

Characteristics of the beginning of the 2019 eruptive crisis at Ubinas volcano (Peru)

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Abstract

Ubinas volcano has produced moderate explosive eruptions during the last ~500 years. With 26 eruptive periods, this composite cone is the most active volcano in Peru. The 2006–2009 and 2013–2017 eruptions impacted people, agriculture, and livestock within 15 km of the vent. On 24 June 2019 a new eruptive cycle started with minor emissions of tephra and aerosols. Activity increased on July 19 with an explosion beginning at 2:30 AM (local time). At that time, seismicity also increased with a predominance of LP-type signals. Two clearly differentiated and wind-controlled volcanic plumes were observed. Initially, the plume reached 6500 m above the summit and the main dispersion axis was ESE, dispersing ash as far as 300 km away to the villages of Jesús de Machaca and Catacora, Bolivia, where ash fall disrupted people's daily activities. While the first plume was still active, a 1200-m-high secondary plume developed and was dispersed to the SE, reaching more than 200 km away into the Tacna region (Peru). After July 19, the SO₂ emission rate increased reaching 9600 TN/day on July 23. The tephra fall on July 19 and gas emissions forced Civil Defense authorities to subsequently evacuate residents living in the valleys around Ubinas within 15 km of the volcano. Just after the tephra fall on July 19, deposit thickness was measured along the secondary dispersion axis, where the nearest populated and most impacted areas are located. The accumulation of lapilli and ash during the July 19 eruption reached 7 mm in the village of Ubinas, 5 mm in Tonohaya, 4 mm in San Miguel, 3 mm in Escacha and Huatagua, 2 mm in Huarina and 1 mm in Matalaque, ~20 km away. Fine ash accumulation was also reported at the Quellaveco mine, 90 km to the SE. Samples collected at 3.2 and 6 km from the vent allowed three types of juvenile clasts to be differentiated; dark- and light-gray scoria and dense, dark-gray lithics. Some juvenile clasts have bands of dark and light material, suggesting a partial mixing (mingling) of compositionally different magmas, which might have triggered the eruption. Based on the variety of juvenile clasts and unprecedented SO₂ emission rates compared to the two past eruptive periods, we expect stronger eruptive activity or at least a long-lasting eruptive cycle.

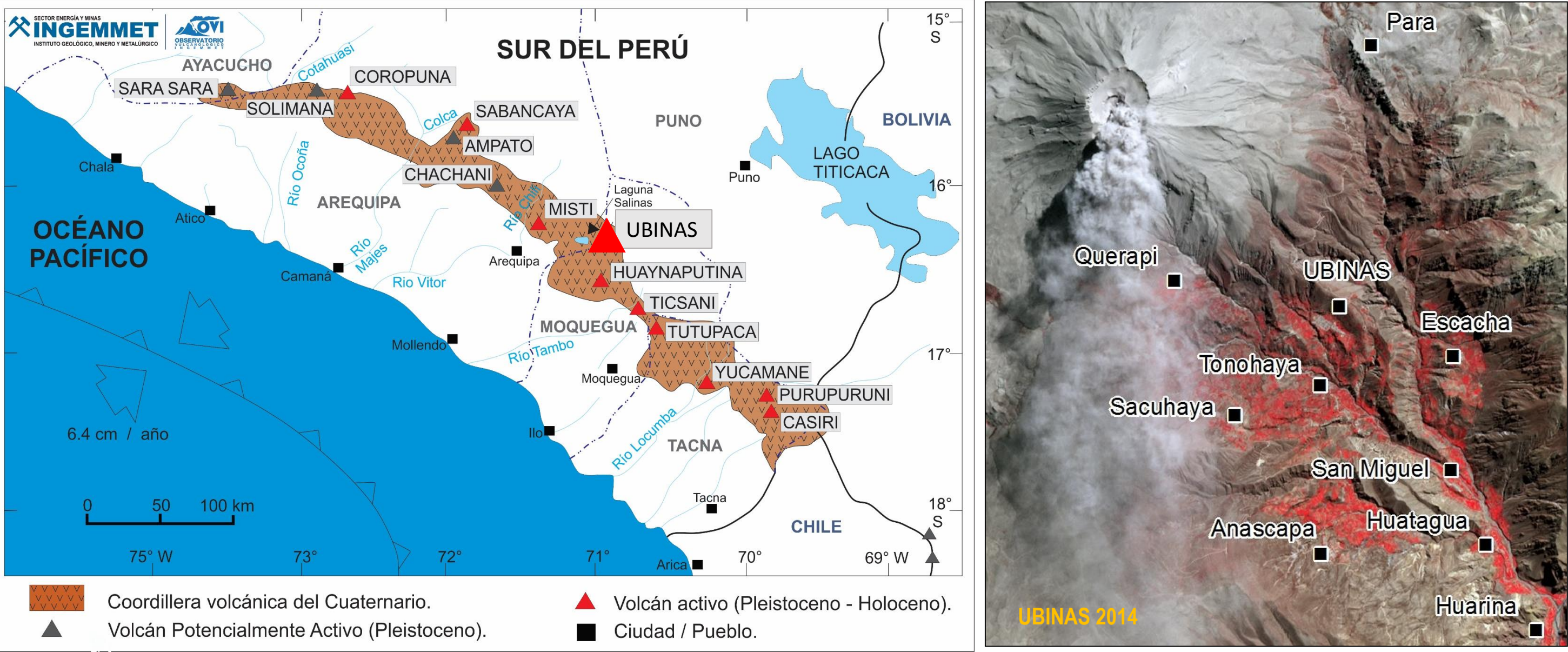
CHARACTERISTICS OF THE BEGINNING OF THE 2019 ERUPTIVE CRISIS AT UBINAS VOLCANO (PERU)

