# Thermochronology on the fore-arc side of Northeast Japan Arc

*Yuya Kajita[1], Shigeru Sueoka[2], Shoma Fukuda[1], Noriko Hasebe[3], Akihiro Tamura[4], Tomoaki Morishita[4], Barry P. Kohn[5], Takahiro Tagami[1]

1. Graduate School of Science, Kyoto University, 2. Japan Atomic Energy Agency, 3. Institute of Nature and Environmental Technology, Kanazawa University, 4. Department of Sciences, Kanazawa University, 5. School of Earth Sciences, University of Melbourne

Northeast (NE) Japan is one of the best regions to study tectonics of island arc, because NE Japan has comparatively obvious island arc components of fore-arc, volcanic front, back-arc and back-arc basin. Therefore, there are many studies on the tectonic evolution of NE Japan (e.g. Amano and Sato, 1989; Sato, 1992; Nakajima, 2013). Ota (2010) says that the mountains in NE Japan are uplifted by compression across arc (i.e east-west compression). However, there are a few quantitative investigations of the mountain uplift and denudation histories which are important factors estimating island tectonics.

As a technique for measuring uplift or denudation rates, some are known (e.g. GPS survey, elevation of terraces, thermochronology etc.), but in regard to million-year-scale mountain uplift and denudation rates, it can be said that thermochronology is the most appropriate method. Thermochronology can reconstruct the time-temperature relationship of rock/mineral samples, based on radiometric ages and closure temperatures specific to the combination of radiometric dating methods and target minerals. Furthermore, some assumptions enable discussion of mountain uplift and denudation histories. At overseas massive orogenic zones thermochronology has been applied since 1970s (Hermam et al., 2013). At NE Japan there are, today, some studies that discuss differences of uplift/denudation history between fore-arc, Ou backbone range and back-arc using thermochronology (e.g. Sueoka et al., 2017; Fukuda et al., 2019; Fukuda et al., in review). However, in these preceding studies, it is not sufficient to discuss a respective and more particular thermal and denudation history about arc component units. Therefore, in this study, we focus on fore-arc side of NE Japan, Kitakami Mountains and Abukuma Mountains and then to estimate detail thermal and denudation history we apply thermochronology there.

We adopt apatite fission-track (AFT), apatite (U-Th-Sm)/He (AHe) analyses as thermochronological methods. AFT ages are 139.4-78.6 Ma at Kitakami, 61.0-40.5 Ma at Abukuma. AHe ages are 51.2-36.1 Ma at Kitakami, 75.9-60.1 Ma at Abukuma. With our results and ages which preceding studies provide we discuss age trend and denudation history respectively.

At Kitakami Mountains, AFT ages become younger gradually (140-80 Ma) from the most eastern locality to around 141.6 degrees longitude locality. On the other hand, all AHe ages are about 50-40 Ma except for the most western locality of which the AHe age is 90 Ma. However, at the most western locality the AHe age is older than the AFT age which usually indicates older ages because of the different closure temperature, so a local thermal event like hydrothermal activity possibly affect the ages of this locality.

At Abukuma Mountains, AFT age trend changes at Hatagawa fault zone (HFZ), which AFT ages tend to be younger in the west side of HFZ than in the east side. AHe age trend also seems to change at HFZ like AFT age trend, but considering the error bars it is not obvious. And at the most eastern locality the AFT age is comparatively young. Because the AFT age is younger than the AHe age at this locality, perhaps, there was a local thermal event like Kitakami Mountains.

 

Then we calculated the average denudation rate using the AFT ages. As the result of calculation, at every locality in Kitakami Mountains and Abukuma Mountains the average denudation rate is <0.10 mm/yr. Therefore, both mountains are stable at $10^{7-8}$ year time scale. However, this result does not suggest that the denudation rate is continuously <0.10 mm/yr, so to construct more detail denudation histories we have to apply new thermochronological method which is available at shorter time scale.

As future subjects, ①improvement of accuracy and precision by further analyzing ②increasing number of sampling localities and employing another thermochronological method (e.g. cosmogenic nuclides analysis) ③applying new thermochronological methods (e.g. thermal inverse modeling by AFT; Electron Spin Resonance thermochronometry) to estimate more detail thermal and denudation histories ④ discussion of geothermal gradient, uplift model and tectonics model at Kitakami Mountains and Abukuma Mountains.

Acknowledgements: This study was carried out under a contract with METI (Ministry of Economy, Trade and Industry) as part of its R&D supporting program for advanced research on long-term stability of geological environment. This study was also supported by the Grant-in-Aid for Scientific Research on Innovative Areas (KAKENHI No. 26109003) from the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

Keywords: Kitakami Mountains, Abukuma Mountains, Thermochronology, Fission-track

 