Geologic history of Nishinoshima volcano: from the past to future?

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The Izu-Bonin-Mariana (IBM) arc, extending southward from Tokyo, is a volcanic front formed by the subduction of the Pacific Plate and is characterized by numerous volcanic islands and submarine volcanoes. Nishinoshima, a volcanic island located approximately 900 km south of Tokyo, is isolated even from its nearest neighbors, situated about 130 km from the Chichijima Islands.
The first recorded volcanic activity of Nishinoshima occurred in 1973. This episode began with a submarine eruption approximately 600 m offshore, where lava effusion formed a new island that eventually merged with the original landmass. This activity ceased after about one year. In 2013, after a 40-year dormancy, Nishinoshima resumed its activity with another offshore submarine eruption. Similar to the previous event, lava flows created a new island that merged with the existing one, leading to significant landmass expansion. The eruptive activity since 2013 has been characterized by alternating active and quiescent phases, with four major stages identified: Episode 1 (2013–2015), Episode 2 (2017), Episode 3 (2018), and Episode 4 (2019–2020). While the activity was characterized by relatively effusive lava flows until the middle of Episode 4, an explosive transition occurred in June 2020. This shift marked the onset of violent Strombolian eruptions, characterized by massive ash plumes and dark tephra (Yanagisawa et al., 2020).
The pre-1973 island, the 1973–74 products, and the eruptive materials from Episodes 1 to mid-4 are primarily composed of andesite with an SiO_2 content of approximately 58–60% (Ossaka, 1991; Maeno et al., 2021). Since andesite is a primary constituent of the continental crust and the oceanic crust beneath Nishinoshima is thin, it is hypothesized that magmas formed at shallow depths evolve into andesitic compositions. Consequently, oceanic volcanoes situated on thin crust, such as Nishinoshima, are regarded as contemporary sites of continental crust formation (Tamura et al., 2016; 2019). Conversely, the explosive eruptions of June 2020 exhibited markedly different chemical signatures. The primary eruptive products were basaltic andesites with approximately 55% SiO_2. Furthermore, a submarine survey conducted by JAMSTEC in December 2020 revealed the presence of dacite with approximately 64% SiO_2 (Tamura et al., 2023). This simultaneous discharge of low-silica and high-silica magmas, known as bimodal volcanism, is a characteristic feature of large-scale caldera-forming eruptions observed along the Izu-Bonin arc. Whether Nishinoshima will revert to effusive andesitic activity or transition toward a catastrophic caldera-forming eruption remains a first-order geological question.
Basaltic activity at Nishinoshima is not exclusive to the 2020 event; regional seafloor surveys have identified ancient basaltic deposits in the surrounding areas (Tamura et al., 2019). During the KM25-09 research cruise using the Research Vessel *Kaimei*, a rock type known as ankaramite, rich in olivine and clinopyroxene crystals, was discovered from a flank volcano on the northern slope of Nishinoshima. Reports of ankaramite are rare, limited to specific locations such as the Doyo Seamount (50 km north of Nishinoshima) and the Kibblewhite submarine volcano northeast of New Zealand. The ankaramite sampled at Nishinoshima contains primitive clinopyroxene with Mg# = (Mg/[Mg + Fe^{2+}] ×100) of ˜95 and Cr = (Cr/[Cr + Al] ×100) of ˜28, suggesting it highly likely retains the primary signatures of mantle-derived magma. In this presentation, I will discuss the geological significance of Nishinoshima, integrating its past activities revealed by recent submarine surveys.

Keywords: How Nishinoshima island grew?, Geologic significance Ogasawara (Bonin) Islands , Research cruise targeting submarine volcano, Continental crust is generated here!

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