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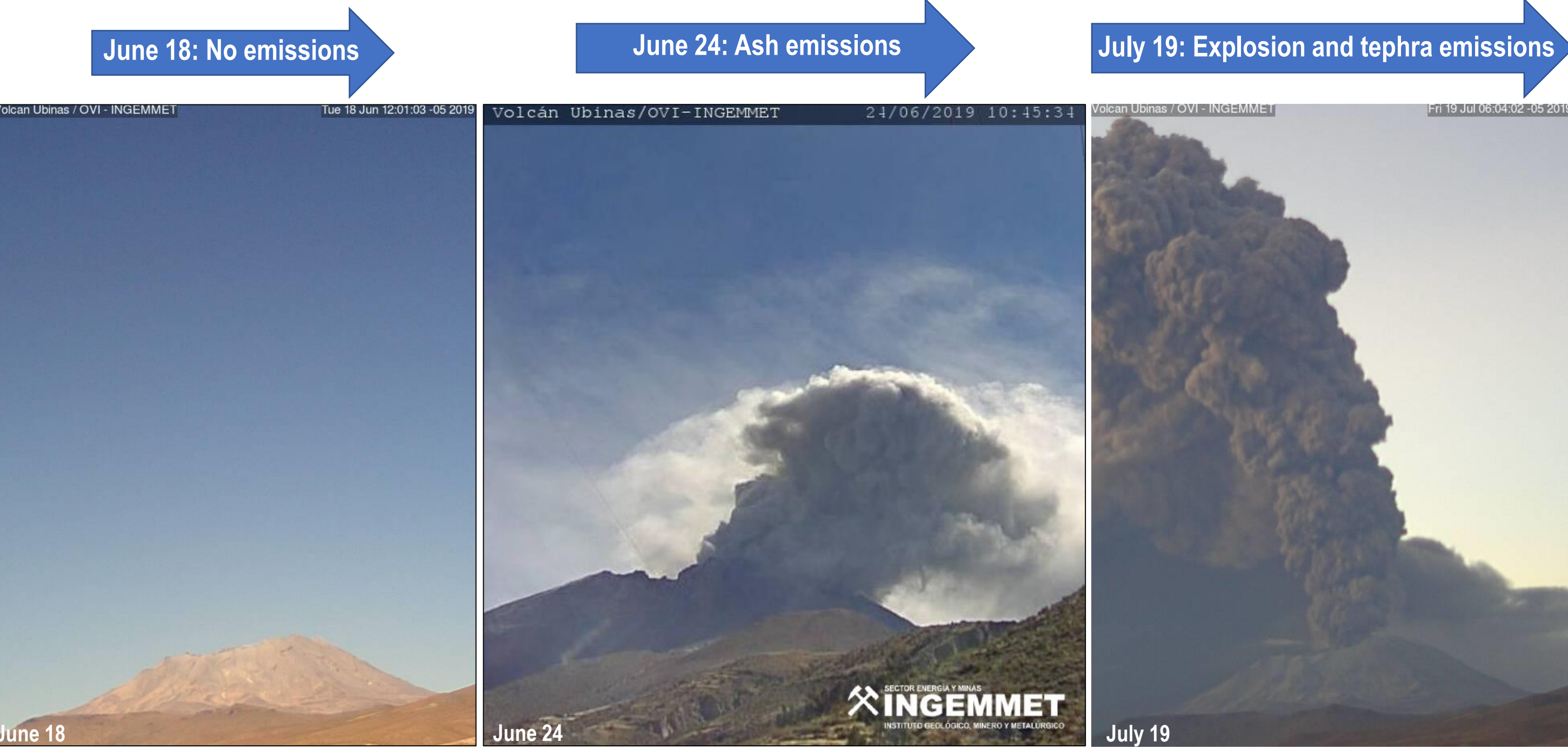
INTRODUCTION

