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Geomorphological evidence of warm-humid and cold-dry glaciations in the dry western Cordillera of the tropical Peruvian Andes

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The western Cordillera of the Andes (14°30'S, 74°W) is characterized by high altitudes, strong radiation and semi-arid conditions. Therefore, glacial processes and resulting landforms differ markedly from these of the outer-tropics. However, under sub-arctic conditions similar glacial landforms occur. This congruence can be explained by comparable environmental conditions, which determine the dynamics of ice flow, glacial erosion, debris production as well as moraine deposition.

Outside the higher latitudes, typical sub-arctic glacial landforms as controlled moraines and trimline moraines (Evans 2009, Ó Cofaigh et al. 2005) remained undescribed until now. These landforms result from polythermal or cold-basal ice flow, respectively, which is typical for polar conditions. Beside this, we also found steep lateral moraines, which give evidence of increased ice thickness, debris production and deposition and warm-basal ice flow, which is conceivable only for alpine-type valley glaciers. Striations of the bedrock give evidence of accompanied basal erosion.

Coexisting trimline moraines and steep lateral moraines rule out the influence of topography on ice thickness and the resulting thermal regime. Therefore, we match the different moraine types to changes in ice thickness, which was controlled by considerable precipitation changes during the last glaciation. An erroneous classification of the observed boulder associations as trimline moraine due to selective erosion after deposition can be excluded due to general arid conditions, slow weathering and the chronological proximity of only a few millennia between both landforms, determined from cosmogenic nuclides.

Therefore, the occurrence of different thermal regimes gives evidence of considerable changes in precipitation during the last glaciation – but furthermore requires an associated change in the thermal conditions to explain the very close spatial position of both ice margins. Changes in ice volume must have change the ELA, though did not affect the mass balance, which points to a close relationship between precipitation and temperature. Future research has to test the hypothesis, if deriving warm-moist and cold-dry conditions were both favorable for past ice advances in the nowadays dry western Cordillera of the Andes.

References:

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