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Thermal characterisation and mapping of the fumeroles on Vulcano, Italy: Potential analogues for Martian terrains

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Abstract

Vulcano is the southernmost active volcanic island of the Aeolian archipelago linked to back arc spreading of the Sicilian microplate. The four main eruptive phases over the last 120 ka are associated with recurrent hydromagmatic to explosive phases and have resulted in the present day La Fossa Cone crater. Active volcanism on Vulcano is currently confirmed to degassing sites (fumaroles) linked to the underlying volcanic plumbing system. Their location, distribution and temperature have important implications for the state of the volcanic system and are often used as planetary analogues for hydrothermal alterations (e.g. [1]) and potential associations with microbial life.

Our work is based on field data collected in summer 2016, 2017 and 2018 as part of the German ROBEX Project - the Helmholtz Alliance for Robotic Exploration of Extreme Environments. ROBEX aimed to bring together scientists and engineers from different communities of both space sciences and deep-sea research. Data collected during the field campaigns includes high resolution aerial drone photogrammetry, thermal IR and UV camera, UV-VIS-NIR spectrometers, thermocouples and fugacity probes. The drone data was processed to produce high resolution (2cm /pixel) mosaics and textured digital elevation models to map the location and extent of the fumerolic fields. The IR camera was used on more than 300 individual fumaroles in 2016 and 2017.

Preliminary mapping results (Fig. 1) show that the active fumaroles are concentrated in cm to m wide fissures in the northern part of the La Fossa Cone. Temperature variations are present between both a) fumaroles within the same fissure (fissure tip to centre and edge to centre) and b) different fissures in general. The IR data clearly shows a wide spectrum of temperatures ranging from 100°C to excess of 350°C. Detailed mapping will be completed during the campaign this summer and is aimed at linking surface features with the temperature distribution. In addition, comparison with previous thermal surveys (e.g. [2] and [3]) will help to support models such as increased permeability or conduit sealing as mechanisms influencing the location and variability of gas and heat flux from active volcanic sites.

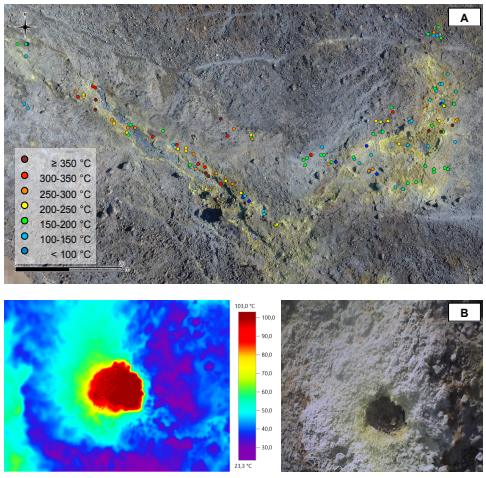

Figure 1: High resolution drone based photogrammetry model and image mosaic with an overlay of the maximum measured temperatures at the mapped fissures, b.) example of an IR image (left) and associated RGB image (right) aquired during the 2017 field campaign.

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References

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