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Evolution of the Ecuadorian arc: construction periods, magmatic productivity and erosion rates

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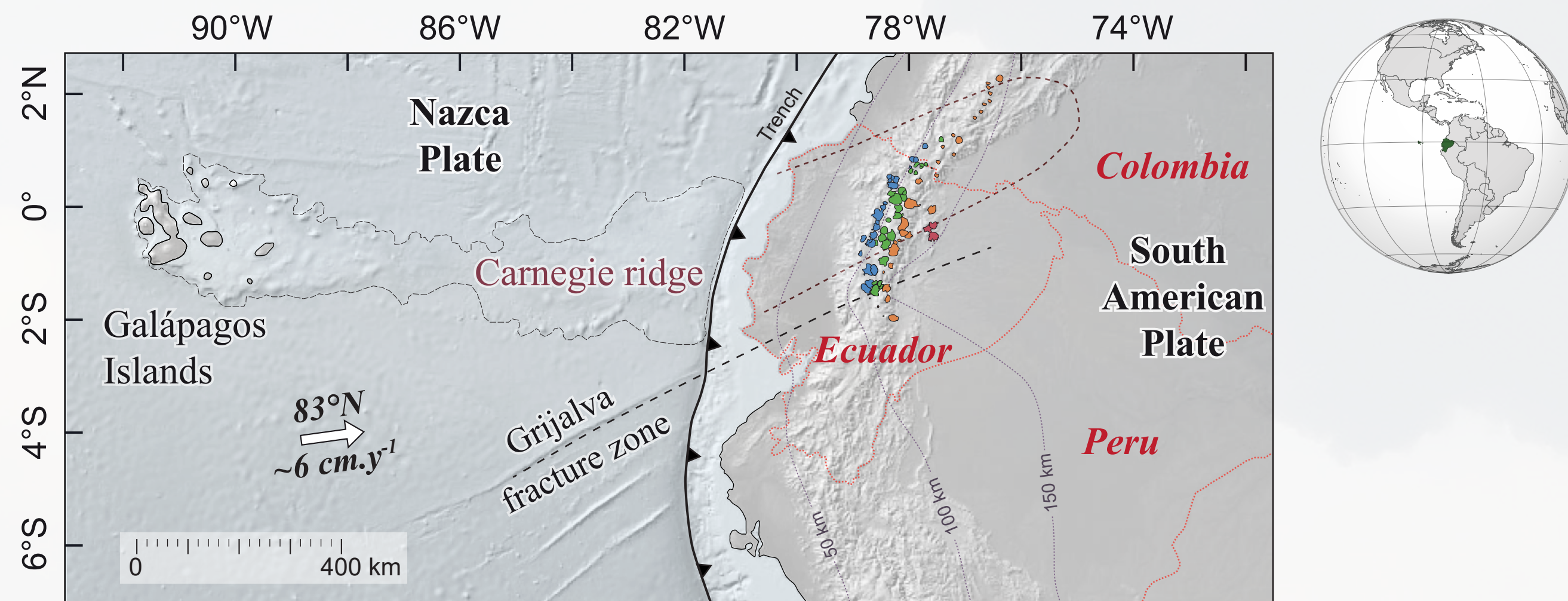
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Evolution of the Ecuadorian arc: construction periods, magmatic productivity and erosion rates

