



## Combining historical and $^{14}\text{C}$ data to assess pyroclastic density current hazards in Baños city near Tungurahua volcano (Ecuador)

Jean-Luc Le Pennec <sup>a</sup>, Patricio Ramón <sup>b</sup>, Claude Robin <sup>a</sup>, Eduardo Almeida <sup>c</sup>

<sup>a</sup> Laboratoire Magmas et Volcans, Université Blaise Pascal - CNRS - IRD, OPGC, 5 rue Kessler, 63038 Clermont Ferrand, France, <sup>b</sup> Instituto Geofísico, Escuela Politécnica Nacional, Ap. 17-01-2759, Quito, Ecuador, <sup>c</sup> Geodinámica, Isabel la Católica y Galicia s/n. Edif. Torre Galicia, 203, Quito, Ecuador

### Abstract

Pyroclastic density currents (PDCs) from Tungurahua volcano, Ecuador, recurrently rush down the northern Vascún valley and threaten the small tourist city of Baños located on its mouth. Estimating PDC hazards, i.e. PDC return rate and extent, is difficult in Baños and Vascún because data from the literature are rare and debated, while geological exposures are few and vegetated. To improve our awareness of PDC hazards in the Baños area, we examined historical documents, conducted new geological research in the Vascún valley, and obtained additional  $^{14}\text{C}$  data. We highlight complex radiocarbon results that may lead to difficulties when interpreting the PDC chronology, and offer recommendations to improve sampling strategies for  $^{14}\text{C}$  age determinations of PDC deposits. Overall, our results show that the 1640, 1773, and 1886 PDC-forming eruptions are recorded in the valley, while products of the 1918 and 2006 events were likely removed. Through considering recorded/unrecorded bias in the reconstruction of past PDC emplacement in Vascún, we calculate a minimal average return rate of 18 PDC-forming events for pre-Columbian and historical eruptions since the devastating 3 ka BP eruption, which translates into a maximum average return rate of 150–200 years in the valley. However, the archives suggest that most PDCs did not affected the now-urbanized Baños area (e.g. 1918, 2006) and we estimate that the city is impacted on average every 350–500 years, a duration that is likely perceived as fairly long for people living in the area. The Baños case-study thus raises questions on how to communicate on uncertain threats and impacts, and how to improve alert messages in a town where economic incomes are essentially based on tourist activities. To better address these issues we plan in future works to focus on cognitive perception of risk and volcanic hazard judgment by populations of Baños and nearby rural communities.

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