Press Releases

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JAMSTEC
National Institute of Advanced Industrial Science and Technology

Nishinoshima eruptions show the formation of continents

Overview

A group of scientists led by Dr. Yoshihiko Tamura has presented that andesitic magmas are directly produced through partial melting of the underlying mantle beneath Nishinoshima after analyzing surface and submarine lava samples collected there. This study project was carried out in collaboration with National Institute of Advanced Industrial Science and Technology and University of Canterbury in New Zealand.

Andesitic magma is unique as it is only found on our planet Earth in the solar system. As the primary raw material of continental crust, andesite has been deeply involved in the development of the earth's surface and its lithospheric plates. The research group has proposed the hypothesis that eruption of andesitic magma in Nishinoshima is likely to be recreating the first appearance of the continents, which they call "advent of continents" (as reported on September 27, 2016). While previous studies had already indicated that unique boninite-like andesitic magmas were generated directly from the mantle, this study has presented in the first time that normal andesitic magmas extruded from the submarine volcanoes currently being active like Nishinoshima have been directly produced from the underlying mantle, when the curst is thin.

The scientists will continue to work on whether their hypothesis is supported also by other submarine volcanoes in oceanic arcs, which erupted on similar thin crust.

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Title: Nishinoshima volcano in the Ogasawara Arc: New continent from the ocean?
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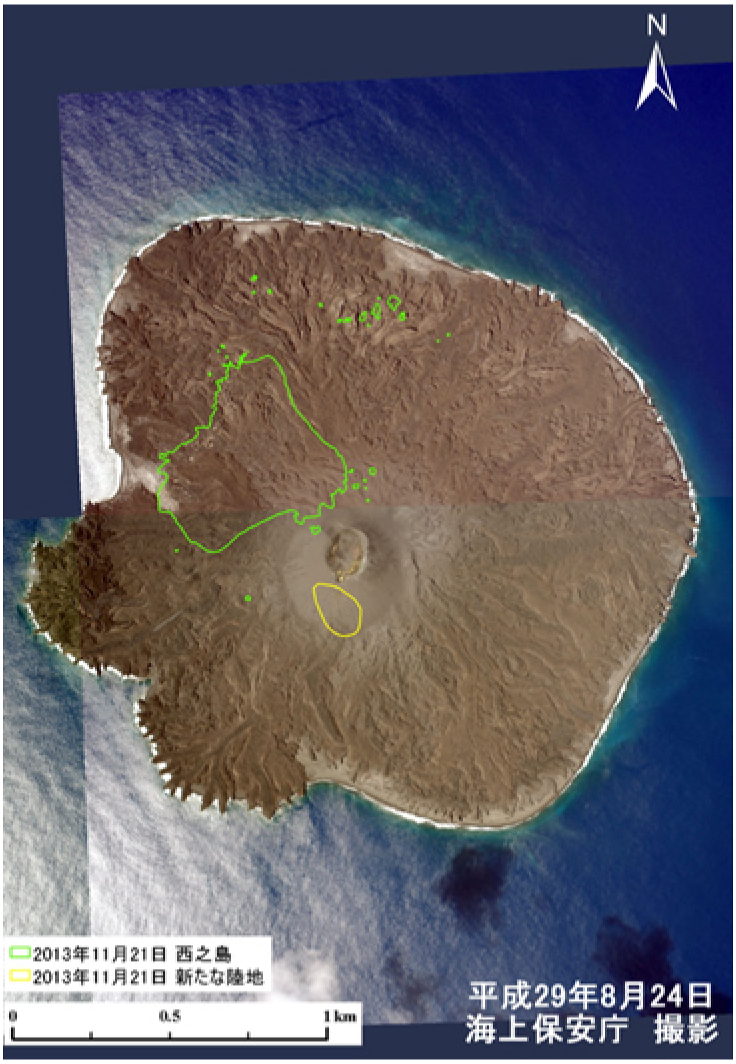

Fig. 1. Nishinoshima is 2,160 m wide (east to west) and 1,920 m long (north to south), and it has an area of 2.96 km^2 (Japan Coast Guard, August 24, 2017). The size is 62 times larger than that of the Tokyo Dome. ©Japan Coast Guard

Fig.2. Eruption in July 2017.
The photo taken from the deep-sea research support vessel *Yokosuka*. ©JAMSTEC