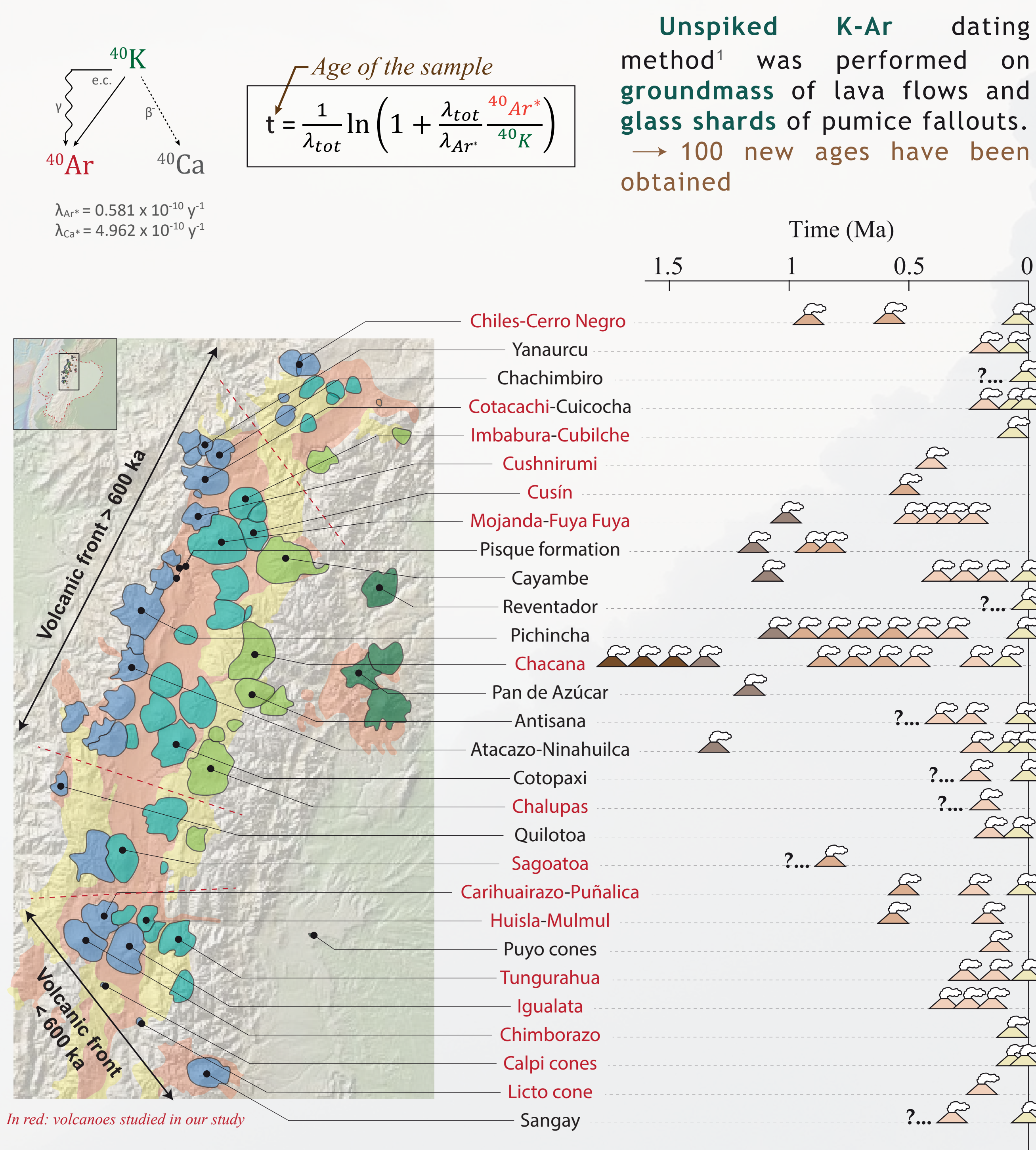
Introduction

In the Northern Volcanic Zone of the Andes, the Ecuadorian arc presents a large number of Quaternary volcanoes, spread over a rather restricted and populated surface area, in front of the Carnegie ridge.

