The low temperature cooling history of the Tanzawa tonalitc complex.

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The South Fossa Magna region is an active arc-arc collision zone that occurred by motions around the TTT-type triple junction, where the Izu-Bonin arc on the Philippine Sea plate collides beneath the Honshu arc on the Eurasia/North American plate.

An island collision of paleo Izu-Bonin arc and migration of the plate boundary is thought to have repeated in the region. It is the multiple collision theory. It is important to identify the uplift and denudation history to understand topographic changes and tectonics caused by such collisions.

Radiometric dating thermochronology on rocks that are exposed at present after intrusion beneath the arc crust and collision is an effective method to understand such histories on the geological timescale. The Tanzawa tonalitic complex is exposed at the center of the Tanzawa block in this region, which is thought to be correlated with the middle curst of the present Izu-Bonin arc by a structural model across the arc, that is derived from recent marine seismic refraction and ocean bottom seismographic refraction survey. In addition, the Tanzawa block is thought to be the newest and the most reliable multiple collided block. As stated above, the Tanzawa block is the most suitable field for synthetic study of tectonics of arc-arc collision.

The history of the Tanzawa block is known from paleontological and sedimentological studies. The intrusion of the Tanzawa tonalitic complex occurred at 15-16Ma, the collision with the Honshu arc at ~6Ma, wide exposure of the complex at ~2Ma, then the onset of collision of the Izu block at ~1Ma. The multiple collision theory pointed out that the collision of the Izu block uplifted the Tanzawa block. However, the cooling history is not clearly understood, because the ages of recent thermochronologic studies (mostly K-Ar) are highly variable and the closure temperature is relatively high. Therefore the objective of this study is to reconstruct the denudation history of the Tanzawa block based on the cooling history obtained from (U-Th)/He and FT geochronometry, whose closure temperatures are relatively low.

The first advantage of (U-Th)/He thermochronometry is the closure temperature that is mostly lower than other geochronometry. The closure temperatures for apatite and zircon are mostly 60-80C, 170-190C, respectively. The temperatures partly overlap with that of FT geochronometry. The second is that the precision of the measurement is very good. On the other hand, systematic errors are caused by zonal distribution of Th-, U-series nuclides in the crystal, Th-, U-rich inclusions and imperfect euhedrallity of the crystal. The simplest method to show the zonation is the application of FT geochronometry. Because of above reasons, the combination of (U-Th)/He and FT geochronometry is very well suited for low temperature thermochronology.

We measured two (U-Th)/He ages for each sample and here consider only the samples that yielded reproducible ages. There is no systematic spatial distribution of (U-Th)/He ages. The spatial distribution of FT ages has not yet been established, although ages of fission-track for zircons vary outside of analytical error. The negatively skewed distribution of confined fission-track lengths in the zircons suggests monotonic slow cooling. Mean ages were 2.0+-0.2Ma (AHe), 3.3+-0.1Ma (ZHe), 4-7Ma (ZFT), and thus, the average cooling rates were calculated at 85C/Ma between ~6-2Ma, 30C/Ma between 2-0Ma respectively.

The paleothermal gradient is poorly known in the Tanzawa block. It seems reasonable to think that it was similar to the present geothermal gradient of 40-50C/km because the position of the volcanic front of the northernmost Izu-Bonin arc has not changed since the late Miocene. Therefore the denudation rates were calculated at 1.6-2.8mm/y between ~6-2Ma, 0.6-1mm/y between 2-0Ma from this assumption. The result shows decrease of denudation rate after ~2Ma, in spite of the collision of the Izu-Bonin arc at ~1Ma.