Throughout the last few years in the Central Volcanic Zone, explosive activity of volcanoes has disturbed the daily lives of people and caused damage to the infrastructure and economic activities. In southern Peru, three eruptive cycles of Ubinas volcano (16° 22' S, 70° 54' W; 5672-m asl) have impacted agriculture and livestock and forced the evacuation of villages within around ~10 km from the vent. With 26 eruptive cycles in the last 500 years, this composite cone is the most active volcano in Peru.

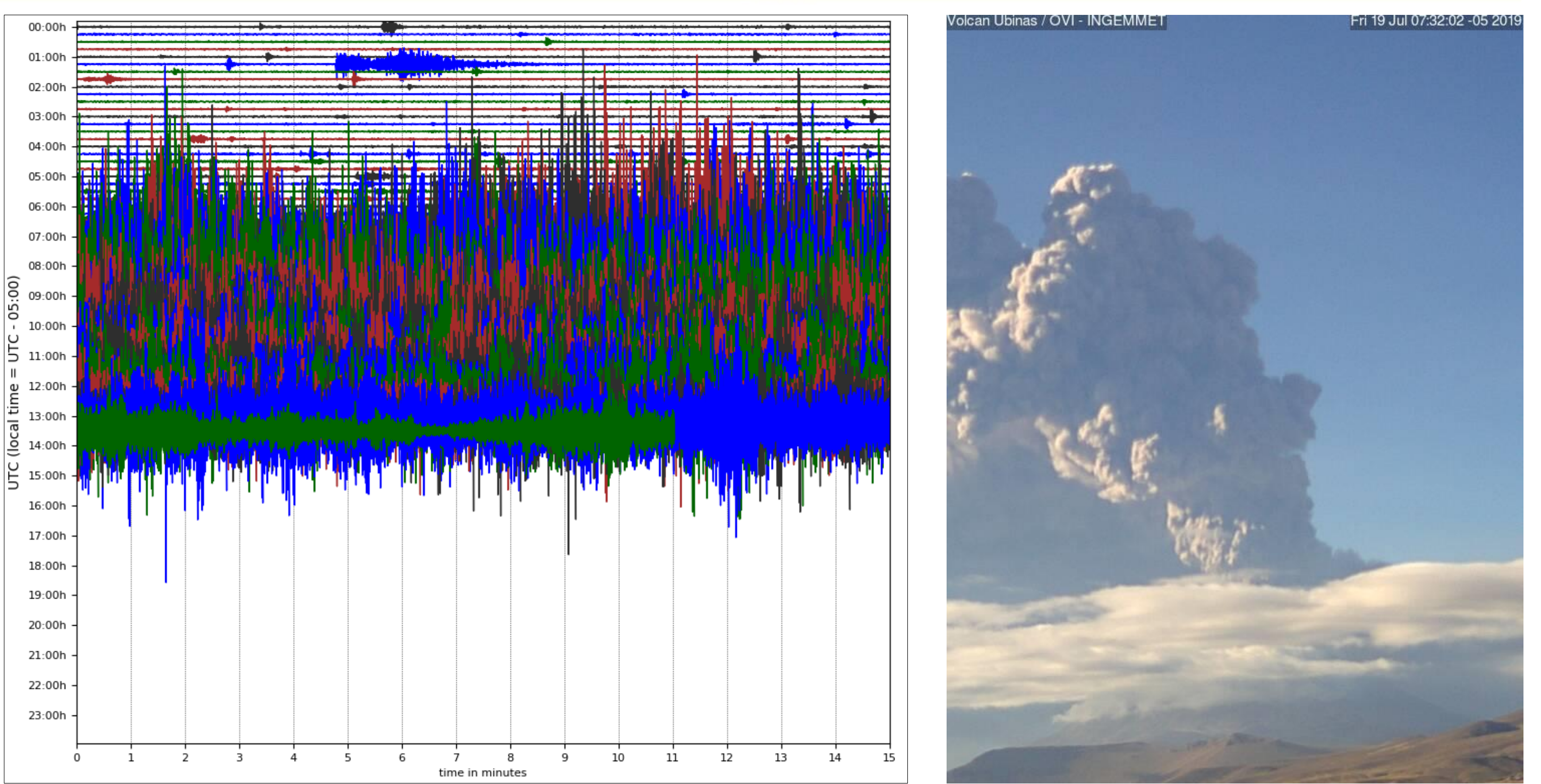
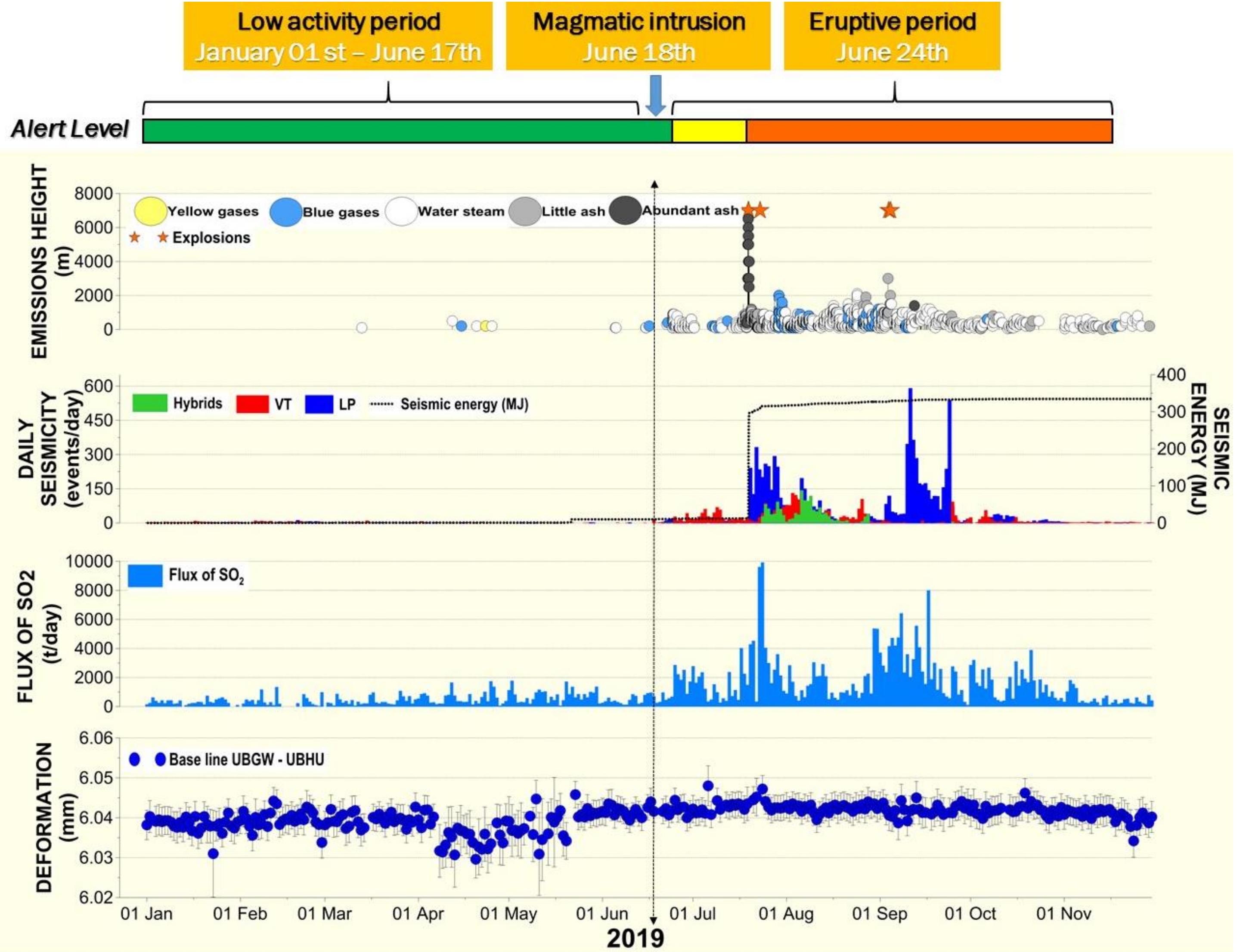


THE ONGOING ERUPTIVE PERIOD

On June 24th 2019, a new vulcanian eruptive cycle started with minor emissions of tephra and aerosols. Activity increased on July 19 with an explosion beginning at 2:30 AM (local time).



