Geophysical Research Abstracts
Vol. 18, EGU2016-17823, 2016
EGU General Assembly 2016

A comparative Study of Circulation Patterns at Active Lava Lakes

Einat Lev (1), Clive Oppenheimer (2), Letizia Spampinato (3), Pedro Hernandez (4), and Kathi Unglert (5)

(1) Columbia University, New York, NY, United States (einatlev@ldeo.columbia.edu), (2) Cambridge University, Cambridge, UK, (3) INGV, Catania, Italy, (4) ITER, Spain, (5) University of British Columbia, Vancouver, Canada

Lava lakes present a rare opportunity to study magma dynamics in a large scaled-up "crucible" and provide a unique natural laboratory to ground-truth dynamic models of magma circulation. The persistence of lava lakes allows for long-term observations of flow dynamics and of lava properties, especially compared to surface lava flows. There are currently five persistent lava lakes in the world: Halemaumau in Kilauea (Hawaii, USA), Erta Ale (Ethiopia), Nyiragongo (Congo), Erebus (Antarctica), and Villarica (Chile). Marum and Benbow craters of Ambrym volcano (Vanuatu) and Masaya (Nicaragua) have often hosted lava lakes as well.

We use visible-light and thermal infrared time-lapse and video footage collected at all above lakes (except Villarica, where the lake is difficult to observe), and compare the circulation patterns recorded. We calculate lake surface motion from the footage using the optical flow method (Lev et al., 2012) to produce 2D velocity fields. We mined both the surface temperature field and the surface velocity field for patterns using machine learning techniques such as "self-organizing maps (SOMs)" and "principle component analysis (PCA)". We use automatic detection technique to study the configuration of crustal plates at the lakes' surface.

We find striking differences among the lakes, in flow direction, flow speed, frequency of changes in flow direction and speed, location and consistency of upwelling and downwelling, and crustal plate configuration. We relate the differences to lake size, shallow conduit geometry, lava viscosity, crystal and gas content, and crust integrity.