

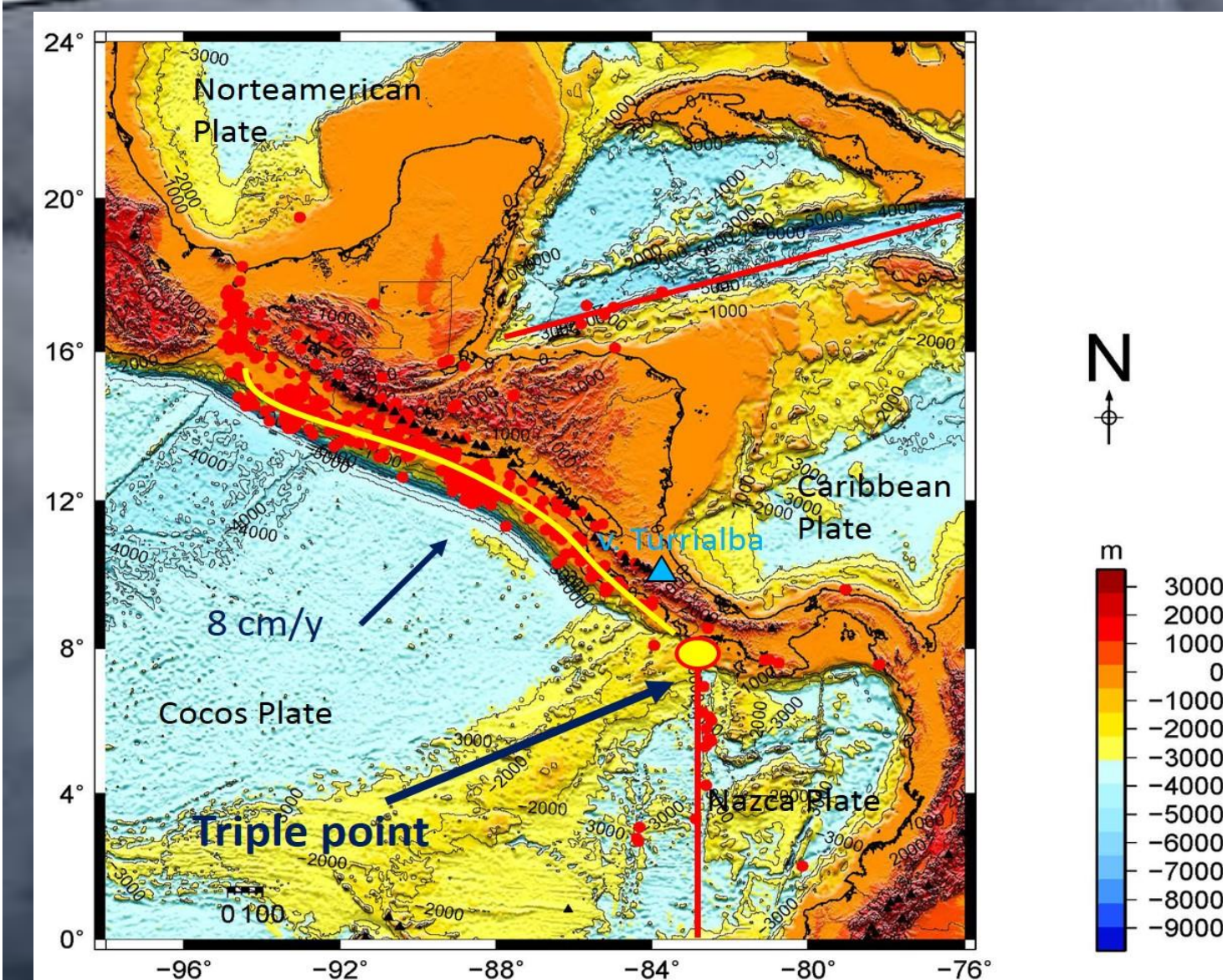
The last step of the volcanic unrest in Turrialba volcano: a new stage of magmatic eruptions

Gino González^{1*}, Raúl Mora-Amador^{1,2}, Carlos Ramírez Umaña^{1,2}, Federico Lucchi³, Dmitri Rouwet⁴, Francesca Forni⁵ & Yemerith Alpizar¹

*ginovolcanico@gmail.com



Geological context



Costa Rica location and tectonic setting

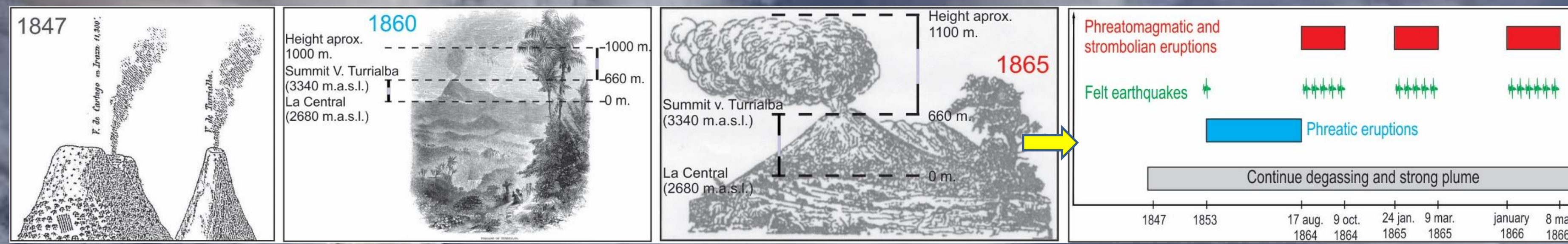


Aerial view of Turrialba volcano, a NE crater (old); b Central crater (eruption 1864-1866); c SW crater (last eruption)



Animals and agriculture affected

Historic activity



2002-2009: UNREST!!!



