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Sub-volcanic slope influencing the development of major structures at volcanoes during strike-slip faulting

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Volcano-basement interactions can deeply determine the structural development of volcanoes basically by the propagation of stress and strain fields from the basement into the volcanic edifice, and vice versa. An extensively studied case of such interactions is the propagation of a strike-slip fault through a volcanic edifice, which gives place to a strong tendency of major volcanic construction and destruction events to occur in a sub-parallel trend with respect to the strike of the fault. During precedent studies, however, both scaled and natural prototypes have always considered that the surfaces on which volcanoes stand (i.e. the sub-volcanic slope) are horizontal.

The scaled experiments presented here show that the dip-angle and dip-direction of the subvolcanic slopes can systematically and significantly change the deformation patterns developed by the volcanic edifice during strike-slip faulting. When the dip-direction of the sub-volcanic slope and the strike of the fault are nearly parallel, an increased development and concentration of the deformation on the down-slope side of the volcanic cone occurs. In medium to long-term, this would imply again a tendency of major volcanic structures growing in a sub-parallel trend with respect to the strike of the fault, but with one preferred direction: that of the dip-direction.

In the experiments, the dip-direction of the sub-volcanic slope was set progressively oblique, up to perpendicular, with respect to the strike of the fault by: 1) rotating in the same sense as the strike-slip fault, or 2) rotating in the opposite sense as the fault. In both cases, the downslope side of the volcanic cone still concentrates the deformation, but the deformed sectors progressively rotate which results in a structural development (construction and destruction) of the edifice occurring clearly oblique with respect to the strike of the fault.

Imbabura volcano (Ecuador) is traversed by the strike-slip El Angel-Río Ambi fault, whose sense of movement (left- or right-lateral) has not been clearly established yet. Aditionally, Imbabura has been constructed on the NW, medium to lower flank of the neighbor Cubilche volcano. The application of the experimental results presented above to the case of Imbabura volcano helps to understand the particular structure of this volcano which displays a complex history of construction and destruction events. Additionally, the experiments strongly suggests that the El Angel-Río Ambi fault is left-lateral.