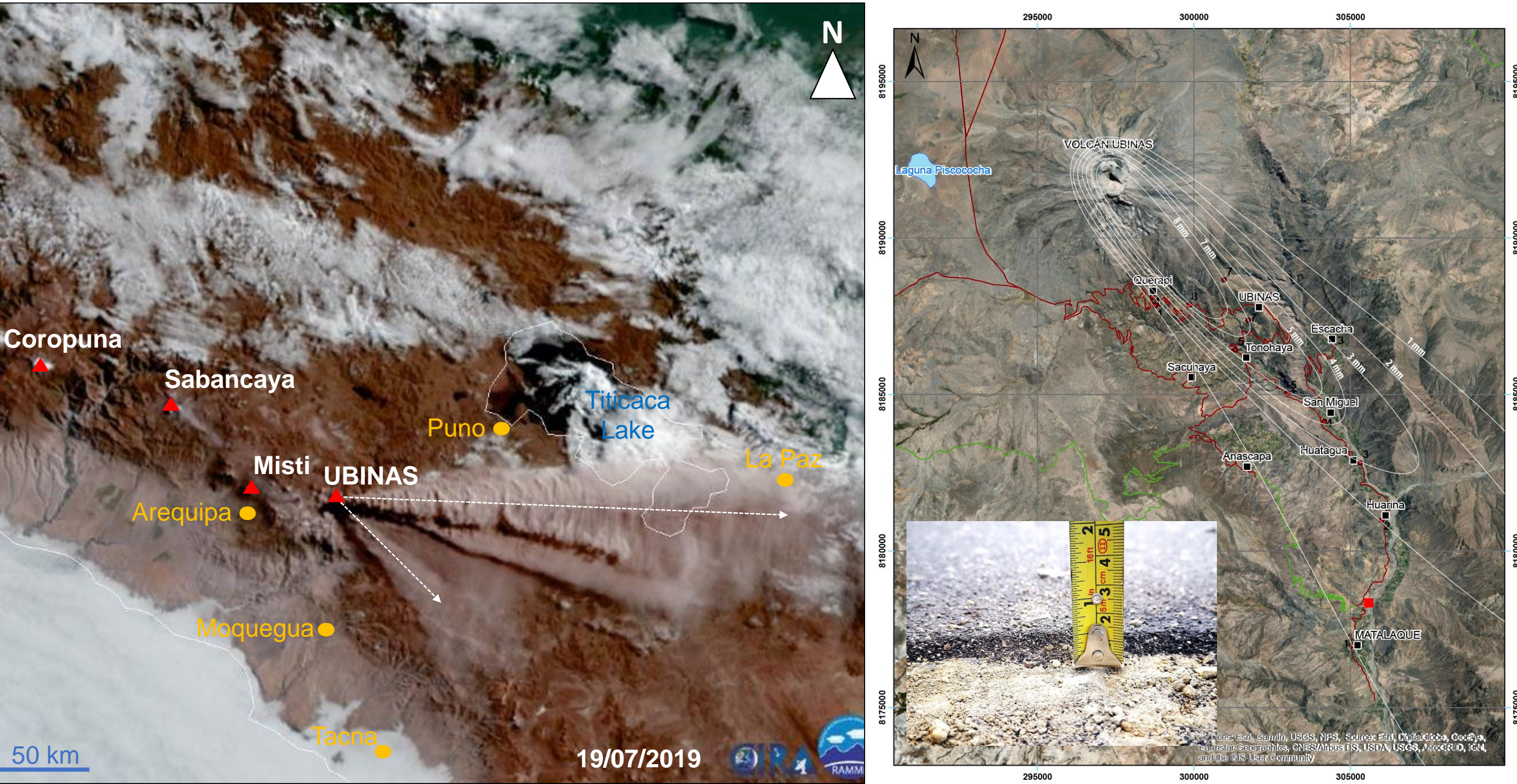
The activity of Ubinas has changed from April to June. These changes were observed in seismicity, deformation, and SO₂ fluxes previous to the eruption. The first change was associated with a small inflation starting in April to May, this activity was followed by an increase in the volcano-tectonic seismicity and emission fluxes of SO₂. Explosive activity with increasing seismicity (predominance of LP-type signals) started on July 19th. Hybrids and VT-type seismicity was accompanied with high flux SO₂ emissions reaching as much as 9600 tons/day.



