Impacts of pyroclastic flows, caldera collapse, and tsunamis during large-scale volcanic eruptions -Krakatau and Kikai calderas-

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Caldera-forming eruptions, which may erupt up to a few thousands of km^3 of magma, are catastrophic volcanic events that pose one of the great natural hazards on earth. Such eruptions are low frequent events, but their impacts are very severe. Even relatively small caldera-forming eruptions may result in several thousands deaths, and alter the global climate. While most recent work on recent eruptions is focused on on-land events, many Quaternary caldera-forming eruptions have occurred in areas of deep/shallow seas, with the production of voluminous pyroclastic flows. Such eruptions are therefore a crucial part of the record of silicic magmatism.

The 1883 eruption of Krakatau in Indonesia (VEI 6) and the 7.3 ka Kikai eruption (VEI 7) of Japan are the famous examples of recent marine caldera-forming eruptions. Other Quaternary marine silicic calderas have been also discovered on subduction zones and near ocean islands; the Shichito-Iwojima Ridge, Izu-Ogasawara (or Izu-Bonin) Arc, the Kermadec Ridge north of Taupo volcanic zone, New Zealand, Papua New Guinea, Vanuatu, and the Hellenic Island Arc in Greece.

Although these eruptions must have significantly and devastatingly affected the development of coastal human activities and environments around the volcanoes, they still remain speculative and controversial, especially with respect to the effects of sea-water on dynamics and evolution of such large-scale silicic marine eruptions. The reasons for this include the rare occurrence and violent nature of this type of eruption, the lack of direct observations, and difficulties arising from global variations in sea levels and local tectonic or volcano-tectonic effects.

Impacts of the 1883 Krakatau and the 7.3 ka Kikai caldera-forming eruptions are introduced in this presentation. Especially, pyroclastic flows, caldera collapse, and (potential) tsunamis are focused with geological characteristics and results of recent numerical simulations. And, we discuss which tsunami generation mechanism are more probable; caldera collapse, submarine explosions, and pyroclastic flows? Although the thickness, distribution, sedimentary structures of submarine deposits would be important for boundary conditions of numerical studies, there is much uncertainty. Thus, drilling of marine pyroclastic deposits is crucial for constraining characters of deposits and quantitatively evaluating volcanic impacts.

Detail survey of deposits around the submarine caldera will enable us to reconstruct the past caldera-forming events; especially, depositional processes of pyroclasts in proximal area, dynamics of huge pyroclastic flows entering sea and their depositional processes, and so on. Geological and petrological studies on pyroclastic deposits could be linked with assessments of volcanic hazards caused by huge pyroclastic flows, ash-cloud, volcanic gases, and tsunamis, which will devastatively impact on very wide areas. Such studies can provide constraints on predicted patterns for future volcanic activity.