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Magmatism on the Moon

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Volcanism on the Moon is dominated by large fissure eruptions of mare basalt and seems to lack large, central vent, shield volcanoes as observed on all the other terrestrial planets. Large shield volcanoes are constructed over millions to several hundreds of millions of years. On the Moon, magmas might not have been buoyant enough to allow for a prolonged activity at the same place over such lengths of time. The lunar crust was indeed formed by flotation of light plagioclase minerals on top of the lunar magma ocean, resulting in a particularly light and relatively thick crust. This low-density crust acted as a barrier for the denser primary mantle melts. This is particularly evident in the fact that subsequent mare basalts erupted primarily within large impact basins where at least part of the crust was removed by the impact process. Thus, the ascent of lunar magmas might have been limited by their reduced buoyancy, leading to storage zone formation deep in the lunar crust. Further magma ascent to shallower depths might have required local or regional tensional stresses.
Here, we first review evidences of shallow magmatic intrusions within the lunar crust of the Moon that consist in surface deformations presenting morphologies consistent with models of magma spreading at depth and deforming an overlying elastic layer. We then study the preferential zones of magma storage in the lunar crust as a function of the local and regional state of stress.
Evidences of shallow intrusions are often contained within complex impact craters suggesting that the local depression caused by the impact exerted a strong control on magma ascent. The depression is felt over a depth equivalent to the crater radius. Because many of these craters have a radius less than 30km, the minimum crust thickness, this suggests that the magma was already stored in deeper intrusions before ascending at shallower depth.
All the evidences for intrusions are also preferentially located in the internal borders and at the periphery of the main Mare basalts. The base of the Mare units potentially formed a preferential zone of magma storage. Furthermore, the weight exerted by the Mare on the lithosphere might have lead to tensional stresses on their sides that, in turn, might have helped magma ascent.
In the end, because of the neutral or negative buoyancy of the magma in the crust and of the lack of tectonic processes, magma transport on the Moon has probably been largely controlled by surface processes such as impacts and volcanism itself.