

Fin whale signals observed at S-net seismic stations

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Real-time earthquake and tsunami seafloor station network called “S-net” (Seafloor observation network for earthquakes and tsunamis along the Japan Trench) was developed by National Research Institute for Earth Science and Disaster Resilience (NIED) in water depths of 100-7,830 m in northeastern Japan. The network consists of 150 observation stations off Boso to Kushiro and Aomori areas (Kanazawa et al., 2016; Uehira et al. 2016; Mochizuki et al., 2016). Each station has seismic sensors and pressure gauges to observe broadband signals from seismic event and tsunami. In this study, we show fin whale signals detected from the S-net data and present the seasonal variation of the signals and the migratory behavior of the whales.

We analyzed seismic station data of S-net from 2016 to 2018. We found characteristic signals with the spectral peak in the frequency bands of 15-25 Hz. One of remarkable features in the signals is that the band width that can be identified as signal is limited in a very narrow range; the signal level is very low or below the noise level in the frequency bands of less than 10 Hz that are typical bands in seismic waves and T-phases. Another feature is that the signals have a short duration of about 1 second and are repeatedly found at regular intervals of several tens of seconds. These are consistent with the features of acoustic signals from fin whales as found in observation data at IMS hydroacoustic stations (e.g., Lawrence, 2004) and also as shown in previous studies such as Iwase (2014) and Sugioka et al. (2015) that analyzed seafloor station data off the Kushiro-Tokachi cable sensor system. We thus assume that the characteristic signals observed at S-net stations are ones associated with fin whale activities. Most of the signals were detected at stations off Kushiro and Aomori areas in cold winter. The signals were also detected at stations deployed in the outer rise area. We suppose that integrated scientific studies across marine biology to geophysics using S-net data could contribute to developing our understandings of various signal sources observed in seafloor areas and of ecological behavior of marine mammals and also to real-time monitoring of their activities and safe navigation of ships by the monitoring.

Keywords: seafloor observation, S-net, fin whale