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Pressure and temperature evolution under large-scale overthrusts - The carbonate platform under the Semail Ophiolite, Jebel Akhdar, Oman

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Large scale overthrusts have significant influence on the pressure and temperature (p-T) evolution of the overthrusted sedimentary basins. These p-T conditions are essential for the formation of energy resources such as petroleum, natural gas and coal, as well as associated forced fluid migration for the generation of mineral deposits. Understanding the p-T evolution over time is key to explore related reservoirs and resources.

An excellent example of overthrusting is represented by the Semail Ophiolite, Oman mountains, the largest ophiolite on Earth. 350 km of ophiolite is exposed perpendicular to obduction direction along the northern coast of the Sultanate of Oman. After overthrusting of this oceanic crust onto the passive continental margin of Arabia, up-doming of the area during Alpine orogeny exposed the margin sediments, which are now easily accessible at the surface (Loosveld et al., 1996). Within the Oman Mountains different canyons provide access to 1,400 m of lithology accumulated through the last 300 My, containing hydrocarbon source and reservoir rocks (Beurrier et al., 1986; Breton et al., 2004). These sedimentary rocks offer unique possibilities to analyze the temperature and pressure evolution of sedimentary rocks influenced by large scale overthrusts.

We reconstruct the thermal and tectonic history of the passive continental margin as result of overthrusting. Particularly, we focus on related forced hydrocarbon generation and tectonically driven oil migration. To this end, we linked structural analysis of the Oman Mountains with petrographic analysis and basin modelling. Thermal history modeling includes implementation of various maturity parameters (i.e. solid bitumen reflectance, Raman spectroscopy of carbonaceous material, and fluid inclusion measurements; Fink et al., 2015; Grobe et al., 2016). Reconstruction of the structural and tectonic history was based on field mapping and stress field restorations. Exhumation phases were constrained using (U-Th-Sm)/He thermochronometry. We present the first comprehensive thermal model of the passive margin, including constraints on both burial and exhumation history. Three solid bitumen generations outline peak burial temperatures of 225 to 240 °C and two later events of tectonically driven hydrocarbon migration. Structural data show that ductile rock deformation was reached during deepest burial. Presented results are summarized and integrated in a numerical basin model of the area.

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