Hypothesis: Compartmentalization along basement-  
Salt Basin, which is located around 500 km to the SW of the Ghaba
'stringers') and associated evaporites. The salt domes possibly
Early Cambrian Ghaba Salt Basin. The salt domes are
unique insights into the dynamics of the Late Neoproterozoic to
whitish Tertiary carbonates, which are cut by wadis.

Satellite images of Qarn Nihayda and Jebal Mayayiz. Both domes are outlined by
diapirs followed by active piercing

After Richard (1998) the growth
Kibrit is located on the Burhaan Fault.
located on the large deep-seated
Jebel Majayiz and Qarat Al-Milh are

1. Introduction & Geology

Six surface-piercing salt domes of interior north Oman provide unique insights into the dynamics of the Late Neoproterozoic to Early Cambrian Ghaba Salt Basin. The salt domes are composed of numerous isolated carbonate blocks (so-called 'stringers') and associated evaporites. The salt domes possibly provide important outcrop analogues for intra-salt hydrocarbon plays in the deep subsurface (3-6 km) of the South Oman Salt Basin, which is located around 500 km to the SW of the Ghaba Salt Basin.

2. Stringers & Facies

Jebel Mayayiz and Qarn Al-Khith are located on the large deep-seated Mandel strike-slip fault zone. Qarn Kibrit is located on the Burhaan Fault. After Richard (1998), the growth history of the domes Qarn Kibrit, Qarn Al-Aram and the shallow Qarn Al-Aram NE can be explained by:

1. Passive dissolution.
2. Burial of the domes = reactivity
3. Reactivation as compactional domes followed by active piercing

So far, it is not known whether the salt domes Qarn Nihayda and Qarn Sahmeh are also fault controlled domes.

3. Paragenetic sequence

The paragenetic sequence is similar for salt dome and SOSB carbonates, but salt dome carbonates are additionally characterized by dedolomitisation and

4. Hydrothermal event?

Dolomite filled hydrofractures (zebra dolomite) are associated with magnesite, barite, celestite and fluorapatite, indicating a possible

5. Stable Isotopes

Carbon isotopes: similar in the salt dome and SOSB carbonates. Negative carbon isotopes in the salt dome samples might be attributed to the dolomitisation of salt dome carbonates during cap-rock formation. Very light carbon and oxygen isotopes in vein cements indicate organic carbon assimilation and the influence of increased temperature/massive water.

6. Maturity: Solid Bitumen

Maturity analyses of solid bitumen in carbonate 'stringers' revealed a range of paleo-burial temperature between 120 and 240°C, for the six salt domes. Assuming a geothermal gradient of 39°C/km this corresponds to depths of 4-6 km. Formation of solid bitumen can be explained by thermal cracking above the "oil window" at around 150-160°C. Qarn Kibrit is the only salt dome which shows two generations of solid bitumen. Few samples show TDC > 8.3% and less solid bitumen is observed than in the subsurface samples from the SOSB.

7. Preliminary Evolutionary Model

The simplified sketch below represents a first approach to establish an evolutionary model for the Jebel Mayayiz salt dome by integrating various data (e.g. maturity, diagenesis, isotopes) of all salt domes.

8. Salt Domes vs. SOSB

Similarities:
- Sedimentary Facies
- Paragenetic succession for co- and mesogenetic processes
- Hydrothermal alteration (?)
- Strategic (negative carbon isotopes: AC7)

Differences:
- Deeper burial of carbonate stringers in Ghaba Salt Basin (4-8 km) than in SOSB (2-5 km)
- Talogenetic diagenesis (e.g.: Dedolomitisation, no halite plugging)
- Less solid bitumen

9. Conclusion

The geological evolution of the carbonate stringers in the Ghaba Salt Basin is in many respects comparable to the evolution of the deeply buried intra-salt carbonates of the South Oman Salt Basin. The surface-piercing salt domes hence form a suitable analogue to the deep intra-salt hydrocarbon plays of the South Oman Salt Basin.

References: