Development of a Permian-Jurassic active continental margin in East Asia, based on detrital zircon U-Pb ages and sandstone provenance of the Hida Gaien belt, central Japan

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The geologic evolution of a Permian-Jurassic active continental margin in East Asia is directly related to the origin and development of Paleozoic rocks of Japan, such as the Hida Gaien, South Kitakami, and Kurosegawa belts. Early Paleozoic corals of the Kurosegawa belt are similar to those of South China (Kido and Sugiyama, 2011), implying possibility that the rocks in this belt were formed in the continental margin of the South China block (e.g., Ehiro, 2001; Isozaki et al., 2011). Whereas, the occurrence of the fusulinoidean genus *Monodiexodina* (Ueno, 2006) indicates that the Middle Permian strata of the Hida Gaien and South Kitakami belts were deposited in the mid-latitude of the northern hemisphere, probably close to the North China block. To solve this complicated issue for the paleogeographic relationship between proto-Japan and East Asian continental blocks, we are now conducting detrital zircon U-Pb dating and sandstone provenance analyses in the Hida Gaien belt to understand the development of a Permian-Jurassic magmatic arc (s) and related basins along an active continental margin.

The lithostratigraphy of the Lower Permian to Lower Jurassic strata was studied in the Hongo and Moribu areas of the Hida Gaien belt, located in the northern part of Takayama City, Gifu Prefecture. The lithology of the Lower Permian and Upper Triassic strata is characterized by tuffaceous sandstone and mudstone. The sandstones of Middle Permian formations contain fragments of mafic to intermediate volcanic rocks. The upper Middle Permian to Lower Triassic strata are turbidite and mudstone of deep-water facies. The Lower Jurassic strata (Suzuki and Kurihara, 2017) are characterized by alternating sandstone and mudstone. The age distribution of 619 detrital zircon grains from these strata shows the following three peaks: (1) 263 Ma (Middle Permian: lower part of the Moribu Formation), (2) 248 Ma (Early Triassic: upper part of the Moribu Formation), and (3) 190 Ma (Early Jurassic). The sandstones also contain Middle Ordovician to Middle Carboniferous grains (465-320 Ma), along with a small amount of Precambrian (1850-1600 Ma) and Late Triassic grains (225 Ma). The sandstone compositions of 13 samples obtained from the Lower Jurassic strata have the average of 32 % quartz, 28 % feldspar, and 40 % rock fragments. Most samples plotted on the field of "evolved and matured magmatic arc provenance" in the discrimination diagram by Kumon et al. (1992).

According to Yoshida and Tazawa (2000) and Yoshida and Machiyama (2004), the sandstones of Middle Permian strata in the Hida Gaien and South Kitakami belts show the characteristics of the transitional provenance from undissected arc to basement uplift by Dickinson et al. (1983). Together with our data for Lower Jurassic sandstones mentioned above, the magmatic arc had gradually matured during Middle Permian to Early Jurassic with the cycle of the active phase of volcanism and denudation. The significant contribution in the sedimentary supply from the magmatic arc to the Permian-Jurassic strata implies that the sedimentary basin of proto-Japan was arc-related basins, such as a fore-arc basin or a back-arc basin, along the active continental margin of East Asian continental blocks. However, a small amount of Precambrian grains indicates that there were factors (e.g., back-arc opening) preventing the supply of old

grains from continental blocks.

キーワード：飛騨外縁帯、砕屑性ジルコン、ウラン一鉛年代、砂岩後背地、火成弧、堆積盆地
Keywords: Hida Gaien belt, detrital zircon, U-Pb age, sandstone provenance, magmatic arc, basin