

Barrick's Glaciers

Technical Report on the Impacts by Barrick Gold on Glaciers and Periglacial Environments at Pascua Lama and Veladero



Coro 1 Glacier, completely covered by dust and debris from activities at Pascua Lama at the end of 2012. In the lower portion of the image explosives in the extraction process are shown to be the cause of the debris cover. Source: Anonymous; Photo location: 29°19'54.73" S 70°01'06.88" W

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By Jorge Daniel Taillant

Center for Human Rights and Environment (CEDHA)

jdtailant@cedha.org.ar



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Jorge Daniel Taillant
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jdtailant@cedha.org.ar

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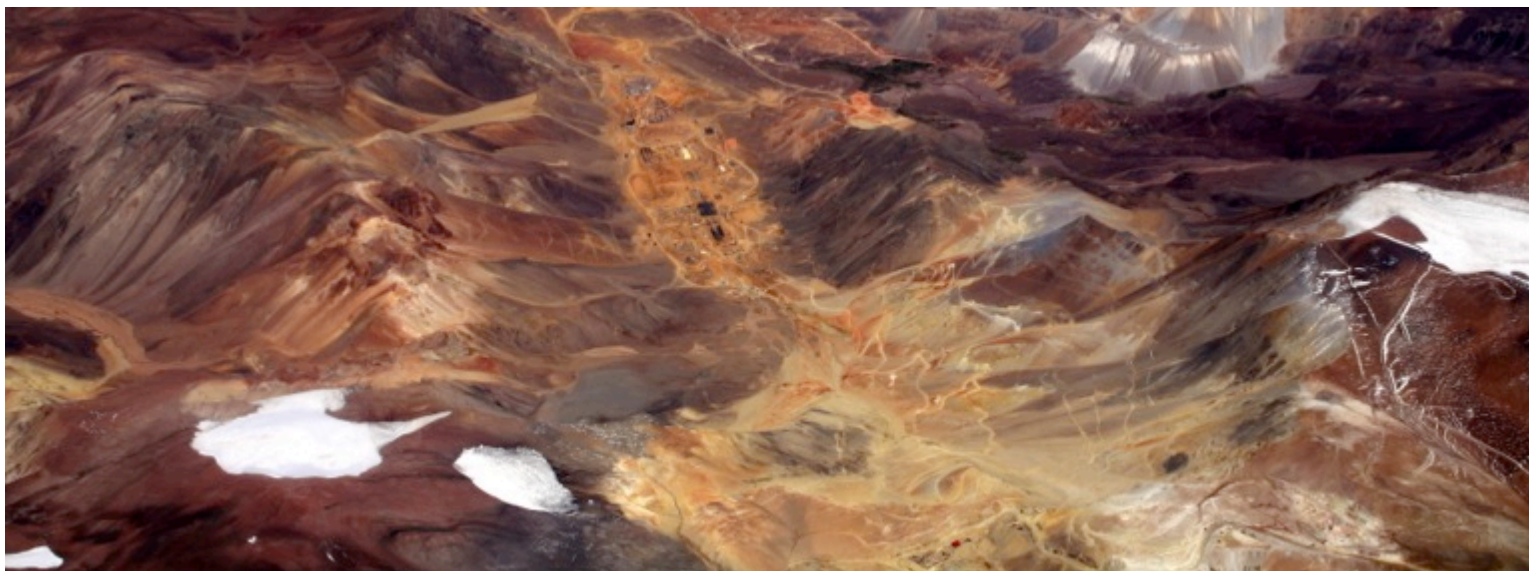


Photo: The Pascua Lama Project and the Los Amarillos, Amarillos and Guanaco Glaciers. Source: R.Posch; see: 29°19'36.04" S 70°01'11.74" W

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We'd finally like to thank CEDHA's staff, and especially Romina Picolotti, who has inspired this and many other environmental causes.

- Jorge Daniel Taillant

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“In the case of Pascua Lama, there are no glaciers in the areas around Pascua Lama nor around Veladero ... Neither Veladero or Pascua Lama contemplate impacting glaciers ... As I said, there are no glaciers near Veladero or Pascua Lama ... Our operations do not impact glaciers in the area.”

- from a video interview by Maximiliano Heiderscheid of Barrick Gold’s VP for South America, Rodrigo Jiménez (2009) ¹

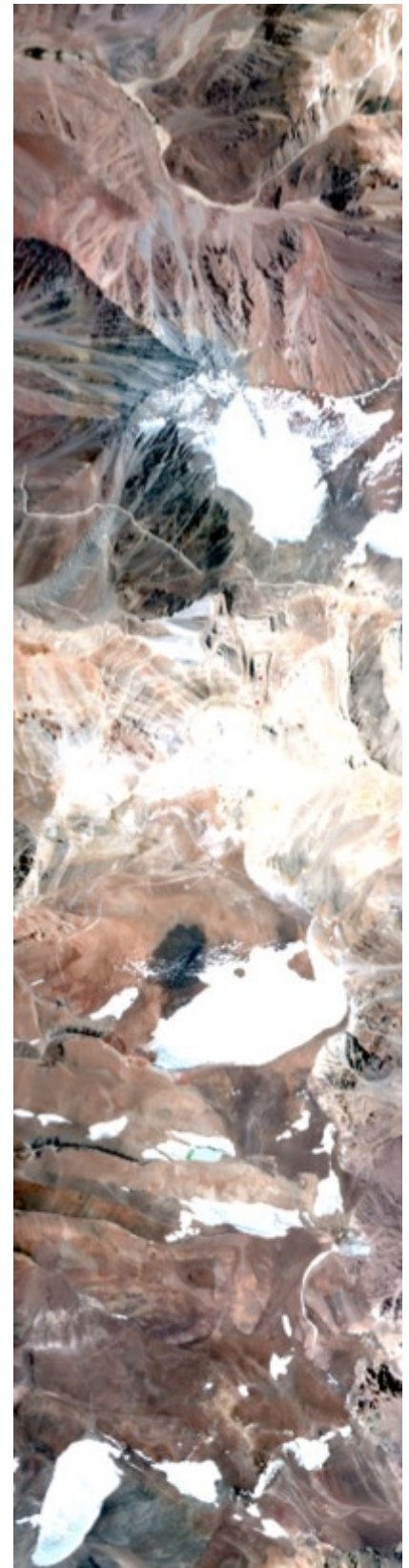
¹ see: <http://www.youtube.com/watch?v=DN8X-HjaP4Q&list=PL5A353061CDEB3FE6>

I. What's in this Report?

- Never-before seen images of the area around Pascua Lama from the month of January 2013, showing the significant deterioration of glaciers in the project influence areas for both Pascua Lama and Veladero;
- Satellite images that show impacts to glaciers from Barrick Gold's activities in Argentina;
- An inventory of glaciers in the Veladero and Pascua Lama impact areas, with a 2005/2006 baseline, showing hundreds of glaciers in the zones of influence, while Barrick only recognizes that seven glaciers are in impact areas;
- A recounting of the evolution of Barrick's conflict with glaciers and periglacial environments at Pascua Lama and Veladero;
- Analysis of the impact that these glaciers and periglacial environments suffer in Barrick's impact areas;
- Information that refutes numerous false statements by Barrick Gold and by public officials at the national and provincial levels, suggesting there is no impact from mining activity to glaciers;
- Numerous photographs and coordinates of glaciers and periglacial environments that are at risk due to Barrick Gold's activities at Veladero and Pascua Lama;
- Easy to understand instructions for the reader about glaciers and periglacial environments, their importance to the local ecosystem and the risks they face from mining activity;



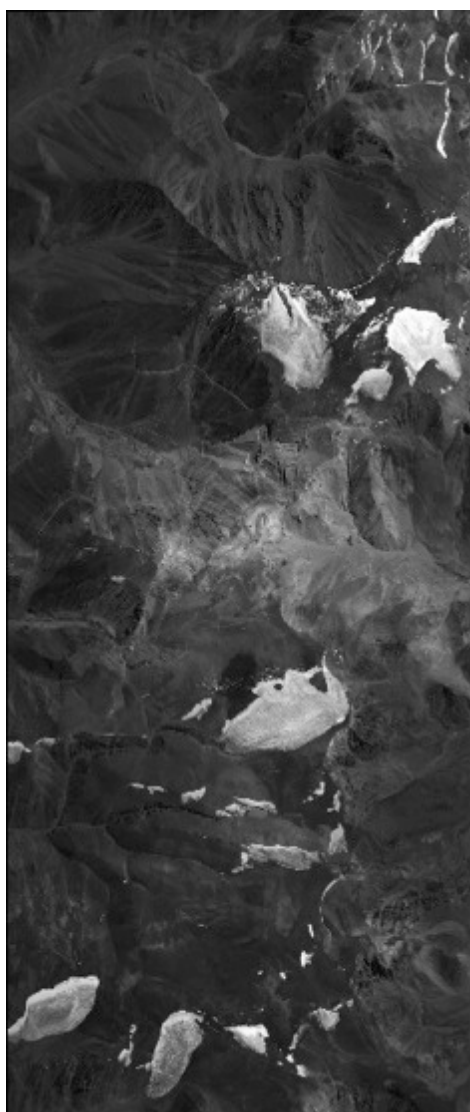
View of Veladero with the magnificent Los Amarillos Glacier in the background. Source: Barrick Gold
Photo Location: 29°24'38.59" S 69°53'17.12" W



Pascua Lama Area.
Source. Digital Global Foundation

II. Executive Summary

Recent satellite images from January of 2013 are surfacing from the areas surrounding Barrick Gold's Pascua Lama and Veladero mining projects, as well as information from the recent official closure order of the Pascua Lama project in Chile which occurred in April 2013 (and which still stood at the time of the publishing of this report), that reveal what many had already presumed: extractive activity at Veladero and the preparatory work at Pascua Lama, have already significantly impacted natural resources (including glaciers and periglacial environments) in project influence areas. We can see a drastic reduction in the area and volume of many glaciers since Barrick Gold initiated activity at Veladero in the mid 2000s. We also witness the total and/or partial covering with dust and debris of various glaciers in the area, as a result of prestripping blasts, vehicular transit, and other works at the mine sites. Finally we also document the disappearance of several glaciers in the area.



It is not true, as Barrick Gold and several public authorities in Argentina have often stated, that there are no glaciers in the project area, or that mining activity does not impact glaciers or periglacial environments.

These statements are absolutely and categorically false, and only serve to cover up what is occurring at the project sites as well as at other project areas in the region. As time passes, and operational activities intensify, and as Barrick Gold moves forward with preparatory work for Pascua Lama, so intensifies glacier and periglacial environment impacts. The evidence to sustain this affirmation is ample and impossible to refute. The closure in Chile by government authorities of the Pascua Lama project is directly related to this impact.

In April of 2013, the Chilean judicial system ordered the total closure of Pascua Lama in Chilean territory, based on the evidence showing the contamination of glaciers and of other natural resources such as vegas systems (highland wetlands) and waterways. The closure is also the result of Barrick Gold's systematic refusal to abide by requests from the government to address its impacts. Barrick Gold simply ignored the requests of the government to introduce methods to protect glaciers, vegas systems and waterways, which is what finally led to the court order to close Pascua Lama. It is uncertain at the time of the publication of this report at what time, if at all, the Pascua Lama project will resume. Also at the closing of this report, the Chilean environmental authority (the SMA) fined Barrick US\$ 16.4 million dollars due to violations of code, including glacier impacts.

In Argentina, public authorities at both the national and provincial levels, have systematically denied that Barrick Gold (and more generally *the mining sector*) impacts glaciers and periglacial environments. Barrick Gold has systematically denied *even the presence* of glaciers in the areas around Pascua Lama and Veladero. The company has subsequently recognized the presence of some glaciers.

But the actual number of glaciers remains a point of denial by the company. Barrick falsely refers to a *few* glaciers on its website, near the project areas, showing only seven glaciers near the project pit area,² and says that “*these are the glaciers*” in the Pascua Lama influence zone. However, our research reveals that there are *hundreds* of glaciers in project influence areas. This report reveals glaciers from 2005/2006 images, the years when Veladero entered into operation, and soon after which preparatory work began for Pascua Lama. We do not have access to images earlier than these dates in order to properly evaluate impacts from the projects since the beginnings of exploratory work, which is when impacts to the glaciers would have begun. Drilling and exploration activity at the mine sites began in the 1990s, and ideally, any baseline starting point should be made at this time. It is possible that images exist from this period, but we do not have access to such images. For this reason, CEDHA utilizes a baseline from the 2005/2006 period.

Unfortunately, the existing evidence indicates that many glaciers visible in the 2005/2006 period, in various sections of the projects’ influence areas, *have already disappeared*. The surviving glaciers, are however at risk due to climate change, which is aggravated by the intense activities at Veladero and Pascua Lama and along the access roads. Our inventory registers 274 glaciers in the projects’ influence area at the time Veladero started operations in 2006.

The 274 glaciers that we have been able to register are visible in the 2005/2006 period and represent approximately 37.5km² of ice, or 3,730 hectares (9,200 acres), and are distributed between Argentina (69%) and Chile (31%). Save for some few cases, Barrick Gold’s impacts to glaciers in the region has been largely silenced and hidden from the public eye. More recent available data is surfacing in Chile, where severe impact is visible due to surface contamination with dust and debris from Barrick’s mass earth removal at the Pascua Lama site in the pre-stripping phases of preparatory work for Pascua Lama. The closure by Chilean authorities of Barrick’s operations in Chile has to do with this impact. On Argentine territory some information was made public several years ago concerning impacts to glaciers at the Conconta Pass, but Barrick Gold never carried out impact studies to determine the source of impacts to these glaciers. They point to climate change as the principal force causing glacier retreat in the Central Andes, but make no reference to the heavy machinery removing ice from the Conconta Pass or the intense vehicular transit in the area. We witness severe glacier retreat in the general area, and also debris deposit on the surface of glacier ice, very near to Barrick’s access roads, while glaciers further away show less retreat. This information is largely unknown in the province of San Juan Argentina, or worse, it is intentionally withheld from the public.

The impacts of mining activity to glaciers and periglacial environments occurs for several reasons, but principally it is due to the movement of earth (including from pre-stripping blasts), and the contamination this process causes to the environment, as glaciers are especially vulnerable to local contamination, principally from atmospheric dust.

Emissions contamination generated by intense industrial activity and due to vehicular transit can also generate impacts including atmospheric impacts that can cause harm to glaciers and periglacial environments. While there is a climate change trend occurring globally, that undoubtedly has effects on the glaciers of the Central Andes, we can affirm that Barrick Gold’s impacts accelerate this general trend and result in increased harm and vulnerability to the glaciers near their operations. This clarification is important to this discussion as the two types of impacts should not be confused, nor should one be blamed entirely for the witnessed deterioration. The impacts are distinct and together account for *total impact*. Melting glaciers should survive still for many years to come, Barrick is unduly accelerating this deterioration. This report focuses on the local impacts caused *or potentially caused* by Barrick Gold’s activities, which accelerate and intensify known global impacts.

² See: <http://pascua-lama.com/medioambiente/cuidado-de-glaciares/>



The Almirante Brown Glacier impacted by Barrick Gold to open an access road to the Veladero mine. Source: Zlato (Barrick's subcontractor). Photo location: 29°58'37.90" S 69°38'00.74" W

How can we be sure that Barrick Gold intensifies global climate change impacts to glaciers?

The melting of glacial ice caused by climate change is a relatively slow process, which can take several decades, hundreds, or even thousands of years, depending on the glacier, the location, the region, and according to climatic conditions in the region and at the specific site. Climate change could even increase the volume of some glaciers. Barrick Gold has employed bulldozers to open up roads to access the Veladero project, and to prepare the extractive phase at Pascua Lama. This is widely known and has been documented for several years. The removal of ice from a glacier with a bulldozer evidently accelerates the deterioration of a glacier. The Almirante Brown Glacier (see above) has seen a dramatic reduction in size since Barrick arrived in the region and opened a road through its location. Barrick has not however produced impact studies to show the influence its activities have had on the glacier.

Drilling in the exploration phase harms glaciers, particularly if they occur through the ice and if lubricants are used. Barrick Gold indicates that there is gold beneath various glaciers, which it can only affirm if it has drilled through the ice. This is already an impact. Easily accessible images on Google Earth show numerous instances where exploratory roads have cut through glaciers. There is evidence in both Argentina and Chile that mining activity by Barrick Gold has caused acid drainage, which can also harm glaciers and downstream waterways. The closure of Pascua Lama in Chile is based partially on this sort of impact. CEDHA published not too long ago, a report in which we show that the same impact is occurring on Argentine territory.³

Explosions in the preparation and extraction phase impact glaciers, lifting enormous clouds of dust and debris into the atmosphere that then soil glacier surfaces. The photograph on the cover of this report is of the controversial Toro 1 Glacier, which according to Barrick Gold has gold underneath its surface. Toro 1 has already been completely covered by debris/dust from explosions in Pascua Lama's preparatory phase. The soiling of the surface of a glacier changes the glacier's albedo (reflectivity) and can cause changes of the glacier's melting point, bringing it into disequilibrium and ultimately to its destruction.

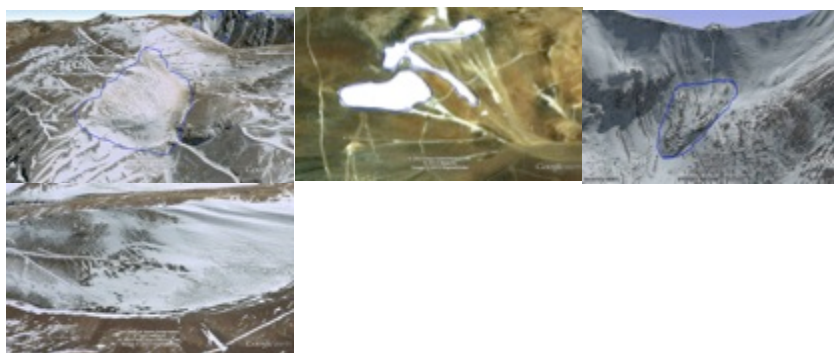
There is so much dust at Pascua Lama generated by the projects' activity, combined with the potent winds in the area, that at the end of 2012, Barrick was forced to suspend pre-stripping activity at Pascua Lama due to the health risks the heavy dust represented for workers.⁴ The

³ see: <http://wp.cedha.net/wp-content/uploads/2011/09/IMPACTO-DE-LOS-EMPREDIMIENTOS-VELADERO-Y-PASCUA-LAMA-SOBRE-LOS-RECURSOS-HIDRICOS-DE-LA-PROVINCIA-DE-SAN-JUAN-CEDHA-2011.pdf>

⁴ <http://www.barrick.com/investors/news/news-details/2012/Construction-Schedule-at-Pascua-Lama-Not-Impacted-by-Pre-stripping-Stoppage/default.aspx>

Chilean authorities (and the justice system) have already fined the company due to these impacts. But Barrick Gold has not taken the measures necessary to revert the situation, such as watering roads, covering trucks, or hauling equipment.⁵ Today the projects is closed as a result of this oversight and failure by the company to comply with government demands.

Barrick Gold has tried to limit the discussion on the impacts of its activity on glaciers to those glaciers near to the pit area at Pascua Lama, but the impact to glaciers and periglacial environment is visible far beyond this area, along the access roads to the project, from Alto del Carmen in Chile, and from Tudcum in Argentina. Until very recently, the evidence of this impact available to the public was very limited, and was only pertaining to the Chilean side of the project. In Argentina, the only reference to glacier impacts made public were regarding two glaciers along the Conconta Pass not too far from the town of Tudcum.⁶ This included the *Almirante Brown* and *Norte* Glaciers. Nonetheless, Barrick *has not and is not* carrying out impact studies on those glaciers, only monitoring studies to evaluate present health after their intervention. Publicly available tools, such as Google Earth, show high-resolution images of glaciers present in this area as well as the vulnerability of these glaciers to activities by Barrick Gold in the region. What is certain is that there has been a drastic reduction of ice mass since 2005, and many of the smaller glaciers in the area have disappeared as activities by the mining company have evolved. We cannot be certain if Barrick's activities are to blame for this regression, since the company has not carried out the necessary impact studies to determine potential impact on these glaciers.



Numerous instances of intromission by Barrick's roads into glaciers. Source: Google Earth.

Barrick Gold has been ambivalent about it's position *vis à vis* its impacts on glaciers and to periglacial environments. In fact the company has practically not mentioned periglacial environments at all nor has it made reference to the risks and impacts it has *or is causing* to periglacial areas. We address Barrick's position regarding these issues in this report.

The company has gone from:

- Recognizing in original studies that *there are glaciers* at Pascua Lama, to saying that there are no glaciers near the site;
- Stating that the air in the project area is naturally pure and that the only atmospheric contamination is from mining exploration activity to saying that the dust in the air is naturally caused;
- Stating that there are glaciers in the pit area to waging semantic battles to change the category and definition of glaciers;
- Stating that glaciers provide water to denying that they have any hydrological relevance;
- Proposing to dynamite glaciers to get to minerals to saying that Barrick Gold protects glaciers;
- Promising to protect glaciers to filing legal action against Argentina's glacier protection law;

⁵ see: <http://wp.cedha.net/?p=12568#>

⁶ see Almirante Brown Glacier at: 29°58'38.61" S 69°37'59.12" W
see Norte Glacier at: 29°58'30.88" S 69°38'41.58" W

Barrick Gold has changed positions and rhetoric on glacier impacts according to changing public opinion and official positions about Barrick's impacts to them.

The *first and primary objective* of this report is to show *which are the glaciers in the region* and the periglacial environment in the area that are in Barrick Gold's project influence area. A *second objective* is to show impacts and risks from Barrick Gold's mining activity to glaciers and periglacial environments. A *third objective* is refute the position by Barrick Gold and some public officials that deny that mining, and particularly Barrick Gold's activities at Pascua Lama and Veladero are impacting glaciers and periglacial environments.

We ask simply that Barrick Gold respect, and that authorities uphold, the National Glacier Protection Law. We ask that information be made transparent, and that we recognize and address the risks and impacts that are visible to glaciers and periglacial environments. We ask also that the necessary studies be carried out to ensure the full respect of the National Glacier Protection Law *vis à vis* operations at both Pascua Lama and Veladero.



The Los Amarillos Glacier, seen from Argentine territory at Veladero. Source: G. Manrique
Photo location: 29°20'39.74" S 69°57'00.04" W

III. The History

The idea of extracting minerals from the El Indio Gold Belt⁷ in the high mountains of the Central Andes was always a challenging one particularly due to the technical difficulties and creative engineering it would imply. This region, 4,000 meters above sea level, is far from human life. The air is thin and breathing is difficult. The climate is inhospitably brutal for most of the year. The earth freezes and thaws cyclically, further complicating industrial works.

Before the arrival of large mining projects to the region, few local folk knew the area mostly due to the difficulty of access. Indigenous peoples (amongst these, the Diaguitas), tell that their ancestors frequented the lands as a passage point between what is now Argentina (to the East) and Chile to the West. The highest peaks *and the glacier-fed watersheds* towards the Atlantic (East) and to the Pacific (West) form the natural and political border between the countries. These are sacred lands with ancestral burial grounds lining the peaks. Besides the indigenous settlers, few others had ever been up in these areas. Perhaps for this reason, foreign mining companies had not ventured into the area to take on the challenge of finding the gold deposits known to be in the region in what is known today as Veladero, Pascua Lama and El Indio. One story tells that when Pizarro took Atahualpa prisoner and demanded a room full of gold for his release, the Incas fled with the gold and hid it away in these hard to reach lands, historically part of the famous Inca Trail.

And while for human life, the area was not so inviting, it was an ideal place for the natural development of glaciers and periglacial systems. These magnificent ice bodies and water reservoirs serve as the pyramid of water basins for lower elevations in Argentina and in Chile. They capture winter snow, convert it to ice and release it slowly over the spring and summer months. It was ideal, that is, until Barrick Gold showed up with the hitherto unimaginable project of mining gold and silver at a mega-scale at 5,000 meters above sea level.



The Pascua Lama project is well above 4,000 m far from human settlements; Photo location: 29°20'33.28" S 69°57'45.25" W
Source: http://www.estrategia.cl/Documentos/Imagenes/65974_12-Pascua-Lama2_2.jpg;

Barrick Gold, the largest gold mining company in the world, was up to the challenge, and gold discovery at Veladero placed in motion a veritable “new gold rush”, with dozens of small and medium sized companies flocking to the Andes in hopes to strike it rich. Coincidentally, the largest mineral deposit found happened to be literally on the border between Argentina and Chile, jurisdictionally complicating any eventual attempt to extract it. Nevertheless, Barrick

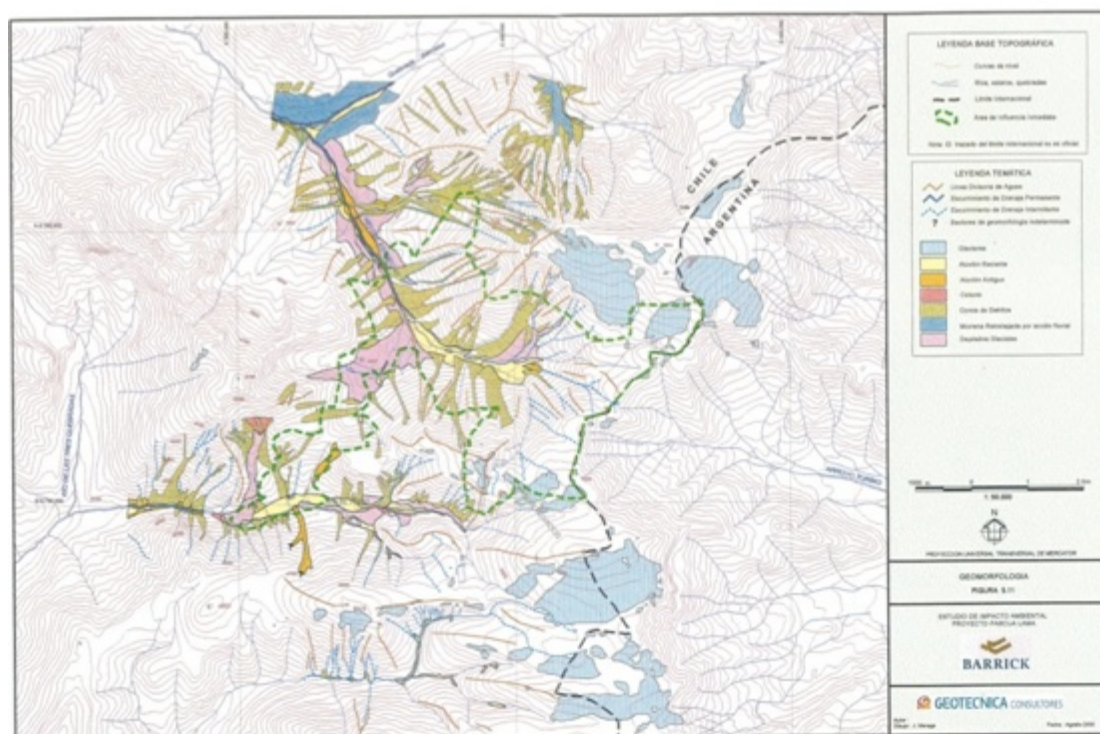
⁷ see: http://en.wikipedia.org/wiki/El_Indio_Gold_Belt

Gold was set on seeking the necessary administrative answers to whatever barriers might exist. They would separate the project into several portions. They would start at Veladero fully within Argentine territory and as the international legal and administrative framework was settled, they would move on to Pascua Lama.

And so, Barrick Gold began working in the high Central Andes in the mid 1990s. By the mid 2000s, Veladero was off and running while Pascua Lama was in the final preparatory and permitting stages. As Pascua Lama was literally 'on the border', a new administrative area would be created through the signing of a bilateral treaty between Argentina and Chile. Barrick would forge a wedge into the border where they could move machinery and begin to move across the border at will and at their own discretion. The company would benefit from specially crafted and specifically tailored legislation for their needs.

Until that moment, no one was speaking about glaciers or *periglacial environments*, a term that was absolutely unheard of on either side of the border. The discussion about glaciers and glaciers impacts of Barrick's operations would come later.

Despite later declarations by Barrick representatives (as the one we quoted above), early impact studies carried out for Barrick Gold already had attested to the presence of glaciers and periglacial environments in the project influence areas. In the geomorphological mapping reproduced below, glaciers are prominently present at, and around, the main project site. In the map, the pit area is mapped as a green dotted line. Glaciers are light blue polygons all around and within the pit site. There are some 20+ glaciers in this image. (From EIA, Chapter 5, Figure 5.11-Geomorphology).



Barrick recognized early on that glaciers existed at Pascua Lama. The company later denied it.

But of course, these were not the colossal Patagonian glaciers that the people of Argentina and Chile were accustomed to seeing on television. These were smaller glaciers, but glaciers nonetheless, with very significant ice mass and water reserves in their interior.

Miners *did* know about these glaciers and about periglacial environments in the high Central Andes. In fact, ice in this area was nothing new for mining companies that had had to deal

with frozen grounds in other projects. Ice was always a problem for sample taking, for earth mass removal, for road access, etc. Reports even exist on how best to break glacier ice to carry out extractive activity, how best to drill, etc.. (see bibliography in the annex)

One of the standard tasks for a geomorphologist for a project in high altitudes where ice may be present is mapping glaciers and rock glaciers (which are debris-covered glaciers mixed with rock and earth). *Geotécnica Consultores*, a consulting firm, was hired to carry out a glacier mapping of the area for Barrick Gold.

Few if any had considered the potential impacts of mining activity to glaciers at the time. Mining was not even considered a risk to glaciers. No one considered the need to protect glaciers or their function for local ecosystems and local hydrology. No one considered the vast amount of water contained in glacier ice or even more so in periglacial environments. In fact, the term “periglacial environment” was hardly known outside of very technical circles.

Barrick Gold certainly did not consider these impacts, and this is clear in the early Environmental Impact Assessments for Veladero and Pascua Lama. On the contrary, the presence of ice for mining companies like Barrick at the time, was more of an operational problem than an environmental risk, due to:

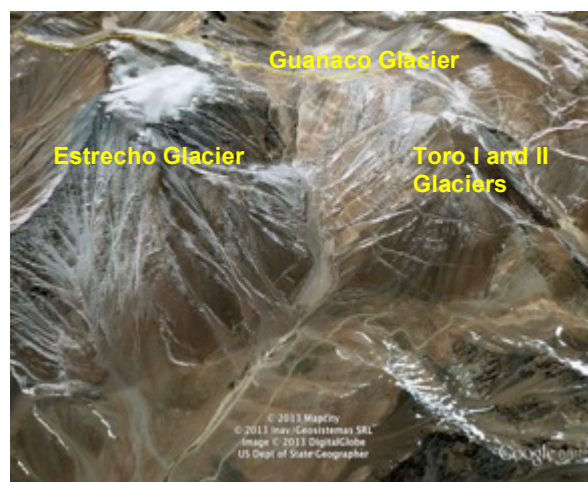
- Where there is ice it is difficult to take samples or construct works (roads, infrastructure, etc.);
- Where there is periglacial environment (frozen grounds with a mix of ice, earth and rock) it is difficult to drill, potentially breaking machinery;
- Where there are frozen grounds, the natural freezing and thawing cycles structurally complicate works, and present difficult engineering design challenges;
- Glacier movement, when the company clears a path for a new road, could bring ice right back over the road, causing transit risks and increased road maintenance costs;
- Glaciers and frozen grounds are unstable which are dangerous for the safety of workers and to the stability of infrastructure;
- The difficulty or impossibility of getting at minerals beneath ice.

Glaciers and periglacial areas were a problem for mining companies in the years prior to Argentina’s National Glacier Protection Law. They were a problem in terms of project costs, design challenges, and because companies would have to carry out extensive environmental studies to work with and around ice affected areas.

What was different about Pascua Lama was that the gold discovered was beneath the ice and Barrick would have to find a cheap and easy way to get to it.

Ice is also a hydrological resource for the mining company, particularly important in a high and dry mountain area such as the region where Veladero and Pascua Lama are located. Glaciers recharge each year and with each snowfall, glaciers are perfect and natural renewable resource. They collect water in the winter, store it and then slowly release it in the natural environment so that the snowfall does not melt away quickly with the rising temperature of the early months of Spring.

In this regard, the reports prepared for Pascua Lama, also indicated the presence of glaciers in terms of hydrological relevance. In the EIA published in 2000, Chapter 5, there are numerous references to glaciers of the area. (e.g. 5-17), and there are references to the importance of glaciers to water supply and river flow of the Rio Toro and the Rio Estrecho, both with glaciers at their basin head immediately at the Pascua Lama pit site. (EIA, 2000, Cap.5-27).



Estrecho/Toro Basins. Source: Google Earth
see: 29°18'07.53" S 70°01'24.15" W

Another point of interest found in the first EIAs of Pascua Lama, is the opinion of the company regarding air quality in the area. Barrick Gold says in these first studies that the atmospheric air quality of the Pascua Lama project was *pure and without dust*. No one seemed to consider that blasting tons of fine debris into the air, combined with strong winds that prevail in the region would or could impact glaciers.

This was something that would be discovered in time. Whether it was ignorance or simply disregard from Barrick Gold's management, the issue was ignored completely.

The main problem for Barrick Gold at this early stage of Pascua Lama relative to glaciers was not how to protect or conserve ice, nor did they envisage a public outcry against destroying glacier ice. The problem was how to get to the gold beneath the ice. In the original documentation presented to the Chilean authorities, Barrick notes 4 glaciers in the pit area, Toro 1, Toro 2, Esperanza and Amarillos. They needed to remove the glacier ice at these sites to get at the gold beneath. Barrick knew there was gold beneath the glaciers because they had drilled into the ice to take samples; Barrick Gold was already drilling into, and impacting glaciers during the exploratory phases of the projects.

In the first impact studies where Barrick described future operations (2000), Barrick referred to the need of "removing" glaciers located at the pit site (EIA, 2000, Chap.6-19) Ironically, and against all logic, Barrick suggested they needed to destroy 10 hectares of ice (28 acres) to "avoid talus instability and environmental impacts." (see EIA Annex, below). Barrick Gold amazingly considered *that to protect the environment it had to destroy glaciers!*

In these first studies, when Barrick enumerates the eventual environmental risks or impacts of the Pascua Lama project, never did the company make any reference what so ever to the impacts caused by destroying glaciers, or removing them. Barrick did not consider this to be an environmental impact to the natural resources of the project influence area.



This position of the company is also visible in the "hierarchy" of environmental impacts it publishes in the 2000 EIA (Table 6.4) where glacier impacts are not mentioned *at all*, and much less considered a principal impact of the project. Here again Barrick completely ignores glaciers. Its clear from this early project documentation that Barrick did not consider that dynamiting a glacier was an impact to natural resources.

Barrick publishes a Glacier Management Plan that proposed removing 10 hectares (28 acres) of ice. Source Barrick Gold (unofficial translation).

Today, in contrast to these earlier years, and due to the strong social pressure against the company for its earlier proposal to dynamite glaciers, Barrick Gold sustains the opposite position, and says it is devoted to "protecting glaciers", as is indicated on the company website (in Spanish only). "Protecting glaciers" is now cited as a company environmental priority, when originally they were not even mentioned in EIAs.^{8,9}

⁸ see: <http://pascua-lama.com/medioambiente/cuidado-de-glaciares/>

It didn't take long for the company's preposterous idea to dynamite and remove glacier ice to cause strong negative reactions in affected communities, principally in Chile. In Argentina, the issue was largely absent from the public sphere. It is at this point that the Chilean authorities get involved, observing this portion of the Barrick's proposed program.¹⁰

Chilean communities downstream from Pascua Lama, particularly the original inhabitants of the Huasco Valley (the Diaguita indigenous peoples) would not tolerate glacier impacts, and much less dynamiting glaciers to get at gold. It was at this time that the now much heard slogan, "Water is more valuable than gold" emerged as a recurring motto for environmental groups opposed to large-scale gold mining. It was at this time that the Chilean government began intervening with controls at the Pascua Lama project. This is how Barrick's problems with glaciers began in Chile, which would, nearly a decade later, end up in a full project closure due to glacier impacts on Chilean territory.

Still miscalculating public opinion, Barrick insisted with getting at the gold beneath the ice. In 2001, Barrick enraged communities further with the intended implementation of its incredible *glacier management plan*.¹¹ The company circulated color brochures depicting in cartoon type images just how it could remove the controversial glaciers (Toro 1, Toro 2 and Esperanza) after dynamite blasting, with bulldozers and relocate the ice at the Guanaco Glacier.



Barrick published colorful brochures explaining to indigenous groups how it would dynamite glaciers, remove ice with bulldozers and haul it off in dump trucks to the nearby Guanaco Glacier. Source: Barrick Gold

It was difficult for most anyone to imagine how one could "manage" glaciers, and much less *move them* from one site to another after blasting them and plowing into them with bulldozers. Barrick was forced to explain their idea. But the resistance to Pascua Lama was now in full force. The above images enraged communities. In reaction to the growing resistance, Barrick shifted their rhetoric, utilizing more creative semantics, and responded that these were not actually glaciers (despite that they had called them so in the previous EIAs). They were "glacierets", or small glaciers that weren't very significant in terms of water contribution. But in fact, they were glaciers and Barrick's own technicians had already said as much. For the company, they were an impediment to getting at gold, for the community they were a lifeline providing critical water resources.

⁹ see: <http://barricksudamerica.com/barrick-y-el-cuidado-de-los-glaciares/barrick/2012-06-13/160511.html>

¹⁰ for info on the suspension of the project 2000 see:

http://seia.sea.gob.cl/externos/admin_seia_web/archivos/3053_20001006_SP.doc

for info on the suspension of the project 2001 see:

http://seia.sea.gob.cl/externos/admin_seia_web/archivos/3053_20010208_SP.doc

¹¹ see: <http://wp.cedha.net/wp-content/uploads/2011/11/Plan-de-Manejo-de-Glaciares-Barrick-english.pdf>

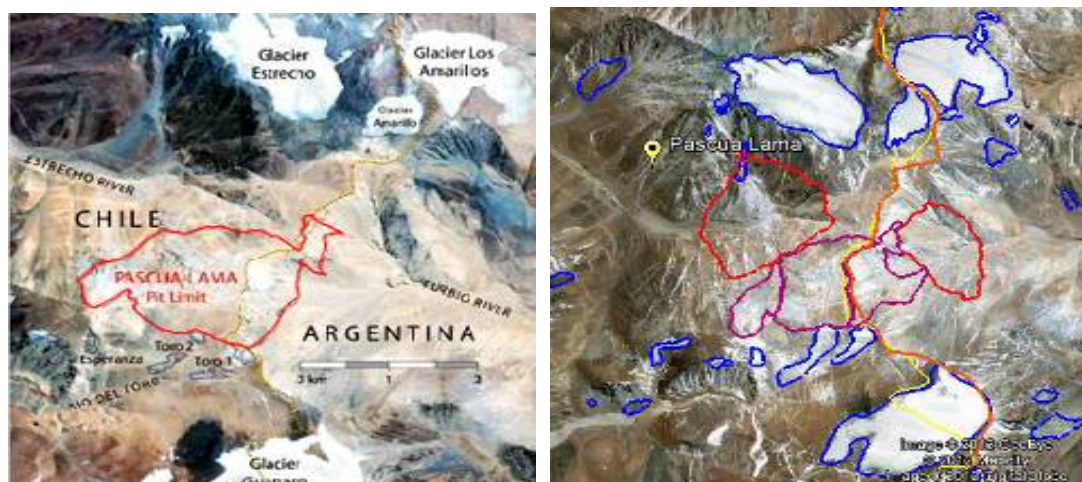
Part of the problem was that at the time, no one had complete or even very basic information about the glacier and periglacial environment resources in the area. Barrick Gold *did* have this information but the company refused to make it public. Barrick had hired glacier experts to fully inventory both uncovered and rock glaciers as well as other periglacial environment characteristic such as permafrost. To this day the breadth of information has been withheld from the public sphere.

Another part of the problem derived from a critical mistake of the Chilean authorities when they rebutted Barrick's proposal to "manage" the three glaciers in the pit area. At that point, the authorities *should have* insisted that Barrick address glacier impacts *at all of the glaciers in the project vicinity and influence area*. But this did not occur. Instead, the "official" focus went directly to the Toro 1, Toro 2 and Esperanza Glaciers. Barrick should have been obliged at that early stage to ensure no impact to any of the area's glaciers, and impact studies of operations should have focused on all of the glaciers in all influence areas.

But alas, and to Barrick's benefit, that's not how the story played out. Barrick was able to divert attention away from the other glaciers in the region, and the focus of concern would be only on Toro 1, Toro 2, and Esperanza. The other *hundreds of glaciers* would remain unprotected and have so until this day.

This would mark the construction of the first great myths Barrick Gold built around Pascua Lama, suggesting that only three glaciers were potentially affected by activity at the project site, and that only the pit area should be considered the project's area of influence. In fact, Barrick's project influence area is substantially much larger and there are many more glaciers (hundreds of glaciers) in the project influence zone. What's more, even in the small area to which Barrick reduced attention, there are at least 20 glaciers that are at risk or already impacted by Barrick's activities. Most of these are completely ignored by the company.

