Study on characterization of Quaternary tectonic movement by uplift estimation using fluvial terraces

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1. Background

Uplift estimation in an inland area is very important for site screening and long-term safety of the geological disposal of high-level radioactive waste project, but is delayed remarkably in comparison with those in a seaside area. For quantitative estimation of late Quaternary uplift in an inland area, the method using fluvial terraces was proposed in previous studies [1]. It is based on the assumption that terraces are formed controlled by the cyclic glacio-eustasy, and relative height between terraces formed under the similar climate such as glacial age or inter-glacial age. Uplift for late Quaternary, which is estimated in both side of the fault by using the relative height of river terraces is almost equal to vertical displacements of these faults for late Quaternary. Hence, the method using fluvial terraces is available for estimating the uplift for late Quaternary in an inland area quantitatively [2]. In this study, we discuss characterization of Quaternary tectonic movement in an inland area by uplift estimation using fluvial terraces and terrace distribution.

2. Tectonic movement in the inland area shown by the uplift distribution[2]

It is possible to find the geotectonic feature that were so far overlooked as deformed zones along active fault, tectonic style of uplift and subsidence by obtaining the 3-dimentional distribution of uplift in late Quaternary. Methodology and concept proposed in this study give practical survey method of late Quaternary 3-dimentional uplift characteristics for the long-term safety of geological disposal of high-level radioactive waste. By applying this method to Quaternary research, new insights on the Quaternary tectonic movement may be given.

3. Active structures shown by terrace distribution

The uplift index of the values of relative height between fluvial terraces and fluvial terrace distribution style indicate active fault and active fold.

At the time of the Mid-Niigata prefecture earthquake in 2004, it seems that no earthquake fault occurs along the Muikamachi fault, and leveling by Geographical Survey Institute detect no displacement along the fault. However, terrace distribution style is different on the both side of the fault [3]. Only lower terrace without covered loam layer distributes over the east of the fault. On the other hand, higher-middle-lower terraces distribute over the west of the fault. The higher terrace is the older, and it shows continuous uplifting. Using the uplift index of the values of relative height between terraces, we estimated that the uplift difference on the both side of the Muikamachi fault during late Quaternary was more than 40m. It suggests that the slip rate of the Muikamachi fault is more than 0.4m/103 year.

There is the MIS6-MIS8 fluvial terrace that tilts toward west on the side of the joint of Shinano and Uono Rivers, and anticline structure, which is congruous with terrace tilting, lies on the south side of the MIS6-MIS8 fluvial terrace. In this area, many stairs of terraces distribute. Relative uplift to the area between the Muikamachi fault and the Suwa-toge monocline, which estimated by using fluvial terraces is 100-200m, but there is no remarkable displacement around the Suwa-toge monocline. Their fluvial terrace features characterize a very active folding.

4. Conclusion

Fundamentally, the difference of terrace distribution style suggests an uplift/subsidence boundary; it gives a base of uplift estimation method using fluvial terraces. This method is available for estimating the uplift during late Quaternary in an inland area. Furthermore, terrace is objective, and its description, which combines with description of tectonic relief, contributes to decrease vagueness and individual variation of the photo-interpretation.

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