VICC 2010

Field Guide

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Volcán Mocho-Choshuenco, Chile

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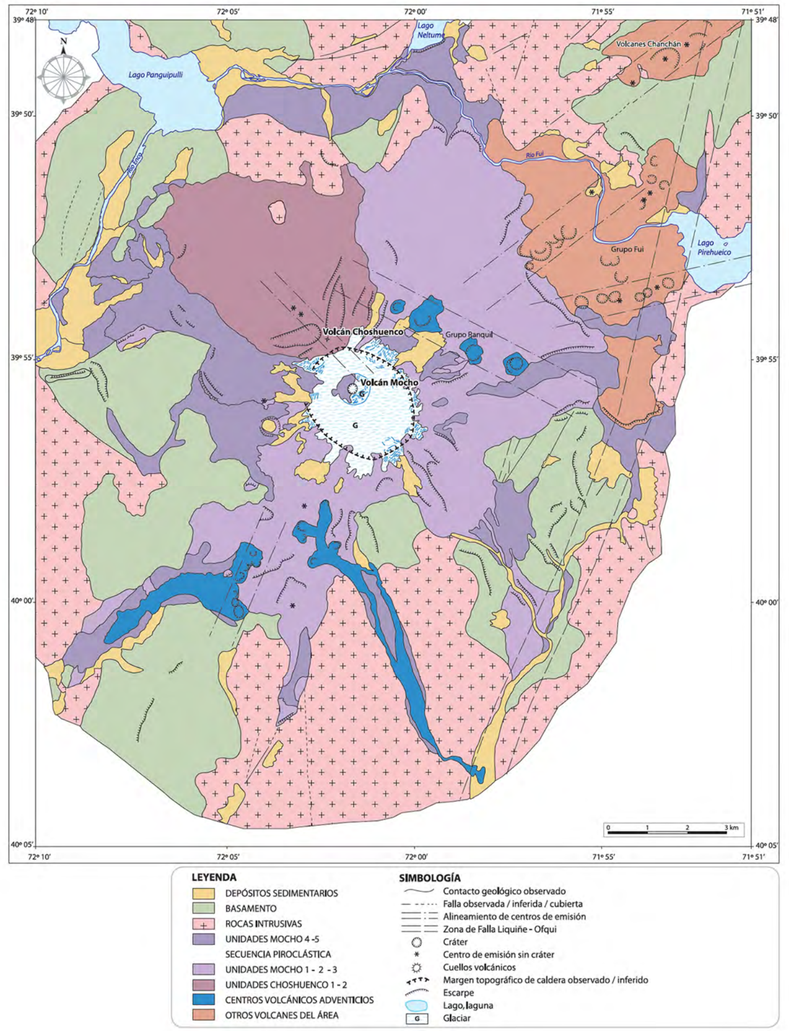
Mocho-Choshuenco volcanic complex

The Mocho-Choshuenco volcanic complex is a Pleistocene-Holocene complex located in the active Southern Volcanic Zone (SVZ) (Stern, 2007), formed by the remnants of an old edifice (Choshuenco peak) and a small stratocone (Mocho) within a caldera structure. The evolution of the complex started in the Middle to Late Pleistocene (Moreno et al., 2006) with the emission of a series of basaltic andesite to andesite lavas. In the early post-glacial period (ca. 11 ka) an explosive phase started with the generation of large-volume plinian fallouts known as the Pirehueico (Naranjo et al., 2001 a,b) and Neltume (Echegaray et al., 1994; Echegaray, 2004; Naranjo et al., 2001a,b) and plinian airfall deposits, both of dacitic to andesitic composition. The Neltume eruption airfall deposits covered an area of more than 4,000 km^2, exxtending more than 50 km to the north. One of these eruptions likely produced the partial collapse of the ancestral edifice forming a caldera structure. The explosive activity continued in the Holocene with the generation of a series of pyroclastic flows (pumice-rich and scoria flows), surge (dry and wet) and tephra fallout deposits both of andesitic and dacitic composition (Echegaray, 2004, Pérez, 2005). Simultanesouly a series of flank cones (Fuy series) were formed on the lower northeastern flank, as well as a small stratocone while lavas and tephra fallout layers started to infill the caldera depression. The last explosive eruption of the Mocho-Choshuenco volcano occurred in 1864 and was accompanied by a highly destructive pyroclastic surge along the western flank of the volcano. According to its postglacial and recent eruptive history, the Mocho-Choshuenco volcano must be considered one of the most hazardous volcanoes of the SVZ and one of the most highly explosive (Naranjo et al., 2001a,b).