We see in the following two images, one from Google Earth and one taken from Barrick's' website. To the left, we see a map of the project area with messages from Barrick Gold and to the right an image taken from Google Earth. The pit area in the image to the left is in red. The pit in the image to the right is in purple. We immediately note that Barrick Gold identifies *only seven glaciers*: the Estrecho, Amarillos, Los Amarillos, Esperanza, Toro 1, Toro 2, and Guanaco Glaciers. Incredibly, the Guanaco Glacier (the largest of the glaciers) is cut in half in the image, perhaps to show less ice volume and hence, less relevance. But if we consider the perennial ice bodies visible in the image to the right, we see that there are some 20 glaciers in this same area, some uncovered white glaciers, and some rock glaciers covered with debris. Barrick's rhetorical reduction of the discussion around glaciers to Toro 1, Toro 2 and Esperanza has been one of its' most effective devices to draw attention away from project impact and to avoid discussing the true glacier inventory at the project site. *Until this day no one has published an official glacier inventory of the Pascua Lama project area. This report offers such a glacier inventory.*



Images compare Barrick's inventory of seven glaciers with a real inventory showing many glaciers ignored by the company. Furthermore, the focus area is only a portion of the true project influence zone, which is 20 times larger.

In this manner, Barrick Gold has concentrated and channeled all discussions around glacier impacts, both public and private, to address risks only in this limited area and only to this handful of glaciers. In the early stages, this conflict did not sway Barrick's intension to get at gold underneath the ice, but the company failed to gauge just how reactive public opinion would be to the plan to dynamite glaciers and attempt to relocate them. The impacts from this miscalculation are haunting Barrick Gold to this day, and have had profound effects not only on the company, but on many other mining companies operating in the region in glacier and periglacial environments.

Barrick Gold needed to soften public opinion about removing and 'managing' 10 hectares of ice (28 acres), and to do this it produced the brochure shown below, using cartoon images of bulldozers chopping up and hauling ice. The images flew through incipient social media channels and became possibly Barrick's worst media blunder in the entire Pascua Lama history. The brochure showed the prominent "Barrick: Responsible Mining Logo", but also a company completely out of touch with basic environmental due diligence and stakeholder concerns.



Not surprisingly, the proposal to *dynamite glaciers and move them* would fail. After communities displayed outrage with Barrick's [Glacier Management Plan](#), the Chilean government forced Barrick to redesign the Pascua Lama project, promising not to intervene the glaciers.

But by then, the anti-Barrick sentiment amongst local communities was firmly in place, and it wasn't long before the first proposals to legally protect ice would materialize. This idea caught on quickly in the Chilean legislature and shortly thereafter, it made its way across the Andes into Argentina's Congress.

Infamous Barrick Brochure explaining how bulldozers would chop up ice (after dynamite was used) and haul off glaciers to another location. Source: Barrick Gold

This is how two legislative initiatives got underway to materialize the world's first glacier protection laws. Incredibly, while only 2% of the world's water is freshwater, and that 75% of that water is in glaciers, no laws existed anywhere to protect the resource. No laws existed anywhere even mentioning *glaciers* and much less *periglacial environments*. Why was this so? Perhaps because glaciers are so far removed from society or because there is so little information about glaciers and the critical role they play in our ecosystems as water storage and basin regulation systems. The blatant proposal by Barrick Gold to destroy glaciers with dynamite during one of the most sensitive environmental eras of our time, when due to climate change rapidly melting glaciers are one of the most telling signs of the environmental ills of modern civilization, began to change this general state of abandonment of one of our most critical environmental resources.

In Chile, where the idea surfaced, people like Senator Horvath, and environmentalists such as the civil society organization *Chile Sustentable*, began pushing for the adoption of a glacier protection law in the Chilean Congress. Roxana Bórquez, Sara Larrain, Rodrigo Polanco and

Juan Carlos Urquidi published *Chilean Glaciers: Strategic Fresh Water Reserves*. And in the annex of this visionary publication, appeared the world's first Glacier Protection Bill.¹²

Unfortunately, this legislative initiative would fail in Chile (although the effort did lead to a [National Glacier Protection Policy](#)) that was adopted in 2008.¹³ But at the end of the 1990s, an Argentine labor union leader turned Congresswoman, Marta Maffei, visited Chile and was sensitized to the plight of farmers and indigenous communities of the Huasco Valley. She had heard problems they faced with deteriorating water reserves. Maffei kept in contact with her Chilean counterparts and in the mid 2000s, traveled again to Chile. She met Sara Larrain and learned about the Glacier Protection Bill proposed to Congress by *Chile Sustentable*. Larrain and her colleagues were greatly concerned with the impacts glaciers would suffer from projects such as Pelambres, Codelco's mining work in the high Andes near Santiago, El Indio and now Pascua Lama. Maffei brought back to Argentina the copy of Chile's proposed legislation and decided to bring it forward to the Argentine Congress. She would adapt the Chilean version according to the specific needs of Argentina and of Argentine glacier resources. This would put into motion the construction of a nationwide legal framework to protect the region's glaciers and frozen grounds.

Maffei built a team of experts, starting with her legal advisor Andrea Burucua. They consulted with glacier experts at the IANIGLA and CONICET. The IANIGLA is Argentina's specialized institute working on glaciers and other ice resources. The CONICET is a body of academics lending their practice to scientific research. Jorge Rabassa, Ricardo Villalba and Darío Trombotto lent their assistance to drafting an Argentine Glacier Protection Law that would focus specifically on Argentina's glacier resources. They also met with geologists and glacier experts at the National University of San Juan, including the renown Juan Pablo Milana who is one of the most knowledgeable persons of glaciers in the San Juan area. They consulted with Alejandro Iza of the International Union for the Conservation of Nature (IUCN), who would later publish one of the first legal studies on glacier protection.¹⁴

Dario Trombotto's contributions were particularly important as one of the few geocryologists (the combination of geology and cryology—the study of ice). Trombotto added the “periglacial environment” to the Chilean version of the law, and with this a much greater territorial region of very significant hydrological value, would now be protected.

The legal framework for protecting Argentina's glacier resources along the Central Andes was being built. The problem for many mining companies like Barrick Gold is that protecting glaciers would necessarily mean limiting much exploration and possibly some extraction as well. Pascua Lama was in serious trouble with the draft glacier bill, as were most mining projects exploring the Central Andes above 3,000m where practically everything is frozen. El Pachón (Xstrata Copper), Los Azules (McEwen Mining), El Altar (Stillwater), Del Carmen (Malbex), Vicuña and Las Flechas (NGX Resources) and many others were all in glacier and periglacial areas and would all have irreconcilable problems with an Argentine Glacier Law which if passed, would sooner or later bring administrative difficulties, perhaps insurmountable, for the projects.

The National Environment Secretary, Romina Picoletti, began receiving complaints from environmental groups in San Juan about what was happening at Veladero and Pascua Lama. The *Fundación Ciudadanos Independientes (FuCI)*, a non-profit organization from de San Juan, helped by glacier expert Juan Pablo Milana, was the first to bring glacier concerns to the courts. The FuCI confronted Barrick's Veladero and Pascua Lama projects in 2005, calling attention to public officials and to the Public Defender about what dust and acid drainage at Pascua Lama would do to glaciers and other environmental resources. In 2005, the FuCI presented a legal complaint against the government of San Juan, for impacts to hydrological resources and to the “cryosphere”—the world of ice. In 2005, 2006 and 2007 the courts would receive a number of charges having to do with glacier impacts. Glaciers had made a presence in the Argentine justice system. For the first time ever, FuCI and Milana had

¹² see: http://wp.cedha.net/wp-content/uploads/2012/10/glaciares-chilenos-borquez-larrain-et.al_.pdf

¹³ <http://wp.cedha.net/wp-content/uploads/2012/10/CONAMA-2008-Pol%C3%ADtica-Glaciares-Versión-Final-Agosto-2008.pdf>

¹⁴ see: <http://wp.cedha.net/wp-content/uploads/2011/04/glaciares-docs-paper-uicn.pdf>

achieved diverting public awareness from our Patagonian glaciers to the *other* glaciers of the Central Andes. They spoke of some 40 glaciers around Barrick's activities at Veladero and now at Pascua Lama, and amongst these they began speaking of a special type of glacier, an enigmatic glacier no one had ever heard of, "rock glaciers". They existed beneath the surface of the earth protected from the rising temperature brought about by climate change. And that wasn't all, they were telling us that the Andes were full of glaciers. Not in the tens, or even hundreds, but in the thousands.

Another individual also surfaced at the time. Ricardo Vargas, a tour guide who would take tourists to visit the faraway ice-covered lands of the *Valle del Cura* and *Sepultura*, now under exploration by Barrick and a dozen other companies. However, with Barrick's arrival to launch Veladero, Barrick Gold had closed the roads to the locals and no longer let Vargas or other mountaineers up into the mountains. Barrick had full dominion of the roads leading up to the glacier lands of the high Central Andes. Vargas sought legal help from a lawyer in San Juan. He joined forces with Diego Seguí and together they filed a complaint to the National Supreme Court charging Barrick with a number of code violations, including the failure to conduct proper public consultation, the lack of environmental insurance, and risks posed to the San Guillermo Biosphere Reserve, a UNESCO protected site.

Actors from different parts of province began getting involved, worried about Pascua Lama's future impacts. The social movement was "sanjuanino" with little or no involvement of national environmental groups. The *Madres Jachalleras*, the *Frente Cívico por la Vida*, and the *Asociación de Viñateros Independientes* (the Independent Wine Makers Association), as well as the civil society organization *Inti Chutez* all joined forces to protest Barrick's impacts on glaciers. A process was underway in favor of glacier protection that would not ease until it went national. There was no turning back.

In addition to concerns over glacier impacts, environmental groups complained of Barrick's disregard and direct impact to vegas systems at Veladero. These are delicate highland wetland systems fed by glaciers, which nurture flora and wildlife. The National Park Service of Argentina had also protested against Veladero's impacts to the vegas systems drowned by Barrick's poorly located lixiviation valley. Park officials succumbed to national and provincial government pressure to give Barrick a green light with Veladero. To this day, National Park Service staff euphemistically refer to the vegas systems lost to cyanide poisoning at Veladero as "Argentina's Sacrifice to Barrick Gold".

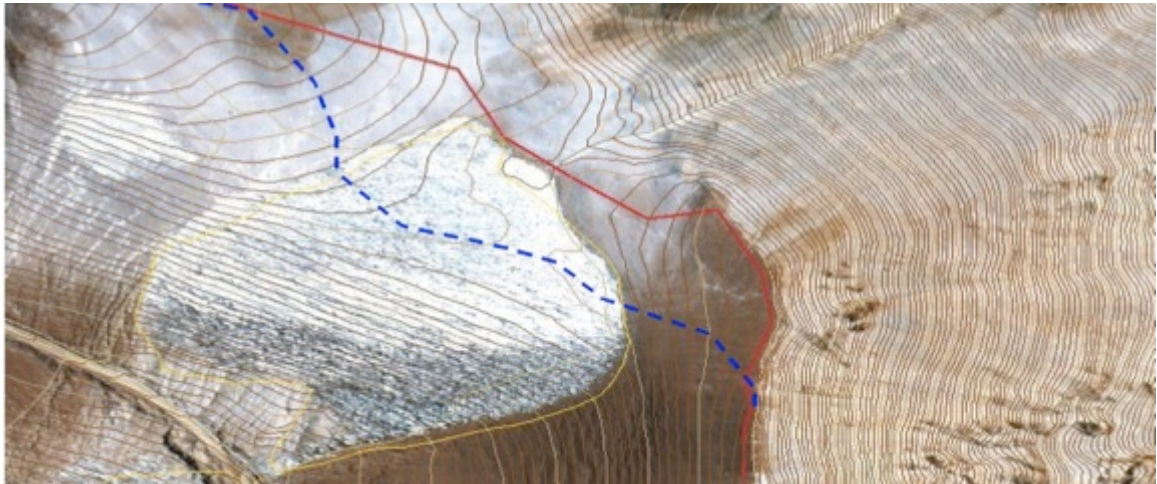
Photographs circulated by workers for Barrick's subcontractor Zlato, showing how bulldozers were removing ice to make room for Veladero's access road. Inti-Chutez obtained clandestine fresh video footage from Veladero showing massive blasting lifting tons of debris and dust picked up by strong winds. These ended up on the surface of glaciers, soiling the pristine white ice, changing albedo and ultimately leading to accelerating melting. The Inti-Chutez video was one of the first to call attention to the impacts of the blasting.¹⁵ Several years later, this activity would be the underlying cause for Barrick's problems in Chile.

Juan Pablo Milana, the San Juan glacier expert, also spoke of an incorrectly drawn glacier on the border. Barrick had drawn the glacier fully within Chilean territory. Milana argued that at least a third of it was squarely in Argentina. The issue was not minor, underneath this glacier was a significant portion of Pascua Lama's gold reserves.¹⁶ Milana took maps to the Environment Secretariat and showed the risks posed by Barrick's activity at both Veladero and Pascua Lama. According to the geologist and glacier expert, Barrick had built one of its waste piles on unstable frozen grounds of the periglacial environment.¹⁷

¹⁵ see: http://www.youtube.com/watch?v=y6FU4m_UQHM

¹⁶ see: <http://wp.cedha.net/wp-content/uploads/2011/11/informe-TORO-1-frontera-incorrecta-Milana.pdf>

¹⁷ see: <http://wp.cedha.net/wp-content/uploads/2011/10/Special-Report-waste-pile-collapse-ENGLISH.pdf>



The Toro 1 Glacier, says Milana, is incorrectly drawn by Barrick Gold on Chilean soil. At least a third would be in Argentina according to Milana's measurements. The blue line is the true border says Milana, not the red line as indicated by Barrick.
Source: JP Milana; Photo location: 29°19'54.07" S 70°01'11.08" W

Milana was the first to speak to the public about Argentina's enigmatic "rock glaciers". Until that moment, few people had ever heard of these ice bodies hidden away underneath the surface of the earth, protected from the changing climate with a thick layer of rock debris sometimes meters thick. These glaciers provided an enormous amount of water to local basins. A satellite image might not show ice cover, but beneath were some of the most significant ice reserves of the Central Andes. This was entirely new information for Argentina, for Chile and for much of the world.

With the surfacing of Barrick's glacier problem now picking up force in Argentina, attention turned to the images circulated by Zlato's workers, showing bulldozers plowing into ice at the Conconta Pass. Zlato was contracted by Barrick to clear the path along 180 kilometers of road from Tudcum to Veladero. This road was full of glaciers, formally untouched by industry. This ice along the roadside was a common feature for the workers making the daily trek up to Veladero. They didn't realize at the time that these were actually small glaciers, glaciers that today are protected by law.



Zlato's bulldozers contracted by Barrick Gold remove ice from the Conconta Pass, just below the Almirante Brown Glacier. Source: Zlato. See: 29°58'39.91" S 69°37'46.39" W

The Almirante Brown Glacier at the Conconta Pass was suffering severe deterioration. Barrick was utilizing bulldozers to remove massive amounts of snow and ice from the area

just beneath the glacier. The road could also be affecting the glaciocsystem that made the area conducive to the presence of a glacier in the first place. Hundreds of trucks passing the site weekly were probably also affecting the glacier. The road effectively permanently separated the lower portion of the glacier from the higher upper section. Was the rapid retreat of the lower portion of the Almirante Brown glaciers being spurred on by Barrick's road maintenance? Or was this the inevitable effects of climate change?

There are no known photographs of the Almirante Brown and Norte glaciers prior to Barrick's intervention. (Barrick surely has such photos). These visible impacts to the Conconta Pass glaciers raised public concern and further fueled a growing anti-Pascua Lama sentiment amongst the local population. The National Glacier Protection Law began to be crafted around this time.

The pressure on Barrick Gold to assume responsibility over glacier impacts began to mount not only in Chile with government intervention but also in Argentina. Barrick contracted several glacier experts, including glaciologists from the IANIGLA to study the health of several of these glaciers, including the Almirante Brown and Norte Glaciers at the Conconta Pass. These were not, we should stress, "*glacier impact studies*". What's the difference? Lots.

The IANIGLA experts (Leiva and Cabrera) are very clear in their first report indicating:

"This study is not an environmental impact study but rather a series of measurements and conclusions relative to the state and possible evolution of the mentioned bodies of ice."

They were studying the current state of the glaciers, but not how they got to that state. The difference is crucial. This is the second myth that Barrick Gold has carefully crafted about its glaciers impacts. They drive the question to address what the state of the glaciers are today and what is likely to happen to them in the near future, but they refuse to focus on why the glaciers are in a vulnerable predicament in the first place. Barrick wants the public to believe that the glaciers in the area:

"have experienced a natural reduction in size in the last 50 years, basically as a consequence of climate change."¹⁸

In other words, according to Barrick Gold, the glaciers are retreating because of global climate change, but not because of the bulldozers plowing into their ice, or due to the mass removal of earth in their surroundings, or the enormous amounts of debris and dust lifted into the air and displaced for kilometers due to the strong winds in the vicinity. Barrick refuses to examine these potential sources of impact to perennial ice in the region.

In Argentina, mining administration is in the hands of the local (provincial) governments. The national government has very little influence on the day-to-day operations of a mining project such as Veladero or Pascua Lama. As such, the National Environment Secretariat (the SAYDS) had not intervened on the issue of mining impacts to ice resources. In fact, the National Environment Secretariat had little say on any other environmental aspects of mining operations. Nor did the National Environment Secretariat have a glacier specialist in its ranks. Even to this day and despite being the authority for implementation of the National Glacier Protection Law, the SAYDS does not have a glacier specialist aboard. Nonetheless, the first steps were being taken to introduce the world's first National Glacier Protection Law.

¹⁸ see: <http://pascua-lama.com/medioambiente/cuidado-de-glaciares/>



A glacier at Veladero which workers call the "San Juan Glacier" (due to its similarity to the provincial borders). It is visible from the Veladero camp. Source: M.Scanu; Photo location: 29°21'15.24" S 69°56'20.25" W

Alarmed by the images Milana was revealing of extensive glacier presence at the heart of Barrick's mining operations, Romina Picolotti, the Environment Secretary sent a team to San Juan to set up monitoring equipment at some of the Veladero/Pascua Lama glaciers. They showed up at the project gates, but were refused entry by Barrick's security after a lengthy consultation with the provincial government, who backed Barrick's intention to keep the national environmental authority out of the project compounds. *Argentina's highest environmental authority was not allowed on the project premises.* Barrick's glaciers would continue at the mercy of the company, without protection, and as long as no one knew about them and the risks and impacts they were facing, and while no one knew the extent of glacier presence in the region, public opinion could be perfectly contained.

Neither Barrick Gold nor the provincial authorities wanted the national environmental authority meddling in provincial mining affairs. At the provincial level, the governor had already allowed for the creation of a specialized environmental sub-ministry under the mining ministry, taking away environmental policing of mining operations from the provincial environment secretariat. In San Juan, to this day, the agency controlling environmental compliance for mining operations *is not* the province's environmental authority, but rather an employee hired and fired by the Mining Minister. This situation generates a clear conflict of interest and is aggravated by the discretionary nature of the decision-making process, and by the lack of transparency of the permitting process, which has for example, a former Barrick consultant handing hydrological permits and reviewing glacier impact evaluations submitted by mining companies. This is the case of Mr. Millon, the Director of Hydrology for San Juan Province. He signs off on the approval of Barrick's hydrological clearance. Millon, incredibly, is a former Barrick consultant for the preparation of its hydrological plan.¹⁹ We review Millon's clearance of Barrick's operations later in this report.

We should stress that in the mid 2000s, public officials of San Juan Province probably did not understand what was really at stake with the glacier impact debate, and less so about the periglacial environment discussion, which still remained as obscure a subject as ever for much of the mining sector. They had little idea of what a rock glacier was, and completely ignored the extent of periglacial environments in San Juan Province. Nobody knew about this natural resource. Nor did Barrick's lawyers seem to catch on to the evolution of discussions at the National Congress about adopting a national glacier law. Given that this was already

¹⁹ see: <http://www.sanjuan.gov.ar/Default.aspx?nld=8892&cld=2> ;
see: <http://wp.cedha.net/?p=12189>

occurring in Chile, this seems to have been a major oversight of Barrick's legal team and Congressional lobbyists supporting the mining industry in glacier areas.

Barrick's team as well as most of the mining sector representatives in Congress missed the ball on the glacier law debate. No one took note. No one read the fine print. The law flew through the House of Deputies and then through the Senate, without so much as a debate. Maffei was Vice President of the Environmental Commission in the lower house, and saw the law through with utter ease. In practice, with no opposition and unanimous support in the first house, the Senate would present little debate as the law would not be opened up for review unless some Senator had an issue with the law. Maffei's bill to protect glaciers and periglacial environments would change the face of mining forever more.

The law passed quietly through the various administrative steps in 2007 and 2008. There was no public debate about the law, there was no media attention, and it went through the mechanics of Congress seamlessly. No one knew of the bill, and more generally, no one knew anything at all about glaciers, and much less about periglacial environments and the critical role that these hydrological resources play in our sensitive ecosystems.

To speak of glaciers in Argentina was to speak of the Patagonian glaciers of the far south, some 22 degrees further south from San Juan. The *Perito Moreno Glacier* is a globally recognized glacier, and anyone visiting Patagonia is likely to visit this magnificent body of ice. (Google Earth: 50°29'14.48" S 73°06'27.73" W). But few Argentines, in fact nearly no Argentines knew very much else about other monumental glaciers such as the Spegazzini, the Onelli, the Ameghino, the Viedma, the Upsala, the Seco, or the Frias, (and even less so about the smaller glaciers of the Central Andes.



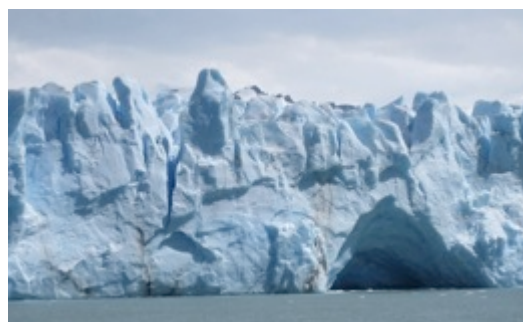
Upsala Glacier: Source: Ana Maria Oss
Google Earth: 49°47'08.33" S 73°13'55.03" W



Viedma Glacier: Source: @mabut
Google Earth: 49°31'15.41" S 73°01'10.43" W



Spegazzini Glacier: Denise Pelissier
Google Earth: 50°22'05.85" S 73°20'21.69" W



Ameghino Glacier: Source: elflaconandy
Google Earth: 50°25'53.52" S 73°14'28.18" W

To speak of glaciers in provinces such as Jujuy, Salta, La Rioja, or Catamarca, was simply unheard of at the time of the passage of the National Glacier Protection Law. One governor, Beder Herrera of the Province of La Rioja, said rather naively to a local media source, "stop screwing around, here in La Rioja, we have no glaciers!"²⁰ We've registered more than 400 in La Rioja Province. This ignorance shouldn't surprise us. His environment minister, Nito

²⁰ see: <http://www.lavoz.com.ar/noticias/politica/dejen-joder-con-criticas-mineria>

Brizuela, had said that he did not know if the El Potro Glacier (the province's largest glacier) was actually a glacier or not. See: Google Earth: 28°23'04.72" S 69°36'16.24" W. He also doubted whether glaciers at Famatina were or were not glaciers. He said publicly that the IANIGLA would have to come study if the El Potro Glacier was actually a glacier or whether it was perennial snow. In fact, the Minister would learn, they are the same thing!!²¹ (for Famatina's glaciers, see: Google Earth: 29°00'55.59" S 67°49'41.43" W).



La Rioja Province's Environment Secretary, Nito Brizuela doubted whether El Potro, the province's largest glacier was a glacier or not. Google Earth: 28°23'04.72" S 69°36'16.24" W

San Juan, surprisingly for many, along with Mendoza province further to the south, probably had the largest number of glaciers, exceeding easily 10,000 bodies of ice. Today, the law protects all of these glaciers. No one knew about this. Ignorance abounded. For this reason, before the veto of the glacier law by the President, no one really knew what was at stake when the law went to the congressional floor. At that time, proposing a law to protect glaciers was like proposing a law to protect penguins or whales, no one would complain. Maffei's law should pass quickly through both houses of Congress. And that is precisely what occurred.

Finally, on October 22, 2008, Argentina and the world had its first National Glacier Protection Law, which also included protection of the periglacial environment.

²¹ see: <http://www.noticiasrioja.com/index.php/news/locales/5875-nito-brizuela-sostiene-que-famatina-no-es-un-glaciar.html>

IV. The National Glacier Protection Law

The National Glacier Protection Law approved unanimously on October 22, 2008²² with little debate on the congressional floor, protected all glaciers, no matter their form or size, rock glaciers, and also permafrost areas of the periglacial environment, and specifically prohibited mining activity where there was perennial ice because they are water reserves and because they help regulate water basins. This means they melt slowly during non-winter months providing water when all of the winter snow has melted. The mining lobby had not taken notice of the glacier law when it passed through Congress. The only politician that realized (albeit too late) what the law entailed, was Senator Gioja, brother of San Juan Province's governor and president of the Senate's Mining Commission. When the law was finally approved, and the reading took place on the Senate floor, Gioja stood up and walked out of the room. The rest of the mining sector would find out soon what had just been voted into law.

Barrick realized immediately that the new glacier law was incompatible with their Pascua Lama project, not only because of the protection of glaciers, but even more importantly, because the law protected periglacial environments. Practically all of Pascua Lama was located on periglacial environment, and this now became illegal under Argentina's new glacier law.

The first studies for Pascua Lama were crudely clear. Consultants hired by Barrick Gold, BGC and geologists Lydia Espizua of Argentina's National Glacier Institute (the IANIGLA)²³ had already published reports that had circulated widely indicating that Veladero and Pascua Lama were both on periglacial environments. Pascua Lama in fact was nearly 100% on periglacial environment. (see table below). These areas were now protected by law.

CMN / BEASA
Estudio de caracterización del Permafrost

Junio 25, 2009
Proyecto No. 0442-009, 0443-009

Tabla 8: Infraestructuras y permafrost.

		Comentario	Probable Permafrost	Posible permafrost
Lama	Area de la Cuenca	Arroyo Turbio, 24.2 km ²	14.2 km ²	7.0 km ²
	Area del botadero	Posiblemente la mayoría del área es permafrost	0.99 km ²	0.46 km ²
	Area del rajo	Toda el área es permafrost	0.91 km ²	0.01 km ²
	Sitio de la planta	Solo pequeñas partes son permafrost	Parcialmente	-
	Tailings Facility	No se espera permafrost a estas elevaciones	-	-
Pascua	Area de la Cuenca	Rio del Estrecho, 35.9 km ²	18.1 km ²	14.2 km ²
	Area del rajo esperanza	Toda el área es permafrost	2.06 km ²	0.03 km ²
	Botadero Nevada	La mayoría del área es permafrost	1.25 km ²	1.58 km ²
	Divisiones norte de los canales	La mayoría de los canales probablemente están localizado en permafrost	Si	Si

Table from BGC report shows that the pit area (the *rajo*) and the waste pile sites (the *botadero*) for Lama (the Argentine side of the project) were on *permafrost*—this is frozen grounds of the periglacial environment. The waste pile is “possible a majority on permafrost” while the pit is “all permafrost”.

²² see: <http://wp.cedha.net/wp-content/uploads/2013/05/Proyecto-Maffei-Ley-de-Glaciares.pdf>

²³ Espizua report: <http://wp.cedha.net/wp-content/uploads/2011/11/Informe-Glaciares-Lama-Veladero-Espizua-2006.pdf>

The following image is also from the BGC report, and shows a test area for permafrost sampling at Lama—the Argentine side of the project (these are frozen grounds of the periglacial environment). Ice is clearly present in the earth.

Lama Permafrost Test Pit Log: TP-L13

Test Pit #: TP-L13 Elevation: 4780 m
 Aspect: SSEE Engineer: HW
 Weather: sunny, 5°C Date: April 16, 2006
 Location (WGS co-ord): Lama (6,755,957/ 402,069)

Depth (m)	Soil Description	Ground Ice	Temp (°C)
0.0	excavation into steep slope (70 – 75%) along road; sand and gravel colluvial deposit; Dmax ~ 32 mm	no ice	
0.4	same deposit as above but cemented with ice; at the interface between the active layer and permafrost a 5 cm thick ice lens was observed (see photo); below this layer the ice is interstitial (Vx); a sample was taken to the lab for ice content analysis (23.4%)	Vx (23.4%)	



Sample taken by BGC in the Lama portion of the Pascua Lama project (Argentina) clearly reveals the presence of frozen grounds. Source: BGC.

What was worse for Barrick Gold was that the law was retroactive in character to all operations underway. There would be no *acquired rights* from earlier project approvals. Ongoing projects must also be evaluated for compliance with the National Glacier Protection Law. Veladero and Pascua Lama would have to produce detailed glacier impact studies showing that they were not destroying glaciers within 180 days. On all counts, this was impossible. The company could not possibly gather the necessary evidence and studies in the time allotted, nor could it show it was not impacting glacier resources, *simply because it was*.

In the event the findings went against Barrick, the government could suspend activities or order their relocation or even their permanent closure. Even if the company could get support from government agencies and officials indicating their project was ok, a well argued lawsuit could definitively kill Pascua Lama.

The only solution possible for Barrick Gold was to attack the validity of the glacier law, and that is precisely what it set out to do.

The Barrick Veto

The National Glacier Protection Law has passed through both houses of Congress with nearly no debate whatsoever. Even the congressional representatives from the most active mining provinces with serious overlaps between glaciers and mining activity hadn't said a word. They simply didn't see it coming. They had no idea what they were voting for. Argentina's President, Cristina Fernández de Kirchner said later to a local media source in San Juan, visibly irritated for having to come out against the law on their behalf:

"They approved [she's referring to the mining province congressional representatives] a proposal unanimously, even if it was affecting their interests ... The congressmen and senators—amongst them the locals—they lifted their hands lightly without knowing what they were voting for, let them deal with it!" ²⁴

The mining lobby figured out what was happening a few hours after the vote in Congress. Their allies in government and in the legislature had fallen asleep, and they found themselves with a consensus document because no one had read the small print nor did they understand what it really meant.

But it was too late to oppose. Argentina had voted into law the world's first National Glacier Protection Act, and the mining sector would have to abide by it. The only way out at this point was that the mining sector, with their provincial and national allies in government, attack the law, and this would have to be done with the assistance of the largest stakeholder, Barrick Gold. Barrick was on the verge of launching their largest project ever, the world's largest and most ambitious gold mining project. They would have to obtain a Presidential Veto.

Only a few days before the vote in Congress became official (if there was no veto), the world's first glacier law that so easily survived both houses of Congress, and which was approved unanimously with no discussion from either house, was vetoed by President Cristina Fernández de Kirchner, justifying her decision for some of the following reasons:

"the prohibition of activities described in article 6 of the bill, if adopted, could affect the economic development of the involved provinces, implying that no activity or works could be developed in the mountain regions. ... the prohibition of mining or petroleum exploration and extraction, including those that occur in periglacial environments saturated in ice, would give preeminence of environmental aspects above activities that could be perfectly authorized and developed while protecting the environment."

[and further on]

And due to this, governors of the mountain region have expressed their concern with the sanctioned norm, as it would negatively impact in the economic development of the investments that are taking place in the said provinces." ²⁵

It's not difficult to see that the very text of the veto, the very first lobby behind the national government comes directly from Barrick Gold and its allies in San Juan. It was so obvious to everyone, that the veto immediately became known informally as "the Barrick Veto".

The veto ²⁶ of the National Glacier Protection Law, a law that no one had seen coming and which silently and fortuitously for many, awoke the interest in glaciers for society, enraged

²⁴ see: http://www.diariodecuyo.com.ar/home/new_noticia.php?noticia_id=414581

²⁵ see: http://www.perfil.com/contenidos/2008/11/13/noticia_0025.html

environmental organizations in Argentina (including our own), and spurred the onset of a national movement to defend Argentina's glaciers, a process that was put in motion and led by national and local environmental groups. A signature collection began to bring back the National Glacier Protection Law. The presidential veto led to the resignation of Argentina's National Environmental Secretary, Romina Picoletti, who had supported the law in Congress.

CEDHA, founded by Picoletti, from that moment on, launched an initiative focused on "democratizing glaciers", educating communities about glacier relevance, promoting glacier protection, and helping bring back the National Glacier Protection Law, to reveal risks to glaciers, and to address the local anthropogenic impacts facing glaciers and periglacial environments.²⁷ This report is a product of this initiative.

Two years would pass of debate in both houses of Congress, and a deep political process that included difficult discussions around the risks of mining to glacier areas. Senator Filmus, who represented the National Government position in the Senate's Environmental Commission, led one side of the debate in Congress. Filmus had presidential instruction to water down the glacier law, while Congressman Bonasso, firmly upheld the vetoed version of the law originally presented by Maffei.

Filmus took the lead representing the official presidential line, and attempted to subdue the original version of the Glacier Law. He proposed eliminating several prohibitions (including mining) as well as specialized studies that the original law mandated for projects in glacier territory. He also aimed to place into provincial government hands, the determination of just how the glacier law would be implemented. Bonasso, in the lower house upheld the Maffei version until the very end of the debate. Negotiations ensued on the part of both positions.²⁸

Every day Argentines went from not knowing a single thing about glaciers, to discussing glaciers daily. The official governing party was frustrated with the Congressional debate, as the issues became a flagship issue for the opposition. But the official position began losing ground up until the vote moment. They hadn't acquired enough votes to derail the law. As the last votes were counted, the tally would have forced a tiebreaker from the Vice President, however he had shown that he would not hesitate in voting against the incumbent government (which he did with a proposed soy tax). In the final run-up to the vote, Filmus and Bonasso struck a deal and a new law surfaced. The agreement proposed a new and even stronger law than either of the proposed bills.

In September of 2010, the National Glacier Protection Law returned, with greater vigor than its predecessor, the first of its kind anywhere, protecting not only glaciers but also periglacial environments, because they are both critical water reserves and because they are important water basin regulators.²⁹ The law passed with a minimal difference in Congress, surprisingly with two votes from national government supporters to avoid a tiebreaker from the Vice President, which they did not want to empower any further as he had turned on the president.

Cristina Fernández de Kirchner had promised that if the law was voted a second time she would not veto the law. She kept her word.

The most worrisome points of the National Glacier Protection Law for Barrick are:

- The definition of *glaciers* (Art. 2) since *all* perennial ice, no matter its size or form is considered to be a glacier; this categorically refutes Barrick's attempt to reduce the category of glaciers like Toro 1, Toro 2 or Esperanza to *glacierets*, or *perennial ice patches*, for example. If the ice survives for more than two years, it's a glacier. The law does not establish a hierarchical relationship between types of protected glaciers vs. non-protected glaciers. For Barrick, this is a significant issues since in the

²⁶ see: <http://wp.cedha.net/wp-content/uploads/2013/04/veto-a-la-ley-de-glaciares.docx>

²⁷ see: <http://wp.cedha.net/?p=12603&lang=en>

²⁸ para una comparación entre las versiones: <http://www.cedha.net/wp-content/uploads/2011/04/glaciares-docs-analisis-art-6-7-15-y-comparacion-filmus-bonasso.doc>

²⁹ see: <http://wp.cedha.net/wp-content/uploads/2012/10/Argentine-National-Glacier-Act-Traducción-de-CEDHA-no-oficial.pdf>

influence areas of Pascua Lama and Veladero there are many smaller glaciers and perennial ice forms which are now protected by law; even “temporary” small ice patches that form in heavy snowfall years and that survive for more than two years are considered glaciers; they are protected by law precisely because nature has found a way to conserve water when snow is copious for drier subsequent years!

- The categorization of glaciers as “of the public good” due to their value as “a hydrological reserve” as well as “a basin regulator” is also a problem for Barrick since it ends all speculation about whether smaller glaciers are actively contributing water to the basins. The law values these glaciers simply because they contain water;
- In addition to glaciers, the *periglacial environment* is protected which is a much more extensive area near project operations and along access roads. Practically all of Barrick’s influence zones for both projects contain periglacial environments. This worries Barrick profoundly since the already public environmental impact studies for Pascua Lama and for Veladero show that there are periglacial environments in key areas of project activity. This fact also takes the discussion about glacier impacts away from the pit area and into areas Barrick had been trying to ignore such as the waste pile site at Veladero, which was ill placed on periglacial environment now protected by law;
- The law calls for the realization of a *glacier inventory* that will finally make official the location of Argentina’s glaciers including all of the glaciers in the Pascua Lama and Veladero areas. This worries Barrick because they have thus far been able to center public and official scrutiny on Pascua Lama’s pit area, ignoring very extensive areas outlying the pit and along the access roads, where there are many glaciers as well as periglacial environment. Our estimates indicate that this expanded area is some 20 times larger than the area that Barrick has focused attention. This implies that Barrick will now have to address its risks and impacts regarding hundreds of other glaciers that it may be potentially impacting, which will mean new costly and time-consuming studies to carry out before they can start operations at Pascua Lama;
- The law prohibits mining in glacier and periglacial areas (Art.6). This worries Barrick because they cannot ignore the fact that Pascua Lama is squarely in glacier and periglacial areas, making the project fully incompatible with the law;
- The law is retroactive in nature, by way of Article 7. This worries Barrick because the law mandates that companies must now review past impact as well as have to face new conditions to validate past permits which could now be revoked or suspended until Barrick provides the necessary studies to show that it is not impacting glaciers. Barrick has not carried out the necessary impact studies regarding glacier impacts in the project’s area of influence, and producing these studies could take several years impeding project implementation and generating legal and administrative difficulties to get activity underway.

V. The Provincial Glacier Protection Laws

Several months before the definitive approval of the National Glacier Protection Law, the provinces with both mining industry and glaciers understood that they would surely lose the battle in the National Congress. Working with Barrick Gold, they began to design a strategy to anticipate the arrival of the national law. Various governors of mining provinces (including La Rioja, San Juan, Jujuy and Salta) traveled to Canada at the end of June 2010 to meet with Peter Munk, the founder and president of Barrick Gold, and his legal advisors in order to define a plan of action. On July 6, immediately after returning (and two months before the National Glacier Protection Law would come up in the National Congress), and without even returning to their respective provinces, the governors called a meeting together with the Mining Secretary, Jorge Mayoral, at the *Casa de Salta* in Buenos Aires, to seal the pact. During that meeting, the plan was born.

The announcement by the governors was made from Buenos Aires. The mining provinces with glaciers in their territory would introduce their own provincial glacier protection laws. These laws would minimize and limit the reach of glacier protection, and eliminate protection for the periglacial environment with the exception of active rock glaciers, a small portion of the

periglacial area. The plan also established that if the Glacier Law were to be passed in the National Congress, they would initiate a legal battle against the law by arguing that any glacier protection law should be provincial *and not national*. In this way, they would reserve the right to sacrifice some bodies of ice (inactive rock glaciers for example) and the periglacial environment more generally, to further mining activity. In this way the provincial laws in Santa Cruz (the first glacier law in the world), San Juan, La Rioja, Jujuy and Salta were born.³⁰

The provincial laws addressed glacier protection from a provincial perspective. All of the laws, in one way or another, contained the following characteristics:

- Emphasis on natural resources (including glaciers) as provincial patrimony under the protection of the province and not the national government;
- No protection (or very limited protection) for the periglacial environment;
- No protection for inactive rock glaciers (glaciers with ice but that do not move);
- No prohibition of mining activity.

VI. Barrick's Reaction to the National Glacier Protection Law

Argentina's new National Glacier Protection Law implied several risks for Barrick Gold that could endanger the Pascua Lama and Veladero projects, possibly leading to their suspension or cancellation. It could also imply high operational costs for both projects in order to comply with the law, such as the study and monitoring of a large number of glaciers that are currently ignored by the company.

The implications of the National Glacier Protection Law for Barrick include:

- The impact that has already been detected on and around glaciers located at project sites and in the zones of influence. For example, there are clear irregularities and illegal activities along access roads;
- The glacier inventory, required within 180 days of the glacier law's enactment (in glacial zones), would finally reveal all the glaciers that until now Barrick Gold has hidden from the public and the government. This report is a precursor to the official publication of a glacier inventory;
- The studies that the company must complete in order to comply with the law will take years to produce and possibly jeopardize the project start indefinitely, without any guarantee of the possibility of overcoming the clear illegality of the project. This is in addition to significant new costs for both Pascua Lama and Veladero.

Barrick came out quickly in defense of its projects Veladero and Pascua Lama, and orchestrated a covert legal attack through a group of associations of mining workers, amongst these, the *Asociación Minera Obrera Argentina (AOMA)*, the *Confederación General del Trabajo-San Juan (CGT-San Juan)*, the *Cámara de Servicios Mineros* and the *Cámara Argentina de la Construcción*. These groups presented an injunction request to the federal courts in San Juan. A few days later, the company and the provincial government made their participation transparent and joined the legal complaint. This was Plan B, which had been devised in Canada and Buenos Aires several months earlier. The attack on the National Glacier Protection Law was in motion.

In less than 48 hours, on November 2, 2010, the federal court, which normally takes months, even up to a year to resolve an injunction request, ruled in favor of the complainants, suspending several articles of the newly enacted National Glacier Protection Law, which now, no longer applied to Barrick Gold.³¹

It is at least curious to see just how fast the justice system reacted to the legal complaint. The verdict by Judge Miguel Angel Galvez was quickly criticized by many social and political

³⁰ see: http://wp.cedha.net/?page_id=1277

³¹ see: <http://wp.cedha.net/wp-content/uploads/2011/11/Fallo-Galvez-Glaciares-San-Juan.pdf>

actors, as accusations of complicity and corporatism invaded the arena. But the verdict stood. Xstrata Copper, which also had issues with glacier areas around its' El Pachón project in San Juan province and Filo Colorado in Catamarca, also presented legal action to the courts and was also granted a suspension of the law.