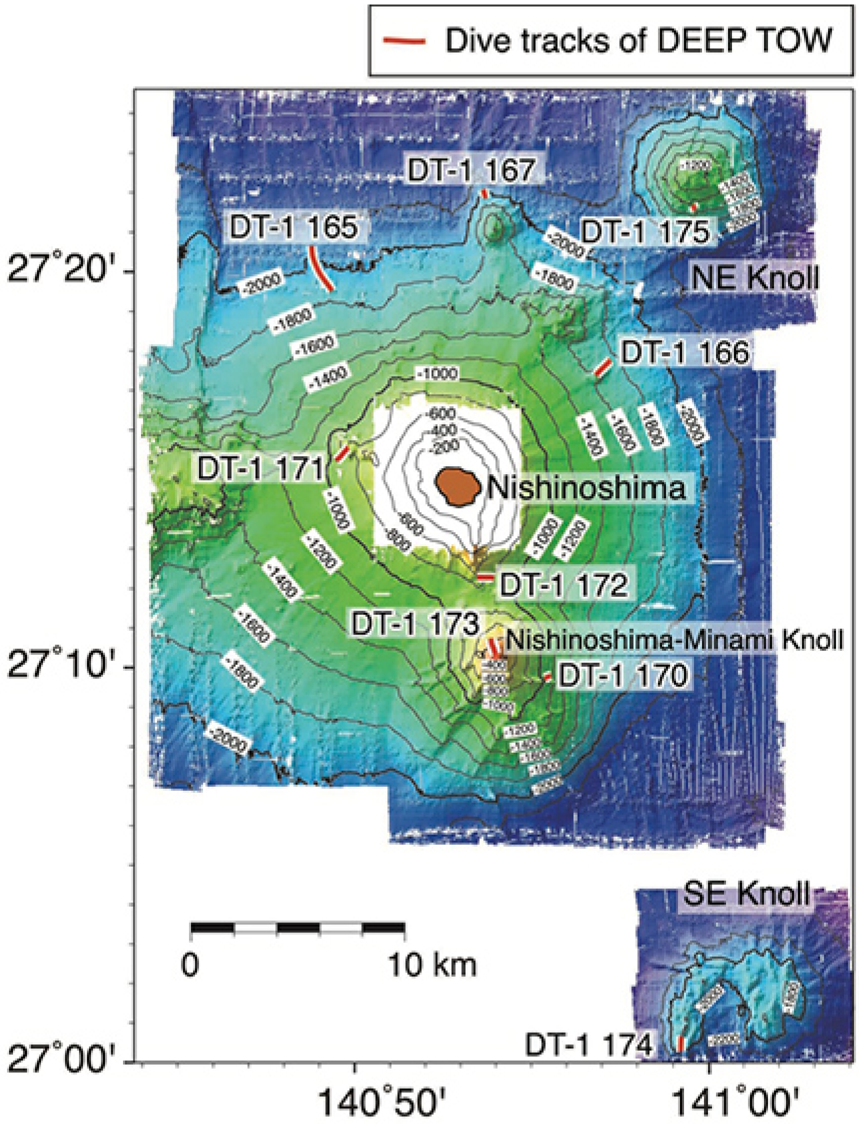

Fig.3 Survey areas in Nishinoshima by the deep ocean floor survey system, DEEP TOW. Surface lavas were collected by NHK using an unmanned helicopter and submarine lavas by JAMSTEC using DEEP TOW. JAMSTEC carried out the rock analysis.

(DEEP TOW: http://www.jamstec.go.jp/j/about/equipment/ships/deeptow.html)

