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Modeling a stepwise diagram of discharge rate by an upward migration of magma chambers: An example from the Esan volcano

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A long-term sequence of volcano growth is an important clue in forecasting how magma inputs and when it erupts, through magma-plumbing system. The Esan volcano, 6km wide, northern Japan, is the best candidate to unravel changes of a long-term discharge rate. A simple 2D elastic model in a hydraulic connection state was performed to study variations of discharge rate that have been attributed to changes of storage conditions rather than supply rate from a deep magma source. The elastic model can forecast either change of time or of volume at the next eruption. A stepwise change in steady-state curve, where the smaller volume is the shorter interval, has been found, and it can be fit to the change of the ratio between radius (*Rc*) and depth (*Hc*) by an upward migration of magma chamber. In the processes, as the ratio *Rc/Hc* becomes to 1.0, the overpressure (*delta Pe*) goes to zero in the shallower crustal levels, where the magma cannot erupt. This constraint could result in the long dormancy for 22,400 years prior to the latest magmatic eruption. Yet in the case that the magma supply is constant, magma continues to input from the deep source to certain crustal depths, which is able to renew an original magma storage system for the next future eruption.

Keywords: volcano, eruption history, magma chamber, migration