But the legal problems around glacier impacts did not disappear for Barrick Gold. On July 3 2012, the National Supreme Court overruled the injunction order by Judge Galvez,³² and severely criticized the grounds on which the order was made. The judges said:

“[the injunction order] is self-contradictory, [and] ... does not comply with the minimum prerequisites for all injunctions ... that ... the reasons given by the magistrates [Galvez] ... are dogmatic and are not sufficient to sustain the decreed measures ... nor has it adequately proven the irreparable damage that the actor is purportedly suffering by not granting the injunction requested.”³³

The National Glacier Protection Law stands again for Barrick Gold with the verdict and glaciers and periglacial environments recuperate their protection in all of the national territory. Today, the case, and the merits of the case are still under consideration by the National Supreme Court. For the moment, Pascua Lama, due to its impacts on glaciers and periglacial environments, continues to be illegal.



Mining activity at Veladero. 2006. Source: G. Manrique

³² see: <http://wp.cedha.net/wp-content/uploads/2011/04/Fallo-Barrick-Revocación-de-cautelar.pdf>

³³ see: <http://wp.cedha.net/wp-content/uploads/2011/04/Fallo-Barrick-Revocación-de-cautelar.pdf>

VII. Which are Barrick's Glaciers?

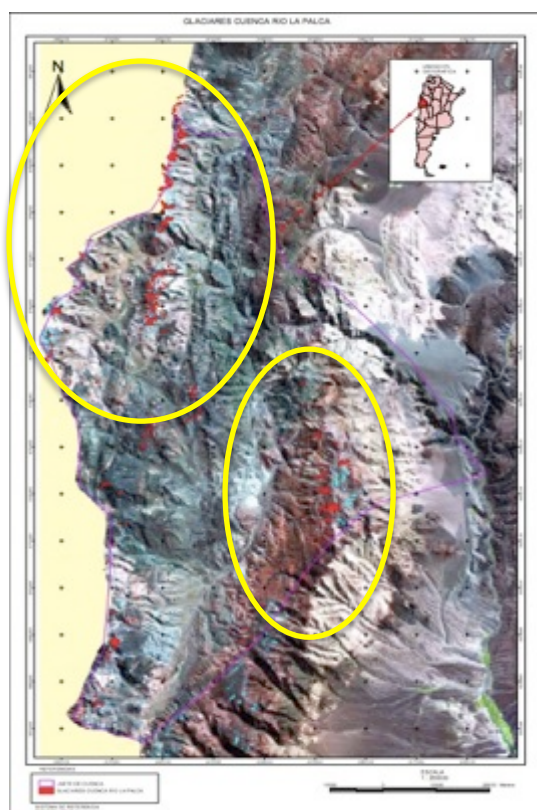
"In the case of Pascua Lama and Veladero there are no glaciers nearby Pascua Lama nor Veladero ... Neither Veladero nor Pascua Lama contemplate impacting glaciers ... As I said, there are no glaciers near Veladero or Pascua Lama ... Our operations do not impact glaciers of the area."

- from a video interview by Maximiliano Heiderscheid with Barrick's Vice President, South America, Rodrigo Jiménez (2009)³⁴

This incredible denial by one of Barrick Gold's highest representatives, after nearly 8 years of conflict precisely over the presence of glaciers in the vicinity of both projects, leads us to the obvious questions, "Which are Barrick's glaciers?", that is, which are the glaciers that are near operations that are *or could be* impacted by Barrick's activities at the Pascua Lama and Veladero projects?

This is one of the principal questions we address in this report. There is much disinformation deriving from the company and from official sources regarding this question. Time is unfortunately not on our side to provide answers in time to protect glaciers in the projects' surroundings. Many of these glaciers are already in a vulnerable state due to climate change, and they are deteriorating even further due to local anthropogenic activity such as mining activity. Some have already disappeared completely.

It's also important to understand that a discussion about Barrick's glaciers in the projects' surroundings needs to begin in the 1990s (and even before that date), and not in the decade when the National Glacier Protection Law was passed (2010s).



Eventually the National Glacier Institute (the IANIGLA) will publish its "official glacier inventory" which will determine exactly where the glaciers in the vicinity of Pascua Lama and Veladero are located.

Unfortunately, to date, neither the IANIGLA, nor the National Environment Secretariat, nor de CONICET (scientific agency lending the academics to carry out the inventory), nor the provincial authorities, have complied with the mandate established by the National Glacier Protection Law, which established the obligation to perform *priority* glacier inventories within 180 days of the promulgation of the law, in areas where mining activity is occurring. That deadline passed in April of 2011.

The reasons may be for the lack of collaboration from the provincial authorities where mining is occurring, or because the National Mining Secretariat does not provide the necessary mapping for current mining projects underway. Whatever the reason, the fact is that nearly 1,000 days have passed since the entry into force of the National

Glacier Protection Law, and not a single official priority glacier inventory has been completed.

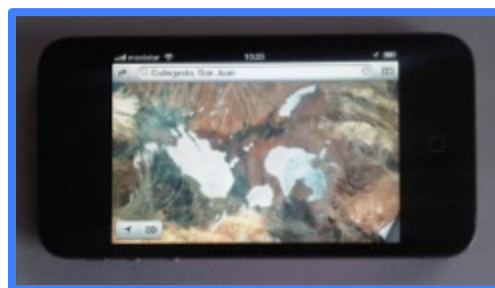
Concerned with the failure of public authorities and agencies to comply with the National Glacier Protection Law, CEDHA, the author of this report, has carried out several of these

³⁴ see: <http://www.youtube.com/watch?v=DN8X-HjaP4Q&list=PL5A353061CDEB3FE6>

inventories for several mining projects in glacier zones. These include: El Pachón (Xstrata), Los Azules (McEwen), Veladero and Pascua Lama (Barrick Gold), Del Carmen (Malbex), El Altar (Stillwater), Agua Rica (Yamana), etc..³⁵ If a non-for-profit civil society organization, with a very limited financial budget, and with very limited access to satellite imagery can carry out in a mere few months, numerous priority glacier inventories, there is absolutely no reason that official state agencies, with ample staff, technical capacity and access to up-to-date imagery should not have completely by now the full spectrum of priority glacier inventories for those areas where mining is underway.

San Juan province, *has* carried out a *preliminary* glacier inventory (not including rock glaciers), on time, but not in form. The inventory, made public in December of 2010, does not actually publish coordinates of the glaciers. On December 27, 2010, within the timetable established by the National Glacier Protection Law, and largely thanks to the work of geologist and glacier expert Juan Pablo Milana, along with various professionals and students on his team, the National University of San Juan published the official provincial glacier inventory. Milana's work in registering the province's thousands of glaciers, advanced rapidly until he began to reveal what the provincial government did not want revealed, that there were glaciers in mining areas, and lots of them! Impacts to glaciers from mining operations were visible in the satellite images being studied. For this reason, before Milana could publish his work and that of his colleagues, he was replaced as the Director of the Glacier Inventory. Silvio Peralta was put in his place and quickly and publicly professed a position favorable to the official provincial line. Peralta was *and is* highly criticized by his professional colleagues, as he repeatedly *and emphatically* has stated to media, to the surprise of many glacier experts in the region, *that there are no glaciers or public works in mining areas*.

With very partial information, the official San Juan Province inventory showcases total surface area of ice, basins, typology, and the number of glaciers, but nowhere does the report indicate precisely where the glaciers are located.³⁶ The report says that San Juan has many glaciers, but doesn't give us any information so that we can find them! It would have been very simple to provide (as we do in this report) a GPS coordinate so that the user of the report could locate the glaciers on Google Earth, or even on a smart phone with any map program.



With a GPS Coordinate you can see Barrick's Glaciers on a smartphone!
Photo location: 29°17'52.65" S 70°00'16.92" W

Furthermore, in the maps published in the report, a strip of about 15km wide in the northern most section of the province, where many mining projects are located, is left off the map! The only information the report *does* publish is a series of satellite images (such as the one above at the beginning of this section) seen from too high up to distinguish precise information about glaciers or to be able to identify useful characteristics about the glaciers. You can reveal more information from the IPHONE image above, than from the images published in the official provincial inventory! One can see, for example, in the image above, the area of the Pascua Lama and Veladero projects as well as the access road. But the image is taken from so high up than even the largest glaciers (such as the ones in the image of the smartphone above) cannot be distinguished.

The reader can download a KMZ file (see in Google Earth with CEDHA's glacier inventory)

Glaciers in the Pascua Lama and Veladero area – Argentina

http://wp.cedha.net/wp-content/uploads/2013/04/Glaciares-de-Barrick-Zona-de-Impacto-Argentina.kmz_.zip

Glaciers in the Pascua Lama area - Chile

http://wp.cedha.net/wp-content/uploads/2013/04/Glaciares-de-Barrick-Zona-de-Impacto-Chile.kmz_.zip

Relevant Infrastructure and Sites (Argentina/Chile)

http://wp.cedha.net/wp-content/uploads/2013/05/Pascua-Lama-Veladero-Poligonos-Proyecto.kmz_.zip

³⁵ see: http://wp.cedha.net/?page_id=1345

³⁶ see: http://wp.cedha.net/wp-content/uploads/2013/04/Relevamiento_Inicial_de_los_Glaciares_de_SJ_Dic_2010.pdf

The Glacier Inventory

What is certain is that the glaciers that are impacted by or potentially impacted by Barrick Gold's activities at Pascua Lama and Veladero are not *three* or *seven* as we often find in the company's media rhetoric³⁷ *but rather hundreds!*

But before we identify precisely which are Barrick's glaciers, we should first define a baseline date from which to register the glaciers. Ideally we would obtain images of the region prior to the commencement of Barrick's activities in the area, including exploratory work, which would take us back to the 1990s or earlier. Unfortunately we do not have images from these years. Barrick likely does.

We've obtained from the Argentine Spatial Agency (the CONAE) images from the early 2000s, but these images are of poor quality and do not allow for detailed analysis. We see larger bodies of ice in the images, but not smaller ones or the details of the ones that are visible. To the right, we reproduce one of these images, for the Conconta Pass area. In this image we can see some 30 glaciers, however the resolution is too low to see details or smaller glaciers.



Early 2000s image of the Conconta Pass show dozens of glaciers

Google Earth begins to have useful imagery for this exercise at about 2005/2006. A visit today to the area using Google Earth, shows precisely these images. The year 2005 was particularly significant in terms of snowfall, which recharged existing ice bodies and as such, smaller glaciers and perennial ice patches (also considered glaciers by the law) are more visible during this period. We should recall that the National Glacier Protection Law establishes that ice that persists for more than two summers is considered a glacier protected by the law. This draws attention to the fact heavy snowfall in a given season can create "temporary glaciers" that survive for several years providing much needed water flow during subsequent drier years.

We chose to take 2005/2006 as a baseline for two reasons:

- 1) Because in that year we begin to have useful imagery to register glaciers;
- 2) Because in that year Veladero begins intense extractive activity;

It would be important to obtain *other* images from earlier years (preferably prior to 1990) and for intermediate years, with greater detail if possible, in order to study ice in the area. Our request to the national state agency (CONAE), which has imagery of the area, took months to get processed and move through the administrative procedure. All of a sudden, we were informed that in a very extraordinary circumstance, the National Environment Secretariat (SAyDS) would from now on decide who is allowed to obtain images from the CONAE—the National Government was clearly concerned that we were conducting parallel glacier inventories of areas with mining operations. Our request was transferred to the SAyDS, and after another lengthy period of over seven months, the SAyDS rejected our request for permission to obtain satellite images. Their justification was that the IANIGLA (the glacier institute) was carrying out the national glacier inventory and as such it would not permit other organizations to accompany the process. In this way, the National Environment Secretariat refuses civil society organizations permission to monitor the implementation of the National Glacier Protection Law, denying a national right of access to environmental information.

CEDHA's glacier inventory, which uses a 2005/2006 baseline, registers some 247 bodies of perennial ice, which includes, uncovered glaciers, perennial ice patches, and rock glaciers in

³⁷ see: <http://pascua-lama.com/medioambiente/cuidado-de-glaciares/>

Pascua Lama's and Veladero's influence areas. If all of these ice bodies were on Argentine soil (a portion are in Chile) all of them would be protected by the National Glacier Protection Law. Because some are in Chile, they are not protected as *glaciers*, but would fall under laws protecting water, as they are considerable water reserves and basin regulators. We should note that an up to date image would not reveal 247 glaciers. It would reveal far fewer. The question we naturally ask is "why are there fewer"? How many were there when mining activity began? How much of the impact they've faced is due to global warming trends and how much to activities by companies like Barrick Gold?

To answer these questions we first need an official baseline control for the glaciers. We need to know exactly how many glaciers existed at the moment Barrick Gold began exploratory work in the region. We would ideally at least have imagery dating to the 1990s. Veladero began exploration in the mid 1990s approximately. Only with this information can we understand precisely what has occurred in this time period. Only with this information can we begin to conduct a precise impact study and determine what has happened to the glaciers in the area due to the impacts they are constantly facing.

The glaciers that we've registered represent an approximate 37.3 km² of ice (or about 3,730 hectares—9,200 acres). To compare this size and extension, we are speaking of an ice reserve considerably larger than the capital city of San Juan Province (Argentina) or five times the size of Vallenar Chile. It's about 4,500 city blocks of ice, the size of an average North American city!

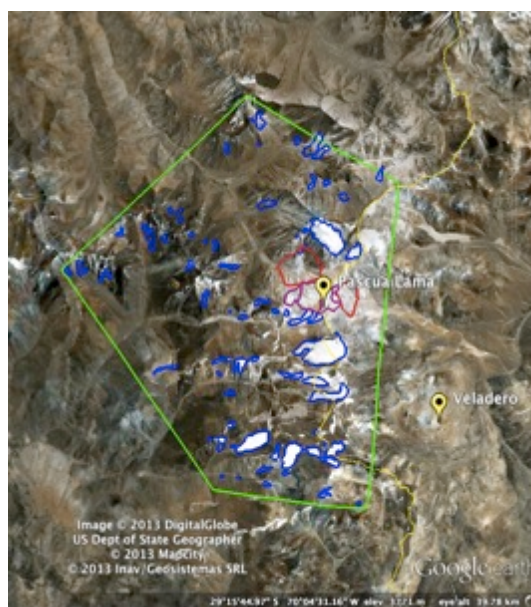
These are perennial ice bodies that can be categorized as glaciers by the National Glacier Protection Law of Argentina, and they are all located in areas directly at (or near) activities underway by Barrick Gold at Veladero and/or Pascua Lama, including along project access roads. These glaciers are or potentially are affected by mining activity, including atmospheric contamination, vehicular transit, blasts, wind, acid drainage, etc. We cannot be certain exactly how these glaciers are impacted since no studies have been undertaken to determine risk or impact.

In Argentina we've registered 171 glaciers existing in the 2005/2006 period, which would be in areas affected by or potentially affected by project activities at Veladero and/or Pascua Lama, including along access roads. Of these, 136 are uncovered glaciers while 35 are covered rock glaciers. They represent some 27.5 km² of ice, or 2,750 hectares (6,795 acres).

Barrick's impact areas on Argentine and Chilean soil.



Some 171 glaciers on Argentine soil
27.5 km² of ice at risk or impacted



At least 76 glaciers on Chilean soil.
9.8 km² of ice at risk or impacted

On Chilean territory we've registered 76 glaciers in Barrick Gold's impact area or in risk areas near Pascua Lama. Of these, 35 are uncovered white glaciers, and 41 are covered rock glaciers. These represent approximately 9.8km² of ice, or 980 hectares (2,400 acres). The following table summarizes our glacier inventory findings, taking the 2005/2006 period as a baseline.

The glaciers in Barrick Gold's impact areas taking the 2005/2006 period as a baseline are:

	Argentina	Chile	Total
Uncovered Glaciers	136	35	171
Rock Glaciers	35	41	76
Total	171	76	247
Km2	27.5 km2	9.8 km2	37.3 km2
Hectares	2,750 ha.	980 ha.	3,730 ha
Acres (approx.)	6,800 acres	2,400 acres	9,200 acres

Incredibly, of these nearly 250 glaciers that are in Barrick Gold's influence and impact area, Barrick has conveniently reduced public focus to just three of them, the ones immediately at the pit site (the Toro 1, Toro 2 and Esperanza glaciers). The company also mentions 4 glaciers on which it is conducting monitoring exercises in the vicinity. They are so large and so close that Barrick cannot ignore them in public communications (these are the Estrecho, Guanaco, Amarillos and Los Amarillos glaciers). Barrick notoriously cuts out more than half of the largest of these (the Guanaco Glacier) in the image it shows to the public, perhaps to avoid revealing the largesse and relevance of this glacier so close to its' operations.

If we look at what Barrick says on its website about glaciers, we find (in Spanish) a page called "Protecting Glaciers" (*Cuidado de Glaciares*)³⁸. On this page, Barrick shows only seven glaciers surrounding Pascua Lama. They are highlighted in yellow. Very suggestive text, in very visible blue lettering reads:

"These are the Glaciers"
(in Spanish: "Estos son los glaciares")

and then, in flash, again, very suggestively, the indication that

"These are the boundaries of the project"
(in Spanish: "Estos son los límites del proyecto")

This is Barrick's media rhetoric very effectively at work. The reality is that **these are not the glaciers** and that **these are not the boundaries of the project!**

³⁸ see: <http://pascua-lama.com/medioambiente/cuidado-de-glaciares/>

As we see from our inventory, it's very clear that there are many glaciers beyond the limits of this reduced map, which Barrick Gold conveys as "The Glaciers". With this image, and with the fraudulent rhetoric, Barrick conveys false information, attempting to reduce the discussion over the glaciers it is impacting, to an area that is infinitely smaller than the real impact zone of both the Pascua Lama and Veladero projects. But even this very limited image that Barrick does public is underreported. There are actually several more glaciers in the image than the seven Barrick highlights.



Barrick publishes on its internet page that there are only seven glaciers in Pascua Lama's impact zone. see: <http://pascua-lama.com/medioambiente/cuidado-de-glaciares/>

As we mentioned earlier, in the very image Barrick Gold publishes on its website, there are more than 20 glaciers that are not identified by Barrick in yellow as they have done with the other glaciers. These are also affected by Barrick's activity at Pascua Lama.

The territory registered in this image is approximately 8kmX6km, or 48km² (that's 4,800 hectares or 11,860 acres). If we consider the area along more than 180kms of access roads, on the Argentine side of the project, and another similar distance on the Chilean side, we begin to realize just how extensive Barrick Gold's project influence is. Additionally, this 8X6 km square is not the full pit-adjacent area which has glaciers and which could be very much impacted by activity at the site by earth movements, blasts, CO₂ emissions, and the strong winds in the greater area.

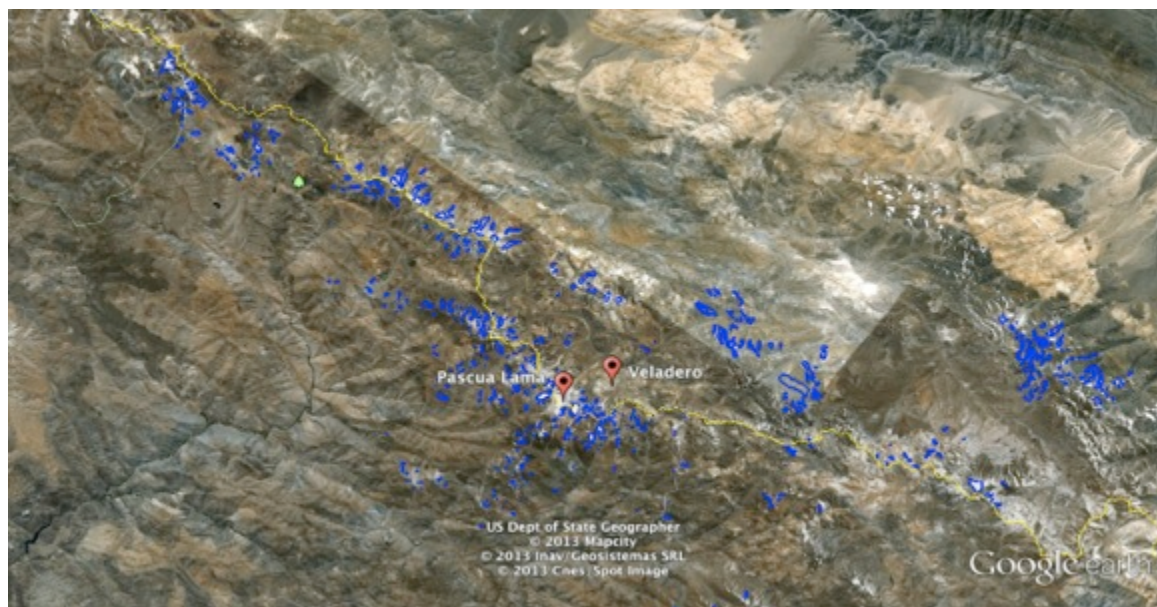
If we take a very approximate measurement of 10km around the project pit and outlying areas, and if we take a strip of 5km on each side of the access road (it could be more), we measure approximately 750km² (75,000 hectares, or 185,000 acres) of territory in Argentina that could be influenced by Barrick Gold's activity at Veladero and Pascua Lama and some

200km² (20,000 hectares or 49,400 acres) of territory in Chile. That's a total of 950km² (95,000 hectares, or 234,750 acres).

The early impact studies for the Veladero project identified these areas as either *direct* or *indirect* areas of influence of the project. The first of these are in the immediate areas of the project and include the pit, waste piles, lixiviation valley, installations, etc. (the area studied by Espizua). The second of these include zones that are further away, but which would also have glaciers.

The real glacier impact area is some 20 times larger than the area which Barrick identifies on its website, and to which it has reduced discussions over glacier impacts. This difference is at the heart of the large numeric difference between our inventory of nearly 250 glaciers, and Barrick's mention of only a handful.

The next image shows a more realistic map of the glaciers in Barrick Gold's influence area. It is larger than the area we have inventoried for this report. These are glaciers that are near the extraction area, but also along access roads and along likely wind paths. We have not examined wind patterns to determine where dust from Barrick's activities might be deposited on glacier ice. Such a study would surely add glaciers to our inventory.



These are hundreds of Barrick's Glaciers disbursed in project influence areas, and along access roads. Barrick only mentions seven of these glaciers when it talks about impacts by Pascua Lama.

Determining a fixed distance from the access roads (5, or 10 km for example) is evidently a very arbitrary decision. We do this in this report to simply draw attention to a number of glaciers in a given area that *could be or are likely to be* affected by activity along these roads. In some cases the true distance to study may be less, but it could also be more.

With a proper impact study, we could identify the glaciers that are indeed in impact areas for activity at Pascua Lama and Veladero. What is certain is that the number of glaciers is not three or seven as Barrick suggests on its website. Unfortunately there is no official inventory as of yet registering these glaciers or measuring impacts from wind, blasts, dust, CO₂, mass removal, vehicular movement, acid drainage, etc. When that inventory is published in a few years time, many of these glaciers, that exist today, or that existed when Barrick began activity, will be gone or will be covered with dust. We've tried to enter into the area to visit the sites, but Barrick refused our entry.

What will Barrick Gold say of this inventory and our analysis?

We know that Barrick Gold will criticize this inventory and our analysis, and attempt to discredit it. This is Barrick's systematic approach to addressing information about its glacier impacts. This is why we've prepared this brief section anticipating what the critiques will be and anticipate our responses to the company's likely rebuttal.

- Barrick Gold will say that many of these bodies of ice are not glaciers, that they are ice patches, ice fields, or glacierets (small glaciers);

Our response: The National Glacier Protection Law defines a glacier as perennial ice, irrespective of its size or form; this is because the sum of small glaciers actually makes a large contribution to the water supply. As long as an iced area survives for at least two years, it is considered a glacier;

- Barrick Gold will say that many of these glaciers are actually seasonal snow that do not show up in an image, taken for instance, in 2013;

Our response: We've registered perennial ice that has evidence of persisting for at least two summers, since the 2005/2006 period. If a glacier such as the (Almirante Brown) disappeared in 2010, as is also the case for several other glaciers, we have sufficient arguments to suggest that it could be due to the impacts by Barrick's activities in the area. For this reason, it is important that we define a baseline moment for a proper glacier impact study, and not depart at the present time (or some future time) when many glaciers will have already disappeared and impacts already occurred. We should recall that exploratory work at Veladero began in 1996, and even before that date. We need to carry out this study and the inventory, departing from a point before Barrick Gold initiated operations, and not beginning in 2013.

- Barrick Gold will say that we've defined a region much larger than their area of influence for Veladero and Pascua Lama, and will try to take the discussion to the area near the pit.

Our response: The Conconta Pass, where it is already known that Barrick has had an impact to glaciers along the access road to Veladero, and where Barrick is currently monitoring impact, is more than 100 kms from the Pascua Lama pit. The access road is 180kms long. Clearly hence, Barrick Gold's impacts are not circumscribed to the pit area. Why then shouldn't studies be conducted for other glaciers along the access road and in the pit vicinity?



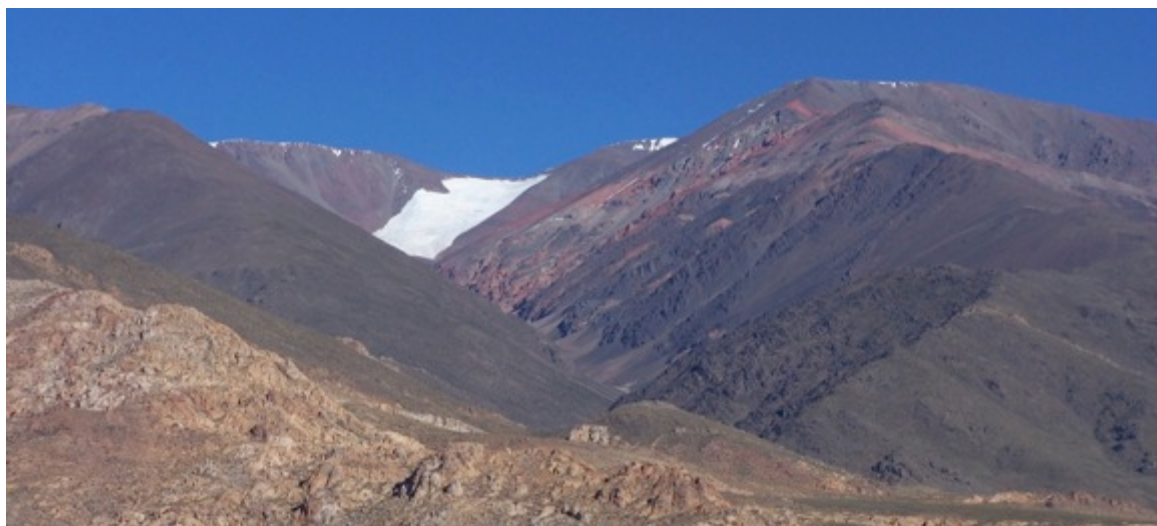
Let us see now where the 247 glaciers most affected by Barrick Gold are located.

The Glaciers on the Access Road

Barrick Gold has concentrated discussions on glacier impacts to activity near a handful of glaciers at Pascua Lama's pit area, mostly in Chilean territory and to a couple of glaciers impacted when the company opened up an access road to the Veladero project, at the Conconta Pass near the town of Tudcum (the *Almirante Brown* and the *Norte* Glaciers). This is a reductionist view of Barrick's glacier impact area, which is very convenient for the company, as it draws attention away from the hundreds of other glaciers which are located in places where the company has direct impact or where there may be impact, either due to vehicular transit, mass removal, blasts, high winds, and other extractive activity underway at both Pascua Lama and Veladero.



The road entry point for the Veladero/Pascua Lama projects, near Tudcum is the onset of a scenic tour through glacier areas along a 180km road. Source: JDTaillant
Photo location: 30°12'05.43" S 69°16'00.01" W



The first visible glacier just outside of Tudcum is the Savage Conconta Gorge Glacier; see: 30°04'08.14" S 69°36'50.51" W; Source: JDTaillant

The image above (taken in 2010 by the author when he attempted to visit the Veladero site but was refused entry by Barrick Gold) is the first glacier visible when you start the climb to the Conconta Pass towards Veladero, and can be seen from Barrick Gold's first road gate at

Tudcum. The ice melt from this glacier feeds the towns of Tudcúm, Buena Esperanza, Colanguil, Rodeo and Las Flores.

You can visit the glacier on Google Earth at: 30°04'08.14" S 69°36'50.51" W. This glacier measures more than a kilometer in length. It sits just above the passage of dozens of large vehicles that take the Veladero access road daily. The local folk say the glacier has retreated substantially since Barrick Gold showed up in the area. It is difficult to know the reason for the retreat, whether it is due to mining activity impact or due to climate change trends. We don't know of any studies focused on this retreat.

Let's look again at a general map of the area we are considering so that we can rapidly identify precisely the glaciers we are focusing on, both in Argentine territory from Tudcum up to Veladero/Pascua Lama and from Alto del Carmen in Chile to Pascua Lama. The yellow line is the border between Argentina (right) and Chile (left). The red lines are access roads.



General project area and glaciers in surroundings. Yellow line is the international border; red lines the access roads.

The mapping of glaciers that we've carried out in this image corresponds to glaciers we've been able to identify analyzing images from 2002, 2005, 2006, 2008, and 2001, and in some cases, 2013. We were not able to obtain images prior to these dates, which would have assisted our task and would have helped obtain a more precise understanding of the evolution of perennial ice in the region. The images from 2002 are from the CONAE (the Argentine Commission for Spatial Activity), available publicly, but they are not of very high resolution, which in turn does not assist in detailed analysis of the available information. In 2005 we were able to obtain better imagery from Google Earth, with much higher resolution than the earlier images.

In order to determine if an ice body is in fact perennial ice, which could be categorized as a glacier (which means it survives for at least two summers), we sought the following attributes:

- That the ice body persist for at least two summers;
- That the images analyzed be from summer months (preferably at the end of summer);
- That the surface of the ice not be only white but show signs of ice persistence;
- That there be signs of movement of the body (crevasses, etc.);
- That the form of the body maintain its shape from year to year;



Barrick Gold opened up an access road through glaciers and periglacial environment, along the Conconta Pass, near the town of Tudcum.

Source: <http://www.cerromercedario.com>

Photo location: 29°59'20.21" S 69°37'10.82" W

a) Glaciers on Barrick's Access Road from Tudcúm (San Juan Argentina) to Veladero

The long 180km road from Tudcum to Veladero (and now also to Pascua Lama) passes through large expanses of land, once utilized for pasturing of local small-farmer livestock. The road begins at the small town of Tudcum, and then slowly climbs through the Conconta Pass, Peñasquito, and then crosses along the Colanguil range, it climbs the Portezuelo de Conconta (at 4,980m) and then descends into the Valle del Cura (the Valley of the Priest). Twisting along riverbanks fed by melting glacier water, it winds through the Brea mountain range, reaching the Despoblado, Rio Blanco and de las Taguas rivers. According to the Knight Piesold impact assessment report put together for Barrick Gold, mining exploration in the area began around Veladero and Pascua Lama in the 1970s. (see EIA, Knight Piesold, 2002, p.2-3).³⁹

Barrick Gold took advantage of an existing mountain path and began work in preparation for industrial usage of the pass with works to:

- Widen the path;
- Reduce incline;
- Ensure permanent maintenance of the access road.

The impact report identified the following towns in the project's influence area:

- Iglesias
- Las Flores
- Tudcúm
- Colola
- Angualasto
- Malimán
- Rodeo
- Pismanta
- Jachal (and others)

³⁹ see: <http://wp.cedha.net/wp-content/uploads/2013/05/veladero-informe-de-impacto-ambiental-exploracion.pdf>

The Knight Piesold report indicates that the waterways of most concern in terms of impacts are the Rio Blanco and Jachal, as they are for agricultural and residential use. (Knight Piesold, 2002, pp.2-4)

Families like the Villanueva in Tudcum were the original proprietors of these lands. But with Barrick Gold's arrival, and with discovery of gold in the area, their legitimate rights were taken through counterfeit documents claiming they had voluntarily sold their lands to a third party who now rents the lands to Barrick Gold. There is a pending case in the justice system to reclaim these lands. Today the Villanueva are fighting to recuperate their ancestral lands, and must ask Barrick Gold for permission to let their animals feed along the Conconta Pass and beyond into the mountain highlands.



Some 20 glaciers straddle the mountainsides near Barrick's entry gate, 5 to 6 kms from the access road to Veladero. It is unknown what impacts are caused by vehicular traffic. The circle marks the Almirante Brown Glacier.

In the photo immediately above from April 25, 2011, we see at least 20 glaciers of similar size to the controversial Almirante Brown Glacier (the Almirante Brown glacier is signaled with a yellow circle), all of these glaciers are between 5 and 6 kilometers from the Veladero access road (visible in the image). As they are all at nearly 5,000 meters above sea level, they have a favorable climate for survival.

Is there impact due to dust from the vehicular transit going through the Conconta Pass? Scientists that have studied the Conconta Pass glaciers say there is risk of such impact. Local folks say they've seen it. They have seen the glaciers reduce in size, however no studies are available to evaluate this claim. Neither Barrick Gold nor the Province of San Juan are carrying out studies as far as is publicly known.

The next image is a satellite picture from end February 2006 (end of the South American summer when winter snow should have melted away), mapping glaciers along the road that are approximately at a distance of 5km to each side of the road. On Argentine soil, from Tudcum and along this road, there are some 100 uncovered glaciers and perennial ice patches (all protected by law) visible in the baseline period 2005/2006, that would be in Barrick's impact zone and at risk due to dust suspension in the air caused by vehicular transit.



Veladero's access road runs through glacier areas; Photo site: 29°55'04.93" S 69°35'41.11" W

It's important to clarify that if we were to look at an image from 2011 or 2013, the number of glaciers and perennial ice patches compared to the baseline we've chosen would be significantly lower. Since Barrick Gold began activities at Veladero we have seen a steady decrease in ice cover. This reduction could be due to several causes:

- 1) the deposit of dust on ice surfaces either making glaciers shrink or invisible;
- 2) the retreat of ice due to global climate change;
- 3) the acceleration of retreat due to other local mining impacts;
- 4) the destruction of ice due to road maintenance and other vehicular impacts;

Because no one has produced the studies needed to determine impacts, it is impossible to determine with certainty, the causality of this reduction in ice cover and in some cases the total disappearance of numerous glaciers since 2006. We do not have information available on the effects of prevalent winds, or on the release of dust from the roads or debris from blasts, that may get deposited on glacier surfaces. We do not know of any company or provincial government studies looking into these impacts. We have learned from exchanges that we've had with academics and glacier specialists of the IANIGLA, in the preparation of this report that some studies are underway on some of the glaciers of the Conconta Pass. This information, however, has not yet been made public nor is it clear that it will become public once it is completed.

There are other glaciers at greater lengths from the access road (between 5 and 10kms or further) that could be impacted by dust from the road. We have not registered these glaciers in our inventory. Had these been included, the number of glaciers would have been substantially higher than 100.



Barrick subcontractor Zlato's bulldozer in 2005 removing ice from Conconta Pass. Source: Zlato

What we do know is that the only place where there have been studies, and where Barrick has clear influence, at the Conconta Pass' *Almirante Brown* and *Norte* Glaciers, there has been a very significant retreat of glacier ice. There is no reason to presume that the same would not be occurring all along the Veladero access road, wherever there has been heavy machinery intervention, which is why further studies are crucial to determine such impacts and/or risks.

Public attention to what was happening at the Conconta Pass, forced Barrick Gold to set up monitoring at the two glaciers where accusations of bulldozers cutting out chunks of ice surfaced in the early to mid 2000s. Nonetheless, with the glaciers already in great retreat, Barrick began monitoring the Almirante Brown and Norte Glaciers, but *did not carry out impact assessments*, but rather, *studies to determine the present state of health* of the glaciers. So today, we know they are retreating and we're monitoring their retreat, but we don't know why they have retreated.

Barrick argues in its communication rhetoric that the impacts to these glaciers come from climate change, and not due to its activities such as dust emissions, bulldozers cutting through ice, or due to heavy vehicular transit (including large trucks, buses and automobiles) or blasts in the area. Can we simply place these glaciers into a larger group of glaciers and say that climate change is melting them away, and that is why they are shrinking?

It's interesting to read the comments made by the scientists from the IANIGLA (Leiva and Cabrera) that carried out the studies for Barrick, reflecting on what might have occurred to these glaciers. They say:

As to the glaciers, one factor that must be taken into account [is] the possible alteration of ablation conditions due to the use of the road [they are talking about the Veladero access road built by Barrick Gold], is the albedo change that would be produced from the dust. While the road is very consolidated due to the heavy tonnage and frequent circulation, and due to the regular maintenance it undergoes, and due to the freezing of the ground, and because it is downwind from the glaciers, this issue merits further specific study, as it can constitute a direct effect on the glaciers. (Leiva and Cabrera, p. 48)

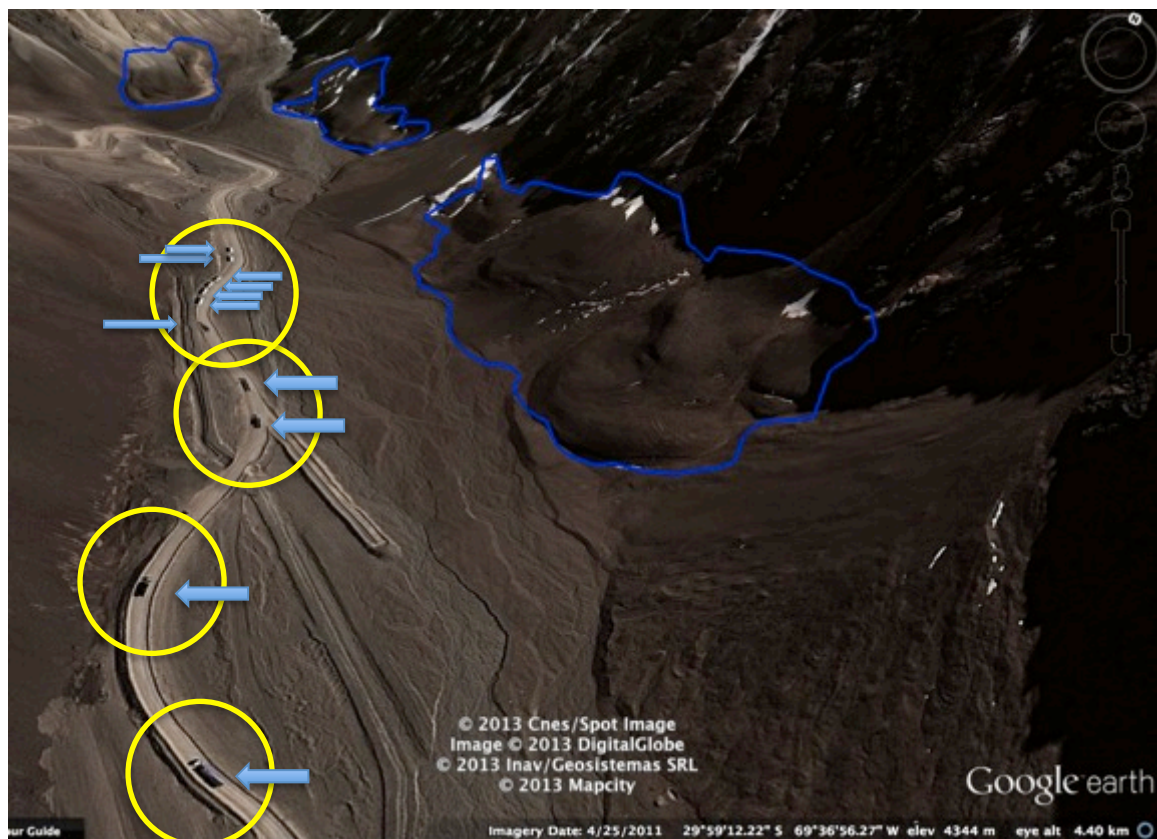
They state several times that *they are not conducting an impact study*, but they are very clear to stress that *there are* impacts generated by dust from heavy transit and that this impact must be carefully studied. Another subtle detail that can be taken from the comments of the authors is the position of the wind. The *Norte* Glacier is upwind (predominant winds) from the road, as is the upper portion of the *Almirante Brown* Glacier. This said, if the wind is blowing from the glaciers to the road, the dust would not affect the glaciers. However, the lower portion of the *Almirante Brown* is downwind from the glacier and it is this portion of the glacier that has suffered the greatest impact, so much so, that it has entirely disappeared. Is this disappearance due to the road? Is it due to climate change? Or is it a combination of both? We don't know, as no one has done the studies.

What is also surprising is that if as the glaciologists indicate, studies should be carried out to determine the impact of the dust (they've said this for a number of years), why hasn't anyone been assigned to do these studies? Also, there are several other glaciers in the vicinity. Why haven't *those* glaciers been studied for impacts or monitored for health? Some of these are at very close distances to the access road and could be suffering significant impacts.

What is the vehicular transit like in the area?

A quick visit today to Google Earth at the Conconta Pass: 29°59'28.07" S 69°36'15.43" W

shows just how serious the vehicular movement is in the area along the Veladero/Pascua Lama access road. This site is just at the entry point to the winding Conconta Pass. The random image uploaded by Google Earth incredibly shows 11 heavy trucks climbing the slope, a surprise for such a remote far-away area, which is so environmentally sensitive. We've indicated the presence of three rock glaciers to the side of the road in blue.



