



The Chimborazo sector collapse and debris avalanche: Deposit characteristics as evidence of emplacement mechanisms

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Abstract

Chimborazo is a Late Pleistocene to Holocene stratovolcano located at the southwest end of the main Ecuadorian volcanic arc. It experienced a large sector collapse and debris avalanche (DA) of the initial edifice (CH-I). This left a 4 km wide scar, removing $8.0 \pm 0.5 \text{ km}^3$ of the edifice. The debris avalanche deposit (DAD) is abundantly exposed throughout the Riobamba Basin to the Río Chambo, more than 35 km southeast of the volcano. The DAD averages a thickness of 40 m, covers about 280 km², and has a volume of > 11 km³. Two main DAD facies are recognized: block and mixed facies. The block facies is derived predominantly from edifice lava and forms > 80 vol.% of the DAD, with a probable volume increase of 15–25 vol.%. The mixed facies was essentially created by mixing brecciated edifice rock with substratum and is found mainly in distal and marginal areas. The DAD has clear surface ridges and hummocks, and internal structures such as jigsaw cracks, injections, and shear-zone features are widespread. Structures such as stretched blocks along the base contact indicate high basal shear. Substratum incorporation is directly observed at the base and is inferred from the presence of substratum-derived material in the DAD body. Based on the facies and structural interpretation, we propose an emplacement model of a lava-rich avalanche strongly cataclased before and/or during failure initiation. The flow mobilises and incorporates significant substrata (10–14 vol.%) while developing a fine lubricating basal layer. The substrata-dominated mixed facies is transported to the DAD interior and top in dykes invading previously-formed fractures.

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