Timing of folding of the Higashiyama Anticline, Niigata Prefecture, Central Japan

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Tectonic inversion in the NE Japan arc is considered to commence sometime after late Middle Miocene. This study concerns the controversial timing of the inversion by dealing with the geology of the Higashiyama Hill in the eastern part of the Niigata sedimentary basin. The overturned Plio-Pleistocene formations make up the western limb of the north-south trending Higashiyama Anticline, which has a horizontal hinge line and a gently dipping eastern limbs.

In this study, we showed that the anticline began uplifting no earlier than the deposition of the middle part of the Pliocene Ushikubi Formation, i.e., 3 Ma, based on paleocurrent distribution. Specifically, it was found that the hinge line largely coincided with one of the main stream of the Miocene-Pliocene paleocurrent system in the southeastern part of the Niigata basin. The stream branched off to the both sides of the present hinge line. This pattern was persistent over a few million years until 3 Ma, during which sandstone layers of the Araya Formation were deposited in the Higashiyama area including the axial part of the anticline. This longstanding pattern evidences flat paleo-topography or even a shallow paleo-trough along the anticline. However, the wide exposure of the Pliocene strata to the east of the anticline appear to indicate that the strata are few times thicker there than in the western limb of the anticline, and further that growth of the anticline began in the Araya stage. The conflict between these estimetes are controvertial.

Our geological mapping and fault-slip analysis suggest that the broad exposure is the surface expression of the north-south extensional deformation of the strata, resulted from northward gravitational spreading of the culmination of the anticlinorium that is bounded at its western margin by the Higashiyama Anticline. 8 mappable-scale faults are infered based on the discontinuous key beds, and one of them were found as south-dipping normal fault in the eastern limb of the anticline. And most of the meso-scale faults are normal fault, too. Then the fault-slip analysis suggests north-south extension. Further, we observed that the north-dipping bedding-parallel faults and some south-dipping normal faults are conjugate relation. These faults acting mappable-scale made repeatedly-exposed strata. We conclude that the anticline began uplifting no earlier than the deposition of the middle part of the Pliocene Ushikubi Formation, i.e., 3 Ma.