Surprisingly 11 trucks (see arrows) line the road entering into the Conconta Pass along the Veladero/Pascua Lama access road. These are sources of local contamination. Photo: Google Earth. Photo location: 29°59'29.79" S 69°36'23.88" W

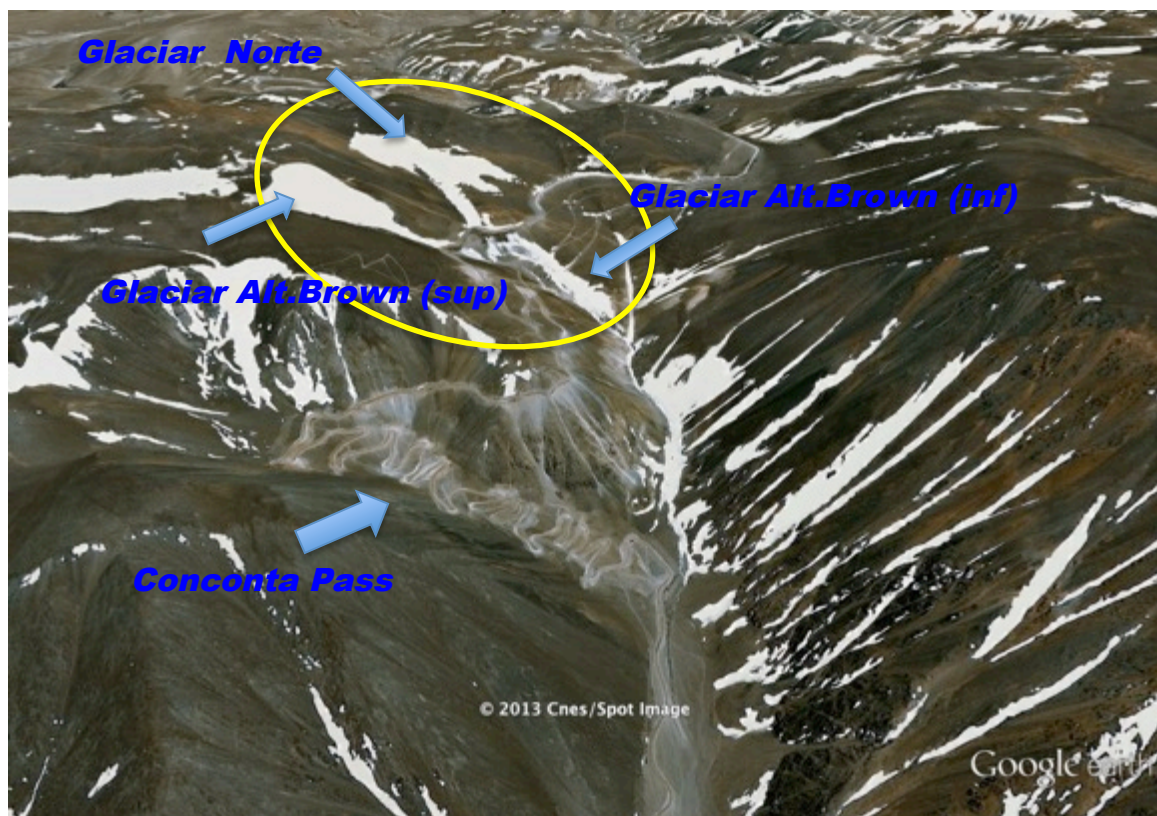
Below is a photograph of the pass, showing again, heavy vehicular movement along the access road to Veladero/Pascua Lama. Chance or not, each time an image is captured of the pass, it's full of trucks! What few have mentioned is that in recent years, other companies are now starting to use this road to access their projects, which may be yet another aggravating factor increasing the local impact the region's glaciers.



Trucks climbing the Conconta Pass.

Source: [http://upload.wikimedia.org/wikipedia/commons/9/93/Paso_Conconta_\(San_Juan_-_Argentina\).jpg](http://upload.wikimedia.org/wikipedia/commons/9/93/Paso_Conconta_(San_Juan_-_Argentina).jpg)

Photo location: 29°59'29.79" S 69°36'23.88" W



Controversial Conconta Pass where Barrick Gold introduced an access road in glacier areas.

Photo location: 29°59'29.79" S 69°36'23.88" W

This image (above) from February 27, 2006 shows various uncovered white glaciers. These are all significant sized glaciers. The *Almirante Brown* Glacier, measures nearly 2.5 kilometers in length. In the image we see it after impacts suffered from Barrick's intromission into the area. The glacier was already in a vulnerable state due to global warming trends, but even greater risks derive from being in the way of a large industrial pass needed to access the Veladero mine.

We don't have images of the glacier when it was intact (perhaps Barrick Gold does have these images and could share them with the public so we can better gauge the health of the glacier before the introduction of the road). We do have however, evidence from the clearing

of ice in the area when Barrick's subcontractors entered with bulldozers to open up a path for their heavy trucks, and separated definitely the upper and lower portions of the glacier. In the next image from 2006 we see the Barrick's Veladero access road already having separated the *Almirante Brown* Glacier. The *Norte* Glacier is above and to the right. Quite possibly at some past time, these glacier formed a single ice mass. Curiously in the image we also see an older road (possibly an old Inca road) beneath Barrick's new road, which passed below the glacier—*had that road been respected*, the glacier may have survived in a better state.



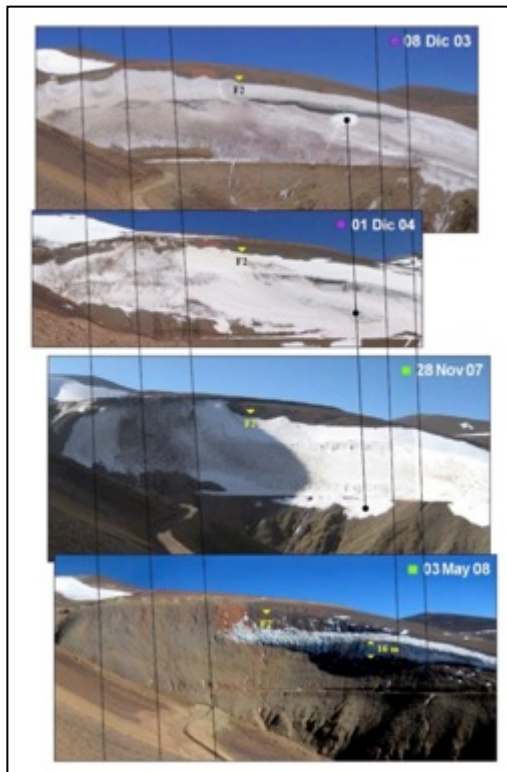
Almirante Brown Glacier (left) and the Norte Glacier (right). Veladero's access road split the glaciers definitively.
Source: F.Berdugo; Photo location: 29°58'41.64" S 69°38'03.38" W

In the next image which we have already seen, we see Barrick Gold's sub-contractors presumably at the moment they are clearing ice from the area and opening up the Conconta Pass. The images are from a video presentation prepared by Zlato, the subcontractor.



Moment when bulldozers opened the Conconta Pass to make way for Barrick's access road to Veladero.
Source: Zlato. Photo location: 29°58'41.64" S 69°38'03.38" W

Below a series of photos from Leiva and Cabrera's report on the *Almirante Brown* Glacier, from 2003, 2004, 2007, 2008 and 20011. A clear reduction of ice mass of the *Almirante Brown* Glacier is evident. The Google Earth 2013 image to the right shows the eventual, and **total disappearance** of the lower portion of the *Almirante Brown* Glacier.



The progressive degeneration of the *Almirante Brown* Glacier, viewed from 2003 to 2011 until the lower area vanishes completely. Photo location: 29°58'36.37" S 69°37'50.82" W

But the *Almirante Brown* Glacier is not the only glacier affected by the impacts from traffic on the Conconta Pass. Below we see a rock glacier located at the edge of the road. The front of the glacier has evidently been impacted by the road. No one has ever mentioned this glacier.



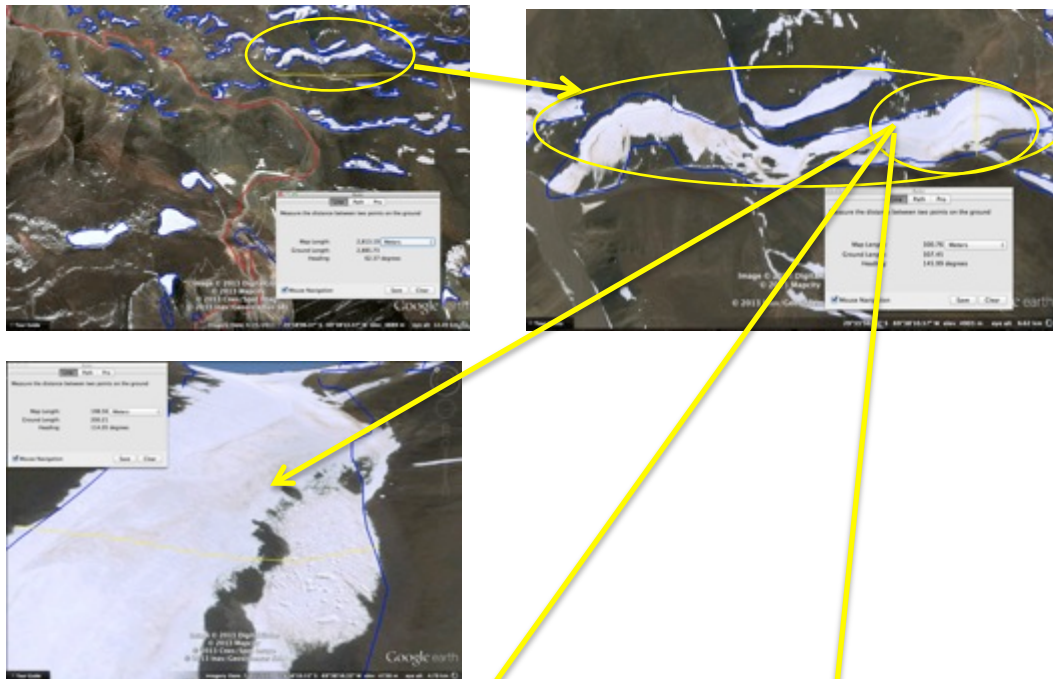
Rock glacier impacted by the Conconta Pass; see: 29°59'33.30" S 69°37'39.32" W

What are the rest of the glaciers like along Veladero's access road?

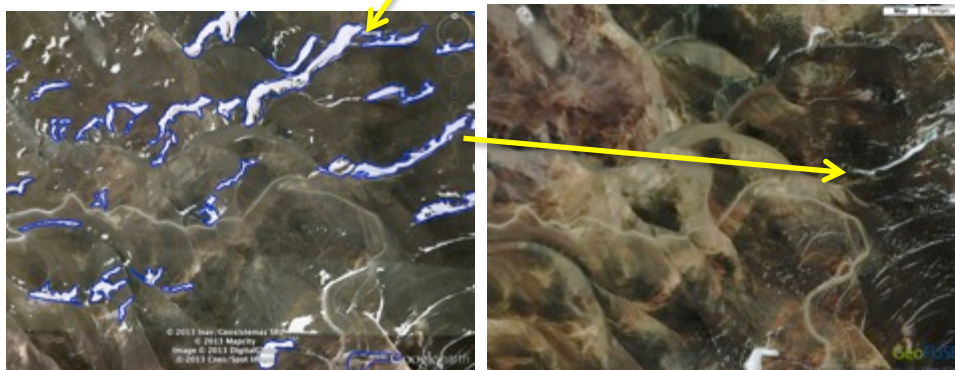
Thus far we've only mentioned the glaciers at the onset of the Conconta Pass. But logically, if bulldozers have impacted this handful of glaciers, they've probably affected other glaciers in the immediate area and along the rest of the Veladero access road. However, no one seems to be studying if there is any impact to the remaining glaciers. Attention has only focused on the *Almirante Brown* and the *Norte* Glaciers.

Below we see a few of these *other* ice bodies, not far from the Conconta Pass and along Barrick's access road. With Google Earth we can measure these glaciers and at least determine their magnitude and even make some rapid calculations of how much ice (and water) they might contain.

The glacier at: 29°56'15.69" S 69°38'27.22" W, for example, at about 4km along the access road from the Conconta Pass towards Veladero, is a whopping 3km long (that's 30 city blocks) and nearly 300 meters wide (three football fields). This glacier is larger than the *Almirante Brown* (before Barrick's impacts) and has approximately 0.9km² of ice. That's 900,000m² of ice or 90 hectares (220+ acres). To put this in understandable terms, we're talking about 90 city blocks of pure ice, literally a small town of ice!



Comparing images on Google Earth Digital Globe from 2011, we see an important reduction in the amount of visible ice, not only of this glacier but of all of the perennial ice in the region.



2005 (Source: Google Earth) 2011 (Source: Digital Globe)
Comparison of images from 2005 and 2011—large reduction of visible surface ice along the Veladero road.

Smaller glaciers in the area have practically disappeared, while the larger bodies of ice have reduced in size considerably from 2005 to 2011. It is impossible to determine, without proper studies, the cause of this reduction.

The reasons may be due to:

- Climate change trends in the region;
- Micro-climate change trends due to local impacts such as vehicular transit;
- Changes in albedo of glacier surfaces due to dust deposit on glaciers;

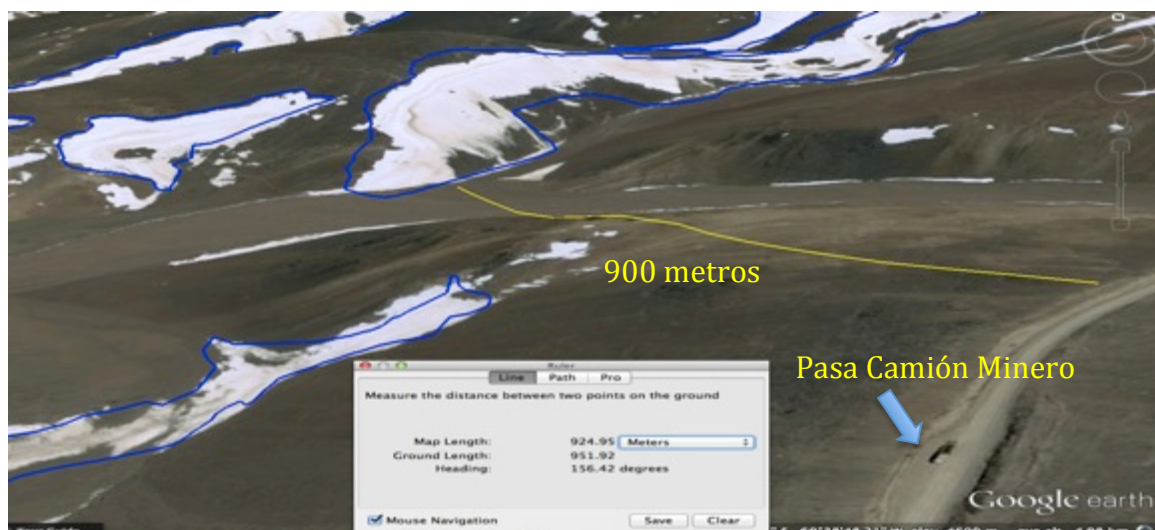
We cannot be sure what the reasons are for the witnessed significant reduction and disappearance of many small glaciers and legally protected perennial ice patches in the area. As far as is publicly known, neither Barrick Gold nor the provincial government have carried out impact studies on glaciers in the area. What is alarming is that by the time the IANIGLA

competes de official glacier inventory, many of these glaciers will simply never be registered, since they no longer exist!

One very valid question we should ask ourselves is just how much water is contained in these relatively smaller bodies of ice. If we take the previous example, and calculate very conservatively that the glacier is about 5 meters thick we are looking at a glacier with a water reserve of about 4.5 billion liters of freshwater. Sounds like a lot, but is it? Let's consider the population of San Juan province, which is approximately 680,000. This glacier, in a direct impact area of Barrick's access road, has enough water to distribute over 6,000 liters of water per inhabitant of the entire province, that's daily drinking water for over nine years! (estimating we drink about 2 liters per person per day). Clearly, that's a lot of water! Certainly, it is enough water to merit a glacier impact study for Barrick's road!

Barrick Gold doesn't mention this glacier in any documents. It doesn't mention the glacier in any images. Nor does the company suggest that there might be impacts to the glacier from vehicular transit or dust. Below is an image of the glacier in reference to the Veladero Access road, it just so happens (chance or not) that a truck was passing just as the satellite image was taken. The glacier point closest to the road is a mere 900 meters away. The image is from 2006. An earlier 2005 image shows the glacier had a similar form. This allows us to consider that it is indeed a perennial ice body or even a permanent small sized glacier. In either case, it is protected by law. A more recent 2013 image shows the glacier is retreating.

See photo below. (Google Earth: 29°56'33.22" S 69°38'50.88" W)

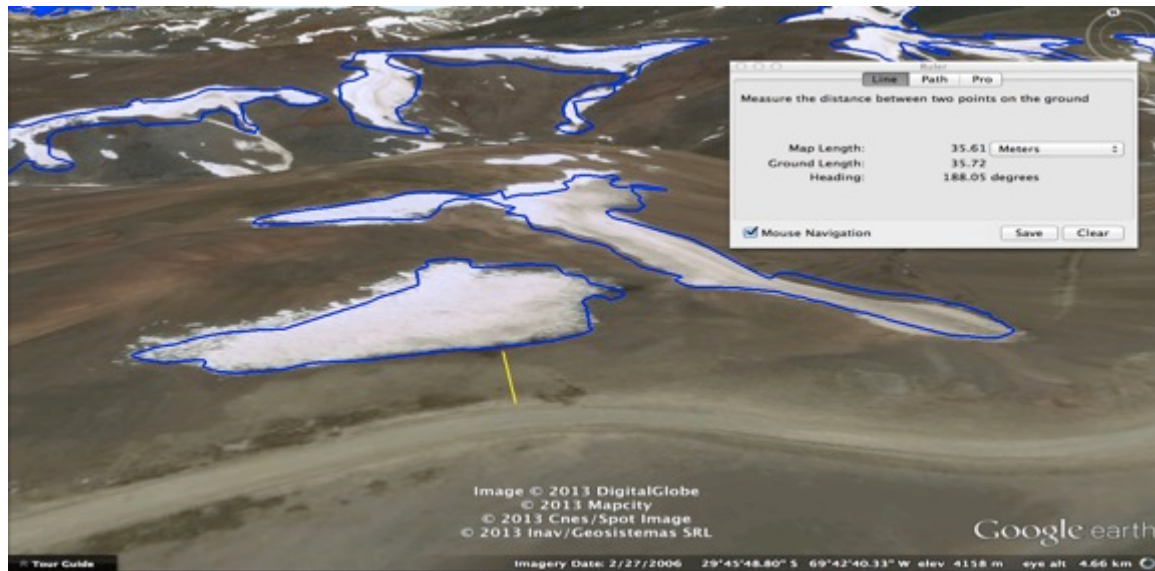


A glacier a mere 900 meters from Veladero's access road is ignored by the company in terms of impacts. This glacier could provide the entire population of the province of San Juan (680,000) with more than 9 years of drinking water. A truck was passing along the road just at the satellite image was captured.

Not far from the previous example, in the following area: 29°57'25.75" S 69°40'21.32" W, we see numerous smaller glaciers but not because of this less important in terms of hydrological value. Google Earth offers images from 2005, 2006 and y 2007 permitting a useful comparison of the area. In all of these images we see the glaciers and/or perennial ice patches protected by law. The two glaciers closest to the road amount to 2 hectares of ice (5 acres). The closest one to the road is a mere 36 meters away. Other large glaciers seen in the background are between 800 and 1,000 meters from the road.

All of these glaciers are in areas of impact for the activities underway by Barrick Gold for both Veladero and Pascua Lama. They contain 2, 6.4 and 13.5 hectares of ice from left to right. That's 24 hectares in total, or 60 acres of ice reserves that are completely ignored by Barrick Gold's environmental impact studies.

Both the provincial authorities of San Juan as well as the National authorities also disregard these glaciers. There is simply no registry as of yet that these glaciers even exist. This is a violation of the National Glacier Protection Law.



A glacier a mere 36 meters from the Veladero access road is in Barrick's influence zone. Barrick ignores the glacier.

Until very recently, we could not obtain images from this area. With Google Earth we can now obtain images beginning in 2005, approximately the date when Veladero commenced extractive operations, however the company had already been working in the area for more than a decade by that time. There are likely impacts to these glaciers along those years. Since 2005, for example, there is a marked and accelerated impact to the *Almirante Brown* Glacier, which leads us to conclude that there is also likely impact to other glaciers in the area. We cannot be sure however, as there are no studies to determine what this impact has been and what part of this might be due to mining activity.

Images now available for 2011, and others that we have seen from 2013, show a drastic reduction of perennial ice in the region. In some cases entire glaciers are gone. For this reason it is very important to set a baseline date well into the past, so that we can study what has occurred to these glaciers over the years and since mining activity began in the region.

Let's consider the following set of images of one of these glaciers since the 2005/2006 period.

The glacier is at: 29°57'23.98\" S 69°40'20.43\" W

The images are from 2005, 2006 and 2011.

Since Veladero began operations, we see a slight reduction in ice mass between 2005 and 2006. This could simply be due to a difference of seasonal snowfall. But when we examine an image from 2011, we are greatly surprised to see that the glacier ice has vanished. There is a lighter color area left in the earth where the glacier had been previously. This disappearance concurs with what happened in the lower section of the *Almirante Brown* Glacier.

Glacier on the Veladero road 2/12/2005
Source: Google Earth



Same glacier 2/27/2006
Source: Google Earth



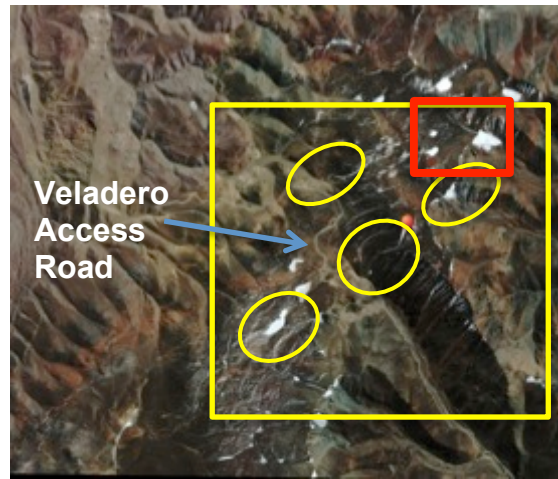
The glacier site on 3/2011; it has disappeared completely
Source: Digital Globe



The comparison of images in the greater area of the Conconta Pass show an alarming reduction of ice mass since the introduction of the access road, including the disappearance of numerous glaciers.



Conconta Pass 2/27/2006 (Google Earth)



Conconta Pass 3/27/2011. Source: Digital Globe

In the following area:
2/12/2005 and
exposed to Barrick's
drastically reduced
69°34'26.30" W),
they would
5,000m), practically
change. Is there
accelerated
reduction? We
the provincial

29°56'17.26" S 69°35'17.30" W comparing satellite images from
3/27/2011 (and then a 3D image) we see that glaciers directly
access road (between 2 and 3 km from the road and at 5,200m) have
in size. Glaciers to the right of the image (at 29°56'24.45" S
protected from the road by ridges and yet at lower elevations where
theoretically be more vulnerable to climate change (between 4,600-
maintain their area. All of these bodies of ice are affected by climate
some localized climate variable along the road that has led to an
collapse of these roadside glaciers? Is vehicular transit the cause of the
don't know because nobody is controlling this impact. Neither Barrick nor
authorities mention these glaciers anywhere.



Glaciers to the
The body of ice
Source (left):



left are exposed to the road. They reduce in size between 2005 and 2011.
to the right is protected from the road and despite lower elevation keeps its size.
2/27/2006 (Google Earth); Source (right): 3/27/2011 Digital Globe

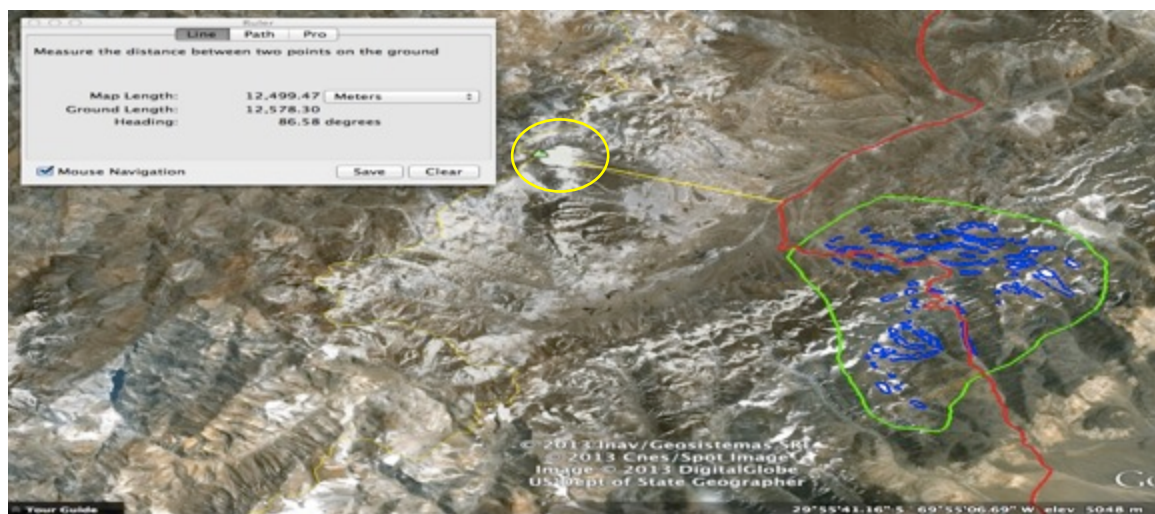


As we climb Barrick Gold's access road to Veladero from the Conconta Pass, we go through an area (about 40km in length) where there do not appear to be any glaciers visible, nor are there rock glaciers present. This does not imply that there may not be glaciers affected by windblown dust in outlying areas. Volcanic eruptions in the Central Andes have caused airport closures as far away as New Zealand, so it is absolutely conceivable that high winds along the Veladero access road, could lead to dust being blown a mere 5, 10 or 15 kms away. The nearby Gualcamayo gold project (Yamana) spews dust that is deposited as far away as the town of Guandacol which is at about a 20km distance.

We might consider looking at potential impacts to glaciers such as the Tórtolas which has approximately 1.5km² of ice (150 hectares, or 370 acres). This glacier is viewable at:

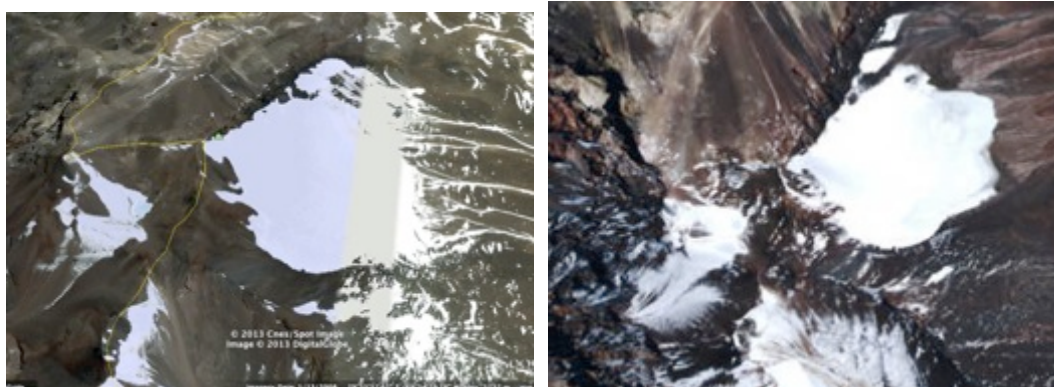
29°56'16.41" S 69°52'56.70" W).

In the following image, we see the relationship between the access road to Veladero and the magnificent Tórtolas glacier (marked with a yellow oval). The glacier is about 12km from the access road.



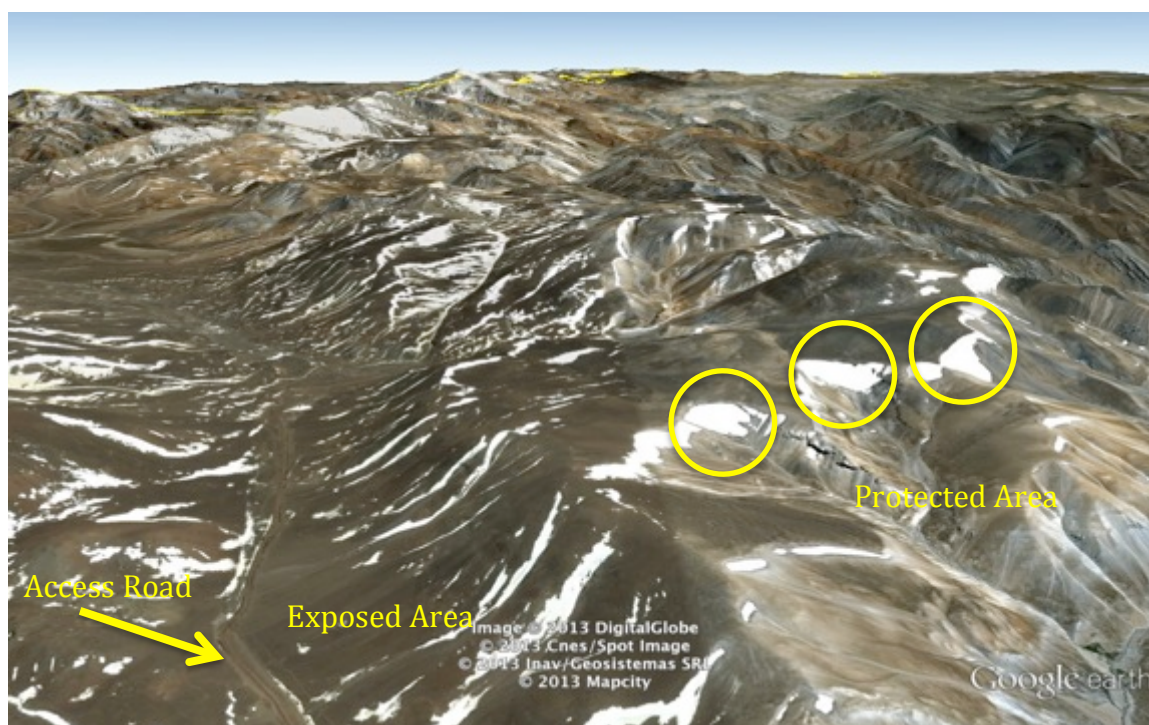
The Las Tórtolas Glacier, one of the largest glaciers along the Veladero access road, covers 150 ha of ice, and is 12 km from the road. It could be affected by dust and wind. It can be seen at: 29°56'16.41" S 69°52'56.70" W: No studies monitor impacts of Barrick's activities on the Tórtolas Glacier.

We can see the following closer images of the Tórtolas Glacier from 1/13/2008 and 3/24/2011, respectively. Curiously, we note that there has been little decline in ice surface cover as in other glaciers of the area. Might this be because it is further removed from the road, or due to other natural reasons. We cannot say, because neither Barrick nor the provincial authorities are studying this glacier.



The Las Tórtolas Glacier on 1/13/2008 (left: Source Google Earth) and on 3/24/2011 (right: Source: Digital Globe) It is possible that the further distance from the road (or perhaps other natural causes) help protect this glacier. No studies are available to determine why this glacier seems unaffected by climate change in the region.

Moving forward from the Conconta Pass and outlying area, we arrive nearer to the Veladero project. Some 30km before Veladero (approximately at: 29°35'25.44" S 69°45'01.29" W) and at 4,200m, we again find glaciers along the access road. At least 46 glaciers or more are in this area nearer now to the actual mine site. Barrick Gold does not mention these glaciers anywhere in their environmental impact reports. They contain some 5.8km² of ice or 580 hectares (1,400 acres). Nobody has registered these glaciers. Nobody is studying these glaciers, or monitoring impacts from nearby activity or from climate change. All of these glaciers would fall under categories protected by the Argentine National Glacier Protection Law and they are all in vulnerable areas exposed to active mining activity, and particularly exposed to Barrick's Veladero/Pascua Lama access road.



Glaciers protected from the access road maintain their size over the years.
see: 29°30'57.33" S 69°44'43.92" W

In this area we consider various glaciers that are near to, but protected from the access road. The road is indicated with a yellow arrow. In the previous image we see several perennial ice bodies protected by the natural ridge in the mountain (see circles). The access road passes at the lower left area of the image about 1.5km from the glaciers. In the backgrounds we can see both the Veladero and Pascua Lama mine sites. There is a slight reduction in ice cover in the sequence of images. Is this possibly simply climate change? Is this due to seasonal snow? Is there vehicular transit impact? These glaciers are closer to the blasts at the projects sites. Might this also impact the glaciers. We don't know, no studies are underway.



October 30, 2008

February 5, 2011

April 11, 2013

b) Barrick's Glaciers in Chilean Territory

In Chile, the Glacier Protection Bill in Congress failed the congressional vote. The regulatory framework is also not as restrictive relative to mining operations in glacier zones or in periglacial environments. Barrick Gold was able to reduce the government's attention to the three glaciers, Toro1, Toro 2 and Esperanza, and to a handful of outlying glaciers in the pit area, including, the Estrecho, Guanaco, Los Amarillos, and Ortigas, Glaciers.



Hundreds of glaciers in the Diaguíta Huascoalto Indigenous Territory are at risk due to mining activity.

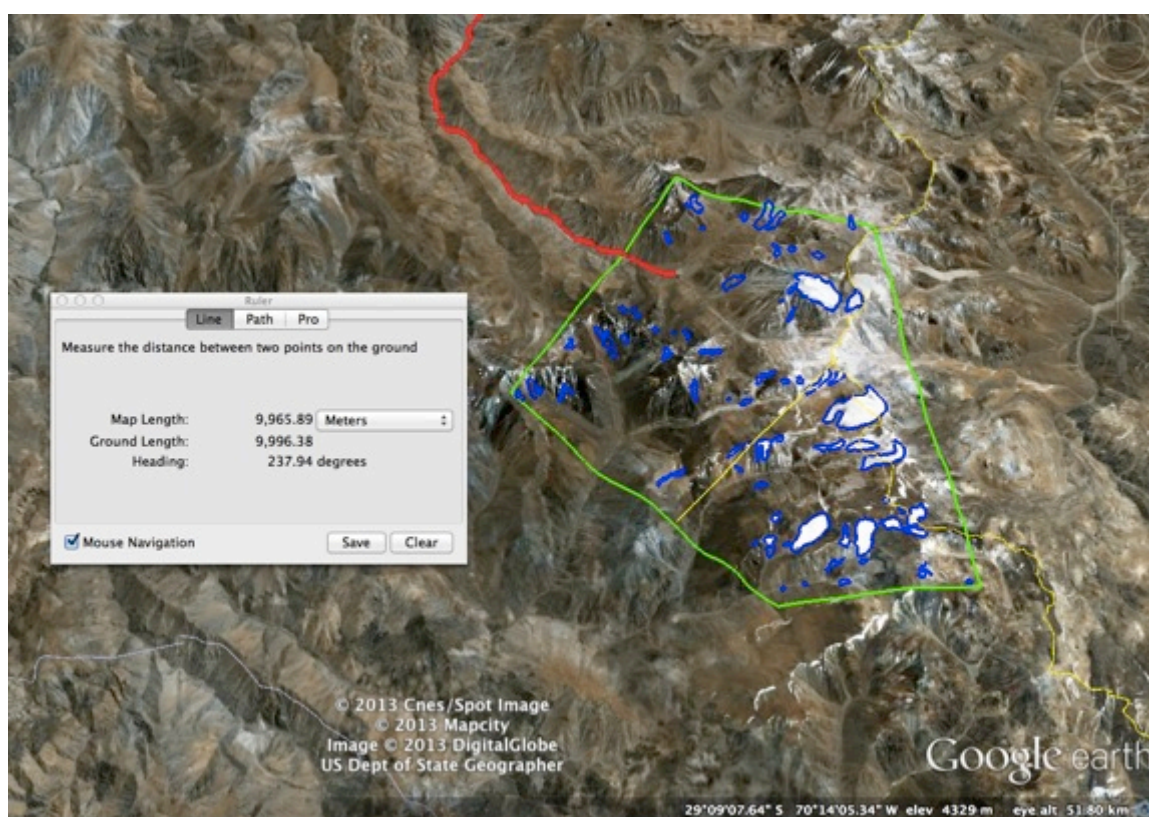
We know that these glaciers (as is the case in Argentina) are but a handful of the total glaciers at risk due to Barrick's activities in the area. There are at least 76 glaciers in the project's immediate impact zone. These are all within a relatively short distance to the central area of Pascua Lama's main activities.

CEDHA recently carried out an inventory and report of the glaciers in the Diaguíta-Huascoalto indigenous territory (see orange polygon in the above image).⁴⁰ This territory, in large part, coincides with Pascua Lama's area of exploration and future extraction.

⁴⁰ see: <http://wp.cedha.net/?p=12271&lang=en>

Within this indigenous territory, there are also other mining projects underway, for example, El Morro (Goldcorp). In the territory (shown in an orange polygon above) we have registered some 400 glaciers including uncovered white glaciers and rock glaciers. In the above image, glaciers are indicated as blue polygons. We've also included glaciers that are near the indigenous territory but not necessarily within it, as these glaciers feed melt water to the territory. These can be seen at: 28°57'59.25" S 70°21'44.40" W. The reader can download the glacier inventory in a kmz file.⁴¹

We also see in this image, the main access roads utilized by Pascua Lama through Chilean territory (the red line), originating at Alto del Carmen. We also see that the closest glaciers to the project area are very close to Pascua Lama's pit area, which is slightly different in the case of Argentina where they are also disbursed along the lengthy 180km access road. If we employ the same technique of defining an approximate area of influence around the project, (we've chosen 10km around the pit site, as well as areas that are in direct line of influence around the project), we obtain the following green polygon. (see image below). In this area we find 76 bodies of ice, of which 41 are rock glaciers and 35 uncovered white glaciers.



Pascua Lama's approximate area of influence in Chilean territory has some 76 glaciers.

We should point out that as was the case in our analysis of Argentina, we have not considered the possible impact of dust due to wind patterns at greater distances. We see that in the previous image, uncovered glaciers, amongst the 400 glaciers in the indigenous territory, could be affected if they are downwind from the Pascua Lama pit site. As far as we know, Barrick Gold is not monitoring Pascua Lama's potential impacts to the glaciers beyond the immediate pit site.

Impacts to glaciers and rock glaciers are visible in the case of mass earth removal particularly in the periglacial environment. These impacts are visible in the form of exploration roads and access roads that cut into periglacial areas. Changes to ambient temperature could also affect periglacial and glacial areas. Dust and debris cover from blasts would directly impact uncovered glaciers in dust-affected zones.

⁴¹ see: <http://wp.cedha.net/wp-content/uploads/2012/12/Glaciares-Huascoaltinos-Google-Earth-Polygons.rar>

The next image was taken by the community water authority (*the Regantes*) in the Huasco Valley downstream from Pascua Lama. They indicate that this is the dust deriving from vehicular transit on Pascua Lama's access road.⁴²

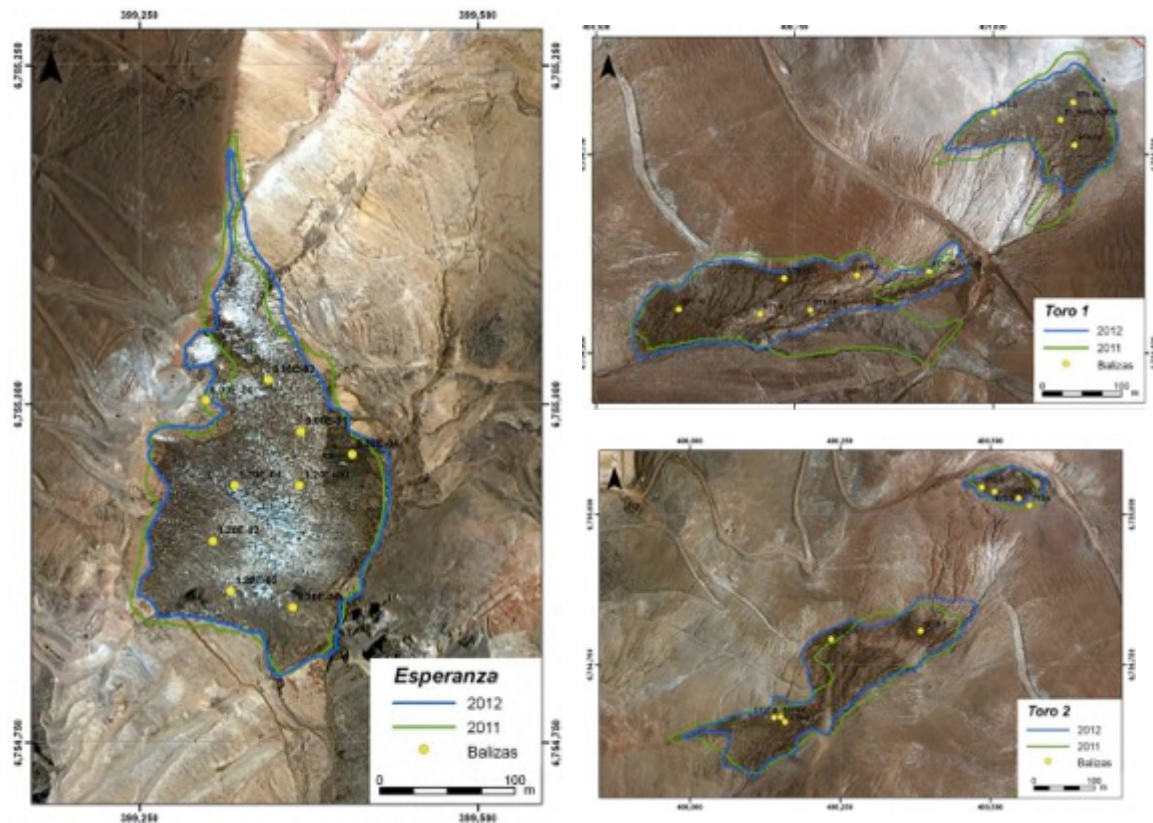


Dust from access road use to Pascua Lama on Chilean territory. This dust is deposited on glaciers and on crops. Report by the Community Water Authority (*los Regantes*), March 2012.

