

Origin of temporal pattern change of small-scale convection in the mantle wedge and volcano distribution on the NE Japan

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Spatial and temporal variation of volcano distribution may be controlled by the temperature change associated with the mantle flow within the mantle wedge. Recent volcano distribution on the NE Japan is characterized by finger-like groups whose axes are almost perpendicular to the strike of plate boundary. This feature is similar to the temperature pattern caused by the small-scale convection (SSC) under the strong shear. Because of this similarity, we have proposed an existence of SSC in the mantle wedge. However, the volcano distribution on the NE Japan in the past shows a different pattern as that observed at present. They may be interpreted as flip-flopping, that is, the region with volcanoes switch to the region without them later, or vice versa. Our previous numerical modellings of SSC in the mantle wedge also show such a pattern change. However, most recent studies show the existence of non flip-flopping also. In this study, we explore possible causes of such different time-dependent behavior by changing the speed of subduction and the geometry of low viscosity wedge where SSC may emerge. We found that the wavelength of roll-type SSC perpendicular to the direction of large-scale flow has two characteristic scales which may be produced by the inclined bottom of the low viscosity mantle wedge. When SSC is in the early stage or the speed of subduction is small, the long-wavelength rolls become prominent. As the convection evolves or the speed of subduction increases, short-wavelength rolls take over the long-wavelength rolls. The transition from the long to the short-wavelength rolls occurs in a several way. We show that flip-flopping is the transitional stage from the long wavelength to the short wavelength rolls. We will discuss possible implications of our results on the temporal and spatial variation of volcano distribution on the NE Japan.

Keywords: small-scale convection, volcano distribution, temporal change