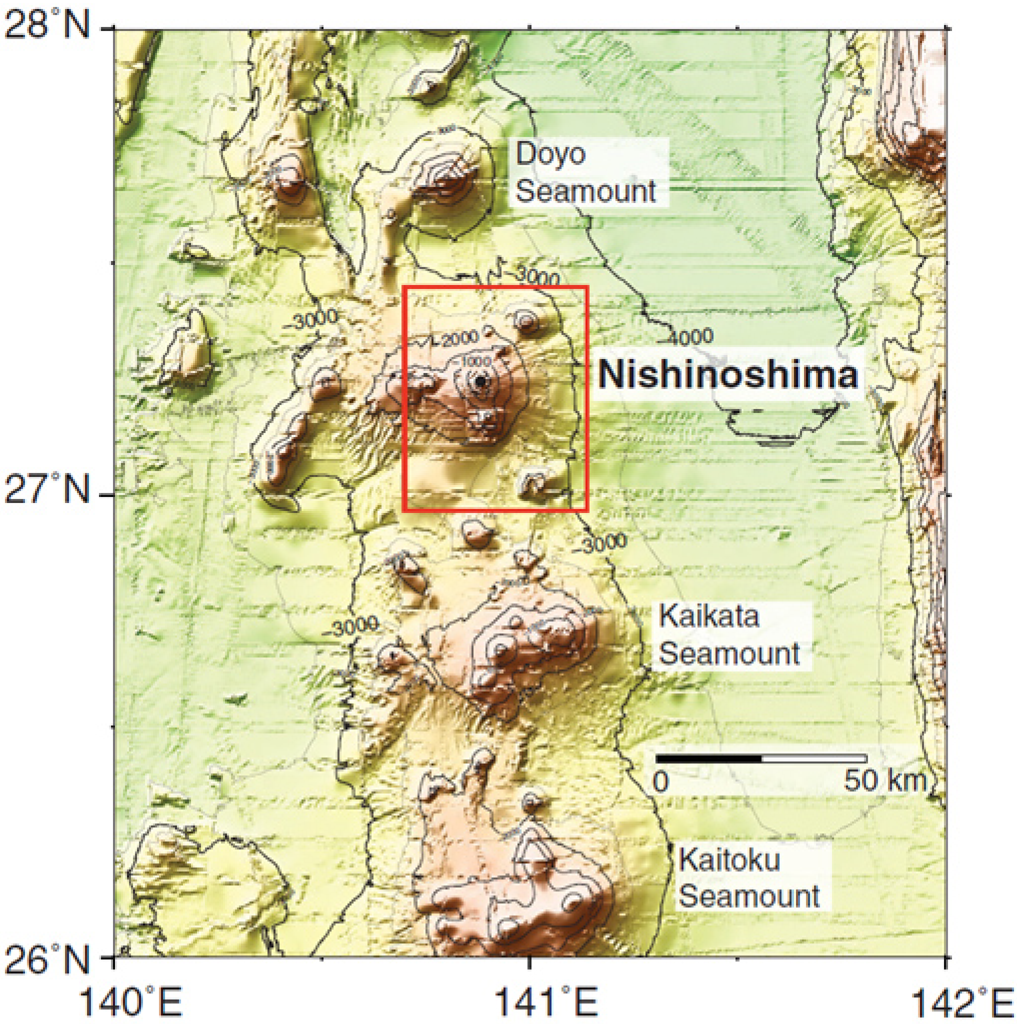

Fig.4 Nishinoshima is 1,000km south of Tokyo, and lies mostly below sea level. Growing from a depth of 3,000m, the Nishinoshima volcano is a massive undersea volcano with a basal diameter of 50 km, and the 2 km diameter summit that has appeared above the surface is referred to as "Nishinoshima." Doyo Seamount, Kinyo Seamount, and other Shichiyo Seamounts continue to the north of Nishinoshima, while submarine volcanoes such as Kaikata Seamount and Kaitoku Seamount tower to the south.

