Geophysical Research Abstracts
Vol. 21, EGU2019-12535, 2019
EGU General Assembly 2019

Link between parasitic cones and giant Tharsis volcanoes: New insights into the Tharsis magmatic plumbing system

Bartosz Pieterek (1), Jakub Ciazela (2), Daniel Mège (2), Anthony Lagain (3), Pierre-Antoine Tesson (2), Marta Ciazela (2), Joanna Gurgurewicz (2), and Andrzej Muszyński (1)

(1) Institute of Geology, Adam Mickiewicz University, Poznan, Poland, (2) Space Research Centre, Polish Academy of Sciences, Warsaw, Poland, (3) Space Science and Technology Centre, Curtin University, Perth, Australia.

Tharsis volcanic province on Mars (15˚S to 45˚N, and 90-140˚W) hosts hundreds of small volcanic cones and vents in addition to the giant volcanoes: Olympus Mons, Alba Mons and the three Tharsis Montes (Arsia Mons, Pavonis Mons, and Ascraeus Montes). The genesis of the small volcanic cones in this area is not yet fully explained. Their genesis may be related to the evolution of the large volcanic edifices, or controlled by the fractures of fault systems. Characterizing the system of small volcanic cones in terms of space and time is essential to understand the Tharsis magmatic plumbing complex.

In this study, we mapped the small volcanic cones of Tharsis (1-65 km in diameter), determined the orientation of their elongated craters or central fissure vents, and dated flanks of six volcanoes. For mapping we used ArcMap and combined the Thermal Emission Imaging System (THEMIS) of Mars Odyssey (MO) (spatial resolution of ∼100 m/pixel) with the Context Camera (CTX) of Mars Reconnaissance Orbiter (MRO) (6 m/pixel). The six volcanoes were dated using crater counting (>100 m in diameter) with the ArcGIS extension CraterTools2.1 on a CTX mosaic. Crater statistics and derivation of crater model ages, including errors, was carried out with CraterStats II by applying the Hartmann's (2005) chronology system.

We identified and mapped 302 parasitic cones. They are unevenly distributed across the Tharsis province. Based on volcano geographic distribution and measured orientations of elongated summit craters and central fissure vents, we distinguish three major cone groups related to 1) Olympus Mons (with orientations of ∼N100) 2) Tharsis Montes (∼N055), and 3) Alba Mons (∼N005). The three identified groups represent distinct episodes of volcanism associated with various giant volcanoes.

To support our hypothesis, we dated six parasitic cones in the identified groups and compared with the ages of Olympus Mons, the Tharsis Montes, and Alba Mons. Interestingly, parasitic cones always show slightly younger age compared to the nearby feeding volcanoes. For example, the age of the last activity for Olympus Mons is 64±30 Ma, whereas for parasitic cones we dated ∼52±12 Ma. Similarly, ages determined for parasitic cones (107±28 Ma and 115±13 Ma) in Tharsis Montes correspond well to the last activity of the Arsia Mons (126±6 Ma) and Pavonis Mons (138±13 Ma). The latest Alba Mons activity (110±30 Ma) might be also linked with parasitic cones (62±9 Ma and 70±20 Ma) situated in Ceraunius Fossae.

The spatial distribution of parasitic cones, along with their alignment and relatively young ages allowed us to distinguish three distinct plumbing systems related to the largest Tharsis volcanoes, perhaps currently dormant. Furthermore, our results indicate that the small volcanoes may have formed 10-20 Ma after the extinction of the last eruptive activity at the nearby giant volcano, which might be related to the smaller pressure needed to feed these parasitic cones compared to the pressure needed to feed summit calderas.