Spatial distribution and sedimentary features of near-source tsunami deposits of volcanic origin

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Spatial distribution and sedimentary features of pumice-dominated and carbonate-dominated tsunami deposits are significantly different from those of heavy mineral-dominated tsunami deposits (Nishimura et al., 2005; Nishimura, 2008; Putra et al., 2013; Paris et al., 2014). The pumice-dominated deposit (pumiceous sand) is a mixture of pumice and beach sand; both are transported and deposited inland by a tsunami. The origin of the pumice in the layer is drift pumice, reworked pumice, and primary pumice fall-out during the tsunami run-up. This unique sediment layer is often observed in near-source tsunami deposits of volcanic origin. Landward thinning and landward fining, those are common for sandy tsunami deposits, are not typical features of these volcanism-induced tsunami deposits.

Volcanism-induced tsunami deposits are informative not only for studies of tsunami-generating process during an eruption but also for investigation of sedimentary features of tsunami deposits in various beach environments. Preservation potential of the deposits are higher than the other usual tsunami deposits because they might be covered immediately by the following ash or pumice fall. However, case studies of tsunami deposits associated with volcanogenic tsunamis are scarce.

The 1994 and 2006 tsunamigenic eruption episodes that occurred at Rabaul, Papua New Guinea, left the pumiceous sand deposits around the source volcanoes. Tavurvur volcano located at the eastern boundary of Rabaul caldera broke into an eruption on October 7th, 2006, and generated a series of local tsunamis. The tsunami inundation area is covered by pumice-rich tsunami deposit. Commonly, the pumice is accumulated in the uppermost part of the layer, and the base of the deposits is sandy. The tsunamis eroded the top of the ash layer deposited before the tsunami occurred. Along the inundation boundary, a distinct belt of accumulated pumice and wood blanches is created. Pumice boulders are also distributed in the inundation area. The origin of these pumice are drift pumice because there are no pumice fall-out layers landward of the tsunami limit. Pumice boulders are not broken, and impact craters are not created around them. Average density of the pumice is about 0.8 g/cm³. Tsunami heights indicated by the deposit distribution are 5-7 m. In Rabaul, similar local tsunami occurred during the 1994 eruption series of Vulcan volcano located at the western boundary of the caldera and the associated tsunami deposits are observed (Nishimura et al, 2005). The previous eruption in 1937 exited some tsunamis (Johnson and Threlfall, 1985) though the tsunami deposits had not been found.

References