Observation of the 2003 Tokachi-oki earthquake through the Off Kushiro-Tokachi cabled observatory and possible speculations

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The 2003 Tokachi-oki earthquake (MJMA~8.0) took place at 04:50 (JST) at almost the same place as the 1952 Tokachi-oki earthquake. Right above the hypocenter of the 2003 Tokachi-oki earthquake, there is a cabled observatory deployed in 1999 as the seventh offshore earthquake monitoring system in the Japanese water. Full unsaturated seismic waveforms were recorded by the observatory as well as seafloor uplift through the water pressure measurements.

Three pressure gauges were located between the coast line and the Kurile trench and recorded the uplifts were 0.35, 0.37, and 0.12 m for epicentral distances of 25.5, 31.4, and 81.8 km, respectively. After the main shock, a continuous uplift of the seafloor is observed at the all three pressure gauge locations with an exponential decay in the rate of uplifts. Although the coseismic uplifts show a strong correlation with seismic asperity estimated by various authors, the postseismic uplifts are relatively space-independent. Since the distribution of the coseismic uplift values is different from that of the postseismic, we preclude that mechanisms of these seafloor uplifts could be caused by two different causes. Since the postseismic continuous uplifts are observed at all the pressure gauge locations, we think that one of the possible cause would be a continuous pressurization of a plane in the subsurface which may require a supply of fluids from deep source and redistribution of such fluids in the shallow and wide area beneath the cabled observation network. Unfortunately, any precursive phenomena were resolved from the acquired data until now. This might imply that precursive changes in observed physical properties are smaller than recoverable threshold in our observation.

Through the analysis of the data, we now think that there might be at least two directions in observation efforts in future seismogenic studies. One is to deploy long-term observatories to cover as long time as possible compared to the recurrence cycle of plate boundary megathrust earthquakes, and the other to access as close as possible to real seismogenic zone to improve the signal-to-noise ratio in observation properties.