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Real time on-site gas analysis - a ballad of (noble) gases, Arsenic and seismicity

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Water and other terrestrial fluids crucially impact processes in the deep surface and in the environment, including some that have significant social implications: fracking, nuclear waste disposal, geological CO_2 sequestration, natural gas and heat production.

However, our current understanding of (geological) fluid dynamics is rather limited as traditional techniques for gas analysis are time-consuming and involve the laborious analysis of very few samples in high-specialized laboratories. To conclude, available experimental methods fall short in tracking fluid dynamics in real time and under field conditions.

To address these technical limitations that impede real-time gas analysis in environmental and geological systems in the last few years analytical methods were developed to quantify (noble) gas concentrations in terrestrial fluids under real-world conditions [1]. Our second-generation self-contained and portable mass spectrometer [2] can be operated in the field permitting the quasi-continuous quantification of He, Ne, Ar, Kr, N_2, O_2, CH_4, CO_2 and H_2 at high temporal resolution (seconds (gases) - minutes (liquids)). Recent tailored technical adjustments empower the instrument to be operated even under harsh conditions such as high temperatures and high water vapor pressures [3] and enable for targeted sampling of rare species for later laboratory analysis.

Our contribution discusses results of on-site gas measurements identifying gas production to modulate geogenic Arsenic mobilization [4] and allowing the possible relation between fluid emanation and seismicity to be critically assessed [3].

[1] ES&T 2012, 46, 8288-8296; ES&T 2016, 50, 13455-13463; ES&T 2017, 51, 846-854 [2] www.gasometrix.com, [3] Front. Water 4, 1032094, Water Res. 214, 118199.