From Petrographic Wonderland to Hard Numbers, or How We Might Combine High End Petrography with Numerical Modeling to Understand Mudstone Diagenesis at the Rock Volume Level - Lessons Learned at a Distant Place

Juergen Schieber[1], Max Coleman[2], Mark Reed[3], Dave Bish[1], and Elisabeth Hausrath[4]

[1]Indiana University, Bloomington, Indiana
[2]Jet Propulsion Laboratory, Pasadena, California
[3]University of Oregon, Eugene, Oregon
[4]University ofNevada, Las Vegas, Nevada

ABSTRACT

The accurate, detailed study of concretions is a promising enquiry, likely to yield interesting and unexpected results.

Long before mudstone petrography at the mineral and micrometer level became practicable, the study of nodules as extreme examples of diffusional redistribution of matter provided us with valuable insights into the likely processes at work when muds turn into rock. Today, examination of mudstone diagenesis is dominated by the petrographic microscope and SEM observation of diagenetic cements and dissolution features and observations typically made over a few square mm of "exposure". Clearly, valuable insights into diagenetic processes can be gleaned from microscope studies, but scaling them up to stratigraphic intervals is far from linear and is fraught with complications.
The need to rely on polished thin sections complicates most petrographic studies because mechanical polishing induces surface damage such as grain plucking and smearing of soft minerals. Argon ion milling, used extensively to study shale porosity, probably is the best sample preparation method for high-end petrographic study of shale diagenesis. It allows to examine mineral grain boundaries and contact relationships in detail and enables us to determine whether minerals precipitated together, replaced each other, or were simply dissolving. Mineral relationships in shales can now be studied in the same way that has long informed igneous and metamorphic petrologists -as chemical reactions set in stone.