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### **Shale oil composition as it relates to production kinetics**

James Bunger<sup>1</sup>, Christopher Russell<sup>1</sup>, Donald Cogswell<sup>1</sup>, James Patten<sup>2</sup>

<sup>1</sup>*JWBA, Inc., Salt Lake City, UT, United States*, <sup>2</sup>*Red Leaf Resources, Inc, Salt Lake City, UT, United States*

Historically, shale oil has been produced in surface retorts where, for economic reasons, residence times in the retort are short. Rapid heatup (e.g., 1 hr or less) is needed to make best use of the reactor space. Examples of such retorts are Union-B, Paraho, Petrosix, ATP, Kiviter, Fushun, TSK (Galoter), and the modified Fischer Assay. Recent research has focused on in-situ processes that may require months or even years to reach desired end temperatures. Examples of retorts that heat at slower rates are Shell's ICP and Red Leaf's EcoShale. In the majority of proposed in-situ technologies, final operating temperatures may be lower by as much as 200°F relative to surface retorts and heat-up rates may be on the order of 2 to 5°F per day. The differences in time-temperature histories impart substantial differences on product yield and product quality. When oil shale is subjected to slow heating rates, differences in rates of cracking, dehydrogenation, and condensation reactions result in lower liquid oil yields but produce a higher quality liquid product. It appears that dehydrogenation reactions are favored at slower heating rates, with attendant production of hydrogen and aromatics. Slow heating rates also favor the bimolecular condensation reactions of aromatics to form coke. The loss in yield is seen in the depletion of aromatics, and some naphthenes. The higher quality is due to both higher concentrations of paraffins (lower concentrations of aromatics) and a lower average boiling range. This paper will discuss the kinetics of gas, liquid, and coke formation and present a comparison of liquid molecular compositions between a surface retort shale oil and an in-situ shale oil. Additional discussion on the conversion of produced oil to marketable products will also be offered.