A beam forming experiment of airgun array energy in Kumano-nada, Nankai Trough

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Seismic experiments with airguns, which are useful to understand the crustal structure, have been conducted many times these days. Multi-channel seismic (MCS) reflection using multi-channel hydrophone streamer is an effective method to figure out highly resolved geological structures. The MCS method is usually use a seismic vessel for airgun shooting and signal recording simultaneously. To reveal deeper target depth as seismogenic zone, two-ship method is valid for the survey. The method uses two vessels for airgun shooting and signal recording individually, and enables us to record larger offset reflection phases. Since the amplitude of large offset signal decreases due to spherical divergence, beam-formed airgun-array is an effective way to enhance the amplitude of large offset signals. The effectivity was verified in a MCS survey off Boso in 2001. Airgun-array generates P-wave signals only because of water, whereas S-wave signals are converted from P-wave at structural boundary. Acquiring PS converted waves are important to reveal the S-wave velocity structure, which is associated with physical property such as poisson's ratio. To record the PS converted waves, two-ship method and wide-angle reflection survey with ocean bottom seismometers (OBS) are suitable.

In the viewpoint mentioned above, a beam forming experiment of airgun-array energy was conducted off Kumano region in the Nankai Trough in September, 2002. Two seismic lines were set for the experiment which consisted of a dip line (COP1) and a strike line (COP2). R/V Kaiyo and Kairei of Japan Marine Science and Technology Center (JAMSTEC) were used as source and receiver vessels, respectively. Kaiyo has a 12000 cu. in. airgun array, composed by eight 1500 cu. in. airguns. Kairei has a 156 channel hydrophone streamer. Five OBS were deployed on the COP2 to record wide-angle reflection and refraction signals in multi components. Offset distance between two ships were changed 10 km, 15 km and 20 km to record the two-ship data in 0-20 km offset range combined with normal MCS data.

Tentative results of the experiment are as follows: 1) The reflection signal amplitude of two-ship data is larger than that of normal MCS data, which may reflect from plate boundary; and 2) In OBS records, the amplitude of later reflection phases of beam-formed source are larger than those of non-beam source signal. This may be related to the effectiveness of beam-formed signal.