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Normal fault growth in layered basaltic rocks: The role of strain rate in fault evolution

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1 **Normal fault growth in layered basaltic rocks: the role of strain rate in fault evolution**

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9 **ABSTRACT**

10 Conceptual models for the evolution of dilatant faults in volcanic rift settings involve a step-wise  
11 growth pattern, involving upward propagation of subsurface faults, surface monocline formation,  
12 which are breached by subvertical, open faults. Immature, discontinuous normal faults are  
13 considered representative of the early stages of mature, linked faults that accommodate  
14 extensional strains. We consider the evolution of surface-breaking normal faults using a  
15 comparison of the distribution and geometry of normal faults from two volcanic rift zones: the  
16 Koa'e fault system, Hawai'i, and the Krafla fissure swarm, NE Iceland. Field mapping highlights  
17 similarities to current predicted geometries, but also prominent differences that are not  
18 reconciled by current models. Variable deformation styles record magma supply changes within  
19 the rift zones, which drive local strain rate gradients. Building on existing studies, we present a  
20 conceptual model of fault growth that accounts for spatial and temporal changes in strain rate  
21 within the deforming regions. We propose that faults in separate rift systems may not advance  
22 through the same stages of evolution and that faults within *individual* rift systems can show

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