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Long-range volcanic ash transport and fallout during the 2008 eruption of Chaiten volcano, Chile

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The May 2008 eruption of Chaitén volcano, Chile, provided a rare opportunity to measure the long-range transport of volcanic emissions and characteristics of a widely-dispersed terrestrial ash deposit. Airborne ash mass, quantified using thermal infrared satellite remote sensing, ranged between 0.2-0.4 Tg during the period 3-7 May 2008. A high level of spatiotemporal correspondence was observed between cloud trajectories and changes in surface reflectivity, which was inferred to indicate ash deposition. The evolution of the deposit was mapped for the first time using satellite-based observations of surface reflectivity.

The distal (>80 km) ash deposit was poorly sorted and fine grained, and mean particle size varied very little beyond a distance >300 km. There were 3 consistent particle size subpopulations in fallout at distances >300 km which suggests that aggregation influenced particle settling. Discrete temporal sampling and characterisation of fallout demonstrated contributions from specific eruptive phases. Some evidence for winnowing was identified through comparison of samples collected at the time of deposition to bulk samples collected months after deposition.

X-Ray Photoelectron Spectroscopy (XPS) analyses revealed surface enrichments in Ca, Na and Fe and the presence of coatings of mixed Ca-, Na- and Fe-rich salts on ash particles prior to deposition. XPS analyses revealed strong surface Fe enrichments (in contrast to the results from bulk leachate analyses), which indicates that surface analysis techniques should be applied to investigate potential influences on ocean productivity in response to volcanic ash fallout over oceans. Low S:Cl ratios in leachates indicate that the eruption had a low S content, and high Cl:F ratios imply gas-ash interaction within a Cl-rich environment. We estimate that ash fallout had potential to scavenge $\sim$42 % of total S released into the atmosphere prior to deposition.