TEPHRA DEPOSITS

The major explosion and tephra emission occurred on July 19th. Two clearly differentiated and wind-controlled volcanic plumes were observed. Initially, the plume reached 6500 m above the summit and the main dispersion axis was ESE, dispersing ash as far as 300 km away to the villages of Jesús de Machaca and Catacora, Bolivia. A simultaneous 1200-m-high secondary plume developed later in the eruption and was dispersed to the SE, reaching more than 100 km away into the Tacna region (Peru).

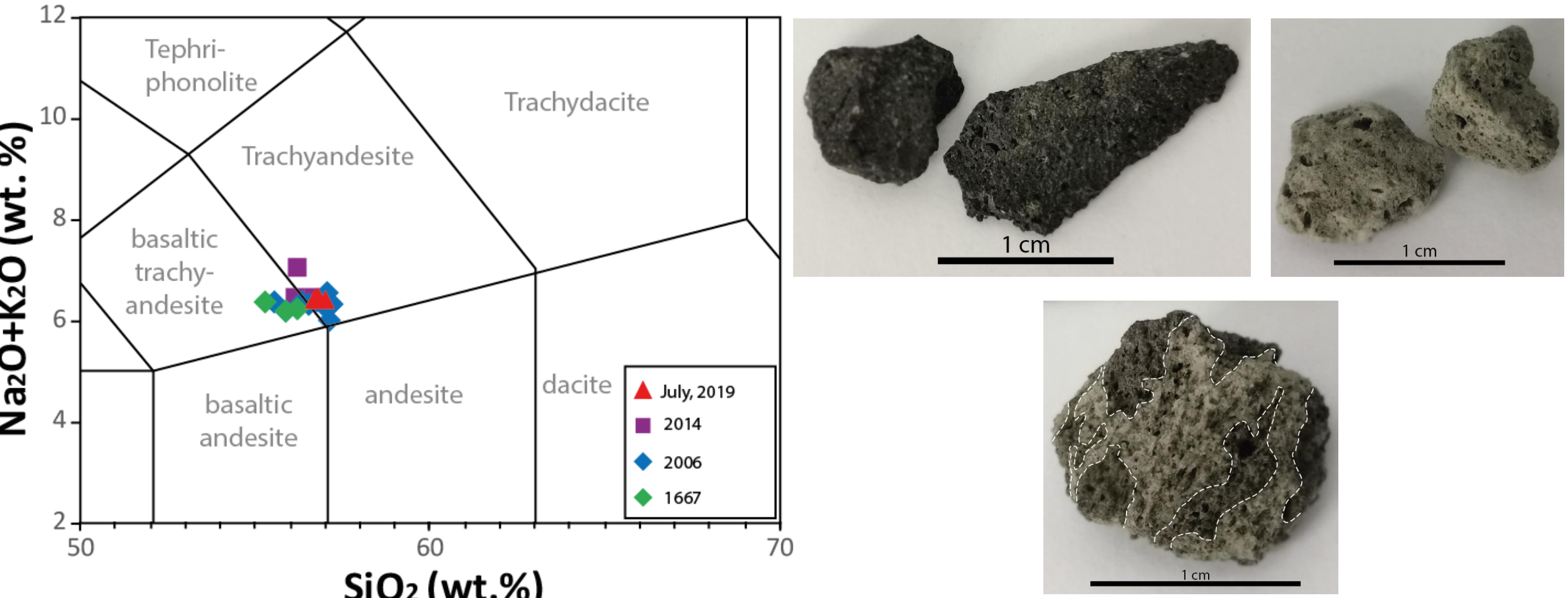
Just after the tephra fall on July 19, deposit thicknesses were measured along the secondary dispersion axis, where the nearest populated and most impacted areas are located. The accumulation of lapilli and ash during the July 19 eruption reached 7 mm in the village of Ubinas, 5 mm in Tonoehaya, 4 mm in San Miguel, 3 mm in Escacha and San Miguel, and 1 mm in Matalaque, ~20 km away. Fine ash accumulation was also reported at the Quellaveco mine, 90 km to the SE.



