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Links between earthquakes, aftershocks, and earth degassing

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When volatiles are exsolved at depth, they must be at rock pressure if no hydraulic connection is made to the free surface hydrostatic boundary condition. The pathway towards the surface will be controlled by either brittle fracture or ductile mechanisms such as porosity waves. If high-pressure fluids are trapped at depth (for example, at the base of the brittle crust), then the sudden fracture of a large earthquake above this high pressure source creates hydraulic connectivity to the free surface that will initiate a rapid fluid pressure release. This pressure pulse will propagate through the newly formed fracture network and generate brittle failure (aftershocks) by substantially reducing the effective confining stress. This hypothsis is investigated from a variety of tectonic environments, and both observations and modelling show that there is a significant correlation in all cases between the calculated evolved fluid pressure field and the observed aftershock patterns. Furthermore, model results demonstrate that the temporal decay of aftershocks is controlled by the regional stress field. The hypothesis that a primary mechanism of aftershock generation is the post-seismic release of trapped, high pressure fluids into the overlying hydrostatically-pressured crust links earthquakes, aftershocks, and earth degassing. Various possible tests of this hypothesis will be discussed.