PRELIMINARY RESULTS ON LAVA FLOW MORPHOLOGIES AND VENT STRUCTURES: AN EXAMPLE FROM THE WESTERN VOLCANIC ZONE, ICELAND.

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Introduction: Iceland exhibits a vast diversity of volcanic landforms and products. Due to its location at high latitudes, and hence, sparse vegetation cover along with good accessibility to most volcanically active areas, Iceland has been a prime region for terrestrial analogue studies to understand, in particular, Martian volcanism.

The 170 km long, NE-trending Western Volcanic Zone is an ultraslow-spreading rift associated to the diverging Mid-Atlantic ridge. It formed about 6-2 Ma [1]. Rifting is coupled with volcanic eruptions. Recently, a total of 44 eruptive units were identified, most of them are post-glacial [2]. In this study we focused on the region c.10 km NE of Thingvallavatn. This area is mapped as the Thjófahraun unit which formed about 3600 yrs B.P. [2]. It is characterized by multiple fissures and scoria and spatter cones from which several lava flows originated.

In 2006, a flight campaign was carried out to image parts of the Western Volcanic Zone about 40 km to the east of Reykjavik (Fig. 1). The HRSC-AX camera mounted to an aircraft is basically identical to the HRSC camera onboard Mars Express.

In 2010, a field campaign was organized to investigate lava flow morphologies, volcanic landforms such as spatter and scoria cones, fissures, and tectonic features. Field activities were primarily focused on two lava flows in the northeastern part of the Western Volcanic Zone. Mapping and description of lava flow features from proximal to distal reaches were complemented with selected Differential GPS profiles perpendicular to flow direction [see also 3, this volume].

Here we report on our observations of lava flow morphologies in general and on one lava flow in particular which was traced from vent to its distal front lobe.

Methods: HRSC-AX data were processed similar to HRSC products. Colour, panchromatic, and digital-terrain-model mosaics were created with spatial resolutions of 1 m (several panchromatic subsets have up to 25 cm/px). The DTM has a vertical accuracy of 10 cm and an absolute accuracy of 20 cm. Prior to the field campaign, selected lava flows were mapped on HRSC-AX imagery in a GIS environment. The extent of mapped lava flows was verified in the field and where necessary corrected using handheld GPS for positioning.

General observations of lava flow morphologies: The study area is located between two NE-trending hyaloclastite ridges. Numerous fissures and cones, and one large tuya manifest the main sources of lava emission. The area between the two ridges was flooded. As a result, the lava plain is moderately sloping towards Thingvallavatn and Skeildbreidur. The lava flows consist exclusively of pahoehoe lava except at distal lobes and where steep scarps were overridden forming aa lava. Open-channel flows formed predominantly near the vent up to medial reaches. Lava tubes can directly emanate from the vent and extend to medial reaches before turning into sheet-type flows and lobes. Due to the low gradient between the ridges, small- and large-scale inflation features and clefts are frequently observed.

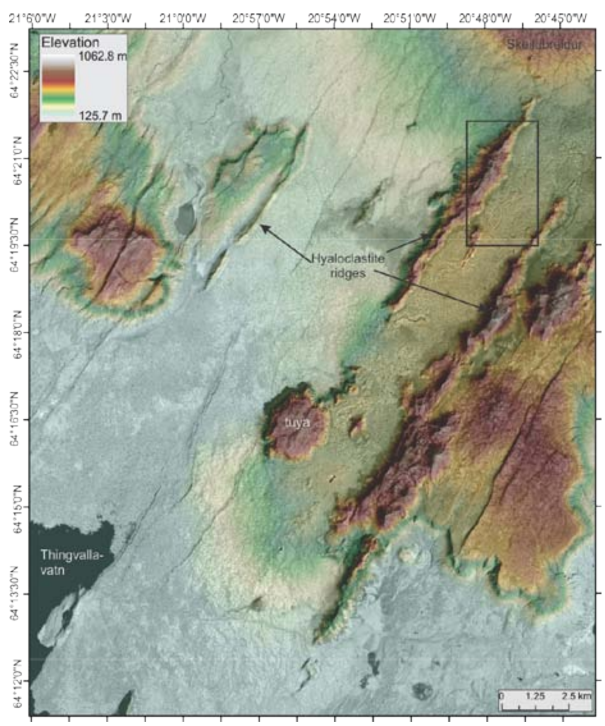

Fig. 1: Western Volcanic Zone, Iceland. Study area is located NE of Thingvallavatn between two prominent hyaloclastite ridges. Box shows location of examined lava flow.