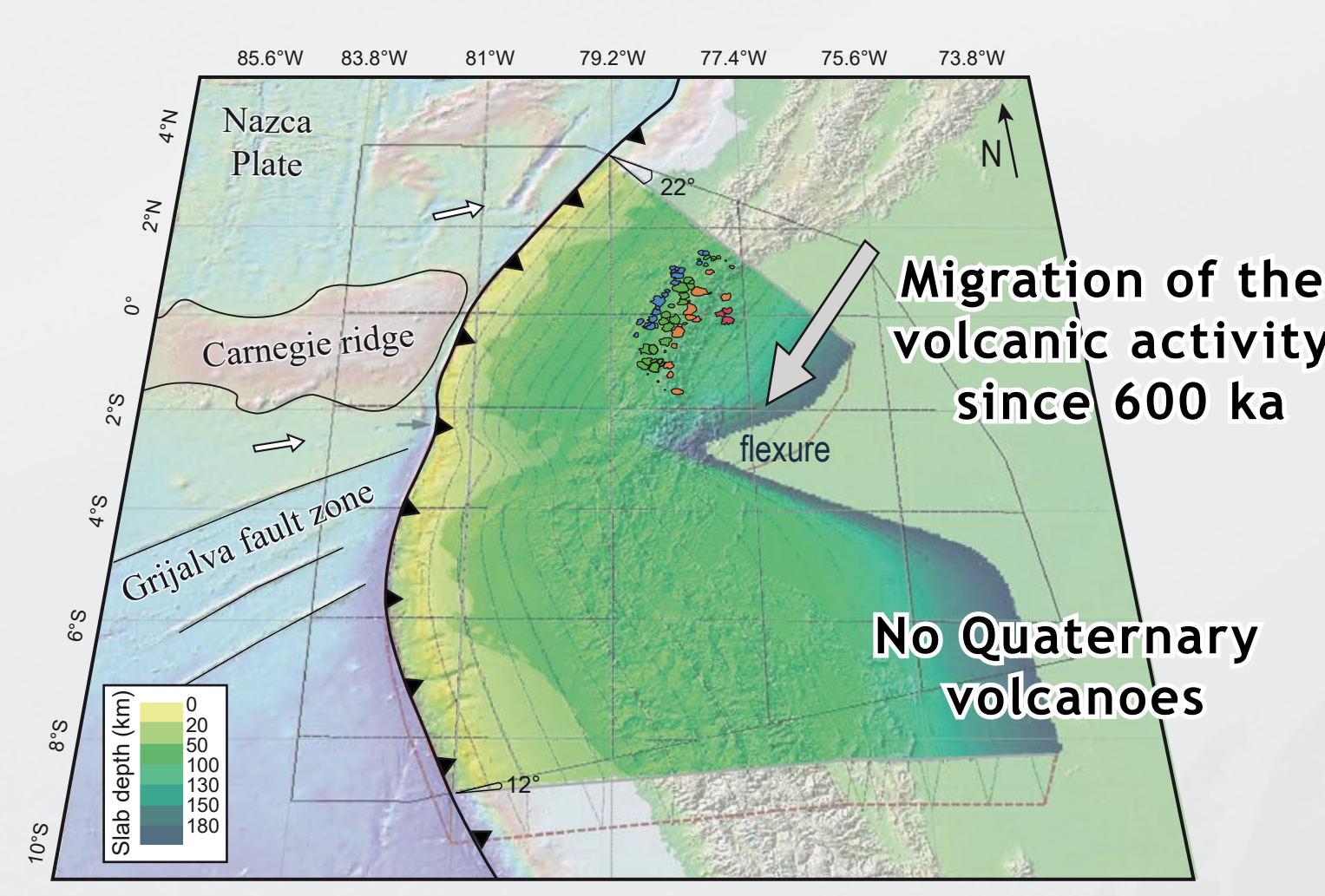
In this study, we combined K-Ar ages and geomorphological reconstructions to determine the activity period of Ecuadorian volcanoes from the Quaternary arc, and to quantify their respective eruptive and erosion rates, in order to understand the relationship between volcanism and geodynamics, as well as their temporal evolution.



