Gutenberg-Richter law in sliding friction of a sticky gel

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abstract

We report spatio-temporal pattern of the stick-slip motion of a gel-sheet slid against a glass substrate. The sliding takes place via the propagation of the wave
of detachment (Schallamach wave).

At large sliding velocity, the detached region is a stripe which moves regularly with constant speed, and the frictional force shows a periodic time dependence.

As the sliding velocity is decreased, the detached region is separated into bubbles which move around irregularly.

In the irregular state, the frictional force shows chaotic time dependence, and the statistics of the event of the force drop obeys the power-law similar to the Gutenberg-Richter law for earthquakes.

In the regular region, the detachment wave is analyzed theoretically, and the velocity and lengths are obtained as a function of the sliding velocity. The transition from the regular to chaotic behavior is shown to be related to the healing of the gel.