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Scientific Challenges of Producing Natural Gas from Organic-Rich Shales - From the Nano-Scale to the Reservoir Scale (Louis Néel Medal Lecture)

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In this talk I will discuss several on-going research projects with the PhD students and post-Docs in my group that are investigating the wide variety of factors affecting the success of stimulating gas production from extremely low permeability organic-rich shales. First, I will present laboratory measurements of pore structure, adsorption and nano-scale fluid transport on samples of the Barnett, Eagle Ford, Haynesville, Marcellus and Horn River shale (all in North America). I will also discuss how these factors affect ultimate gas recovery. Second, I present several lines of evidence that indicate that during hydraulic fracturing stimulation of shale gas reservoirs there is pervasive slow slip occurring on pre-existing fractures and faults that are not detected by standard microseismic monitoring. I will also present laboratory and modeling studies that demonstrate why slowly slipping faults are to be expected. In many cases, slow slip on faults may be the most important process responsible for stimulating gas production in the reservoirs. Finally, I discuss our research on the viscoplastic behavior of the shales and what viscoplasticity implies for the evolution of the physical properties of the reservoir and in situ stress magnitudes.