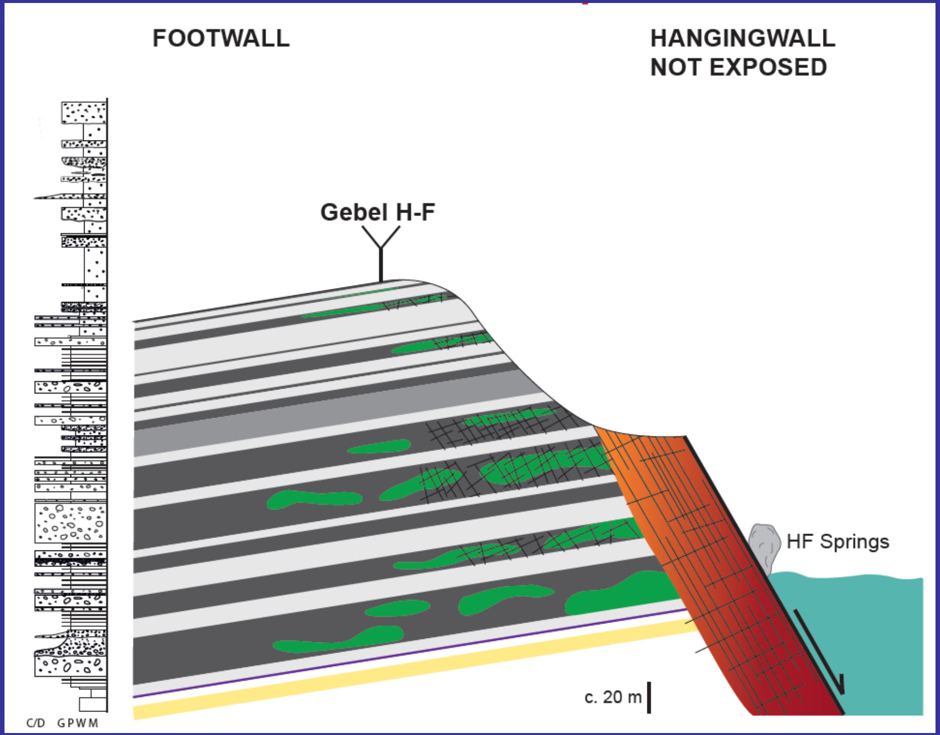


Timing of dolomitisation



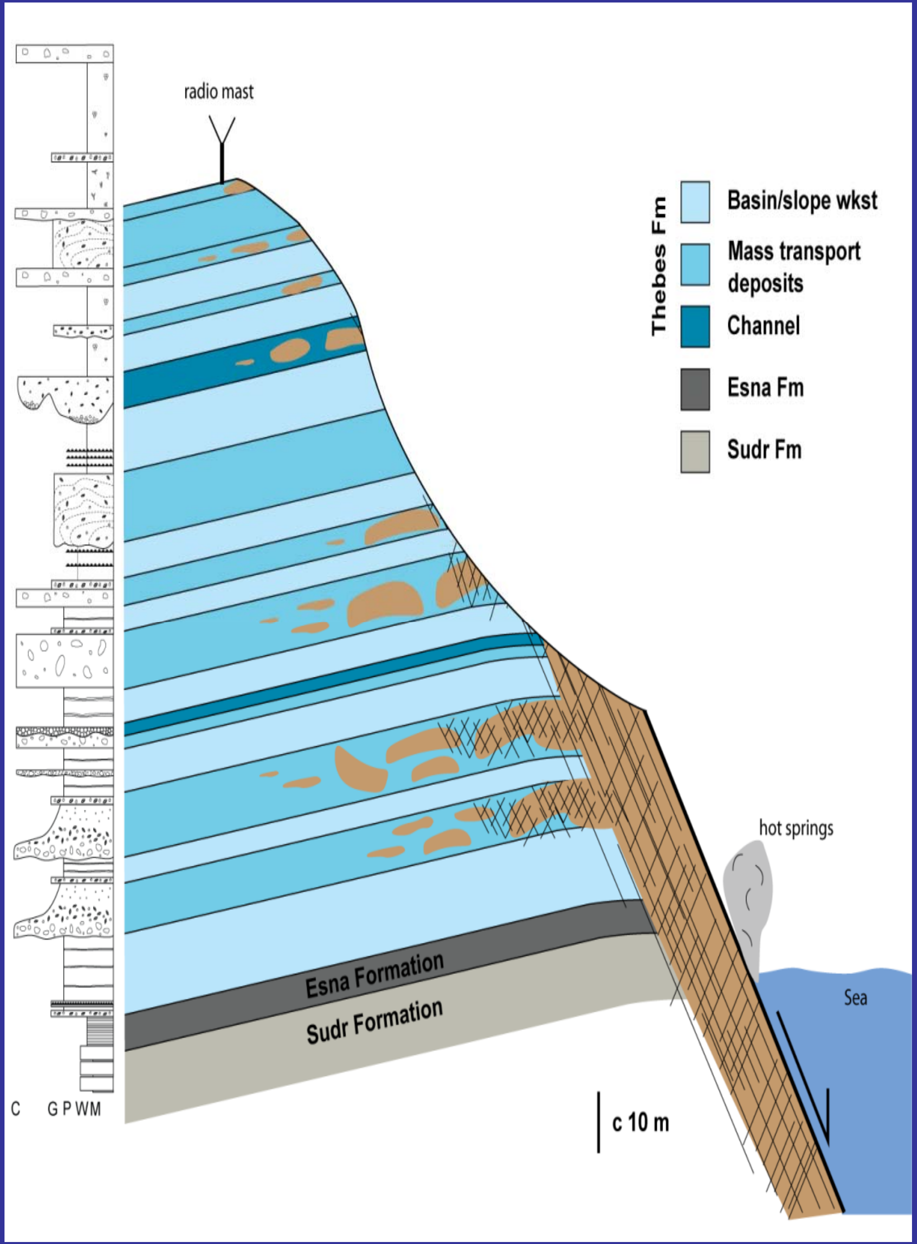
1. First phase of dolomitisation along higher permeability beds
2. Second phase of dolomitisation adjacent to HFF to form massive dolomite
3. Faulting and erosion





