Hydrothermal Alteration of Oil and Gas Reservoirs: A Fundamental Process

Langhorne Smith*
Reservoir Characterization Group, New York State Museum,
Room 3140 CEC, Albany, NY, 12230 USA
Lsmith@mail.nysed.gov

and

Graham Davies
Graham Davies Geological Consultants, Suite #113, Alistair Ross Technology Center
3553 31st Street N.W., Calgary, AB, T2L 2K7

ABSTRACT

Hydrothermal alteration is not restricted to local dolomitization and other mineralization around faults in a few localities, but occurs in a wide variety of structural and stratigraphic settings all over the world. Hydrothermal alteration products may include, but are not restricted to, matrix and fracture-filling dolomite, recrystallized limestone (including development of microporosity), bedded and fracture-filling chert, induced breccias and fractures, pore- and fracture filling anhydrite, calcite, ferroan calcite, ankerite, quartz, fluorite, barite, bitumen, authigenic clay minerals, sulfides and more. Furthermore, leaching of limestone, dolomite, and other minerals is a common occurrence in hydrothermally altered reservoirs and can be a primary control on reservoir quality.

First order-controls on hydrothermal alteration products include composition, thickeness and permeability of the host rock, the pressure, temperature and chemistry of the hydrothermal fluid, the effectiveness of the seal, the efficiency of the fluid recharge, distance to the basement and basal sandstone aquifer, and the type and timing of faulting.

Examples of different types of hydrothermally altered reservoirs and seals will be shown from the Appalachian Basin, Venezuela, Wyoming, Africa, Australia and the Middle East. Structural settings where hydrothermal alteration occurred in these cases vary from subtle post-rift extensional faults to strike-slip faults and associated Reidel Shears to basement-rooted thrust faults. Host rocks in the examples include limestones, dolomites, shales, marls and sandstones (most sedimentary rocks).

A better understanding of possible hydrothermal alteration products will help to identify hydrothermally altered reservoirs and develop better exploration models and development plans.