RECOMMENDATION OF GEOCHEMICAL STRATEGY FOR MONITORING SHALE PLAY EXPLOITATION.

B. GARCIA, V. ROUCHON, J-P. DEFLANDRE

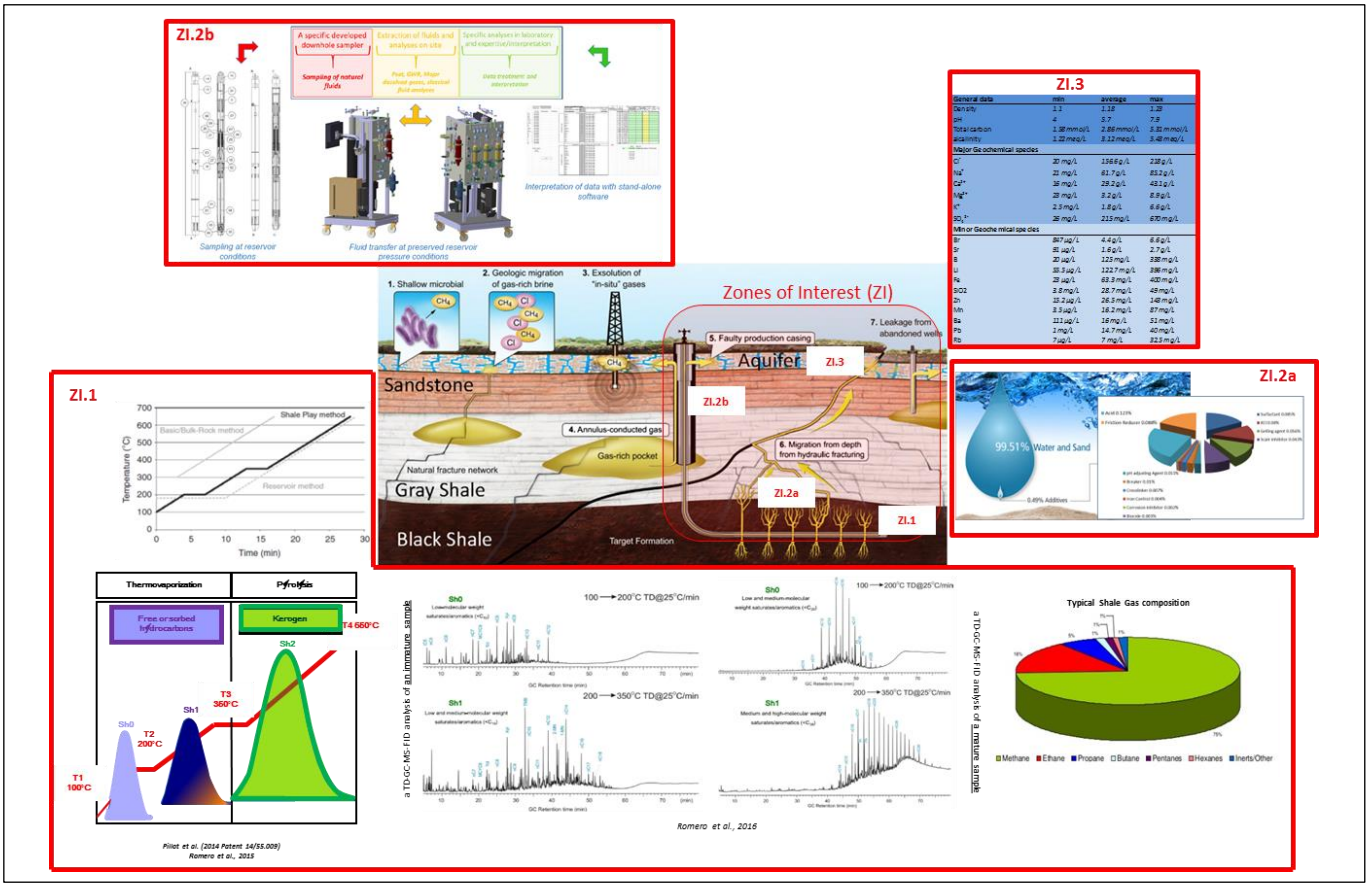

Figure 1: Zones of interest (ZI) for a geochemical strategy concerning the monitoring of Shale Plays. ZI.1 = the Shale Play itself. ZI.2a = the fracturing fluid. ZI2.b = the wells and ZI3 = the natural aquifers (deep, shallow and potable).

Background

Producing hydrocarbons from source rocks requires creating permeability within the rock matrix by at least hydraulically fracturing the source rock. It corresponds to the production of hydrocarbon products 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.

In the geological context of a sedimentary basin, aquifers are always present in the vicinity such shale formations: deep aquifers (near the shale formation) up to shallow and potable (surface) aquifers.

