

Borehole image and outcrop aspects of fractures and fractured reservoirs in Jabal Madmar (Oman)

Observation, interpretation and calibration

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Field trip location:

Jabal Madmar is a well-exposed anticline located close to the city of Adam. It is part of the Salakh Arch structure in the southern foothills of the Oman Mountains. It shows excellent exposures of fractured carbonates in the Natih formation.

Jabal Madmar has been extensively studied and provides a very good analogy with some of the most prolific fractured carbonate fields in North Oman.



Field trip itinerary and outcrop location

Field trip program and topics:

Participants will leave Muscat early morning and will take the direction of the small city of Adam. A brief introduction about the regional geological and structural settings will be delivered during the road trip, at the close neighbourhood of the 3000-metres culminating Jabal Akhdar. The outcrop location in Jabal Madmar will be reached

after about three hours. The visit will include two main outcrop sites located at a walking distance from the car parking area. These sites will allow observations and discussions about the classification of natural fractures encountered in the reservoirs and their relationships with mechanical stratigraphy.



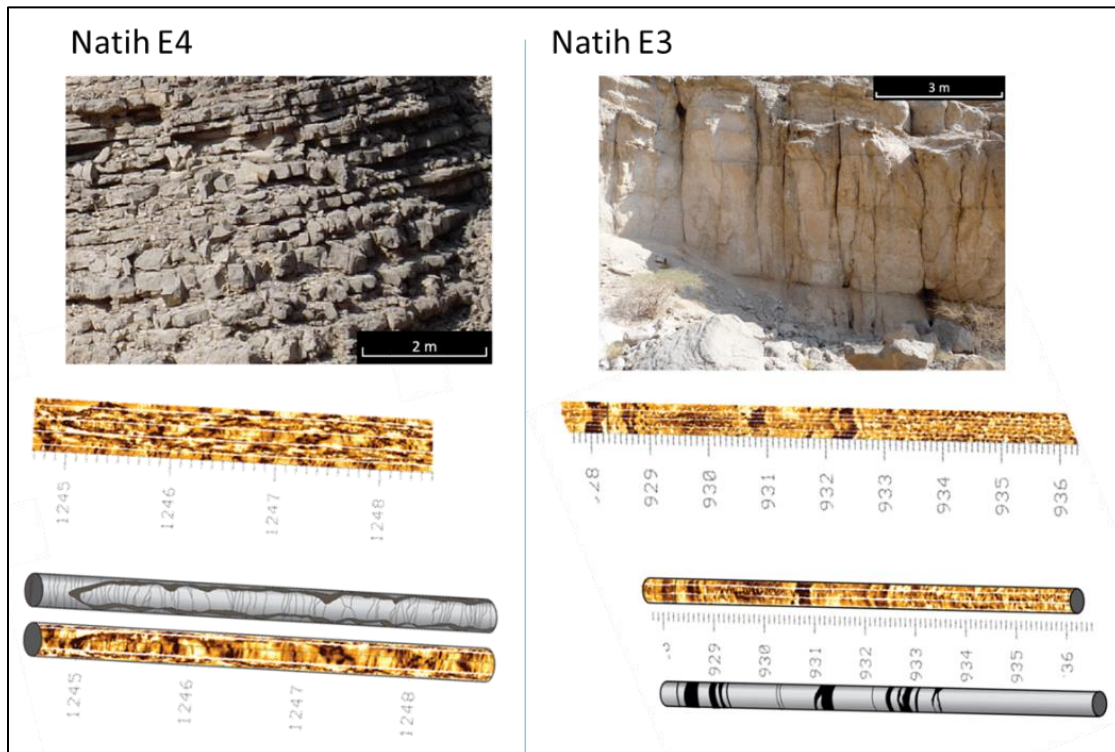
Natural fracture system exposed in Jabal Madar Natih formation.

Participants will have the opportunity to make interactive comparisons the fractures visible on the outcrops and their expression in real subsurface borehole images. Relevant borehole image data will be selected in reservoirs in the same stratigraphic formations as the observed outcrops to ensure optimal analogy. Participants will be encouraged to make an effort to distinguish the descriptive and interpretative

aspects relative to both outcrop and BHI-based activities. Among others, the following topics will be discussed:

- Description of fractures versus interpretation of fractures on BHI and on the outcrops,
- What are the limits of observation in both cases (borehole image resolution, Outcrop weathering conditions, Directional sampling bias, etc.)
- Can we overcome, and if yes how can we overcome some of these limits?
- Distinction between artificially induced fractures and natural fractures: how can the outcrop observations help?
- The links between surface and subsurface. How could we better calibrate the models based on image interpretation?

Note that due to the nature of the visited outcrops and to the likelihood of high temperatures during the month of October, this field trip will require a reasonable level of fitness.



Comparison between stratigraphy and fractures in Natih E4 and Natih E3. Outcrop photographs are compared with BHI images and interpretative drawings.

Approach and methodology

The success of the field trip will rely on a combination of approaches and methodologies combining:

- Outcrop and borehole image observations. *BHI printed at various scales will be available on the outcrops for direct comparisons.*
- Integration with multidisciplinary datasets. *As much as possible, the discussion should include input from petrophysical data as well as production and dynamic data characteristic from reservoir analogues.*
- High level of interactivity. *Exercises will be proposed and discussions between participants will be strongly encouraged.*