DENSITY-DRIVEN FLOW, VISCOELASTICCOMPACTION AND MINERAL REACATIONS INHYDROCARBON BASINS

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Density-driven viscoelastic compaction,pressure solution and mineral reactionsare important processes in sedimentarybasins. In the conventional modelling ofsediment compaction and mineralreactions, the rheological behaviour ofsediments is typically considered asporoelastic or purely viscous. In fact,compaction due to pressure solution anddensity-driven flow in porous media isfar more complicated. A generalisedmodel of viscoelastic compaction,pressure solution and mineral reactionsin hydrocarbon basins is presented byincorporating both poroelastic andviscous effects together with a morerealistic dissolution and precipitationmodel of mineral reactions. Thenonlinear reaction-diffusion equationsare solved numerically and differentcombinations of physical parameters areused to simulate realistic situations intypical sedimentary basins. Numerical simulations have shown thatporosity-depth profile is nearlyexponential followed by a transitionfrom poroelastic to viscous region. Thesudden switch is often associated with ajump to a high pore pressure and lowpermeability region where mineralizedseal may be formed. This study revealsthat the reduced first order reactionmodel is a very good approximation indescribing the extent of the overallmineral transformation and stillreproducing many essential features ofmineral reactions if appropriatereaction rate laws are used. Comparisonof numerical simulations with real datahas shown very good agreements.