The primary hazard associated with the Mocho-Choshuenco is the possibility of highly explosive eruptions accompanied by pyroclastic flows and/or surges as has occurred several times in very recent history. Tephra fallout could reach populated areas in Argentina (to the east) affecting both tourism and agriculture. Another hazard is related to the permanent ice-cap that fills the caldera depression (Rivera et al., 2005), as it is a potential source for lahar generation. Finally, it is likely that new flank cones will form on the lower northeastern flank, accompanied by associated lava flows, as has been recurrent in the last 6,000 years.

COMPLEJO VOLCÁNICO MOCHO - CHOSHUENCO



DAY 1

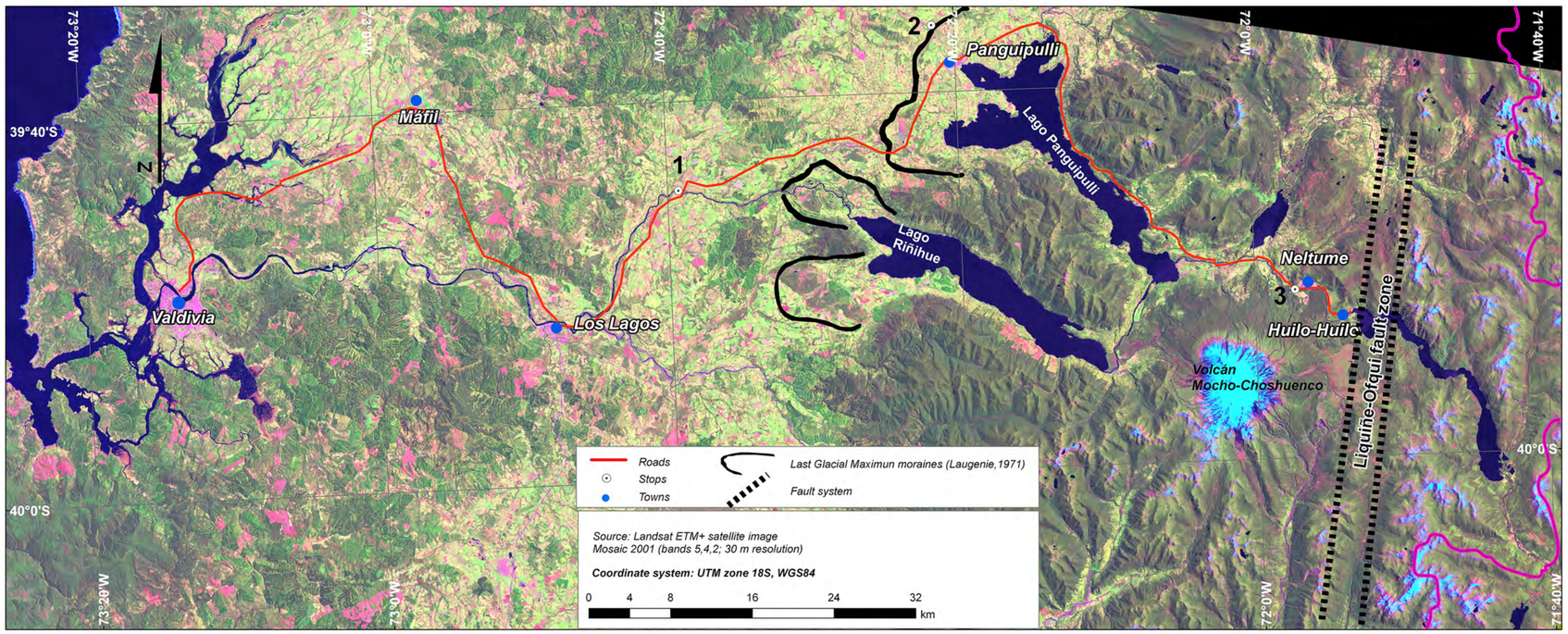
Geological and Volcanological Tour from Valdivia to Huilo Huilo Reserve

A five hour drive east from Valdivia to the Huilo Huilo Reserve will include two stops on the way. We will pass through the towns of Máfil, Los Lagos and Panguipulli, transversing a total of 160 km.