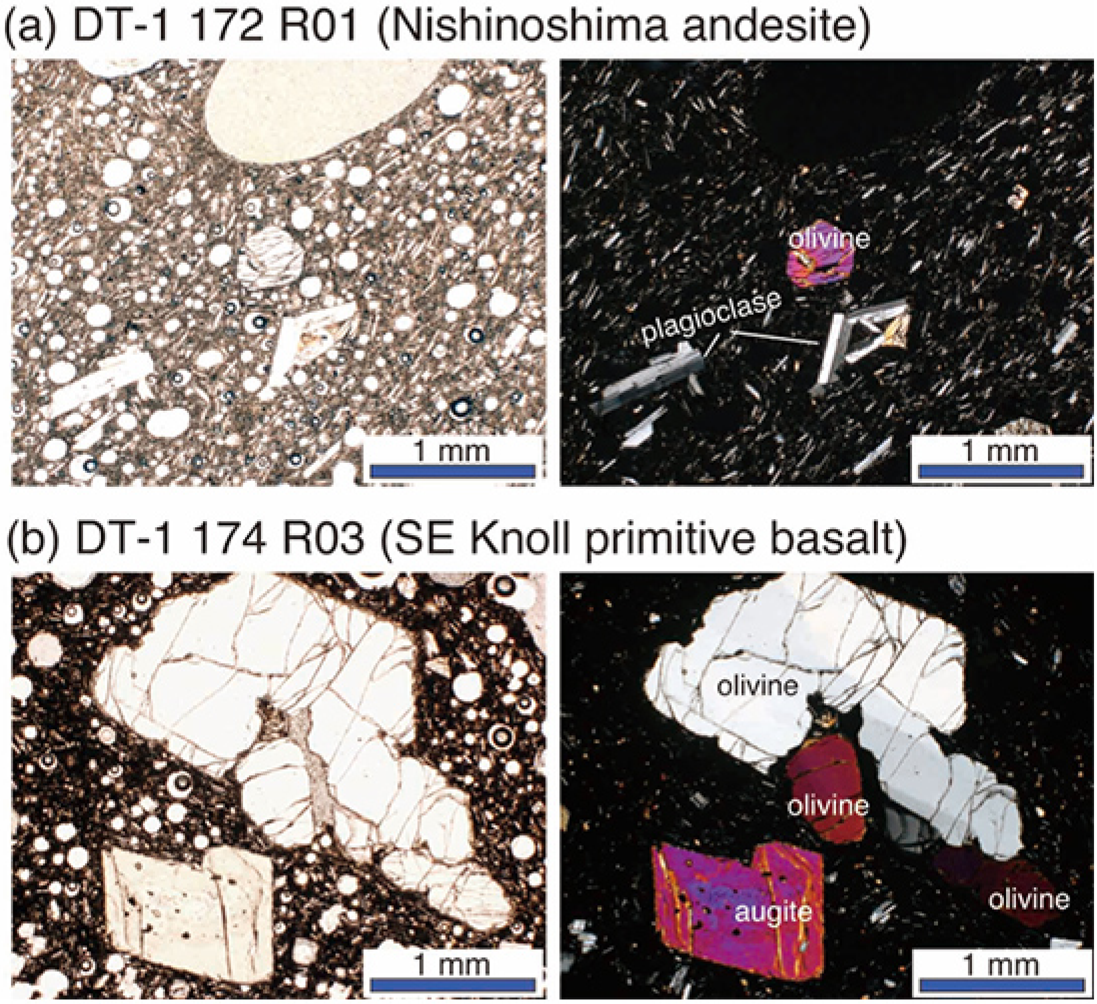

Fig.5 Photomicrographs of Nishinoshima andesite and SE (southeast) Knoll basalt, under plane- and cross-polarized light.

(a) Phenocryst-poor Nishinoshima andesites contain olivine phenocrysts, in addition to plagioclase and augite.

(b) Basalt from the SE Knoll. SE Knoll primitive basalts are generally rich in phenocrysts and contain olivine, augite, and plagioclase as phenocryst phases.