At the end of October 2012, Barrick Gold was forced by the Chilean authorities to suspend pre-stripping activities at Pascua Lama due to the high dust content in the atmosphere due to blasts and the effects this might have on worker health.⁴³ This dust also impacts on glaciers. Next we see three glaciers in the pit areas, Esperanza, Toro 1 and Toro 2, towards the end of 2012, already completely covered by dust and debris from Barrick's pit preparation activity.

⁴² see: <http://wp.cedha.net/wp-content/uploads/2013/04/informe-visita-de-regantes-a-glaciares-pascua-lama-marzo-2012-smalldoc.doc>

⁴³ see: <http://www.barrick.com/investors/news/news-details/2012/Construction-Schedule-at-Pascua-Lama-Not-Impacted-by-Pre-stripping-Stoppage>



Esperanza, Toro 1 and Toro 2 Glaciers, completely covered by dust/debris from Pascua Lama activity.
Source: CECs 2012

We can see other glaciers on Chilean soil, and their exposure to Barrick's activity. The most notorious impacts have occurred at and around the pit site, but there are numerous activities beyond as well. The Esperanza Glacier (see below) shows extensive road activity around its edges and into the ice body. See at: 29°19'50.90" S 70°02'12.01" W



The Esperanza Glacier on Chilean soil, shows extensive road work around edges. The image is from 2005.
See at: 29°19'50.90" S 70°02'12.01" W

The previous images is taken in 2005, while Barrick Gold was focused on exploration and preparing Pascua Lama. The Esperanza glacier still had a chance to survive at that state. However, more recent photographs are showing that the damage suffered by the glacier is extensive and likely irreversible. It is now completely covered by dust and debris. The cover

of this report is of the nearby Toro 1 Glacier, also complete covered by dust and debris from Pascua Lama's preparatory activities. The strong winds in the area aggravate the problem.

There are also other areas where glacier impacts are readily visible on Google Earth. We see in the following image, for example, that a mining road has been placed through a rock glacier. The reader can visit this site at:

29°09'52.79" S 70°01'02.36" W



Rock Glacier with mining activity cutting through its surface.

See at: 29°09'52.79" S 70°01'02.36" W

Barrick Gold begins monitoring dust and debris deposited on glaciers very recently. The Centro de Estudios Científicos (CECs) is now conducting these studies.⁴⁴

In the CEC's first monitoring report (2012) we note various observations, including that of 36 samples taken, at different points of measurement, there is manifest evidence of an increase in dust where mass earth removal was taking place. (CECs, 2012, p.11). The researches conclude:

"in terms of comparing between measurements taken from 2012 with respect to 2010, we detect that in sample areas, we have an increase of dust at 4 glaciers while a decrease at one." (CECs, 2012, p.11)

It is at least curious to see that the official studies on Barrick Gold's impacts on glaciers due to suspended dust/debris are positive in Chile, while in San Juan, the authorities say that there is no impact from mining activity.

⁴⁴ see: <http://wp.cedha.net/wp-content/uploads/2012/11/7-Monitoreo-de-MPS-y-PCG-Pascua-Lama-2012-2.pdf>

IIX. The Study by Lydia Espizua of the IANIGLA

There has been much confusion deriving from a report produced in 2006 by IANIGLA geologist Lydia Espizua, which focused on glaciers and periglacial areas at Veladero and Pascua Lama. The information in the report has been manipulated by public officials and by Barrick Gold to suggest that Barrick's projects have no impacts on glaciers. This is simply untrue, and misinterprets the findings in Espizua's report. This section is about this misinterpretation.⁴⁵

In this study, Espizua, contracted by Barrick Gold, carries out research on glaciers of three basins, the Turbio, Rio Potrerillos and the Canito, and a portion of the Los Amarillos and Las Taguas. Both Barrick Gold and the Province of San Juan have utilized the findings of this study to suggest that activities by Barrick Gold do not have impacts on glaciers. This is simply not the conclusion drawn by Espizua.

Firstly, the area studied by Espizua is not the project's total influence area for either Veladero or Pascua Lama. Espizua studies a *small portion* of the project influence areas, some 100km², when the actual influence area is as much as 20 times greater. Espizua also studies only seven glaciers, the Los Amarillos, Guanaco, Canito and 4 other glaciers, which she calls Gla C34, Potrerillos, and Gla P08. Neither does Espizua carry out an inventory of glaciers in the full influence area.

Secondly, Espizua's work looks at the coincidence of project infrastructure with glaciers or permafrost. This is *not* an environmental impact assessment of mining activity on glaciers and permafrost. This is yet another of the myths that has been created around glacier issues at Pascua Lama. Some confusion has derived from the title chosen by Espizua for the section of her report on page 44, which is called "Impacts of Mining Infrastructure of Pascua Lama to Glacial and Periglacial Environment". We must understand that Espizua is merely comparing a map of glaciers to a map of infrastructure offered by Knight Piesold Consulting, produced in 2004 for Barrick. What she does is simply to see if any of the project's infrastructure is programmed on glaciers or on periglacial areas.

Espizua concludes hence, that there is no project infrastructure on uncovered glaciers. She does say, however, there is indeed impact on periglacial areas. (unofficial translation)

"The discontinuous permafrost area that will be affected [by project infrastructure] for these works is 300 hectares (740 acres), what represents 17% of the discontinuous permafrost area of the Turbio basin. ... [she then adds] The Pascua Lama pits, Penelope West and East, the conveyor belt (both superficial and underground), and the roads would affect 130 hectares (320 acres) of discontinuous permafrost." (Espizua, 2006. P.44)

We stress that Espizua is not looking at the impacts of project activity, but rather at the physical presence of infrastructure, and whether there is overlap with frozen areas. It was not in Espizua's terms of reference to conduct an environmental impact assessment of mining activity on glaciers or on periglacial areas.

Espizua's report is a very important early academic testimony in the evolution of the project, but *it is not* a finished study about all of the glaciers of Barrick's influence area, nor does it provide information about the potential impacts of mining activity in the area. Further, one cannot conclude from this study that Barrick has carried out all of the necessary studies to determine glacier presence or glacier impacts (or those related to periglacial environments) for the project's influence areas. This is what both San Juan Province and Barrick Gold repeatedly say in various cases. This is both false and deceiving.

Since practically no one knew of glaciers in the area, and since there was no publicly known glacier inventory of any sort (both the company and the province do have such inventories in their possession today), public officials utilized the Espizua report to make the public believe

⁴⁵ see: <http://wp.cedha.net/wp-content/uploads/2011/11/Informe-Glaciares-Lama-Veladero-Espizua-2006.pdf>

that there was in fact an inventory (and it was simply these few glaciers) and that Barrick Gold had a clean bill of health on glacier impacts for the project.

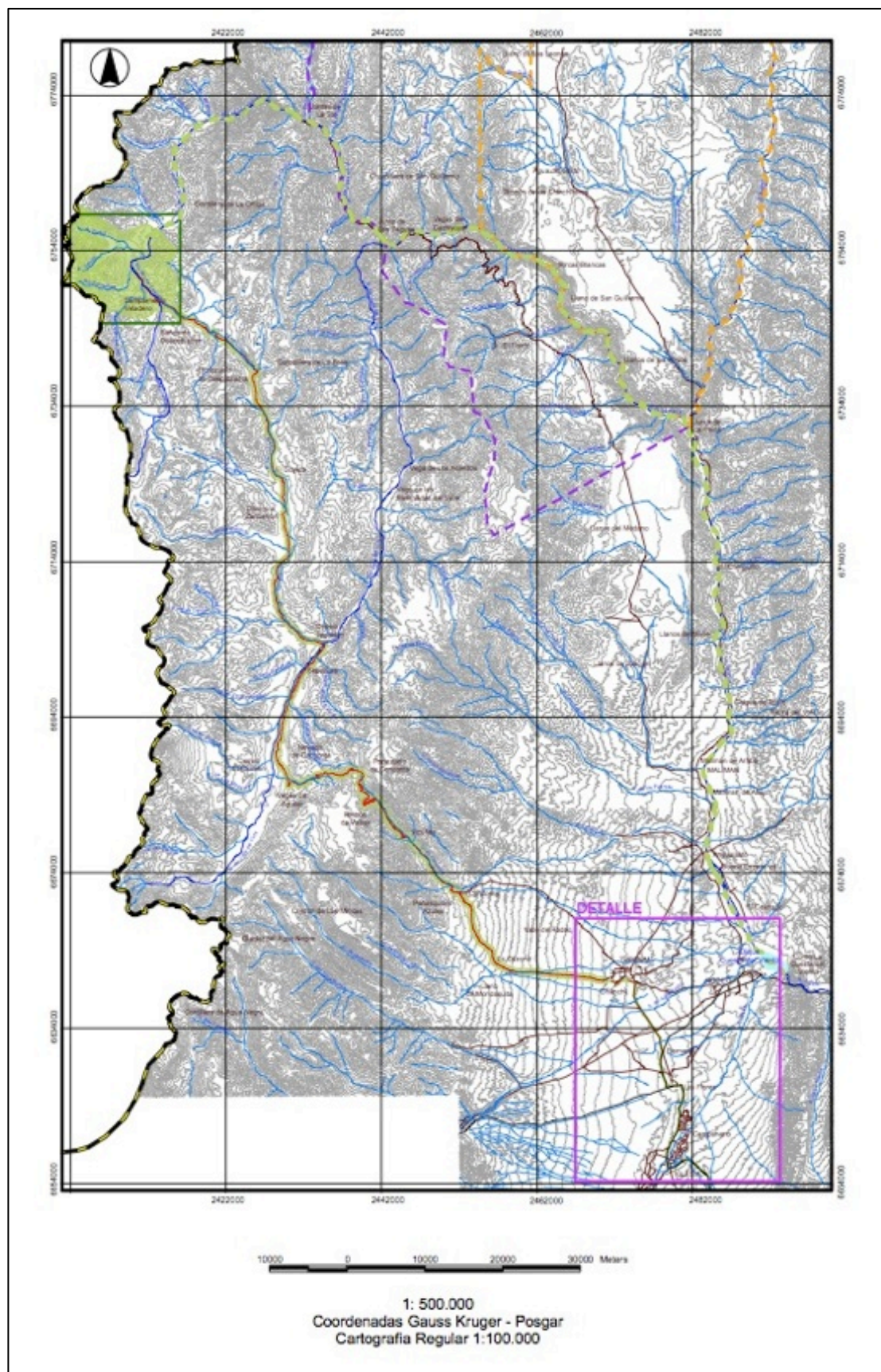
We can see in the next image, in a green polygon, the study area for the Espizua report. And we can also see the many more glaciers in the region. The red lines are the access roads to the mine sites.



The green polygon denotes the approximate study area for the Espizua report. It is clear that this is not the full area of impact for Barrick Gold's Veladero and Pascua Lama projects, but only a small portion.

Espizua's study area (green polygon) is only a small portion of Barrick Gold's impact areas for Veladero and Pascua Lama. There are many more glaciers, hundreds more, in the immediate area surrounding the pits and along the access roads (in red). Barrick's media machinery has focused on the Espizua report and her study on only seven glaciers to draw attention away from a much larger impact. By doing this Barrick has left off of its impact studies more than 90 percent of affected glaciers and periglacial environment.

In the original Knight Piesold document, the influence area is mapped and defined (see below) in the following manner. In this document, the area is clearly not the Espizua polygon, but also includes access roads and other regions (shown below in green).



Some additional aspects of Espizua's report are worthy of mention when considering Barrick's impacts to glacier resources, and particularly in regards to Argentina's new Glacier Protection Law.

Espizua says:

- That the periglacial environment at Veladero-Lama begins at 3,750 meters and reaches 5,300m (Espizua 2006, p.37) That is, above 3,750 meters we are in areas that are potentially prohibited for Barrick Gold's Pascua Lama and Veladero projects;
- That discontinuous permafrost (frozen grounds that thaw and refreeze cyclically) are between 4,150 and 5,175 m. This is an important area since it could be a very active water contributor to the basin;
- That in addition to uncovered glaciers, there are numerous rock glaciers (both active and inactive) and other periglacial forms such as talus glaciers, protalus ramparts (another type of rock glacier), and creeping soil (which also implies ice content)—all of which are protected by law; (Espizua, 2006, p.23-25);
- That perennial ice patches exist (these would be glaciers under the new glacier law) between 4,900 and 5,300m;
- That the water contribution by the melting of these ice bodies is significant in elevated areas;
- That the hydrological value of glaciers and periglacial areas, is significant in the months of January and February, which implies that they are strategic reserves that regulate basins, another function protected by the glacier law; (Espizua 2006, p.43);
- That the Arroyo, Canito, Turbio and Rio Turbio basins, are primarily fed by melting glaciers; (Espizua 2006, p.43);
- That Pascua Lama will affect 300 hectares (740 acres) of discontinuous permafrost;
- That the Pascua Lama, Penelope West and East pits will affect 170 hectares (420 acres) of discontinuous permafrost;

IX. What is the impact of mining activity on glaciers?

What are the typical impacts of mining activity on glaciers and periglacial environments?

- Due to direct removal of ice or by mass removal affecting ice;
- Due to disturbances in the structural balance of glaciers;
- Due to the placement of weight on glacier ice;
- Due to the opening of roads through or on glacier ice;
- Due to the perforation of glacier ice;
- Due to disturbances in the ecological and hydrological function of ice;
- Due to atmospheric contamination;
- Due to hydrological impacts;
- Due to impacts to the glaciosystems that are conducive to glacier formation;

Barrick Gold incurs in all of these impacts in one form or another at the Pascua Lama and Veladero mines.



Dust and debris from blasts at Veladero in 2006. Source G. Manrique.

a) Impact due to Removal of Ice at the Pascua Lama Pit

When the debate first appeared on the impacts of Barrick's activities on glaciers, there was little public understanding of the real risks of mining to glacier resources. The most obvious concern derived from what was surfacing at Pascua Lama, *the direct destruction of glaciers from the pit area*. The company needed to remove the ice to get at the gold. It was clear that none of the glaciers in the pit area would survive this sort of intervention. There was another project in Kyrgyzstan the [Kumtor](#) mine by Canterra which had similar problems. Canterra was intervening a mineral site, which was in the path of a glacier, and had removed ice from the pit site to get at minerals. Canterra was also depositing sterile piles on glacier ice, which also was having a significant impact on the ecological balance of the glacier. Barrick Gold had a similar problem in store with the Nevada Waste Pile, which is projected on periglacial environment, on top of an active rock glacier and on permafrost grounds. The main issue hence was Barrick's intention of removing glaciers from the pit area.

This direct ice removal for the Toro 1, Toro 2 and Esperanza glaciers would imply their destruction. Barrick did not want to forego the gold underneath the glaciers, and in response to the negative reaction of stakeholder communities, Barrick proposed to "move" the glaciers to another site, to the Guanaco Glacier nearby (to the right in the next image). This proposal was rejected outright by the Chilean government, which prohibited Barrick from touching the three glaciers. It was a good gesture on the part of the Chilean government, but not very logical in terms of the real impact that the glaciers would suffer from being so close to operations. The three glaciers (as is now being confirmed) would be severely impacted from dust and debris lifted from massive earth removal in the prestripping process. Pascua Lama hasn't even begun operations yet and the three glaciers are already fully covered in debris.

(see photo of Toro 1, on the cover of this report).



Earth removal from prestripping and blasts rapidly deteriorating Toro 1, Toro 2 y Esperanza Glaciers due to pit proximity. Photo location: 29°19'32.15" S 70°01'33.36" W

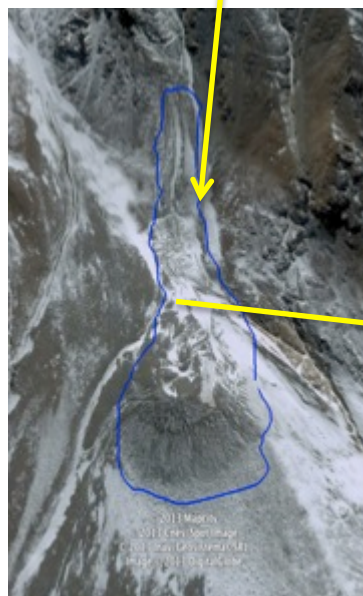
b) Impact due to Rock Piles on Glacier Surfaces

The second immediate issue that emerges is the presence of a rock glacier located inside the area destined for the Nevada Norte Waste Pile, where millions of sterile tons of rock will be placed. Placing weight on delicately balanced and moving ice is not a good idea. It can change the structural balance and lead to total collapse of the body. This rock glacier is perfectly visible on Google Earth (see photo below). Pascua Lama's geomorphological study had already identified this rock glacier in the projected waste pile area but no one had reacted to the information. Above the waste pile site is the magnificent *Estrecho Glacier*, and the smaller *Amarillos Glacier*. The ice in this basin, including the rock glacier, feeds the rivers below. We can see in the image below, the rock glacier creeping down the mountain slope. It has the typical tongue form of a rock glacier, with an abrupt and straight edge of about 30-40 degrees.

The glacier can be seen at: 29°18'26.38" S 70°01'22.70" W



Barrick Gold will place Nevada Norte waste pile on a rock glacier



Rock Glacier 2010 (Google Earth)



2013, Digital Globe Foundation

If we take a close look at this glacier, zooming in, we see the rock glacier advancing downhill.

The Google Earth image is from March 16, 2010. Until that time, the glacier was perfectly intact. What's surprising is however, that in the more recent images (2013), we see that Barrick Gold has run a road over the glacier surface. This can affect the protective debris cover, exposing the ice core and lead to the collapse of the glacier.

Both excessive weight placed on a rock glacier, or removing debris from its surface can irreversibly affect the ecological balance of the glacier. In Argentina, running this road through the rock glacier is illegal according to the National Glacier Protection Law. The rock glacier is in Chilean territory however, which is why Barrick can do this.

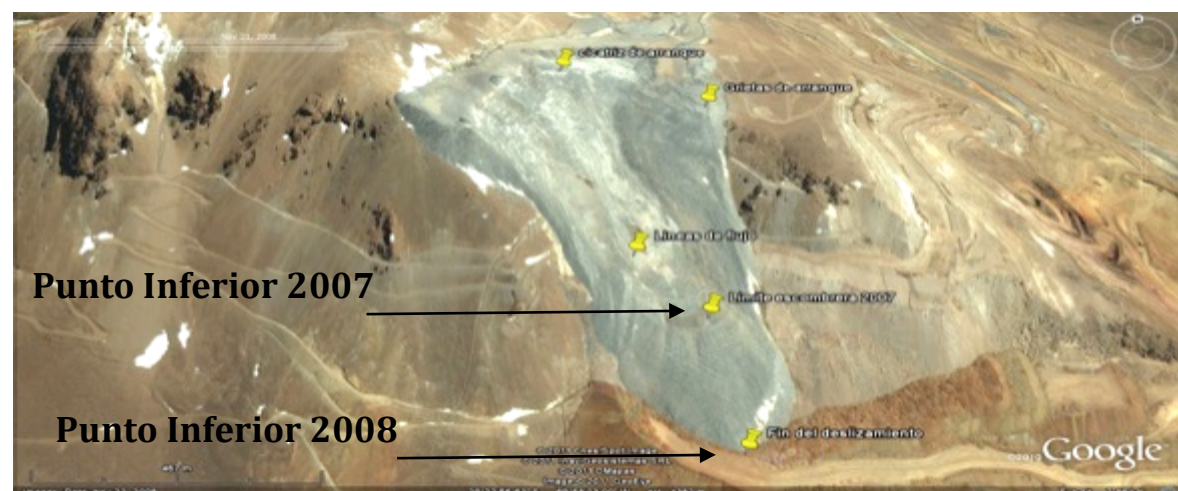
c) Impacts due to Depositing Sterile Rock on Periglacial Environments

As we have said before, the deposit of significant weight on frozen grounds is not a good idea. Frozen grounds can be in a permanent state of flux, freezing and thawing. They move, they creep. They expand and contract.

Terrifying images from a [recently published report](#) by the well known geologist and glacier expert, Juan Pablo Milana, of the University of San Juan, showing that in 2008 Barrick Gold concealed a dangerous collapse of a portion of a waste pile at the Veladero mine, located near Veladero's lixiviation site. The collapse of the waste pile, which had been placed on unstable periglacial areas, was larger than 20 football fields and more than 40 meters high, came crashing down more than 300 meters, stopping on one of Barrick's access roads. Barrick didn't inform the authorities of the accident. Milana declares in his report that he had warned public officials that waste piles should not be placed on periglacial environments. He also suggested that a containment wall should be build to protect the Valle del Cura, Taguas and Palca rivers in the event there was a collapse (as eventually occurred).

Milana compared images from 2005, 2007 and 2008, from the site of the collapse (all of these are available on Google Earth utilizing the time feature). Sometime between 2007 and 2008 the collapse occurred. The site and sequence can be seen at:

29°22'45.00" S 69°57'40.58" W



Veladero waste pile ill placed on periglacial grounds. A collapse of 300 meters occurred in 2007/2008.

Waste piles, says Milana

“are planned to remain stable, since acid drainage of the piles must be controlled, and any accidental movement of a waste pile not only implies risk to workers but a change in the planned construction, and a clear impact to the environment.”

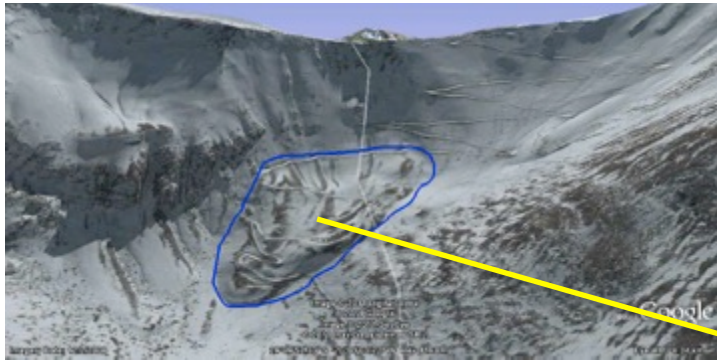
d) Impact due to Severing of Glaciers and Rock Glaciers

Roads that cross over and/or through glaciers and/or rock glaciers affect their ecological balance as well as their structural and functional processes. They can impact their active layers (which are their moving portions in permanent cyclical processes). An artificial gorge into a glacier or rock glacier can destabilize the glacier and result in eventual partial or total collapse. The removal of surface debris of a covered glacier or of a rock glacier thins the protective cover that keeps the internal ice cold. The cut will necessarily alter the ecological balance of the glacier's surface, and induce changes to that surface as the glacier attempts to readjust the protective cover, sending the sensitive ice deeper into the core. Melting of sensitive ice will likely occur in this process.

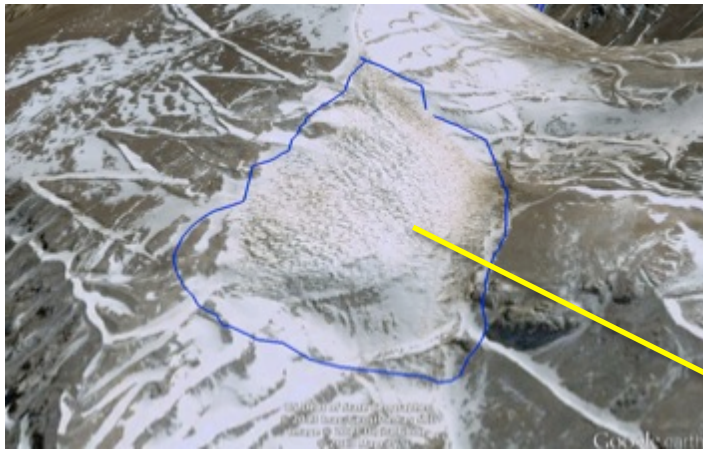
If the cut is deeper into the glacier, it might affect the older and more stable ice core, causing partial or total melting.

Barrick Gold ignored the presence of glaciers and rock glaciers in early stages of exploration and has caused noticeable impacts that are visible in satellite images. We've already mentioned the rock glacier in the Nevada Norte waste pile site, which now has a road running through it.

A quick visit to the project site on Google Earth reveals extensive road impacts to glaciers and rock glaciers. We can see below some of the images and geographic coordinates which the reader can visit. There are many others.



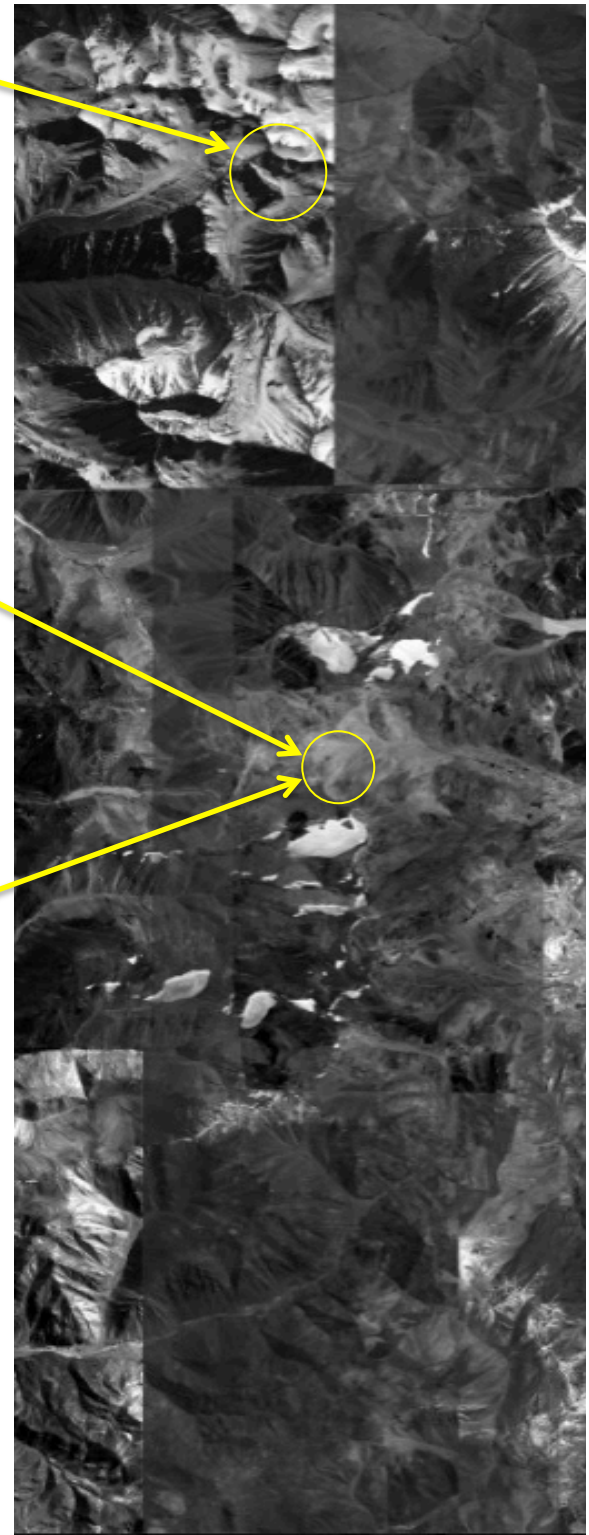
Mining roads on rock glaciers.
See: 29°09'53.11" S 70°01'08.16" W



Barrick's roads on and at the Esperanza Glacier. Near the pit.
See: 29°19'51.79" S 70°02'12.77" W



Barrick's roads on the Toro 1 Glacier (2008). Near the pit.
See: 29°19'59.69" S 70°01'18.49" W



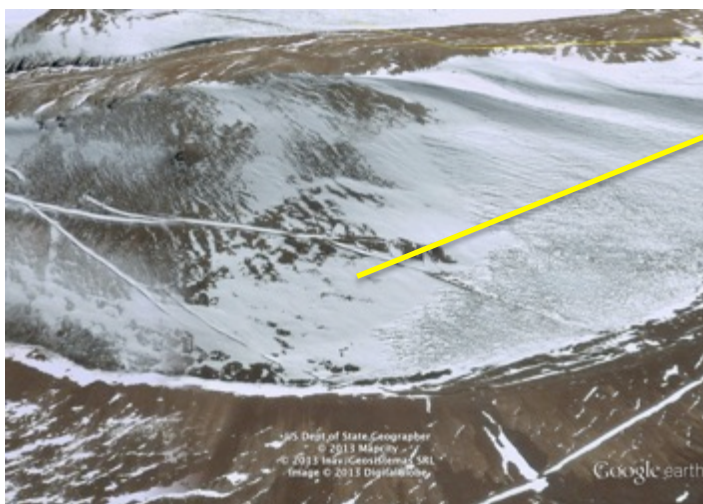
Pascua Lama Area; Source Digital Globe Foundation



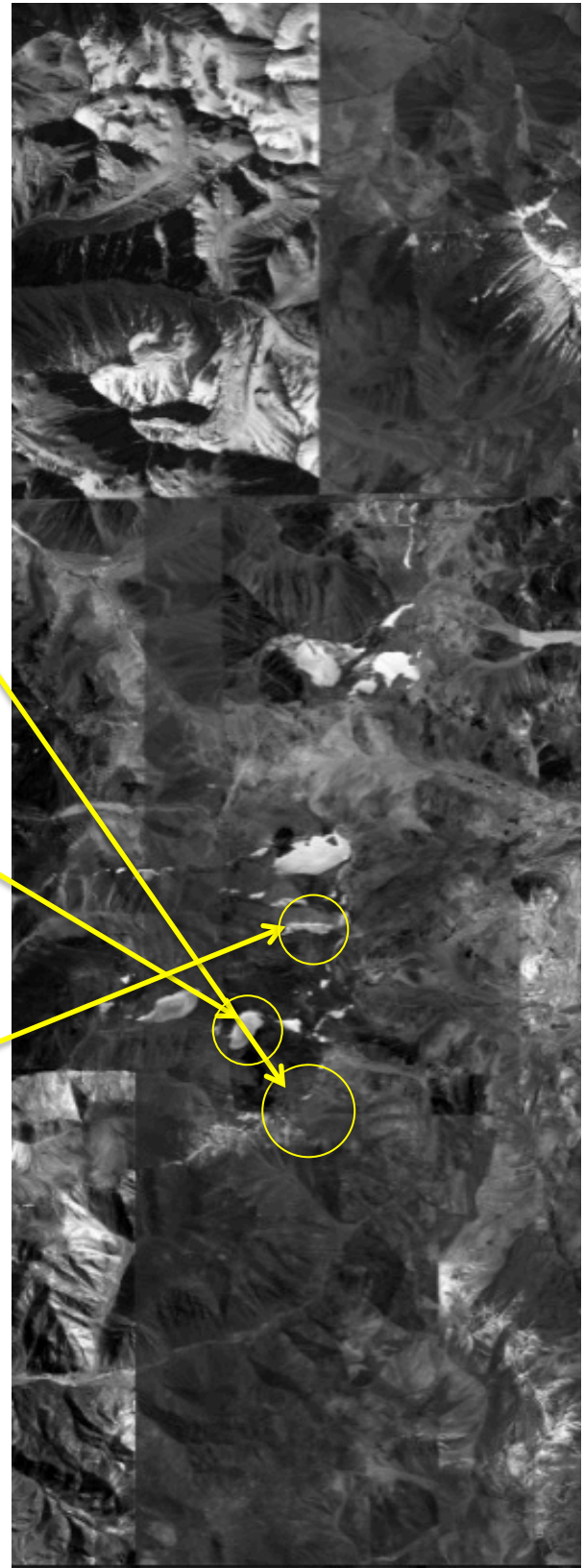
Barrick's roads and other glaciers.
See: 29°24'39.73" S 70°00'55.19" W



Barrick's roads and the Ortigas 2 Glacier.
See: 29°23'27.59" S 70°01'55.37" W



Barrick's roads and other glaciers. Near the pit.
See: 29°22'04.68" S 70°01'27.92" W



Pascua Lama Area; Source Digital Globe Foundation



Barrick's roads and rock glaciers.

See: 29°24'58.14" S 69°59'51.03" W

e) Impact due to Dust, Debris and Atmospheric Contamination

While the onset of Barrick's glacier conflict never mentioned dust and debris deposited on glaciers, today it is one of the most significant issues for the company. The Toro 1, Toro 2, and Esperanza glaciers, the closest glaciers to Pascua Lama's pit, are today completely covered by debris from Barrick's activities. This dust is also an issue for ice near Barrick's access roads or downwind from the prestripping or blasts occurring today at Pascua Lama. The cover of this report is a telling image of the Toro 1 Glacier, which shows just how severe this impact is.

In Barrick's original EIAs for Pascua Lama, the company considered that the area surrounding the pit was of "pure air with very low particle matter and absence of gases" (EIA, 2000, Chapter 5-38). In the section on "Air Quality" Barrick identifies "vehicular transit on dirt roads" as the principal source of contamination at the time in the area. Barrick also mentions "ventilation" and air "circulation" in the region resulting in the quality of the air. (EIA, 2000, Cap. 5-38).

Barrick Gold says, regarding Pascua Lama's influence area:

"the intermediate influence area (AIT) of the Pascua Lama project is considered as an area of 'pure air' with low levels of particulates in suspension and absence of gases. There are no sources of significant emissions in this area of dust or gases of industrial origin. The emissions correspond to mining exploration activity and the wind erosion of the grounds, which as a low concentration of fine matter and is covered by snow during winter." (EIA, 2000, Cap. 5-38)

The company is admitting in its early studies that, before initiating activities at Pascua Lama, the air is pure, that there is much wind, and that the only source of contamination in the area is from mining exploration activity. Today, the suspension of particulates is high, the concentration of fine debris is massive and road use is causing contamination at the pit area and along access roads.

We should also consider that in the region, many other projects are underway in exploratory phases. Perhaps no one at the time imagined that San Juan might have 180 projects conducting exploratory work in a veritable "California" style gold rush.

In the following images, of dust from vehicular transit and mass removal at Pascua Lama, and of blasts, we see the obvious problem faced by the glaciers in the vicinity.



Blasts at Veladero lift dust and debris into the atmosphere. Year: 2006. Source: G. Manrique



Dust at Pascua Lama
Photo location: 29°18'22.84" S 70°00'42.58" W



Blasts at Pascua Lama



Dust and debris blasted into the air at Veladero. May 2013. Source: G.Manrique



Dust and debris blasted into the air at Veladero. April 2013. Source: G.Manrique

We suggest that the reader take a moment to look at the following very short videos, the first of which is only one minute long. They give a sense of what occurs with each of these blasts. We see and understand from this evidence just how glaciers are soiled by mining activity. The second two videos are from Veladero/Pascua Lama activity.

1) video shows the dust and debris effects of mining blasts

<http://www.youtube.com/watch?v=Q-4v5lwEGHA>

2) video shows blasts and activity at Veladero:

<http://www.youtube.com/watch?v=9kl6gv5RkKk>

3) video shows blasts and truck movement at Veladero

<http://www.youtube.com/watch?v=UGupJajv32M>

Little by little, the dust in suspension and fine debris in the environment is covering and deteriorating the glaciers in the area of Pascua Lama's pit. By changing color, the albedo (reflective) capacity is altered, which directly affects melt rate. In the following sequence of images, from March 12, 2005, to March 2008, to January 2013, we see the drastic

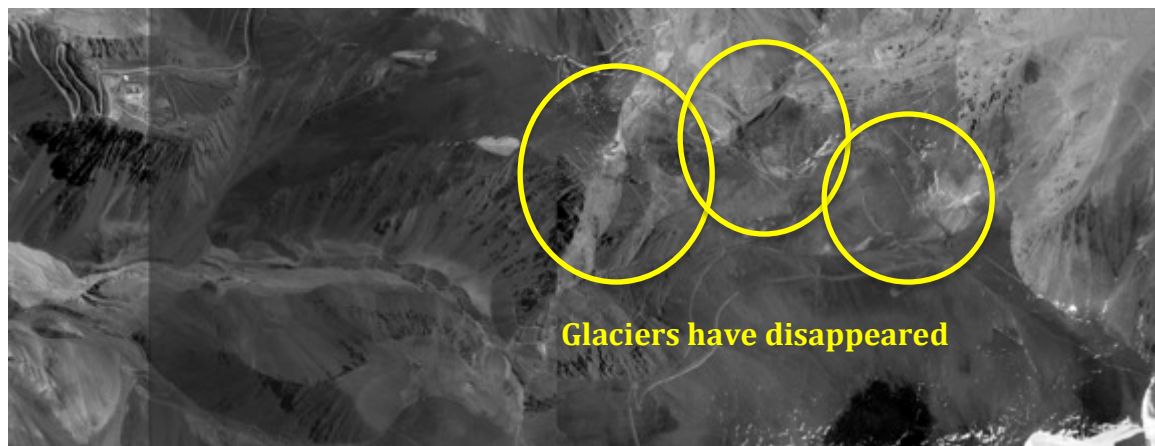
degeneration and eventual visible disappearance of the Toro 1, Toro 2, and Esperanza Glaciers. This is a direct impact of Barrick's activity at the Pascua Lama project.



Images from March 2005. The three glaciers are still visible. Source Google Earth.



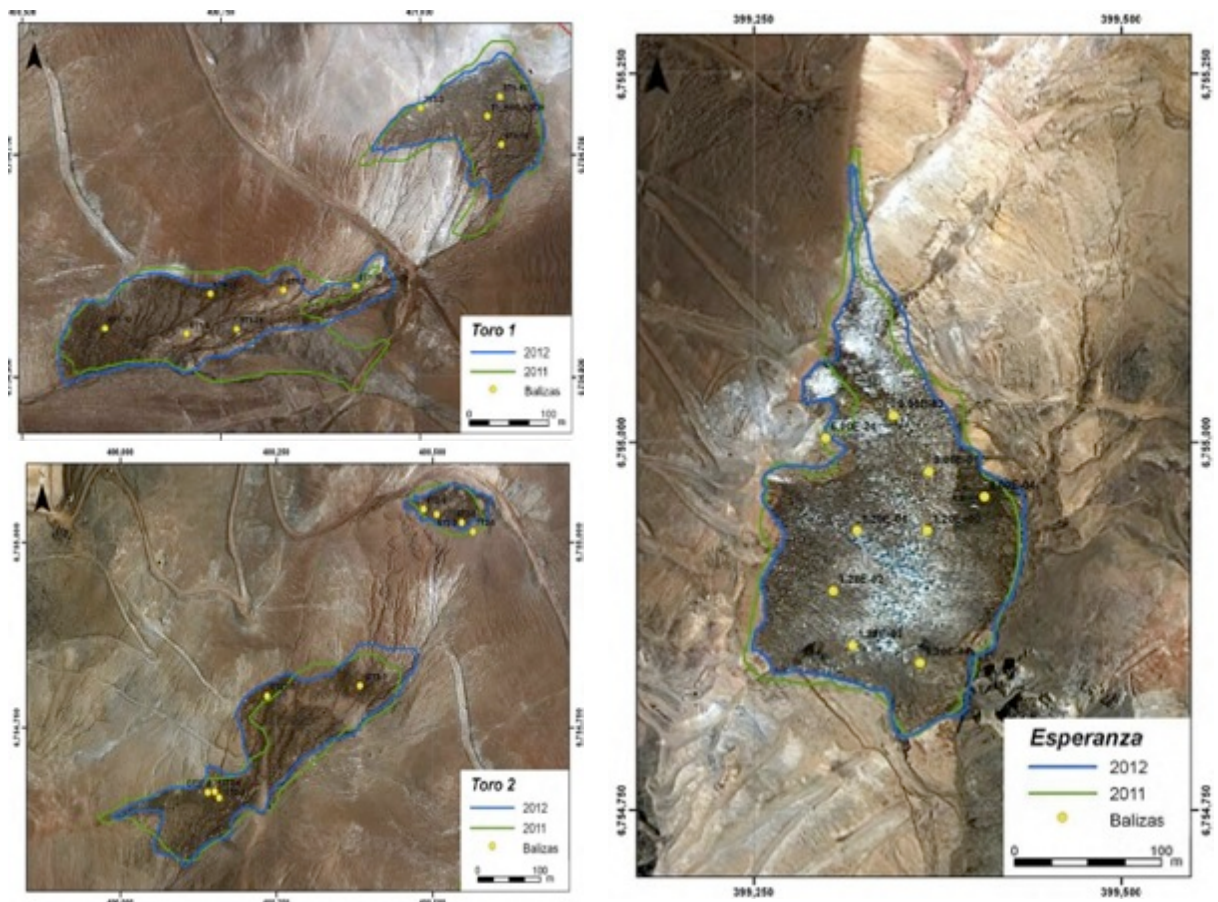
March 2008. Notorious reduction of Toro 1, Toro 2, and Esperanza Glaciers. Source: Digital Globe.



January 2013. Toro 1, Toro 2, and Esperanza are no longer visible. Source: Digital Globe Foundation

Below we publish three satellite photos from a recent report of the CEC (Centro de Estudios Científicos) of Chile, contracted to monitor glacier evolution at Pascua Lama near the pit area.⁴⁶ They are images of the Toro 1, Toro 2 and Esperanza Glaciers. They are *completely* covered by dust and debris from the mass removal of earth and other activities such as prestripping in preparation of Pascua Lama. The project has not begun the extraction phase and the glaciers are already massively impacted.