Stop 1. Malihue Bridge (39°44'50"S, 72°38'35"W).
This bridge spans the San Pedro River, which was dammed by the Valdivia earthquake of May 22 1960, the most powerful earthquake ever recorded (9.5 on the Moment Magnitude scale). It produced a tsunami which affected virtually all of the Pacific Ocean basin, as far as Japan and the Aleutian Islands. A few kilometers east of Malihue, and downstream of Lake Riñihue, the river was dammed by landslides triggered by the earthquake (Taco 1, Taco 2, Taco3) resulting in the partial flooding of Valdivia ("Riñihuaso"). After a successful artificial drainage effort involving hundreds of people, the flood was finally controlled.

Stop 2. Terminal moraine west of Panguipulli (39°37'12"S, 72°20'57"W)
During the Pleistocene, in the lakes region of southern Chile, glaciers extended westward more than 50 km from the main spine of the Andes, with huge piedmont glaciers covering all the present lake basins. We will observe glacial till on the roadside on the way to Lanco, which lies 3 km west of the town of Panguipulli, along with glacial erratics, which are part of the terminal moraine which surrounded the present Lake Panguipulli at the end of the Last Glacial Maximum (LGM).

Stop 3. Portal Huilo Huilo (39°51'13"S, 71°57'12"W)
At the entrance of Huilo Huilo Reserve we will observe basaltic andesite lavas from the Fuy Group (Upper Pleistocene to Holocene), locally covered by the Pilmaiquén pyroclastic flow (ca. 1900 years BP). The Fuy Group consists of a series of flank cones and associated lava flows, of which the one visible at Huilo Huilo Falls (Salto Huilo Huilo and Salto El Puma), shows remarkably well-developed columnar jointing (probably due to valley confined flow), with an excellent example at "reloj basáltico". The Pilmaiquén pyroclastic flow covers a large area is up to 2 m thick in this zone, with well-developed accretionary lappilli structures (due to high humidity during emplacement).



GLACIOLOGICAL STUDIES AT MOCHO-CHOSHUENCO VOLCANO

The Mocho-Choshuenco Volcano has two different cones, Mocho and Choshuenco and is located at 39°56'S, 72°02'W. The volcano last erupeted in 1864 (González Ferrán, 1995). Most of the summit area of both cones is covered by glaciers, 16.9 km^2 in total (Rivera et al., 2005). As is the case for most Andean glaciers, Mocho's glaciers have retreated in the last decades, shrinking from 28.4 km^2 in 1976 to 16.9 km^2 in 2003 (Rivera et al., 2005). In spite of this reduction in surface area, no significant glacial thinning has been detected for the period 1961 and 2005 (Rivera et al., 2006).

