EPSC Abstracts
Vol. 11, EPSC2017-848-1, 2017
European Planetary Science Congress 2017


# Holuhraun 2014−2015 Eruption Site in Iceland: A Flood Lava Analogue for Mars

**Joana Voigt** (1), Christopher W. Hamilton (2), Stephen P. Scheidt (2), Léa E. Bonnefoy, (2), Ingibjörg Jónsdóttir (3), Ármann Höskuldsson (3), and Thorvaldur Thordarson (3)
(1) Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany (joana.voigt@dlr.de), (2) Lunar and Planetary Laboratory, University of Arizona, Tucson, USA, (3) Faculty and Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland

## 1. Introduction

The surface of Mars includes enormous flow fields produced by lava and/or fluvial events [e.g., 1, 2, 3]. The origin of the surface is mainly inferred from morphological and topographical observations based on high-resolution images. Therefore, flow textures (e.g., facies), and topographical relationships can be used as a key tool in reconstructing the evolution of the emplacement and provide information on physical parameter, such as viscosity and effusion rate. The Holuhraun 2014−2015 eruption, with an area of 83.5 km$^2$, is the largest flood lava flow in Iceland since the Laki eruption in 1783–1784 [4, 5]. Studying the products of such a large and recent eruption provides unique insights into the emplacement of flood lavas on Earth and other planetary bodies. Large effusive eruption on Earth are infrequent in the modern geologic record and therefore the 2014–2015 lava flow at Holuhraun offers an ideal study area for examining lava flow textures (i.e. facies) that are unaffected by modification processes induced by running water, aeolian sedimentation, and vegetation. We here present the first facies map of the whole Holuhraun lava flow, which we linked to the chronological emplacement history [5]. Furthermore, we present strong analogues to Martian flow fields, especially within the youngest volcanic province on Mars, Elysium Planitia [1].

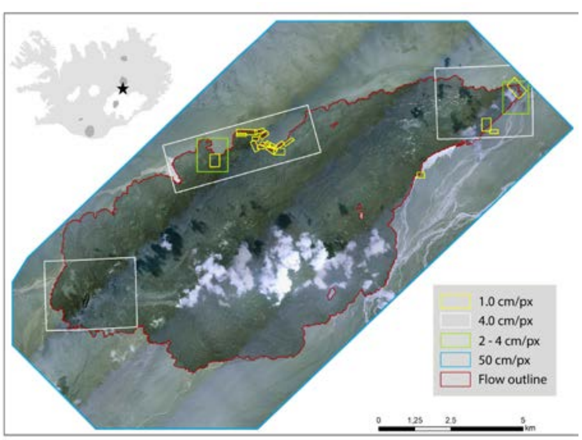


Figure 1: Location of Holuhraun eruption side on Iceland. Boxes represent used remote sensing data in respect to their resolution.

## 2. Data and Method

To map the facies at the Holuhraun lava flow we used an orthomosaic (50 cm/pixel) to generate a facies map of the whole lava flow field with a digitalizing scale of 1:800. Detailed analyses are based on remote sensing data obtained using Unmanned Aerial Vehicles (UAVs) at resolutions of 1–4 cm per pixel and used to generate 4–20 cm per pixel Digital Terrain Models (DTMs). In-situ field observations establish detailed descriptions of the different facies and their relationships to one and another. For a compilation of this information we generated a geospatial database in ArcGIS to compare the known eruption chronology to the different facies. Investigations in Rahway Valles and Marte Vallis on Mars were supported by the Context (CTX) camera (6 m/pixel) [6], High Resolution Imaging Science Experiment (HiRISE) camera (0.3 m/pixel) [7] and topographic constraints from the Mars Global Surveyor (MGS) Mars Orbiter Laser Altimeter (MOLA).

## 3. Results

The facies map of the whole Holuhraun lava flow field contains six main spatial facies, including the two endmembers of lava flow morphologies, ‘a‘ā and pāhoehoe types, as well as “transitional” morphological types—including spiny/rubbly, shelly pāhoehoe, and platy/shelly types—and vent-type material (Figure 2). Within these main facies we identify structures specific to individual lava types, such as lava channel rims, linear compressional ridges and extensional rifts, platy-ridged pattern, spirals and inflation features including lava rise pits and wedges. Comparing our results of the main morphological units with the chronological emplacement map from Pedersen et al. (2017) [5] shows that the main facies are strongly linked to different emplacement episodes. Furthermore the facies we identify at Holuhraun are common on Martian surface. In particular, we observe that flow units in Rahway Valles and Marte Vallis regions of Mars commonly exhibit surface morphologies that closely resemble the "transitional" lava flow types observed in association with the 2014–2015 Holuhraun eruption in Iceland and we infer that they are similarly the products of large fissure-fed eruptions, rather than the products of aqueous flooding events.

