

Risk analysis of volcanic lakes - Limnic and phreato-magmatic eruption risks in lake Cuicocha, Ecuador

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Cuicocha is a young volcano adjacent to the inactive pleistocene Cotacachi volcano complex, located in the western cordilleras of the Ecuadorian Andes. A series of eruptions with intensive ash emission, lahars and collapse of the caldera occurred around 4,900 – 1,300 y BP. Over the last few hundred years, a caldera lake has developed with a maximum depth of 148 m, filled by rain water as well as hydrothermal water. Lake water is characterized by increased temperatures and conductivity. Nowadays, several post volcanic activities, such as emission of volcanic gases (39 % CO₂, 32 % N₂, traces of CO, CH₄, O₂) and an input of hydrothermal water occur.

In the hypolimnion of the lake, CO₂ accumulation occurs up to a saturation level of 78-fold, but the risk of a limnic eruption can be excluded at the present. The lake possesses monomictic stratification behaviour, and during overturn an intensive gas exchange with the atmosphere occurs.

Investigations concerning the sedimentation processes of the lake point out only a thin sediment layer of a few cm, and in large areas of the lake gas eruptions from the bottom occur. Lake bottom is partly depleted of sediment in form of wholes, and no lake colmation exist. Decreases in the water level of about 30 cm year⁻¹ indicate a percolation of lake water into fractures and fissures of the volcano. This water level decrease and possibly the gas eruptions on the lake floor were triggered by a nearby earthquake in 1987. Thus, the volcano Cuicocha has an increased risk of a phreato-magmatic eruption.