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Thermal imaging, seismo-acoustic signals and SO2 degasification following a partial summit collapse at El Reventador volcano, Ecuador

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El Reventador volcano is currently the most active volcano in Ecuador. It is located in the sub-Andean region, 90 km to the east of Quito. Since its last reactivation in 2002, El Reventador has produced more than 60 lava flows, numerous small pyroclastic density currents, and multiple changes to the uppermost morphology of the summit. The most recent major morphological change began in April 2018, when intense explosive activity led to the partial collapse of the northwestern flank of the edifice. This event left a horseshoe-shaped scar open to the northwest approximately 400m long x 150m wide x 200m deep. In this study, we integrate infrared (IR) thermal imaging, SO2 gas measurements, and seismic and infrasound signals to better understand the evolution of this unusual activity. In particular, we focus on a subset of 170 explosions between April and November 2018 corresponding to the highest-quality thermal images from the northeast fixed infrared camera and most complete records from the other sensors (gas, seismic, infrasound). IR images obtained during an overflight in June 20th, 2018 reveal the existence of at least five vents (A-E) exposed within the new feature, with two located along the upper part of the scarp, a third in the middle, and two near the bottom. SO2 degassing is generally low at El Reventador (< 600 T/d), but showed a peak probably related to the formation of the new feature. Seismic and infrasound records from sensors located on the eastern flanks also show a clear and consistent reduction in the number and amplitudes of explosions posterior to the summit collapse. In general, explosive activity is observed at each vent, though sometimes multiple vents can be active simultaneously. The majority of activity (96%) in this time period occurred in the three uppermost vents (A-C), with the rest occurring in the bottom two (D, E). In the 13 months since the partial collapse, a new pyroclastic cone has grown within the confines of the scarp. Recent visual images obtained from the northeast show that the height of the new cone now exceeds that of the crater rim. This situation has led to small pyroclastic density currents along the northeast flank of the volcano due to overflowing of the new cone. Correlation of data from these four combined techniques will help to identify the unique signature of each vent and thus aid in classifying the source vent of an explosion even in the absence of any visual/thermal observations.