Geophysical Research Abstracts
Vol. 13, EGU2011-9735-1, 2011
EGU General Assembly 2011

The regular shape of stratovolcanoes with implications to eruptive characteristics: a DEM-based approach

Dávid Karátson (1), Massimiliano Favalli (2), Simone Tarquini (2), Alessandro Fornaciai (2), and Gerhard Wörner (3)

(1) Eötvös University, Physical Geography, Budapest, Hungary (dkarat@ludens.elte.hu), (2) Istituto Nazionale di Geofisica e Vulcanologia, Pisa, Italy, (3) Geoscience Center, University of Göttingen, Göttingen, Germany

The shape of the most regular-shaped stratovolcanoes of the world has been studied to mathematically define the form of the ideal stratovolcano. Based on the Shuttle Radar Topographic Mission data we selected 19 of the most circular and symmetrical volcanoes, which incidentally all belong to subduction-related arcs surrounding the Pacific. The selection of volcanoes benefitted from the introduction of a new definition of circularity which is more robust than previous definitions, being independent of the erosional dissection of the cone.
Our study on the shape of stratovolcanoes was based on the analysis of the radial elevation profiles of each volcano. The lower half section of the volcanoes is always well fitted by a logarithmic curve, while the upper half section is not, and falls into two groups: it is fitted either by a line ("C-type", conical upper part) or by a parabolic arc ("P-type", parabolic/concave upper part). A quantitative discrimination between these groups is obtained by fitting their upper slope with a linear function: C-type volcanoes show small, whereas P-type volcanoes show significant negative angular coefficient. The proposed threshold between the two groups is -50×10 -4 °/m.
Chemical composition of eruptive products indicates higher SiO2 and/or higher H2O content for C-type volcanoes, which could imply a higher incidence of mildly explosive (e.g. strombolian) eruptions. We propose that this higher explosivity is responsible for forming the constant uppermost slopes by the deposition of ballistic tephra and its subsequent stabilisation at a constant angle. By contrast, P-type volcanoes are characterized by a smaller SiO2 and H2O content, which can be responsible for a higher incidence of effusive events and/or a lower incidence of upper flank-forming (i.e. mild) explosive eruptions. Therefore, the concave upper flanks of these volcanoes may be shaped typically by lava flows. Based on this hypothesis, we propose that the morphometric analysis of the elevation profile of stratovolcanoes can provide insights into their dominant eruptive style.