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Interaction between reactivity and flow in the in-situ production of oil from oil shale

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There are several reaction models for the transformation of kerogen to the various products formed. The weight loss mechanism is important, but so is the rate at which different products are formed. The stoichiometry of the reactions taking place is usually assumed and made consistent with as many pieces of kinetic and compositional data as are available. Even so, the mechanism, the reactions and product descriptions (molecular weights, properties, etc.) are rarely unique. In this paper, we examine different stoichiometric/kinetic models that describe the formation of various products (methane, higher molecular weight gases and liquids, coke and other solids) from kerogen. The three-phase relative permeability models are usually derived by combining the oil-water relative permeabilities and gas-liquid relative permeabilities. The extrapolation of the "typical" relative permeability models to zero end points is questionable. The mobilities of phases are governed by ongoing permeability changes and viscosities which are changing as temperatures, pressures and compositions of the fluids change. The mobility of phases is linked to the reactivity models, because the components which are assigned higher mobilities rapidly move toward the production well, whereas heavier products spend more time in high temperature zones. The interplay between the reactivity and mobility phenomena is examined in detail in this study, by postulating alternate kerogen transformation models to explain the same kinetic/compositional data. These are studied in conjunction with a variety of three phase relative permeability representations and it is shown that significantly different outcomes with respect of the gas-liquid-coke product distributions are predicted with different combinations.