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Temporal changes of radon concentrations in waters from deep boreholes and their possible relation to seismic activities, northeast Japan

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We have been monitoring daily changes of radon concentrations in the deep borehole waters since early April, 2007; the boreholes exist in northeastern Japan along the Pacific coastal region where is now on high alert of probably approaching large earthquakes. Such monitoring has been carried out to predict earthquake and volcanic eruption; mostly the radon data have been obtained by measurement of radon in atmospheric air and in spring water. We carried out radon counting for pumped-up waters from two boreholes: one is approximately 1600 m deep (the first borehole) and another approximately 1200 m deep (the second borehole). The first borehole is a few hundred meters away from the Pacific coast and the second ca. 15 km. The distance between the boreholes is ca. 55 km.

One radon counter was set at the end of March 2007 for the first borehole and the other counter in the beginning of November 2007 for the second borehole. The second borehole has been used to measure precise temperature variation at depth and the height of the water head. During continuation of those measurements for the second borehole the deep water could not be pumped up. Therefore the radon data from the second borehole is not enough. We can show some other available data as well as radon data obtained from the second borehole.

The pumping-up rate of waters from the boreholes is constant and steady. In the beginning, radon counting has been integrated for every ten minute (the first borehole only). The results, however, showed considerable fluctuations ranging from several tens Bq

to a few thousands Bq (average Bq in ten minutes). Therefore, integration for every ten minutes showed extremely fluctuating variations even for one day. One hour integration resulted in still highly fluctuated Bq values for the borehole waters. Twenty-four hours integration rather improved the considerable fluctuation; Bq variation is within a few thousands (average Bq in twenty-four hours). Although the fluctuation is still large, it seems to respond to something happening in deep earth. The radon counting for the waters from the second borehole fluctuates between 2000 and 4000 Bq. In July earthquake (magnitude= 6.6) occurred and its epicenter was in the crust near Japan sea cost and app. 300 km away from the borehole. One month before the earthquake radon counting started increasing and reached to much more than 4000 Bq. After the earthquake radon counting dropped off down to the normal fluctuating value. Another earthquake (magnitude=5.9) happened in early December: its focus is in the mantle off the Pacific cost and epicenter away from app. 200 km from both the boreholes. Two radon counters were working to measure radon when the earthquake took place. The radon concentration of the waters from the first borehole showed no change before the shock, but right after the tremor radon concentration increased up to more than ca. 3500 Bq within one day and decreased gradually. In contrast the radon concentrations of the waters from the second borehole started increasing in early November and approached to ca. 5500 Bq. When the counting reached the maximum value, the earthquake happened and the radon concentration rapidly decreased to normal but fluctuating values. The variation of the radon concentration of the first borehole waters is strikingly contrasted with that of the second one before and after the tremor in early to middle December. Although fault-activity-relating mechanical properties, including delta CFF and volume strains, were calculated, the calculation cannot account for the reason of the contrasted change of radon concentrations in the waters from two different boreholes. In this presentation we are going to show the precise daily variation of radon data as well as calculated fault-activity-relating mechanical properties.