

What are the main factors that trigger the giant-landslides in the Peruvian western Andes? The Aricota giant-landslide case study.

F. Delgado¹, S. Zerathe², S. Schwartz², C. Benavente¹, L. Audin², J. Carcaillet² and Aster Team³

¹Pontificia Universidad Católica del Perú, Av. Universitaria 1801, San Miguel-Lima, 15088 – Perú. delgado.f@pucp.edu.pe

²Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, IRD, IFSTTAR, ISTERre, 38000 Grenoble

³Aix-Marseille Univ., CNRS, IRD, Coll. France, UM 34 CEREGE, Technopôle de l'Environnement Arbois-Méditerranée, BP80, 13545 Aix-en-Provence, France

The central part of western Andes concentrates giant paleo-landslides that mobilized large volumes of rock, well preserved due to hyper arid climate of this region (Audin and Bechir, 2006; Pinto et al., 2008; Crosta et al., 2014; Crosta et al., 2015; Crosta et al., 2017; Mather et al., 2014; Zerathe et al., 2017) and bring us the opportunity to study the sequence of ancient events.

The main goal of this study is to identify the role of climate and tectonics phenomena's on the triggering of giant-landslides in Peruvian western Andes. We realized a multidisciplinary study on the Aricota landslide by using high-resolution DEM derived from Pléiades satellite image (Lacroix et al, 2016. Zerathe et al, 2016.) and coupled with cosmogenic nuclide methodology, We realize dating on the main body of landslides and main scarps in order to obtain chronological constraints of the gravitational destabilization events.

We identified two events: (1) a first event with an estimated volume of ~2 km³ that event generated an impressive dam in the main valley and formed a lake approximately 6 km long upstream; and (2) a second event of rocks avalanche with an estimated volume of ~0.3 km³. ¹⁰Be dating (17 samples) suggest ages of 17.9 ± 0.7 ka and 12.1 ± 0.2 ka (weighted mean and 1 sigma uncertainty of the weighted mean) for these two events. Comparing those mean ages with local paleoclimatic reconstructions, we noticed that the failures match well with two important wet events of the Altiplano: Heinrich 1 (14 - 18 ka) and Younger Dryas (11 - 13 ka), which correspond to the formation of the Tauca and Copiasa lakes respectively (Placzek et al., 2013). This suggests that the climate probably played an important role in the triggers of landslides. However, as several neotectonic faults also affect this area (in the 50 km of radius, e.g. Incapuquio fault or Purgatorio fault), we can't rule out a possible seismic trigger or even an earthquake/climate coupling.

On the western flank of the Andes, the Aricota landslide is one of the few dating events. Although there are numerous recognized paleo-landslides. So, other new landslides ages, should also allow us to know more about the origin of these phenomena in this arid region.