



Glacial and volcanic evolution on Nevado Coropuna (Tropical Andes) based on cosmogenic ^{36}Cl surface exposure dating

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We have reconstructed the evolution of the paleo-glaciers of the volcanic complex Nevado Coropuna (15°S, 72°W; 6377 m asl) through the interpretation and dating of geomorphological evidences. Surface exposure dating (SED) based on the accumulation of ^{36}Cl on the surface of moraine boulders, polished bedrock and lava flows allowed: 1) to confirm that the presence of ice masses in the region dates back to $>80\text{ ka}$; 2) to produce chronologies of glacial and volcanic phases for the last $\sim 21\text{ ka}$; and 3) to obtain evidences of the reactivation of volcanic activity after the Last Glacial Maximum.

Bromley et al. (2009) presented ^{3}He SED ages of 21 ka for moraine boulders on the Mapa Mayo valley, to the North of Nevado Coropuna. Our ^{36}Cl SED SED for moraine boulders from the valleys on the NE sector of the volcanic complex suggest a maximum initial advance between 20 and 16 ka, followed by another expansion of similar extent at 12-11 ka.

On the Southern slope of Nevado Coropuna, the ^{36}Cl ages show a maximum initial advance that reaches to the level of the Altiplano at 14 ka, and a re-advance at $\sim 10\text{-}9\text{ ka BP}$. Other data show minor re-advances at 9 ka on the Northern slope and at 6 ka to the South of the volcanic complex. These minor positive pulses interrupted a fast deglaciation process during the Holocene as shown by two series of ^{36}Cl SED from polished rock surfaces on successively higher altitudes along the valleys of rivers Blanco and Cospanja, to the SW and SE.

Despite the global warming occurring since 20 ka, deduced from the record of sea surface paleo-temperature of the Galapago Islands (Lea et al, 2006), the evolution of the fresh-water plankton from Lake Titicaca (Fritz et al, 2007) is consistent with sustained glacial conditions until 10-9 ka as suggested by the present work.

Exposure ages of three lava flows indicate a reactivation of the magmatic system as the paleo-glaciers abandonned the slopes. The eruptive activity migrated from the West, where we found a lava flow of 6 ka, to the East, where we dated two units similar to the previous one at 2 and $<1\text{ ka}$.

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