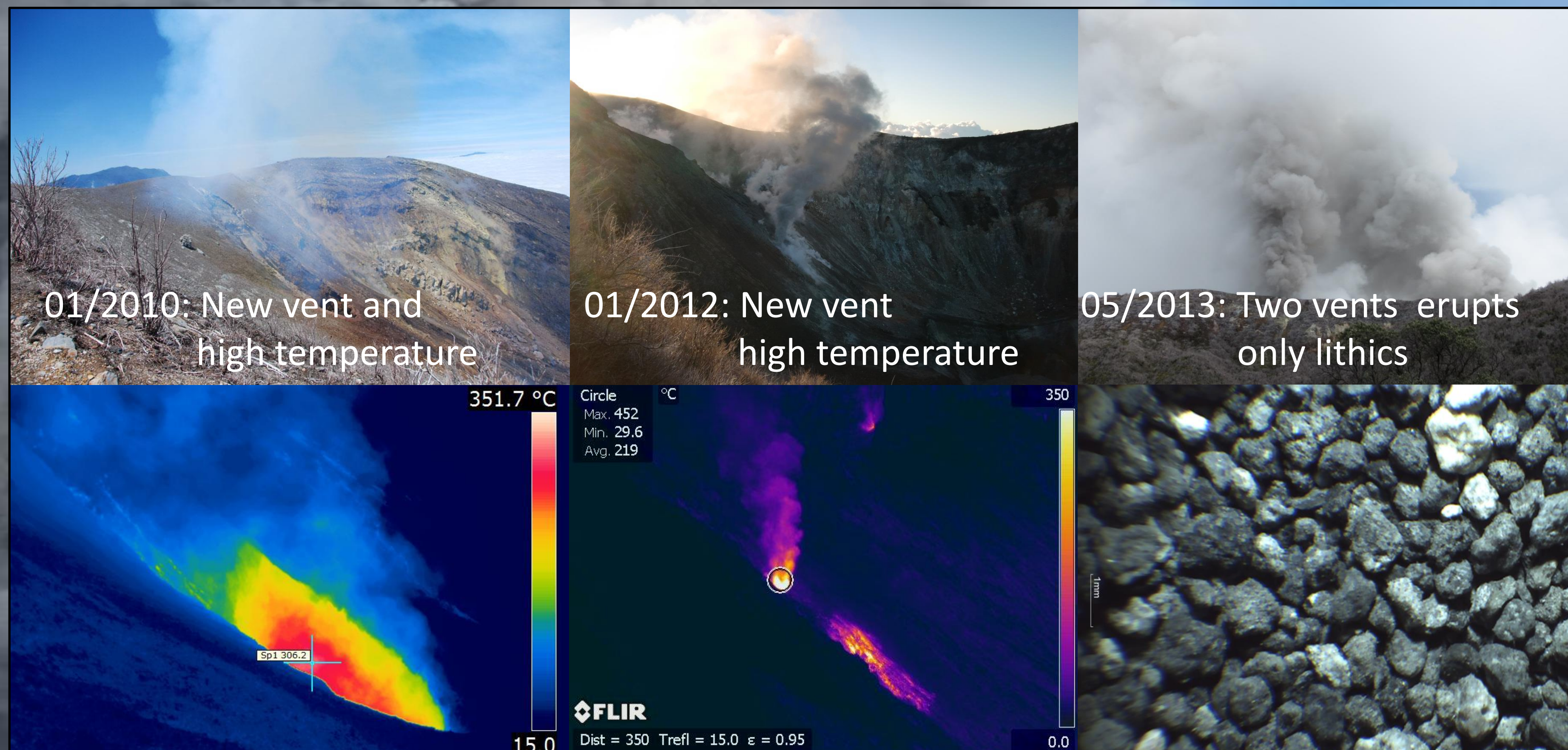
2002: Detected SO₂, seismic swarm

2006: seismic swarm

2007: SO₂/H₂S; ³He/⁴He: 8.2

2009: Strong degassing ³He/⁴He: 7.6

Phreatic eruptions occurred: UNREST!!!

