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Effect of Authigenic Grain-Coating Chlorite on the Resistivity and Reservoir Quality of the Lower Carboniferous RKF Sandstones (Rhourde El Krouf Field, Berkine Basin, Algeria)

In the Rhourde El Khrouf Field, the upper portion of the Tournasian-Visean deltaic "RKF sandstones" produces oil and gas-condensate. The underlying "lower RKF sandstones" have high log-derived porosities and low resistivity, suggesting brine saturation. However, density/neutron logs and pressure data suggest hydrocarbon presence. To settle this issue, upper-RKF core and lower-RKF cutting samples were analyzed petrologically, revealing that the sandstones of both subunits are similar in composition and diagenesis: most are fine-grained mature quartzarenites, with early diagenesis characterized by the formation of grain-coating Fe-rich clays, followed by feldspar dissolution, and precipitation of kaolinite and magnesite. During burial-diagenesis, Mg-siderite and quartz cements precipitated intermittently and grain-coating clays recrystallized into Fe-chlorite (2b-polytype chamosite) and minor illite. Excepting compaction, quartz cement is the main porosity-reducing agent. Its distribution is opposite to that of grain-coating chlorite, reflecting that chlorite coatings effectively inhibit quartz overgrowth.

In the hydrocarbon-saturated "upper RKF sandstones", chloritic coats are scarce (0-4.75%) but their presence lowers resistivity, as indicated by the negative correlation (R=0.62) between resistivity-log values and point-counted chlorite volumes. Enhanced conductivity is attributed to high-salinity (~300gr/l) water trapped in grain-coating-clay microporosity.

The low-resistivity "lower RKF sandstones" are characterized by exceptionally high volumes of grain-coating chlorite (up to 19%, typically 5-10%), hence few quartz cement, explaining their high porosity and friability. Because grain-coating chlorite demonstrably reduces resistivity, the interpreted high water saturations in the "lower RKF sandstones" could relate to clay-mineral-bound water and low-resistivity pay zones could exist.

Recent well testing has confirmed that the low-resistivity sandstones produce water-free hydrocarbons.