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Geologic Structure and Active Tectonics of the Frontal Part of Hidaka Thrust System, Hokkaido, Japan: example of Umaoi HIlls

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Due to the contraction of Eurasian and NOrth American/Okhotsk plates and west ward motion of the Kuril fore arc sliver, a NS trending fold-and thrust belt was formed in the western part of Hokkaido axial zone. By the collison of two plates, large scale, wedge-thrust structure associated with the delamination of lower crust in the Kuril arc has been formed since the mid-Tertiary. This movement also produced the west-vergent thrust system and westward migration of thrusting. In the frontal part of this thrust system, the Umaoi hills is a formed as fault-related fold. The Umaoi hills are NS trending anticlinorium. On the western flank of the Umaoi hills, west-dipping flexures are recognized on the geomorphological surface in late Quaternary.

Where is the plate boundary between Eurasian and North American/Okhotsk plates in northern Japan has been a long-standing question. Nakamura[1983]proposed that the boundary shifted to the eastern margin of the Sea of Japan at 1-2 Ma. Seno[1987]suggested that the jump of plate boundary occurred at 0.5 Ma. If the plate boundary shifted from the Hokkaido axial zone to the eastern margin of the Sea of Japan, the horizontal convergence rates in the Hokkaido axial zone should be decreased during 2-0.5 Ma.

the purpose of this study is to examine the hypothesis that Eurasian and North American/Okhotsk plates shifted from the Hokkaido axial zone to the eastern margin of the Sea of Japan at 1-2 Ma or 0.5 Ma, and to reveal the rate of horizontal shorting in the western part of the Hokkaido axial zone.

To reveal the activity of the thrusting in late Cenozoic and the mechanismsforming the Umaoi hills, high resolution shallow sesmic reflection profiling was undertaken across the western part of the Umaoi hills. Together with data on surface geology, sesmic profiles, drill holes, and tectonic geomorphology, the mechanisms of the formation of the Umaoi hills, rate of uplifting and shorternig were studied using a balanced geologic cross-section method. Seismic CMP reflection profile across the western flank of the Umaoi hills demonstrates the growth folding of the Umaoi hills.

The array of shallow drill cores along the seismic line suggests that the late Quaternary sediments(ca. 30 ka) are also involved in the growth strata. The basal horizon of the growth strata almost corresponds to the top of Nina Formation dated at 3.5 Ma. Thus the Umaoi hills began to uplift after the deposition of the Nina Formation and its uplifting has been continued in late Quaternary. The vertical uplifting rate of the Umaoi hills estimated from tha balanced cross section is 0.3-0.6 mm/yr since 3.5 Ma.

The late Quaternary uplift of the Umaoi hills shows an asymmetric form. Vertical displacement of the late Quaternary sediments(ca. 80 ka) on the western flank of the Umaoi hills deduced from drill-core array is about 50 m. Thus the rate of uplift of the Umaoi hills is larger than 0.6 mm/yr. The uplift rate on the eastern flank since 135 ka is estimated 0.2-0.3 mm/yr. The rate of uplifting of the western Umaoi hills in late Quaternary is obviously larger than the one since last 3.5 Million years. These results suggest that the plate boundary was not transferred from the Hokkaido axial zone to the eastern part of the Sea of Japan at 1-2 Ma or 0.5 Ma.

The amount of horizontal shortening was estimated from the balanced geologic cross section. East-west convergence yielded 10 km of shortening across the Umaoi hills and the eastern thrust belt. As the Yuni thrust displaced the horizon dated at 10.5 Ma in the Biratori-Karumai Formation, the onset of thrusting was younger than 10.5 Ma.Thus the average rate of horizontal shortening has potential larger than 1 mm/yr. The balanced model predicts a 10 degree east-dipping main thrust with a maximum vertical slip rate post-3.5Ma of 0.6 mm/yr and a horizontal shortening maximum rate of 3.5 mm/yr.The Miocene-Holocene horizontal slip rates on main thrust shows 1-3.5 mm/yr.