

Aquifers survey in the context of source rocks exploitation: from baseline acquisition to long term monitoring

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Producing hydrocarbons from source rocks (like shales: a mix of clays, silts, carbonate and sandstone minerals containing matured organic matter, i.e. kerogen oil and gas, but also non-hydrocarbon various species of chemical elements including sometimes radioactive elements) requires to create permeability within the rock matrix by at least hydraulically fracturing the source rock. It corresponds to the production of hydrocarbon fuels that have not been naturally expelled from the pressurized matured source rock and that remain trapped in the porosity or/and kerogen porosity of the impermeable matrix.

Azimuth and extent of developed fractures can be respectively determined and mapped by monitoring the associated induced microseismicity. This allows to have an idea of where and how far injected fluids penetrated the rock formation.

In a geological context, aquifers are always present in the vicinity -or on fluid migration paths- of such shale formations: deep aquifers (near the shale formation) up to sub-surface and potable (surface) aquifers.

Our purpose will be to track any unsuitable invasion or migration of chemicals species coming from matured shales of production fluids including both drilling and fracturing ones into aquifers. Our objective is to early detect and alarm of any anomaly to avoid any important environmental issue. The approach consists in deploying a specific sampling tool within a well to recover formation fluids and to run a panoply of appropriate laboratory tests to state on fluid characteristics. Of course for deep aquifers, such a characterization process may consider aquifer properties prior producing shale oil and gas, as they may contain naturally some chemical species present in the source rocks. One can also consider that a baseline acquisition could be justified in case of possible previous invasion of non-natural fluids in the formation under survey (due to any anthropogenic action at surface or in the underground).

The paper aims at presenting the protocol and routine test we propose to make our early detection approach efficient for production of shale hydrocarbon fluids, in considering the source-rock reservoir itself, the aquifers, and also the chemical species present in the fluids that are used for hydraulic fracturing operations.