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Glacial geomorphology of Ésera valley and Maladeta massif. From the reconstruction of past glacial phases to the actual remaining glaciers

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The Ésera valley is located in the central Pyrenees (Spain). The southern slope of this upper valley corresponds with the northern slope of Maladeta Massif, where we can find some of the highest mountains of the Pyrenees as Aneto Peak (3,404 m a.s.l.) and more than 20 peaks higher than 3,000 m a.s.l. This valley hosts one of the largest concentration of the remaining glaciers in the Pyrenees. This valley is composed of granitic rocks in the upper areas, and by limestones and slates at the bottom of the valley. The landscape has been modelled by glaciers during the different Pleistocene glacial stages and glacial features have been well preserved, specially in the granitic areas (polished bedrocks, u-shaped valleys, etc). Also, moraines constitute a good glacial record, although provide discontinuous information. During the Last Glacial Cycle (LGC) there were some phases of glacial stabilization, recognised in the landscape as moraines thus allowing the reconstruction of glacial evolution since the Last Maximum Pyrenean Glacier, 60,000 years ago. The moraine associated to this expansion event is located at 1725 m a.s.l. and at a distance of about 7 km from the actual glaciers (fronts at 3,000 m a.s.l.).

Pllan d'Están paleolake, located at 1,840 m a.s.l. in this valley provides continuous information about past climate variations during the LGC. At the age of 45,000 years this valley was already deglaciated. At that age, Pllan d'Están was a proglacial lake mostly covered by snow the whole year and being filled by rhythmite sediments. This lake was disconnected from the glacier 35,000 years ago and started a new glaciolacustrine phase in an environment where biological activity is increasing. Finally, during the Holocene (11,700 years) the lake was a peatbog or an ephemeral lake.

Along the valley, there are other glacial features, as frontal moraines and polished bedrocks which indicate glacial stabilization phases during the Oldest Dryas (13,000 – 16,000 years) at 2,000 m a.s.l. and Younger Dryas (12,000 years) at 2,300-2,400 m a.s.l. These results will be combined with new cosmogenic dates to complete the information about glacier evolution. The last glacial expansion occurred during the Little Ice Age (LIA), a cold period that ended 200 years ago. This phase is recognised in the landscape with the largest and almost continuous moraines, located around 2400-2600 m a.s.l. (frontal moraines). In some cases, these moraines reach almost 90 m height.

Nowadays, glaciers in this area and, in general, in the Pyrenees, are disappearing rapidly. The climate warming of the last decades has caused an increase in its wastage and shrinkage, losing more than 12 m in thickness in the last 10 years, so they are in risk to disappear in short time. The shrinkage of glaciers causes changes in the landscape, as the development of new lakes (proglacial lakes) or the development of new soil, so the generation of new mountain ecosystems.