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Jelly Quakes - Characteristics of periodic slip events in an analog model of strike slip seismotectonics using ballistic gelatin.

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Large lithospheric strike-slip faults, such as the San-Andreas Fault, North-Anatolian Fault, or the Tancheng-Lujiang Faultzone, are major sources of seismic hazard. The interplay of complex 3D-geometry and displacement style along the fault, coupled with a varying rheological layering makes it very difficult to model these faults on all relevant timescales. Here we present a novel experimental approach to model intra- and interplate strike-slip faults using a physical/ analog model. We model earthquakes as a stick-slip process, following a rate-and-state frictional law, with glass beads as granular material within a molded fault zone. Crustal elasticity is introduced by using ballistic gelatin (30 w%, pig skin) as analog material. Furthermore, the low-strength and viscous deep crust below 15 km depth, is modeled using a viscoelastic silicone oil (PDMS-G30M). The layered model crust floats on sugar syrup and is compressed in pure shear vice configuration. We monitor the compressive force along with surface kinematics from optical image correlation.

The fault is oriented at 45° to the compression direction imposing ideal strike-slip kinematics onto it. After an initial loading phase the model shows periodic slip events occurring alongside with creep on the fault. Using digital image correlation, surface displacement maps are obtained which are similar to those of natural earthquakes. Coseismic displacement along strike is showing a similar bell-shaped distribution as for natural faults. Furthermore, the recurrence intervals and stress drops are scalable to the natural prototype.

The modeling results are combined with numerical rate-and-state models using physical parameters from the experiment. This enables us to explore a wide range of parameters and to draw connections between the parameters that control the behavior of seismic and aseismic fault systems.