AAPG Datapages/Search and Discovery Article #90319 ©2018 GEO 2018 13th Middle East Geosciences Conference and Exhibition, Manama, Bahrain, March 5-8, 2018

Micro-Rhombic Calcite and Micro-Porosity in Early Cretaceous Reservoirs – The Role of Burial Diagenesis Driven by Plate Tectonics

Volker Vahrenkamp[1], Hussein Hoteit[1], and Carlos Santamarina[1]

[1]ANPERC, KAUST, Thuwal, Saudi Arabia.

ABSTRACT

Micro-porosity with pores smaller than 10 microns and pore throats smaller than 1 microns is volumetrically the most prominent porosity type in Early Cretaceous carbonate reservoirs of Arabia. A better understanding of the origin, distribution and properties of the micro-porosity is of the highest importance for hydrocarbon production with most of the remaining oil in the super giant reservoirs of the Middle East locked in it. The application of the new technique of clumped oxygen isotope thermometry has revealed that in Abu Dhabi micro-rhombic calcite, which hosts the micro-porosity formed at temperatures between 50 oC and 90 oC. This together with temperature gradients from basin modelling and detailed burial curves indicates recrystallization of pre-existing calcite minerals at depth of several hundred meters during burial diagenesis in the Late Cretaceous (Turonian to Campanian). This time period is characterized by the obduction of oceanic crust onto the eastern margin of the Arabian plate burying the Early Cretaceous strata to a depth of some 10km over an area extending 350 km by 100 km. Consequently, the limestone sequences at the plate margin lost all porosity and were compacted to about 80% of their original thickness. A fluid flow model has been created to investigate whether pore fluids expelled from compacting carbonates at the Eastern plate margin were instrumental in the whole-scale recrystallization to micro-rhombic calcite of the platform interior sediments which were not overridden by the oceanic plate. The model implies that fluids were squeezed from the compacting sequences and constrained to flow westwards and strata bound as upwards flow was prevented by overlying seals composed of shale sequences. A further drive for fluid flow may have been added by hydrothermal convection introduced by heat from the deep burial and hence increased fluid temperatures at the plate margin. The overall aim is to better understand the processes and flow paths during burial diagenesis to unravel regional gradients in micro-porosity distribution and associated properties.