Diagenetic Processes in intra-salt carbonates of the Late Neoproterozoic to Early Cambrian South Oman Salt Basin

1. Geological setting and Scope of the study

The South Oman Salt Basin is one of three Late Neoproterozoic intra-Cambrian salt basins of Oman. They belong to one belt of restricted evaporitic basins, which span from Oman to Iran (Hamzat 1 Salt) and Pakistan (Salt Range) and probably further to the East (Central Tethys Matrix and Conway Morin, 1990).

2. Halite-cemented Ara Cores

- a) Facies: Stromatolite, well B. The core shows halite-cemented fenestral pores and vuggy pores parallel to the laminae. Probably early origin of halite as pores would have been more compacted during burial and as no other cements were observed in thin section. All cores are 8 cm wide.
- b) Dolomitization: Creation of porosity in laminae and dolomitized intercrystalline fracture cement. Samples for stable isotope data were taken from these fabrics.
- c) Halite cementation: Characterized as deduced by solid bitumen–imregnated microlithon (blue halite is a result of gamma-irradiation).
- d) Late halite cementation: Characterized as deduced by solid bitumen–imregnated microlithon (blue halite is a result of gamma-irradiation).
- e) Dedolomitization: Thin section stained showing calcite replacing dolomite.
- f) Hydro-fracturing: Characterized as deduced by solid bitumen–imregnated microlithon (blue halite is a result of gamma-irradiation).

3. Petrography

Diagenetic Framework for Halite cementation

- a) Plugging of core shows halite-cemented fracture with a black median band, consisting of corroded breccia dolomite, carbonates and thus halite (CoCl2-H2O), which are cemented by solid bitumen (B-2 refer to following Figs.).
- b) SEM image shows halite-cemented fracture with a black median band, consisting of corroded breccia dolomite, carbonates and thus halite (CoCl2-H2O), which are cemented by solid bitumen (B-2 refer to following Figs.).
- c) SEM image shows halite-cemented fracture with a black median band, consisting of corroded breccia dolomite, carbonates and thus halite (CoCl2-H2O), which are cemented by solid bitumen (B-2 refer to following Figs.).
- d) SEM image shows halite-cemented fracture with a black median band, consisting of corroded breccia dolomite, carbonates and thus halite (CoCl2-H2O), which are cemented by solid bitumen (B-2 refer to following Figs.).

4. Geochemical Data

- Stable Isotope Data of carbonates

5. Models for early and late Halite-cementation

- a) Solid bitumen fills intercrystalline pore space in halite cements.
- b) Solid bitumen-cemented zone in A1C
- c) Solid bitumen-cemented zone in A1C
- d) Solid bitumen-cemented zone in A1C

6. Conclusions

- Pervasive halite cementation in the Intra-Cambrian Ara carbonate stringers is controlled by early reflux of highly saline ECI-rich brines due to deposition of the evaporite cycle above the carbonate.
- The early halite depletes porosity characteristics to near zero and occurs preferentially in the uppermost parts of a stringer, while solid bitumen is concentrated in the lower parts.
- Partial dissolution of the dolomite and the early halite cement with subsequent formation of oil and solid bitumen creates microfractures, which can mislead to an opposite interpretation: i.e. halite post-dating solid bitumen.
- Late halite has a low impact on reservoir quality and formed by redistribution of early halite and in fractures, which initially are of hydrothermal origin.

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