The influence of CO_2 gas and carbonate water on the mechanical stability of chalk

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The mechanical strength of high porosity chalk is affected by using carbonate water as IOR fluid. The water-weakening effect is enhanced due to increased dissolution of chalk in the presence of CO_2(aq). In this study, the mechanical properties of chalk were compared with and without CO_2(aq) present in the injected water. By use of a standard triaxial cell, series of samples with –and without pre-flooding at confining pressure of σ_c=0.5-1.0 MPa were hydrostatic loaded up to yield point at room temperature or 90 ^oC. Then a major part of the samples were exposed to subsequent creep and flooding phases at increased stress levels of about 2 MPa above yield point. In all cases flooding experiments were performed without any backpressure and with flooding pressure varying between 2 and 8 bar. Injection of pure CO_2 gas into water-saturated chalk resulted in only marginal weakening of the chalk material. At stress levels beyond the yield point, the chalk exposed to carbonate water becomes considerably weaker than chalk flooded with pure Eq. Water. At a given flooding pressure of carbonate water, an increase in temperature to 90 ^oC improved the chalk stability. Flooding with CO_2 saturated modified seawater, which contained an enhanced concentration of sulfate, increased the strain significantly due to the precipitation of $CaSO_4.2H_2O$(s). The preferential oil-wet cores at S_{or}=0.62 experienced an increased strain of 20 % compared to the water-wet test series during flooding with CO_2-saturated Eq. water. Increasing the confining pressure by a factor of 10, strain values of about 10 times higher or even more were observed when flooding with carbonate water. The experimental observations are discussed in terms of chemical and pressure dissolution of chalk.