Thermochemical Sulphate Reduction Impacts on Carbonate Petroleum Reservoir

LEI JIANG[12]

[1] Key Laboratory of Petroleum Resources Research, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China; lei.jiang@mail.iggcas.ac.cn

[3] Department of Geology and Geophysics, Yale University, New Haven, CT 06511, USA; lei.jiang.lj362@yale.edu

Interest in the creation of secondary pore space in petroleum reservoirs has increased because of a need to understand deeper and more complex reservoirs. The creation of new secondary porosity that enhances overall reservoir quality in deeply buried carbonate reservoirs is controversial and some recent studies have concluded it is not an important phenomenon. Here we present petrography, geochemistry, fluid inclusion data, and fluid-rock interaction reaction modelling results from Triassic Feixianguan Formation, Sichuan Basin, China, core samples and explore the relative importance of secondary porosity due to thermochemical sulphate reduction (TSR) during deep burial diagenesis. We find that new secondary pores result from the dissolution of anhydrite and possibly from dissolution of the matrix dolomite. Assuming porosity before TSR was 16% and the percentage of anhydrite was 6%, modelling shows that, due to TSR, 1.6% additional porosity was created that led to permeability increasing from 110 md (range 72 to 168 md within a 95% confidence interval) to 264 md (range 162 to 432 md within a 95% confidence interval). Secondary porosity results from the density differences between reactant anhydrite and product calcite, the addition of new water during TSR, and the generation of acidity during the reaction of new H_2S with the siderite component in pre-existing dolomite in the reservoir. Hence, the overall increasing of secondary porosity due to TSR would be more than 1.6%. Fluid pressure was high during TSR, and approached lithostatic pressure in some samples; this transient overpressure may have led to the maintenance of porosity due to the inhibition of compactional processes. An additional >1.6 % porosity is significant for reserve calculations, especially considering that it occurs in conjunction with elevated permeability that results in faster flow rates to the production wells.