Oldonyo Lengai: Trip Report March 12-14, 2010

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Measurements of crater depth, diameter of crater rim and crater throat, and stratal dips or slope were made using compass, inclinometer, laser rangefinder, and handheld GPS receiver.

NORTH CRATER

Oldonyo Lengai's North Crater was quiescent when visited Friday, 12 March 2010. The crater rim, approximately circular, ranges in diameter from 270 to 310 m (fig. 1). Crater depth is 110 to 122 m, two-thirds or more of that is the height of cliffs that rise directly from the crater floor to its throat, and the remainder is the height of the sloping crater rim (fig. 2). If the crater has not deepened since June 2009, then a depth of 80 m reported by T. Fisher is an underestimate. From its rim, the crater mouth slopes inward 30 degrees, descending at that pitch for 15–30 m before ending abruptly at the cliffs of the crater throat. Fine-grained pale gray or light-brownish gray ash, in part altered by weak solfataric steaming, mantles the upper slopes. A rockfall that occurred before April 2009 (A. Daneel's photos in GVP monthly reports) has scalloped the northeast crater slope, leaving a shallow scar 70 m wide (figs. 3, 4). Outward-dipping beds of vent-building tephra, exposed by the scar, provide visual evidence that the mouth-coating ash is thin, only 30 cm or less in most places (fig. 4).

The throat is about 200 m diameter. The crater floor has an area of 3.26 ha. It lies at an altitude slightly lower than the "Pearly Gates" traversed on the westside climbers' route (fig. 5).

The scene on March 12 appeared largely or entirely unchanged from that appearing in photos taken one month earlier (February 2010); at that time, pahoehoe had floored nearly half of the crater floor. The smell of H_2S was weak, SO_2 smell was undetectable, and steam escaped from the few cracks that cut across the crater slopes. Neither steam nor fume were notable in the deeper part of the crater. Several volcanic and erosional events, listed next, can be surmised from geologic relations on the crater floor, although none of the events is dated except by knowledge of their presence or absence during previously documented visitation. The recent lava flows and hornitos described below presumably are carbonatite, but none was sampled because they are inaccessible.

(1) Globs of lava are spattered on the throat walls. The spatter and rock alteration obscure much of the layering of strata exposed in the cliff faces.

(2) Rubble from wall collapses has formed talus cones that cover more than half the crater floor. The oldest of these talus deposits comprises large blocks from the rockfall that carved the east side of the crater slopes (pre-April 2009) (fig.

Figure 1. View north from summit of Oldonyo Lengai toward North Crater. Top of Pearly Gates lava flow visible emerging from fog on west slope (left). USGS photo by D. Sherrod, Mar. 13, 2010.

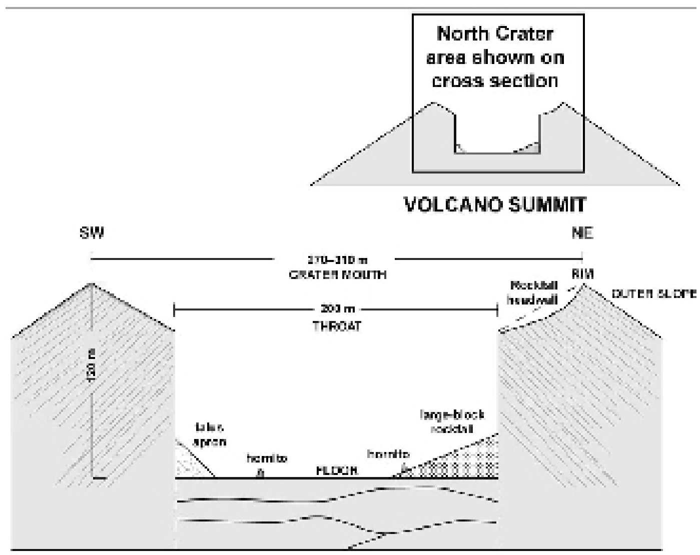

Figure 2. Cross section of North Crater on Mar. 12, 2010.

