ENHANCED COMPACTION OF STRESSED NORTH SEA CHALK DURING WATERFLOODING

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Abstract The high porosity chalk found in North Sea petroleum reservoirs is mechanically very weak; in many cases there is little or no cementation. When placed under high stress it compacts significantly. The material obeys a rate-type compaction model which is based on friction between the coccolith fragments. In this model, after the material exceeds its yield point many of the particles in contact are subject to almost enough shear force to overcome frictional resistance to motion.

Compaction tests were performed on material for which the native saturation was preserved before testing. The initial water saturation was about 5%. The material was constrained in a uniaxial-strain condition before and during waterflooding. Prior to waterflooding with simulated sea water, the material was allowed to creep for several days. Contacting the chalk with water effects a substantial additional compaction immediately after the water is introduced to the sample. The results clearly indicate that localized compaction follows the water front through the sample. The effect was easily seen on plastic material (stress above the yield point), but was negligible in elastic (pre-yield) material.

The water-induced compaction was about 1% bulk strain (for plastic material) occurring over a six-day period after water injection. However, after waterflooding the sample requires a larger-than-normal increase in stress before compaction begins again. The net result after a large increase in stress beyond the water front passage is that the compaction is the same as if the mate-

rial had not been waterflooded. The long-term effect on produced oil is small, but changes in permeability in the water flooded zone may be experienced in the field.