Introduction:
Volcanism was globally widespread on Mars in the early history of the planet, but focused with ongoing evolution in Tharsis and Elysium [1]. Evidence for post-Noachian (<3.7 Ga) volcanism in the Martian highlands is rare (e.g., Tyrrenhus and Hadriacus Montes) and, to our knowledge, few, if any, younger volcanic edifices have been reported so far. Here we focus on two spectacular cones with outgoing flows and three dome-like structures surrounded by flow units, that might change this view.

The study area is located in Terra Sirenum (Fig. 1), a highland region which was included by [2] as part of the large Eridania paleolake, a possible source for the formation of the Maadim Vallis outflow channel during the Hesperian/Noachian period [2].

Thermal characteristics

Two cones (a – cone T1, b – cone T2) are associated with flows that partly cover the cones themselves. Overlapping flow margins suggest a repetitive process of their formation. The edges of the flows seem to be relatively steep, based on MOLA measurements, reaching values between 4° (for eastern cone T2) up to 20° (for western cone T1). The flows originated from the breached cone’s centers, not from their flanks. Flow E seems to originate beneath cone T2. CTX images.

Morphology: cones

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Morphology: domes

Two investigated domes are covered by CTX and HiRISE images (Dome B and C), enabling observations of small details. The domes stand between 350 m and 530 m above the surrounding plains and have steep flanks with slopes between 17° and 23.5°. Topographic data also reveal sloping heights, decreasing in southern direction.

Ages

The observed cones may represent Martian small-scale volcanic edifices with associated lava flows, but they are different in morphology to previously observed Martian scoria cones [3, 4] or tuff rings/cones [5]. The steep-sided morphology suggests that highly viscous lava formed them. The material exposed by scarp might be fine-grained volcanic ash resulting from fragmentation of highly viscous lava and explosive eruption(s). Based on our observations and the similarities to terrestrial obsidian flows, we interpret these features as probably volcanic in origin and post-Noachian in age (Fig. 6). If so, volcanic edifices composed of evolved magmas may not only be present in the northern lowlands [6], but also in the ‘middle of nowhere’: in the southern highlands far away from any known volcanic centers.

We currently have no explanation why such evolved volcanism might have occurred in those regions and how such magmas were generated. But our finding may expand our knowledge about evolved magmas on Mars, which seem to be more widespread than previously thought [7-10]. The cones and flows in Terra Sirenum might represent ideal candidates for spectroscopic observations.

References