Geologic structure of Toyama Trough analyzed from seismic data of reflection profiling

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Toyama Trough is 200 km in length, 20-50 km in width and 1000-2000 m in depth of water is located from Toyama Bay to Yamato Basin, offshore Toyama to Niigata Prefectures (Kato et al. 1990).

We utilized Seismic Processing Workshop with seismic data of reflection profiling by Japan National Oil Corporation (FY1976 basic investigation report on physical exploration for domestic oil and natural gases in the Western Hokkaido to Niigata offshore area) and discussed the history of structural development in Toyama Trough. In addition chronostratigraphy and timing of shifting event of Toyama Deep Sea Channel through about center of Toyama Trough were also estimated.

Acoustic stratigraphy of seismic cross section is classified into A to E formations and the acoustic basement, and is compared with the marine geology of offshore eastern Noto Peninsula (Okamura, 2002) and northern Toyama Bay (Sakurai et al., 1972) and also with onland geology of the Hokuriku area (Fujii et al., 1992).

'A' formation is correlative to Toyama-wan Group (Pleistocene to Holocene, 1.5 Ma-), B-D formations are correlative to Joetsu-oki Group (Middle Miocene through Pliocene, 15-1.5 Ma), E formation is correlative to Suzu-oki Group (Middle Miocene, 16-15 Ma), and the acoustic basement (Lower Miocene and older, -16 Ma).

Toyama Trough was a rift zone because of its thick sediments in contrast to thin crust of 15 km in thickness (Okamura, 2003). This rifting activity had been continued up to about 15 Ma (Okamura, 2002) with spreading of Japan Sea (30-13 Ma: Sato, 1994). Further, volcanic activity occurred on the continental slope of Honshu side during the spreading epoch of Japan Sea(20-17 Ma), the acoustic basement finished to form until about 16 Ma. Consequently, it is possible that the area of Toyama Trough had been once a rifted zone due to E-W extension with N-S trending normal faults. Then, it is considered that NW-SE extension with NE-SW trending normal faults occurred in the region from south edge of Toyama Trough to northern Toyama Bay. Because most normal faults were active during sedimentation of D-C formation (Middle to Late Miocene), it is possible that the same NW-SE trend of extension as the spreading of Yamato Basin had continued until this period. After sedimentation term of B formation (Late Miocene and after), reverse faults is confirmed on the profile. Therefore, a stress reversal from E-W extension to compression at Toyama Trough is probable around the period of stratigraphic boundary between C and B formations (8-6.5 Ma). Because reverse faults formed during the B period are confirmed continuous up to the sea bottom, they are still active now. As for tectonic trend, N-S and NE-SW striking normal faults formed during expansion of Japan Sea were reactivated as reverse fault, demonstrating a tectonic inversion (Okamura et al, 1995). Normal fault activity is ceased until the later Late Miocene, and compression regime continues up to now.

Toyama Deep Sea Channel was formed on the seabed down-cut by clastic supply by building of Hida Mountain Range. Two stepped uplifting of the Mountain range occurred during the periods 2.5-1.5 Ma and 0.8-0 Ma (Oikawa, 2003). Age of Toyama Deep Sea Channel is interpreted after B period (6.5 Ma-). Toyama Deep Sea Channel began to form during 2.5-1.5 Ma (Pliocene), with considering Hida Mountain Range. Additionally, during B period, an oblique succession of channel levee sediments is confirmed that it has been shifted westward from the foot of Sado Island during 2.5-1.5 Ma. Consequently, Toyama Deep Sea Channel was formed by two steps of 2.5-1.5 Ma and 0.8-0 Ma, in consistence with onland tectonic activities concerning the formation of nascent plate boundary along the eastern margin of Japan Sea.