Reservoir Quality Assessment: Petrography as a Tool for Deciphering Kinetically-dominated Systems and the Need for Petrographic Education

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As exploration efforts turn increasingly to unconventional reservoirs and, especially, to deep, hot targets, accurate prediction of reservoir quality becomes a great challenge. In rocks that have experienced a protracted history of post-depositional chemical and mechanical alteration, rock properties cannot be readily predicted from primary sediment characteristics. A dominant reason for this difficulty is that, despite temperatures that are somewhat elevated compared to the surface, reactions in sedimentary basin are relatively sluggish and driven largely by kinetics (rate-controls) rather than by thermodynamics. In such systems, prediction of reaction paths and mechanical behavior cannot be obtained from an understanding of bulk composition and thermal conditions alone. In sedimentary basins, rocks inevitably preserve a complex history of their modifications. Efforts to predict the progress of an individual, pore-modifying reaction (e.g., quartz cementation) must take the proper historical context of the reaction (i.e., its individual rate-control) into account. Predictive approaches that do utilize such a conceptual framework can meet with great success.

The broad field of sedimentary petrography involves the tools and skills required to assess kinetically-dominated processes and the complex historical records they leave behind. Although polarized light microscopy remains fundamental, the tool-kit of the modern petrographer encompasses a broad range of supporting methods. Cathodoluminescence, both SEM- and light microscope-based, fluorescence microscopy, and back-scattered electron imaging are examples of techniques that are yielding vital new insights into the post-depositional processes operative in reservoir rocks. Despite the advent of such technologies, and the great (and growing) practical utility of petrography, opportunities for university students to learn petrography have been diminished as a consequence of several intersecting historical factors that have displaced petrography courses from the curriculum. A multi-media digital resource, Sandstone Petrology: A Petrographic Image Atlas, is the result of an NSF-funded project to create and assess materials that lend efficiency to the study of highly visual subject matter. It is the hope that projects such as this will serve to support the growing industry demand for expertise in the area of rock characterization and rock property prediction.