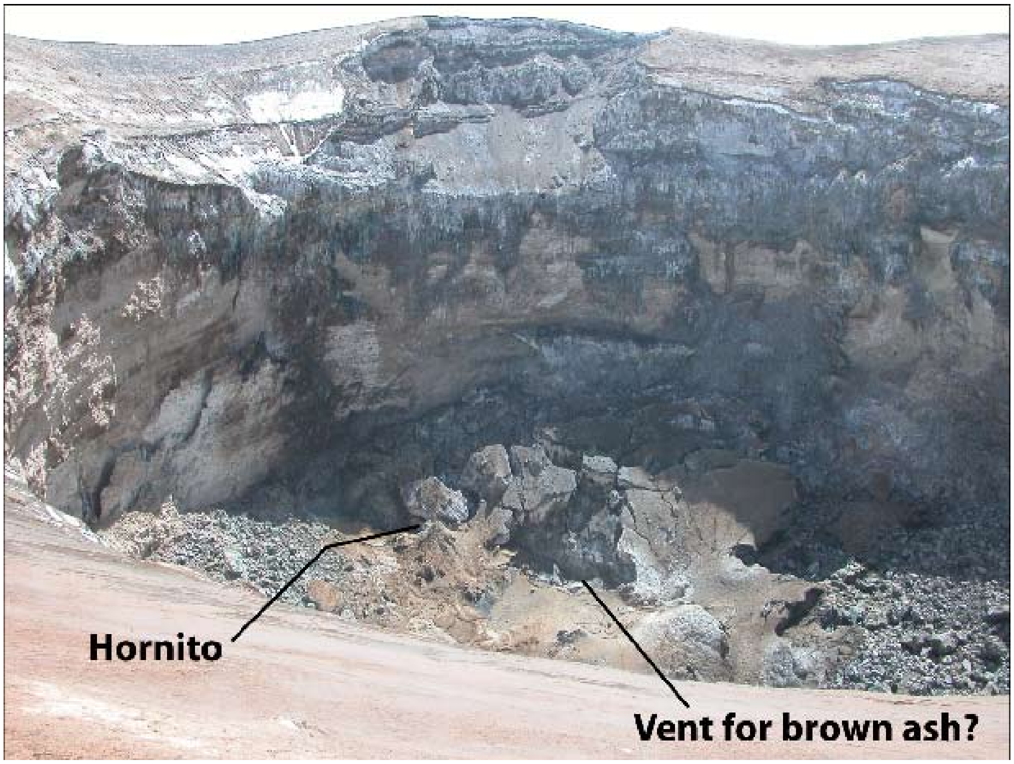

Figure 3. View northeast showing large-block rockfall on crater floor and resulting scar on northeast rim. USGS photo by D. Sherrod, Mar. 13, 2010.

Figure 4. View north toward the rockfall scar on northeast rim. USGS photo by D. Sherrod, Mar. 12, 2010.

3). This large-block rockfall has light brown ash on it, erupted from a 3–4-m wide pit blasted through the talus debris. The several smaller ash-rimmed craters that appear in March and April 2009 photos (S. Lübben and B. Wilhelmi, respectively, posted on Fred Belton's Web site) are now muted. Also nestled among the large-block talus field is a small hornito. It and the short pahoehoe flows that issued from it are covered by the same brown ash that coats the talus. If the hornito is a product of June 2009 activity described and pictured in various reports, then the brown ash must postdate June 2009.

(3) Young gray pahoehoe, lacking any ash cover, covers about 1.37 ha, or 40 percent of the crater floor (fig. 6). It issued from three bocas near the north crater wall (scene essentially identical to that photographed by Frank Möckel

in February 2010, posted on Fred Belton's Web site). Within this field of pahoehoe is the second of the two hornitos on the crater floor.

The faintest of noise could be heard from the area of the three bocas in the North Crater. The sound was reminiscent of sloshing heard deep in pits on Kīlauea, although with more of a drumming percussion, like that of periodic gas release occurring every 3–10 seconds, but wind across the crater rim made it extremely difficult to resolve the crater sounds or their origin.

