Detection of Low-shield Volcano with Effusive Vent in Oceanus Procellarum on Moon, using Chandryaan-1 TMC Data

A.S. Arya*, R.P.Rajasekhar, Thangjam Guneshwar Singh, Ajai, A.S Kiran Kumar and R.R.Navalgund

Space Applications Centre,
Indian Space Research Organization,
Ahmedabad – 380 015
*as_arya@sac.dos.gov.in

Chandrayaan-1, the first Indian mission to Moon was launched on 22 October, 2008. Chandrayaan-1 carried about 11 instruments, including TMC (Terrain Mapping Camera) with unprecedented spatial resolution of 5 m and multi-viewing capability to generate 3-dimensional model of Lunar terrain. This gives a unique opportunity to analyse and study these features in detail and stereo mode. The shield volcanoes are of immense interest to us as they could yield significant information about the emplacement of the basaltic magma, its origin and nature of the eruption, thus unwinding the history of evolution of the planetary body. As per old conventional belief, all lunar magmas were of very low viscosity and due to the low lunar gravity, these magma were incapable of building the accumulative structures of positive relief like shield volcanoes and cinder cones. So these features were considered a mystery.

However, it has been surmised that lunar magmas too have variable viscosity and are capable of accumulation into mounds, cones and dome-like features.

Usually flood basalt flows have very low viscosity resembling the viscosity of motor oil, spreading far, wide and flat. But some of the later eruptive events around the periphery of the basins suggest magmas of a thicker variety and capable of building visible relief or dome like structures with larger blister-like formations having rounded profiles. The type of domes which have a central vent are considered to be shield volcanoes. The other type of dome has no vent opening and these are believed to be the upwellings of magma columns that distorted, but failed, to rupture the surface and erupt out. Since all these types of features occur in groups, it is often very confusing to differentiate a cinder cone from a shield volcano?

The Oceanus Procellarum region of Moon has been interesting in terms of cluster of domes and cones. Numerous domes have been identified earlier in Marius hill region.

However, a very interesting dome with an effusive vent has been detected in the contact region of Imbrian and Erastothanian Mare basalts, which is a strong candidate of low shield volcano with an effusive vent.

So far no such dome with an effusive vent has been demonstrated in 3 dimensional view as elegantly as in the Chandrayaan-1 TMC data. The morphological and morphometric measurements indicate possibility of low energy degasification of a sub-crustal magma nest and resultant volcanic shield.