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# Temporal changes of chemical compositions of waters from deep boreholes and its relation to seismic activities

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We have monitored temporal and chemical changes of the deep borehole waters continuously for last two years. The boreholes exist in northeastern Japan along the Pacific coast and this region is now on high alert of probable approaching large earthquakes. Among some dissolved elements and compounds in the deep groundwater, such as $Cl^-$ and Ra can be rather sensitive indicators of earthquake (Tsunogai and Wakita., 1995). Therefore, in this study, we carried out daily analysis of $Cl^-$,$SO_4^{2-}$and $Br^-$ in waters as well as its pH at three sites in the region.

The chemical compositions of the deep groundwater differ much among the boreholes. Although the deep groundwater from one borehole (A) change its chemistries as well as pH on the monthly basis, the chemical compositions of the other deep borehole (B, C) waters do not change much for more than two years with some exceptions. Chemical correlations among dissolved ions seem fine. Such elemental correlation can be accounted for by mixing between two groundwater bodies in the depth. During the monitoring period, two rather large earthquakes occurred: one is magnitude=6.8, and the other is Magnitude=7.2. A smaller one occurred under the inland and a larger one occurred in deep oceanic mantle to the east of the Japan trench. The chemical compositions of the borehole A stared compositional changes of the groundwater approximately one month before the earthquake occurred under the inland. In contrast no drastic change could be noticed before the oceanic earthquake. The groundwater of the borehole B and C did not change at all before the inland earthquake, whereas their compositions change drastically after the earthquake. They did not change their compositions when the oceanic earthquake happened

Fault-activity-relating mechanical properties, including delta CFSs, volume strains, and induced by fault activities of the two earthquakes were calculated by using

MICAP-G. The calculation cannot account for the reason or abrupt change in concentration associated with the inland earthquake nor the absence of any chemical sign expected to be in association with the oceanic earthquake.