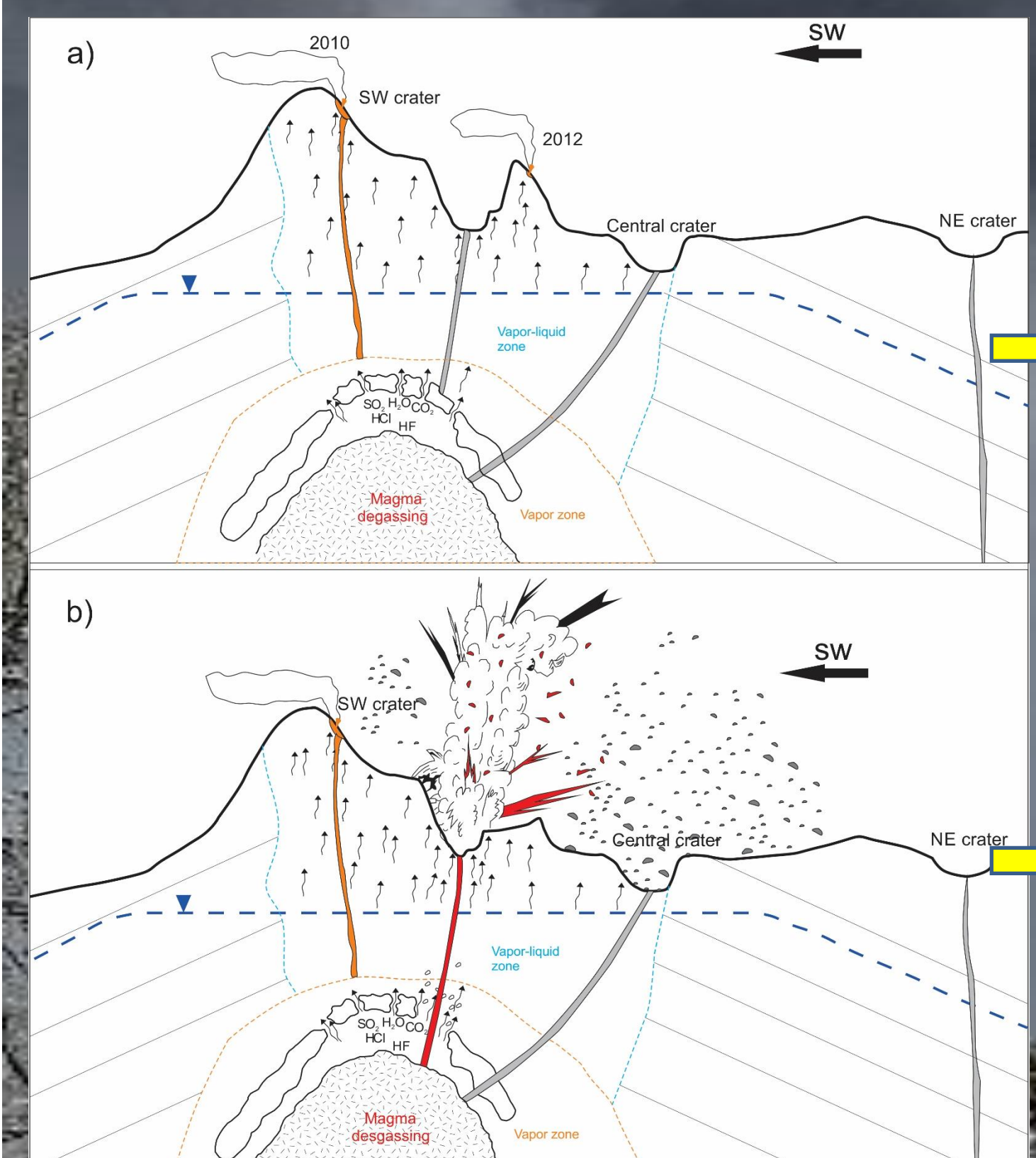


01/2010: New vent and high temperature

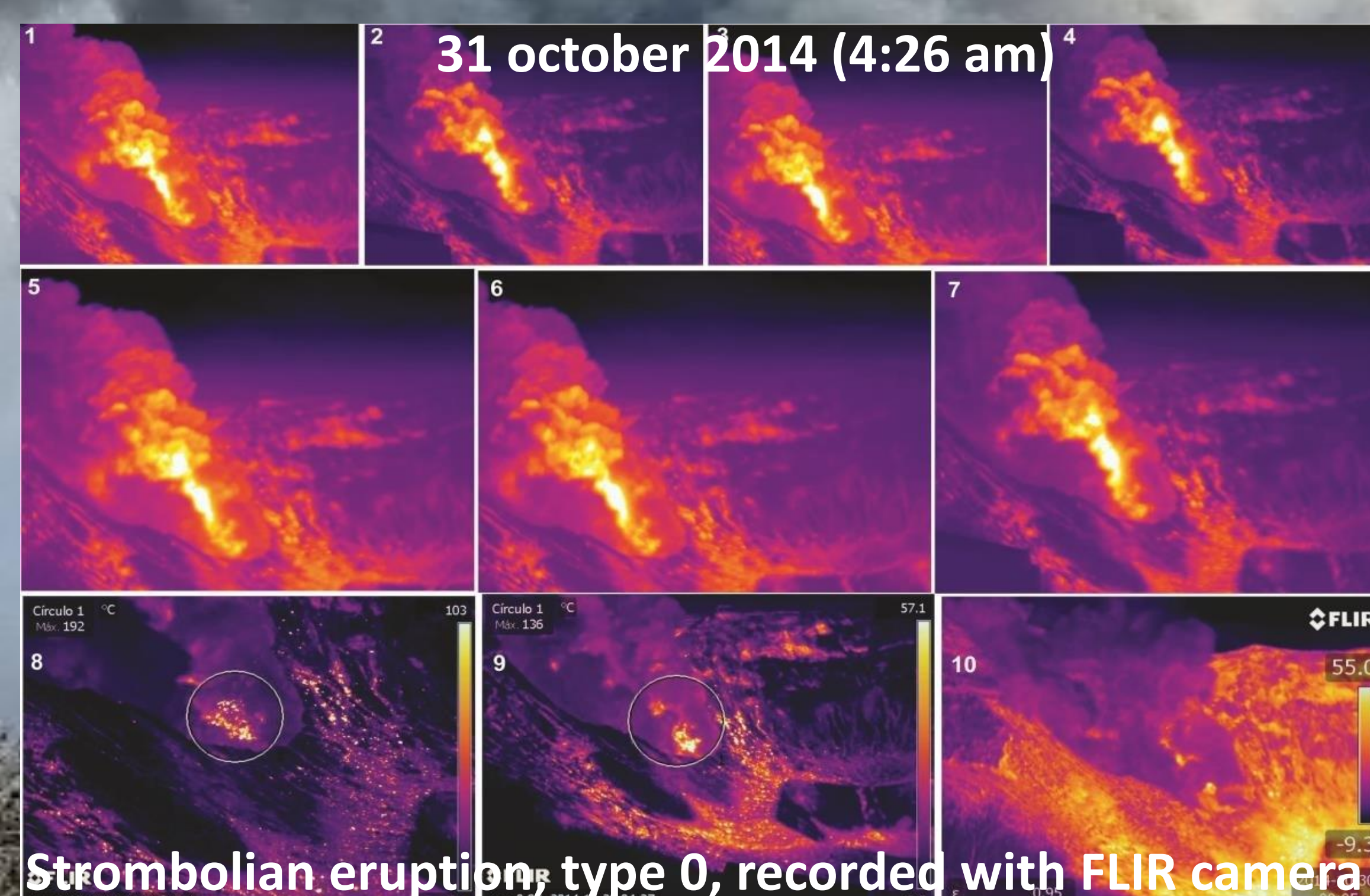
