A time gap in the caldera-forming eruptions of Kikai volcano: Estimation based on paleomagnetic directions and secular variation

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The durations of caldera-forming eruptions that produce large volumes (>100 km^3) of pyroclastic ejecta are poorly understood due to the absence of direct observations. However, clarifying the timescale of these catastrophic hazardous events is essential for understanding associated eruption dynamics and links with the eruptible portions of the underlying magma system. Here, we propose a method of timescale estimation based on paleomagnetic secular variation. A sampling procedure was developed for accurate oriented samples of pyroclastic deposits including volcanic ash. This procedure makes it possible to obtain the mean remanent magnetization of a tephra layer with a 95% confidence limit of about 2˚, which is comparable to those of well-determined directions for lava. Based on this procedure, the 7.3 ka Kikai caldera-forming eruption was investigated as a trial. Samples for paleomagnetic measurement were collected from the basal ash-rich part of the lowermost plinian pumice fall (Koya pumice fall) at Satsuma Iwo-jima, Kyushu. We also checked a baking effect by overlying pyroclastic flow (Koya ignimbrite) on the basis of thermal demagnetization. The difference of 6.9 degrees in the remanent magnetizations between Koya pumice and reported data of the uppermost co-ignimbrite ash-fall (Kikai-Akahoya Ash) suggests the caldera-forming eruption of a considerable duration (approximately 100 years) on the basis of average rate of secular variation. Paleomagnetic directions from pyroclastic deposits could be a powerful tool for estimating timescales of large explosive eruptions.

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