Porosity preservation in deeply buried (8552 m) mudstones of the Vienna Basin (Austria)

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The Vienna Basin is a Neogene pull-apart basin which is situated between the Eastern Alps to the West, the Carpathians to the North-East and the Pannonian Basin to the East. Its principal source rock for oil and gas are Malmian mudstones of the Mikulov Formation. We examined core samples provided by OMV from this unit that were recovered from depths of 8160 m to 8552 m, and studied their microfabrics in argon ion milled samples with a FEI Quanta 400 FEG scanning electron microscope, and quantified their mineralogy with X-ray diffraction (XRD).

XRD analysis shows that the main components of bulk samples are quartz, calcite and clay, and also reveals minor amounts of ankerite, plagioclase and pyrite. The clay mineralogy of these deep samples was quantified with X-ray diffraction through application of the mineral intensity factor (MIF)-method of Moore and Reynolds (1997). The clay fraction of the deep mudstones contains 17-28% illite/smectite (I/S) mixed-layer mineral, 63-70% illiteand 9-13% chlorite. R3 ordering with 90% illite in I/S prevails at these great depths.

Whereas we did not expect to find preserved porosity in samples from such depths, we nonetheless found significant porosity and a variety of pore types of nanometer to micrometer size range. Although the fabric appears tightly cemented and packed at low magnification, phyllosilicate framework pores up to 2 µm are common in interstitial areas between harder grains, and are in places held open because of “clamping” of phyllosilicate platelets by diagenetic cements. Carbonate framework pores of similar size occur in early diagenetically cemented areas. In addition, the margins of calcite grains have in places undergone partial dissolution (probably due to organic acid production during late diagenesis), leading to pores in the 100 nm to 1 µm size range. Organic matter occurs as two broad categories, amorphous and structured. The latter lacks pore development, whereas the former occurs interstitially between other minerals and shows well developed OM-pores (10-500 nm).

Overall, these observations suggest that there is a potential to produce gas from very deeply buried mudstones.