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Association of cone sheets and radial dykes on Ascraeus Mons (Mars): structural analysis and modelling

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Ascraeus Mons was one of the first of the Martian volcanoes to be imaged by the High Resolution Stereo Camera (HRSC) experiment onboard the ESA Mars Express spacecraft. These images show much of the volcano at a higher resolution than previously (12 m/px), and details of its lava flows, sinuous rilles, flank vents and tectonic features. Concentric fractures systems (pit chains, grabens) around the volcano, changing transitionally into radial structures systems have been recognized and cartographed using a HRSC mosaic. The structural interpretation showed strong analogies with concentric dykes (cone sheets) on many terrestrial volcanoes such as Isla Fernandina (Galapagos), Tejeda Complex (Canary Islands) and Cuillins Complex (Isle of Skye, Scotland). In particular this last terrestrial analogue has been studied in detail and with the use of a Finite Element Method (FEM) modeling the shape of the magma chamber that originated the cone sheets on the Cuillins Complex was discovered (Bistacchi et al. 2010). An oblate inflating magma chamber is responsible for the formation of those structures. By analogy, we tested the presence of an oblate magma chamber below Ascraeus Mons. We measured the diameter of the transition zone between concentric and radial structures on Ascraeus Mons flanks, that is strongly related to the diameter of the deep magma chamber (1-1.2 magma chamber diameters). With a FEM model built for Ascraeus we have been able to discover the average depth of the oblate magma chamber, which could have originated the concentric structures. The presence of a plume with an oblate summit instead of the magma chamber has also been tested. Moreover an additional oblate shallow magma chamber that likely originated the summit caldera has been verified. In addition, the deformation event that originated the structures on Ascraeus flanks has been dated by crater counting, resulting very recent.