Temporal variation of source locations and occurring conditions of continuous tremors at Aso volcano

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In November 2014, magmatic eruptions started at Aso volcano after 20 years dormancy. About one year before this eruption activity, a new eruptive vent was opened and several ash emissions occurred in January 2014. At this period, significant changes in both amplitude and peak frequency of continuous tremors had been recognized. The amplitude of 5-10 Hz band-filtered seismograms recorded at station SUN increased gently until December 22, 2013 (Stage I). The peak frequency increased from 2 to 3 Hz. Until December 30 (Stage II) the amplitude increased rapidly (3 Hz). After a sharp amplitude decrease on December 30, the amplitude took high value until January 2, 2014 (2 Hz, Stage III). From 2 to 3 January it reduced sharply. The amplitude increase similar to Stage I was observed for 10 days (3 Hz, Stage IV). From 13 to 20 January, it took very low value with 1.8 Hz peak (Stage V).

In this study, we focus this two-months stage of volcanic activities to understand source process of the continuous tremors.

For locating tremor sources, we perform a grid searching using a spatial distribution of amplitude ratios of the tremors recorded at five seismic stations around the crater. Estimated source locations distribute from the ground surface to a depth of 700 m beneath the crater and migrate through the analyzed period. The source depths in Stage I to IV are 260, 180, 190, 350 m, respectively. Distribution of these source locations connects the ground surface and the upper end of the crack-like conduit (Yamamoto et al., 1999). It also passes through a low resistivity area (Kanda et al., 2008). This may indicate the shallowest pathway of volcanic fluids, which has never been revealed.

Julian (1994) suggested that continuous tremors caused by oscillation of channel walls through which fluids pass. Using this model, we find that both amplitude and peak frequency of the oscillation depend on conditions of both channel thickness and output fluid pressures. For instance, increase of channel thickness makes amplitude to increase. The increase in the thickness can be regarded as expansion of a fluid pathway according to increase of fluid supply (Aki et al., 1977). Additionally, as an output pressure increases, both amplitude and frequency increase as well. Increase and decrease of the output pressure can relate to choke and widening of the pathway, respectively.

Based on all information aforementioned we suppose qualitatively temporal variation of source locations and occurring conditions of the continuous tremors at Aso volcano as follows. In Stage I, we observed the increase of both tremor amplitude and peak frequency. This was caused by increase of fluid pressure in the pathway to reflect supplying of larger amount of volcanic fluids. In order to satisfy this pressure increasing, a conjunctive portion at the upper edge of the crack-like conduit that connects to a narrow pathway into the crater was widened. In Stage II, observed increasing of amplitude was owing to an expansion process of the whole part of this narrow pathway. At the end of this stage when we observed both amplitude and frequency dropped, pressure in the upper part of the pathway decreased due to an opining of the vent. In Stage III, the pathway was still enlarging to transport the fluids, which caused large tremor amplitude. The fluid supply then decreased. We detected it as a sharp decrease of tremor amplitude and increase of the peak frequency. In Stage IV, fluid supply increased again. To satisfy the increase of the fluid pressure, the upper part of the crack-like conduit was expanded again. However, observed amplitude

was not so large rather than the Stages II and III because establishment of the pathway had been already completed in those stages. At the end of this stage, occurrence of ash eruptions led to pressure drop in the shallower portion of the pathway so that we could detect both the amplitude and frequency decreased.

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