The origin of the Hida belt: Lu–Hf and U–Pb systematics of the zircon

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Introduction

The Hida belt is in the northern part of central Japan and consists of Permo-Triassic low *P*/*T* metamorphic rocks and Permo-Jurassic plutonic rocks. Many previous studies have revealed the magmatic ages of the plutonic rocks and the metamorphic ages and facies of the metamorphic rocks (e.g. Takahashi et al., 2018; Horie et al., 2010, 2018). However, the origin of the Hida belt is not yet clear and still being discussed. The plutonic rocks of the Hida belt comprise the Hida Older Granites (256–229 Ma: Takahashi et al., 2018) and the Hida Younger Granites (197–191 Ma: Takahashi et al., 2018). In East Asia, granites of the above two age-ranges commonly occur only in the southern part of the Korean Peninsula (North China Craton) and in Northeast China (Central Asian Orogenic Belt: CAOB). The plutonic rocks of the two areas with the same U–Pb age can be distinguished with the Lu–Hf systematics in zircon, as will be mentioned later. In this study, we present U–Pb zircon dates and Lu–Hf isotopic compositions of the Hida plutonic rocks and discuss the origin of the Hida belt.

Method

We collected two granite samples along the Kubusu and Onagatani rivers in Toyama City, central Japan. The U–Pb zircon dates and Lu–Hf isotopic compositions were measured with a Neptune-*Plus* multiple-collector inductively coupled plasma mass spectrometer (MC-ICPMS; Thermo Fisher Scientific, US) combined with an Analyte G2 ArF excimer laser system (Photon-Machines, Canada) at the Japan Atomic Energy Agency.

Results

U–Pb zircon dating: The dates yield Permo-Triassic (290–230 Ma) and Jurassic (200–175 Ma) clusters.
Hf zircon isotopic compositions: The ε Hf(t) values of the Jurassic zircons vary widely from −1.9 to 3.0. In contrast, the Permo-Triassic zircons have significantly high, positive ε Hf(t) (7.3–10.5). The model age of the former zircons is 1330–1020 Ma, whereas that of the latter is 780–600 Ma.

Discussion

The U–Pb zircon dates of the granite along the Kubusu and Onagatani rivers is 200–175 Ma (this study), which is equivalent to that of the Hida Younger Granites (Takahashi et al., 2018). Yamada et al. (2019) also reported the U–Pb zircon ages of 190–180 Ma from the Hida Granite in Toyama and Ishikawa prefectures.
The attached figure shows the relationship between the U–Pb age and ε Hf (t) of zircons. The data from the Hida belt do not fall into the range of the North China Craton (area surrounded by red dashed line in the attached figure: Yang et al., 2006) but fall into the range of the CAOB (area surrounded by blue dashed line in the attached figure: Yang et al., 2006). Moreover, the Hf model ages (1330–1020 Ma: this study) from the Hida plutonic rocks are younger than that from the Jurassic (187–172 Ma: Jo et al., 2018) plutonic rocks of the Gyeonggi and Ogcheon belt in Korea (2400–1630 Ma: Jo et al., 2018), but are similar to that from the Triassic-Jurassic (245–189 Ma: Yang et al., 2017) plutonic rocks of the CAOB including the Khanka Block (1541–466 Ma: Yang et al., 2017). These results support that the Hida belt originated from the CAOB. On the other hand, the presence of pre-Paleoproterozoic zircons from the Hida

plutonic-rock bodies could be the evidence for their North China origin (Horie et al., 2010, 2018). It is necessary to measure the Hf isotopic composition of zircons to examine the origin of the Hida belt. As described above, the measurement of the Lu–Hf isotopic compositions, in addition to the U–Pb dates of zircons, will give much more information for the origin and provenance analysis of the clastic rocks.

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