5.3 **Modeling Deformation and Fracturing of Oil Shale Rock Induced by In Situ Fluid Generation**

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The formation of fluids inside oil shale during retorting can lead to the formation and growth of fractures resulting from stresses associated with fluid production inside the rock. This process is analogous to hydrofracturing, except that fluids are generated in situ instead of being injected at high pressure into the rock. The formation and growth of fractures creates permeable pathways that control oil and gas expulsion and migration during the production stage and may allow water to flow into the retort pod in the post-production stage. The stress field acting on the rock is a consequence of both the boundary condition (such as the overburden stress) and the fluid pressure gradients within the pores and fracture apertures. We have developed a model that explicitly couples elastic deformation and fracturing of the rock, based on a discrete element method, with continuum models for fluid flow and heat conduction. Kerogen decomposition is modeled by a first-order, temperature dependent, chemical kinetic model. The growth of fractures in the retorted shale was simulated for some simple geometric configurations and several types of boundary conditions, including free-surface boundaries and fixed boundaries with and without external stress. The effects of the rate of fluid production and the heterogeneity of kerogen concentration distribution inside the rock on fracturing patterns were systematically investigated using the model simulations. Qualitative agreement was found between simulation results and experimental observations. The challenges that must be overcome to improve our capabilities for simulating fracturing dynamics of oil shale and the expulsion of hydrocarbons will be discussed.