Construction periods, arc development

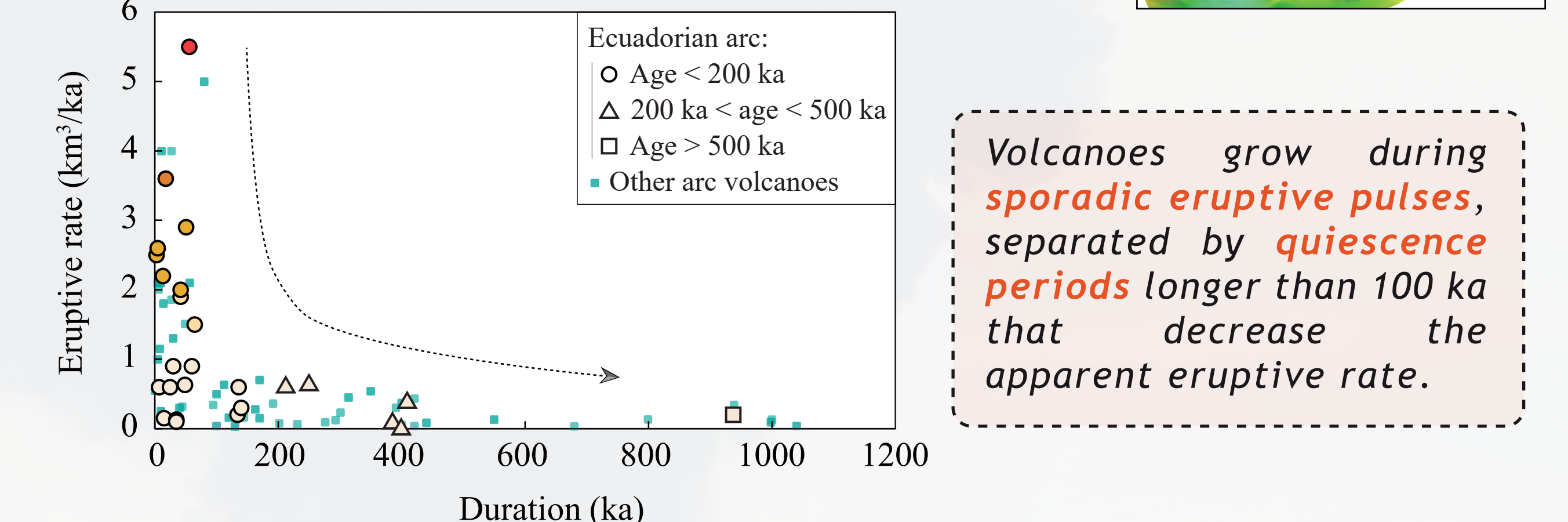


The Quaternary arc development began between 2.6² and 1 Ma in the north and migrated southward since 600 ka. This evolution could be due to a geodynamic reorganization related to the lithospheric faults activation and to the slab geometry at depth³, influenced by the Carnegie Ridge and Grijalva fracture zone subduction.

