Geophysical Research Abstracts
Vol. 18, EGU2016-2311, 2016
EGU General Assembly 2016

The magmatic and eruptive response of arc volcanoes to deglaciation: insights from southern Chile

Harriet Rawson (1), Tamsin A. Mather (1), David M. Pyle (1), Victoria C. Smith (2), Karen Fontijn (1,3), Stefan Lachowycz (1), José A. Naranjo (4), and Sebastian F.L. Watt (5)

(1) Dept. of Earth Sciences, University of Oxford, South Parks Road, Oxford OX1 3AN, UK, (2) Research Lab. for Archaeology, University of Oxford, South Parks Road, Oxford OX1 3QY, UK, (3) Dept. Geology and Soil Science, Ghent University, Krijgslaan 281-S8, 9000 Gent, Belguim, (4) Servicio Nacional de Geología y Minería; Avenida Santa María 0104, Santiago, Chile, (5) School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK

Volcanism exerts a major influence on Earth's atmosphere and surface environments. Understanding feedbacks between climate and long-term changes in rates or styles of volcanism is important, but unresolved. For example, it has been proposed that a pulse of activity at once-glaciated volcanoes contributed to increasing atmospheric carbon dioxide accelerating early Holocene climate change. In plate-tectonic settings where magmatism is driven by decompression melting there is convincing evidence that activity is modulated by changes in ice- or water-loading across glacial/interglacial cycles. The response of subduction-related volcanoes, where the crust is typically thicker and mantle melting is dominated by flux melting, remains unclear. Since arc volcanoes account for 90% of subaerial eruptions, they are the most significant sources of volcanic gases and tephra directly to the atmosphere.

Testing the response of arc volcanoes to deglaciation requires careful work to piece together eruption archives. Records of effusive eruptions from long-lived, arc stratovolcanoes are challenging to obtain and date; while deposits from the explosive eruptions, which dominate arc records, are prone to erosion and reworking. Our new high-resolution post-glacial (<18 ka) eruption record from a large stratovolcano in southern Chile (Mocho Choshuenco) provides new insight into the magmatic response following the removal of a regional ice load. We observe significant variations in eruptive flux, eruption size and magma composition across three distinct phases of post-glacial volcanic activity. Phase 1, shortly after deglaciation, was dominated by large explosive eruptions of dacite and rhyolite. During Phase 2 (7.3 – 2.9 ka) eruption rates and eruptive fluxes were lower, and activity was dominated by moderate-scale basaltic-andesite eruptions. For the past 2.4 kyr (Phase 3), eruptive fluxes have been elevated, and dominated by explosive eruptions of intermediate magmas.

We propose that this time-varying behaviour reflects changes in crustal plumbing systems, and magma storage timescales. During glaciations, magmas stall in the crust and differentiate to form large, evolved melt reservoirs. After the ice load is removed, much of this stored magma erupts (Phase 1). Subsequently, less-differentiated melts infiltrate the shallow crust (Phase 2). Then, as storage timescales increase, volcanism returns towards more evolved compositions (Phase 3). We suggest that on these short timescales, these observed variations are unlikely to reflect changes in mantle melt flux. Instead, the phenomena are consistent with changes in crustal stress fields due to unloading. This tripartite pattern of evacuation, relaxation and recovery may be a general feature of previously-glaciated arc volcanoes.