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Richard E. Larese[1], Donald L. Hall[2] (1) Clastic Petrology Consultant, Durango, CO
(2) Fluid Inclusion Technologies, Inc, Broken Arrow, OK

Impact of Interactive Textural, Compositional, and Diagenetic Controls on Potential Reservoir Quality of Low Permeability Sandstones

Sandstone reservoir quality may be greatly influenced by burial diagenetic processes which are programmed by pre-burial depositional texture and framework composition. These chemical/physical processes may be compartmentalized within discrete sandstone sequences on the basis of grain size trends attributed to variations in depositional energy. Chemical compaction processes are most pronounced in finer grained intervals in which they provide an important in situ source of silica/carbonate cement. In some instances, physical-chemical compactional mechanisms may account for >60% of primary porosity lost in "tight gas" sandstones.

Mineralogical composition of reservoir sandstones is critical to reservoir quality development, as contrasting framework grains behave differently with burial diagenesis. Feldspar dissolution can generate virtually all effective pore space in some "tight gas" sandstone intervals. Conversely, labile lithic fragments may be subjected to significant ductile-grain physical deformation controlled by lithic type, abundance, and distribution heterogeneity within the depositional system. Integrated SEM/CL and fluid inclusion analyses indicate that brittle-grain physical deformation of relatively stable quartzose/feldspathic framework components adversely impacts reservoir quality as well.

Correspondingly, detrital framework chert also exerts a significant influence on sandstone reservoir quality relative to porosity reduction, preservation, and enhancement. In part, the intensity of these chert-driven diagenetic mechanisms is controlled by the volumetric ratio of chert to quartz framework grains. In several Western Canada "tight gas" intervals, maximum sandstone porosity (~ 17%) occurs in fine-medium grained intervals possessing maximum chert abundances of roughly 12-24 volume % and corresponding quartz abundances of >37%. Apparently, the uniform distribution of chert in more quartzose sandstones retards the unit's exposure to normal quartz cementation effects and increases its exposure to corrosive pore fluids resulting in dissolution and porosity enhancement. However, chert quantities > 40% result in extensive compactional welding and associated irreversible porosity loss.