Stress inversion analysis of the 1983 feeder dike at the Miyakejima volcano: Implications for the migration of eruptive craters

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An analogical method is presented for determining the distribution of flank eruption craters on the polygenetic volcano. The method is to use the mechanism of diverse slip on a shear plane with respect to the attitudes of principal stress regime and stress ratio f{=(s2-s3)/(s1-s3)}. An attempt of this methodology for the 1983 composite feeder dike of the Miyakejima volcano suggests that the character of magmatic overpressure plays an important role to determine the direction of magma flow within the dike. Since f is the ratio of the overpressure to the tectonic stress and influential in the shear direction, the value of f varies with the direction of dike propagation. For example, the smaller f (~ 0) indicates the subvertical magma flow direction. On the other hand, the larger f (~ 1.0) indicates the sublateral magma flow direction, suitable for the flank eruption. The geological observations for the 1983 eruption and the resulting feeder dike support this idea.

The eruptive fissures on the Miyakejima volcano have changed their positions in last 2500 years. Based on the present tectonic stress regime and assuming the larger value of f (= 1.0), an estimated distribution of shear direction coincides well with the historic craters or fissure distribution. This suggests that the crater or fissure positions migrate under the constant stress state characterized by the NW-SE direction of sHmax (~s2) and relatively small overpressure from the intrusive magma. However, some historic eruptive dikes (the 2500 yrBP Hattyodaira event to the south; and the AD2000 event to the northwest) occurred outside the estimated distribution. These events may be involved in caldera formations, and in the resulting stress perturbation.