

8. Landforms made by volcanic activities

8.2 Longitudinal profiles of volcanoes

Longitudinal profile properties of volcanoes can well be recognized when horizontal distance x from summit and slope gradient S at each point is plotted on a log-log paper (Fig.8.4 and 8.5). In the case when the gradient of regression line is positive, profile is convex upward, when negative the profile is concave and when horizontal the profile is straight. Sharp breaks in the slope curvature are generally recognized. The validity of computer simulations is verified by this procedure.

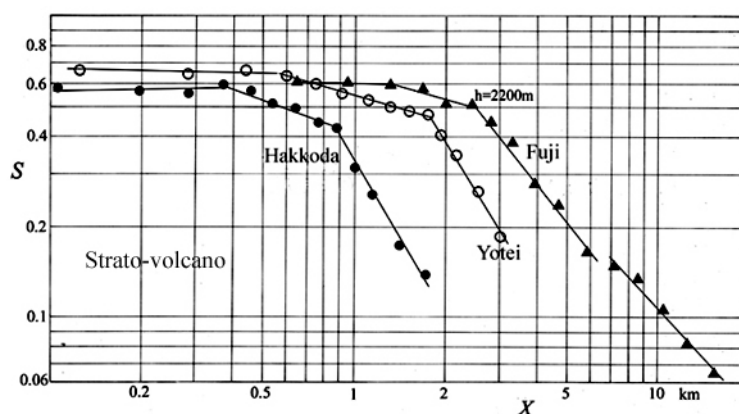


Fig.8.4 Relationship between slope gradient and horizontal distance from summit for strato-volcanoes

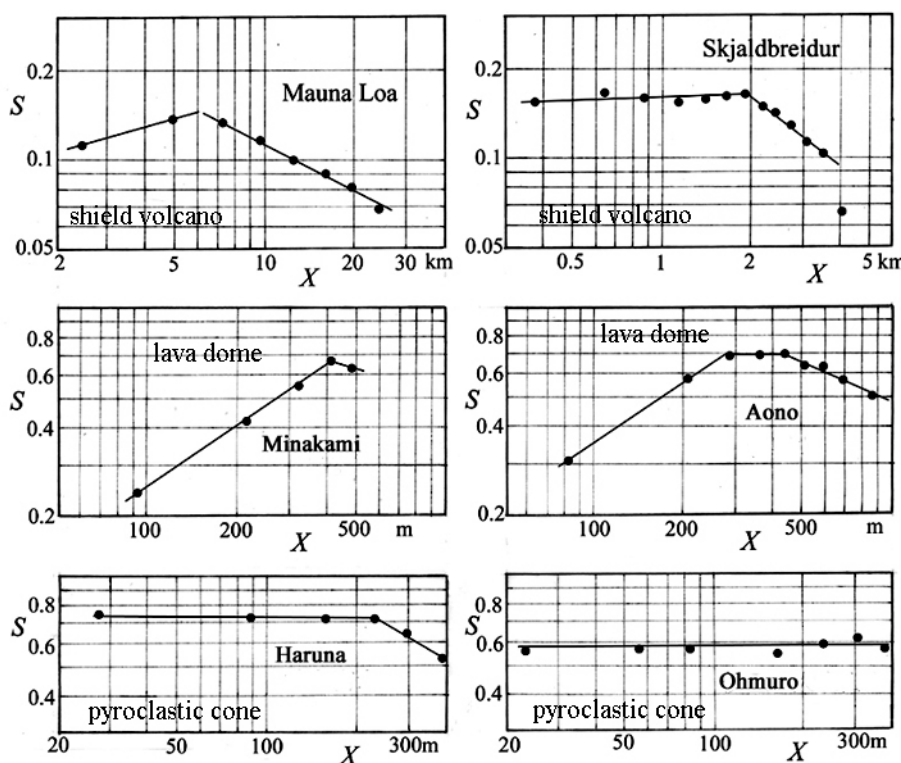


Fig.8.5 Relationship between slope gradient and horizontal distance from summit for shield volcano, lava dome and pyroclastic cone

Lava flow simulation:

Continuity equation of lava flow is represented by

$$\frac{\partial h}{\partial t} + \frac{1}{B} \frac{\partial(Bq)}{\partial x} = 0 \quad (8.3)$$

where h is thickness of lava flow, B is flow width. Mass flux of lava flow q is

$$q = hv = \rho gh^3 \sin \theta / 4\eta \quad (8.4)$$

where η is viscosity of lava and ρ is density of lava.

Fall and accumulation of pyroclastics:

Pyroclastics ejected from crater fall down according to the size and distance x from the crater. The volume is supposed to be inversely proportional to x . Critical angle of the deposited surface is about 30 degrees. The excess amount slides down the slope and nearly straight scree slope is made.

The following simulated profiles are formed up by a great number of eruption events. The relationship between $\log x$ and $\log S$ which is used for the verification of the simulations is shown on the upper right of the figures.

