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Interpretation of the past glacial landforms from the present processes: the hypothesis of the secondary moraine

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The new glacial dating techniques do not always solve the problems regarding the interpretation of the paleoclimatic significance of the glacial forms, due to the complexity of the geomorphologic processes involved. A traditional geomorphologic observation, frequently forgotten, suggests carrying out the interpretation of ancient landforms through the study of current processes. In Peñalara glacial cirque (40º51'N, 3º57'O; 2.428 m asl), located in Sierra de Guadarrama, 70 km to the north of Madrid, two small and consecutive moraine arches can be found, which preserve a very clear glacial form except for a sector affected by a torrent. Up valley from these small arches several large moraine ridges arise. The traditional interpretation given to these separated units was that the large moraines had overtopped the small ones and, therefore, the former were subsequent to the latter. Even it was considered that both units could belong to different glaciations. It was difficult to admit that a first advance created small arches, whereas a later advance swept an important part of the crystalline weathered mantle, forming moraine accumulations much bigger than the former ones. We have carried out absolute dating techniques on five moraine boulders from each moraine system, analysing the production of the cosmogenic isotope Cl36 (Palacios et al., 2012). The results show that both units belong to the same period (21-17 ka BP). In order to explain this fact, we analyzed current glaciers which show similar characteristics to the former ones in Peñalara. We found similar glaciers in Kebnekaise massif (Northern Sweden) and in Tröllaskagi massif (Northern Island). In these glaciers, the ablation surface acts as a snow catchment basin. The snow swept by the wind accumulates on the leeward side of the moraines creating a small glacier which moves the boulders of this moraine and forms its own small moraine arches. This example confirms that the interpretation of ancient landforms can be deduced by the observation of current processes.

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