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Active fault segmentation and structural development of the eastern flank of the Ou Backbone Range, northeast Japan

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The Kitakami Lowland fault zone (KLFZ) is an active reverse fault zone that extends for more than 70 km in length. KLFZ can be classified into south and north areas, bordering around the Waga River. In the north area, active faults developed along the eastern flank of the Ou Backbone Range (OBR). In the south area, active faults are divided into along the eastern flank of the OBR and in the Kitakami Lowland. Several deep seismic profilings have proved structural development intersect at right angles to the arc. But structural development direction parallel to the arc has been little investigated.

In light of recent E-W trend stress field since Pleistocene time in the northeast Japan arc, geomorphological and geological maps showing the detailed distribution since Pliocene time are keys to show the changes of the structural development. In order to connect geomorphic and geologic data to crustal deformation, it is important that the shallow branched fault is investigated, in that many active reverse fault zones form branched fault in the shallow depth and a variety of surface deformation. The objectives of this thesis are: 1) investigation geomorphology and Geology at the surface of several active fault traces consisting the active fault zone, 2) estimation of subsurface structure and its development associated with active fault trace, and 3) discussion of the difference of crustal deformation between the north and the south area.

Active faults were mapped on the basis of geomorphological and geological maps. Investigation of tectonic geomorphology and fault outcrop provided a variety of surface deformation and activity of the active faults. Subsurface geological structure and its development of the active faults were interpreted, based on shallow seismic reflection profiling, gravity survey in some location. Subsurface geometry of fault model was constructed from amount of shortening and shape of deformation using area balancing method. Strike, location and range of the fault model were inferred from tectonic geomorphic and geologic structure.

As a result, KLFZ and active fault around it are consisted two categories in the north area and four categories in the south area. Location and structure of the fault models should be studied further, but the results of subsurface structure and its development indicate that consecutive active fault zone of the surface is composed by several fault formed by different structural development.

1) In comparison with those (shortening: $<$0.5 km/2 Ma, length: 10-15 km) in the Kitakami Lowland, amount of shortening and length of the fault model below the OBR (shortening: 1-2 km/2 Ma, length: 10-20 km) are large. This different indicates that displacement due to faulting along the volcanic front (OBR), have accumulated at a rate of 101 orders than that of the Kitakami Lowland.

2) In comparision with those in the south area, amount of shortening and length of the fault model in the north area are large. It should be noted that the largest fault model (Uwandaira fault group and Yokomoriyama fault, 1896 Rikuu Earthquake; M7.2) is located the area which the Quaternary volcano is not distributed in the volcanic front.

3) Main active fault is distributed along a steep Bouguer anomaly gradient, northern part of the Morioka-Shirakawa tectonic line, and in and around the low velocity zone of the lower crust by seismology.

Structural development difference between the north and south area, seismogenic fault of historic earthquake, Bouguer anomaly map, distribution of Quaternary volcano, and crustal heterogeneity suggest that development of active fault is controlled by basement structure, distribution of Quaternary volcano, and crustal heterogeneity. It is suggested that segment of active fault of the surface is controlled by these factors.

Keywords: Kitakami Lowland fault zone, seismic reflection profiling, area balancing method, slip rate, amount of shortening