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Geophysical evidence of gas seepage and mass movement in the Laacher See volcanic lake, western Germany

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The Laacher See caldera lake, formed by a series of phreatomagmatic and Plinian eruptions around 12,900 years BP, has been receiving increased attention lately with several studies investigating the present-day volcanic and geodynamic activity in the eastern Eifel, a densely populated area in western Germany. Volcanic activity beneath Laacher See is most notably evidenced by several gas seeps in the lake and its surrounding shore, emitting CO_2 of magmatic origin. During a 2019 survey, several geophysical techniques were used to investigate the CO_2 seeps at the lake floor. Here, we present results from multibeam echosounder and sub-bottom profiler data showing the presence of gas in both the water column (i.e. gas flares) and the lake sedimentary infill. Enhanced seismic reflections and acoustic blanking illustrate different levels at which free gas is accumulated in the lake sediments. Additionally, several stratigraphic horizons containing mass-transport deposits (MTDs) are observed in the laminated lake infill. The origin of these MTDs remains unclear, yet possible causes of slope failure in Laacher See might include seismic shaking, anthropogenic lake level fluctuation, and an increased fluid/pore pressure in the sediment due to free gas. Our results give a first indication of free gas in the lake infill, with further research needed to investigate the possible link between gas presence and mass movement in the lake. The monitoring of gas seeps at Laacher See and a further understanding of its gas-laden sedimentary infill can ultimately contribute to a better volcanic hazard assessment in the area.