

Relation between tilt oscillation and seismicity during the 1991-1995 dome eruption at Unzen Volcano, Japan

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Unzen Volcano in SW Japan began to erupt on November 17, 1990, and growth of an associated dacite lava dome occurred from May 20, 1991 to early February 1995. In this study, the relationship between tilt oscillation and temporal changes of seismicity level during the dome growth was investigated. Just before the dome emergence and during the dome growth, cyclic tilt oscillation within a period of 1 to 3 h was observed in the EW component at the FG1 station located about 680m west from the crater. Yamashina et al. (1994) assumed that the oscillation presented the repetition of inflation and deflation at the uppermost part of the active vent, suggesting a cyclic upward flow of lava with high viscosity. They made a formula to successfully estimate the daily supply rate of lava using the magnitude of tilt oscillation. Umakoshi et al. (2011) revealed that the HF seismicity in the crater area around the dome emergence of May 20, 1991, increased and decreased repeatedly within a period of 1 to 2 h, which correlated with tilt cycles in such a way that the seismicity increased during uplifting on the craterward side. In contrast, when the craterward ground was subsiding, the seismicity rate was much lower. They concluded that the cyclic tilt is caused by repeated inflation and deflation of the conduit and the HF earthquakes represent brittle failure of the stiff rock near the conduit. Although high seismicity in the crater area continued through the entire period of dome growth, it has yet to be investigated whether such synchronization emerged in other periods of dome growth or not. Comparing tilt data with earthquake counts in 10-min intervals, it was found in a few cases that the temporal changes of the seismicity level correlated with the tilt oscillation. These were in November- December in 1993, February-March in 1994, and April-May in 1994, when the HF seismicity level was high. However, the manner of synchronization was different from that found in May 1991, that is, seismicity rate increased gradually during uplifting on the craterward side, and then decreased gradually during subsidence on the craterward side. The period was generally 2-4 h, which was longer than the period in May 1991. This suggests that the source process of HF earthquakes is different between the cases in May 1991 and those after November 1993. No clear correlation with tilt oscillation was found in the period from June 1991 to October 1993, when the LF seismicity level was high. Also, there are some cases in which the temporal changes of HF seismicity did not correlate with the tilt oscillation. These indicate that the synchronization between tilt oscillation and seismicity level emerged only in parts of the periods when the HF seismicity level was high.