

Improving Field Lava Flow Temperatures with Lab-based Spectral Emissivities for The 2014–2015 Holuhraun Eruption.

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▶ To cite this version:

Jonas Biren, Muhammad Aufaristama, Lionel Cosson, Leire del Campo, Hao Li, et al.. Improving Field Lava Flow Temperatures with Lab-based Spectral Emissivities for The 2014–2015 Holuhraun Eruption.. AGU 2021 Fall Meeting, 2021, Online, France. 10.1002/essoar.10509906.1. insu-03559136

HAL Id: insu-03559136 https://insu.hal.science/insu-03559136

Submitted on 7 Feb 2022

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INTRODUCTION

How to measure lava flow temperature more precisely?

Lava flows are one of the main hazards related to effusive basaltic volcanism. To minimize their impact during emplacement, we use lava flow distance-to-run predicted by propagation models. These models rely on surface Temperature (T), a key source term parameter that is commonly determined using infrared (IR) measurements of lava radiative heat fluxes by remote sensing (RS) techniques (ground- or satellite-based) [1]. Their results are however subjected to important errors related to the poor knowledge of spectral emissivity (ε) , commonly considered constant (e.g., 0.97 for basalts) [2, 3]. This oversimplification is an important source of uncertainties in derived temperatures, which restrain our capacity to accurately model active lava flows.

In this study, we confront thermal maps modeled with constant ε and based on ε laboratory measurements. We describe the methodology used to improve previous RS thermal maps using lab-based ε measurements. We discuss the potential impacts from improvements of temperature accuracy on lava flow thermo-rheological modelisation.



Holuhraun eruption, Bardarbunga volcano (2014-2015, Iceland



METHOD

Spectral emissivity of basaltic magma from the 2014–2015 Holuhraun eruption was measured in situ. Spectra were systematically acquired over a wide spectral range (400–8000 cm^{-1}) covering TIR, MIR and SWIR, and up to ~1800 K using IR emission apparatus [4]. Then, we transformed the ε -T relationship into equations at two wavelengths of interest for RS; 10.9 μm (TIR), and 1.6 μm (SWIR). Finally, we implemented these equations in Aufaristama et al. (2018) [5] thermal model and run the refined model as follow: 1- First iteration with constant ε (0.97) to determine T.

2- Creation of emissivity map for each band using T to calculate ε .

3- Second iteration with $\varepsilon_{calculate}$ to refine lava flow T.

Improving field lava flow temperatures with lab-based spectral emissivities for the 2014–2015 Holuhraun eruption **Jonas Biren^{1*}, Muhammad Aufaristama², Lionel Cosson³, Leire del Campo³, Hao Li¹, Joan Andújar¹, Aneta Slodczyk^{1,3}**

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NH25A-0528



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Difference in T due to lab-based Emissivity



CONCLUSIONS

Lab-based IR results help increasing accuracy in temperature retrieval by Remote Sensing techniques (by \geq 50°). These observations imply that lava is less likely to loose heat radiatively thus taking longer time to dissipate. In turn, it allows for longer distances to be reached increasing ultimately the associated hazard especially in inhabited area. Consecutively, our results will help reduce the error related to thermo-rheological models [6] of lava flows and support hazard assessment during effusive volcanic crisis.



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