Prediction of Mechanical Compaction during Deep Burial

Fisher, Quentin[1], Tony Crook[2], Christine Souque[1] (1) Rock Deformation Research Limited, Leeds, United Kingdom (2) Rockfield Software Limited, Swansea, United Kingdom

Mechanical compaction of siliciclastic sediments is usually thought to be restricted to shallow burial depths. Pervasive mechanical compaction of sand-rich reservoirs involving porosity collapse and grain-fracturing may, however, occur during deep burial resulting in a dramatic reduction in reservoir quality. Reservoirs particularly prone to mechanical compaction are those that have high porosity and medium to coarse grain-size, which become exposed to high mean effective stresses. The requirement of high effective stresses and high porosity means that late stage mechanical compaction is usually confined to reservoirs that are very deeply buried and have been rapidly buried under low geothermal gradients. Diagenetic modelling provides a good indication as to which sandstone reservoirs would be susceptible to mechanical compaction during deep burial. However, the extent of grain-fracturing varies as a function of structural position. Studies of several outcrop examples that have experienced pervasive porosity collapse have shown that grain-fracturing is sometimes more pervasive in tightly folded sandstones than those that show less signs of macroscopic deformation. Here we show how sophisticated geomechanical modelling using a commercial finite element simulator (Elfen) may be used to predict regions within deeply buried reservoirs in which porosity collapse is most likely to have occurred.