⁴⁶ see: http://wp.cedha.net/wp-content/uploads/2012/11/CECs_CMN_Balance-de-Masa-Glaciares-y-Glaciaretas-Pascua-Lama-def-rev2_SH.pdf



Three satellite images reveal that the three glaciers, Toro 1, Toro 2 and Esperanza are completely covered by debris. Source: CECs

The report produced by the community water authorities (the *regantes*) in Chile⁴⁷, product of their visit to Páscua Lama proves very revealing. It shows troubling close-up images of what is happening to several glaciers in the area. What appears to be barren earth in the image to the left, is actually a glacier, completely covered by dust and fine debris. To the right, the same phenomenon.



Photos by community water authorities near the Páscua Lama pit show debris-covered glaciers. 2012

⁴⁷ see: <http://wp.cedha.net/wp-content/uploads/2013/04/informe-visita-de-regantes-a-glaciares-pascua-lama-marzo-2012-smalldoc.doc>

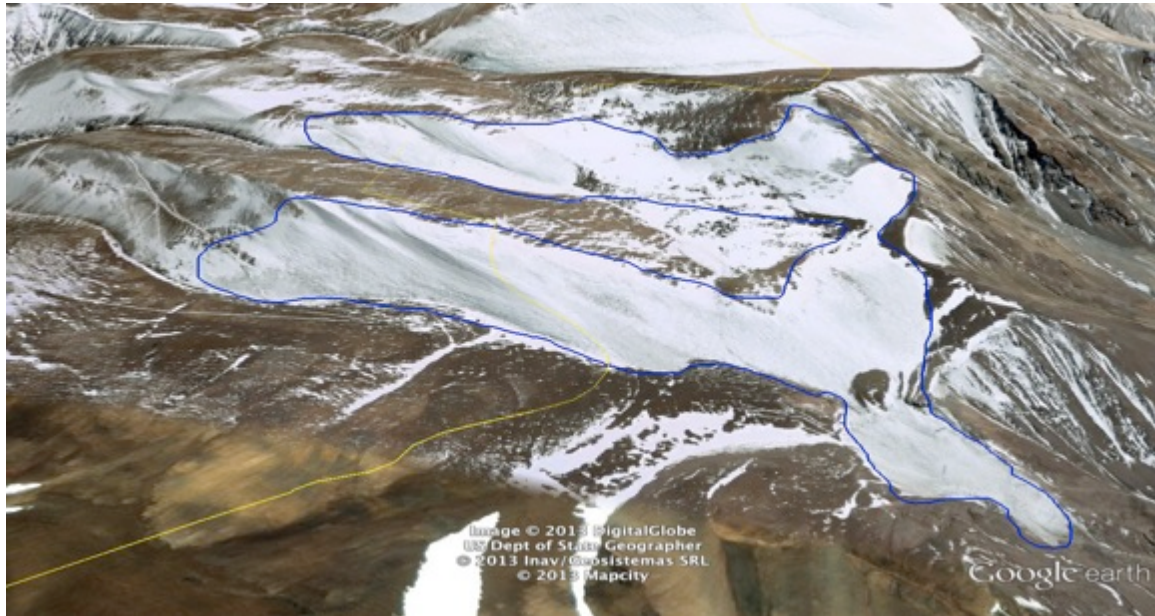
The following image, from the cover of this report, is categorical, revealing the impact suffered by the closest glaciers to Pascua Lama's pit area. This photo was taken recently by a Barrick Gold worker, and sent to CEDHA with a request to maintain anonymity. The entire surface of the Toro 1 Glacier is covered in dust and debris deriving from work in the immediate area.



Toro 1 Glacier, completely covered by dust and debris from activity at Pascua Lama.
Source: Anonymous contributor. 29°19'55.12" S 70°01'08.14" W

The Retreat and Worrisome Separation of the Canito Glacier

The Canito Glacier is located at: 29°21'55.78" S 70°00'28.58" W, a mere 300-500 meters south of the Guanaco Glacier, and is on the border between Argentina and Chile. It is only 3km from the Pascua Lama pit area and 2km from the principal activity at Veladero. The Canito Glacier is surrounded by mining activity.



The Canito Glacier on the Argentina/Chile border, is surrounded by mining activity of Veladero and Pascua Lama and is showing serious signs of impact. See at: 29°22'03.49" S 70°00'48.53" W

The terminal tongue of the glacier is at about 1,000-2,000 meters from main activity at the Veladero project. The glacier is nurtured from higher zones that unite at the tongue area. As several other glaciers along the border ridge, it is visible (or was visible) from the Veladero project area in the lower as well as from infrastructure at Pascua Lama. Below we show a picture of the mountain ridge where the Canito glacier is visible, along with several other glaciers. This glacier was studied by the IANIGLA since evidence was made public that Barrick Gold was impacting glaciers along the Conconta Pass. Lydia Espizua, geologist and glacier specialist at the IANIGLA conducted studies on the Canito in 2006. More recently, the IANIGLA has posted a website with information from this 2006 study and other information about the Canito and outlying areas.⁴⁸

The ovals in the third panoramic image show the approximate areas of Veladero's main activity as well as activity at Pascua Lama. Clearly the two projects are related geographically, as are their impacts on the nearby glaciers.

⁴⁸ see: <http://www.glaciares.org.ar/paginas/index/canito-turbio>



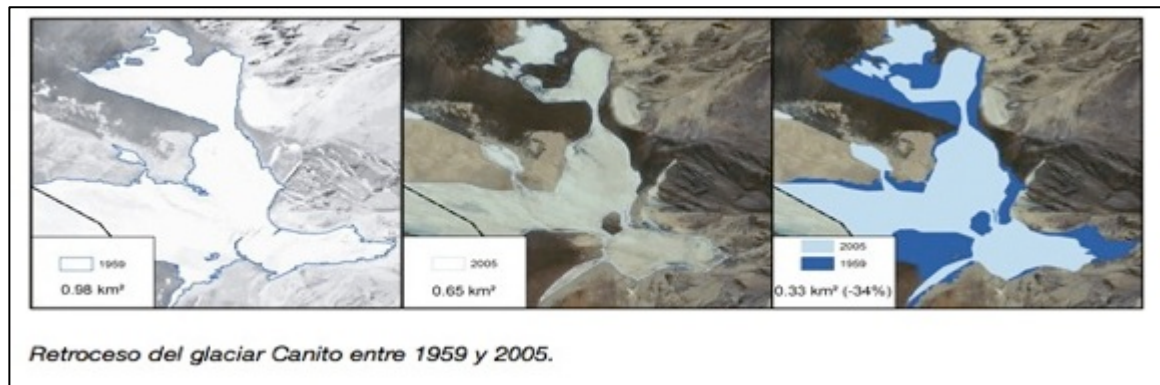
Image of the Canito Glacier's tongue, from the Espizua report 2006.



Photo from the IANIGLA report shows glaciers along the border ridge near Pascua Lama and Veladero.

Recent evidence shows troublesome impacts to the Canito Glacier over the course of the last few years. The next image is a sequence that Espizua displayed in her 2006 report. We see the Canito Glacier, in Argentine territory, in images from 1959, 2005, 2010 and 2011. And then an additional more recent image is reproduced from 2013. We notice a significant

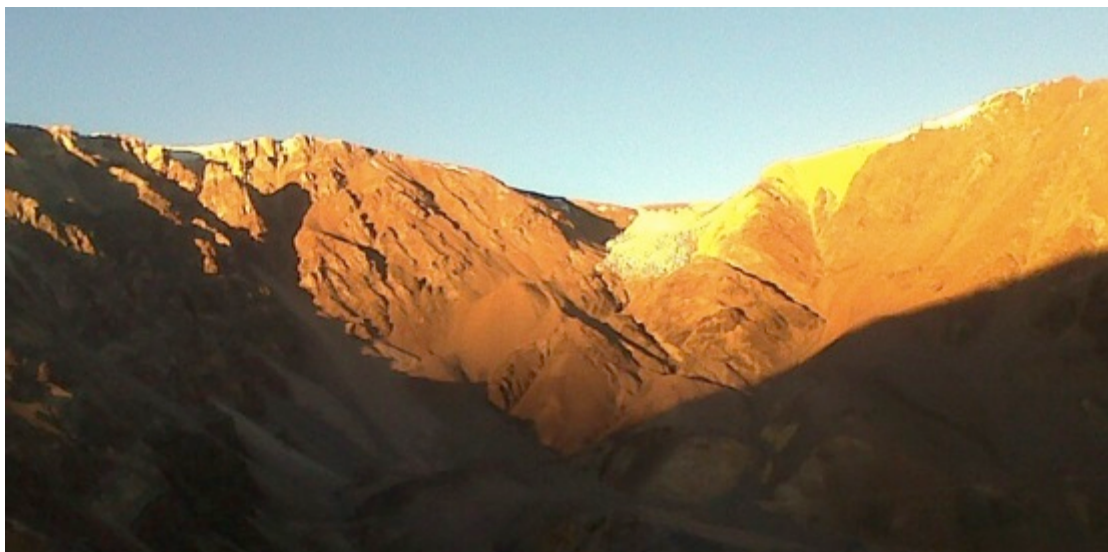
reduction in the ice mass in 2011 and a progressive de-linking of the portions of the glacier into several smaller glaciers.



Surprisingly, the last image of the area, from January of 2013, shows that the tongue of the Canito Glacier, that measured some 500m long, and dropped into Argentine territory, is no longer visible—or is only slightly noticeable. We presume the tongue is covered by dust/debris, but we cannot be sure. We also see the dismembering of the Canito into several smaller sections. It is possible that the separation of the ice bodies is causing a shrinking of the tongue and ultimately its complete disappearance.



Photographs 2012 of the Guanaco Glacier (right) and the Canito (left and below). It is darkening.
Source above: Fredys Espejo; Source below: G.Manrique



Canito Glacier

2005 (March 2005, Source: Google Earth)



2010 (April 2010, Source: CEAZA)



2011
(May 2011 (Source: CECs, IKONOS))



2013–The Tongue of the Canito disappears
(January 2013, Source: Digital Globe Foundation)

f) Barrick's Impacts to Periglacial Environments

We mentioned earlier that Barrick Gold has irreconcilable conflicts with Argentina's new National Glacier Protection Law, not only because of its protection of common uncovered glaciers, but also because the law protects periglacial areas. Periglacial environments are, like glaciers, natural resources that act as hydrological reserves and basin regulators, perhaps even more so than glaciers! The law specifically refers in Article 6, and in section (c) of the article, to the prohibition of mining in periglacial areas.

(unofficial translation)

Art. 6° – Prohibited Activities

All activities that could affect the natural condition or the functions listed in Article 1, that could imply their destruction or dislocation or interfere with their advance, are prohibited on glaciers, in particular the following:

- a) The release, dispersion or deposition of contaminating substances or elements, chemical products or residues of any nature or volume. Included in these restrictions are those that occur in the periglacial environment;
- b) The construction of works or infrastructure with the exception of those necessary for scientific research and to prevent risks;
- c) Mining and hydrocarbon exploration and exploitation. Included in this restriction are those that take place in the periglacial environment;
- d) The installation of industries or the building of works or industrial activity.

The *periglacial environment* is an area (or ground) that is frozen. It is a strip of land generally located between a glaciated area (where uncovered white glaciers are visible) and the forest line where vegetation grows. The periglacial environment includes various frozen elements (cryogenic elements). Amongst these, rock glaciers (active or inactive—which means with or without movement), creeping frozen soil (grounds that move), permafrost (permanently frozen grounds), etc. Rock glaciers are considered to be part of permafrost. This environment may have areas that are permanently frozen 100% of the time, and others which melt and freeze cyclically. These latter areas are evidently actively contributing to water basins.

Lama	Area del botadero	Posiblemente la mayoría del área es permafrost
	Area del rajo	Toda el área es permafrost
	Sitio de la planta	Solo pequeñas partes son permafrost
	Tailings Facility	No se espera permafrost a estas elevaciones
Pascua	Area de la Cuenca	Rio del Estrecho, 35.9 km²
	Area del rajo esperanza	Toda el área es permafrost
	Botadero Nevada	La mayoría del área es permafrost

We've already mentioned the studies by BGC and by glacier expert, Lydia Espizua.⁴⁹ Both publish detailed reports about periglacial environments at the Veladero and Pascua Lama projects. The studies do not however, publish absolute data on all of the areas encompassed and influenced by the project, but rather focus on the areas near the pit.

We see in BGC's summary of permafrost presence (table to the left) that the pit ("rajo") and the waste piles ("botaderos") at Pascua Lama are mostly or all permafrost. "*Todo es área es permafrost*" = "All of the area is permafrost". Or "*la mayoría del área es permafrost*" = "most of the area is permafrost".

Barrick's consultants, BGC, reveal that the pit and waste pile sites at Lama (the Argentine site of the project) is all or mostly permafrost. Source: BGC

In Argentina, this is illegal.

In Espizua's study area, the geologist estimates that periglacial environment (today protected by law) exists between 3,750 m and 5,300 m, on south facing mountain sides. Espizua finds frozen grounds, rock glaciers (both active and inactive), fossil glaciers, and other periglacial elements in the study area. (Espizua, 2006, p. 37) She also indicates that 300 hectares (740 acres) of permafrost (frozen grounds of the periglacial environment) would be impacted by the pit, waste piles, roads and conveyor belt, etc. (Espizua 2006, p.44) and 130 hectares (320 acres) by the Pascua Lama pit. This is illegal according to Argentina's National Glacier Protection Law.

How do we determine the presence of Periglacial Environment?

Until very recently, determining the presence of periglacial areas was a very complicated task, which could practically only be done by visiting the site and carrying out very detailed temperature and other studies, as was carried out by Espizua in 2006. It was a tedious task, complicated, and requiring much time and effort to determine where frozen grounds were located. In some cases, certain parts of periglacial environments could be identified with high resolution satellite imagery, by identifying rock glaciers. Espizua in fact, establishes the altitudinal limits of the periglacial environment by registering altitude at the lowest points of the rock glaciers present and the highest limits utilizing the lowest points of uncovered glaciers. (Espizua, 2006, pages 21 and 37).

This is possible because as a rule of thumb, the lower limits of the periglacial environment are indicated by the lowest limit of rock glaciers. For someone trying to determine the presence of

⁴⁹ The Espizua Report (in Spanish): <http://wp.cedha.net/wp-content/uploads/2011/11/Informe-Glaciares-Lama-Veladero-Espizua-2006.pdf>

frozen grounds without doing extensive studies, analyzing satellite images for the presence of active rock glaciers is one possible route which will give a good (although not complete) indication of where this area might be located. We should not think that rock glaciers are *one* of the elements found in periglacial environments, but they are not the only one!

However, one cannot map periglacial environments only by looking for rock glaciers, as it is possible to have periglacial environment *without any rock glaciers at all*. In this case where no rock glaciers are present, it was nearly impossible to identify periglacial environment utilizing satellite imagery alone. The only way was to visit the site and take careful long-term temperature measurements. We've heard technical experts that today must carry out periglacial environment mapping as mandated by the National Glacier Protection Law, say that they cannot do this work in the time allotted due to its complexity and to these technical difficulties.

Nonetheless, this great limitation has recently changed with the development of a completely automatic tool developed by permafrost experts at the University of Zurich. Scientists have developed an internet-based tool that can accurately map frozen grounds around the world. This tool is so new, that many geologists, geocryologists and other experts that work with permafrost areas, are still learning about the tool's existence and particularities.

The use of the tool is so simple that even a non-expert can use it. It takes seconds to download the tool to a home computer and then with a program like Google Earth, in seconds, any place visited on the planet is quickly analyzed for the presence of frozen grounds.

To download the files necessary, go to the following link:

http://www.geo.uzh.ch/microsite/cryodata/pf_global/GlobalPermafrostZonationIndexMap.kmz

The link will download a file to be opened in Google Earth.

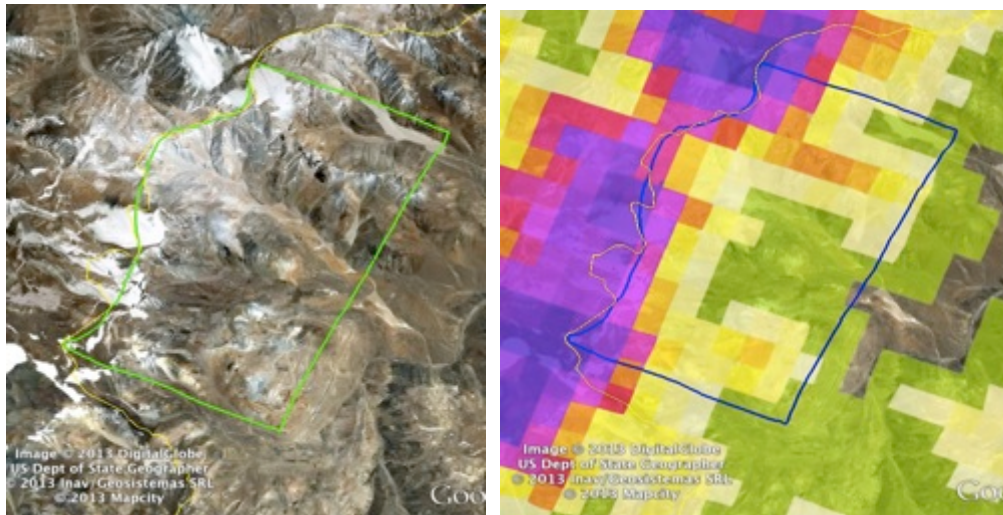
For more information about the tool go to:

http://www.geo.uzh.ch/microsite/cryodata/pf_global/

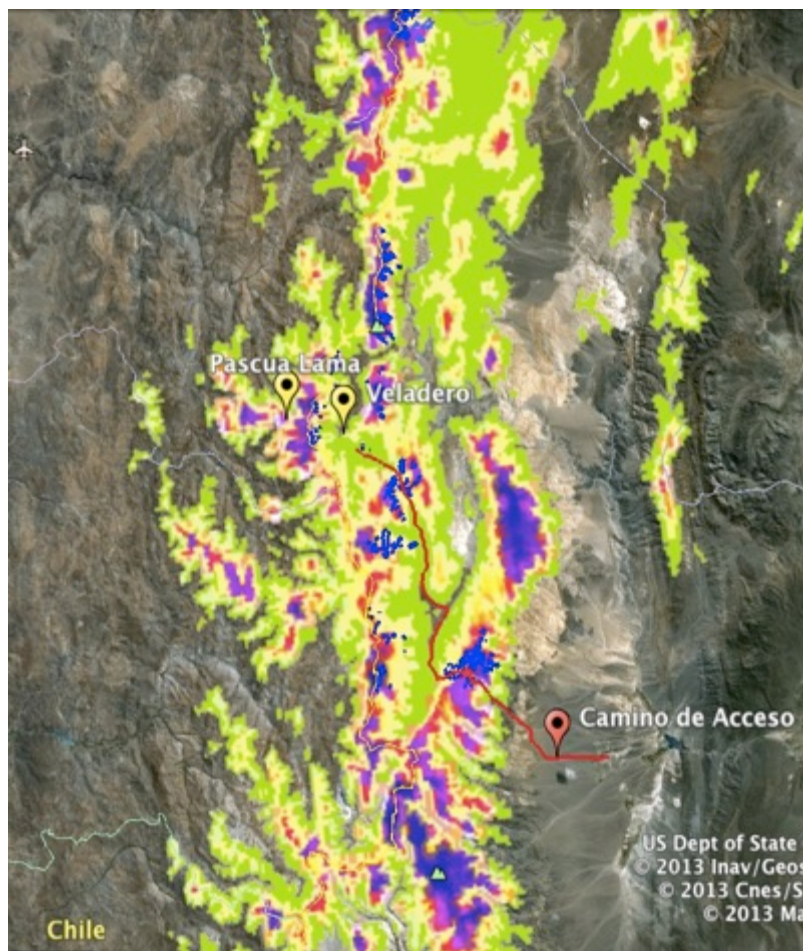
Let's see how we would use this tool to consider the information obtained from Espizua's study, considering she had to do many weeks of experiments and data gathering. We can then also consult several other areas at or near the Pascua Lama and Veladero projects to examine the terrain for the presence of legally protected frozen grounds.

What took Lydia Espizua days and weeks to do, with site visits and analyzing satellite imagery, to develop a sense and mapping of where the cold areas are in the Pascua Lama and Veladero project areas, we can do in mere seconds. While we cannot gather specific data, we can develop a very precise map of where the ground is very frozen, where it is probably frozen, and where it *might be* frozen. This is an enormous step in data gathering that allows for scientists to start with a basic map in hand, and with a high degree of certainty about where they will find frozen terrain. In terms of setting out targets for protective measures in a project's impact areas, the tool is priceless.

After we've downloaded the permafrost tool, and visited the Veladero/Pascua Lama site on Google Earth, we see the following picture (right). The purple and red areas are the coldest regions. The yellow zones are where there would be periglacial environment under favorable conditions (for example on mountainsides facing south) and the green areas, are areas of uncertainty where more studies such as the ones Espizua carried out would be needed.



The green polygon is Espizua's study area (left). To the right is the permafrost mapping tool result of the area. Red and purple zones are very cold, yellow zones may have frozen grounds, green is uncertain.



The Zürich University permafrost mapping tool helps us identify frozen grounds near Pascua Lama and Veladero

If we extend the map to a greater area around the mining projects, we see appear several zones where we are likely to find periglacial areas near Pascua Lama and Veladero. We've placed markers where the central areas of both projects are located and left the access road marked in red.

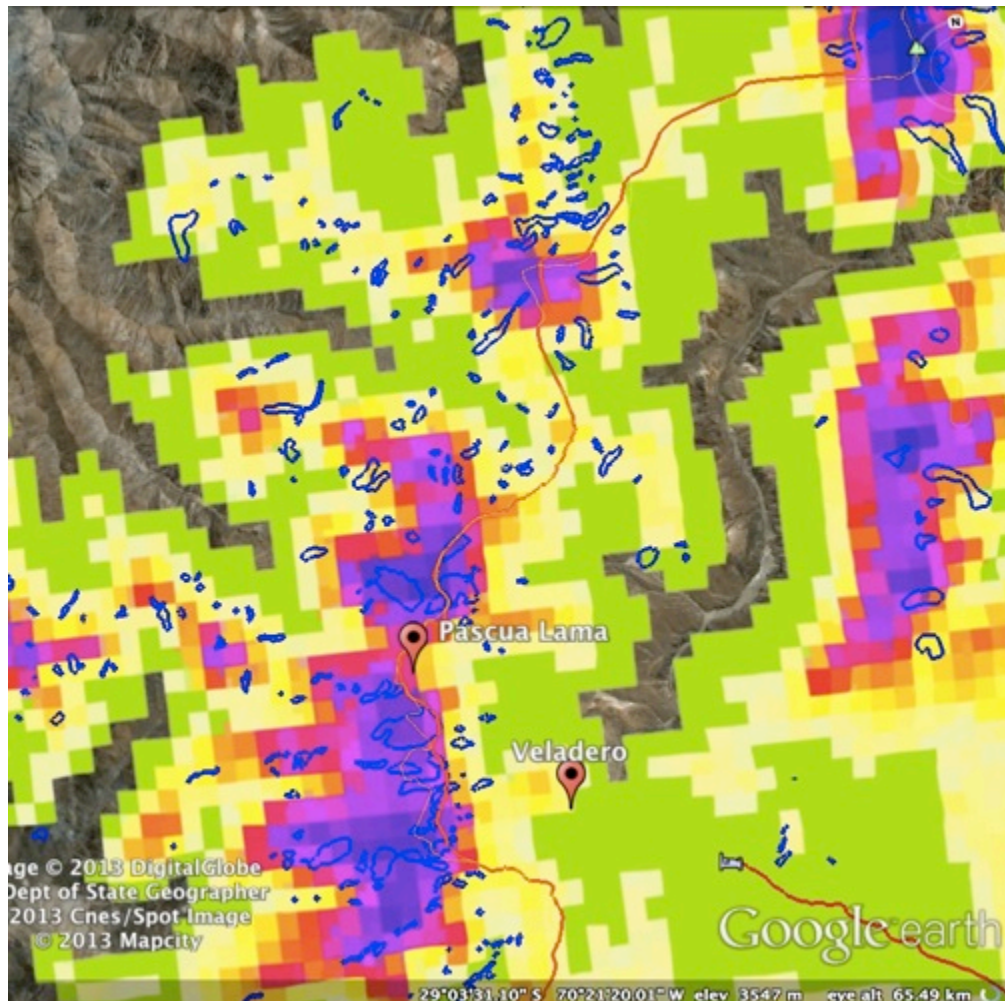
This tool allows us to quickly identify the areas where the company and public officials should be carrying out surveys and detailed studies.

Presently, the company has not studied most of these areas for potential impacts to periglacial environments.

Once we see this map, we understand why Barrick Gold is very concerned with the Argentine National Glacier Protection Law. Most of the project influence areas are in periglacial areas, including around the pits and along the access roads.

The purple and red zones are the coldest areas. There, periglacial environments are nearly certain. Yellow zones will be frozen if they meet basic criteria, like facing south, or being in the shade. Green zones are uncertain and need more study.

If we get closer to this image, and consider the glacier mapping exercise we've carried out we can compare how our inventory looks in comparison to the permafrost map. If the two are accurate, most of our glaciers should be in colder regions, with rock glaciers mostly in the yellow/green areas. The comparison is right on. The glaciers we've mapped all fall within the expected ranges. We can also guess from the mapping that the glaciers nearer to the green and yellow fringes are likely to be the ones providing more water to the environment, since they are in warmer areas.



There is correlation between the permafrost map results for Pascua Lama and Veladero areas, and CEDHA's glacier mapping inventory.

The positive correlation between our inventory and the permafrost map is revealing. Firstly, it reinforces the validity of our work. Our glaciers have all been correctly identified in the colder areas. We don't have glaciers in areas where they are unlikely to be which means we are not mistaking fossil rock glaciers (with no ice content) for active or inactive rock glaciers which both have ice cores. Conversely, it proves the usefulness of the permafrost mapping exercise. The automated system of mapping cold areas has produced a result that coincides with the area's coldest features as have been already identified using satellite imagery. While the permafrost map cannot be taken as a definitive study or conclusion on the presence of frozen grounds, it does offer an extremely useful preliminary mapping exercise, with which further studies can be programmed and carried out.

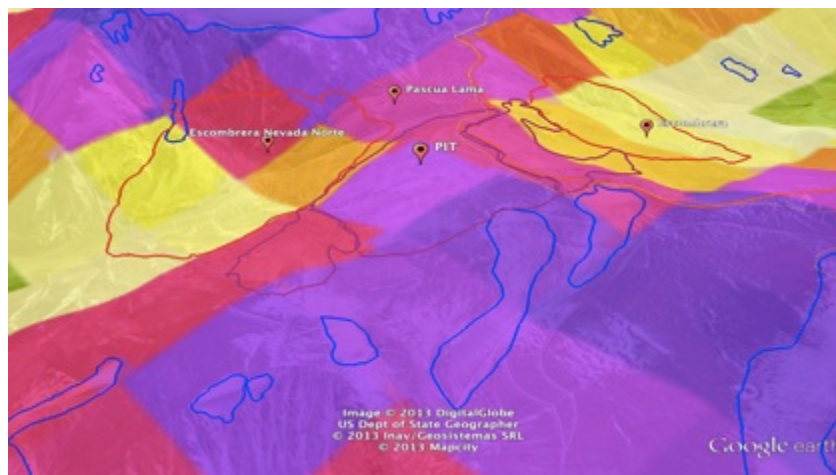
But more importantly, the permafrost map has enormous policy value for numerous actors. For public officials working to control mining operations, it can help determine where to call for detailed periglacial mapping and impact studies. It can help the IANIGLA create a national preliminary periglacial map, based on which it can produce an official periglacial map for the entire country. It can help identify where mining projects may be operating in periglacial environments. For mining companies or other companies wishing to operate in cold areas, they can produce a quick map of where they are likely to encounter frozen grounds.

The IANIGLA, the Environment Secretariat, the Justice System, now all have readily available preliminary information upon which to make policy and legal decisions about potential impacts to periglacial areas.

With this information in hand, “precautionary” actions can be taken to call for studies, to limit activity, or to suspend activity if needed, until it can be properly determined that the activity does not violate the National Glacier Protection Law. By comparing this data to a mapping of mining projects in the region, the agencies working on the implementation of the Glacier Protection Law can determine where priority glacier inventories must be made.

We recommend the immediate suspension of all mining and other industrial activity taking place in areas mapped by the permafrost tool to be frozen areas until the proper studies can be carried out to confirm that the activity is not harming periglacial environments.

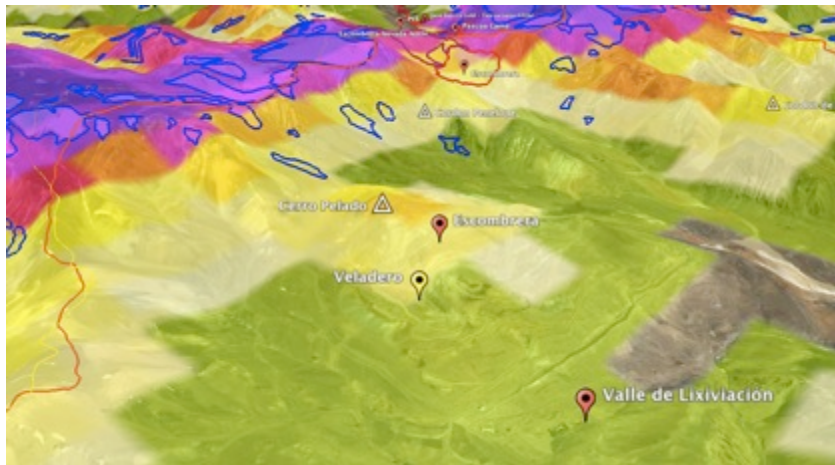
The area around Pascua Lama’s pit.



The pit area at Pascua Lama is one of the coldest areas in the region, shown in purple.

We see in Pascua Lama’s pit area that we are completely within periglacial environment. The tool shows us that this area is the coldest (the color is purple to red). The actual pit site is completely within the coldest region—while outlying areas are still either red or yellow. This confirms the results from BGC’s study, which after extensive measurements concluded in the same way. It would have been extremely useful for public officials to have this information prior to defining the studies Barrick Gold should produce. There are several glaciers (blue polygons) visible in the image. We can also see the rock glacier in the Nevada Norte waste pile site, which is red and yellow according to the permafrost map.

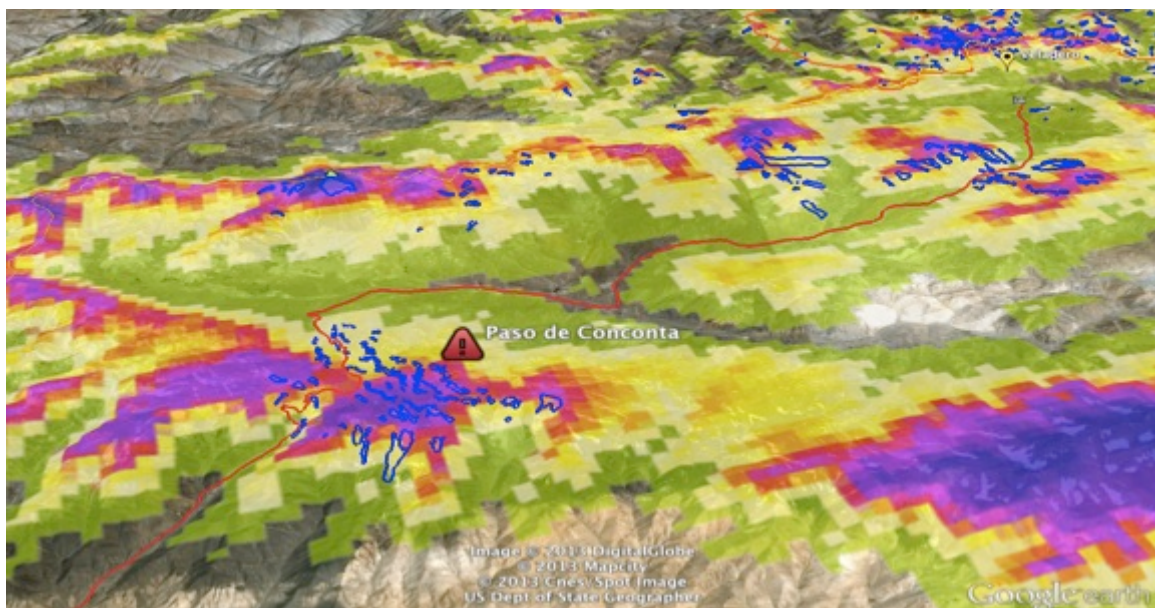
Permafrost in Veladero's Activity Zone:



The area of operations at Veladero is in the fringes of the Periglacial Environment

With the permafrost mapping tool activated at the Veladero site, we see quickly that Veladero is situated in the fringes of the periglacial environment, where the potential water value and contribution is high. We can see the Pascua Lama project marked in the background of the image. The fact that the project is largely in the green areas, which according to the map would be areas of uncertainty, does not imply that risks are less. In fact, quite the opposite is true. The uncertainty zones could be areas of cyclical freezing and unfreezing, which if saturated with ice, could be very significant and active water contributors to the lower basins. We know that Barrick Gold chose to place their waste pile on frozen grounds in this area, which according to geologist Pablo Milana resulted in the massive collapse of the waste pile sometime between 2007 and 2008.

The Veladero Access Road and the Periglacial Environment



The Veladero access road is practically all or very near Periglacial Environment.

In the above image we see the Veladero/Pascua Lama access road. We see Veladero in the far upper right corner. The red line leading up to Veladero crossing diagonally across the image is the access road from Tudcum going through the Conconta Pass. We do not know if

Barrick Gold has carried out a periglacial environment study for the access road, but it is clear that the road is practically all in or very near frozen grounds.

What is the impact of Barrick's mining activity to Periglacial Environments?

Just as mining operations can impact glaciers, so can they impact the periglacial environment. In the case of Veladero and Pascua Lama, there is evidence that Barrick Gold has already had impacts to the periglacial environment.

These are some of the ways Barrick's activities could be affecting the periglacial environment:

- Impacts due to the introduction of exploratory roads or roads for project related vehicular transit;
- Impacts due to the removal of frozen grounds along the access road;
- Impacts due to the removal of frozen grounds in the extractive process;
- Impacts due to micro-climate impacts producing temperature changes in micro regions;
- Impacts due to the deposit of waste on frozen grounds.

X. Barrick Gold and the Chilean Authorities

"Mining projects can only move forward if they comply with and strictly respect environmental resolutions, qualifications and institutions, as government we cannot accept projects that do not comply with that which was authorized, and as such, if this is the situation, so be it."

María Ignacia Benítez
Chile's Minister of Environment
(reacting to Barrick's Pascua Lama closure by the justice system)
Source: <http://www.youtube.com/watch?v=zxagEg1ultw>

At the time of this report, Barrick Gold had suffered (a few weeks earlier) the total closure of its Pascua Lama project, due to environmental impacts registered by State agencies and companies hired to monitor environmental impacts at the mining project, including impacts to glaciers, waterways, vegas systems, etc.⁵⁰ Barrick Gold appealed this decision to the courts, but the legal action was rejected and the closure stood. A few weeks later, the SMA, Chile's new environmental authority, finished its environmental audit and found 24 serious violations of code, 23 of which Barrick Gold accepted. Soon afterward, the SMA announced that the closure stood and that it would fine Barrick Gold its highest environmental fine ever, US\$16.4 million. In its verdict, the SMA accused Barrick of misrepresenting information (lying) about impacts.⁵¹

The official website of the Chilean authority (<http://www.sea.gob.cl>) offers the administrative communications between the company and the government. On this site one can consult the original environmental impact studies dating back to 2000. We note the early concern of the Chilean authorities due to impacts registered on ice resources by Pascua Lama's activities, as well as a steady escalation of the tone of the statements by the authorities, which culminated in the total closure of April of 2013.

Below we reproduce some sections of the diverse resolutions sanctioned against Barrick Gold for environmental violations at Pascua Lama. We notice in several of these, the knowledge by both company and State authorities of the dust and debris contamination on glaciers.

⁵⁰ see: <http://wp.cedha.net/?p=12568>

⁵¹ see: <http://www.latercera.com/noticia/negocios/2013/05/655-524913-9-superintendencia-de-medio-ambiente-paraliza-pascua-lama-y-aplica-historica-multa.shtml>

The total closure was based on a complaint presented by indigenous communities leaders⁵², and was grounded on:

- The lack of compliance by the company of due diligence obligations on the construction and authorization of safety works to avoid environmental contamination;
- Evidence that shows the contamination with heavy metals of waterways (particularly in the Estrecho River, which is born from the Estrecho Glacier);
- Contamination of Vegas (highland wetlands);
- Contamination of glaciers with dust and debris;

Several agencies participated in the monitoring and control of Barrick Gold's activities at Pascua Lama, amongst these, the *Dirección General de Aguas (DGA)*, the *SERNAGEOMIN* (mining control agency), and Chile's environmental authority, the *Superintendencia de Medio Ambiente (SMA)*. Additionally, other civil society/independent agencies such as the *Centro de Estudios Científicos (CECs)* have been hired to monitor glacier impacts at Pascua Lama.



Barrick's Bulldozers destroy vegas to construct lixiviation valley at Veladero. The yellow oval shows the presence of vegas systems (wetlands) which would be destroyed by the lixiviation valley. Source: Zlato

Below are some excerpts from some of the numerous documents produced by the control agencies of the Chilean government. We see several instances where Barrick has violated the law and where the State shows serious concern over glaciers in the project vicinity. This led to a fine levied on Barrick Gold in 2011 due to glacier impacts and because the company did not comply with the measures it should have installed to avoid impact. Another statement in August of 2012 shows again how Barrick Gold fails to comply with measures to protect glaciers. This would subsequently lead to the full project closure in April of 2013.

What is truly surprising in this sequence of communications and resolutions/sanctions, etc. is the systematic failure of the company to address the impacts on glaciers. The Chilean authorities made numerous attempts to bring the issues to the company to get Barrick Gold to

⁵² see: <http://wp.cedha.net/wp-content/uploads/2013/04/solicitud-de-no-innovar-5-abril-2013.pdf>

take measures for the benefit of the glaciers in the project area. Barrick chose to ignore these sanctions and recommendations.

From Resolution 22 (January 26, 2010)

"The SEREMI for Public Health for the Atacama Region ... requests to initiate a sanction process indicating that it reveals non-compliance of the Resolution b) increase in emissions of particulate matter ... and as a consequence of the operations of the company's activities, the following was verified:

... b) suspended particulate matter is observed, product of the failure to humidify and stabilize roads inside the mine area. Also observed is the emissions of particulate matter product of movement of soil at the site of the maintenance workshop ... the said fault implies non-compliance of a previously agreed measure by the company."

6.2 Non-compliance to 4.4:3. Increase in emissions of particulate matter, due to not implementing measures designed to diminish and/or eliminate emissions of particulate matter generated by activities mentioned, including:

- confinement of truck unloading generated by activities before mentioned, operating inside the mine;
- Covering of the surface of roads with material to avoid abundance of fine matter and using of appropriate additives to maintain efficiency in the control of suspended dust;
- Humidification of roads inside the mine site;
- Maintaining humidity on dry days;
- Frequent watering of roads, addition of salts and other treatment in all impact sectors of the project;

From Resolution 22: (February 1, 2011)

"That the company at the time of the audit had not complied with the obligations established in 3.30, in reference to considerations of community observations relative to, Points of Water Capture; Increase in Emissions of Particulate Matter; Analysis of Glaciers, Monitoring Noise ...

... an increase in the rate of emissions of particulate matter. The principle source of emissions are: blasts, loading of trucks, transport of material on inside roads, unloading of material in processing area and waste dumps ...

Due to particulate matter, the company mentions that the accumulation of dust on a glacier can reduce albedo, translating into an increase in the melting rate. 1mm of dust can increase the melt rate by 15% ... and a cover of 10mm can increase it to twice the melt rate ... the competent authority requested a study on this issue.

Considering 6.2: Analysis: Glaciers:

Regarding the emission of particulate matter, ... glaciers will suffer and increase in the accumulation of dust on their surface, which will translate to an increase in the melt rate of the ice.

The company points out that the project has not confined trucks and argues that the RCA does not mandate covering trucks. ...

The sanction to the company with fine is the equivalent of 300 UTM

From Resolution 186: (August 20, 2012)

"Due to the increase in melt rate of ice due to the increase in the accumulation of dust on the surface of the ice, the company had agreed to implement, among other things, to the use of confined trucks. This measure is not being complied with according to that observed on site. The trucks in the mine have no type of cover whatsoever."

One question we can ask ourselves is *why is Barrick Gold ignoring the observations and the demands of the State authorities to take measures to protect glaciers and avoid impacts?*

One possible answer is that the fines Barrick Gold expects to have to pay are simply too low to make compliance worth while, as compared to the value of the gold that the company expects to extract from the mine. In this hypothesis and calculation, Barrick Gold surely could not have imagined that they would face a full project closure.

Another explanation would be that it is simply impossible for Barrick Gold not to impact glaciers from their activity at Pascua Lama. Mining blasts send lots of dust and debris into the air. This is largely unavoidable and with the high winds in the area, it may be that Barrick simply cannot avoid causing irreversible harm to glaciers. Barrick's CEO Peter Munk has said as much in public statements he has made complaining about environmental limitations placed on mining projects.

We believe that this second option is quite viable, since there is no magical solution to the dust generated from mining blasts. This would effectively make mining in this area incompatible with ensuring a sustainable and healthy environment.

XI. Barrick Gold and the Argentine Mining Authorities (and the control of the mining sector)

The recent sanction and total closure of Pascua Lama in Chile for reiterative infractions and non-compliance by Barrick Gold of numerous regulations and obligations to avoid environmental damage, and the simultaneous reaffirmation of Argentine authorities that there is no impact by Barrick's activities, only shows how little control there is of mining operations in Argentina.

