Gas detection and quantification using iXblue Echoes high-resolution sub-bottom profiler and Seapix 3D multibeam echosounder from the Laacher See (Eifel crater lake)

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Gases are most often driving volcanic and limnic eruptions. Contrary to atmosphere, CO_2 bubbles are easily detected in water column, particularly using hydroacoustic methods (Vandemeulebrouck et al., 2000). Two pioneering studies have monitored gas venting into Kelud Crater Lake (Indonesia) from a hydroacoustic station shortly before volcanic eruptions in 1990 (Vandemeulebrouck et al., 2000) and 2007 (Caudron et al., 2012); the later allowing to empirically quantify CO2 fluxes by acoustic measurements. However, despite hydroacoustic detection capabilities, fundamental advances are limited by technology performances. Quantification remains complex due to the 3D structure of clouds and acoustic interactions between bubbles. It is thus necessary to accurately map bubble clouds, to monitor their evolution and possibly to dissociate different gas origins to reduce volcanic risk, which is major in aqueous environments. Here, we present preliminary results from near-surface geophysics of sedimentary deposits and water column gas distributions and quantification at the Laacher See (Eifel, Germany), using Echoes high-resolution sub-bottom profiler and iXblue Seapix 3D multibeam echosounder, respectively. Backscatter profiles of elements in the water column allow to distinguish fish and gas bubbles and highlight several concentrated colocation of bubble plumes. Ongoing research on the Target Strength (TS) of bubbles suggest they are of very small size (~35 µm), which would explain why, in the same spot, we did not observe gas bubbles using camera mounted on ROV. This also raises new perspectives to improve CO2 budget modeling from volcanic bubbles release. Meanwhile, the Echoes 10 000 provide more than 40 m of penetration with an 8 cm-resolution, and reveal paleoenvironmental and paleoclimatic reconstruction perspectives, 3D modeling of remobilized materials and tephra deposits from volcanic activity, as well as gas diffusion through the sediment. Our geophysical scientific approach contributes to a wider scientific effort to improve forecasting of volcanic and limnic eruptions and participates to improve early warning systems by constant collaborations with academic research.

Bibliography:

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