Westfälische Wilhelms-Universität Münster

Fachbereich Physik

> Allgemeines Physikalisches Kolloquium

> Donnerstag, 11.10.2018 um 16 Uhr c.t.

Prof. Dr. Magali Billen

University of California Davis, Earth and Planetary Sciences

"Deep earthquake triggering limited by rate of slab deformation in the transition zone"

Deep earthquakes occur in cold, subducting lithosphere at depths of 350-700 km, coincident with a series of mineral phase changes. Due to the higher pressure and temperatures within the slab, earthquakes at these depths cannot be triggered through the same brittle fracture processes responsible for triggering shallow (0-50 km) earthquakes. Laboratory experiments show that metastable transition of olivine to minerals stable at higher pressure is a viable mechanism for earthquake triggering through the formation of super-plastic anti-cracks. While the depth limit of metastable olivine in the slab is determined by temperature, there is not a strong correlation between the depth distribution of deep earthquakes and the thermal state of the slab. However, the experiments showed that anti-crack formation also requires a sufficiently large rate of deformation. Here we show that the variability in the depth distribution of deep earthquakes can be explained by spatial variability in the rate of internal deformation of subducted lithosphere. Two-dimensional, time-dependent simulations of long-term dynamically-driven subduction show that distribution of strain-rate in the slab changes as the slab deforms in the transition zone. Snap-shots of the depth distribution of the peak strain-rate at temperatures of 900–1000° C mimic the present-day snap-shots of seismic moment release rate for individual subduction zones. Strain-rate limited triggering of deep earthquakes can explain the pronounced difference in seismicity in slabs with similar thermal state, such as Tonga (high seismicity rate and evidence for folding) and Japan (low seismicity rate below 500 km and strongly planar slab), and complete lack of deep seismicity (except at 660 km) in Peru-Chile. While current models demonstrate the link between the time-variable state of deformation of the slab and the present-day pattern of deep seismicity, development of subduction-zone specific models is necessary to constrain the strain-rate threshold for triggering deep earthquakes.

Kolloquiums-Kaffee
ab 16 Uhr vor dem Hörsaal

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