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Environmental fluctuation observed on deep seafloor off Tokachi in Hokkaido and off Hatsushima Island in Sagami Bay

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When the 2011 off the Pacific Coast of Tohoku Earthquake of JMA magnitude 9.0 occurred at 14:46 JST on March 11th 2011, tsunamis whose amplitudes were about 20 - 80 cm were observed with JAMSTEC's cabled observatories deployed on deep seafloor off Hokkaido, in Sagami Bay, off Muroto Cape in Kochi and DONET. Among those observatories, at the deep seafloor observatory off Hatsushima Island in Sagami Bay and at the observatory off Kushiro-Tokachi in Hokkaido, the observation with several other sensors, such as CTD (conductivity, water temperature and water depth) sensors, current meters, TV cameras and so on, have been conducted besides seismometers and tsunami pressure gauges. Water depth of cable end stations of the observatories to which those multidisciplinary sensors are attached are 1175 m off Hatsushima Island and 2540 m off Tokachi, respectively. At 22:31 JST on March 15th 2001 the Eastern Shizuoka Prefecture Earthquake of JMA magnitude 6.4 occurred in north-west of off Hatsushima Island observatory. In this presentation environmental fluctuation on deep seafloor observed with those two observatories will be reported.

When the off the Pacific Coast of Tohoku Earthquake occurred on March 11th, the pressure gauge of CTD at the off Kushiro-Tokachi observatory detected the beginning of pressure increase associated with tsunami at 15:07. It increased up to about 60 cm in water height at the period between 15:12 and 15:18. The electro-magnetic current meter whose sampling rate is 2 Hz detected northward bottom water current at the same time. Considering background current, current velocity increase associated with the tsunami is estimated about 2 cm/s. In water temperature, conductivity and echo intensity of ADCP (Acoustic Doppler Current Profiler), significant fluctuations were not observed.

At off Hatsushima Island observatory, decrease of water pressure associated with the tsunami began at 15:32. It decreased about 80 cm in water height at 15:48, then began to increase about 160 cm from the minimum at 16:17 and degreased again to the same level of 15:48 at 16:55. The fluctuation of water pressure has continued until March 15th. Significant fluctuation of water current was not observed with ADCP whose sampling interval is 1 minute. However, echo intensity of ADCP, which corresponds to the amount of suspended materials, increased up to about 13 dB at 15:23 and then decreased to usual level at 17:00. After that it began to increase again at 01:17 on March 12th and it increased larger than ever up to about 18 dB at 01:37. Those echo intensity increases indicate regional land slide occurred in Sagami Bay, considering that the occurrence of submarine telecommunication cable trouble was reported by KDDI, although mudflow or strong water current was not observed at the observatory.

When the Eastern Shizuoka Prefecture Earthquake occurred, unfortunately ADCP and some other equipment were stopped because of scheduled blackout conducted by TEPCO just before the earthquake occurred. Nevertheless, the CTD sensor worked at that time and water temperature increase of 0.3 degree whose pattern was characteristic to mudflow was observed. Gamma ray intensity fluctuation was also observed, though it can be affected by sedimentation of suspended materials associated with biological spring bloom on sea surface.

In summary, as deep-sea environmental fluctuations besides bottom water pressure fluctuation caused by tsunamis, bottom water current fluctuation associated with tsunami caused by off the Pacific Coast of Tohoku Earthquake was observed on deep seafloor off Tokachi and increase of suspended materials which indicates landslides or mudflow associated with both earthquakes were observed on deep seafloor off Hatsushima Island.

Keywords: the 2011 off the Pacific Coast of Tohoku Earthquake, the Eastern Shizuoka Prefecture Earthquake, deep-sea environmental fluctuation, off Hatsushima Island in Sagami Bay, off Tokachi in Hokkaido, bottom water current