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Geologic evolution of surface-piercing salt domes in the Ghaba Salt Basin, Interior Northern Oman: First results

J. Schoenherr (1), A. Heimann (1), L. Reuning (2), J.L. Urai (1), R. Littke (3), P.A. Kukla (2), M. Holland (1) and Z. Rawahi (4)

(1) Geologie – Lehr- und Forschungsgebiet Endogene Dynamik, Lochnerstrasse 4-20, D-52056 Aachen, Germany (j.schoenherr@ged.rwth-aachen.de), (2) Lehrstuhl für Geologie und Paläontologie und Geologisches Institut, Wüllnerstrasse 2, D-52056 Aachen, Germany, (3) Lehrstuhl für Geologie, Geochemie und Lagerstätten des Erdöls und der Kohle, Lochnerstrasse 4-20, D-52056 Aachen, Germany, (4) Petroleum Development Oman LLC, P.O. Box 81, P.C. 113, Muscat, Sultanate of Oman

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 (GSB). Field observations have shown that exotic carbonate blocks and associated evaporites exposed in these salt domes represent an important outcrop analogue for intra-salt hydrocarbon plays in the subsurface (3-6 km) of the South Oman Salt Basin and possibly elsewhere.

Outcrop and microfacies analysis revealed that the carbonates developed as open-marine shallowing upward successions from basinal (mudstone laminites) to peritidal (thrombolites) environments. Diagenetic modifications are shallow burial cements including euhedral calcite and quartz, reducing parts of the primary porosity of the calcite matrix. Deep burial processes are indicated by pressure solution seams and by the presence of at least two generations of solid bitumen (“dead oil”), lining the walls of pore cements, microfractures and stylolites. Maturity analyses of this solid bitumen indicate a range of burial palaeo-temperatures between 100-200 ˚C. This broad range in paleo-temperatures indicates that the individual carbonate blocks reached burial depths ranging from at least three to around six kilometer (assuming a geothermal gradient of 30˚C/km). This implies that the carbonate bodies experienced a complex structural evolution due to halokinetic movements during their rise to the surface,

which can be deduced from a chaotic juxtaposition of several fractured and isoclinaly folded carbonate blocks.

Our results show that the carbonates associated with the salt domes have undergone strong diagenetic modifications during their burial and uplift history with at least two oil charges occurring, which is consistent with the evolution of the intra-salt Ara carbonates of the South Oman Salt Basin. The surface piercing salt domes hence suggest that hitherto unexplored deep intra-salt hydrocarbon plays, similar to the SOSB, might also exist in the Ghaba Salt Basin.