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The initiation of brittle faults in crystalline rock

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# 1 **The initiation of brittle faults in crystalline rock**

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## 12 **Abstract**

13 Faults in the upper crust initiate from pre-existing (inherited) or precursory (early-  
14 formed) structures and typically grow by the mechanical interaction and linkage of these  
15 structures. In crystalline rock, rock architecture, composition, cooling, and exhumation  
16 influence the initiation of faults, with contrasting styles observed in plutonic rocks,  
17 extrusive igneous rocks, and foliated metamorphic rocks. Brittle fault growth in granitic  
18 rock is commonly controlled by the architecture of inherited joints or preexisting dikes. In  
19 basalt, abundant joints control the surface expression of faulting and, enhanced compliance  
20 due to abundant joints leads to folding and deformation asymmetry in the fault zone.  
21 Highly reactive mafic minerals likely become rapidly evolving fault rocks. In foliated  
22 metamorphic rocks, fault initiation style is strongly influenced by strength anisotropy  
23 relative to the principal stress directions, with fracturing favored when the foliation is  
24 aligned with the directions of principal stress. The continuity of micas within the foliation  
25 also influences the micromechanics of fault initiation. Brittle kink bands are an example of  
26 a strain-hardening precursory structure unique to foliated rock. Each of these fault  
27 initiation processes produces different initial fault geometry and spatial heterogeneity that  
28 influence such properties as fault permeability and seismogenesis.

## 29 **1. Introduction**

30 Detailed study of small faults has illuminated the processes by which faults initiate and  
31 grow in the upper crust. Several decades of research address these processes in

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