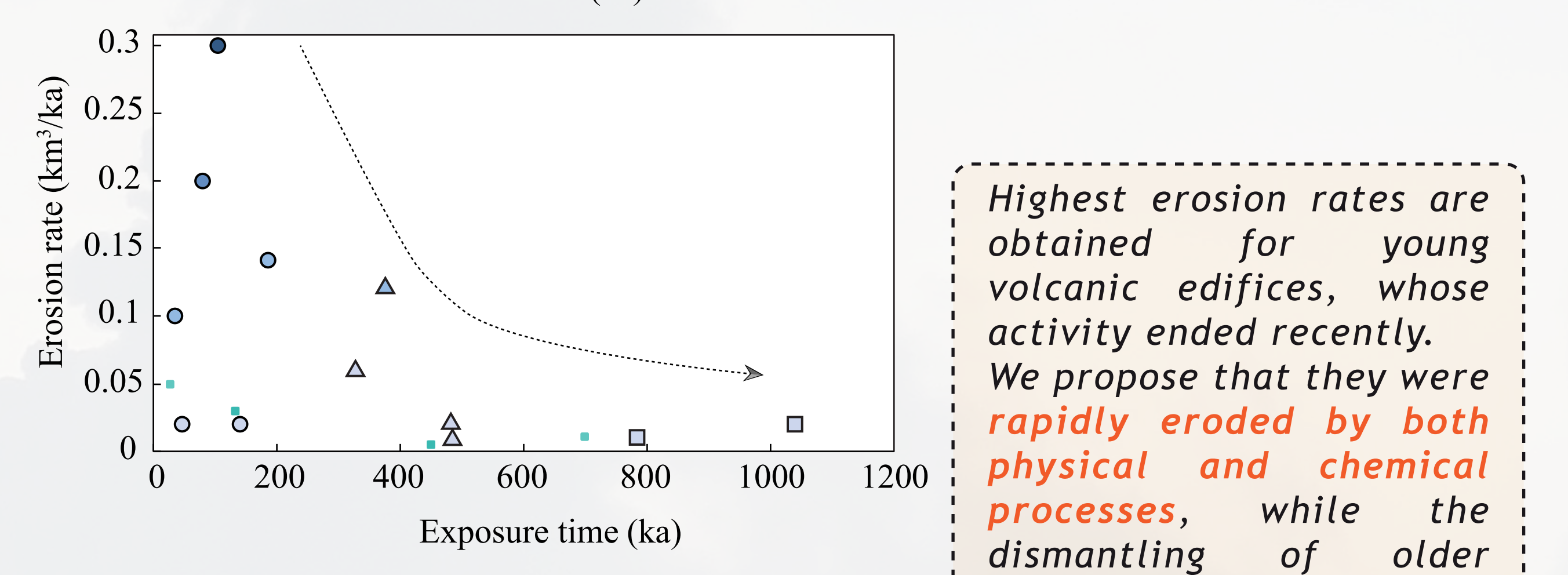


Eruptive and erosion rates

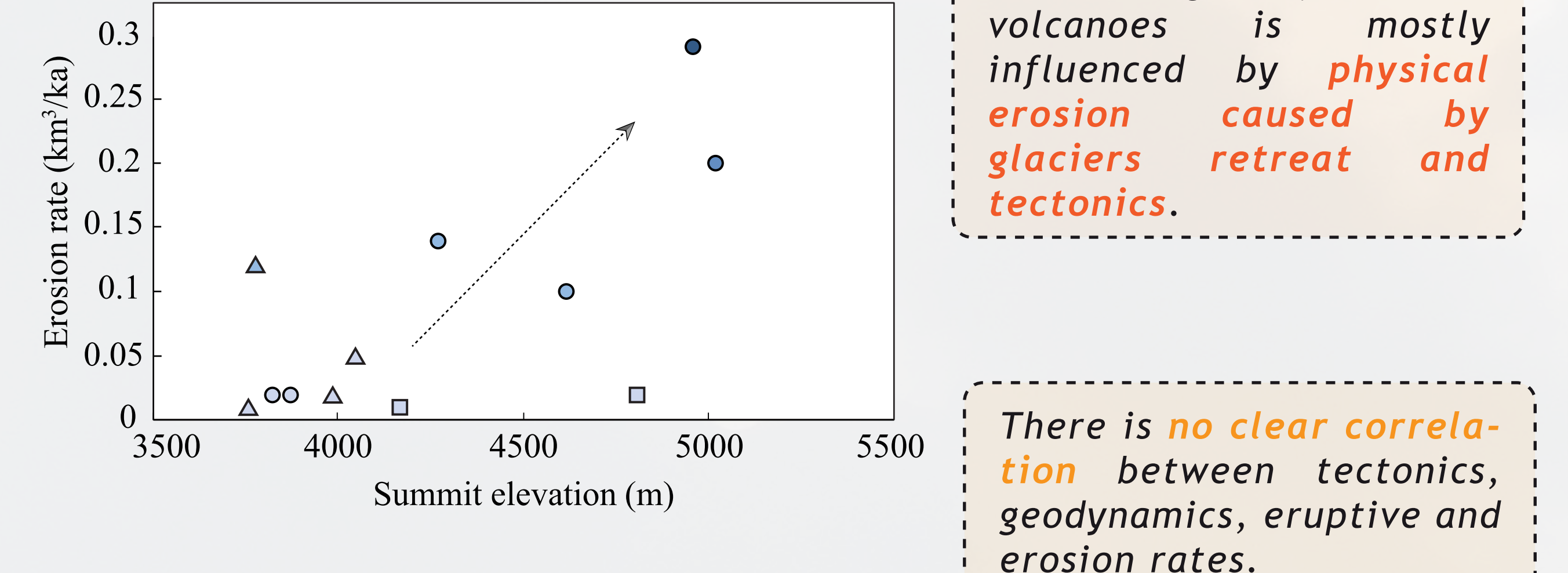
Numerical reconstructions of volcanoes paleotopographies extrapolated from non eroded surfaces of the present-day topography allow to calculate emitted or eroded volumes^{4,5}. Together with our new ages, we can calculate the **eruptive and erosion rates**.



