New Frontiers in Natural and Chemical Tracers monitoring for Reservoir management

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Tracing test campaign in oil or gas reservoir is one of the most powerfull techniques to obtain experimental data for a better description and understanding of the reservoir, interwell connectivity, multilevel/allocation approach or to design a future Enhanced Oil Recovery. It's also a usefull tool to modelize the water flow in simulation models of porous media/rocks, laboratory core test or just to estimate the residual oil saturation. After decades of used of radionucleides, this time is over, new frontiers in analytical sciences are benefit to direct multi-monitoring of ultra-trace element (natural tracers) or ultra trace of chemical/geothermal such as halogenated or fluorescent tracers. Simple (no sample preparation), sensitive (ppt or ng.L^{-1} level), rapid (less than 6') and robust (direct analysis even in brine or high salinity reservoir water (150g.L^{-1}).

We will discussed here of the analytical development story and we highlight with figures of merit obtained along reservoir monitoring. We will finished with a few perspectives offered by the techniques such as well integrity and geological storage monitoring.

[1] Direct sensitive simultaneous determination of fluorinated benzoic acids in oil reservoir waters by ultra high-performance liquid chromatography-tandem mass spectrometry, Serres-Piole, C., Moradi-Tehrani, N., Lobinski, R., Preud'homme, H. (2011) *Journal of Chromatography A* 1218, 5872-5877.

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[3] Water Tracers in Oil Field Applications: A Guideline, Serres-Piole, C., Moradi-Tehrani, N., Allanic, C., Lobinski, R., Preud'homme, H., (2011) Journal of Petroleum Science and Engineering 98-99, 22-39.

Simulation of magma ascent prior to the high risk caldera forming eruptions of Campi Flegrei

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The dynamic magmatic processes prior to the 39 ka Campanian Ignimbrite (CI) eruptions at Campi Flegrei (CF), occurring during magma ascent, cannot be observed directly in nature. Therefore, experimental simulations of CI magma ascent are necessary and will give detailed insight to the mechanisms of CF super eruptions.

A pressure decrease during magma ascent accompanied with fluid oversaturation in the melt initiates bubble nucleation, growth, coalescence and segregation, and possible partial crystallization, which lead to a substantial density decrease and a change in viscosity. These processes may act as driving forces for increased ascent rates and may lead to catastrophic eruption styles.

Discrepancies of previous studies demonstrate that the *P-T-t* conditions and volatile contents (H_2O, CO_2, Cl) of the primitive melt prior to the eruption, generating the CF volcanic products are not well constrained. This study is focused on the conduction of continuous decompression experiments [1] using a trachytic CI composition [2] to gain insight into the dynamic degassing processes. First isothermal decompression experiments, above the liquidus at 1050 °C, are performed using a starting pressure of 200 MPa and H_2O content of 5 wt% and a continuous decompression to 75 and 50 MPa with different decompression rates. Additionally, two different types of sample material (glass cylinders / glass powder) are used.

Changes in decompression rate and type of starting material lead to significantly different degassing behavior of the melt. Fast decompression rates lead to massive volatile oversaturation, thus bubble nucleation is the predominant mechanism. In contrast, bubble growth is the prefered mechanism at slow decompression rates to reequilibrate the system. In ongoing experiments, additional volatiles (CO_2, Cl) will be added to simulate conditions closer to the CF volcanic system. To investigate heterogeneous bubble nucleation caused by decompression induced crystallization processes, experiments will be performed at lower temperatures below the liquidus.

[1] Nowak, M. *et al* , 2011, Am Mineral, 96: 1373-1380 [2] Civetta, L. *et al* , 1997, J Volcanol Geoth Res, 75(3-4): 183-219.

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