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Quantifying Methane Ebullition in Shallow Waters

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Lake sediments have been identified as environments of significant methanogenesis and bubbles are considered the most effective pathway in which methane can travel from the sediment to the atmosphere. Bubbles protect the gas inside from oxidation, which rapidly occurs to methane in oxic environments. Bubble-water gas exchange does occur during a bubbles' rise in the water column and in deep water bubbles may completely dissolve before reaching the air-sea interface. In shallow waters, which the majority of the world's lakes are, methane bubbles typically reach the atmosphere.

Lake Wohlen is a 2.7 km2, 18-m deep hydropower reservoir built in 1920 by the impoundment of 15 km of the River Aare downstream from the city of Bern, Switzerland. Along most of the reservoir throughout the year, methane bubbles can be seen reaching the surface. A year-long study of methane concentrations and emissions of Lake Wohlen has discovered that this reservoir is a large methane emitter, despite its small size. Dissolved methane concentrations increase by an order of magnitude from the beginning of the reservoir to the dam indicating intense methanogenesis within the reservoir. Ebullition surveys using inverted funnels as gas traps throughout the reservoir have found that average methane emissions from Lake Wohlen to the atmosphere via bubbles is an order of magnitude higher than that of the average temperate reservoir. Methane ebullition emission from Lake Wohlen alone is on the order of the total average tropical reservoir emission, which is thought to be much higher than temperate reservoirs. Isotopic analysis of gas confirms that the methane is strictly biogenic. Ultimately, this small, shallow Swiss reservoir emits an incredible amount of methane each day and remains highly methanogenic throughout the year.