DISAMBIGUATION OF THE NUNATAK VIEDMA: A BASEMENT BLOCK PREVIOUSLY CONFUSED AS A VOLCANIC CENTER

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Abstract. Historically, the nunatak Viedma was confused with a volcano because its air-view morphology resemble that of a volcanic center, and there was a lack of proper fieldwork. Our field-data shows mainly sedimentary sequences, affected by metamorphism that can be classified as schist and gneiss affected majorly by isoclinal folding. We conclude that the nunatak Viedma is not from volcanic origin due to the observation of exclusively metamorphic outcrops, and its morphology shaped by conspicuous glacial landforms.

Keywords: Nunatak Viedma, Viedma Volcano, Austral Volcanic Zone, AVZ, Southern Patagonian Ice Field, Patagonian Andes.

1 Introduction

The nunatak Viedma constitute a hard to access outcrop of rocks located at 49º22´SL 73º19´WL in the eastern flank of the Southern Patagonian Ice Field (Figure 1). Up to know there has been a discussion about its geological origin and composition, fired by its inaccessibility and the lack of proper fieldwork. The nunatak Viedma was first interpreted as a volcanic complex by Lliboutry (1956), after the study of aerial photographs showing a landscape that resemble that of a small cluster of volcanic cones (Figure 1). Soon after, Shipton et al. (1959) undertook a field exploration of the nunatak, and arrived to the conclusion that was a basement block.

However, there has been a lack of specific field work since that time, and there is a growing list of non-technical (Martinic, 2008) and technical papers (Kilian, 1990; Kobayashi, 2010) that still wrongly describe the nunatak Viedma as a series of volcanic cones, and is still listed as part of the AVZ in many current volcanoes data bases (The Smithsonian's Global Volcanism Program).

On the "Viedma Volcano" working hypothesis, Kilian (1990) found in situ layers of fresh pumice, ash deposits and hot mud flows on the surface of the Viedma Glacier between the Nunatak Viedma and Paso del Viento (Kilian pers. comm., 2011; Figure 1). Although the samples were not taken in situ from the nunatak Viedma, this author related the found evidence of volcanic activity to the supposed Viedma Volcano, due to its proximity, and because its geochemical signature was different of that from the Lautaro Volcano, located 50 km approximately to the NW. More recently, Kobayashi et al. (2010) conducted a lithological mapping of the nunatak Viedma, based on ASTER image analysis, under the assumptions that it was a volcano edifice, describing lithological variations that define the supposed edifice with variable compositions ranging from 51% to 63% of SiO2 wt%.

Field-work made during the austral summers, in January of 2011 and 2012, allowed to undertake a field-examination of the nunatak Viedma and pick up rock samples from the nunatak itself. On the basis of field-studies and laboratory analysis of detrital zircon and petrographycal studies we define that the nunatak Viedma is a block of low metamorphic rocks of early Jurassic age.

2 Observations

2.1 Petrographical Analysis

The outcrops show sedimentary heterolitic units that could be assigned to turbiditic sequences, and are strongly affected by isoclinal folding.

The studied samples display different metamorphic degrees. Most of them can be classified as gneiss or schist due to their macroscopic textures (Figure 2 and 3).

Figure 2. The outcrop shows a gneiss texture affected by weathering on the surface (orange patch), affecting the

leucocratic minerals and was affected by glacier erosion and plucking.
They are mainly composed of quartz and alkali feldspars which sizes ranging from 0.2 to 1.4 millimeters. In some samples quartz ribbons usually appear following the foliations of the rock. Garnets, zircons and opaque minerals only occur as subordinated species.

Figure 3. Hand sample showing a gneiss texture with melanocratic bands, compose by white micas, and leucocratic sectors domain by quartz and feldspars, and affected by metamorphism.

The melanocratic facies are thinner than leucocratic bands and are mainly composed of phyllosilicates (biotites and white micas) and opaque minerals, that represent between 40 to 70% of the total volume. The orientation of these minerals constitute the foliation of some samples.
Finally carbonates, filling small cavities, and micas produced by plagioclase alteration seems to be a superimposed secondary assemblages.

2.2 Morphologic Analysis

Field-based observations

Morphology of the nunatak is largely controlled by glaciary processes. The basement outcrops are partially covered with coarse glacial drift, from pebble to boulder size. In elevated, flat areas, there are structures associated with periglacial environments, particularly patterned ground.
On the perimeter of the Nunatak, the terrain slope is steep, particularly on the west. Outcrops, are in some cases vertical, and have horseshoe shapes, especially around lakes, which show evidences of glacier activity, like glacier striations. This basins are oriented in south and east direction, according to the ice flow direction. The water from this lakes is perfectly pure and drinkable. The margin of the lakes are characterized by repetition of debris concentric flat shapes, that we associated with ancient coast lines, related with the different levels of the lake during the past.
There is a glacial connection crossing the nunatak from west to east at its center. On the west, the tongue of ice is higher, around 1250 mbsl while the eastern side is located at 950 mbsl. The outcrops of this passage show very conspicuous striations in this direction (W-E).
The outcrops observed are composed by conspicuous sedimentary sequences, with the alternation of sands and mudstones, with folding in most of the cases and affected by metamorphism. In some areas, the outcrops are highly affected by superficial alteration giving to the rock a reddish-yellowish color. The morphology of the area is controlled by glacier activity, where the landscape shows rounded shapes, with signs of erosion and plucking in the outcrops.
On the perimeter of the Nunatak periglacial lakes are dominated by glacial dynamics, and are smaller than their higher counterparts. Periglacial lakes change the level of water in a period of hours, according to the glacial behavior and they are in between the Nunatak and the lateral moraines of the Viedma Glacier.