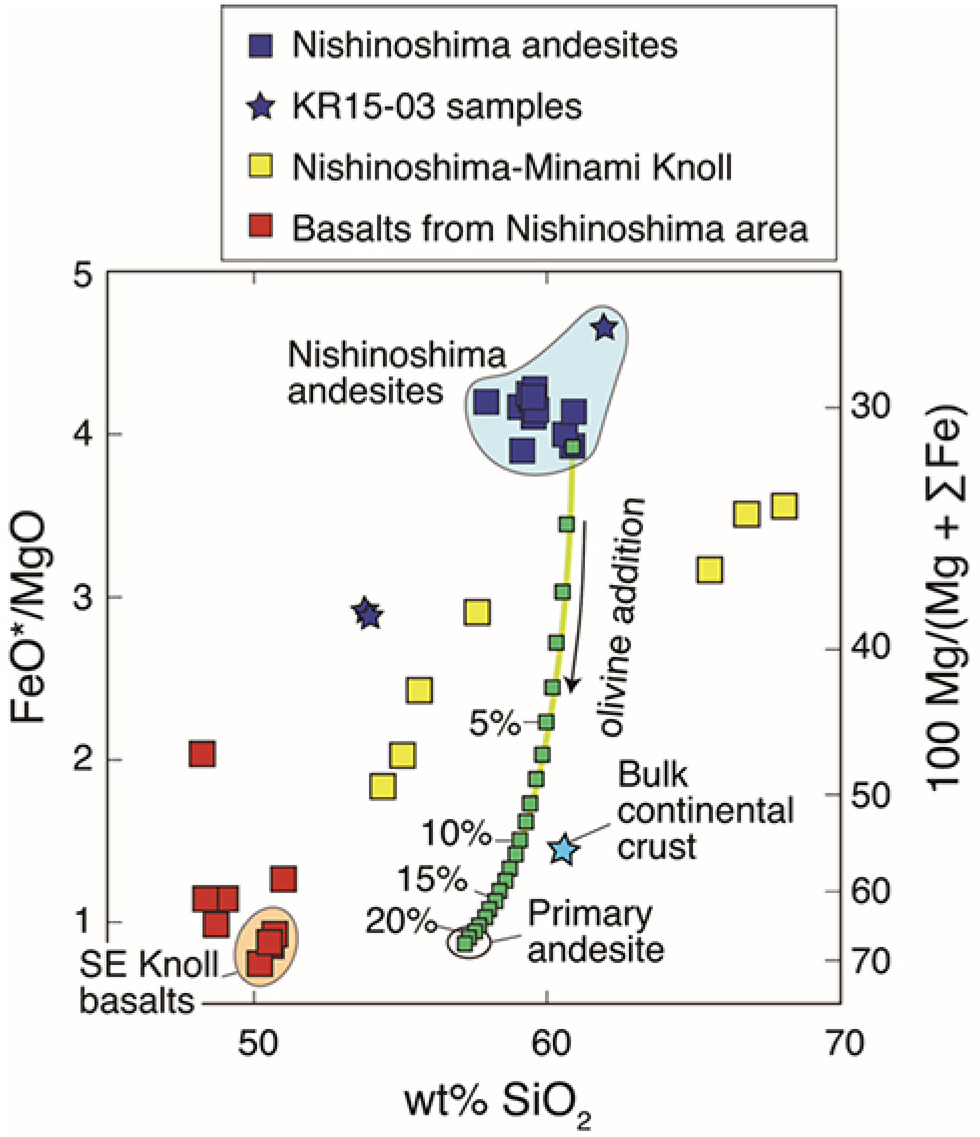

Fig.6. Variation diagram of wt% SiO_2 vs. FeO*/MgO and Mg-number [100 Mg/(Mg + ∑Fe)]. The numbers on the line indicate the percentages of added equilibrium olivine. Interestingly, 10 % addition of equilibrium olivine to Nishinoshima andesite produce andesite, which is akin to bulk continental crust (Rudnick & Gao, 2003). Twenty one percent addition of olivines results in primary andesite, which is in equilibrium with mantle olivines. ©2018 Yoshihiko Tamura