A nighttime visit to the rim from camp was made on March 13. At that time the crater and all vents within it were dark. No incandescence was seen.

SOUTH CRATER

The south crater, where we camped, is now dotted by ballistic craters, features presumably resulting from the eruptive events of 2007–08 (fig. 7). The shallow impact craters, as wide as 1.5 m diameter, chiefly or entirely postdate the ashfall that accompanied the 2007–08 eruptions, judging from crater preservation and the deformation of surface beds. Craters were sparse closer to the vent, especially on steep slopes, so the sense of a directed muzzle that might be inferred from the distribution of ballistic craters may be an artifact of

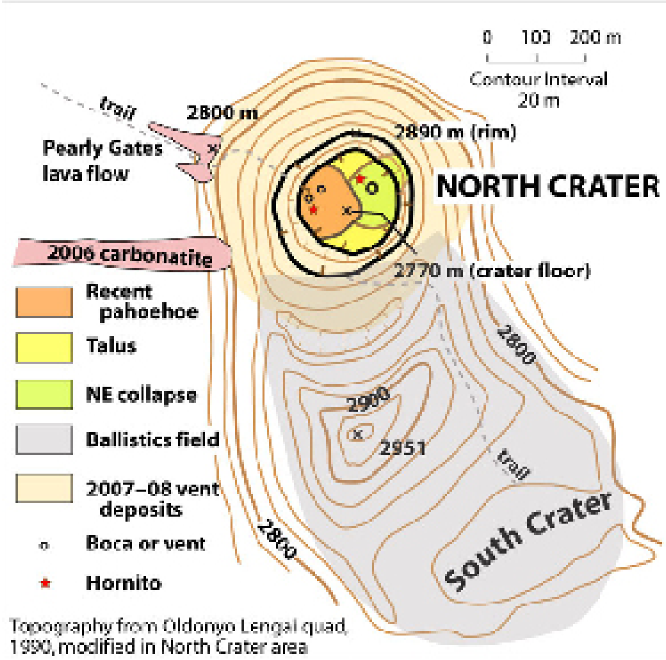

Figure 5. Map of North Crater area on Mar. 12, 2010.

Figure 6. View northwest toward boca and young pahoehoe on crater floor. USGS photo by D. Sherrod, Mar. 12, 2010.

favorable summit slopes.

HAZARDS

Under current quiescent conditions, the chief hazard at the North Crater is crater rim stability. The rim's circumference is marked by a faint footpath traced by the many visitors who wish to see as much of the crater floor as possible or who walk to the east rim on clear mornings for a better view of Mounts Kilimanjaro and Meru. Rim-collapse hazard may diminish with time, as the rim materials become better cemented; or it may increase as ongoing alteration weakens otherwise stable rock. Those who walk the rim need to watch for traces of circumferential fractures and then judge where the onstrike projection of those fractures might approach the rim. The northeast rim seemed especially unstable.

We detected no perceptible gas hazard during our visit. The summit area is well ventilated, and the smell of sulfide gas was weak. Measurements made by inserting a handheld field device* into low-temperature steaming cracks at the summit detected no CO_2. Null values were also obtained when placing the CO_2 monitor into shallow pits in the south crater where soil gas might percolate, but the holes were so shallow (<60 cm) that summit breezes probably prevent gas accumulation. Concentration of ground CO_2 is unlikely to pose a hazard for those in closed areas (tents?), given the wind across the summit area. The North Crater's cliff-lined walls preclude access to the only obvious topographic trap for CO_2.

*The device, Analox Corp.'s CO_2 Buddy, is specifically for personal protection and has default alarms at 0.5%, 1.5%, and 4% CO_2. The manufacturer specifies that it will read down to 0.01%, but low concentrations are not reported reliably and ambient atmospheric concentrations typically read 0%.

Figure 7. View south-southwest across South Crater, 0.7 km from North Crater vent. Arrows point to three of the more than 200 ballistic craters visible in the field of view. USGS photo by D. Sherrod, Mar. 12, 2010.