Satellite Image Interpretation

According to satellite imagery, it is possible to see different structures over the surface of the Nunatak. We identify a northern and a southern blocks.
On both blocks it is possible to identify glacial cirques associated to the main lakes, oriented eastward on the southern block of the nunatak and south/south-east, on the northern block.
It is possible to distinguish the headwalls, as well as steps, and tarn lakes. The north block have the summit on the confluence of four cirques, conforming a horn with four arêtes. A hanging valley with a tarn it is located at the south face of this block, and on the NW of it, there is a truncated spur heading NW-SE which is conspicuous.

3 Conclusions

No evidence of recent or ancient volcanic activity was found whatsoever in the Nunatak Viedma. The nunatak is not from volcanic origin, and its morphology is shaped by conspicuous glacial landforms. We further conclude that the shape of the lakes previously confused as volcanic cones, have an origin related with glacier processes.

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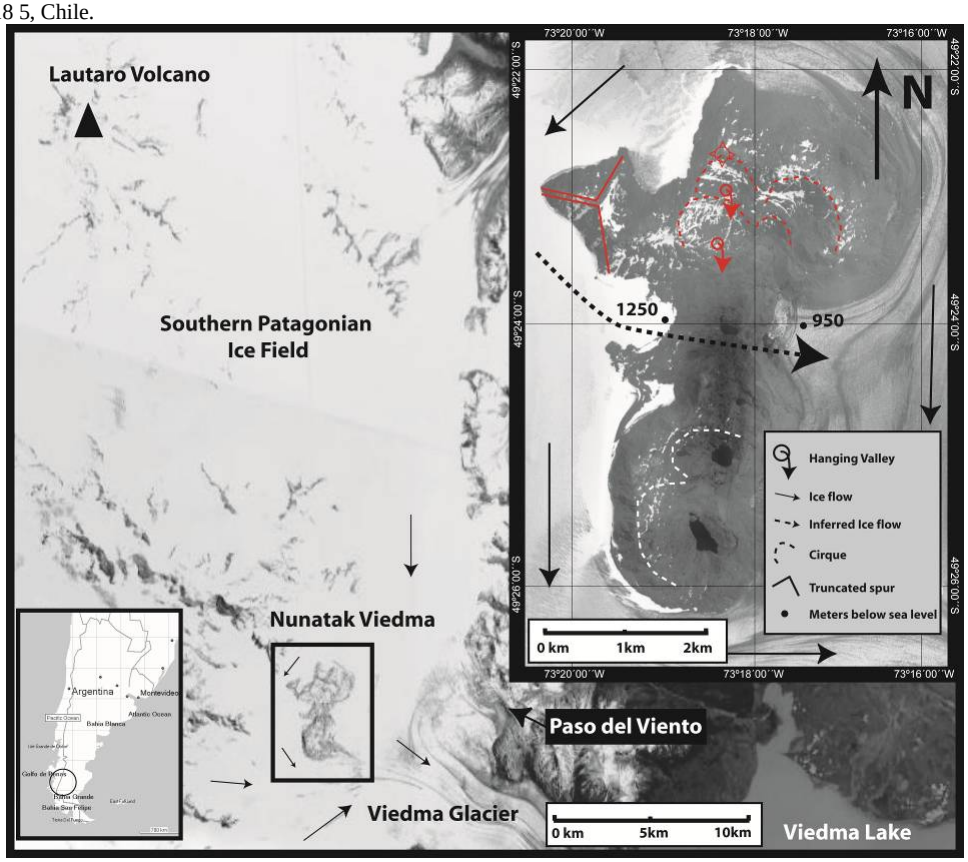

Figure 1. The image shows the studied area, which is inside the Southern Patagonian Ice Field, in Argentina. The detailed view shows a geomorphological sketch of the glacial features, previously described as a volcanic centre.

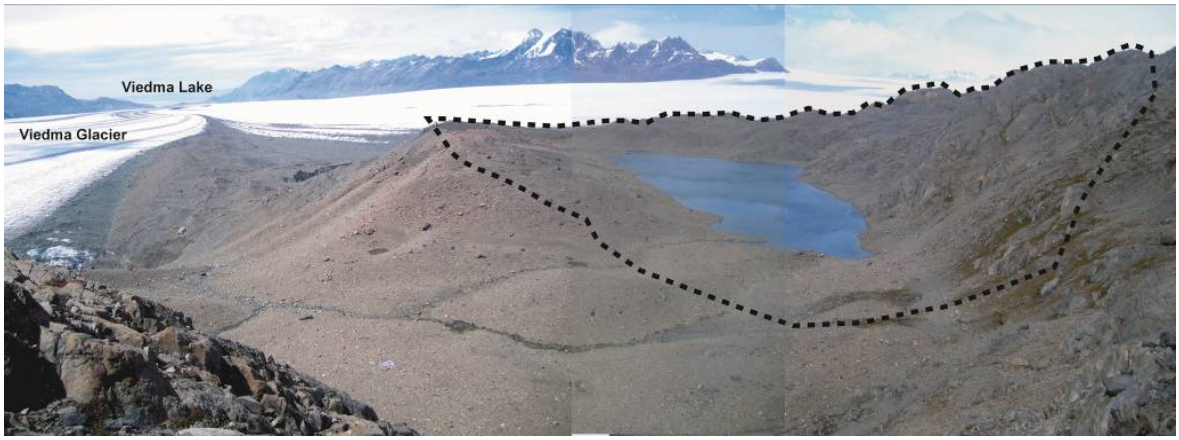

Figure 3. The image shows a panoramic eastward view of one of the main inner lakes of the nunatak Viedma. Striped lines indicate morphology previously confused as a volcanic crater. The lakes are surrounded by outcrops of metamorphic rocks and glacial debris. It is

possible to see different levels of coast lines around the mayor lakes.