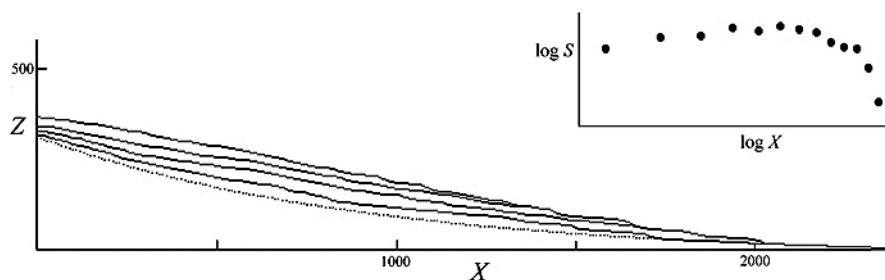


Fig.8.9 Simulation of the evolution of shield volcano
Events of lava flow effusion are 30 times with different magnitude.
The validity is verified by the relation between $\log S$ and $\log X$ shown on the upper right.

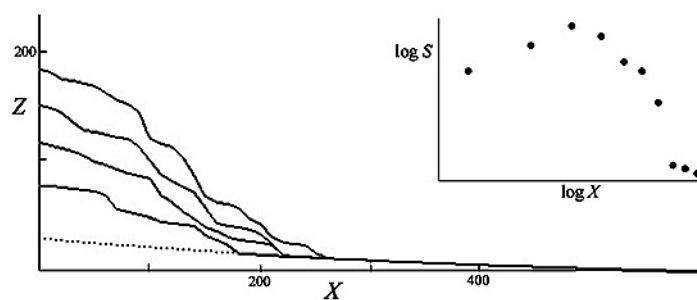


Fig.8.11 Simulation of the evolution of lava dome
Events of lava flow effusion are 20 times with different magnitude. Viscosity is higher than that in the case shown in Fig.8.9.

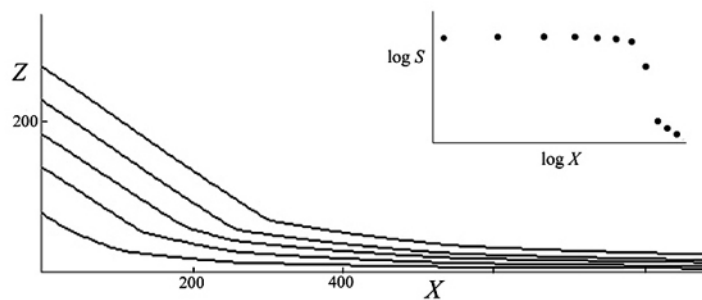


Fig.8.12 Simulation of the evolution of cinder cone
Events of the ejection of pyroclastics are 1000 times with different magnitude. The amount of falls of pyroclastics is inversely proportional to X , distance from crater. Critical angle of deposition is 32 degrees.

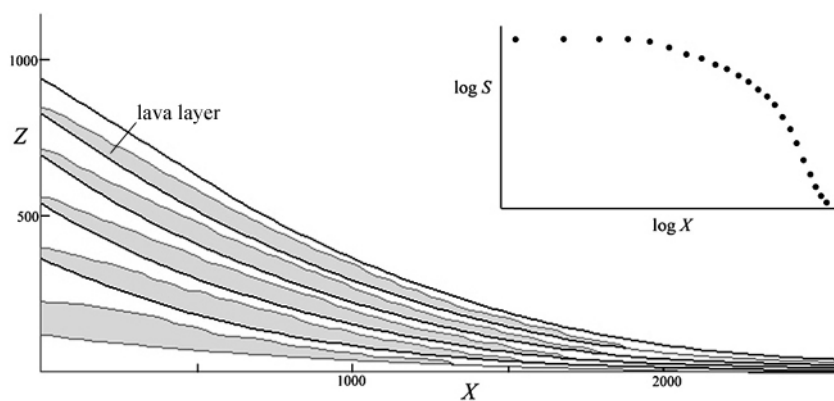


Fig.8.13 Simulation of the evolution of strato-volcano
A sequence of lava flow effusion, fall of pyroclastics and erosion of running water is repeated 5 times. The relation of $\log X$ to $\log S$ is very similar with that in Fig. 8.4

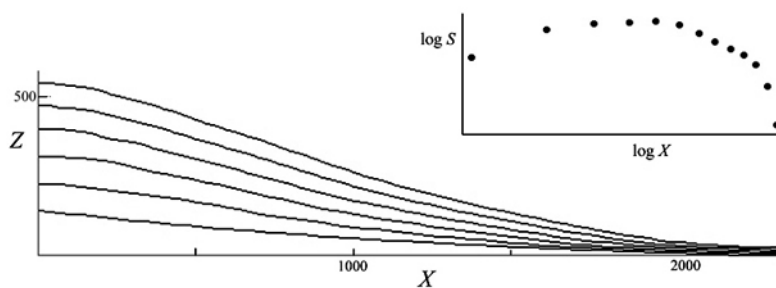


Fig.8.14 Simulation of the evolution of shield volcano
Short duration of ashfall and fluvial erosion is followed after each series of lava flow effusion.