Geophysical Research Abstracts
Vol. 12, EGU2010-8848, 2010
EGU General Assembly 2010

Dynamics of laccolith intrusions, with applications to Earth and Moon

Chloé Michaut

Laboratoire de Géophysique Spatiale et Planétaire, IPG Paris, Univ. Paris Diderot, St Maur des Fossés, France (michaut@ipgp.jussieu.fr)

Laccoliths are shallow magmatic intrusions which lead to the vertical displacement of the overburden, creating a characteristic dome-like topography at the surface. Laccoliths shape, structure and characteristics have been well studied on Earth and laccoliths have recently been proposed to explain various geological features such as domes or floor-fractured craters at the surface of the Moon, Mars or Mercury (Head et al, 2009). On the Moon, several elongated low-slope domes have recently been identified as possible laccolithic-type intrusions (Wöhler et al, 2009), although their diameters are typically twice as large as terrestrial laccolith diameters.

The dynamics of magma intruding and spreading laterally below an elastic crust is modeled and analyzed. Depending on the initial overpressure in the magma reservoir, on the injection rate and on the properties of magma and crust, three regimes are identified and characterized by different thickness to length and thickness to time scaling laws. The first regime is controlled by the elastic response of the crust and the intrusion shape is determined by elastic deformation of the crust under constant pressure. When the time and flow length become larger than an elastic time scale and length scale, the edges of the flow become steeper and the regime changes to a gravity current regime. When the flow is thick enough to accomodate the overpressure below, its thickness remains constant and the flow enters a third sill-like regime, where only its length increases.

The scaling law between flow length and thickness in the elastic regime fits observations done on a series of laccoliths at Elba Island, Italy (Rocchi et al, 2002). The shape, elastic thickness and length scales derived from this model also fits the observed shape, characteristic length and thickness of laccoliths on Earth.

On the Moon, the smaller gravity and a drier crust would lead to increase the characteristic elastic length scale for laccolithic intrusions by a factor of about two, which would explain the discrepancy noted by (Wöhler et al, 2009). And hence, low-slope domes identified on the Moon might well result from laccolithic intrusions at depth.