01/2012: New vent high temperature

05/2013: Two vents erupts only lithics

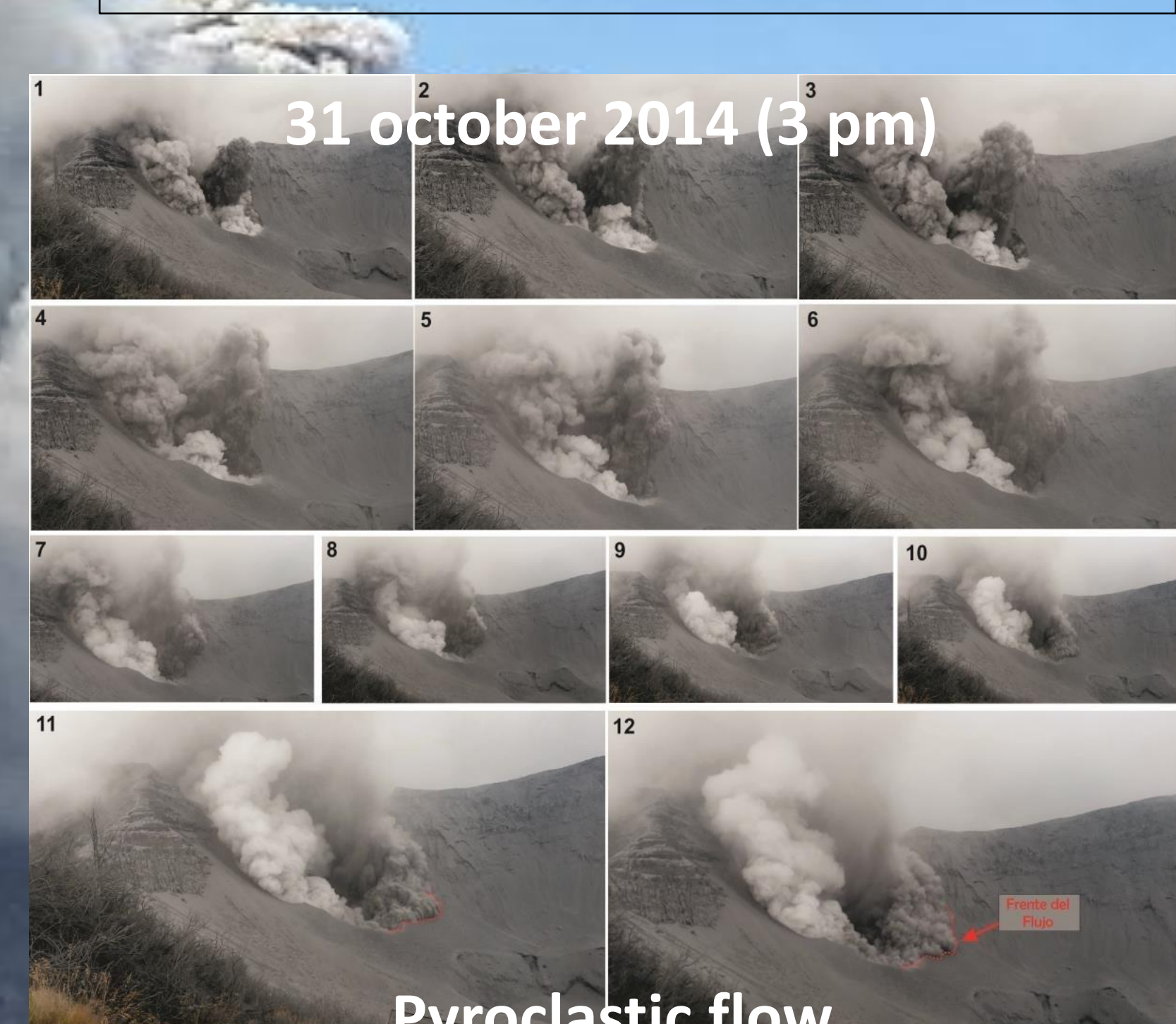
The last step: magmatic eruptions



