Regional Issues in Jurassic Pore Systems – Echinoderms, Syntaxial Overgrowth Cements and a Fifth Porositon

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Abstract

Regional and well established carbonate geological and diagenetic processes are re-examined in Jurassic carbonate reservoirs using the large amount of quantitative mercury injection capillary pressure (MICP) pore system data acquired by Saudi Aramco in the last eight years. An extensive Berri field data set included petrographic data and MICP pore system data obtained by Thomeer analysis. The Berri data from four Jurassic carbonate reservoirs is compared to other data, and specifically the Ghawar Rosetta Stone data using a regional depositional context. The anticipated increase of Jurassic carbonate-rim cement to the North of Ghawar is evident. Much more important from a pore system perspective are the amounts of syntaxial overgrowth cement and the correlative increase of echinoderms and foraminifera in the Hadriya and Fadhili. These latter increases necessitate a fifth porositon (F-ESO), an additional maximum pore-throat diameter mode in the Hadriya and Fadhili pore system models, as compared to the four porositions that describe the pore systems of the Ghawar Arab D limestone and the Berri Arab and Hanifa. Review of the Abqaiq petrographic and MICP data of Ross et al. (1995) provide independent support for the four porositons of Clerke et al. (2008) and also indicate the presence of a fifth (F-ESO) porositon in the Abqaiq Arab D.

The pore system effect of the predicted and present carbonate rim cements is imperceptible. Echinoderm and foraminifera are very abundant in the Berri Fadhili and show a steady decrease in abundance upward through the Berri Jurassic section, i.e., the Fadhili, Hadriya, Hanifa and the Arab. Echinoderm abundance is closely linked to marine salinities and high magnesium calcite. Quantitative determinations of echinoderm and foraminifera abundance are shown to be correlative to and useful as a predictor of the pore destructive syntaxial overgrowth cement. Regional models of reservoir quality distribution could potentially be improved using maps of high precision Ca/Mg ratio relating to the high magnesium calcite of echinoderms and syntaxial overgrowth cements and maps of echinoderm abundances and habitats. These regional maps could relate broadly and inversely to reservoir quality and depositional salinity