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Depth of magma storage in volcanic arcs: testing the influence of regional parameters using a global data compilation

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The depth of magma storage is an important parameter for volcanic hazard assessment: if a volcano possesses a reservoir at shallow depths it is usually associated with a higher risk for significant eruption. Thus, understanding the parameters that influence the depths of magma storage is of primary importance.
We perform a global data compilation to evaluate the potential influence of regional parameters on the depth of magma storage beneath explosive andesitic arc volcanoes. We collected data at 70 andesitic volcanoes (from basaltic-andesitic to andesitic-dacitic volcanoes) in 8 continental and transitional arcs. We compare the depths of magma storage with the type of crust in the slab and the upper plate, the age of the crust, its thickness, the convergence angle of the subducting plate, its velocity, the dip of the slab, its age, the duration of the current subduction, the stress in the upper plate, in the intra arc, and in the back arc area, and the surface heat flux. The data related to crustal structure and subduction parameters are compiled from publications, the stress data are evaluated using the World Stress Map project and Centroid Moment Tensor solutions of earthquakes, and the heat flux data are compiled from publications and from the Global Heat Flux Database of the International Heat Flow Commission (IHFC).
We observe that no significant correlation can be extracted with the exception of the interaction between the shallowest depth of storage and the intra arc stress regime: volcanoes in extensional and strike-slip settings can develop shallow reservoirs whereas volcanoes in compressional settings lack them. Thus, magma ascent through the upper crust seems influenced by intra-arc tectonic settings. We propose a simple conceptual model for how the tectonic setting affects magma ascent in the brittle upper crust. The intra-arc stress regime can influence magma ascent in two ways: first, it determines whether the conditions are favorable for vertical dike propagation, i.e. maximum tensile stress $\sigma 3$ in the horizontal plane, and second, it determines the type of pre-existing structures that can act as magma pathways.