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Mechanical Modeling of Dike Pathways in the Crust: Effect of Layering and Surface Loads

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Magma is generated mostly in the Earth's mantle by decompression melting and transported through the crust to reach the Earth's surface. The main mechanism for magma transport is diking, but the pathways taken by magma-filled dikes to eruptive vents on the surface are in most situations poorly understood. Here we present results from a numerical simulation tool developed over the course of several years (Dahm, 2000, Maccaferri et al., 2010 and 2011) designed to retrieve the energetically favored pathways of dikes propagating in a user-defined stress field. Here we illustrate the deviations induced by the following factors: layering, loading of a volcanic

edifice, unloading induced by crustal thinning, caldera formation, development of fault scarps. Layering in rock rigidity causes dikes to deflect. Layering in density, but not in rigidity, does not deflect dikes but may cause their arrest. If the interfaces between layers are not strongly welded, dikes may deviate and propagate along the interface as a sill. Sills may originate, among other mechanisms, due to a load decrease on the surface that rotates the principal stresses and causes the least compressive stress to be vertical. We will present applications of our simulations to rift environments and calderas.

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