31/oct/14



Strombolian eruption, type 0, recorded with FLIR camera

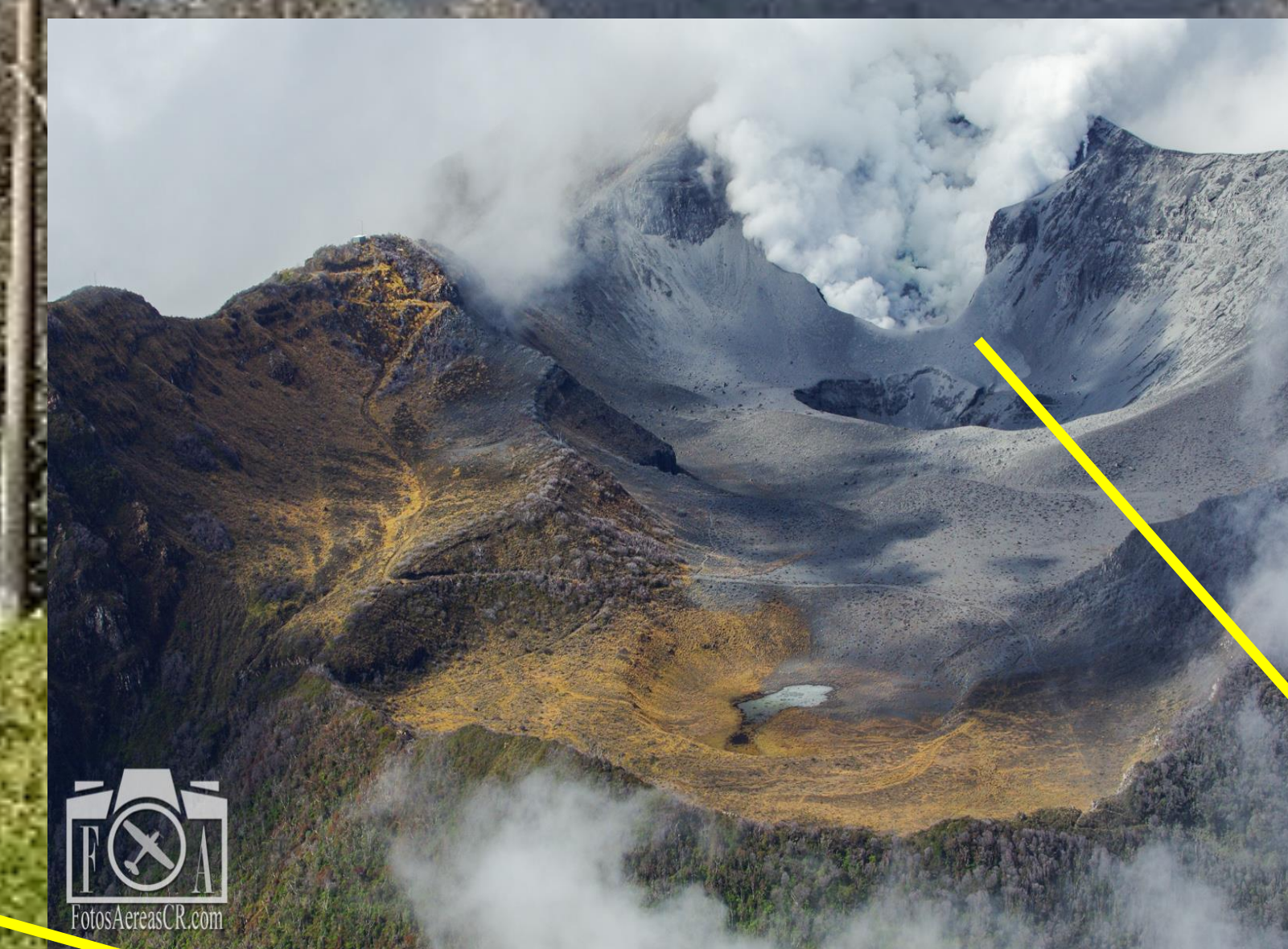


