The effect of open water for flow and depositional mechanisms of Koya pyroclastic flow: an examination from the ignimbrites distributed on Tanega-shima

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Koya pyroclastic flow (Ui, 1973) is a large-scale pyroclastic flow occurred at the 7.3 ka (Fukusawa, 1995) Akahoya eruption of Kikai caldera. Akahoya eruption started from large-scale Plinian eruption which formed plinian pumice-fall deposit and intraplinian pyroclastic-flow deposit and terminated with eruption of Koya pyroclastic flow (Machida and Arai, 2003; Maeno and Taniguchi, 2007; Fujihara and Suzuki-Kamata, 2013). The Koya ignimbrite is distributed over the proximal islands (Iwo-jima and Take-shima) and the adjacent islands (Tanega-shima, Yaku-shima and Kuchinoerabu-jima) and the mainland of south Kyusyu (Satsuma and Osumi peninsulas) around Kikai caldera (Ui, 1973; Machida and Arai, 1978; Ono et al., 1982; Maeno and Taniguchi, 2007; Geshi, 2009; Fujihara and Suzuki-Kamata, 2013).
Although it is clear that Koya pyroclastic flow traveled across the sea because of the distribution of the ignimbrite and study of the Holocene relative sea-level change (e.g. Tanigawa et al., 2013), there is no discussion about the effect of open water for Koya pyroclastic flow.
Products of Akahoya eruption contain two types of volcanic glass shards. The one is “high-SiO_2 glass shards” (ca. 75 SiO_2 wt. %), and the other is “low-SiO_2 glass shards” (ca. 65 SiO_2 wt. %). The ratio of both types of glass shards shows vertical variation within the Koya ignimbrite (Fujihara and Suzuki-Kamata, 2013). Based on the ratio of both types of glass shards, Fijihara and Suziki-Kamata (2013) concluded that the early phase products of Koya pyroclastic-flow eruption contain only high-SiO_2 glass shards and low-SiO_2 magma started to erupt at later phase of the pyroclastic flow eruption.
To reveal the effect of open water, we adopted these methods, geological survey, chemical analysis of glass shards and thickness and pumice size measurement.
For chemical analysis of glass shards, matrix samples of the Koya ignimbrite on Tanega-shima in 4 sites were sampled from base to top with regular level interval. 40-100 glass shards were selected at each level and measured the major element composition by EPMA. While high-SiO_2 glass shards can be recognized throughout the ignimbrite, low-SiO_2 ones exist only at the upper level of it. The early phase products of Koya pyroclastic-flow eruption reached to Tanega-shima because this vertical variation is equal to that of the ignimbrites on proximal area, Satsuma peninsula and Osumi peninsula (Fujihara and Suzuki-Kamata, 2013). Lower contents of low-SiO_2 glass shards from upper most level compared with that of Osumi peninsula suggest that the flows which contain abundant in low-SiO_2 glass shards occured at the later phase of the pyroclastic flow eruption cannot reach to Tanega-shima. This is conformable the fact that the ignimbrites on Osumi peninsula are thicker than that of Tanega-shima.
The maximum pumice size (MPS) was measured from the Koya ignimbrites of Satsuma peninsula, Osumi peninsula and Tanega-shima. Proportional connection between MPS and distance over water (see Figure) suggests that Koya pyroclastic flow was experienced the successively selective loss of large pumice during traveling over water. From this proportional connection, the distal limit of Koya pyroclastic flow traveling over water estimated approximately 70 km from source (see Figure). Tanega-shima is located in almost the distal limit.
Based on above discussion, it is easy to estimate that Koya pyroclastic flow lost a great many amount of pyroclasts in the sea during traveling across the sea and the Koya ignimbrite widely lies on the sea floor

around Kikai caldera.

Keywords: Kikai caldera, Koya pyroclastic flow, the effect of open water, volcanic glass shards, Tanega-shima, distal limit of pyroclastic flow