

## Unraveling hidden, frequent, and small-scale eruptions by sub-lacustrine event flow deposits: Adataro and Bandai volcanoes and Lake Inawashiro-ko, Fukushima, Japan

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Lakes and lacustrine deposits nearby volcanoes receive and record eruption and eruption-induced density flow (including lahar) events. A 29-m-long sedimentary core obtained at 90 m deep, center of Lake Inawashiro-ko, northeast Japan, records frequent and various volcanic events occurred at Adataro and Bandai volcanoes in the past 50,000 years. Event flow deposits are recognized and characterized by sedimentary facies, petrography, grain size, and chemistry of bulk deposits and included glass shards. The characteristics of event deposits clarify their origin, depositional, and formation processes. The clay-rich gray event deposits (Gm/Gs) are interpreted as a distal cohesive lahar. Presence of sulfide/sulfate minerals and high sulfur content point to a source from hydrothermally altered material ejected by a phreatic eruption at Adataro volcano. The brown event deposits (Bm/Bs) are marked by common presence of fresh volcanic glass shards derived from Bandai volcano, which infers contribution of juvenile material. Clay-rich nature and presence of low-grade hydrothermally altered minerals in the deposits indicate that magmatic hydrothermal eruptions and associated partial edifice collapse caused the density flows. Precise ages of the event deposits by the age-depth model of the core reveal unknown and more frequent volcanic activities at the two volcanoes.

Keywords: small-scale eruption, lahar, phreatic eruption, magmatic hydrothermal eruption, Bandai volcano, Adataro volcano