31 October 2014 (3 pm)

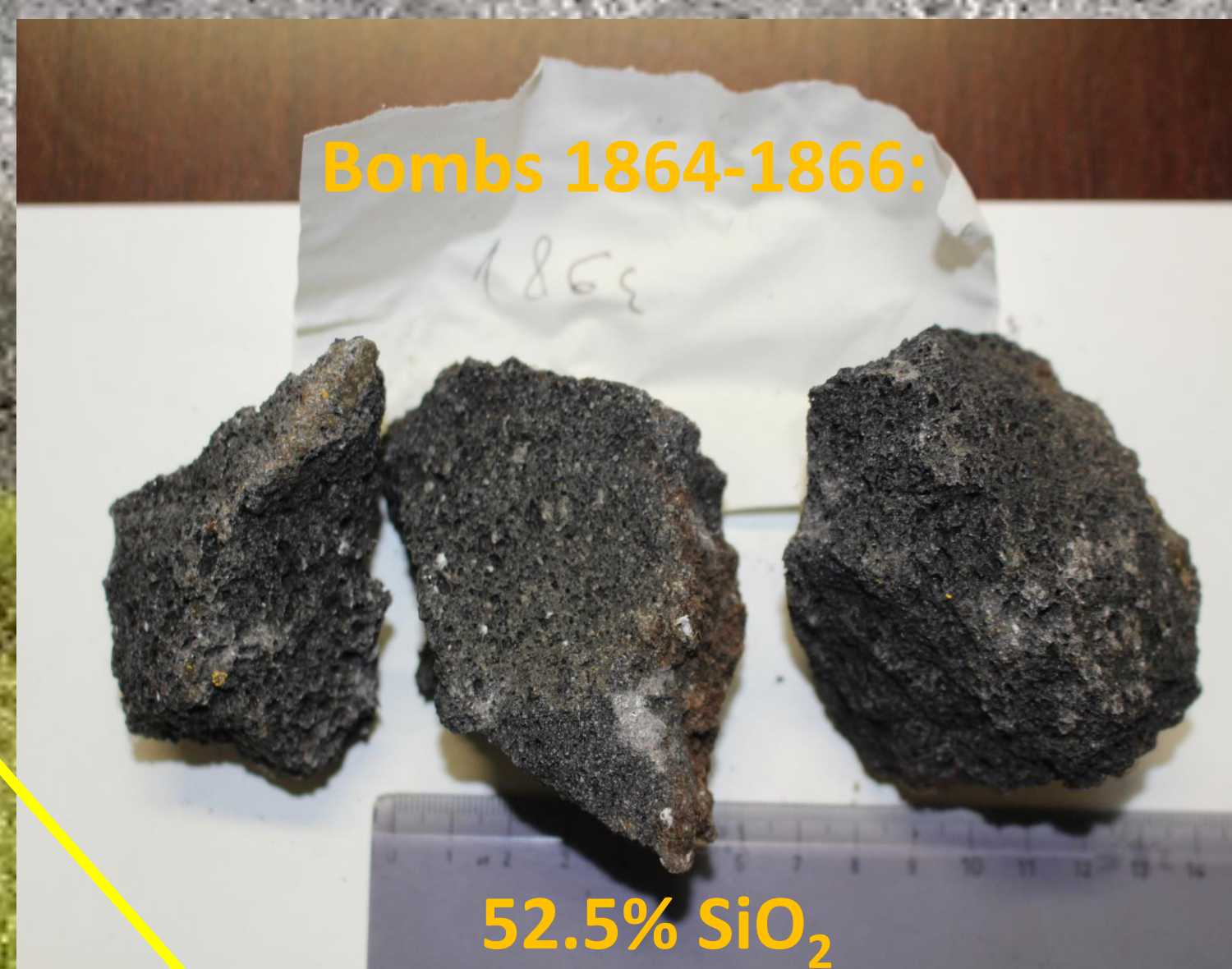
Pyroclastic flow



12/mar/15

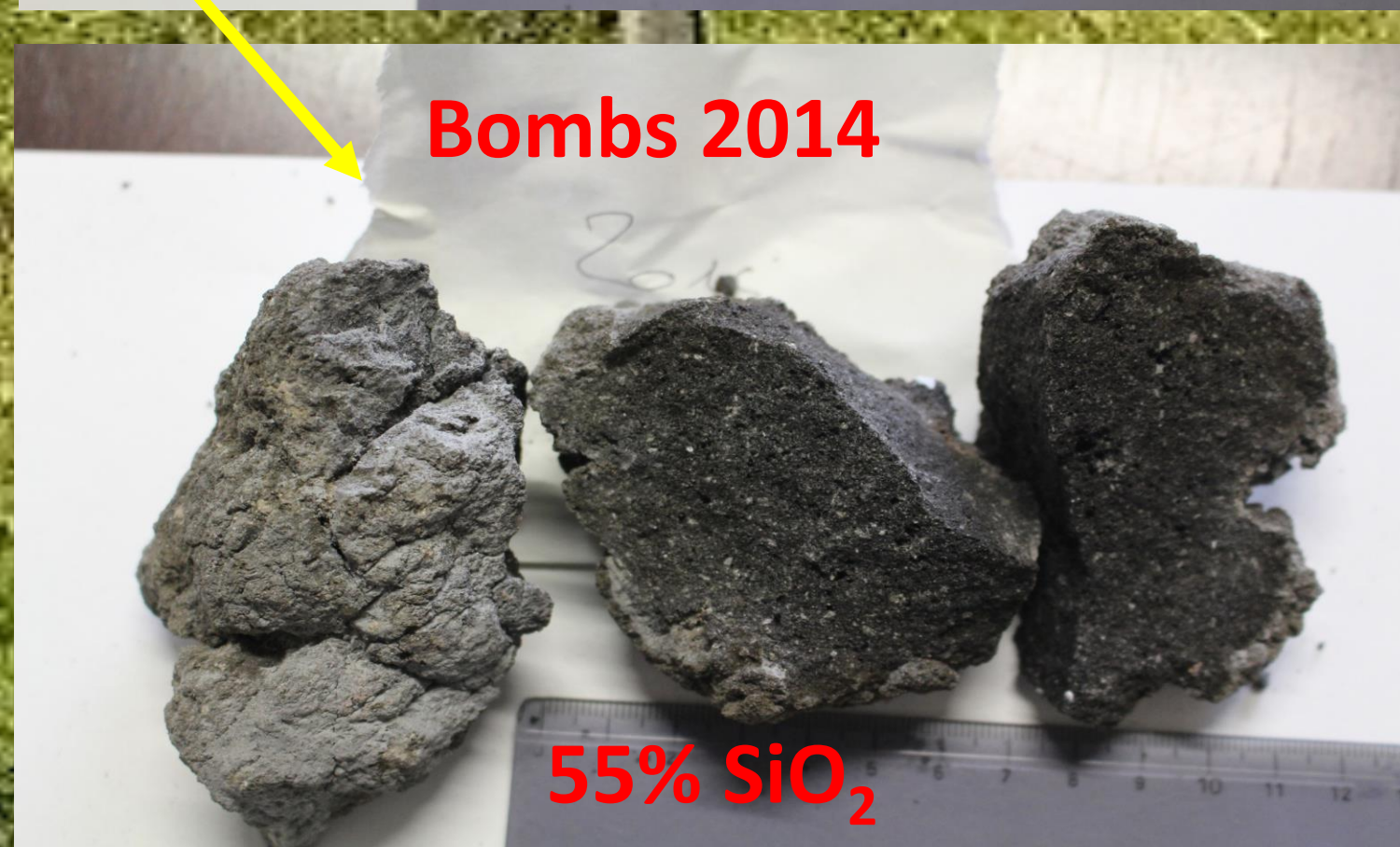


