# The Permian–Triassic granitoid and gneiss in the Dinosaur Valley Fukui Katsuyama Geopark and other areas, Fukui Prefecture, Central Japan

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## Introduction

Various studies have been conducted of the Early Cretaceous Tetori Group that yield many dinosaur fossils in the Dinosaur Valley Fukui Katsuyama Geopark. On the other hand, many pre-Cretaceous small rock bodies that sporadically occur in the western part of the Geopark and other areas of Fukui Prefecture remain unstudied. These rock bodies are regarded as the Hida granitoid and Hida gneiss (e.g., Fukui Prefecture, 2010), the basement rocks of the Tetori Group and other Mesozoic to Cenozoic sedimentary units. However, the only petrological or geochronological study is Shibata and Uchiumi (1992), who reported a K–Ar alkali feldspar age of 178 ±5 Ma from the Mt. Murakuniyama granitoid in Echizen City to the southwest of the geopark. Here we present the results of petrographical and geochronological studies that help to characterize the granitoid and gneiss.

## Geological Setting

Pre-Cretaceous granitoid and gneiss sporadically occur in the northeastern part of Fukui Prefecture (the Reihoku district), the western part of the Hida Belt. In this study, we investigated the granitoid or gneiss of four areas, the Saragawa– Bandojima area in the geopark, Mt. Genampo area in Ono City, and Mt. Taiheizan and Mt. Murakuniyama areas in Echizen City. (1) Granite, gabbro, orthogneiss, and greenish gneiss crop out in the Saragawa–Bandojima area, covered by the Upper Cretaceous sedimentary rock and felsic tuff or Miocene andesite. (2) Two types granitoid crops out in the Mt. Genampo area: one is partly crushed and crops out in the southern foot of Mt. Genampo, whereas the other is undeformed and crops out in the northern foot of Mt. Genampo and Hokyoji to the north. (3) Granite and gabbro occur in the Mt. Taiheizan area, and (4) granite, diorite, and gabbro crop out in the Mt. Murakuniyama area.

## Analytical Methods and Results

We took a granitoid sample from the Saragawa–Bandojima, Mt. Taiheizan, and Mt. Murakuniyama areas, two granitoid samples from the Mt. Genampo area, and a gneiss sample from the Saragawa–Bandojima area. Then we conducted the modal and the zircon U–Pb dating by the LA–ICPMS equipped at Nagoya University. The results are summarized in the attached table.

## Discussion

The results of zircon dating indicate that zircons from the granitoid bodies crystallized in the Middle Permian to the Early Triassic. The zircon U–Pb age of the Murakuniyama tonalite (250.9 ±2.5 Ma) is older than the alkali feldspar K–Ar age (178 ±5 Ma: Shibata and Uchiumi, 1992). We consider that the zircons in the Murakuniyama tonalite crystallized at ca. 250 Ma (Early Triassic), and a tectonic thermal event of 200℃ (blocking temperature of alkali feldspar) or more overprinted at ca. 178 Ma (Early Jurassic). The low Th/U ratio of the zircons of the Bandojima orthogneiss body suggests that the zircon age, 231.8 ±1.8 Ma, is metamorphic. A local metamorphic event probably occurred in the Saragawa–Bandojima area around

 

231 Ma, together with the intrusion of the Saragawa tonalite. From the amount of magnetite of each sample, we consider that the granitoid in the Mt. Genampo and Mt. Taiheizan areas is of magnetite series.

References

Fukui Prefecture, 2010, *Fukui Pref. Publ. Corp. Const. Tech.*, 173p /Shibata and Uchiumi, 1992, *Bull. Geol. Surv. Japan*, **43**, 359–367.

Keywords: Dinosaur Valley Fukui Katsuyama Geopark, Hida Belt

Table Summary of the petrographical and geochronological analyses of five granitoid and one gneiss samples from the geopark and adjacent areas.

| Name of rock body | Main constituent minerals | Accessory minerals | Zircon $^{238}U$–$^{206}Pb$ ages | | | Th/U ratio of zircons |
|---|---|---|---|---|---|---|
| | | | Age range | LPP* | YC age (2σ)** | |
| Saragawa tonalite | plagioclase, quartz, biotite, chlorite, and muscovite | zircon, monazite, and opaque minerals (magnetite poor) | 266–223 Ma | 243.8 Ma | 230.7 ± 4.1 Ma (n = 7, MSWD = 2.2) | 0.15–0.37 |
| Hokyoji granodiorite | undeformed plagioclase, quartz, alkali feldspar, biotite, muscovite, and hornblende | zircon, titanite, and opaque minerals (magnetite rich) | 285–248 Ma | 267.6 Ma | 256.1 ± 1.9 Ma (n = 10, MSWD = 1.6) | 0.41–1.21 |
| Genampo tonalite | partly crushed plagioclase, quartz, alkali feldspar, and biotite | zircon, epidote, and opaque minerals (magnetite rich) | 295–263 Ma (with a 322 Ma grain) | 272.4 Ma | 271.9 ± 1.9 Ma (n = 22, MSWD = 1.4) | 0.44–0.89 |
| Taiheizan monzonite | plagioclase, alkali feldspar, biotite, and chlorite | zircon, garnet, and opaque minerals (magnetite rich) | 249–233 Ma | 243.8 Ma | 243.0 ± 1.6 Ma (n = 22, MSWD = 1.11) | 0.63–1.29 |
| Murakuniyama tonalite | plagioclase, quartz, and muscovite | zircon and opaque minerals (magnetite poor) | 289–240 Ma | 247.3 Ma | 250.9 ± 2.5 Ma (n = 26, MSWD = 1.5) | 0.47–1.65 |
| Bandojima orthogneiss | quartz, alkali feldspar, alternation of plagioclase, chlorite, and biotite | zircon, epidote, titanite, garnet, and opaque minerals (magnetite poor) | 251–225 Ma | 234.9 Ma | 231.8 ± 1.8 Ma (n = 12, MSWD = 1.4) | 0.01–0.41 (mostly <0.1) |

* Largest graphical age peak on an age-probability plot

** Weighted mean of the youngest age-cluster (YC), consisting of the youngest zircon age and the other ages with the error bar (±2σ) overlapping with the youngest age