

Zircon U-Pb geochronology of Nagasaki Metamorphic Rocks and related geological units in Kyushu, SE Japan

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Introduction Nagasaki Metamorphic Rocks (NMR) occupy the Nishisonogi (NsP) and Nomo (NmP) peninsulas of Nagasaki Prefecture and the western part of the Amakusa Shimoshima Island (ASI) of Kumamoto Prefecture, SW Japan. Nishimura et al. (2004), Takeda et al. (2002), and other researchers proposed that NMR consist of Late Cretaceous Sambagawa Metamorphic Rocks (SMR), Early Cretaceous Higo Plutonic Rocks, Triassic Suo Metamorphic Rocks, and Late Cambrian Metagabbro Complex. In addition, Late Cretaceous-Paleogene sedimentary rocks cover NMR. In this study we measured the zircon U-Pb ages of NMR and related rocks and to propose a model of tectonic evolution of NMR.

Geologic Setting Geologic setting of each distribution area of NMR is as follows.

The NsP consists of SMR and Late Cretaceous Oseto granite, in apparent ascending order, and the Paleogene cover of the Akasaki, Terashima, Matsushima, and Nishisonogi groups.

The NmP consists of SMR, Higo Plutonic Rocks, Suo Metamorphic Rocks, and Nomo Metagabbro Complex, in apparent ascending order, and the overlying Upper Cretaceous Mitsuzue and Paleogene Koyagi formations and Paleogene Takashima and Iojima groups.

The ASI consists of SMR, Higo Plutonic Rocks, Upper Cretaceous Himenoura Group, and Paleogene sedimentary rocks, in apparent ascending order.

Materials and method The samples we studied were as follows.

ASI: SMR

NmP: Metagabbro Complex from the eastern and western coasts, and a metamorphic-rock cobble from the Lower Eocene Koyagi Formation

The U-Pb age was measured with the LA-ICP-MS equipped in the Graduate School of Environmental Studies, Nagoya University.

Age dating results

SMR from the ASI: The age composition of zircons (%) was as follows: Early Cretaceous (7.1), Jurassic (30.3), Triassic (19.6), Permian (7.1), Paleoproterozoic (33.9), and Archean (1.8). The youngest zircon age (YZ) was 117.4 +/- 3.7 Ma.

Metamorphic-rock cobble: The age composition of zircons was as follows: Late Cretaceous (18.4), Early Cretaceous (47.4), Jurassic (7.9), Triassic (10.5), Permian (5.3), Carboniferous-Cambrian (2.6), and Paleoproterozoic (7.9). The youngest zircon age was 87.4 +/- 2.0 Ma.

Metagabbro Complex: U-Pb data from three spots out of five gave the concordia age of 526 +/- 19 Ma.

Discussion

NsP: SMR with the YZ of 74 Ma (Late Cretaceous) lacked zircons of 130-160 Ma (including the magmatic hiatus in Korea: 110-158 Ma; Sagong et al., 2010), suggesting that the protolith was deposited in the trench near the Korean Peninsula in the Late Cretaceous (Kouchi et al., 2011). The Oligocene Matsushima Group contains pebbles of metamorphic rocks (Nagahama, 1962).

NmP: The metamorphic-rock cobble differed from the SMR of ASI and NsP, because it contained many Late Cretaceous zircons. The cobble bearing bed has paleocurrent indicators showing that the cobble was derived from SMR in the NmP (Nagahama, 1965). The SMR in the NmP were hence exhumed by the Early Eocene.

ASI: SMR in the ASI contained zircons formed during the magmatic hiatus in Korea and may have had different hinterland from the SMR in the NsP. 110-158 Ma igneous rocks widely occur in Zhejiang-Guangdong provinces Southeast China, suggesting that the protolith of the SMR in the ASI was deposited in the trench off Southeast China in the Early Cretaceous (around 117 Ma). In the ASI, the Late Cretaceous Himenoura Group contains pebbles of metamorphic rocks (Yamaguchi et al., 2008).

Tectonic evolution of the SMR in NMR: The protolith of the SMR in NMR was deposited after 121 Ma in different parts of the trench along the eastern margin of Asia, metamorphosed, and was successively exhumed in latest Cretaceous-Oligocene times in the ASI ->NmP ->NsP.

Metagabbro Complex: The complex (ca. 500 Ma) in the eastern part of the NmP occurs along the axis of a small syncline, suggesting that the complex as a whole occupies the uppermost part of NMR as a low-angle sheet-like body.

Keywords: U-Pb age, zircon, LA-ICPMS, Nagasaki metamorphic rocks, Sanbagawa metamorphic rocks