

## The Incahuasi resurgent caldera (Ayacucho Province, Peru), a site of high-magnitude explosive eruptions in Miocene times

J.-L. Le Pennec<sup>1,2</sup>, M. Rivera<sup>3</sup>, Y. Soncco<sup>3</sup>, A. de La Rupelle<sup>1</sup>, J.-L. Paquette<sup>1</sup>, K. Cueva<sup>3</sup>, J. Vela<sup>3</sup>,  
H. Guillou<sup>4</sup>

<sup>1</sup>Laboratoire Magmas et Volcans, Université Clermont Auvergne, CNRS, IRD, Campus Universitaire des Cézeaux, Aubière, France

<sup>2</sup>IRD, Alemania y Guayanas, Quito, Ecuador (jeanluc.lepennec@ird.fr)

<sup>3</sup>INGEMMET, OVI, Umacollo, Yanahuara Arequipa, Peru

<sup>4</sup>Laboratoire des Sciences du Climat et de l'Environnement, LSCE/IPSL, CEA-CNRS-UVSQ, Université Paris-Saclay, Gif sur Yvette, France

In this work we document a large Miocene resurgent caldera located south of the Ayacucho province (area between the cities of Coracora, Jaqui and Pauza), where geothermal-epithermal economic potentials might exist, and this is the first resurgent caldera ever reported in the Peruvian territory. Geological studies combined with geochronological and remote sensing analyses allowed us to recognize a flat and depressed area at Laguna de Parinacochas (3278 m asl), a 10 x 8 km-large salar (salt lake) encircled by hills and elevations peaking at about 3600 m asl. On the north-western side of the salt lake, the crest consists of weathered whitish-yellowish ignimbrite deposits, with local sliding structures towards the lake. The eastern side of Laguna de Parinacochas exhibits a series of normal faults at the north-western base of Sara Sara volcano, with subsidence towards Laguna de Parinacochas depression. In our interpretation these morpho-structural features around the lake are expressions of the southern part of a wider caldera complex. Siliciclastic and finely stratified lacustrine sedimentary sequences, in which major ca 9 Ma-old Plinian tephra fall deposits are interbedded, are exposed in the area and support the existence of an intra-caldera paleo-lake. Altered zones with kaolin and silicified patches, fluid circulations, hot springs, bubbling, and sulfur smells are reported within and on the edge of a vast 25 x 35 km-wide structure that we call the Incahuasi caldera system. The caldera is likely polygenic and the last collapse event occurred during the eruption of the approx. 300 cubic km, 9 Ma-old rhyolitic Caraveli ignimbrite, which flowed 100 km west to the Pacific seashore. In addition, a combination of structural elements reveals that the 16 x 18 km-wide and about 1 km-high volcanic complex located north of Laguna de Parinacochas has been upheaved partly by tectonic processes, and also by volcanic resurgence, as evidenced by a typical apical graben associated with intense alteration features. The lavas that cap the resurgent dome are dated at ca 6.6 Ma and seemingly mark the end of the activity at the Incahuasi caldera system. Younger volcanism in the area includes formation of the Sara Sara edifice, a quaternary volcano that grew near, but outside of the Incahuasi caldera complex. Sara Sara erupted essentially rhyo-dacitic products, notably during repeated powerful Plinian events of Pleistocene age. This suggests the presence of a potentially still active silicic reservoir at some depth beneath the area.