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Burial and thermal history simulation of the Abu Rudeis-Sidri oil field, Gulf of Suez-Egypt: A 1D basin modeling study

Ahmed Awadalla, Omar A. Hegab, Mohammed A. Ahmed, Saad Hassan

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INTRODUCTION

The Gulf of Suez has excellent hydrocarbon potential and is considered as the most prolific petroleum province in Egypt. The Abu-Rudeis-Sidri oil field is located on the eastern coast of the Gulf of Suez about 25 km north of the Belayim Land Field and to the SE of the October and Ras Budran fields (Figure 1). The exploration activities in Abu-Rudeis-Sidri oil field started in March 1947 by drilling the Rudeis-01 well (R-1). This well bottomed at 2410m in the Kareem Formation and was classified as a dry hole. The R-2 well was the first one that discovered oil in the Nukhul Formation. The exploration activity pointed to test the pre-Miocene potentialities started in 1978 by drilling the ARS-1 well which encountered oil-bearing horizon in the Nubia Formation. Between 1978 and 1991, thirteen wells were drilled in order to study the extension of the Nukhul Formation and to evaluate the pre-Miocene potential [EGPC 1996].

It is critically important to calculate and calibrate the temperature history and predict pore fluid pressures during the evolution of the basin. The compaction state and related porosity facilitated the determination of bulk thermal conductivities for heat flow calculations [Hantschel and Kauerauf 2009]. The reconstruction of the thermal evolution and burial history of the Abu Rudeis-Sidri oil filed including the tectonic evolution responsible for the development of the basin, sedimentary distribution, and petrophysical properties are achieved by 1D basin modeling approach. This provides information on timing and mechanism of thermal activation, maximum paleotemperatures, conductive cooling and paleotemperature gradients. A forward modeling of the geologic processes (subsidence, structural and tectonic events) and the characteristics of rock and fluid properties as a function of the paleo-history of the Abu Rudeis-Sidri oil field has been performed on seven wells.

Burial-thermal profiles were prepared using PetroMod®1D software. The information used for each well include age, top, thickness, the stratigraphic level for unconformities and associated hiatuses, corrected bottom-hole temperatures, vitrinite reflectance, and Rock-Eval pyrolysis data. The thicknesses were derived from the composite well logs and geological reports. The source rock assignment and their respective properties, total organic carbon (TOC), hydrogen indices (HI) and the hydrocarbon generation kinetics are implemented in order to simulate the thermal maturity of the organic-rich intervals.

The objective is to simulate the total geological situation including tectonic events, deposition, erosion, uplift, etc… of the Rudeis-Sidri oil field with a comprehensive 1D model to evaluate burial and thermal histories. The present work focuses on the relation between the multi tectonic phases and basin-fill history and presents an interpretation of the spatial variation of the temperature field and geohistory. In addition, the main controls on the temperature profile and the associated implications are discussed.