Non juvenil ash



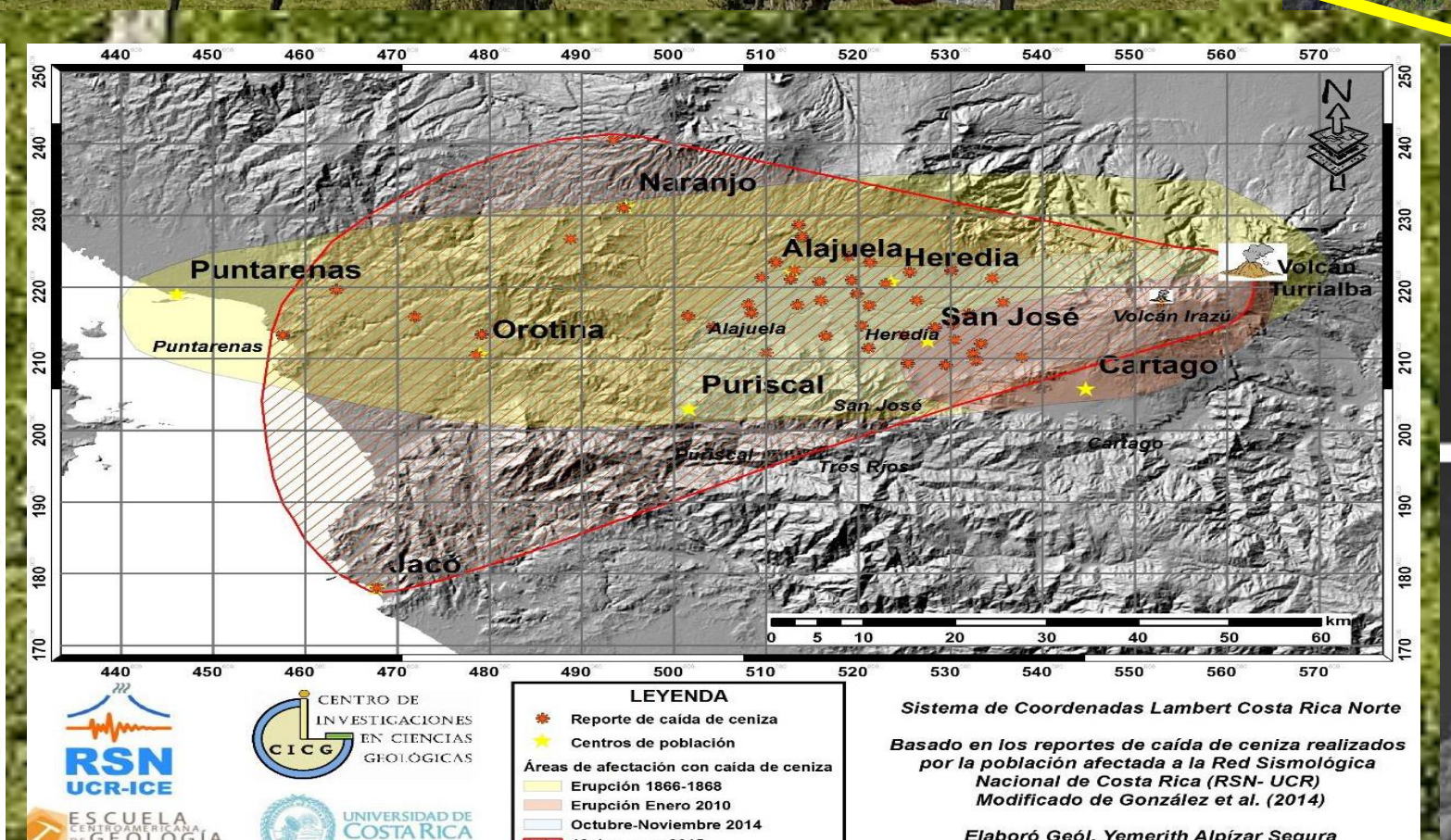
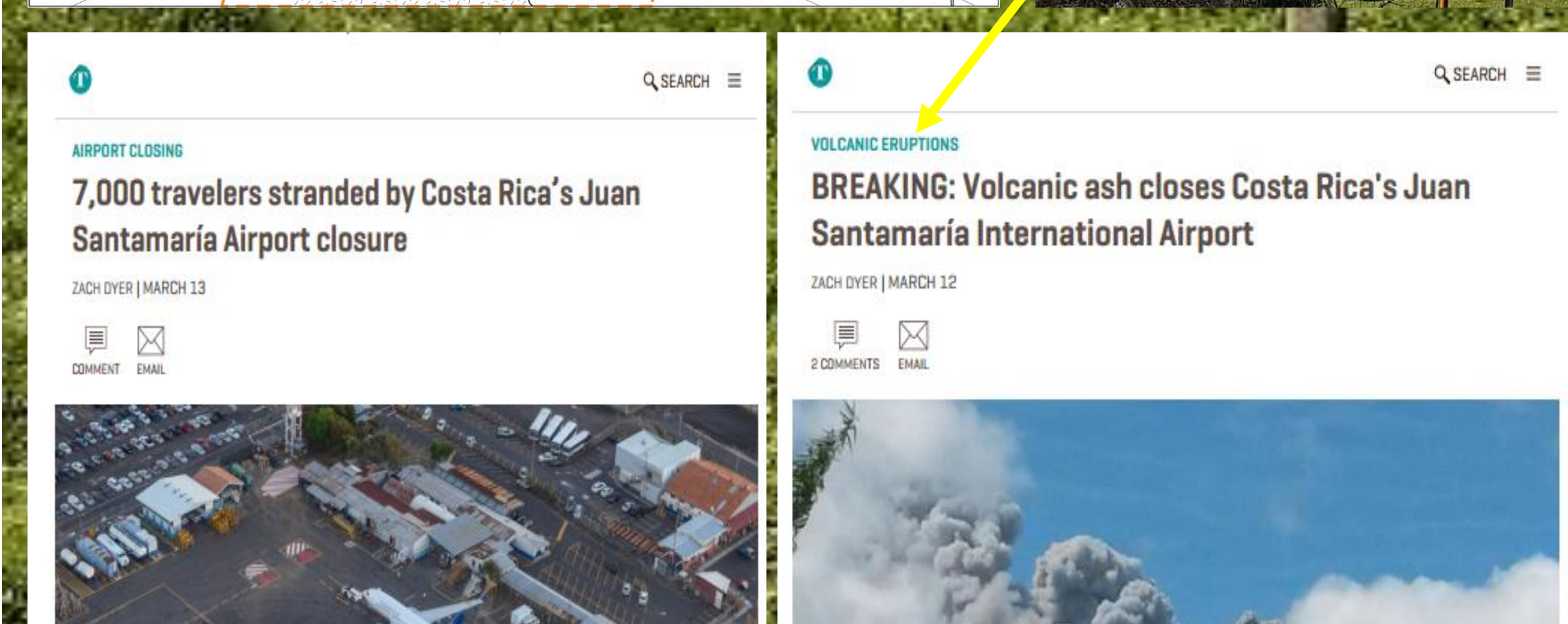
Bombs 1864-1866:

