Double rootless cones around Lake Myvatn in Iceland, as analogues to double cones in Athabasca Valles, Mars.

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Introduction: Rootless cone is a unique volcanic morphology which is formed by lava-water interaction. On Mars, rootless cones have been pervasively identified in various regions [1, 2, 3]. Particularly the young rootless cones in Central Elysium Planitia is a key in understanding young Martian volcanism. Terrestrial rootless cones are good analogue to understand resent Martian magmatism. Morphological and geological survey for rootless cone tells us its explosivity and its formation.

In Athabasca Valles, Central Elysium Planitia on Mars, there exists a remarkable style of rootless cone (Fig.1). These cones have an inner cone in their summit crater [double cone]. We suggested a possibility of successive explosions at the same place with decreasing explosivity [4,5]. We found similar double rootless cones in Iceland by aerial photo investigation (Fig.2). Here we report field investigations on Myvatn rootless cones in comparison with the Martian cones.

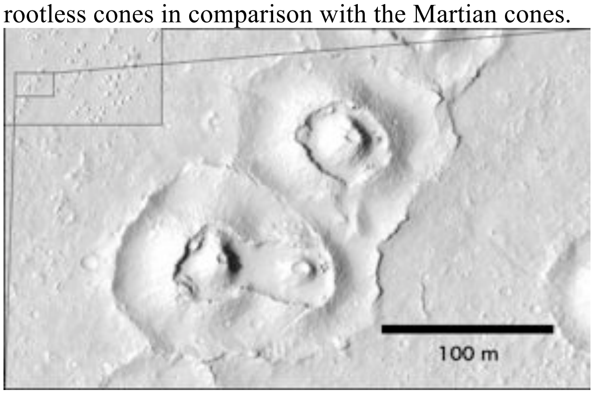

Figure 1: Double cone in Athabasca Valles, Mars (HiRISE: PSP_002226_1900)

Figure 2: Double rootless cone on Geitey island, Lake Myvatn (photo: Loftmyndir ehf).

Geological back ground: Double rootless cone exists around Lake Myvatn in northern Iceland. The basaltic lava flows of 2300 years ago emanated from Threngslaborgir east of the lake filled up old Lake Myvatn. During the emplacement of lava flow in Lake Myvatn rootless cones were formed by lava-water interaction [6].

Distribution: Most of rootless cones locate around shore of the old-lake (Fig.3). We mapped 514 of rootless cones; 416 for single cone, 78 for double cone, and 20 for lotus fruit cone (several inner cones exist in summit crater). Several rootless cones locate in downstream area of Laxadalur (e.g. Hagi and Nes).

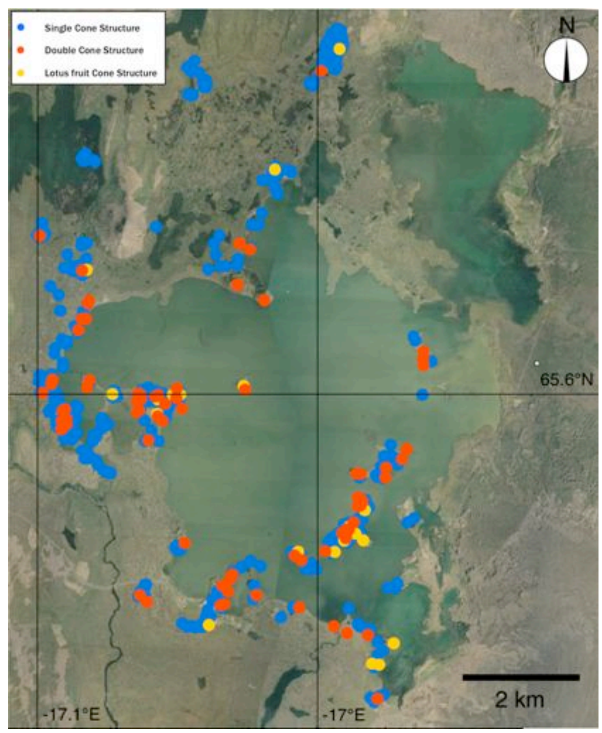

Figure 3: Distribution of rootless cones around Lake Myvatn.

