The drilling investigation at Satsuma-Iwojima, southern Kyushu, Japan: To understand the preparation processes of the 7.3 ka Kikai-Akahoya (K-Ah) eruption

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Although a caldera-forming eruption rarely occurs, the eruption obviously cause a catastrophic hazard. In order to prepare the eruption, it should be essential to understand a precursor phenomenon and/or preceding eruptions. However, we volcanologists have not experienced such large eruptions. Thus, geological investigations of eruptive deposits of a caldera-forming eruption must be only way to understand the eruption sequence. In addition, petrological analysis of the eruptive deposits could give us useful information for understanding of preparatory magma processes of a caldera-forming eruption. 7.3 ka Kikai-Akahoya eruption at Kikai volcano is the youngest, largest caldera-forming eruption during Holocene in Japan and has been investigated in detail (Maeno and Taniguchi, 2007). In addition, it has been already known that possible preceding effusion of rhyolitic lava flow, Nagahama lava, occurred just before the K-Ah eruption. However, the sequence of the effusion of the lava has not been revealed, because the bottom of the lava flow is not exposed. Thus, the preceding eruptive activity has not been fully understood.

In order to reveal precursor phenomenon and/or preceding eruptions of the K-Ah eruption, we carried out the drilling investigation at Satuma-Iwojima island to recover the core not only of the Nagahama lava flow but also deposits below the lava. Considering the expected thickness of the lava flow, the deep drilling with more than 200 m in depth is needed. However, it was impossible to do this due to our limited budget. Then, we carried out the drilling within the caldera, near the caldera wall formed by the Nagahama lava. In general, caldera wall is usually widened due to the collapse of a steep caldera wall. Thus, we expected that the drilling near the caldera wall could reach the bottom of the remnant of the lava beneath the terrace deposits. The drilling was completed 140 m in depth, recovering the core. The terrace deposits composed of breccia of the caldera wall (Nagahama lava) and post-caldera volcanoes are found until 39 m in depth, whereas massive lava flow units are recognized from 39 to 140 m in depth. It can be considered that these lavas are products of the post-caldera activity, in which three post-caldera volcanoes, such as old-Iwaodake, Inamuradake, and young-Iwodake ones in ascending order, have been recognized in the Satsuma-Iwojima island. The rocks of these volcanoes are dacite from Iwodake, and basalt and basaltic andesite from Inamuradake. Newly recovered rocks can be chemically divided into three types, basalt, low-Mg andesite and high-Mg andesite ones. Whole-rock chemistry of these rocks, including Sr-Nd isotope ratios, are obviously different from those of already known post-caldera lavas from Inamuradake and Iwodake volcanoes. The high-Mg andesite type is characterized by high Mg, Cr and Ni, and low TiO_2 content at SiO_2=ca. 60 %, resemble to the bonnite. In addition, quite distinctive Sr-Nd isotope ratios (eg., $^{87}Sr/^{86}Sr$ = 0.7042 –0.7054) of these newly found rocks suggest that source materials of these rocks are completely different from those of Inamuradake and Iwaodake volcanoes.

In summary, the drilling project could not perform our primary objective. However, the project can give us several important results that are useful to understand a caldera volcano. Firstly, the caldera wall has not been largely modified after the K-Ah eruption. Secondly, the caldera floor is deeper than 140 m below sea

level. In final, several unknown post-caldera volcanoes exist beneath Inamuradake and Iwodake volcanoes. The unique rocks of these newly recognized post-caldera volcanoes could completely revise the genesis of the post-caldera magma of Kikai volcano.

References:

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Keywords: Kikai caldera volcano, drilling, post-caldera volcano, high magnesian andesite