52.5% SiO₂



Bombs 2014

55% SiO₂



Abstract

In 1864-1866, Turrialba volcano had a strombolian eruption with some phases of phreatic and phreatomagmatic activity, that covered the Central Valley of Costa Rica with a variable thickness of ash. During this eruption, the ash fell up to the province of Puntarenas, 110 km west of Turrialba. After more than 100 years of hydrothermal activity, in 2005 the gas emission showed an increase of (HCl+HF)/CO₂ and (SO₂+H₂S)/CO₂ ratios (Vaselli et al. 2009), which indicates a change from a hydrothermal to a magmatic fluids source. Conforming with data from Hilton et al. (2010), we obtained increased values of R/R_{air} (⁴He/³He) from 6.85 to 8.2 and CO₂/³He from 9.4 to 19.6 x10³. The highest values were measured in the SW crater. These geochemical changes were accompanied by an increase in seismicity and temperatures of the newly appeared fumaroles. After that, on January 2010, a new phreatic eruption occurred from a 100 m large, new vent in the inner wall of the SW crater. Small amounts of ash fell in the Capital San José. On 12 January 2012, a second phreatic eruption occurred along the rim between the SW and Central craters, near the Arbol Quemado gas fracture (which has been active since 2001). The day before this eruption molten sulphur flows were originated from Arbol Quemado. A third phreatic eruption on 21 May 2013 involved both the new vents simultaneously. All the erupted material was lithic. The volcanic unrest continued with tremor episodes and LP seismic signals accompanied by a further increase in the temperature of fumaroles, reaching 700 °C, as measured by FLIR thermal camera. During the night of 29-30 October 2014, a first strombolian eruption occurred as demonstrated by direct observation, temperatures near 900°C measured by FLIR thermal camera and the release of ballistic scoriaceous bombs and abundant magmatic gases (type 0; Leduc et al. 2015). This was the first magmatic eruption of Turrialba volcano since the major 1864-66 eruptive period. The eruption produced the collapse of a large portion of the eastern inner wall of the SW crater. Some scoriaceous bombs were collected during the following days, together with ash samples in different sectors of the summit area. Petrochemical analyses of the bombs were compared to those of the bombs of the 1864-66 eruption, in order to evaluate variations in the eruptive dynamics and feeding system. Early results revealed a basaltic andesitic composition with a similar petrography (plagioclase, pyroxene and olivine) and porphyricity compared to the 1864-66 juvenile products. Morphoscopic SEM analyses of ash revealed the dominant occurrence of lithic fragments consisting of sulfate and hydrothermalized aggregates. This means that ash is almost entirely related to the phreatic explosions, as result of the wall collapse. Other eruptions occurred in December 2014, and, more recently, in March and April 2015. Ash fell in different provinces, including San José, and caused the closure of the international airport of Costa Rica for one day.