Northern lava flow – proximal to distal:

The examined lava flow (Fig. 2) originated from a 300 m long fissure which partially developed into two point-sourced cones to the SE (Fig. 3). The NE part of the fissure is rimmed by up to 50 m of scoria and spatter. One cone is made of a pile of individual lava tubes caused by a dominant effusive style of eruption also indicating its late-stage emplacement. Draining of lava forming the main lava flow occurred to the NE over a c.20 m high cliff, and the lava travelled up to 4.6 km from the fissure. The lava flow developed an open main channel (c.15 m wide and 3 m deep) close to the source and subsequently widens further downstream to up to 110 m. Two small lava lobes developed where the main flow changed direction by 90°. From the base of the cliff below the fissure to the distal front lobe an elevation difference of 60 m is noted. The transition from open-channel flow to a sheet dominated flow occurs over 350 m. Within this zone small pressure ridges developed.

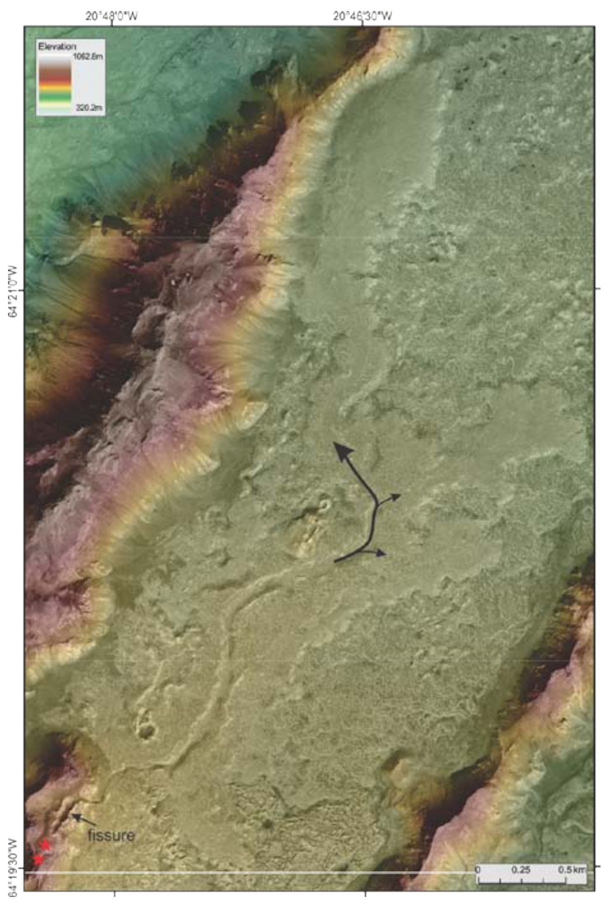

Fig. 2: Studied lava flow (see box in Fig. 1). The tion fissure and the two cones are marked at lower left.

Fig. 3: Source region of lava flow. Eastern portion of the low shield volcano Skeildbreidur is showed in the distance.

Further work: Detailed morphometric studies will be carried out on selected lava flows based on remotely sensed data and ground-based Differential GPS. Hard rock samples at various locations within the flows were collected. Petrographic and petrologic analyses and viscosity measurements will be performed to estimate bulk flow rheologies. Laboratory results are then compared to conventional methods to determine lava rheology. The results will be applied to suitable volcanic lava flows on Mars in order to reliably estimate rheology, and hence, eruption properties.

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