Summary and conclusions

- Dolomitisation occurs in lower Thebes Formation, adjacent to HFF
- Dolomitisation most likely, took place from seawater circulating within HFF and into higher permeability beds
- Fluid temperatures probably >60ºC
- Genetic relationship of dolomite bodies is unclear
- ?Dedolomitisation during uplift, rainwater percolation
- Mouldic and vuggy porosity, but pores are isolated and part-cemented by dolomite and calcite (marine and meteoric)



Acknowledgements

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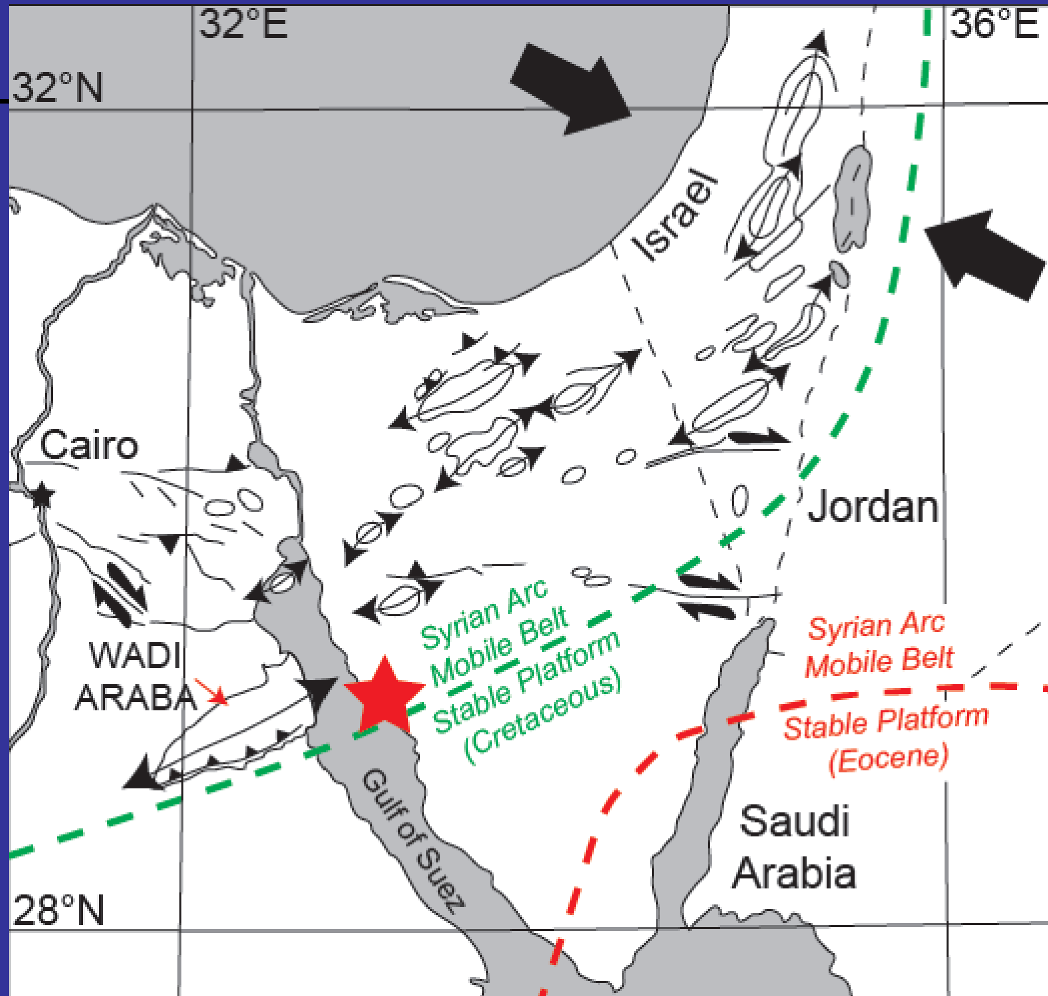
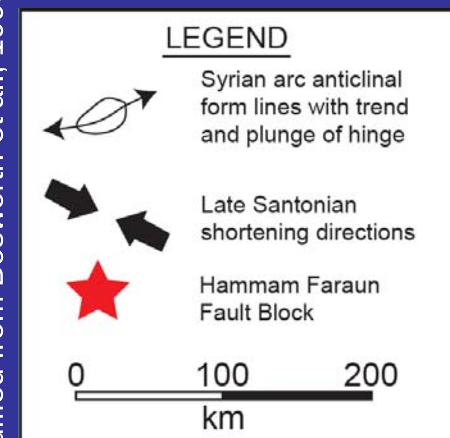
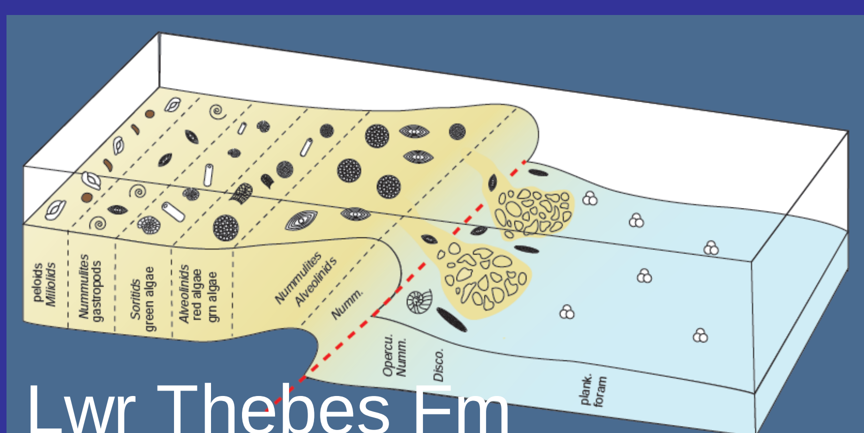
Palaeogeography

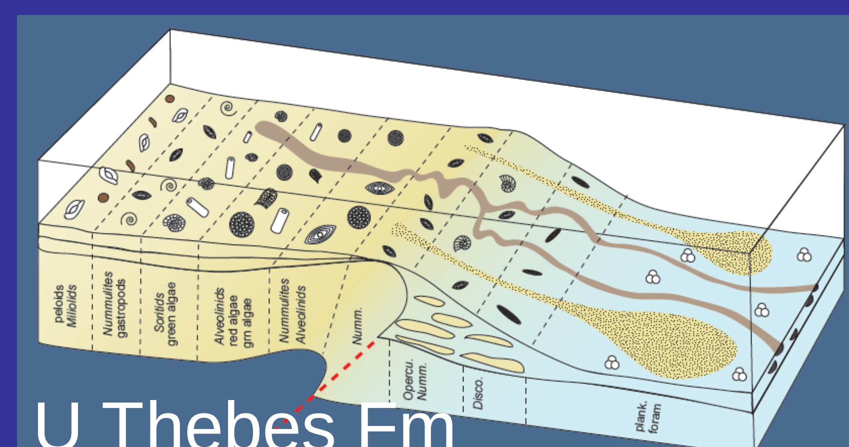


Modified from Bosworth et al., 1999 & Bauer et al., 2003





Lwr Thebes Fm



U Thebes Fm