



## **36Cl Exposures Ages and Equilibrium Line Altitude (ELA) of the Ampato Volcanic Complex (Southern Peru).**

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In this work we present the results obtained from the reconstruction of the ancient glacial Equilibrium Line Altitude (paleoELA) and the dating of various glacial phases on the Ampato volcanic complex (15°24'S-15°51'S, 73° W; 6.288 m asl), in the Central Andes. In order to calculate the paleoELAs we used two methods: the Accumulation Area Ratio (AAR) and the Area X Altitude Balance Ratio (AABR). The dating was obtained by cosmogenic methods (<sup>36</sup>Cl). We sampled: 1) boulders, in a stable position, larger than 1m and located on the crest of the moraines; and 2) polished and striated bedrock outcrops, which indicate the retreat of ice.

In every studied valley we found voluminous moraines related to the Local Last Glacial Maximum of the Pleistocene (LLGMP). The dating obtained from the sampled boulders ranges from  $17.9 \pm 0.1$  to  $13.6 \pm 0.1$  kyr. We estimate that the most significant deglaciation process started at 12 ka on the Ampato volcanic complex and adjacent areas also covered by ice, such as the Patapampa altiplano. In certain valleys we found re-advance moraines such as in Huayuray valley, located on the Northern slope of the volcanic complex, dated at  $11.4 \pm 0.21$  kyr. The last generalised advance is related to the Little Ice Age (LIA). During this event the glaciers formed small moraines which are close to the current glacial fronts.

In Huayuray valley we estimated a paleoELA (AAR) of  $\sim 5,200$  m during the LLGMP asl and  $\sim 5.810$  m asl during the LIA. Similar data was obtained using the AABR method:  $\sim 5.150$  m asl during the LLGMP, and  $\sim 5.750$  m asl during the LIA. In Mollebaya valley (East face of the volcanic complex) the paleoELA (AAR) during the LLGMP was at  $\sim 5.350$  m asl and during the LIA it reached  $\sim 5.740$  m asl. Using the AABR method the LLGMP and LIA paleoELAs are  $\sim 5.070$  and  $\sim 5.700$  m asl, respectively.

In Pujro-Huayjo valley, to the Southwest, the paleoELA (AAR) during the LLGMP was  $\sim 5.390$  m asl. LIA moraines are absent in this valley. We calculated the ELA from the glacier in 1955 at  $\sim 5.725$  m asl. Using the AABR method, the ELA was lower:  $\sim 4.940$  m asl during LLGMP and  $\sim 5.635$  m asl in 1955. Finally, in the Mucurca valley, West face of the volcanic complex, the LLGMP paleoELA was at  $\sim 4.930$  m asl and at  $5.100$  m asl during the most recent advance (Lateglacial phase). Using the AABR method we obtained a value of  $\sim 4.865$  m asl for the LLGMP paleoELA and  $\sim 5.015$  m asl for the Late glacial phase.

On average the the LLGMP ELA was 5220 m asl (AAR) and 5010 m asl (AABR). Based on the modern (1955) ELA from Pujro-Hayjo valley, the LLGMP ELA lowering was  $\sim 550$  m (AAR) and  $\sim 625$  m (AABR).

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