

# Rock glaciers, Western Andes, Chile, Version 1

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## USER GUIDE

### How to Cite These Data

As a condition of using these data, you must include a citation:

Kammer, K 1998. *Rock glaciers, Western Andes, Chile, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. <https://doi.org/10.7265/8aha-3j86>. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT [NSIDC@NSIDC.ORG](mailto:NSIDC@NSIDC.ORG)

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/GGD282>



National Snow and Ice Data Center

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**Notice:** This data set was first published on the [1998 CAPS CD](#).

The text for this document was taken unchanged from that CD.

The research area is located along a transect from 18S to 29S in the Chilean Altiplano, the western part of the high intramontane plateau in the Central Andes. This region is located in an extremely arid zone between the tropical and westerly circulation belt. The so-called 'Andean Dry Diagonal' crosses the research area from NW to SE. Modern tropical glaciers exist in the northernmost part of the research area at 18S, whereas the first glacier in the west wind zone appears only at 27S. In the central part of the area there are no modern glaciers, even on the highest peaks above 6700 m elevation. This indicates that in vertical extension there is no upper boundary to the permafrost zone.

According to the concept of 'thermal readiness' in subtropical arid high-mountain areas, the lack of glaciers is attributed to the lack of precipitation. Striking evidence of former glaciation between 18S and 29S suggest that environmental conditions, particularly the moisture regime, changed significantly during the late Quaternary period. Humidity and effective moisture are the most important climatic parameters in this extremely arid area. Between 24S and 26S there is a summer precipitation rate of probably less than 50 mm. North of 24S there is an increase of precipitation with the increasing influence of the tropical circulation on the area. South of 26S there is an increase of precipitation due to the increase of winter precipitation of the westerlies. The area exhibits a large variety of different climates and a large number of environmental archives that are highly sensitive to climatic changes. Thus the dry Andes are an ideal laboratory for studying past climates, latitudinal shifts of climatic zones, or vertical shifts of geocological belts.

Over 120 rock glaciers have been mapped from chosen test sites using aerial photographs. Several rock glaciers were visited in the field to compare the results. From the collected data (height above sea level, exposition, activity, latitude) we tried to conclude (paleo-)climatic implications. The distribution was compared with summer and winter precipitation patterns of the research area. The highest number of observed rock glaciers appears in the north and very south of the transect 18 and 29S. Between 23S and 27S there is a sharp decline in the number of rock glaciers. It coincides with the present-day position of the 'Dry Diagonal' in the Western Andes. Most of the mountains in this section have no rock glaciers, although there is sufficient debris supply available. Focusing activity, altitude and latitude of the observed rock glaciers north of 24S respectively south of 27S there is a domination of active and inactive rock glaciers in comparison to relict rock glaciers.

On the other hand there are no active rock glaciers between 24S and 27S. In this part relict rock glaciers can lie 800 m higher than the estimated annual 0 degree C-isotherm. If we compare rock glacier activity and number with the precipitation pattern of the area we note that the biggest number of active rock glaciers lie in the region with highest precipitation rates. In the driest part of

the test area where the Andean Dry Diagonal crosses the Western Andes there are no active rock glaciers. They can be found in areas with estimated annual precipitation rates of 200 mm and more. Most of the observed rock glaciers lie in today ice free cirques. These were probably built up after, or at, the time of a general ice decay. For the northern part between 18S and 24S we suggest glacier advances during the so-called Tauca-phase at 12'000-8000 yr BP. The majority of the rock glaciers in this area can only have formed after 8000 yr BP. In the southern part of the research area at 29S we dated a late Holocene glacier advance at 2600 yr BP, and thus rock glaciers must have formed at the time of the general ice decay after 2600 yr BP.

The altitude of active rock glaciers in the Chilean Andes between 18S-29S corresponds to the trend of the annual degree C-isotherm with a sharp interruption in the driest zone between 24S-27S. In this part with less than 100 mm precipitation/yr the annual 0 degree C isotherm has no control on rock glacier activity - the observed relict and inactive rock glaciers lie distinctly higher.

The driest zone of the research area corresponds with the area with a striking reduction of number of rock glaciers and also coincides with the zone where no active rock glaciers could be found. We conclude that the so-called 'Andean Dry Diagonal' cannot have changed significantly its position since the time when the rock glaciers were formed, probably in the middle and late Holocene. But we assume an intensification of precipitation to form rock glaciers in the driest part of the research area.

## 1 DETAILED DATA DESCRIPTION

- Location: Chilean Altiplano, Chile
- Time Range: Inventory of rock glacier data, no date given
- File: chilerg.dat
- Columns: Inventory no., elevation of the front [m ASL], length [m], width [m], mean orientation, longitude [W], latitude [S], rock glacier type, activity
- File: chilecrt.gif
- Comments: Gif image of a chart of estimated Chilean rock glacier activity. For users with access to a PostScript printer or viewer, a file (chilecrt.ps) of this format is available.



Figure 1.

This active rock glacier (EN 10 of the inventory) at 29°S in the Encierro-valley must be younger than 2600 yr BP - as the cirques were filled with ice at that time. The rock glacier is active, the inclination of the front is  $> 35^\circ$ .

## 2 REFERENCES AND RELATED PUBLICATIONS

Jenny B., Kammer K. 1996: Jungquartre Vergletscherungen. Geographica Bernensia, in Ammann et al. 1996: Climate Change in den trockenen Anden. G46

Ammann C, 1996: Aktuelle Niederschlagsmuster. Geographica Bernensia 1996: Climate Change in den trockenen Anden. G46

Kammer K., Ammann C.: Rock glaciers in the Western Andes between 18-29S and climatic implications (in prep.)

## 3 CONTACTS AND ACKNOWLEDGMENTS

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## 4 DOCUMENT INFORMATION

### 4.1 Publication Date

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1998

### 4.2 Date Last Updated

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