Morphology: We determined detailed topographic profiles of Myvatn rootless cones by RTKGPS (Real-Time Kinematic GPS), then calculated its slopes and volumes.

For double rootless cone, it is found that the slope angle is constant over the entire edifice. Since the constant slope angle of 33 degree is similar to the repose angle of slightly-irregular shaped granular material, the morphology suggests ballistic deposition of non-cohesive pyroclasts. The slope angle of the outer cone is larger than that of the inner cone (Fig. 4).

For single cone, the slope angle depends on the cone diameter (Fig.5, 6). Bigger cone (cone diameter: more than 100 m) has a constant slope, while the medium cone has largely different profile; the slope is increasing towards the summit.

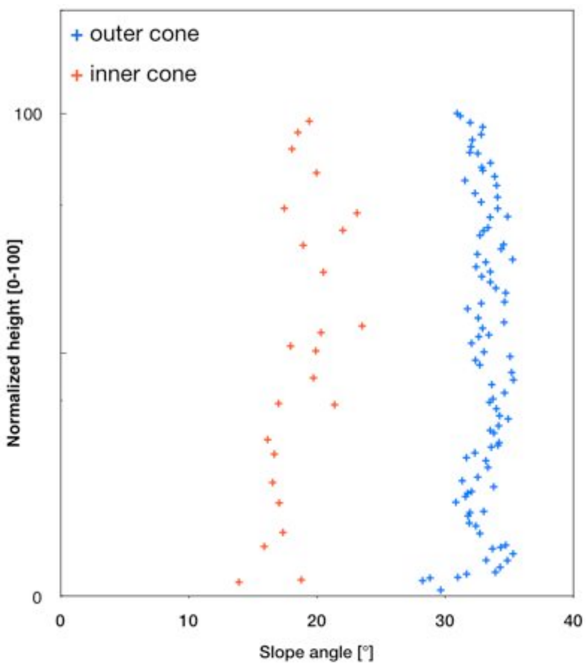

Figure 4: Slope angle of outer cone (blue) and inner cone (red).

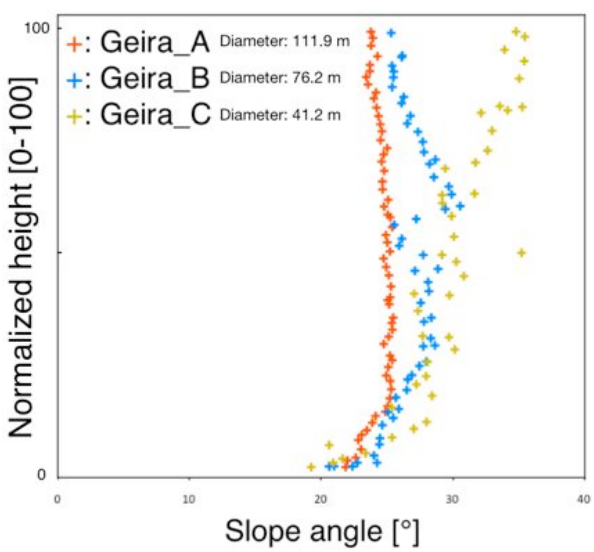

Figure 5: Slope angle of different size rootless cones.

Figure 6: Rootless cones in Geirastadir, Myvatn. There are 3 rootless cones, A, B, and C in descending order of the size.

Constituent materials: The constituent material is different between outer cone and inner cone. Main part of the outer cone is composed of lapilli-size non-cohesive pyroclasts, whereas that of the inner cone is welded-pyroclasts or agglutinate. We consider the difference of cohesive force between the pyroclasts should control the morphological difference and slope angles.

Grain size distribution. Grain size distribution of the pyroclast is related to the magnitude of the explosion. The explosion with higher intensity produces large number of fine grains by intense fragmentation. In this presentation, we will focus on fine grain percentage, and discuss difference of explosivity between single & double cone, and double cone's inner & outer cone.

References:

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