Petrogenesis of Oligocene to Miocene volcanic rocks in the Tonami area, central Japan: temporal evolution of continental- to island-arc volcanism during the Japan Sea opening

*Raiki Yamada[1], Toshiro Takahashi[2], Hayato Ueda[2]

1. Graduate school of science and technology, Niigata University, 2. Faculty of Science, Niigata University

The Japan islands was torn from the continent to form island-arc by spreading of the Japan Sea in Late Oligocene to Early Miocene. Basaltic to rhyolitic active volcanism occurred in the Japan arc during the Japan Sea opening. Since many researchers have targeted mainly mafic volcanic rocks for petrological study, petrological and geochemical studies on Oligocene to Miocene rhyolites are not still enough. Therefore, we examined Oligocene to Miocene volcanic rocks, including Chattian to Aquitanian and Burdigalian to Langhian rhyolites, on the basis of petrology and geochemistry.

Oligocene to Miocene strata consist of the Tori Conglomerate, Usunaka Moonstone Rhyolite, and the Iwaine and Iozen formations, in stratigraphically ascending order (Sudo, 1979; Ganzawa, 1983), the study area, Nanto City, Toyama Prefecture. The Tori Conglomerate is composed of conglomerate and sandstone, whereas the others are composed of volcanic and pyroclastic rocks; the Usunaka Moonstone Rhyolite, and the Iwaine and Iozen formations consist of rhyolitic welded tuff, andesites (lava and pyroclastic rocks), and rhyolites (lava and pyroclastic rocks), respectively. In this study, weighted averages of ^{238}U–^{206}Pb ages of 22.4 ±0.7 and 16.3 ±0.6 Ma are obtained from zircons in the Usunaka Moonstone Rhyolite (welded tuff) and the Iozen Formation (aphyric lava; the same outcrop as FU06 of Ganzawa (1983)). These ages indicate formation ages of the rhyolites, because they are consistent with K–Ar (Yamasaki and Miyajima, 1970; Ueda and Aoki, 1970) or fission track ages (Ganzawa, 1983), whose blocking temperatures are much lower than zircon U–Pb age.

Following petrogenesis of Oligocene to Miocene volcanic rocks is considered by whole-rock chemical compositions (major and trace elements, and Sr–Nd isotopes) and comparison with other studies. The Usunaka Moonstone Rhyolite (25–22 Ma) is alkalic rhyolite showing intermediate compositions between continental rifts and continental-arcs, and its magma was S-type and relatively dry. Therefore, it is continental-arc rift-type rhyolite, and mafic magma in subduction zone would have melted crustal materials derived from sedimentary rocks. Andesitic volcanism of the Iwaine Formation can be divided into two stages (e.g., Yamada and Yamada, 2018); amphibole-bearing andesite (high Sr andesite; 19–18 Ma?) and two pyroxene andesites (18–16.5 Ma?). Amphibole-bearing andesite is low-SiO_2 adakite (Martin et al., 2005) generated by partial melting of mantle wedge matasomatised by adakitic melt formed by slab melting. Two pyroxene andesites, who and equivalent beds have the large distribution in the Hokuriku region, are continental-arc type tholeiites, and their compositions suggest AFC (assimilation and fractional crystallization). The Iozen Formation (16.5–15.0 Ma) has intermediate chemical compositions between continental- and island-arcs, and its magma was I-type and had high water content. The Iozen Formation got primitively dacitic to rhyolitic composition, and almost only fractional crystallization occurred in magma chamber. High-temperature state, which had continued since the Iwaine Formation, in mantle wedge would had caused crustal melting.

Above genesis of Oligocene to Miocene volcanic rock in the study suggests that high temperature was kept in mantle wedge and continental crust during the back-arc spreading and that tectonic settings changed as time went on; continental-arc rift, continental-arc, and continental- to island-arc. This reflect that the Japan arc developed from continental- to island-arc through the Japan Sea opening, a back-arc formation.

Ganzawa, Y. (1983) *Jour. Geol. Soc. Japan*, **89**, 271–286.
Sudo, S. (1979) *Mem. Geol. Soc. Japan*, no. 17, 187–194.
Ueda, Y. and Aoki, K. (1970) *Jour. Japan Assoc. Mineral. Petrol. Econ. Geol.*, **63**, 28–29.
Yamada and Yamada (2018) *Sci. Rep. Niigata Univ., Geol.*, **33**, 25–40.
Yamasaki, M. and Miyajima, Y. (1970) *Jour. Japan Assoc. Mineral. Petrol. Econ. Geol.*, **63**, 22–27

Keywords: Japan Sea opening, volcanic rocks, rhyolite, petrology, zircon U-Pb age

