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The December 2018 eruption of Ambrym volcano: Constraints on the magma plumbing system through the joint analysis of ground deformation and degassing data

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In the past 30 years, magmatic activity at the basaltic volcano of Ambrym (Vanuatu), which hosts a notable 12-km-diameter caldera, has been characterized by strombolian activity restricted to the two (or more) semi-permanent lava lakes. Little is known about the magma plumbing system of this volcano, due to its remote location (lack of instrumentation) and its persistent background activity (which does not provide insights into deeper magmatic processes). In the past 4 years, however, two effusive intra-caldera eruptions have allowed us to exploit ground deformation (InSAR) and degassing (satellite-based hyperspectral measurements) data. In particular, ground deformation measurements during the December 2018 eruption show a migration of magma from within the caldera to more than 20 km into the SE Rift Zone and towards the ocean. A similar event has not occurred at Ambrym since the 1930's, and this is thus the first opportunity to model the propagation and emplacement of magma in the volcano's well-defined rift zone.

In addition, a spectacular, island-wide signal from a decompressing source accompanied this intrusive event, as well as an extinction of the five lava lakes associated with multiple crater collapse, ash clouds, and followed by a drastic decrease in degassing. We use InSAR ground deformation measurements to track the decaying subsidence signal during the days and weeks following the eruption. By combining SAR images from multiple satellites (ALOS-2, Sentinel-1, and Cosmo-SkyMed), we are able to model the geometries, locations and pressure changes due to multiple deformation sources, including the initial intra-caldera dike intrusion, the SE rift zone intrusion, caldera faulting, and the deep, decompressing source. Together with ground observations and satellite gas measurements from Sentinel-5P's TROPOMI, which allow for reconstructing sulphur dioxide emission rates and injection heights into the atmosphere, these models provide us with a comprehensive overview of an extremely active, yet understudied volcanic system and the magma plumbing system that drives its persistent activity.