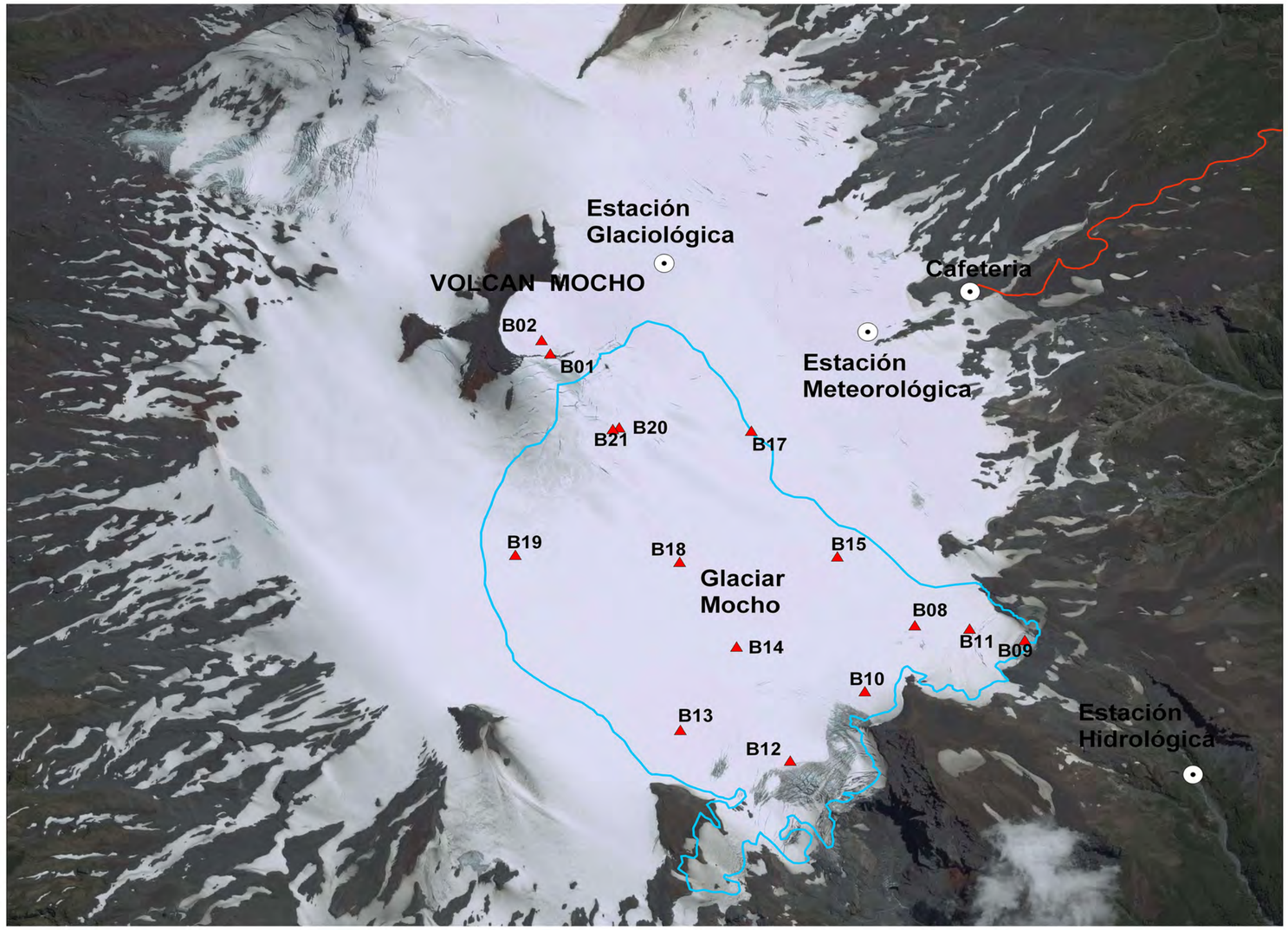
The south-eastern side of the Mocho-Choshuenco Volcano is covered by a 5.1 km^2 glacier of which occupies a large caldera. CECS started a mass balance monitoring programme on this glacier in May 2003. The program consists of monitoring a network of 15 stakes, which are distributed from an elevation of 1723 m a.s.l. to 2416 m a.s.l., a few metres below the summit. The programme uses the following instruments and techniques to monitor the glacier:

- Automatic Weather Station (AWS) at an elevation of 1995 m a.s.l. (since April 2006)
- River gauge station at an elevation of 1343 m a.s.l. (since December 2009)
- Monthly stake measurements
- Monthly snow pit observations
- Montly GPS measurements (stake positions and kinematic survey)

Aluminium stake at Mocho Glacier.

PVC stakes at Mocho Glacier.

Snow pit observations at stake 18.



DAY 2.

Glaciological Tour to Mocho Volcano

The road up to the volcano will be climbed in 4x4 vehicles. Above the tree line (1250 m) the road continues up the slopes of the volcano to the glacier's front at 1850 m. From the toe of the glacier we will continue on foot up to the meteorological station (Estación Meteorológica on the map), which lies at 1955 m a.s.l. After a brief pause we will continue up easier snow slopes to the base of the Mocho volcanic cone, where a "Glaciological Station" (2170 m a.s.l.) consisting of a dome tent will be erected. At this rest stop there is a snow pit, stakes and snow/ice radars. From the Station, the summit (2422 m a.s.l.) can be reached in less than 1 hour by climbing a hard-pack 40° snow slope. At the summit there will be a group led by Margit Schwikowski (PSI, Switzerland) drilling a firn core. The return will follow the same route back to Portal Huilo Huilo where there will a barbecue.

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