

地すべりに先行するスティックスリップ現象 Stick-slip Motion Preceding a Landslide

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The characteristics of seismic signals generated by the mass movement are considered to reflect the property of the sliding surface, and the use of seismic data for landslide study attracts more attention recently. In the meantime, scientists seek for precursory signals before the large failure of landslides in the seismic data. Here we analyzed the seismic data associated with 2015 Rausu landslide, and found intermittent tremors before the substantial mass movement.

The Rausu landslide started moving before 6:30 on April 24 based on the eyewitnesses, and the large deformation occurred between 11:30 and 16:30 on the day (see the Figure). The size of the landslide is about 380 times 260 m, and the sliding distance is 10-20 m with the rotation of 8 degrees clockwise. The coastal seafloor uplifted and emerged above the level of high-tide due to the buckling of the layers at the toe of the landslide.

A seismogram near the Rausu landslide recorded curious intermittent tremors one day before the substantial mass movement. Each tremor has almost identical waveforms, and the amplitude increases linearly as a function of time. The tremors continued about 20 hours, and on the next day, a large deformation was observed.

This tremor sequence is an evidence of the stick-slip movement of the landslide before the large failure occurs. The identical waveforms suggest that the source location and mechanism are very similar in the sequence, which indicates the tremors are generated at a particular small area. The amplitude and interval of the tremors may reflect the physical properties of the slip surface. The constant interval of the tremor occurrence suggests that the shear stress accumulation was very stable at the precursory creeping stage. This is the first observation suggesting that the heterogeneous structure such as asperities on the slip surface play an important role to control the movement of landslide, and adding a new aspect on the conventional understanding of the mechanism to control the mass movement.