Mining companies in Argentina have access to, and the direct and active support of, the highest public authorities. This is not the case for representatives of communities affected by the sector that have wanted to voice their concerns on numerous occasions only to find closed doors and aggressive police forces willing to let dogs loose on peaceful protesters. Stakeholder communities face systematic denial of information and very limited or no access to spaces for participation on issues related to the industry.



Provincial and national authorities with the President of Barrick Gold, Peter Munk in Canada, at the moment they devised their collective strategy to counter the National Glacier Protection Law.

From left to right, Jorge Mayoral (Secretary of Mining), Amado Boudou (Vice President of Argentina), Juan Manuel Urtubey (Governor of Salta Province), Beder Herrera (Governor of La Rioja Province), Peter Munk (President of Barrick Gold), Cristina Fernández de Kirchner (President of Argentina), Walter Barrionuevo (Governor of Jujuy Province), José Luis Gioja (Governor of San Juan Province).

In provinces such as La Rioja or more generally, in North West Argentina (the NOA region), the need to find development formulas and strategies to lift communities out of poverty and promote more effective development models, combined with the recent discovery of important mineral reserves, has generated a strong investment trend in mining over the last several decades. In the 1990s, the Executive responded to this opportunity by introducing new public policy and spurring on legislative reform to favor mining investments.

Unfortunately, this process has not been accompanied by the necessary political support for the social and environmental control and safeguards needed for the sector.

There are no effective guarantees provided by public agencies to ensure that the mining sector is minimizing its impact. The official position, both at the national and provincial levels is that mining is harmless and that it produces no impacts to natural resources, and as regards this report, to glaciers, and periglacial environments.

The case of Pascua Lama is a useful example to illustrate the inequities of the current situation on each side of the border, as it involves a single project, the same operator and the same activity. The only real difference is the seriousness and effectiveness of the public officials in the mining sector in each country, and the inequitable levels of transparency and public participation on each side of the border.

Pascua Lama was closed in Chile due to solid proof of contamination to vegas systems, to waterways, and to glaciers, while in Argentina, the official position is that the project complies with all regulations and laws. The provincial authority in San Juan has published numerous statements and reports indicating that Pascua Lama is environmentally sound and that it complies with the environmental code, and specifically that it does not impact glaciers or periglacial environment areas.

In Chile, Pascua Lama and the El Morro project, face serious problems with public participation issues for affected communities. There is an ample space for participation and fairly extensive transparency throughout the administrative process, with most official documentation about the project available online. Media is quite open to debating the issues from both sides. In Argentina the situation is quite different. Local media is mostly closed to critique, particularly in San Juan, where the provincial government has complete control over editorial content. The *Diario de Cuyo*, for example, the most important daily in San Juan, has very openly told us they will not publish anything that criticizes the mining sector.

Reflections on the Mining Debate in Argentina

The mining sector in Argentina is dominated by two radically opposed positions. *Yes to mining* and *no to mining*. There are few intermediate points of reference.

While it is not our intention to use this report to take a position on this debate, what we can say is that the official position on mining which suggests that mining does not contaminate, is simply and objectively false. It's impossible to remove minerals from the ground without significant contamination to the natural environment. All mining projects, be they open pit or underground mining operations, contaminate. *This is an inescapable reality. It is an undeniable fact.*

All of the following are common characteristics of mining operations:

- To mine you have to move earth, crush rock, and destroy the natural environment. This will cause acid drainage when water flows over the exposed minerals and rock;
- The waste from mining operations either due to the chemicals used, or to the natural acid drainage that occurs from exposing rock, is toxic, and inevitably ends up in some artificial hole made to contain this residue, or seeps into waterways;
- These pockets of contamination persist for hundreds and thousands of years and represent enormous risks to the environment and to people, particularly if any of the

- content slips into non-contaminated areas, which ultimately, is likely. They will challenge future generations to ensure that they do not contaminate other areas;
- The long term nature of this mining contamination implies that the public sector will sooner or later have to assume the burden of protecting the public good, as the companies that created the risk will at some future time cease to exist and will not be around to assume responsibility;
 - Dust and debris from mining operations deriving from blasts, as well as heavy vehicular transit contaminates air, soil and water affecting human health and the natural environment;
 - The large movement of industry at mining operations cause micro-climate changes to the local environment;
 - Large industrial activity creates noise, heavy traffic, and other impacts that affect the natural state of the environment, causing an overall character change to the local environment, affecting flora, fauna and human life;
 - Intense personnel activity in a given area creates local contamination (waste, sewage, etc.);

Mining, by nature, is a contaminating process, and this is impossible to avoid. No matter how responsible, no matter how compliant with the law. Mining contaminates. There is no such thing as a mining operation that does not contaminate. In fact, mining is one of the most contaminating and most destructive industries on the planet. Anyone who says that mining does not contaminate is not telling the truth, and we need to begin any debate about mining from this starting point. There is no mining without contamination.

These very strong statements in no way imply that we are proposing a world without mining. We could not produce or communicate this report without the benefits of mining, nor would we have the many benefits of modern life has to offer without mining. All societies must establish their priorities, their values, and rules for cohabitation. They must set their objectives in terms of expectations for quality of life and development. And as long as these objectives and values are respectful of established laws, and ensure the full realization of human rights, collective and individual, and as long as our decisions and value systems exist in a realistic and sustainable framework, the choice to mine or not to mine, will always be a sovereign choice of the people and their governors. Both decisions (*to mine, or not*) are viable and perfectly rational options.

The laws, regulations, good practices etc. that have been established for the mining sector exist precisely because we need to delimit the tolerance levels that we want to set for the impacts caused by mining. In those societies where mining is permitted, laws, regulations and different codes (including volunteer codes) establish the thresholds of the sector, limiting contamination to those levels which society has decided it is willing to tolerate to obtain the benefits that mining offer us (tax income, jobs, mineral security, industrial inputs, development, etc.). A mining company that complies with the law still contaminates. We must understand this very basic reality. We cannot say that because a mining company complies with the law that it is not contaminating. If it complies with the law, then it is contaminating within the threshold that society has allowed the company to contaminate.

A society may legitimately decide to tolerate mining for the benefits it offers, but it may also decide that it does not want to sacrifice the environment for the benefits offered by mining. A society may choose to ban a certain type of mining, such as open pit mining, or large-scale mining, or mining conducted with cyanide. It may ban mining of radioactive minerals, or allow indigenous communities the discretion of whether it allows mining in its territory. Or a society may decide to exclude mining from certain protected areas, such as a UNESCO biosphere reserve, or where there are wetland vegas systems. Or, a society may decide, as it has in Argentina, that mining will be prohibited where there are sensitive glacier and periglacial systems. These are all valid and sovereign decisions that societies must make when faced with the option of exploiting mineral wealth. This is not about being pro-mining or anti-mining, but rather it is a debate about models of development that we wish to adopt as a society, in search of equity, sustainable development and the full realization of human rights.

In this regard, environmental authorities play an important role in ensuring the fundamental limits that we have established for our industries, and mining is a critical industry. The State, through its three powers (but largely through the Executive Branch) is entrusted with ensuring that our industries work to our benefit, and that above all, the public good, and public health (including environmental health) are protected. The State is entrusted with the due diligence responsibility of ensuring that mining companies are complying with the law. The State must monitor and address the issues that may arise that place the public good in peril. In terms of mining, the State must address impacts, force companies to lower and if possible, eliminate risk, and it is the State that must periodically review operations and carry out due diligence to ensure social and environmental health and safety.

Characteristics of the Mining Sector and its Relationship to Society in Argentina

In an ideal world, environmental authorities (the environmental institutions such as the Environmental Secretariats and Ministries) would have as much, or more, relative political power, authority, capacity, personnel and budget to carry out controls and ensure due diligence and regulatory compliance of mining operations, as the relative political power of mining authorities (the mining Secretariats and Ministries). Unfortunately, this is not the case in Argentina, neither at the provincial or federal level.

Mining Ministers or Secretaries, particularly at the provincial level, have infinitely more political power than their environmental counterparts, and this conditions the capacity, and political will power of environmental authorities to carry out their work in an independent and effective manner.

In San Juan, for example, the creation of a “Secretariat of Mining Administration and Control” (the mining police), independent of the Provincial Environmental Secretariat, and directly underneath and dependent of the Mining Ministry (the agency of the State that promotes mining), transferred the environmental due diligence and regulatory control of mining to the agency that most wants the sector’s expansion.⁵³ This is a formula for failure and inefficiency, and does not promote equitable and sustainable development. In cases where severe environmental issues may be at stake (such as the compliance of the National Glacier Protection Law or in the protection of a UNESCO Biosphere Reserve such as San Guillermo), or in the protection of delicate vegas systems, the state cannot guarantee fair and independent review of very sensitive environmental compliance issues.

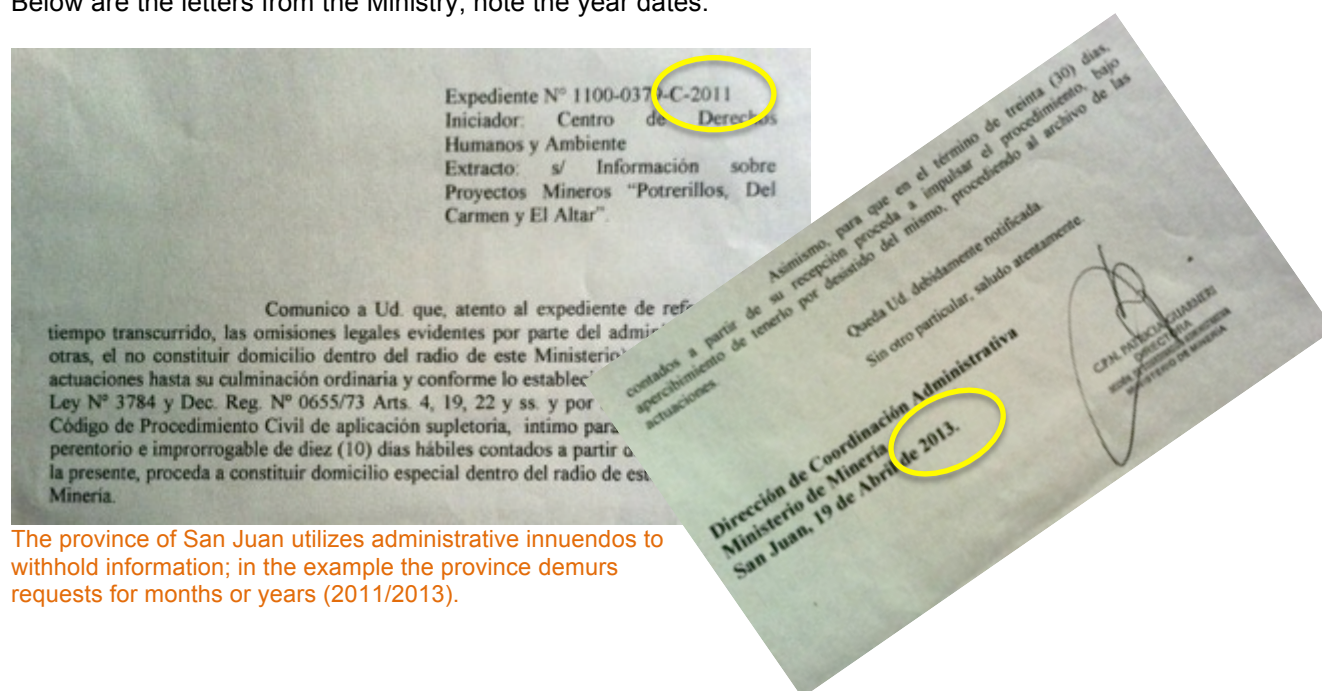
Unfortunately, in Argentina, in most provinces, environmental authorities have little real power, they generally have very low budgets, and reduced capacity and effectiveness to carry out industrial controls, and even less so *vis à vis* the mining sector. This is in contrast to mining sectors, which are generally well staffed, have high budgets, high prestige and relative political strength.

This inequity of conditions between the environmental public good and the industrial/commercial/mining sector, is further aggravated by the great imbalances of public administration where there is little or no transparency, and where information access is scarce or non-existent, and where in most cases, public participation is very limited or also, non-existent. Mining projects are generally approved without real public consultation or access to information. In many cases, such as in La Rioja, for example, there isn’t even a publicly available list of the mining projects currently underway in the province. In La Rioja, no environmental impact statements are made public. In San Juan, only a handful of impact statements are placed on the Ministry’s website. The La Rioja’s Mining Ministry doesn’t even have a website. And despite public statements by the provincial governor of San Juan, suggesting the province provides information to interested stakeholders, in practice this is not the case.

⁵³ for the province’s organogram see: http://dgrhyo.sanjuan.gov.ar/images/docs/organigrama_gobierno.pdf

One example of this situation which exemplifies the barriers and administrative hurdles existing to obtain information from the Ministry of Mining in San Juan, so that stakeholder are not able to obtain information, follows: Our organization, CEDHA, requested information in 2011 about several mining projects under exploration in glaciers areas. After several months we received a response indicating that the province did not know what projects we were inquiring about. We learned through an informal telephone conversation with one of the staff of the ministry, that in fact they knew very well which projects we were inquiring about, but since they registered those projects with slightly different names (for example, El Altar, vs. Altar), they could not and would not respond. We later received a notification, in May of 2013, from the Mining Ministry, notifying us that if we did not constitute residency in San Juan within 10 days, they would presume our request for information was abandoned. We received the letter several days after the deadline had expired!

Below are the letters from the Ministry, note the year dates.



The province of San Juan utilizes administrative innuendos to withhold information; in the example the province demurs requests for months or years (2011/2013).

In Argentina, mining operations, decisions, projects, etc. are cast upon the public in a *de facto* manner. Projects are already designed, planned, and underway when communities find out about them, with little or no real or effective participation in the lead up, or in the strategic decisions that take place along the way that give rise to those projects in the first place. Stakeholder concerns are not taken seriously nor are they addressed by the authorities or by the companies. This failure of engagement, this alienation of society and of legitimate stakeholders is increasingly causing social tension and is leading to strong resistance from communities against mining projects, particularly in provinces such as La Rioja, Catamarca, and Córdoba. A few days before the publication of this report, yet another violent unprovoked confrontation occurred at Famatina, La Rioja, by government police attacking non-violent protestors who oppose a mining project in the Famatina area.

If there were more information, and if it were accessible, if there really were consultative processes which gave communities the opportunity to engage and address their real concerns, if communities were allowed to participate in strategic decision-making and land use decisions, if there were transparent systems of access to information, if the management of mining were trustworthy, and if communities were able to gain access to project administration, *there would surely be a better and more constructive atmosphere to address the issues that mining brings up for all societies, and there would likely be much less violence in the sector. Surely strategies could develop in harmony with public opinion and consensus building could occur in the sector. There would surely be areas in our society where mining could be promoted in more equitable and socially acceptable ways, and there would also be areas where very legitimately mining would not be permitted.*

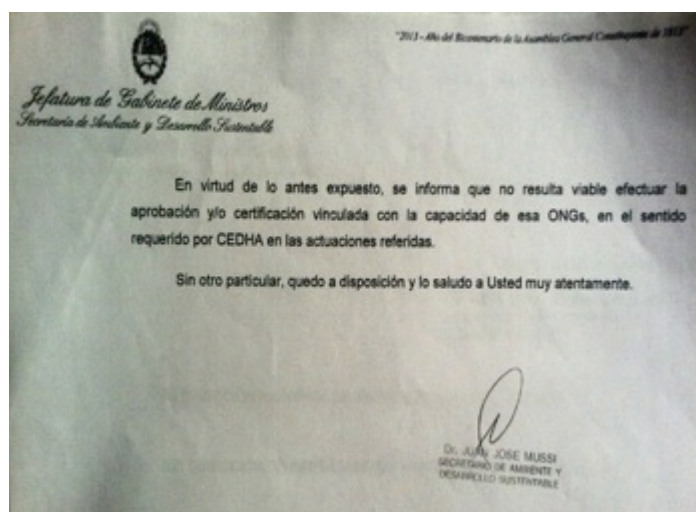
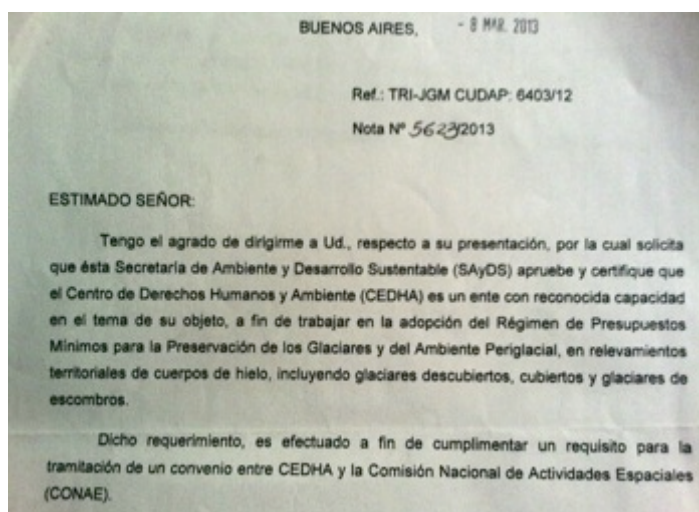
But this unfortunately is not how things get done. Information is not made available to the public. Information requests are ignored for months or even years. If legal action is not taken against public officials who receive these requests, they generally go unanswered. The only relationship that exists between the mining administration at the official level (national and provincial) and concerned stakeholders, is one of administrative barriers that work to delay, complicate, and deny information. Community concerns are largely ignored and mining occurs today, largely divorced from social processes and evolution.

In the absence of real and effective state controls over mining operations, there is a great necessity on the part of society to engage in the control of the sector, and this befalls on civil society actors dedicated to this task. Our organization is an example. Faced with the fact that the state agencies tasked with carrying out priority glacier inventories were not doing so, we've started carrying out these inventories. With partial information, sometimes with outdated information (since the state agencies such as the National Environmental Secretariat denies us the ability to obtain satellite images from the State's spatial agency, the CONAE), we set out to produce these inventories ourselves, and have to end up accusing the State of failing or ignoring its due diligence responsibility.

In the past, civil society organization could obtain these images from the CONAE. We met with CONAE authorities, and were very well received. They were ready to give us images, but had to first establish an institutional agreement. At that time we started publishing our reports about mining activity in glacier areas. The administrative request for the images began to delay. Eventually, after many months of waiting for this approval we were told that a new regulation was in place and that we would have to ask permission to sign the agreement to the National Environment Secretariat (the SAYDS). Several more months passed before we got a response from the SAYDS, indicating that they had refused our request.

Below is the letter we received from the Environment Secretary, Mr. Mussi, rejecting our request suggesting that they refused our request because we were not on an NGO registry of the SAYDS and that since the IANIGLA (Argentina's glacier institute) was already carrying out the glacier inventory it was not necessary that they approve the agreement with the CONAE so that we could carry out these inventories.

This manipulation of public power is an abuse of public authority, intended to delay, impede, and deny public participation in a legitimate action of public interest, related in this case to the mining sector development model. It seems absurd that a non-profit environmental Argentine organization has to request satellite images of Argentine territory to a foreign foundation, because the state agency that should provide this information as a public service, is politically manipulated by the state authority that doesn't want civil society to know where mining operations coincide with glaciers.



Letter from Argentina's Environment Secretary to CEDHA denying CEDHA access to satellite imagery.

This is not the most effective way to work towards accountability in the mining sector or to convince society that mining is a sustainable proposition for development. The current situation, as we are seeing over and over again, is generating much skepticism amongst the general public. The reiterative denial of information and the publication of false and deceiving information by the public authority generates anger, frustration, and distrust of the public authority and also of the private sector.

The official response to public skepticism and criticism is to systematically deny all social concerns, and refuse to address the concerns in any significant manner. The highest public officials (governor and other authorities) accuse “environmental organizations” of being the cause of troubles for companies like Barrick Gold, as is the environmental due diligence violations found reiteratively by the Chilean government did not exist. Environmental groups are seen as a destructive force for the sector that is against provincial progress and development. These positions further entrench differences, making any rational solution highly unlikely.

The recent report by the Secretary of Hydrology, Mr. Millon (ex-Barrick Gold consultant), which gives Pascua Lama a clean bill of health on glacier impacts, with a very light review, of poor professional caliber, and the reiterative public appearances and statements by the new Director of the Glacier Inventory, Mr. Silvio Peralta which say absurdly and inexplicably that there are no glaciers where there are mining operations, only discredits the public administration a mining sector, that has already been high devalued in the recent past.

How did mining authorities in Argentina react to the Chilean closure of Pascua Lama Due to Environmental Violations?

The recent example in Chile of the closure of Pascua Lama grounded on Barrick’s systematic violations of the environmental code, in contrast to the Argentine example, offers an excellent point of comparison.

In Chile, the administrative procedure that led to the Pascua Lama closure was the result of a series of actions carried out by numerous agencies and actors, including the *Dirección General de Agua* (DGA), the *Superintendencia de Medio Ambiente* (SMA), the *SERNAGEOMIN* (the mining authority), and the Justice System of Copiapó. All of these acted in independent manner, by providing information, carrying out due diligence and collaborating in a collective control of the mining operation. While this collective control resulted in a large blow to the mining sector, today, the company is cleaning up its act, investing in repairs and in the necessary works to protect the environment, as should occur in all cases. This is what we should expect from the public sector.

In Argentina, however, the same project, the same company, the same activity, and the very same circumstances, are innocuous to the environment, according to the public agencies involved in monitoring Barrick Gold’s compliance. The environmental authorities ignore the situation. The only agencies which have come out with statements, are the mining secretariats (both national and provincial) to say that everything with the Argentine portion of the project is going as planned, and that the company complies with all environmental codes.

We should recall that the Chilean closure was not an abrupt and sudden act. It was the consequence of a series of administrative actions taken by the State to address a long review of Barrick’s operations, over several years, which were generating concerns over environmental risks and impacts that were seen in reiterative inspections during the 2010-2013 period.

While the Chilean mining and environmental authorities were coming down on Barrick Gold for not complying with laws and regulations, and for impacting glacier and water resources, in Argentina, quite a different situation and position from the public sector were evolving. In 2008, the National Congress unanimously voted a National Glacier Protection Law. A few

days later, the National President vetoed the law, claiming that provinces saw glacier protection as a hindrance to economic development. As a result the Environment Secretary, Romina Picolotti, resigned. She was replaced with a former lawyer representing contaminating industries. Barrick Gold, in cahoots with the provincial government filed a lawsuit against the Glacier Protection Law. The justice system resolved an injunction suit to rule the law suspended in favor of Barrick, in a record 48 hours.

The IANIGLA (the National Glacier Institute), which should have carried out priority glacier inventories along with the CONICET, within 180 days from the entry of the glacier law into force, has demurred 1,000 days and still *not a single priority inventory has been completed*. San Juan province does not help the process along, and instead publishes its own deficient inventory of glaciers, where it actually doesn't show the public a single glacier of the more than 6,000 glaciers it has supposedly inventoried; their location is a mystery, but the Glacier Inventory Director claims reiteratively that there are no glaciers where there is mining. A civil society organization published a report showing heavy metal presence in waterways downstream from activity areas at Pascua Lama and Veladero, not unlike what the Chilean authorities are revealing. The province and the company have retorted that the report has data of dubious origin (ironically, *almost comically*, the data is Barrick's own data!). The province created a commission to review glacier impacts of mining operations and as a first report it publishes a clean bill of health for Barrick's Pascua Lama project. Curiously, the director of the report is a former Barrick Gold consultant; today he reviews Barrick's hydrology impacts. A few weeks later, the Chilean government closes Barrick Gold for 24 violations of code, grounded on reiterative failure to comply with the law and with regulations, water contamination, glacier impacts, vegas destructions, etc. etc. and Barrick Gold a few days after that agrees to 23 of the 24 accusations.⁵⁴ But in Argentina, everything is fine with the project.

How are two so diametrically opposed official views concerning the same project, possible. It is the same company, working at the same site, with the same impacts and issues and yet the two mining authorities have completely different opinions about Barrick Gold's environmental due diligence. One says it is perfect, and the other says there are systematic violations of code, that the company lies, and that the company has ignored requests to address risks and impacts.

The principal and highest public officials, such as the National Mining Minister (Jorge Mayoral) and the Provincial Mining Minister (Felipe Saavedra) came out publicly shortly after the Chilean closure to reassure the public that on the Argentine side of the project, all was well. The house was in order and the company was complying with all of the laws and regulations governing the project. Curiously however, while the mining authorities came out to say everything was fine, the environmental authorities made no comments. They were silent. It seems that logically, the environmental authorities in Argentina should have been the first to step up and take some sort of position with respect to the closure of the project across the border, and yet, it is clear from the reaction, that neither the provincial or the national environmental authorities really know much about what is going on at Pascua Lama, and much less have the political authority to comment. The reality is that the environmental authorities are largely irrelevant with regards to Pascua Lama's environmental status.

Ironically, and what is of great concern, is that the environmental reasons for the Pascua Lama closure in Chile (vegas contamination, waterway contamination, glacier impacts) are all the same issues which social and environmental groups have been concerned with and accusing Barrick Gold of impacting, all along.

The governor of San Juan was one of the public authorities that came out strongly immediately after the Pascua Lama closure in Chile. His comments were diametrically opposed to that of the Chilean environment minister, who emphatically sustained Chile's sovereign right and insistence that mining companies respect the law. The San Juan

⁵⁴ see: <http://snifa.sma.gob.cl/SistemaSancion/Documento/DownloadDocumento/132>

governor instead, speaking practically as if Pascua Lama were his own project, spoke in the first person and stated:

"At Lama, we continue to work, we've complied with all of the prerequisites of the law, we have everything in order. In San Juan, all is normal and we will continue working and are confident that the problems will be resolved in Chile"⁵⁵

San Juan Province's Audit of Barrick's Pascua Lama

A special mention is called for regarding the recent publication entitled, "Report on the Joint Audit of the Veladero and Pascua Lama Projects"—in Spanish "*Informe de Auditoria Conjunta de los Proyectos Veladero y Pascua Lama (sector Lama)*".⁵⁶ This report is significant, because at first glance, we presume it is a step in compliance with the National Glacier Protection Law, in fact the text of the report says specifically, on page 15:

"By virtue of the Provincial Decree No. 1246/2012, Article 2 calls for Environmental Audits stipulated in Article 15 of Law 26.639 [the National Glacier Protection Law] for mining projects in Andes Mountains in San Juan Province."

The report is carried out by the Provincial Coordination Counsel for the Protection of Glaciers in the Province of San Juan, led by Mr. Jorge Eduardo Millon, today Sub Secretary of Hydrological Resources and Director of Hydrology of the Province. The Province entrusts Mr. Millon to review Barrick's projects Veladero and Pascua Lama for their hydrological impact. We see with this report how the provincial government constructs an unsound and inappropriate process to address due diligence in the mining sector.

The report is supposed to be a due diligence review of Barrick's projects, but in practice, the product itself is of very poor quality and is riddled with serious weaknesses and conflicts of interest. The conclusions of the report state:

⁵⁵ http://www.diariodecuyo.com.ar/home/new_noticia.php?noticia_id=567841

⁵⁶ see: <http://wp.cedha.net/wp-content/uploads/2013/04/auditoria-millon.pdf>

(Unofficial Translation of section of conclusion section of the report)

Following with the above in the maps included in this report we verify the following:

- There are no present impacts, generated or potential, due to the coincidence of present or future infrastructure in the study area, on uncovered glaciers, glacierets and/or ice patches nor on active or inactive rock glaciers;
- There are no impacts, nor have any present impacts been identified or generated, on uncovered glaciers, glacierets or ice patches, due to dust dispersion deriving from activities or present or projected works;
- To the extent that established protective measures are maintained, monitoring and prevention, there is no significant potential impact on glaciers, glacierets, ice patches, due to dust dispersion deriving from activities or present or projected works;
- We should clarify that the dispersion of dust, does not have impact on debris covered glaciers or on rock glaciers;

According to the above results, and considering the Law 26.639 [the National Glacier Protection Law] are the generated potential impacts validated in the Veladero and Lama EIAs?

Considering the audit carried out, this Special Environmental Audit Unit, decides to validate the evaluation of environmental impacts included in the available information, confirming that there is no impact to cryoforms in the study. Ratifying, in regards to the Veladero and Pascua Lama projects, and considering both infrastructure works, and present and future mining activity, which to the extent that preventive and protective measures are taken, in the Environmental Impact Reports, and in the renewal of these reports to date, in addition to those enclosed in this report, we identify NO [sic] significant impacts generated or potentially generated, on protected geoforms, existing in the glacial and periglacial environment.

Conclusions from the Report by the Department of Hydrology of San Juan Province, is in direct contrast to findings by the environmental authority in Chile. Source: Dept. Hidráulica de San Juan.

These conclusions (above) of the Department of Hydrology, in addition to contrasting diametrically with the findings of the Chilean environmental authorities, suffer innumerable problems and fatal flaws, amongst these:

- Firstly, Mr. Eduardo Millon is an ex-Barrick Gold consultant having worked on the company's hydrological plan, which seriously undermines his credibility as now the public official who must give Barrick Gold a clean bill of health on hydrological impacts;
- Secondly, the only information reviewed by Mr. Millon, is Barrick's own information. The province has not carried out its own studies on the anthropogenic impacts to glaciers in the company's area of influence; the reference to studies by third parties are generally outdated material;
- Thirdly, the team that carried out the audit, only had three days to do the field work, which would make it impossible to carry out a serious audit procedure. Considering that there are 171 glaciers on Argentine territory in the company's area of influence, in addition to the human difficult of working at 4,000-5,000 meters, in addition to the short hours during which work could be carried out (we've calculated an 8 hour day, which is actually far too long for the conditions), the team would have to have carried out a marathon job of visiting one glacier ever 8 minutes (without stopping for lunch or rest). This audit was physically and materially impossible, unless it was merely a visit to a handful of glaciers near the pit area and even then it could only have been superficial in nature;
- The report does not publish a full glacier inventory;
- The report focuses on a small study area based on the original IANIGLA study from 2006 carried out by Espizua, which as we have said earlier, is only 1/20th of the actual

project influence area; considering there are some 171 glaciers, the study area proposed only examines a handful of these;

- The study ignores glaciers along the access road (more than 100kms in length), and yet the report does mention the potential impacts to the Almirante Brown and Norte glaciers, which would hence make impacts to other glaciers along the road absolutely rational to address; here is what the report says about these glaciers along the road;

Given the close proximity of the glaciers at Conconta, the access road to the mines audited, by coincidence of the Environmental Impact Declaration, the companies maintain the road with the necessary humidity so that the transit of vehicles does not generate excessive dust that might affect glaciers. (p.14).

We ask hence, what about other glaciers along the road. There are about 100 of these glaciers, so why only monitor two? No one is studying the others;

- Only some elements of the periglacial environment are addressed (for example active rock glaciers) but the greater periglacial environment is not studied or monitored, as is mandated by the National Glacier Protection Law. This would include frozen grounds which do not necessarily display rock glaciers;
- The report says that no significant impacts or potential impacts to geofoms have been identified, when actually, studies mentioned in the annexes such as those of CECs 2012, do mention impacts. We already know publicly that the Toro 1 Glacier, that is partially in Argentina, and significant portions of the Canito Glacier, also on Argentine territory, are completely covered with dust and debris;
- The conclusions on page 15, that say, in sum, that there are no general or potential impacts on uncovered glaciers, due to dispersion of dust, is clearly false, since not only have we seen this impact in Argentine territory, but we have also seen that this is the case in the recent audit of the Chilean authority which resulted in the closure of Pascua Lama precisely, for among other things, this impact. It would be completely irrational to assume that crossing the border would eliminate this impact!

What is clear when one reviews this report, of very poor and dubious quality, is that the provincial authorities in San Juan province, have not carried out the independent controls to ensure that the necessary impact studies have been carried out effectively. With the Chilean authority audits now available, the San Juan authorities should have a better basis upon which to work. The public official position that there is no impact of mining activity in San Juan, or the statement that there are no glaciers at Pascua Lama, or that mining activity does not affect glaciers, or that there is no mining where there are glaciers and periglacial environments, is simply absurd and only serves to discredit the seriousness of the public officials and agencies that carry out compliance and due diligence controls of the mining sector. When the public did not have access to satellite imagery, as for example when Barrick Gold began operations at Veladero, these affirmations could go by unchecked. Today this is impossible. Anyone with an Internet connection can verify quickly that this information is false.

The Provincial Glacier Inventory Director, Silvio Peralta said incredibly and very unprofessionally, and to the large surprise of his colleagues;

"We haven't seen any glaciers affected by mining activity, nor by any industrial activity, by tourist activity or by road works. We've seen that the glaciers are there, nearby, but the mining activity doesn't reach them, and doesn't affect them".⁵⁷

In conclusion, regarding the Argentine public authorities, and in particular in regards to the provincial level authorities, unfortunately, we do not see public officials with a clear and transparent commitment to control the mining sector in terms of its social and environmental risks and impacts. Nor do we see the seriousness and professionalism that is necessary to confront the environmental risks and impacts that exist in the sector.

The lack of transparency, false information, lacking information, and the systematic lies that come from the official sector produce distrust in society and increase conflict, which will only grow if these flaws are not addressed.

⁵⁷ see: http://www.diariodecuyo.com.ar/home/new_noticia.php?noticia_id=439842

Conclusions

We've presented a list of evidence, including images, public documents, and studies from expert groups, showing serious conflicts between Barrick Gold's activities at Pascua Lama and Veladero, relative to its glacier and periglacial environment impacts. We also highlight numerous examples where public authorities are not meeting their basic due diligence to address these impacts.

Some of the more salient points addressed in this report are:

- There are glaciers and periglacial environments where there is mining in the region;
- There are glaciers and periglacial environments in areas directly impacted by Barrick Gold's activities at its Pascua Lama and Veladero projects;
- There are hundreds of glaciers in the project influence areas, and not the handful to which Barrick Gold refers on its website;
- Barrick's influence area in Argentina is at least 20 times larger than it suggests;
- Since Barrick Gold began activities at Veladero and Pascua Lama satellite imagery reveals a severe reduction in ice mass;
- In the pit areas at Pascua Lama, there are severe impacts to the Toro 1, Toro 2 and Esperanza Glaciers due to dust and debris from Pascua Lama's preparatory work which have been verified by Chilean authorities;
- There is evidence that other glaciers, such as the Canito Glacier, in Argentina, is also suffering severe impacts. The Canito is experiencing dismemberment, and is also visibly affected by dust;
- Barrick Gold has impacted glaciers along the Veladero access road, including the Almirante Brown Glacier at the Conconta Pass;
- There is evidence that other glaciers similar to the Almirante Brown are suffering impacts along the access road, potentially due to vehicular traffic impact;
- Many glaciers along the access road, which were already vulnerable due to climate change, have already disappeared since Barrick Gold initiated activity at Veladero;
- There is extensive periglacial environment in Barrick Gold's influence area for both projects which have not been studied for potential mining activity impact;
- Barrick Gold placed a waste pile on periglacial environment at Veladero (despite recommendations not to, which is likely to be the reason for a dangerous collapse of the pile some time in early 2008);
- Barrick Gold is repeating this mistake at Pascua Lama by placing the Nevada Norte waste pile on periglacial environment;
- Studies have not been carried out to determine the real impact of activities at Pascua Lama and Veladero to glaciers and/or to periglacial environments;
- Barrick Gold as well as national and provincial public officials deny both the presence of glaciers and periglacial environments as well as potential or actual impacts of activities by Veladero and Pascua Lama;
- Neither the company nor the State offer transparent information about what is occurring in project influence areas or on the impacts of mining to glaciers and periglacial environments;
- The studies mandated by the National Glacier Protection Law have not been carried out, nor have the priority glacier inventories in mining areas, mandated by the law;
- Barrick Gold has glacier inventory information but does not publish it openly;
- The province of San Juan published an incomplete glacier inventory, which does not show where its' glaciers are located; the province also published impact studies which are not adequate, suggesting falsely that Barrick Gold's Pascua Lama and Veladero are complying with the law;
- Neither Barrick Gold nor national or provincial public authorities are complying with the National Glacier Protection Law;

All of these points discredit the company and the official position that Pascua Lama and Veladero do not impact glaciers or periglacial environments. Until a few weeks ago, the information and evidence of this impact was little known publicly. Nonetheless, the total

closure of the Pascua Lama project on Chilean territory, officially confirmed these accusations. This closure, in part based on glacier contamination by Barrick Gold at Pascua Lama, confirms what we are saying, and refutes categorically the multiple affirmations by public officials, at the national and provincial level, that there are no environmental problems at Pascua Lama and Veladero.

What should be done now with this information?

First of all, we should follow the evolution of the situation in Chile, where Barrick Gold is undergoing a serious review of operations, which have been evaluated by authorities to be in violation of the law and which imply irreversible impacts to glaciers and to periglacial environments.

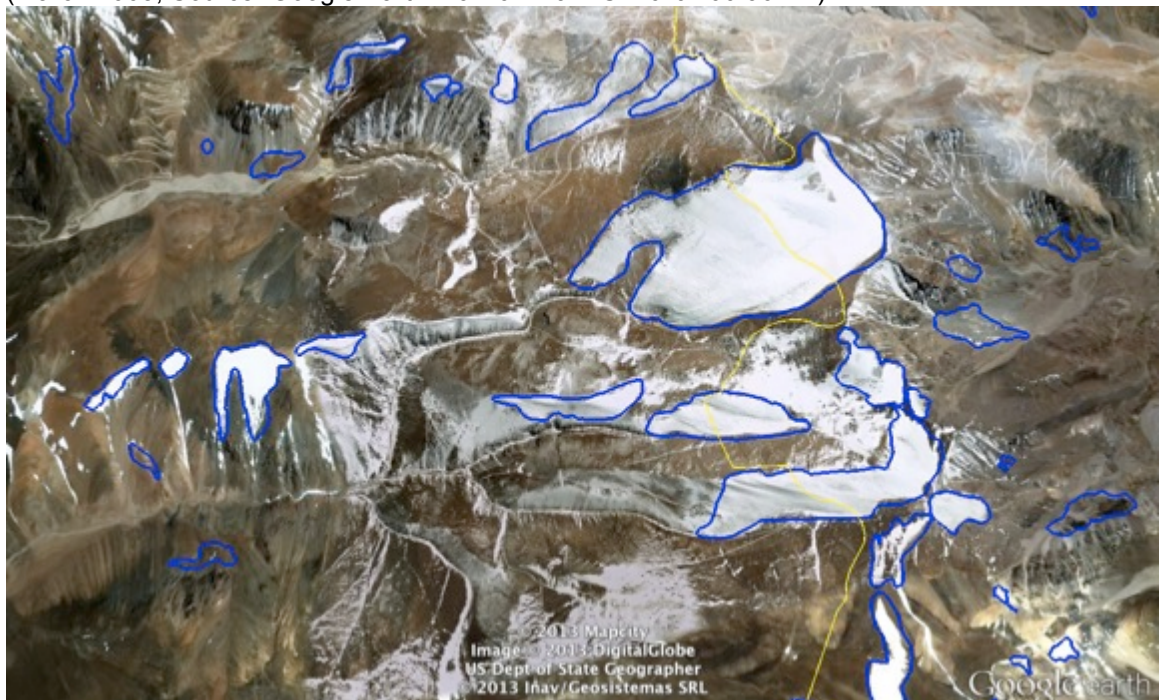
Environmental authorities in Argentina, both at the provincial and national levels should assume their due diligence and legal responsibilities and adhere to the following steps before advancing with the Pascua Lama project. With respect to the Veladero project, there are also necessary actions to avoid future impacts to ice resources of the area.

