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Dehydration faulting in serpentinite: regular vs. slow earthquakes

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It has been well documented in the laboratory that dehydration of hydrous minerals in subducting slabs can generate intermediate-depth earthquakes. However, these earthuqkes has not been well characterized. Here we report two different-types of earthquakes generated by dehydration of antigrite in serpentinite peridotite using the Paterson deformation apparatus at temperatures beyond the stability of antigorite. The first-type of earthquakes is a single event characterzied by a relatively large stress drop and a short duration. The second-type of earthquakes are multiple stick-slip events followed immediately by the single big event. They are characterized with much smaller stress drips and longer duration. There is a narrow temperature range for faulting in serpentinite. Fluid filled mode I cracks in olivine or pyroxene-rich zones are crucial for the self-organization and generation of mode II shearing in serpentinite. Our results suggest that dehydration of hydrous minerals can generate new faults in homogenous rocks (regular earthquakes) and small tremors (slow earthquakes) along the pre-existing fault caused by regular earthquakes in subduction zones.