

## Postseismic changes in groundwater pressure at the TKZ observatory (2000-2020)

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We observed a large anomalous change in groundwater pressure at TKZ (Takarazuka) associated with the 2018 Osaka Hokubu earthquake ( $M_{jma}$  6.1) occurred in 18 June 2018. TKZ observatory is located 26 km west of the epicenter. Groundwater pressure decreased 14 cm just after the earthquake, and then it suddenly increased. Total increase of the groundwater pressure was 4.65 m at TKZ seventeen days after the earthquake.

After 2000, we observed eight postseismic changes in groundwater pressure more than 10 cm at TKZ. Six of the eight postseismic changes were caused by all earthquakes whose JMA seismic intensity scale were more than 3 at TKZ. Other two were caused by earthquakes whose JMA seismic intensity scale were 2 at TKZ.

In particular, three postseismic changes in groundwater pressure associated with the 2000 Tottori Seibu earthquake, the 2011 Tohoku-oki earthquake and the 2018 Osaka Hokubu earthquake were more than 1 m. Normalized curves of the there groundwater-pressure increases after the earthquakes are similar to each other.

These postseismic changes in groundwater pressure are not caused by sudden increase of groundwater pressure near TKZ, because hydraulic conductivity (permeability) of the well in TKZ is  $2.3-3.5 \times 10^{-8}$  m/s ( $2.3-3.5 \times 10^{-15}$  m<sup>2</sup>) and groundwater-pressure increase at TKZ should finish less than one day if we have sudden increase in groundwater pressure near the well.

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