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Earthquake-controls on metamorphism of the lower continental crust

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Prior to orogeny most of the lower crust is dry, impermeable, and mechanically strong (Jamtveit et al., 2016). During an orogenic event, the evolution of the lower crust is controlled by infiltration of fluids along localized shear or fracture zones. An increasing number of observations from a wide range of orogenic belts indicate that ductile deformation and shear zone development is preceded by highly localized brittle deformation, and that eclogitization of the lower crust is related to such brittle deformation. In the Bergen Arcs of Western Norway, shear zones initiate as pseudotachylite-bearing faults, and the fault wall rocks show abundant microstructures indicating fragmentation without shear (Austrheim et al., 2017), and many features similar to what is observed during shock metamorphism. These observations are all indicative of seismic slip. Earthquakes in the strong and dry lower crust require higher stress levels than can be sustained over 'tectonic' time scales indicating the presence of short-lived stress pulses, or a local weakening processes. We will discuss these mechanisms in the light of recent observations from Mw> 7 fossil earthquakes in the Bergen Arcs and in the lower crust in other tectonic settings.

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