## 4. Conclusions

Our results show that there is indeed a link between main facies and the emplacement time. Due to the fact that the chemical composition of the Holuhraun 2014‒2015 event was constant over the eruption period the facies map provides a great opportunity in studying the controlling factors of the morphologies. Further work will concentrate on links to the topographic variations, effusion rate, rheology and emplacement chronology of flow units.


## Acknowledgements

The authors want to thank the Faculty and Institute of Earth Sciences of the University of Iceland in providing assistance and the Vatnajökull National Park (Vatnajökulsþjóðgarður) Service for providing permission and support for the fieldwork. Joana Voigt acknowledges the Geological Society of America (GSA) for supporting the field trip with a Graduate Student Research Grand 2016 and the GSA Lipman Research Award. Christopher Hamilton acknowledges funding support from NASA PGG Grant # NNX13AQ05G and MDAP Grant # NNX13AK62G.


## References


[1] Vaucher, J. et al. (2009), Icarus 204. [2] Jaeger, W. L. et al. (2010), Icarus 205. [3] Tanaka, K. et al. (2014), pamphlet 43 p. [4] Gudmundsson et al. 2016 Science. [5] Pedersen et al. 2017 (in press) Journal of Volcanology and Geothermal Research. [6] Malin, M. C. et al. (2007), J. Geophys. Res. Planets 112. [7] McEwen, A. S. et al. (2007), J. Geophys. Res. Planets 112.


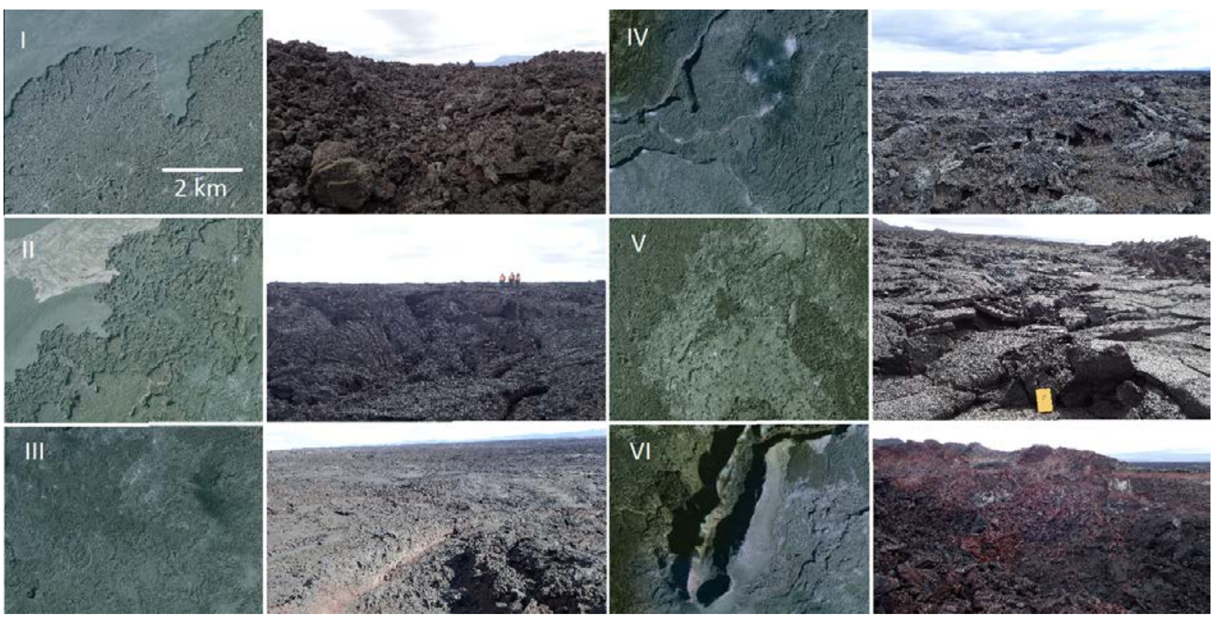


Figure 2: Overview of each facies of the Holuhraun lava flow field based on a mapping scale of 1:800. Left-hand side shows the surface structure seen by remote sensing data with 50 cm per pixel. Right-hand side are examples from the field observations of the relevant facies. I. ʻAʻā-type, II. Spiny/Rubbly-type III. Pāhoehoe-type, IV. Shelly Pāhoehoe-type, V. Platy/Shelly-type, VI. Vent-type.