CHARACTERISTICS OF THE ERUPTIVE PRODUCTS

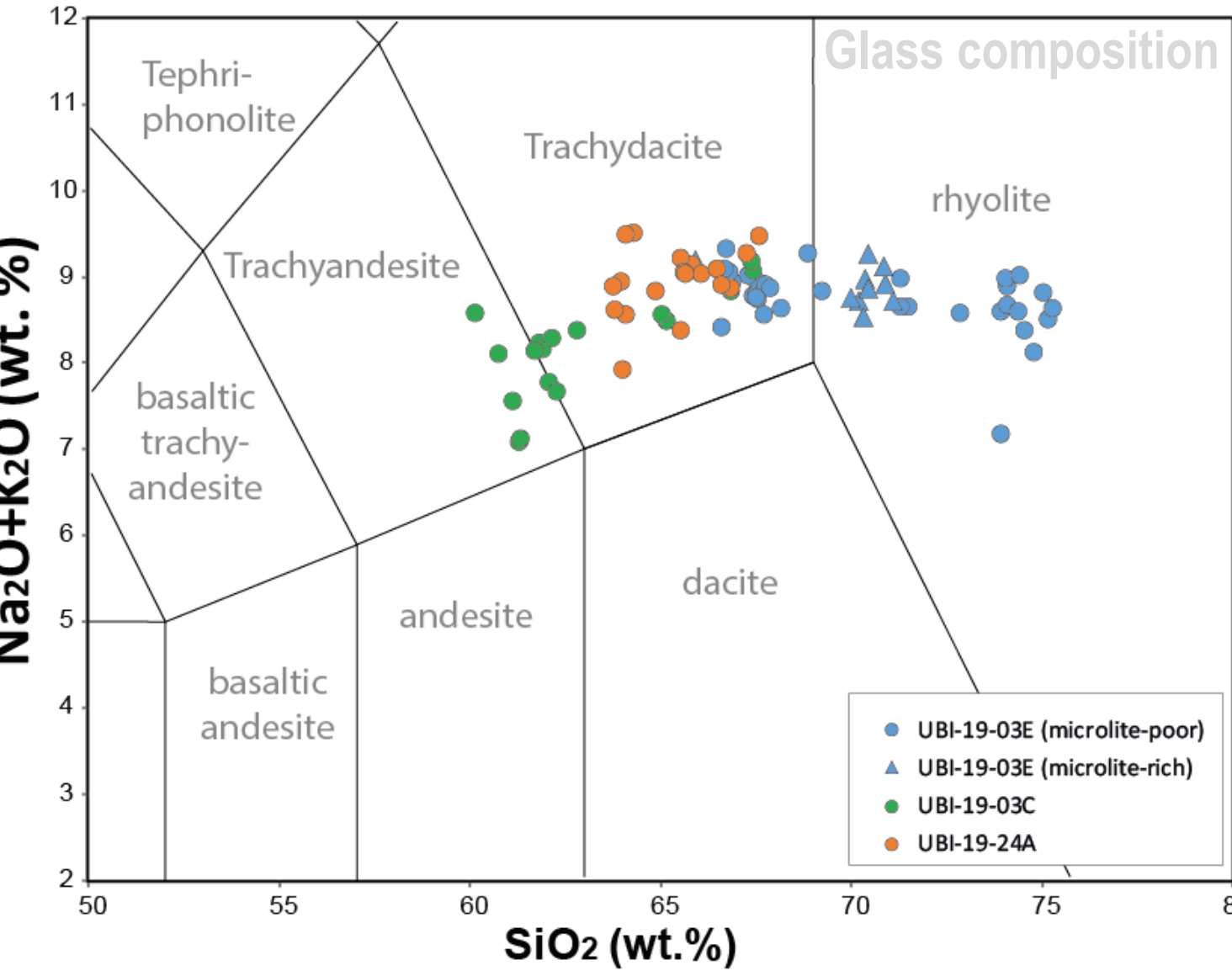
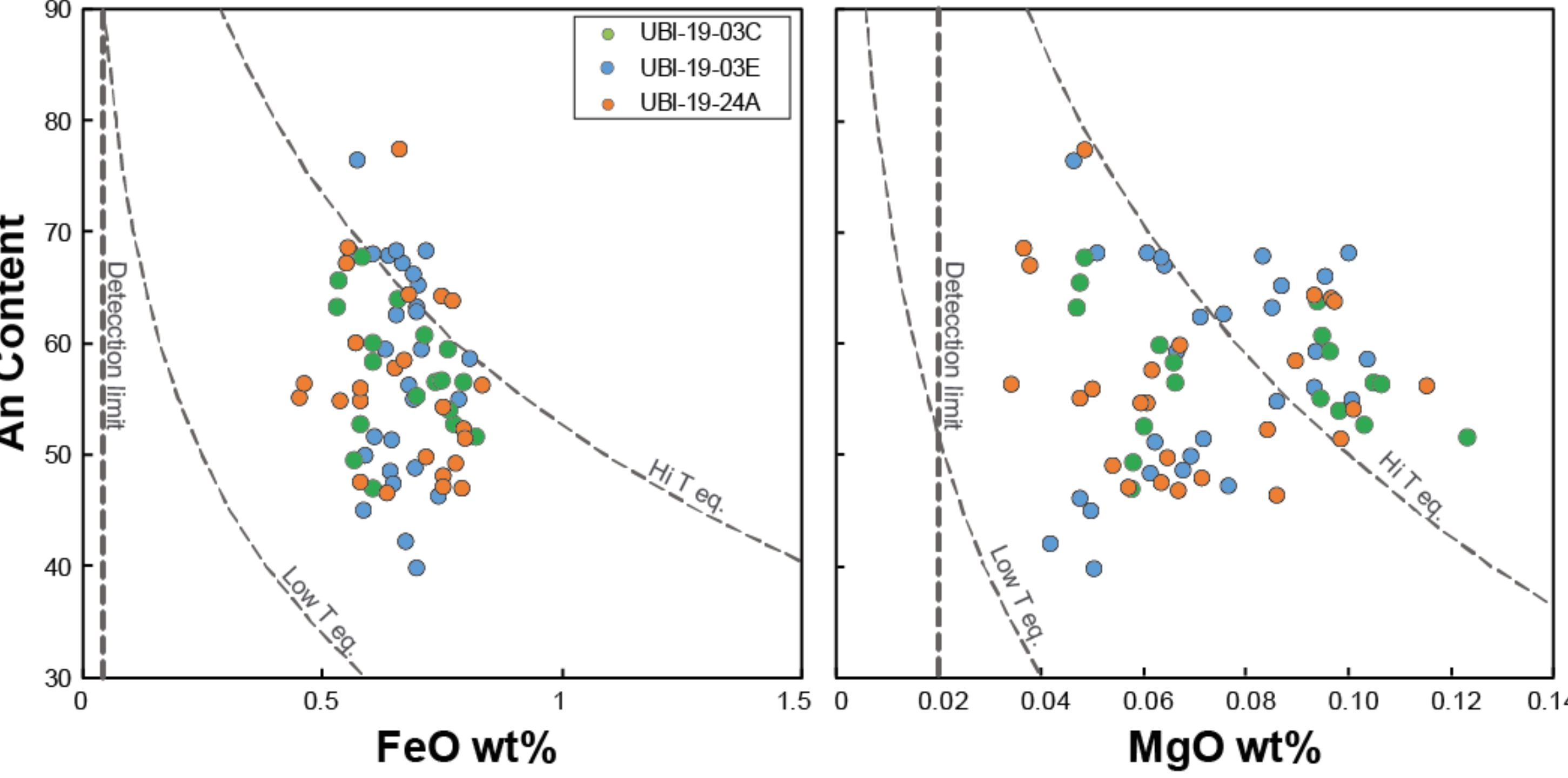
Collected samples show angular to sub rounded shapes, with sizes that reach 2-cm diameter at 3.2 km from the vent. Three types of juvenile clasts are distinguished; dark- and light-gray scoria and dense, dark-gray lithics. Rare juvenile clasts have bands of dark and light material.

Whole-rock chemical analyses indicate trachyandesite compositions, which are similar to material emitted during the 2013-2017, 2006-2009 and 1667 eruptions.



Microprobe analysis suggest that despite the similar whole-rock compositions, some compositional differences exist in the groundmass. Microprobe analyses indicate two types of glass in samples collected from the July 19th eruption; trachyandesite (UBI-19-03C) and rhyolite (UBI-19-03E). Glass from July 22nd (UBI-19-24A) suggest an intermediate composition between the other groups emitted during the previous days.

On the other hand, An contents of plagioclase versus FeO wt.% and MgO wt.% cluster together as a high-temperature group (Hi T eq. line; 1000C) with no apparent differences among the collected samples.



SELECTED REFERENCES

- Rivera, M., Thouret, J.C., Mariño, J., Berolatti, R., Fuentes, J., 2010. Characteristics and management of the 2006–2008 volcanic crisis at the Ubinas volcano (Peru). J. Volcanol. Geotherm. Res. 198, 19–34.
- Rivera M, Thouret J-C, Samaniego P (2014) The 2006-2008 eruptive products of Ubinas volcano, Peru: characteristics and implications on eruptive dynamics, magma production and hazards. J. Volc. Geoth. Res. 270: 122-141.