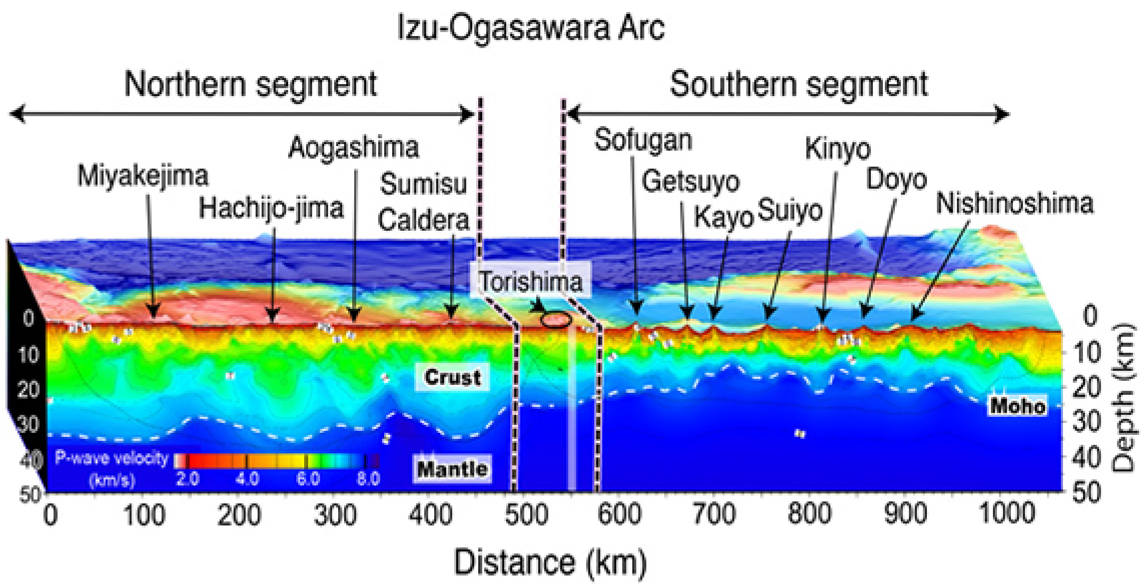

Fig.7 At a crust thickness of 21 km, Nishinoshima is one of the closest islands to the mantle. Below this thin crust lies a mantle composed of plagioclase peridotites, which melt and produce Nishinoshima andesite. ©JAMSTEC

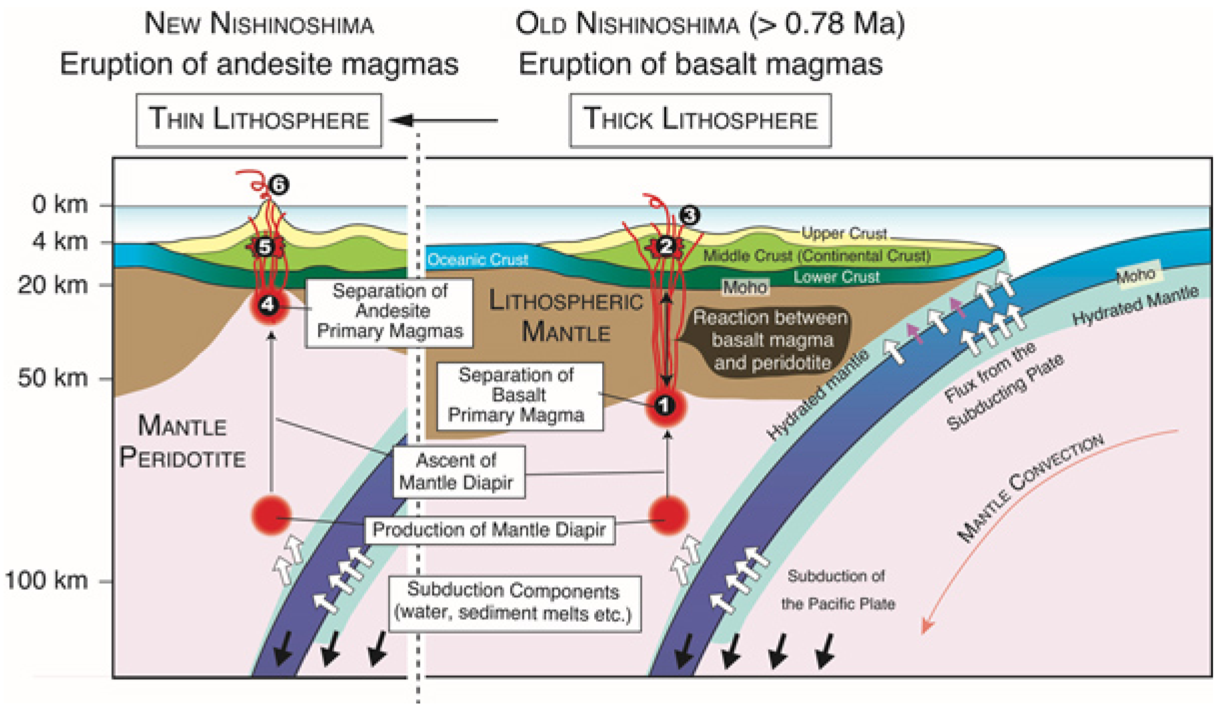

Fig.8. The change of magma formation in Nishinoshima. In the ancient past (more than 780,000 years ago), the deepest parts of the mantle melted, producing basaltic magma (1) which erupted via the magma reservoir (2). This magma created small seamounts (3) in the surrounding ocean. As time passed, magmatic activity caused the temperature of the mantle to rise, and the shallowest parts of the mantle (plagioclase-peridotite) began to melt (4). This resulted in the present-day Nishinoshima magma reservoir (5), which extrudes andesitic magma (6). ©2018 Yoshihiko Tamura

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