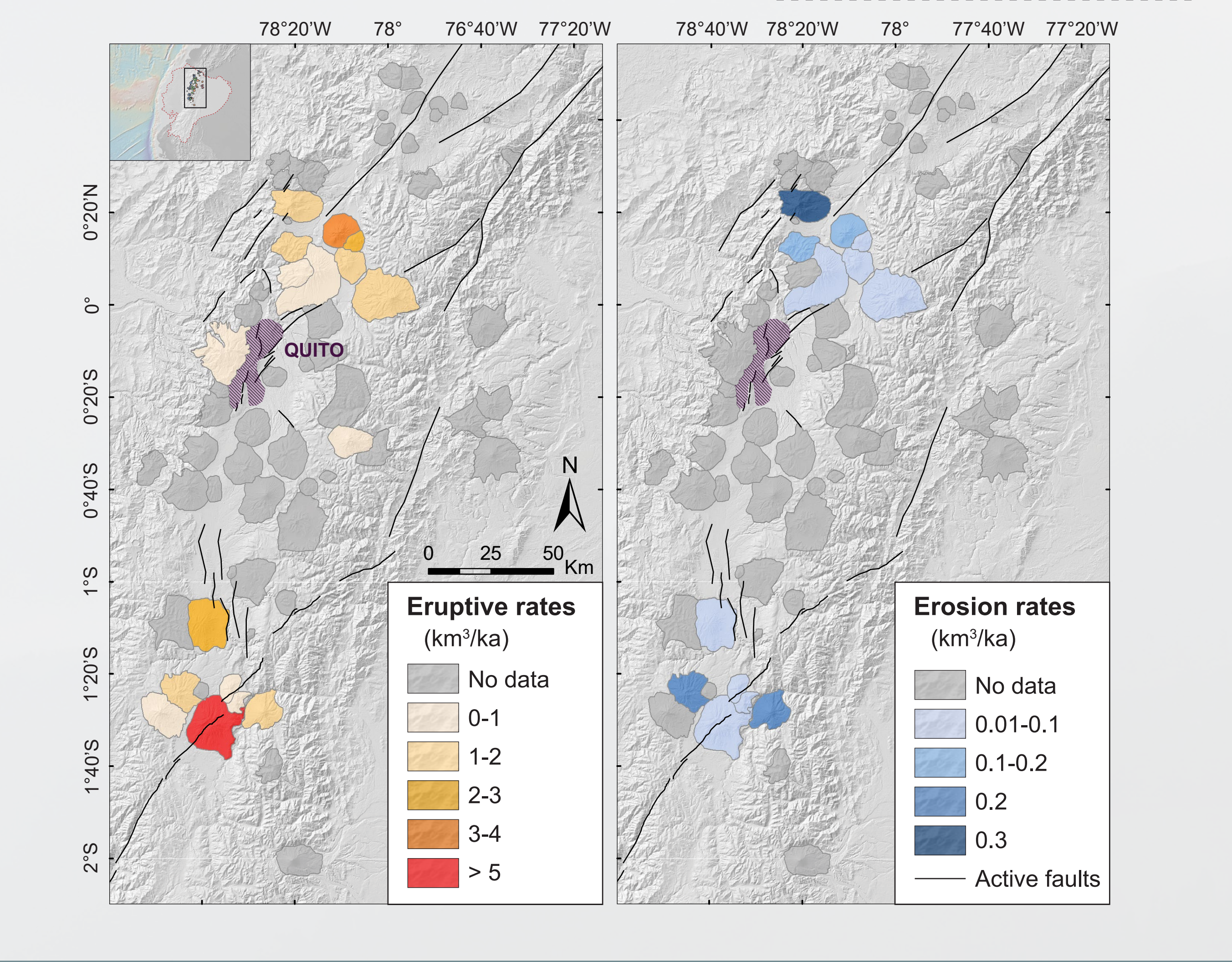
Volcanoes grow during **sporadic eruptive pulses**, separated by **quiescence periods** longer than 100 ka that decrease the apparent eruptive rate.



Highest erosion rates are obtained for young volcanic edifices, whose activity ended recently. We propose that they were rapidly eroded by both physical and chemical processes, while the dismantling of older volcanoes is mostly influenced by physical erosion caused by glaciers retreat and tectonics.



There is **no clear correlation** between tectonics, geodynamics, eruptive and erosion rates.



Conclusions

Unspiked K-Ar dating method performed on groundmass or glass can be successfully applied to Andean Quaternary volcanoes.

The spatial distribution of the Ecuadorian arc is influenced by **tectonic activity** and **slab geometry**. Volcanism migrates southwards since 600 ka.

Eruptive and erosion rates show that activity pulses are separated by quiescence periods, which carved the volcanoes morphology by different erosion processes depending on the age and degree of weathering of rocks.

References :

- ¹ Gillot et al. (2006), Acta Vulcanologica, vol. 18, 55-66.
- ² Opdyke et al. (2006), Geochemistry, Geophysics, Geosystems, vol. 7.
- ³ Yepes et al. (2016), Tectonics, vol. 35, 1249-1279.
- ⁴ Lahitte et al. (2012), Geomorphology, vol. 136, 148-164.
- ⁵ Germa et al. (2015), Journal of Geophysical Research: Earth Surface, vol. 120, 1206-1226.

Full references for geochronological data, eruptive and erosion rates available in Bablon et al. (2018)

My schedule for the future : PhD defense in November 2018 ... then looking for a postdoc!

