



PLEISTOCENE PALEOTEMPERATURES, HEADWATER SLOPES OF  
ARROYO NEGRO AND RIO BLANCO,  
CORDON DEL PLATA, MENDOZA, ARGENTINA

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Permafrost exists today high in many alpine regions, but during the glacial maxima of the Pleistocene, it surely was both more extensive and more intense than it is today. Most of the reconstructions of Pleistocene paleoclimatic conditions have been based on oceanic core samples and on studies near the termini of the continental ice sheets that expanded into mid-latitude lowlands; only a few have involved evaluation of the features produced by permafrost above the glacier surfaces in mountainous areas. The most likely mountains to have well developed permafrost landforms are those in arid or semi-arid regions, because a thick snow cover insulates the ground from the low temperatures so that permafrost, even if present, is not effective in generating distinctive landforms. The Cordón del Plata, one of the ranges in the dry Andes of Mendoza Province, Argentina, is well situated to have received sufficient precipitation during the last glaciation to develop glaciers that filled valleys as low as 2150, yet had many areas above the ice where strong winds kept snow cover thin. In these areas, above the surface of the ice, in the valleys, patterned ground and other landforms characteristic of permafrost developed wherever appropriate geologic materials existed.

In the Cordón del Plata, lobate and small linguoid rock glaciers, which develop within the permafrost zone and are unassociated with glacier ice, are active today only on steep south-facing (shaded) slopes of high valleys where the local mean annual air temperature is at least 3°C below the mean annual air temperature at that altitude. The calculated mean annual air temperature at 3500 m, the altitude of the lowest of these rock glaciers, is about -1°C, so the temperature at the shaded valley walls would be about -4°C and that on slopes facing the sun above 0°C. Relict (or fossil) rock glaciers of the same type are not common in the parts of the Cordón del Plata studied, but the lowest of those observed is about 3.200 m in Quebrada de los Vallecitos and is on a northeast facing slope rather than a shaded one. This suggests a mean annual temperature outside the glacier tongue of no higher than -5°C, or about 7°C lower than the present temperature at that altitude. Large sorted circles are active today in a few places in the Cordón del Plata above 3.900 m, with calculated mean annual air temperatures of -3°C or lower, but they formed on surfaces at 3.400 m during

Neoglaciations and a few developed as low as 2.500 m on slopes of Arroyo Negro during the last Pleistocene glaciation. This also suggests air temperatures about 7°C lower than the present at that time on slopes near the margin of the ice tongues.

Relict sorted stripes that end in garlands at the former ice margin are present on northeast-facing slopes from 3.500 m to 3.700 m. Gelifluction streams are now active above 3.800 m where materials derived from till and from phyllites contain enough fine debris to permit such movement. Some gelifluction streams above the Lagunita del Plata terminate about 4.000 m in a series of large sorted nets that are subdivided into smaller nets. Linear troughs that seem to outline large polygons are present at one place at 4.050 m, but they are likely relict, not active today. Taken together, the active and relict features on the slopes of the Cordón del Plata indicate temperatures on surfaces above the Pleistocene glaciers that were at least 6°C below the present temperatures in the same areas.