Study

Our purpose will be to track any unsuitable invasion or migration of chemical species into aquifers, originating from the production of matured shale fluids. Our objective is to provide methodologies to detect any chemical compositional anomaly in aquifers, in order to assess environmental impacts. The approach consists in deploying a dedicated sampling tool within a well to recover formation fluids and to run a series of appropriate analyses to provide a status on formation fluid characteristics.

The reservoir conditions are preserved and with a specific fluid transfer at surface, the analyses and interpretation/recommendations in real time could be performed.

Results

The recommendations presented below describe briefly the protocol for monitoring the 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.

These recommendations described the different steps to realize baseline measurements and processes survey for long-term monitoring with iteration operations in order to put in evidence any leakages/impacts of shale play exploitation.

Characterization and monitoring are necessary with some samplings that must be realized in order to well represent the “underground/real” conditions

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Science-based Recommendations

Here, the different steps are listed in the chronological order of the strategy to be deployed and concern the geochemical aspects for a strategy monitoring.

Baseline measurements

- 1-from cuttings and cores samples, realization of a complete characterization of shale play with the new Shale Play method developed from the Rock-Eval technique (Romero et al., OGST, 71: 37, 2015). The Hydrocarbon and non-hydrocarbon species will be determined.
- 2- realization of a complete characterization of fluids used for fracturing operations
- 3- realization of a complete characterization of geochemical species present in the surroundings aquifers (from deep to sub-surface/shallow and potable aquifers)
- 4- determination of a monitoring strategy on the long term, as a function of:
- 4a – the variety of chemical compounds known to occur at different levels of the fracturing/production process
- 4b – the nature/origin of these compounds
- 4c – their localization within the fracturing/production process
- 4d – their performance for monitoring purposes (signal/noise ratio)

Operations Survey and long-term monitoring

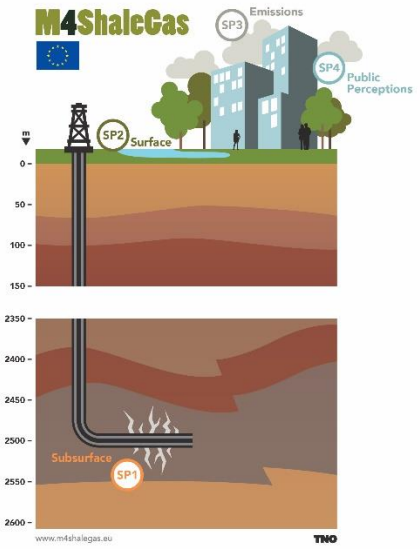
- 5 – deployment of the methodology presented above with specific samplings (downhole sampler preserving the reservoir conditions (especially for pressure) with an appropriate transfer and a geochemical composition determination))
- 6 – interpretation of the compositional data with a dedicated software (mixing, phase partitioning, chemical reactivity)

Table 1: Type of analyses to perform in regard to the process period.

Time of operations **Baseline measurements (1 to 2 years)**	**Type of analyses**	
	Free and sorbed HC's species	**Non-hydrocarbon species related to shale plays**
From cuttings and core samples	Low to medium molecular weight aliphatic and aromatic HC's (<C20)	
	Medium and High molecular weight HC's (C10-C30)	
	C1 to C5	
Realization of a complete characterization of fluids used for fracturing operations	**Free and sorbed HC species**	**Non-hydrocarbon species related to shale plays**
		Organic compounds used in base fluids
		Additives used in fracturing fluids
The different aquifers potentially impacted (deep, sub-surface and potable)	**Free and sorbed HC species**	**Non-hydrocarbon species related to shale plays**
	Low to medium molecular weight aliphatic and aromatic HC's (<C20)	
	Medium and High molecular weight HC's (C10-C30)	
	C1 to C5	
		Organic compounds used in base fluids
		Additives used in fracturing fluids
		CO_2, N_2, Noble gases
		cations
		anions
		Minor/Traces elements
During operations and for long term monitoring (3 to 20 years) **The different aquifers potentially impacted (deep, sub-surface and potable)**	**Type of analyses**	
	Free and sorbed HC species	**Non-hydrocarbon species related to shale plays**
	Low to medium molecular weight aliphatic and aromatic HC's (<C20)	
	Medium and High molecular weight HC's (C10-C30)	
	C1 to C5	
		Organic compounds used in base fluids
		Additives used in fracturing fluids
		CO_2, N_2, Noble gases
		Cations and anions
		Minor/Traces elements

The Project

M4ShaleGas examines the potential environmental impacts and risks related to **shale gas** exploration and exploitation in Europe with the goal to build a technical and social knowledge base on best practices and innovative approaches for **m**easuring, **m**onitoring, **m**itigating, and **m**anaging these impacts.



4 sub-programs:

- SP1-subsurface
- SP2-surface
- SP3-air emissions
- SP4-public perceptions

Funding:
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Horizon 2020 Topic LCE-16-2014:
Understanding, preventing and mitigating the potential environmental impacts and risks of shale gas exploration and exploitation.

Project duration:
1 June 2015 – 30 November 2017

Coordination:

TNO

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