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Diagenetic processes near the gas-water contact in Cenozoic sandstones of the Austrian Molasse Basin

GROSS, D.[1], GRUNDTNER, M.-L.[1], LINZER, H.-G.[2], PYTLAK, L.[1], SACHSENHOFER, R.F.[1], SCHEUCHER, L.[2]

[1] Montanuniversität Leoben, Lehrstuhl für Erdölgeologie, Peter-Tunner-Straße 5, 8700 Leoben, Österreich
[2] Rohöl-Aufsuchungs AG, Schwarzenbergplatz 16, 1015 Wien, Österreich
email: doris.gross@unileoben.ac.at

The Molasse Basin, extending from Geneva to Vienna, is the northern foreland basin of the Alps and comprises shallow to deep marine sediments since Eocene time. In the present study, the interaction between biogenic gas generation, alteration and the associated formation of pore cements is investigated based on 80 sandstone samples of Oligocene/Miocene age. Cement phases in pores precipitate or dissolve depending on pH-conditions. Thus, cement phases are an important archive for reservoir forming processes and their timing.

Rock-fluid interactions were investigated focusing on gas- and water-bearing sections near the gas-water contact (GWC). Sediment petrographic techniques were applied to establish the mineralogy and diagenetic history of siliciclastics. In addition, stable isotope ratios ($\delta^{13}C$, $\delta^{18}O$) were measured from carbonate cements.

No significant mineralogical variation can be identified between water- and gas-bearing litharenites. Both show good reservoir qualities (porosities up to 30%). During early diagenesis, a first cement generation with fibrous calcite and a second with micritic calcite were formed. Paleo-PT conditions and stable isotope ratios of accumulated gas indicate a simultaneous gas hydrate formation. With increasing burial depth, gas hydrates become unstable and free gas is accumulated. Partial dissolution of carbonate cements is linked to changes in pH conditions, likely caused by a slight influx of thermogenic hydrocarbons.

A third generation of carbonate cement precipitated along the GWC during late diagenesis. Considerable concurrent dissolution of siliciclastic components suggests alkaline conditions. The $\delta^{18}O$ of calcite cement shows a slight, but obvious negative shift. Geochemical data suggest that the formation of calcite cement in direct proximity to the GWC is related to the interaction of earlier released Ca^{2+} with CO_2, dissolved in formation water.