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The Chaitén 2008 eruption: explosive eruption characteristics and tephra dispersal

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Chaitén volcano, situated in the southern Chilean Andes at 42.8 °S, began erupting explosively and without warning on 2nd May 2008. The early and most intense stages of the eruption lasted approximately one week, and represented the largest explosive eruption globally since that of Hudson, Chile, in 1991. The eruption was also the first explosive eruption of rhyolitic magma for almost a century. Widespread tephra deposition caused significant regional-scale disruption to agriculture, and aviation across southern Chile and Argentina was periodically affected for one month. Severe local impacts in Chile led to the evacuation of more than 5000 people.

The proximal tephra fall deposit contains multiple layers, corresponding to individual eruption phases. Early clearing of the conduit produced a dense rhyolitic lapilli deposit with very little juvenile material. This was followed by pulsatory explosions of extremely homogeneous crystal-poor rhyolite. The overall volume of the tephra fall deposit was ∼0.2 km3 (dense-rock equivalent). Eruption column heights reached ∼19 km height during the most energetic phases, but these were of notably short duration given their intensity. After 8th May 2008 the Chaitén eruption entered a dome-forming stage, which is ongoing.

The series of explosive phases during the first week of the Chaitén eruption interacted with a strong and variable wind field. This produced a complex, lobate fall deposit that reached the Atlantic coast of Argentina and covered ∼2 × 105 km2. Measurable ash fallout occurred at a distance of 1000 km downwind. Ground measurements of the distal ash deposit correspond well with satellite observations of plume dispersal and ash deposition, and reflect the differing transport directions of ash-rich clouds from separate explosive phases. The overlap of multiple deposits in the medial fallout region is confirmed by the multiple modes in deposit grain-size distributions. Grain-size measurements also provide evidence of cloud aggregation processes, affecting rates of fine ash fallout.

The complexity of the Chaitén fall deposit, resulting from a multi-phase eruption and changing wind patterns, could only be revealed through a combination of rapid field measurements of the distal deposit and modern satellite observations. The long-term preservation of this ash deposit is likely to be extremely sparse; such effects also limit the recognition of previous eruptions. The 2008 eruption was widely cited as the first at Chaitén for ∼9000 years, but recent field data shows that much more recent eruptions have occurred. These were of similar magnitude to, and in some cases far larger than, the 2008 eruption. Each of these previous eruptions also sampled a homogeneous rhyolite magma stock, stored at depths of ∼10 km beneath the volcano.