

Geochronological study of the Motodo Formation in the Hida Gaien Belt, Fukui Prefecture, Central Japan

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We carried out a U-Pb geochronological study of the age-unknown Motodo Formation in the Hida Gaien Belt, central Japan.

PREVIOUS STUDIES The Motodo Formation is a southward-facing, red-bed-dominant formation, consisting of conformable three members: the Nakajima Tuff Breccia (NTB), Wasadani Conglomerate (WC), and Kumokawa Conglomerate (KC) members, in ascending order (Ono and Takeuchi, 2001). Kawai et al. (1957) correlated the Motodo Formation with the Lower Cretaceous Kanmon Group, which also consists mainly of red bed. Ono et al. (2003) constrained the age of the Motodo Formation between Early Jurassic and Early Cretaceous and supported the correlation of Kawai et al. (1957), because (1) they obtained zircon CHIME ages of 201 +/- 20 Ma and 202 +/- 30 Ma from granodiorite clasts in the WC Member, and (2) they found that the pre-Late Cretaceous faults of the Hida Gaien Belt arranged the distribution of the Motodo Formation. On the other hand, Omura (1968) considered that the Motodo Formation is a Late Permian to Triassic formation, because (i) limestone clasts in the Motodo Formation yield only Paleozoic fossils, such as *Codonofusiella* sp. and *Lepidolina toriyamai*, (ii) the geologic structure of the Motodo Formation is discordant with that of the Middle Jurassic-Early Cretaceous Tedoru Group, and (iii) the paleomagnetic directions of the Motodo Formation and Kanmon Group are significantly different.

SAMPLE AND METHOD LA-ICP-MS, U-Pb analyses of zircons from the following four samples were carried out: (1) andesitic tuff breccia of the NTB Member, (2) a granodiorite clast and (3) matrix sandstone of the WC Member, and (4) felsic tuff breccia of unknown affiliation that was sampled from the distribution area of the Tedoru Group in previous geologic maps, about 100 m to the north from the base of the Motodo Formation.

RESULTS (1) **Andesitic tuff breccia:** Analytical data of 14 zircon grains showed 2 clusters on concordia plots. We consider that the concordia age of the younger cluster (consisting of 3 zircon ages), 253.0 +/- 3.6 Ma (2 SD) is the age of deposition. (2) **Granodiorite clast of the WC Member:** The weighted mean of the ²⁰⁶Pb/²³⁸U age of 14 zircons was 252.8 +/- 3.1 Ma, which, we consider, is the age of formation of the granodiorite. (3) **Matrix sandstone of the WC Member:** Age data from 77 zircons all clustered between 300 Ma and 250 Ma, with the concordia age of the youngest zircon of 248.7 +/- 8.8 Ma. (4) **Felsic tuff breccia:** The weighted mean of the ²⁰⁶Pb/²³⁸U age of 12 zircons was 254.2 +/- 2.5 Ma, which, we consider, is the age of deposition.

DISCUSSION The andesitic tuff breccia of the NTB Member (253.0 +/- 3.6 Ma), granodiorite clast of the WC Member (252.8 +/- 3.1 Ma) and felsic tuff breccia (254.2 +/- 2.5 Ma) are all products of Late Permian (Changhsingian) igneous activity. The youngest zircon age of the sandstone of the WC Member (248.7 +/- 8.9 Ma) suggests that the sandstone was deposited in Early Triassic (Olenekian) or later. Considering the conformable relationship of the three members of the Motodo Formation, these age data strongly suggest that the age of deposition of the formation was Late Permian (Changhsingian)-Early Triassic (Olenekian). Although there still remains a possibility that there is a large age difference between the NTB Member and the other 2 members from the CHIME ages of Ono et al. (2003), it is unlikely that a 200-Ma granodiorite body was distributed in the hinterland, because no zircons younger than 248.7 +/- 8.9 Ma were detected in this study. A similar unimodal age distribution with the detrital zircons of the Wasadani sandstone is also detected from the sandstone of the Lower-Middle Triassic Inai Group in the South Kitakami Belt, NE Japan. The Inai Group includes red beds (Horikawa and Yoshida, 2006), a common feature with the Motodo Formation. The Inai Group and the Motodo Formation may have coevally deposited in a similar climatic environment.

Keywords: red bed, zircon U-Pb age, Kanmon Group, Nakajima Tuff Breccia Member, Wasadani Conglomerate Member, Inai Group