Pressure Generation below the Muti Fm. – the Natih Petroleum System Deeply Buried under the Semail Ophiolite, Oman Mountains

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Abstract

Understanding sedimentary basin evolution is the key to access entrapped reservoirs. Especially for hydrocarbon (HC) reservoirs, the knowledge of temperature and pressure generation is important.
In this context, the Oman Mountains and its overthrusted Mesozoic carbonate platform offer unique possibilities for scientific studies: With the Natih Fm. they contain one of the most efficient HC systems of the Sultanate of Oman (Terken, 1999), overthrusted and deeply buried by sedimentary nappes and a massive ophiolite, before basin inversion and later Alpine orogenesis brought the layers back to the surface. Incised by deep canyons/Wadis the whole stratigraphy is accessible and analyzable without drilling.

Top layers of the Natih Fm. are interpreted to embody an overpressure cell resulting out of the deep burial in combination with burial induced HC generation (Hilgers et al., 2006; Holland et al., 2009). Suspected top seal is represented by the Muti Fm., the northern continuation of the Fiqa shale seal (Terken et al., 2001). Additionally, the Nahr Umr seal below the Natih Fm. favors the generation of burial induced overpressure (Terken, 1999).

The main goal of our research is an integrated, numerical 2D basin model of the Mesozoic carbonate platform spanning from the foreland basin to the coastline. In this sense, we studied different sedimentary units focusing on their thermal and structural evolution. Thermal and pressure history were reconstructed using various maturity parameters (e.g. vitrinite and solid bitumen reflectance, fluid inclusion measurements), while reconstruction of the structural history was based on field mapping and stress field restorations.

Here we present first results on the pressure evolution in the Natih Fm., i.e. under the Muti seal, influenced by ophiolite emplacement. Combining fluid inclusion measurements with independent paleo thermometers, namely solid bitumen reflectance and Raman spectroscopy, enables us to do so. In combination with well calibrated multi-1D basin models, we outline the influence of internal HC generation and burial on these pressure conditions.