Pre- and co-seismic ground-water level changes associated with the M_w8.1 1946 Nankai earthquake

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Extensive reconnaissance survey was carried out over an epicentral area of the 1946 Nankai earthquake of 21 Dec.1946 by Hydrographic Division of Maritime Safety Agency for the purpose of examining damage of hydrographic facilities. It was found from the survey that ground-water levels of shallow wells in mostly unconfined aquifers changed before and after the 1946 Nankai earthquake of M_w 8.1. The changes of ground water levels occurred on the coastal areas of Shikoku and Kii peninsula, near the periphery of the aftershock area. The results from this reconnaissance was carefully examined by Kawabe (1991).

About one week prior to the earthquake, groundwater levels dropped at 16 sites over the coats of 400 km long (Fig.1). At most of the sites ground-water also became muddy or salty, suggesting that sea-water mingled into fresh-water aquifers. Immediately after the earthquake drop or rise of ground-water level also happened at 27 sites extensively over the area of 400 km x 100 km on Shikoku and Kii Peninsula (Fig. 2). The sign of coseismic water-level change at wells varied with its azimuth of the fault, but the drop predominated in most of the area.

Fig.2 Ground-water level change prior to the 1946 Nankai earthquake. Solid circule, drop or decrease; open circle, rise or increse

The preseismic drop in ground-water level of shallow unconfined aquifers is possibly due to the drainage of shallow ground-water into the underlying confined aquifers. At the same time the drop of the ground-water level in shallow unconfined aquifers allowed the sea water to migrate into the fresh water where dilatations occurred. This drainage was possibly caused by opening of fractures in the confined layers due to dilatation that took place in the crust widely over the epicentral area. A possible interpretation for the dilatation is attributed to a slow slip on the plate interface or splay faults that are originated from it. A slow slip on a

fault with 1/3 of the 1946 fault width at a 30 km depth can sufficiently produce volume changes with an order of 10^{-6} over the coastal areas, comparable to the amount of coseismic volume changes.

In the 1,500-year history of the Nankai-trough large earthquakes (Mw>8.0), hot springs at Dogo (“DGS” in Fig.1) and other hot springs almost always suffered from decreases in discharges of hot spring for a while after the large earthquakes. Such decreases can be explained by the same mechanism as can be applied to the drop of ground-water levelsobserved in 1946, suggesting that the shallow-depth wells even in unconfined aquifers are very sensitive to crustal deformation preceding to large earthquakes.

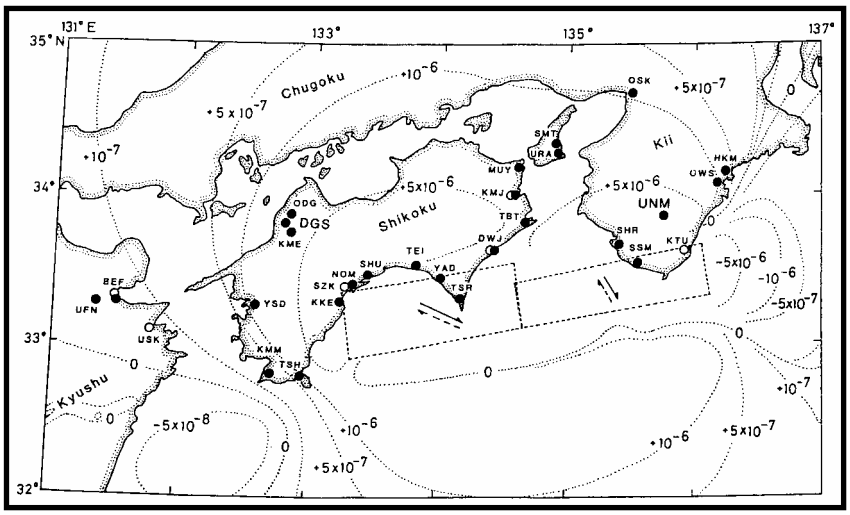

Fig.1 Co- and post-seismic ground-water level change associated with the 1946 Nankai earthquake. Solid circule, drop or decrease; open circle, rise or increse

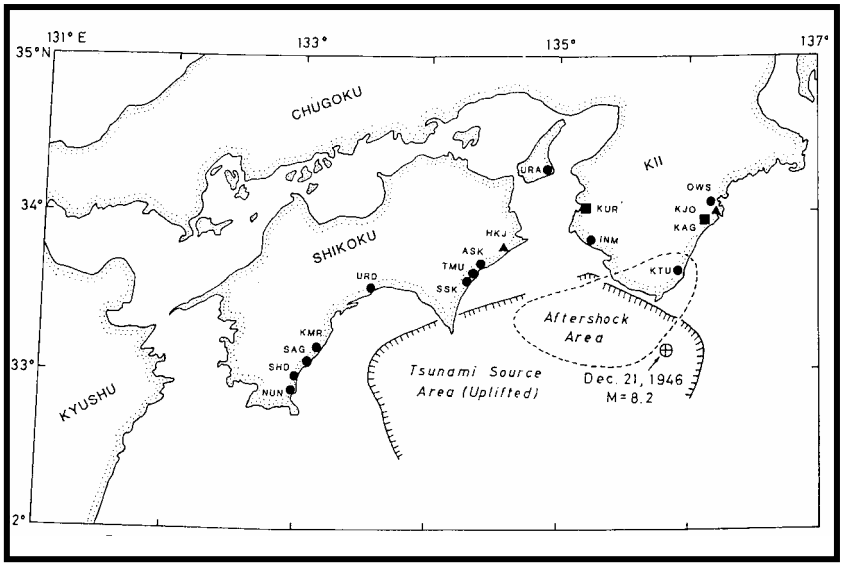

Fig.2 Ground-water level change prior to the 1946 Nankai earthquake. Solid circule, drop or decrease; open circle, rise or increse