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Clay mineralogy of the malmian source rock of the Vienna Basin: Effects on shale gas exploration?

Andrea Schicker (1), Susanne Gier (1), and Ulrich Herzog (2)

(1) Department of Geodynamics and Sedimentology, University of Vienna, Althanstrasse 14, 1090 Vienna, Austria (andrea.schicker@univie.ac.at), (2) OMV Exploration & Production GmbH, Trabrennstrasse 6-8, 1020 Vienna, Austria

In an unique opportunity the diagenetic changes of clay minerals of a marlstone formation with only minor differences in provenance and depositional environment was studied from shallow (1400 m) to very deep (8550 m) burial.

The clay mineralogy of 46 core samples from ten wells was quantified with X-ray diffraction in applying the mineral intensity factor (MIF)-method of Moore and Reynolds (1997). The clay fraction of the marlstone contains a prominent illite/smectite (I/S) mixed-layer mineral (20 to 70 wt%), illite (20 to 70 wt%), chlorite (0.5 to 12 wt%) and kaolinite (2 to 17 wt%). The amounts of I/S and kaolinite decrease with depth, whereas illite and chlorite increase. A gradual transformation of smectite to illite through mixed-layer I/S intermediates is recognized. With increasing depth the illite content in I/S intermediates increases from 25% to 90% in parallel the ordering of the mixed layer I/S changes from R0 (25% illite in I/S) to R1 (60-80% illite in I/S) to R3 (90% illite in I/S). R3 ordering prevails at depths greater than 4000 m and implies that the effect of the expandable mineral smectite is negligible.

This paper covers a part of a shale gas feasibility study on the main Vienna Basin hydrocarbon source rock (Mikulov Formation, a Malmian marlstone) recently performed by OMV. Shale gas production usually is enabled by pumping fluids (mainly water) into a gas-mature source rock in order to generate fracture permeability. Expandable clays within the source rock can dramatically reduce stimulation effectiveness and gas production.

Moore and Reynolds (1997) X-ray diffraction and the identification and analysis of clay minerals. Oxford University Press, New York, 378 p.