



## **Equilibrium Line Altitude fluctuations at HualcaHualca volcano (southern Peru).**

Jesus Alcalá (1), David Palacios (2), and Jose Juan Zamorano (3)

(1) Universidad Nacional Autónoma de México, Instituto de Geografía, México DF, Mexico (jalcalar@ghis.ucm.es), (2) Universidad Complutense, Dep. AGR y Geografía Física, Madrid, Spain, (3) Universidad Nacional Autónoma de México, Instituto de Geografía, México DF, Mexico

Interest in Andean glaciers has substantially increased during the last decades, due to its high sensitivity to climate fluctuations. In this sense, Equilibrium Line Altitude (ELA) is a reliable indicator of climate variability that has been frequently used to reconstruct palaeoenvironmental conditions at different temporal and spatial scales.

However, the number of sites with ELA reconstructions is still insufficient to determine patterns in tropical climate or estimations of atmospheric cooling since the Last Glacial Maximum. The main purpose of this study is to contribute in resolving tropical climate evolution through ELA calculations on HualcaHualca (15° 43' S; 71° 52' W; 6,025 masl), a large andesitic stratovolcano located in the south-western Peruvian Andes approximately 70 km north-west of Arequipa.

We applied Terminus Headwall Altitude Ratio (THAR) with 0.2; 0.4; 0.5; 0.57 ratios, Accumulation Area Ratio (AAR) and Accumulation Area Balance Ratio (AABR) methods in four valleys of HualcaHualca volcano: Huayuray (north side), Pujro Huayjo (southwest side), Mollebaya (east side) and Mucurca (west side). To estimate ELA depression, we calculated the difference between the ELA on 1955 with its position in the Maximum Glacier Extent (MGE), Tardiglacial phases, little Ice Age (LIA) and 2000. Paleotemperature reconstructions derived from vertical temperature gradient 6.5° C / 1 km, based on GODDARD global observation system considered the most appropriate model for arid Andes.

During MGE, the ELA was located between 5,005 (AABR) and 5,215 (AAR 0.67) masl. But in 1955, ELA rose to 5,685 (AABR) - 5,775 (AAR 0.67) masl. The ELA depression between those two phases is 560 - 680 m that implies a temperature decrease of 3.5° - 4.4° C.

The experimental process based in the use and contrast of different ELA reconstruction techniques applied in this study suggests that THAR (0.57), AAR (0.67) or AABR are the most consistent procedures for HualcaHualca glaciers, while THAR with ratios 0.2; 0.4 and 0.5 tend to underestimate it's position.

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