MULTI-PHASE POROSITY-PRESERVING CHLORITE CEMENTATION IN SHALLOW MARINE VOLCANOCLASTIC SANDSTONES, SAWAN GAS FIELD, PAKISTAN

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Sandstones with anomalously high porosity and permeability at great burial depth and high temperatures are of economic importance, as a significant amount of hydrocarbons have been discovered in these reservoirs. The Sawan gas field lies 500 km northeast of Karachi, in the Middle Indus Basin. The reservoir rocks, Cretaceous volcanoclastic sandstones (Albian-Cenomanian) of the Lower Goru Formation, show anomalously high porosities (20%) at depths of 3000 to 3500 m.

The sandstones are subarkoses to lithic arkoses and sublitharenites to feldspathic litharenites. Strongly altered volcanic rock fragments are the most important lithic component. The clay fraction (<2 mm) consists of Fe-rich chlorite (chamosite) and illite. Diagenetic features such as compaction, quartz overgrowth cements, carbonate- and chlorite cements and feldspar dissolution can be observed.

Authigenic chlorite occurs as two-phase pore lining cement, pore filling cement and chloritized detrital components, all having similar chemical compositions. The pore lining cement, comprising a 5–10 mm thick rim covering all detrital grains, clearly developed in two generations; an older, poorly crystallized and a younger better crystallized growth. The latter comprises euhedral, pseudohexagonal crystals, oriented with their faces perpendicular to the host detrital grain surface. Rim precipitation occurred after an initial stage of compaction but early relative to other diagenetic phases. Both chlorite rim generations grew by direct precipitation from pore waters, using products derived from volcanic rock fragments. In areas with no, thin, or discontinuous chlorite rims, quartz cementation is common. Well-developed chlorite rims inhibited quartz cementation, preserved anomalously high porosities and permeabilities, but did not inhibit carbonate cementation.

The restriction of the porosity preserving diagenetic processes to sandstones deposited in a very shallow marine environment with occasional influx of meteoric water provides evidence for a primary depositional control during the burial process and could indicate an eogenetic chlorite precursor phase.