Advancements in exploration and In-Situ Recovery of sedimentary-hosted uranium

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This paper describes recent advancements in exploration technologies for sedimentary-hosted uranium deposits as basis for improved model-based planning and optimization of in-situ recovery (ISR).

High-resolution shallow (<500 m depth) seismic in combination with refraction tomography is used for high-fidelity imaging of true-depth stratigraphy of sedimentary formations, tectonic faults and specific structures for the improved understanding of (hydro)geology in general and as potential indicator for uranium mineralization in particular.

A new-generation geophysical downhole-wireline tool with pulsed neutron generator has been developed (i) to accurately measure U grade (PFN [prompt fission neutron] method with important *in-tool* corrections for systematic influences), (ii) to determine geophysical parameters including porosity, density, macroscopic neutron cross section (clay content) and deduced permeability, and (iii) to log the mineral composition (based on element-specific gamma ray spectroscopy applied to natural gamma rays as well as gamma rays from inelastic neutron scattering, thermal-neutron capture and neutron activation) – all by one tool.

This new data - together with conventional geophysical and geochemical information – provides an excellent aid to the assessment of ISR feasibility, the design of wellfields and plan-ning of wellfield operation.

A new kinetic leaching model (reactive transport) has been specifically adjusted to acidic leaching conditions considering kinetic rates of the main neutralizing and redox reactions as function of both pH and oxidation potential (balance of e- acceptor species). It is used as an effective tool for predicting wellfield recovery curves, estimating chemicals' consumption and optimizing leaching chemistry (i.e. dosage of chemicals to injection lixiviant) in dependence on mineralogical conditions (abundance of main reactants).