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Seasonal variability, seismic disturbance and the recovery on the seafloor, off Sanriku, Northeastern Japan

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In order to investigate environmental changes and recovery from the 2011 Tohoku Earthquake, we have conducted long-term monitoring of the deep-sea by deploying stations along the continental shelf off Sanriku, northeastern Japan. Phase one monitoring was carried out between August, 2012 and October, 2013 at initial water depths of 300 m and 998 m. The second monitoring phase was carried out between July, 2014 and May, 2015 at a depth of 982 m. ADCP, CTD, DO, turbidity sensors and a time-lapse camera system powered by lithium-ion batteries were installed at each station.

At the 300 m site, we observed a prominent water-temperature decrease from 8.0 to 2.0 °C in early May, 2013. This change was caused by the intrusion of cold Oyashio water into warmer coastal waters (Hanawa and Mitsudera, 1986). Oxygen concentration ranged between 250∼320 μM but we recorded occasional short-term depletions to ca. 200 μM. Turbidity sensors recorded increasing spikes between early April and mid-May, 2013. During this period, the camera also captured high-density marine snowfall inferred by spring phytoplankton blooming and a dense ophiuroid community. The 998 m site showed a constant temperature of ca. 2.9 °C throughout the year. Oxygen concentration was around 25 μM, which is typical for an oxygen-depleted zone in the northeastern Pacific. The dominant benthic organisms at the 998 m were ophiuroids, but the faunal composition and the population density were different from those observed at the 300 m site. At both sites, migrations of benthic organisms were not observed throughout the monitoring periods.

On 7th December 2012, a strong earthquake (M=7.3) whose epicenter was close to the 998 m site occurred. This earthquake induced a temporal increase in turbidity and burial of the benthic organisms and burrows seen on the sediment surface. However, the organisms reappeared on the surface the next day. On the 17th of February, 2015 another huge earthquake (M=6.9) occurred during the second monitoring phase. A turbidity increase by this earthquake was also recorded at the 982 m site. Seafloor photographs taken after the earthquake showed that small scale mounds constructed by benthic organisms were destroyed and the sediment surface homogenized. However, benthic organism activity was not affected by this disturbance. Small-scale mounds were slowly re-constructed, and the sea floor was back in its original condition two months after the earthquake.