A joint workflow towards a reliable quantification and understanding of NMR surface relaxivity

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Abstract. Nuclear Magnetic Resonance is a common tool for the oil and gas industry, as well as for academia and science in order to characterize porous rocks under different perspectives. It is utilized to characterize the pore fillings, i.e. if the pores contain oil, gas or other hydrocarbons, water / brine, or any mixture of the mentioned fluids. Besides, porosity and the related pore size distribution are of utmost importance to quantify the storage volume and transport properties of porous rock and according formations. Nevertheless, in order to transform transversal relaxation time spectra into a pore size distribution, a "tuning parameter" needs to be defined: the so-called surface relaxivity value, which is more or less the ratio of the surface area related to the pore volume. Very often, this parameter is estimated from nitrogen adsorption measurements, which can provide direct information about the specific surface area related to mass or to pore volume of the investigated specimen. Unfortunately, this approach tends to fail for many different rock types, especially, if the "mineralogical and textural complexity" (i.e., clay type and content, as well as occurrence of Fe- / Fe-oxide/-hydroxide minerals) increases in comparison to classic reservoir rocks (i.e., Berea or Bentheimer type rocks). Accordingly, this parameter is part of an ongoing discussion within the core analysis community for a long time by now. Here we would like to present a joint workflow (a combination of petrophysical and mineralogical methods, including 2-D and 3-D imaging) that is able to deliver very reliable and individual surface relaxivity values for core samples. Within this case study, we have tested about a dozen different sandstones, all together covering a large range of mineralogical and petrophysical complexity and data. The Workflow and the according results will be presented and discussed in detail in comparison to "conventional" approaches.