

Tectono-geomorphology of the epicenter regions along the eastern margin of Japan Sea - aspects from submersible investigation

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A concentration zone of active faults and folds has developed in the Quaternary period and in the upheaval zones along the eastern margin of Japan Sea from Awa-shima Island through Tobi-shima Island to Oga Peninsula other than Sado ridge and Okushiri ridge.

Okushiri ridge is a clear active fault zone, since the 1940 Off Shakotan Peninsula, the 1993 southwest off Hokkaido, and the 1983 Nihonkai-chubu earthquakes occurred within this zone.

A sense of the terrace tilting topography does not coincide with crustal movement of Okushiri Island by the 1993 earthquake. An enbayment depression, where the both terminals of Okushiri and Sado ridges meet is located, became an epicenter region of the 1983 earthquake does not always correspond to the existing landform of large scale.

In addition, a remarkable active fault is recognized along Sado ridge, away from existing epicentral regions. Therefore, there is the problem that we should elucidate on seismotectonics of this area.

In July 2001, the authors carried out a series of submarine investigations by the research submersible 'Shinkai 6500' in Sado and Okushiri ridges of easternmost Japan Sea.

The YK01-06 cruise investigates integrated interdisciplinary synthesis about occurrence of subbottom active faults and marine environment of the easternmost Japan Sea for the purpose of elucidating a real image of the earthquake tectonics, which is useful in seismogenic potential evaluation.

This paper reports about seabottom tectono-morphology from the results of twelve submersible dives, in particular argues a comparison of earthquake tectonics of these epicentral regions and a seismic gap of 1993 southwest off Hokkaido earthquake and 1983 Nihonkai-chubu earthquake.

Fresh slope collapse and ground cracks, and debris sedimentation were observed by the diving investigations that visited earthquake epicentral and tsunami source regions, and many samples were collected for geological, geochemical, and biological studies.

On the other hand, in between these epicentral regions, at the outskirts of Kaiyou and Shiribeshi seamounts, slope collapse and ground fissures, and debris sediments were observed buried under muddy cover.

Since the typical sedimentation rate of deepsea flats in the easternmost Japan Sea is around 20cm by 1000 years, it is almost certain that paleo-earthquakes developed large slope collapses in the past during several thousand years.

No historical earthquake along the western side of Sado ridge is known, but paleo-events are probable for several thousand years, because older slope collapses and ground fissures were observed by diving investigations.

In addition, an about 1000 years interval of turbidites is provided from a small trough in Sado ridge, which denotes a potential of seismogenic activity equal to Okushiri ridge.

Similarly, the possibility that seabottom of the eastern margin of Japan Sea is another cold seep area of the scale equal to Sagami Bay and the Nankai Trough becomes clear.

At the seabottom off Mutsuta cape, bacteria mats, discovered in 1999, reached about 800,000 square meters areas on a slope by east and west 800m, north and south 900m, depth of the water difference about 100m. Geomorphologically, it became clear to be located in a flat bench of inflection zone next to the tip of a debris zone of andesite boulders supplied by the Mutsuta collapsing coast.

Here, several lines of fissures with pitch-black parts were observed in dense bacterial mats, which can be attributed to ground fissures and muddy water spouts possibly with the 1993 earthquake.

Such a large-scale, strongly dense bacterial mats may have lasted for a long term and received the damage by the 1993 off southwest Hokkaido earthquake, although it becomes almost recovered now.