

Zircon U-Pb dating of igneous-rock clasts from the Monobegawa and Nankai groups in Shikoku, SW Japan

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INTRODUCTION

The Lower Cretaceous strata of the Chichibu Composite Belt in Shikoku, SW Japan, are divided, from bivalve fauna and lithofacies, into the Monobegawa and Nankai groups (MG and NG; Tashiro, 1985). Tashiro (1985) also suggested that the Nankai fauna indicates lower latitude than the Monobegawa fauna. Matsukawa and Eto (1987), on the other hand, suggested that the two groups were deposited in a same basin, where the Boreal-Tethyan mixed ammonite fauna inhabited. Matsukawa and Eto (1987) further discussed that some clasts in the Hauterivian Shobu Formation (Fm) of the NG were supplied from the pre-Cretaceous rocks of the Kurosegawa Tectonic Belt (KTB) on the south of the basin. To solve the confusion, we measured the zircon U-Pb age of igneous-rock clasts from the Hibihara Fm (1 clast) and Yunoki Fm (1; MG) in central Shikoku, and the Hoji Fm (1; MG) and the Shobu Fm (2; NG) in eastern Shikoku.

METHODS

We separated zircons from igneous-rock clasts and measured the U-Pb isotopic ratios of each grain on the LA-ICP-MS equipped in the Graduate School of Environmental Studies of Nagoya University. Data with the $(^{206}\text{Pb}/^{238}\text{U} \text{ age}) / (^{207}\text{Pb}/^{235}\text{U} \text{ age})$ between 0.9 and 1.1 were used for discussion.

RESULTS

Granite clast from the Albian Hibihara Fm : We obtained 14 concordant measurements ranging in age between 133 and 120 Ma and calculated the $^{206}\text{Pb}/^{238}\text{U}$ weighted mean age of 126.4 +/- 2.5 Ma.

Granite porphyry clast from the Aptian Yunoki Fm : We obtained 12 concordant measurements with the age clusters at 129-122 Ma (N=6), 137-135 Ma (N=2), 181-174 Ma (N=2), 269 Ma (N=1), and 2,334 Ma (N=1) and calculated the $^{206}\text{Pb}/^{238}\text{U}$ weighted mean age of 125.4 +/- 2.6 Ma from the youngest 6 grains.

Granite porphyry clast from the Aptian Hoji Fm : We obtained 13 concordant measurements ranging in age between 143 and 118 Ma and calculated the $^{206}\text{Pb}/^{238}\text{U}$ weighted mean age of 130.0 +/- 4.4 Ma.

Granite clast from the Hauterivian Shobu Fm : We obtained 34 concordant measurements with the age clusters at 173 Ma (N=1), 186-184 Ma (N=2), 218-193 Ma (N=27), and 232-224 Ma (N=4) and calculated the $^{206}\text{Pb}/^{238}\text{U}$ weighted mean age of 203.9 +/- 2.5 Ma from the 27 grains forming the largest age cluster.

Granite porphyry clast from the Shobu Fm : We obtained 11 concordant measurements scattering in age at 204-203 Ma (N=2), 241-228 Ma (N=3), 263 Ma (N=1), 287 Ma (N=1), 1,910-1,879 Ma (N=2), 2,090 Ma (N=1), and 2,263 Ma (N=1) and calculated the concordant age of 203.4 +/- 2.8 Ma from the youngest 2 grains.

DISCUSSION

The igneous-rock clasts from the MG are 130-125 Ma in age. Coeval igneous rocks occur in the Kitakami Belt of NE Japan, around the Bohai Bay, and along the South China coast (e.g., Kiminami and Imaoka, 2013; Li *et al.*, 2014; Tsuchiya *et al.*, 2015). Since the measured clasts are all cobble size, the provenance was probably near the eastern shelf margin of Asia. Moreover the Late Jurassic-Early Jurassic paleophytogeography (Kimura, 1987) indicates that the MG, having the Ryoseki-type flora, must have been deposited along the Zhejiang coast of South China or on the south.

The age of the igneous-rock clasts from the Shobu Fm (NG) is 204 Ma, which does not coincide with the age of the igneous rocks in the KTB (around 400 Ma: Hada *et al.*, 2000; Murata *et al.*, 2006). Further, the sandstone on top of the Shobu conglomerate has many detrital zircons of around 200 Ma, but no 400-Ma and Early Cretaceous zircons. Hence the 200-Ma clasts of the Shobu Fm, differing in age from the igneous rocks of the KTB, must not have been supplied from the south. Hence the Hauterivian of the MG and NG was probably deposited along different parts of the East Asian coast. A possible candidate of the hinterland of the Shobu Fm is Indochina, where Triassic igneous rocks are widely exposed but Early Cretaceous igneous rocks are rare.

Keywords: U-Pb age, LA-ICP-MS, Lower Cretaceous of the Chichibu Composite Belt, Southwest Japan, East Asia, igneous-rock clast