



Topography and Tilt at Volcanoes

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For optimal monitoring of deformation, instrumentation should be strategically deployed at the location most sensitive to changes in the source of that deformation. Tilt – the change in inclination angle – is an extremely sensitive indicator of surface deformation. Cyclic tilt variations of only a few microradians have been linked to shear stress as magma ascends through a volcanic conduit, or a pressure source in the upper edifice. However, such tilt variations are focused close to the summit, where deployment of a tiltmeter can be difficult logistically. Inflation or deflation of a deep magma reservoir yields a much broader deformation signature at the surface. Here, we investigate the influence of topography on tilt through deformation modelling using COMSOL Multiphysics. We show that tilt is sensitive to the elevation and slope angle. Furthermore, tilt can be amplified or reduced by over an order of magnitude, or even reversed in polarity, close to topographic features such as valleys, cliffs and ridges. We present guidelines on where tiltmeters should be deployed to be most sensitive to changes in reservoir pressure, conduit pressure or shear stress, and show that topography should be considered alongside distance to the source.