Abstract

ENGLISH

**Key words**: Magmatic intrusions, Elastic-plated gravity current, Thermal processes, Rheology, Temperature-dependent viscosity, Elastic sheet, Laccolith, Sill, Earth, Moon, Low-slope domes, Floor-fractured craters, Elastic-sheet thickness, Crater depression, Gravitational anomalies, Detection through machine learning methods.

On Earth, most of the magma does not reach the surface and solidifies at depth in a wide range of different morphologies (batholith, bysmalith, laccolith and sill). Geological and geophysical observations allow studying the intrusion processes. In contrast, intrusive magmatism on other terrestrial planet is poorly documented. On the Moon, several morphologies have been proposed as resulting from the emplacement of magmatic intrusions such as the numerous low slope domes in the lunar maria or the atypical characteristics of floor-fractured craters. However, such observations must be linked to magmatic intrusion dynamics models in order to provide insights into magma physical properties, injection rate, emplacement depth and the intrusion process itself.

In this thesis, we propose a model for a temperature-dependent viscosity elastic-plated gravity current to get some insights in the dynamics of cooling shallow intermediate-scale intrusions (sill, laccolith). In particular, we examine the effect of the rheology, crystallization and heating of the surrounding medium on the dynamics.

In addition, a second model relates the spreading of an elastic-plated gravity current under a variable topography.

the effect of both the cooling and the topography on the dynamics of shallow intermediate-scale intrusions

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At shallow depth, magma makes room for itself by bending of the overlying strata and can be modelled as an elastic plate gravity current. In this thesis, we investigate the morphology of laccolith

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investigate the dynamics of a cooling elastic-plated gravity current and use it

cooling of shallow intermediate-scale intrusion such as sills, laccoliths or bysmaliths. In particular, we develop a model for a cooling elastic-plated gravity current that take into account the magma rheology, crystallization and the heating of the surrounding medium. Application to laccoliths morphologies show that, if cooling is an efficient mechanism for the arrest of laccolith in the bending regime, as confirmed by observations, an additional cooling mechanism is needed to explain the exact size of laccoliths.

On the Moon, the circulation of fluid should be if not inexistent, at least very small and the model support the magmatic orgini of numerous low slope domes. Numerous floor-fractured craters have also been proposed to be form by emplacement of a magmatic intrusion below their floor. T test this hypothetis, we proposed a model that account for the spreading of a laccolith beneath a variable topography. The model show good agreement with the observation.

In particular, we proposed a model that account for the cooling of the magma and the heating of the surrounding rock.

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