

Temporal gravity anomalies observed in the Tokai area and a possible relationship with slow slips

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The water in Earth's mantle is closely related with plate subduction and volcanism. Recent studies revealed that the mantle wedge corner at approximately 30 km depth holds high-pressure water, where many slow earthquakes occur. To quantify how such water behaves during slow earthquakes helps us understand the mechanisms of these earthquakes and (eventually) a part of the long-term water cycle between the interior and surface of the Earth. However, little evidence has thus far been reported on the transient flows of such deep water. Here, we report anomalous, negative mass anomalies during two recent long-term slow slip events in the Tokai area in Japan, which were detected by absolute gravity measurements over 20 years. We present a poroelastic fluid flow model assuming a localized deformation within the fault fracture zone. The model can reproduce the gravity change with a permeability range between those suggested by laboratory experiments and numerical simulations of slow earthquakes.

Keywords: gravity, slow earthquakes, poroelasticity, slow slip, subduction zone, water