

## Analog experiment for limnic eruption

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### 1. Introduction

The explosive discharges of CO<sub>2</sub> gas (= limnic eruption) at Lake Nyos and Monoun killed about 1800 people around the lakes in mid-1980s. The cause of the limnic eruption was the excessive accumulation of CO<sub>2</sub> gas in lake water. The CO<sub>2</sub> gas originated from a degassing magma. A mineralized water containing CO<sub>2</sub> gas is expected to be discharged on the lake floor. The accumulation of the dissolved CO<sub>2</sub> gas facilitated strong stratification of lake water. In this study, laboratory analog experiments were carried out to reveal the elemental process in limnic eruption.

### 2. Experiments

A (CO<sub>2</sub> dissolution and degassing) In a clear acrylic plastic cylinder vessel, 2L of pure water with pH indicator (methyl red) was placed. The inner diameter and height of the vessel is 150mm and 300mm, respectively. The head space of the vessel was filled with pure CO<sub>2</sub> at 0.2 MPa. After the confirmation of CO<sub>2</sub> dissolution with the color change of solution, the pressure of vessel was reduced to 0.1 MPa within 10 seconds.

B (CO<sub>2</sub> generation with a chemical reaction) A clear acrylic plastic cylinder was prepared for experiment. The inner diameter and height of the cylinder was 94 and 310 mm, respectively. The cylinder can be separated at the position the height of which is 34 mm from the bottom. The upper and lower parts of cylinder can be separated by use of a thin plastic sheet. Inner volume of lower part of cylinder is 235 ml. Two different solutions, 1M HCl and 0.2M Na<sub>2</sub>CO<sub>3</sub> were placed in upper or lower rooms of cylinder. By taking off the sheet, the above two solution was reacted.

### 3. Results and discussion

In the experiment-A, a generation of CO<sub>2</sub> bubbles were observed, however the rate of generation was low, therefore, no convection of solution was induced, because the generated bubble upraised individually. The result suggests the degree of super saturation in terms of CO<sub>2</sub> dissolution was insufficient.

In the experiment-B, when Na<sub>2</sub>CO<sub>3</sub> solution was placed in the upper part of cylinder, rapid generation of CO<sub>2</sub> gas happened, and the upper face of the gas-liquid two phase fluid reached near the upper end of cylinder. When HCl solution was placed in the upper part, the reaction between solutions and the generation of CO<sub>2</sub> bubbles was limited, therefore, the convection in solution was not induced. The measured density of Na<sub>2</sub>CO<sub>3</sub> and HCl solutions was 1.023 and 1.018 g/cm<sup>3</sup>, respectively, suggesting the rapid generation of CO<sub>2</sub> gas was triggered by the gravitational descent of heavy solution and subsequent effective reaction between solutions.

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