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FAMoUS goes to Guatemala: Integrated thermal and high-speed imaging of explosive activity at Santiaguito dome and Volcan de Fuego

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The combined use of high-speed visible and infrared cameras is a novel technique capable of unparalleled resolution of different eruptive processes at different time and space scales.
In January 2012, a field campaign to Guatemala has been carried out to study the current activity of Santiaguito and Fuego, two of the most active volcanoes of the world, showing different eruptive styles. While Santiaguito was approached by a multiparametric experiment combining also tilt, seismo-acoustic and photogrammetric monitoring (see expedition account at http://expedicionsantiaguito.blogspot.com/), at Fuego only the FAMoUS (Fast MoUltiparametric Setup) equipment has been deployed. The equipment comprises a synchronised high-speed infrared (FLIR SC645) and visible range (Optronis) cameras acquiring images at 100-200 and 500 fps, respectively, and two microphones. A GPS receiver allowed the synchronisation of the acquired data with other installed monitoring systems.
At Santiaguito dome the activity was characterised by the production of highly viscous lavas flows and coulée venting from the dome's summit, rolling of (incandescent and not) metric-sized blocks and eventually block and ash flows, accompanied by intermittent summit explosions. These latter occurred from eruptive fissures which were oriented according to the local stress field at the top of the dome. Continuous recordings and observation during four days of activity from a distance of ca. 2.5 km and ca. 1.2 km above, remarkably revealed that i) two geometrically-distinct systems of fractures are periodically and sequentially activated: one controlled by the flow field at the upheaved lava tumuli at the summit, and a second system marking the rim between the issuing lavas and the confining wall rocks; ii) tilt inflation/deflation cycles occurr with about 20 minute periods; iii) recurring explosions (ca. 20 minutes to 2 hours) cause gas- and ash-emission streaming through the two fracture systems eventually ejecting ballistics on the active lavas and dome surroundings; iv) after the first main explosion, a minor ash emission follows within a few minutes from the tumuli area; iv) continuous degassing is restricted to the high temperatures fumaroles at the rim of the tumuli while degassing from the summit is driven by the intermittent explosions.
At Fuego, two days of quasi-continuous recording was carried out from an observation point located at ca. 900 m horizontal and 200 m vertical distance from the summit crater, respectively. Here the volcanic activity consisted of mildly to moderate energetic explosions producing cannon-like ejection of incandescent meter-sized ballistics up to 850 meters from the vents, and of small buoyant volcanic plumes rising for 100-300 m and rapidly dispersed in atmosphere by the strong winds, and short-lasting ash-venting. This two-fold activity was randomly interchanging and discontinuously occurring in time. Although our observation point prevented the direct view of the active vents, thermal images were able to distinguish at least three eruptive vents from which gas-solid mixture jets issued. Combined high-speed thermal and visible images allow the discrimination of gas-particles coupling/decoupling, the estimate of ejection velocity of ballistics and the thermal evolution of the observed plumes.