3.1 Parametric Controls on the Composition of Oil Generated by In Situ Pyrolysis of Oil Shale

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This paper describes experiments that examine the effects of four parameters relevant during *in situ* pyrolysis: hydrostatic pressure, temperature, heating duration, and effective stress. All experiments were conducted as closed system pyrolysis experiments. The starting material for all experiments was prepared from a large block of Green River Oil Shale taken from the Mahogany Zone.

Effective stress on a rock is exerted by overburden and supported via the granular matrix of the rock. To generate effective stress in our experiments, a spring-loaded frame was constructed that applied stress to a 1-inch diameter sample. By using different sets of springs, the samples were loaded with up to 1000 psi. Samples were encased in Berea sandstone cylinders, jacketed in steel, and clamped to limit lateral strain. This uniaxial loading was similar to what the oil shale experiences *in situ*. Special alloy springs ensured that the load did not diminish as the springs were heated along with the sample. The entire device was placed in a Parr bomb for heating. The oil shale cylinders initially expanded, then shortened by the end of an experiment. The maximum expansion was recorded by a piece of gold foil wrapped on one of the load frame support posts.

Three experiments provide an example of how pyrolysis at progressively higher effective stresses yields hydrocarbon liquids with a lower average molecular weight and a higher API gravity. The 1000-psi effective stress experiment yields the highest concentrations of chains shorter than $n\mathrm{C}_7$, the 0-psi experiment yields the lowest concentrations, and the 400-psi experiment yields intermediate concentrations. Above $n\mathrm{C}_{7,}$ the relationships are reversed.

The systematic relationships demonstrated for the straight-chain alkanes are also found in the aromatic compounds, cyclic alkanes, and branched-chain alkanes. Changes in pressure and temperature modify the magnitude of the differences seen in these relationships. Our experiments also demonstrate that various parameters interact in unexpected ways. For example, variations in hydrostatic pressure have a small influence on the liquid composition; however, when changes in hydrostatic pressure interact with effective stress, the observed variations become much more significant.