1. Preparatory activities at Pascua Lama on Argentine soil should cease (as has occurred in Chile) until there is full certainty that activities are not impacting glacier resources;
2. Priority glacier inventories should be carried out immediately as well as mapping of periglacial environments in Pascua Lama and Veladero impact zones including at:
 - a. the pit area;
 - b. areas surrounding access roads;
 - c. areas affected by winds originating from the project area;
3. A baseline should be defined for the glacier inventory (and for periglacial environments) that begins at the onset of exploratory activities at Veladero and Pascua Lama (preferably since or before 1990);
4. Strategic Environmental Impact Studies should be carried out in relation to glacier impacts and periglacial impacts in all of the areas of impact for all activity of the project;
5. All past impact to glaciers and periglacial environments should be repaired where possible (for example, to rock glaciers);
6. All information on the state of glaciers and impacts should be made accessible and transparent to the general public, including making satellite and/or photographs of Argentine territory, available, as for example through the CONAE;
7. Public participation should be encouraged to all interested stakeholders in particular in the implementation of the National Glacier Protection Law;

ANNEXES: Before/After Images

Before Pascua Lama:

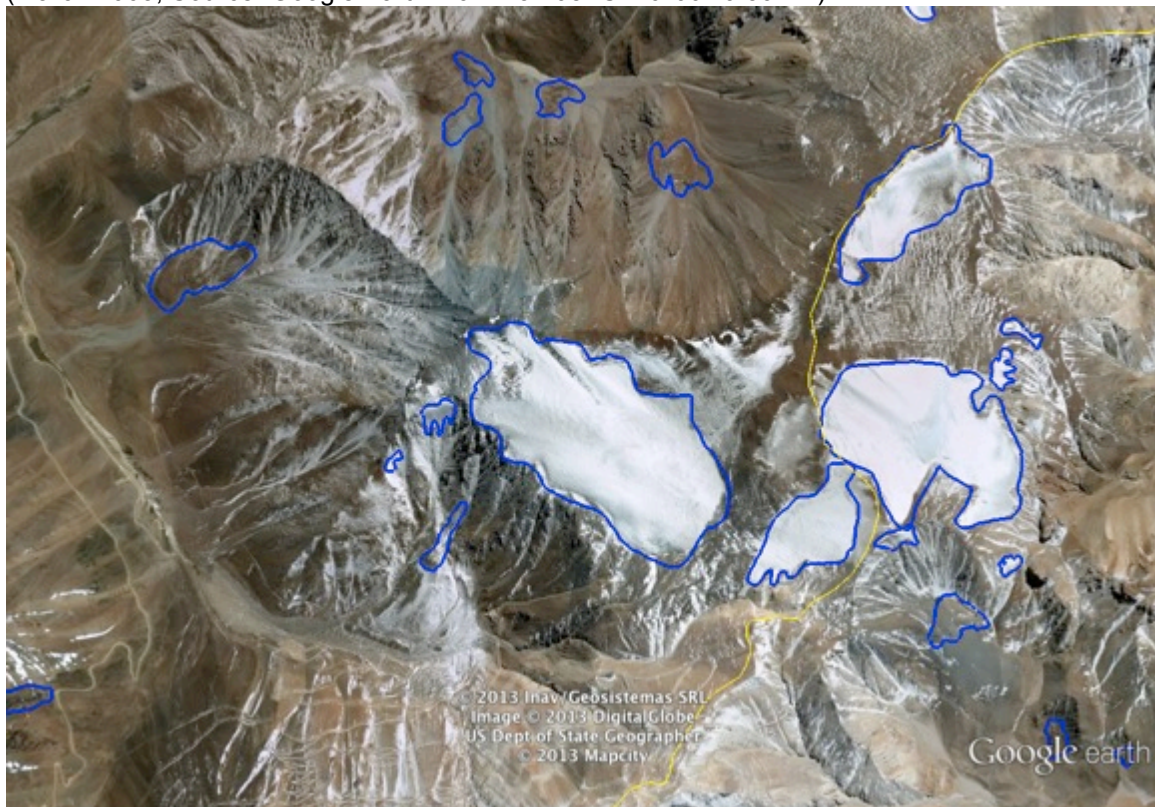
(March 2005, Source: Google Earth: 29°20'44.97" S 70°01'00.90" W)



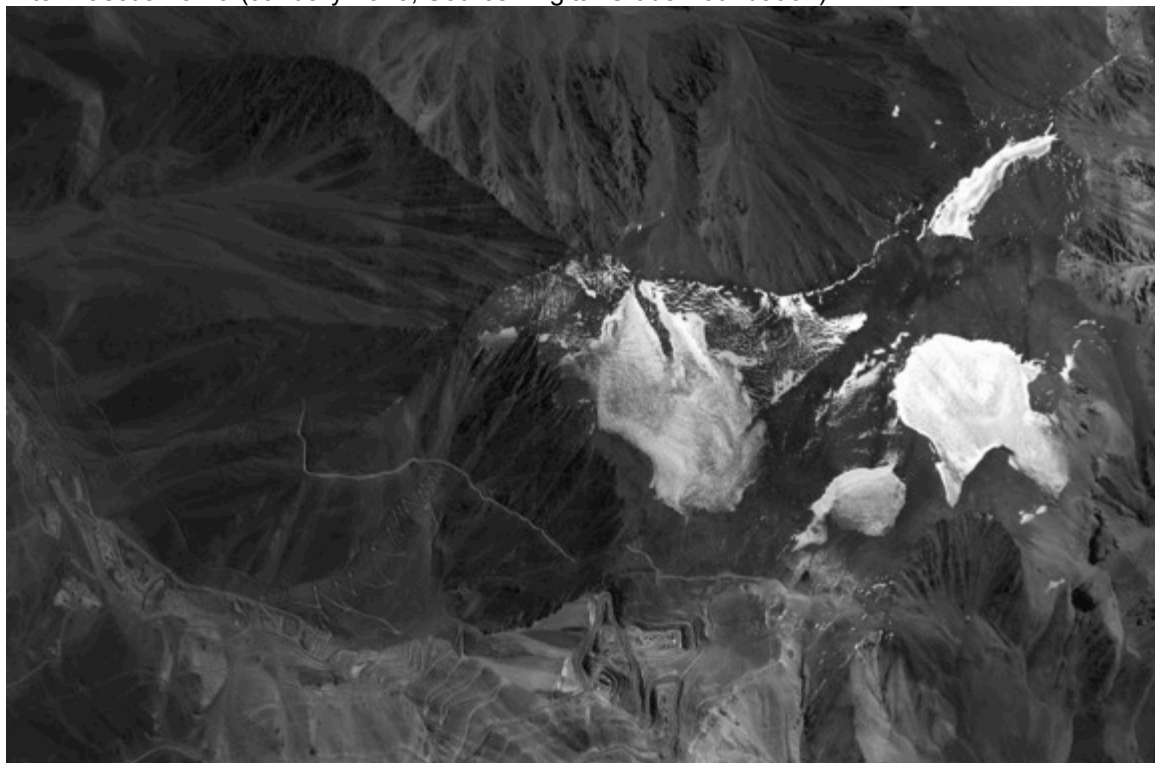
After Pascua Lama (January 2013, Source: Digital Globe Foundation)



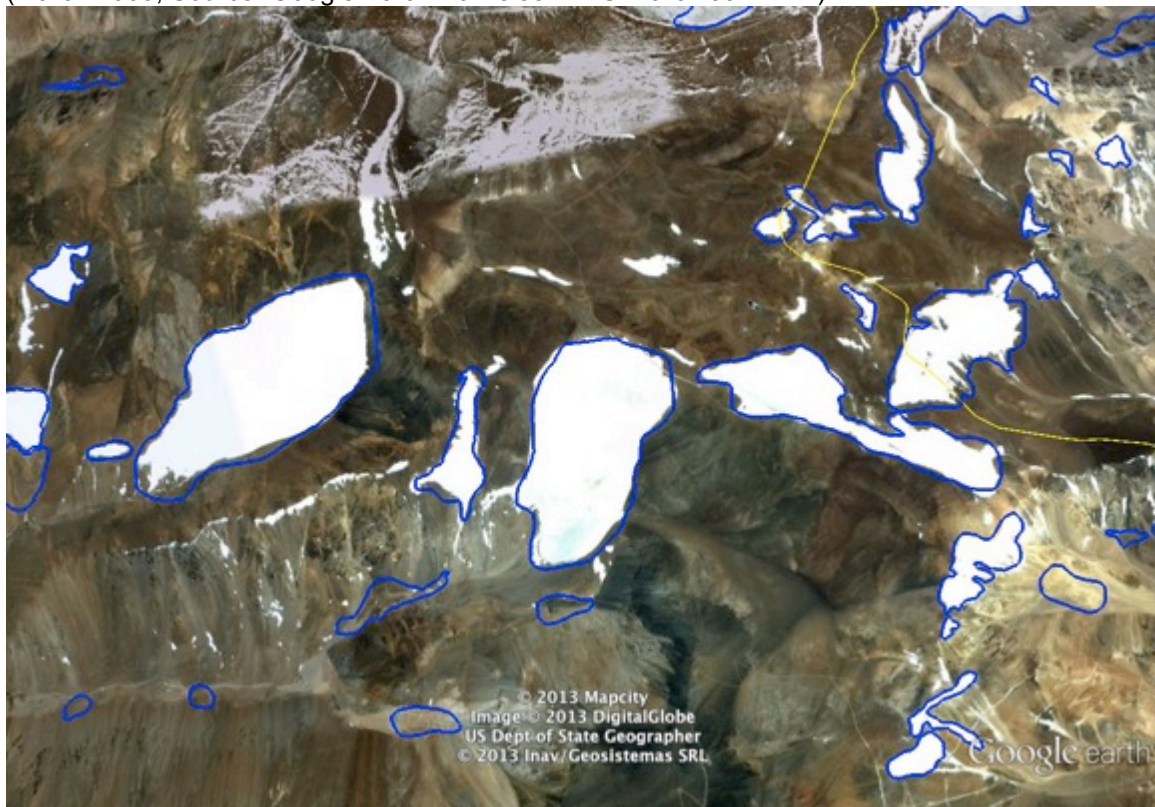
Before Pascua Lama –Estrecho, Amarillos, and Los Amarillos Glaciers
(March 2005, Source: Google Earth: 29°17'54.08" S 70°00'29.59" W)



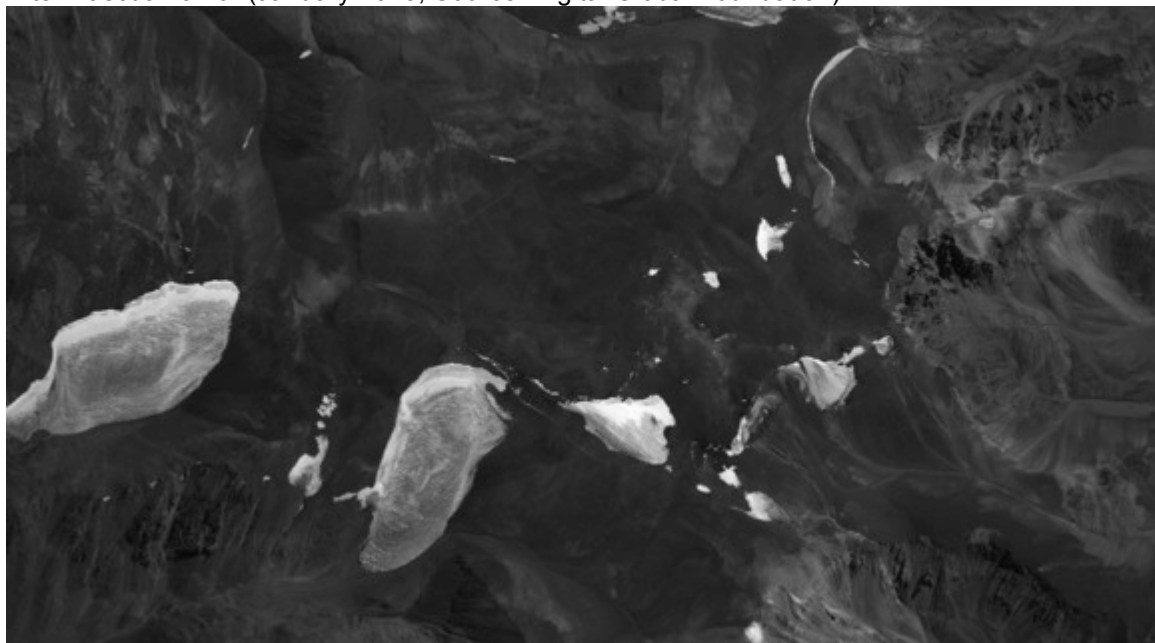
After Pascua Lama (January 2013, Source: Digital Globe Foundation)



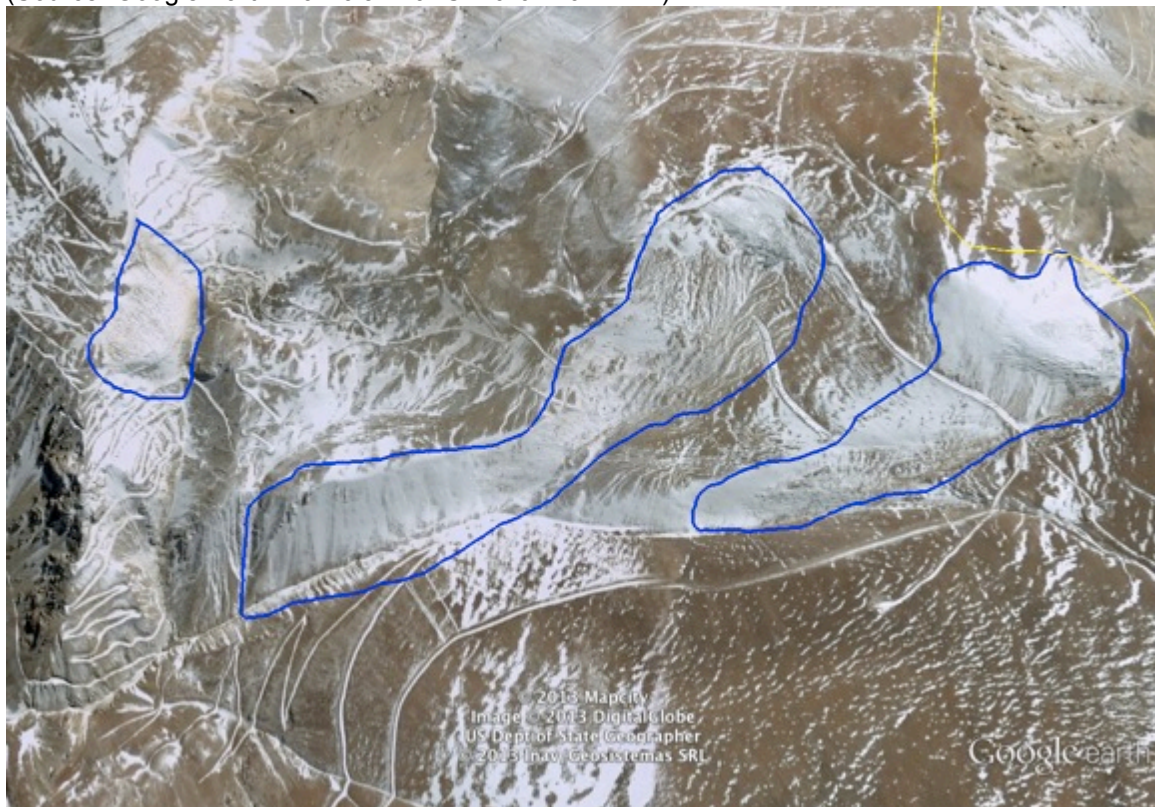
Before Pascua Lama: Ortigas 1 y 2 Glaciers
(March 2005, Source: Google Earth: 29°23'33.74" S 70°01'59.44" W)



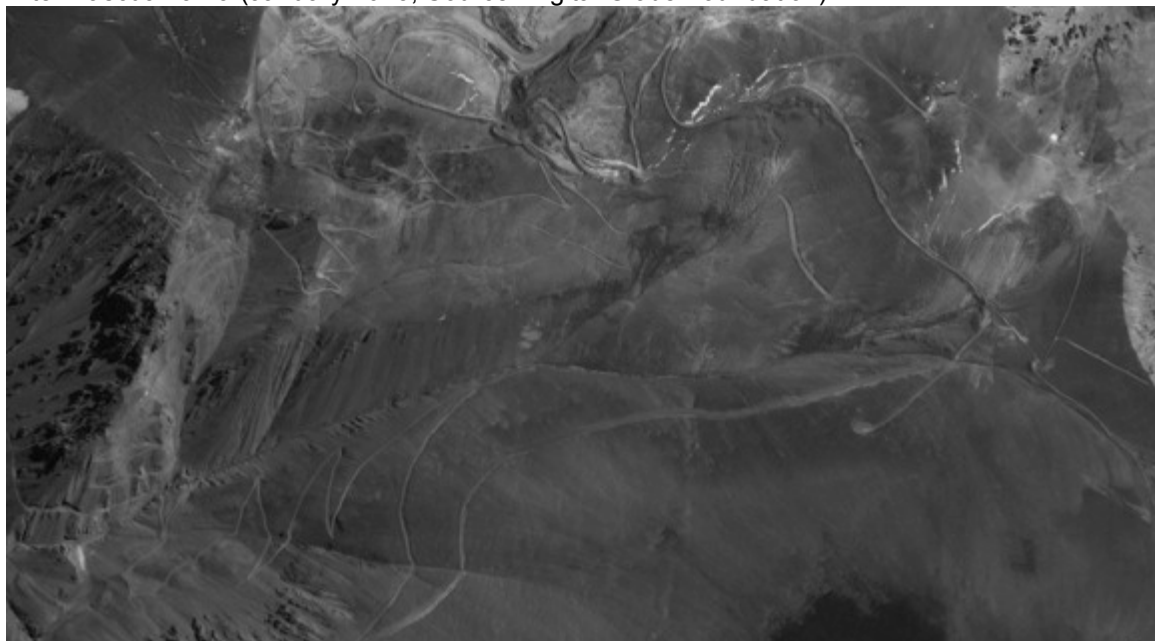
After Pascua Lama: (January 2013, Source: Digital Global Foundation)



Before Pascua Lama - Esperanza, Toro 2, Toro 1 Glaciers (from left to right)
(Source: Google Earth: 29°19'57.79" S 70°01'40.41" W)



After Pascua Lama (January 2013, Source: Digital Globe Foundation)



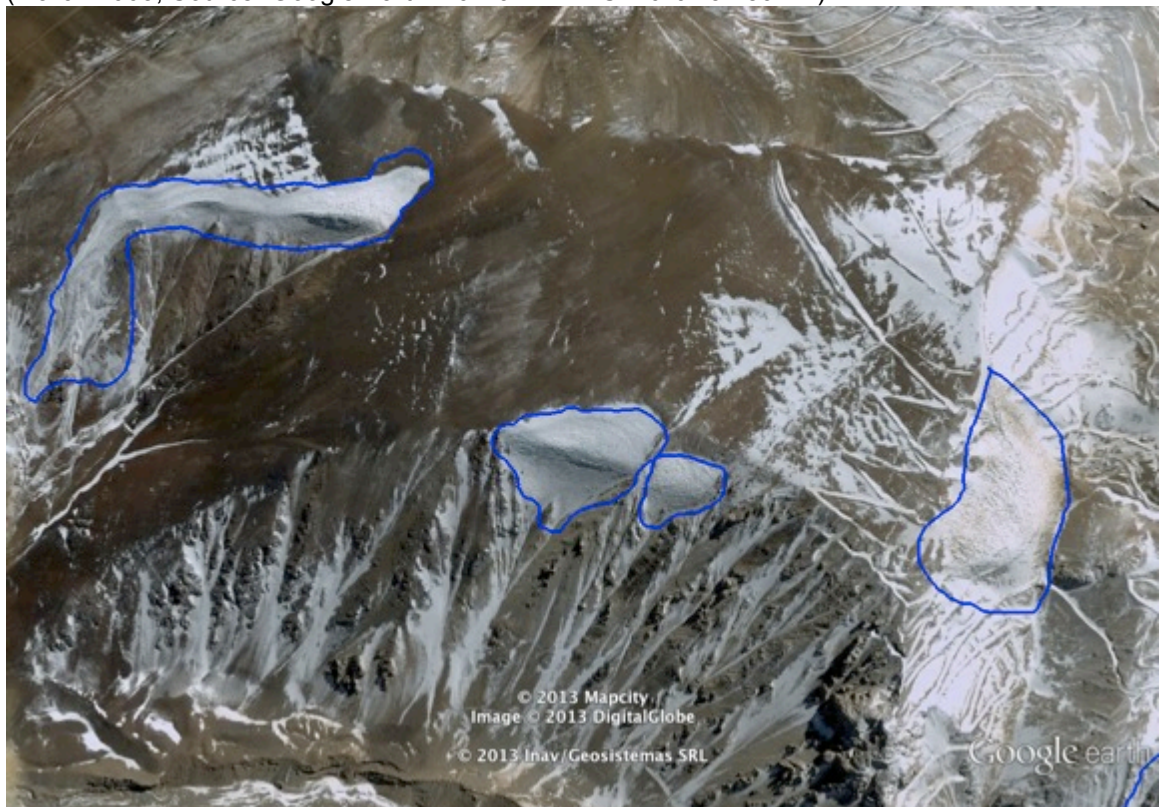
Before Pascua Lama – Rock Glacier in Nevada Norte Waste Pile Site
(March 2005, Source: Google Earth: 29°18'04.69" S 70°01'44.05" W)



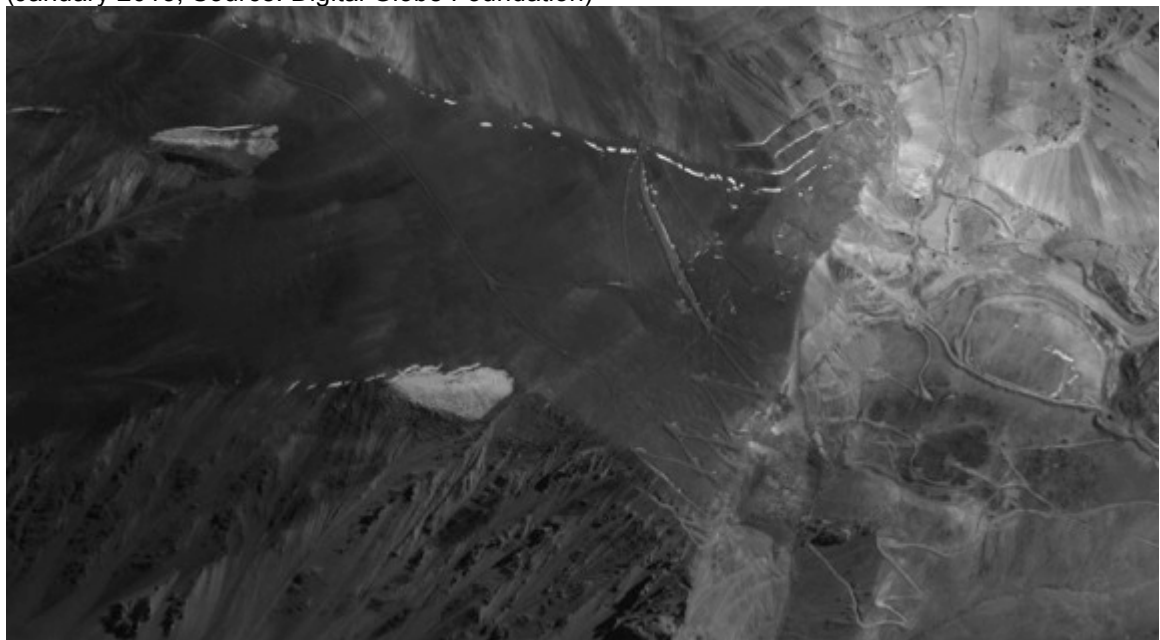
After Pascua Lama
(January 2013, Source: Digital Globe Foundation)



Before Pascua Lama –Esperanza and other Glaciers
(March 2005, Source: Google Earth: 29°19'44.42" S 70°02'34.89" W)



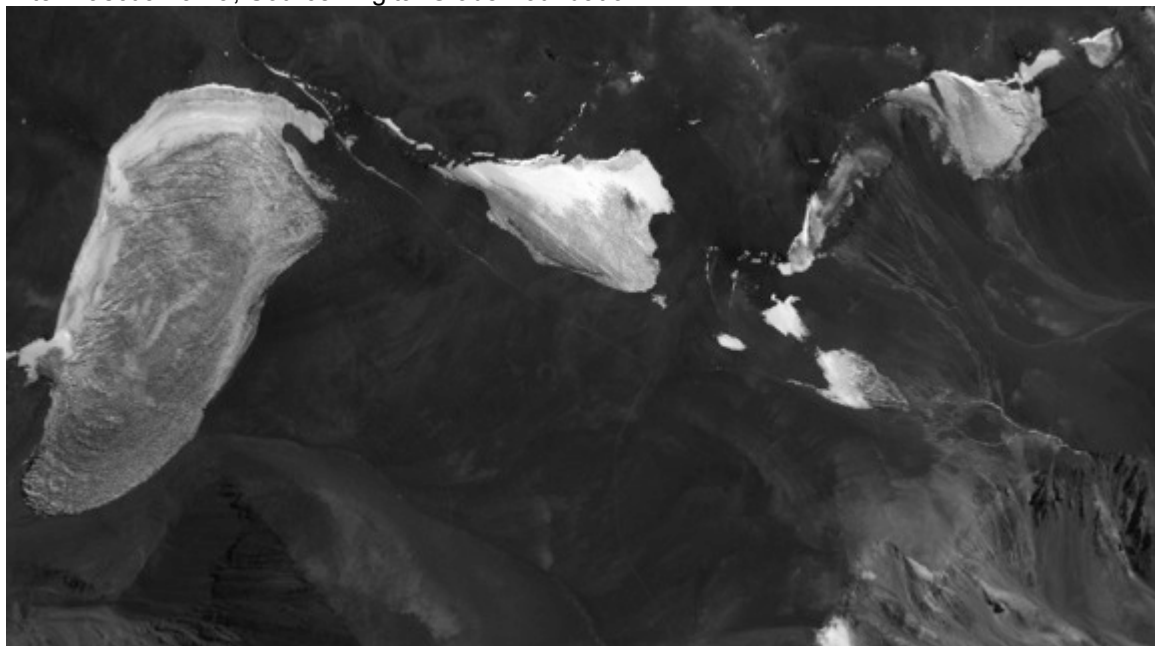
After Pascua Lama
(January 2013, Source: Digital Globe Foundation)



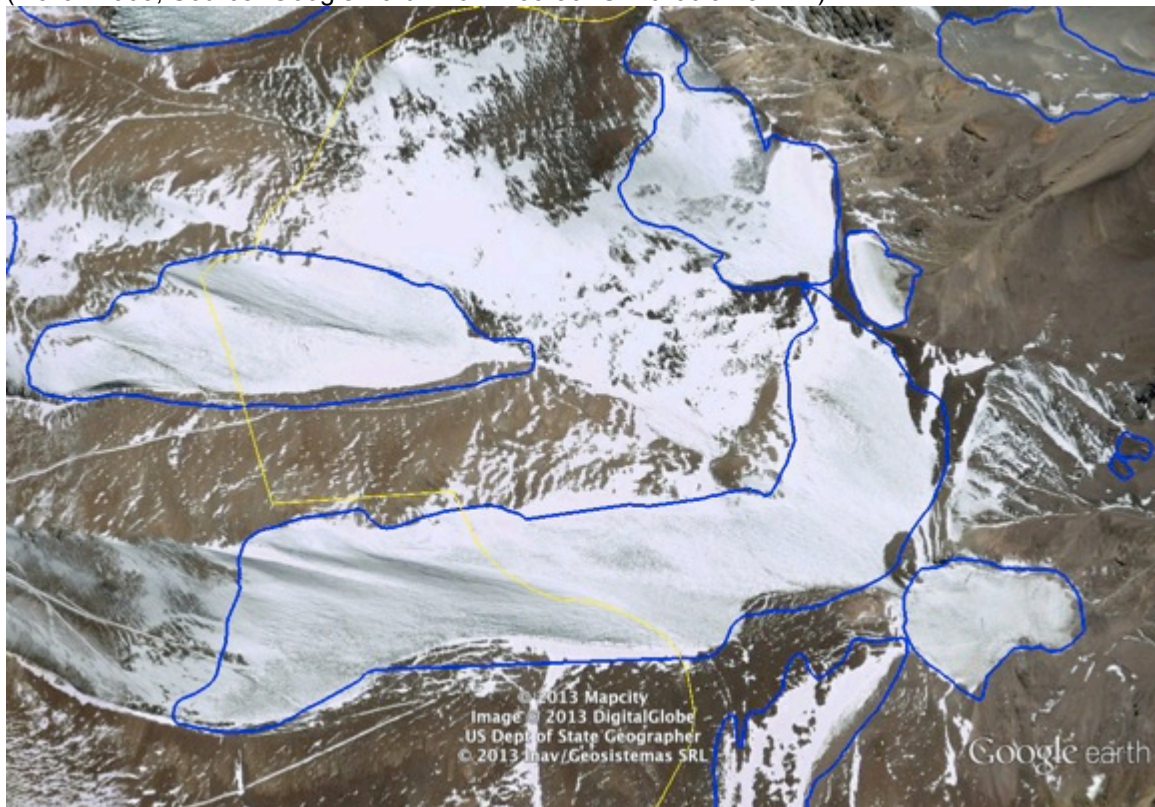
Before Pascua Lama –Ortigas Glacier and others
(March 2005, Source: Google Earth: 29°23'38.30" S 70°01'16.79" W)



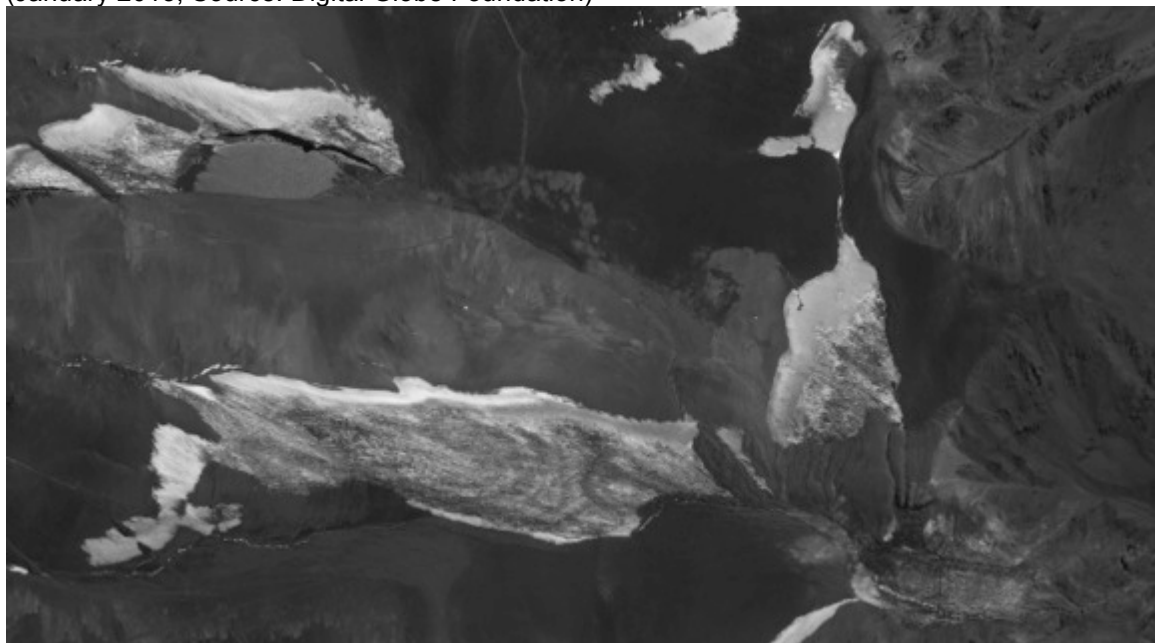
After Pascua Lama; Source: Digital Globe Foundation



Before Pascua Lama –Canito Glacier
(March 2005, Source: Google Earth: 29°21'59.56" S 70°00'37.37" W)



After Pascua Lama
(January 2013, Source: Digital Globe Foundation)



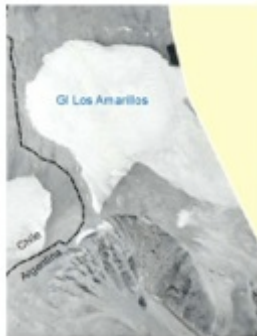
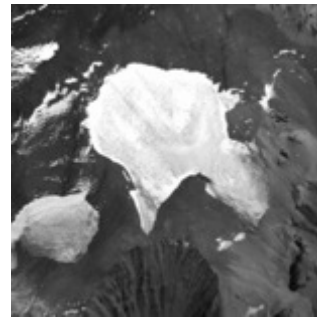


Figura 10: Glaciar Los Amarillos en 1959 (izq.) y en el 2005 (der.).

Source: Espizua 2006, p.14.



2013 Source: DGF.

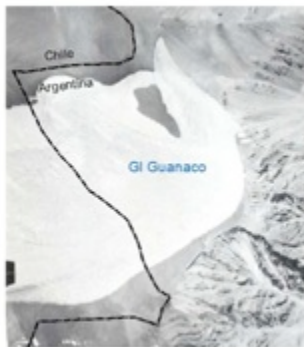
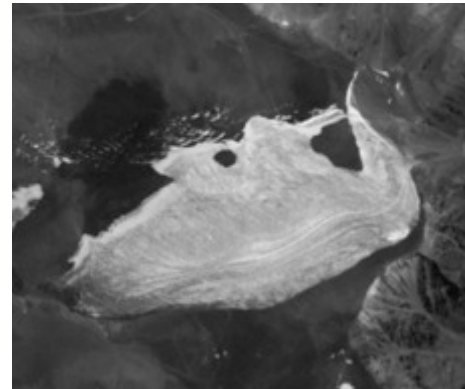


Figura 11: Glaciar Guanaco en 1959 (izq.) y en el 2005 (der.).

Source: Espizua 2006, p. 15.



2013 Source: DGF

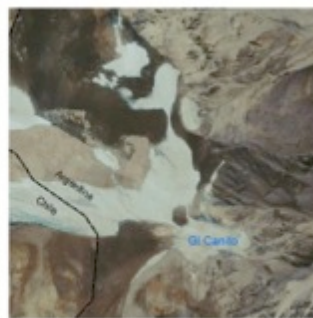
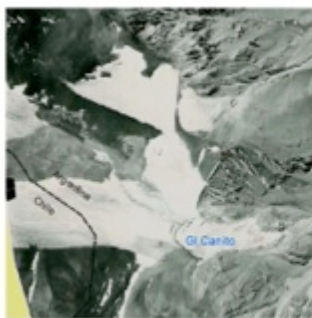
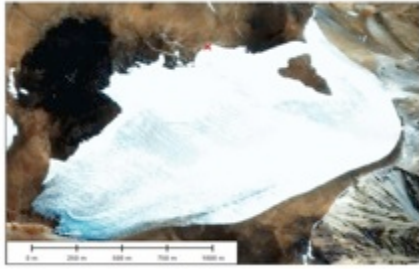


Figura 12: Glaciar Carrizo en 1959 (izq.) y en el 2005 (der.).

Source: Espizua 2006, p. 15



2013; Source: DGF

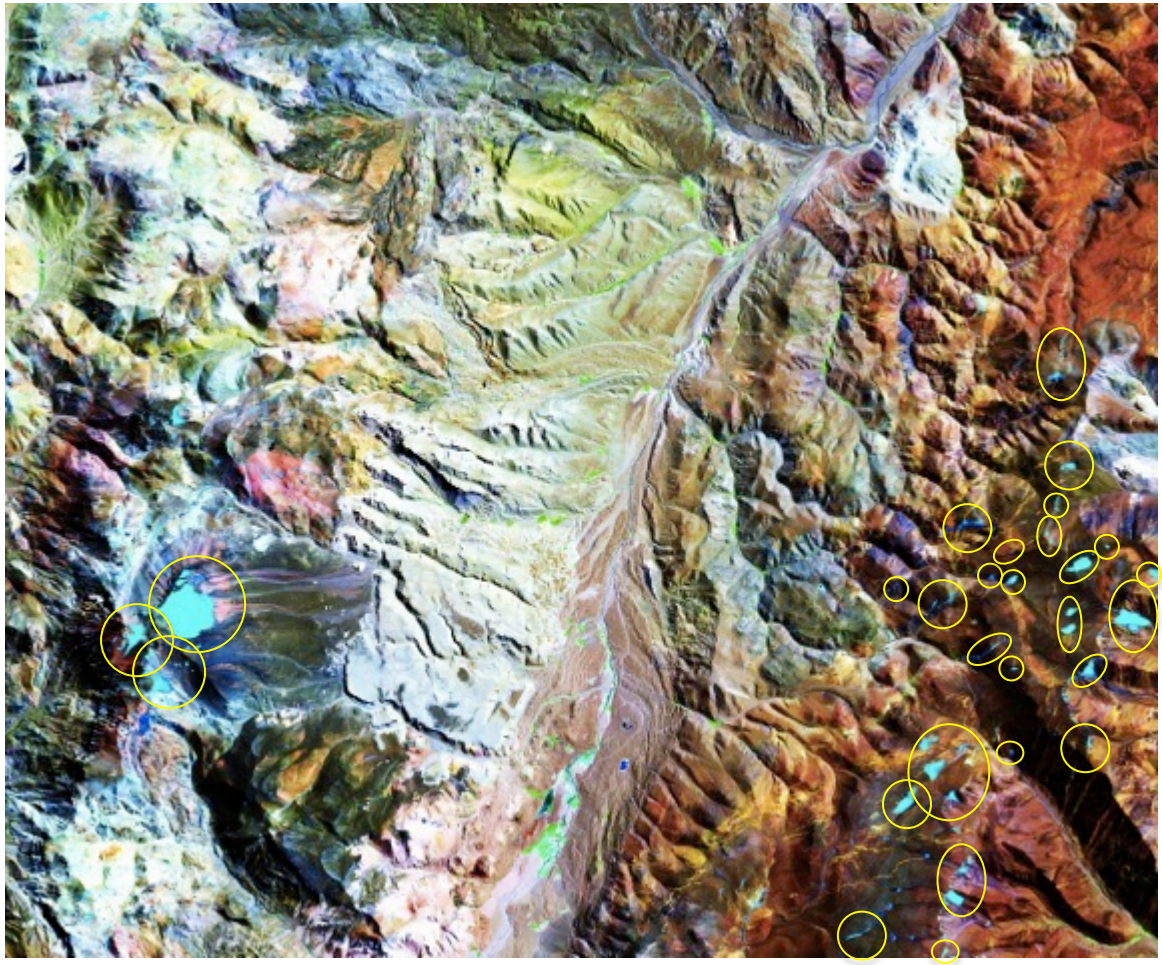


Source: Espizua 2006, p. 16.



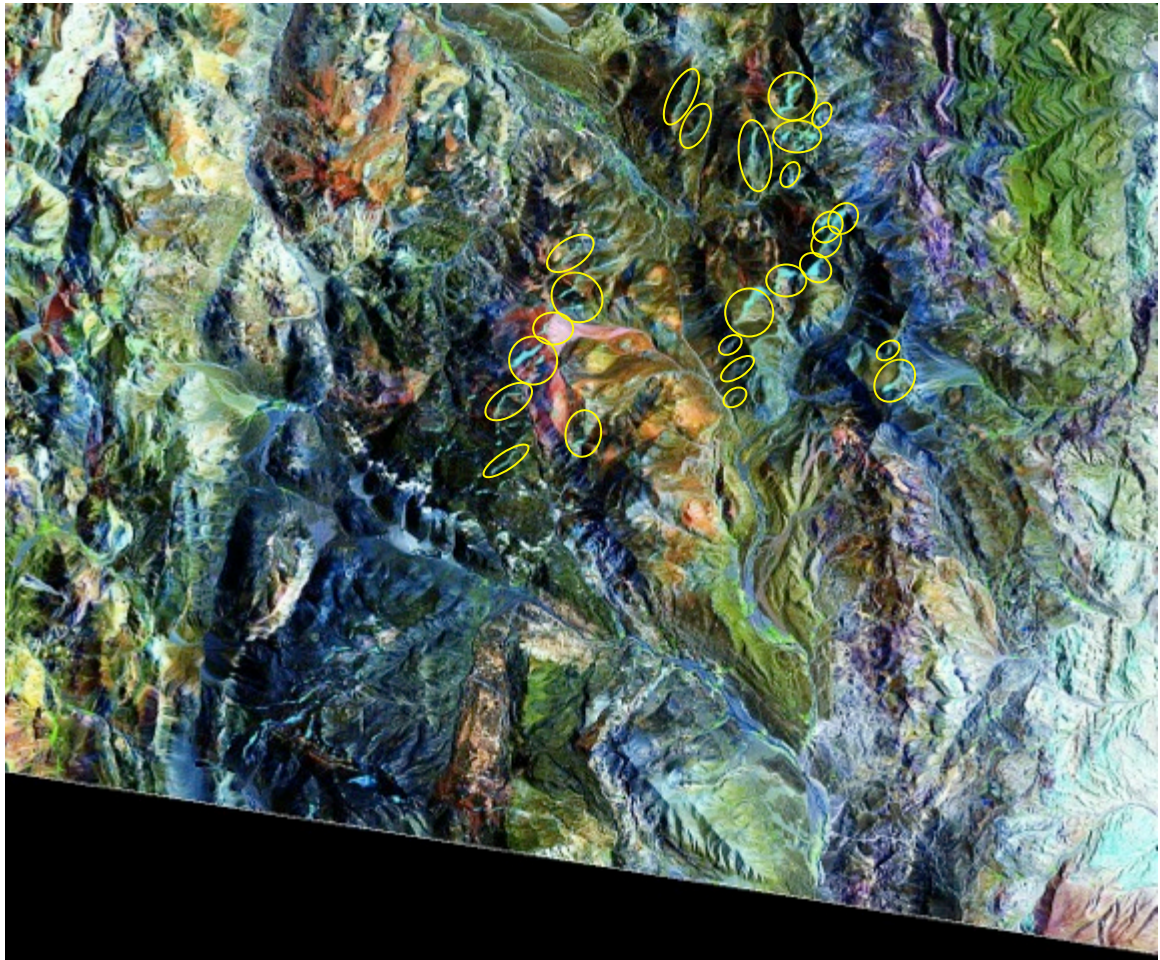
2013; Source: DGF

THE CONCONTA PASS (Source: CONAE 2002)



Just South of Veladero

29°31'35.77" S 69°47'57.23" W (Source: CONAE 2002)



About the Author



In Rodeo, Cuesta del Viento, San Juan Province, with the Central Andes in the Background

Jorge Daniel Taillant (Daniel), born in Buenos Aires, of paternal San Juan origins, has more than 15 years of experience in issues related to sustainable development. He has worked for numerous agencies and organizations, amongst these, non-profit organizations, multilateral institutions (World Bank, UN, EU, OAS, etc.) and as advisor to governments.

Daniel's professional career initiates focusing on the public policy and local development. He turns later to environmental policy and human rights in a business context. He has lived in North America, Asia, Europe and several counties in Latin America. He returned to Argentina in 1999 with his wife to found The [Centro de Derechos Humanos y Ambiente \(CEDHA\)](#), in Córdoba Argentina. CEDHA focuses on the defense of victims of environmental degradation and promoting a more harmonious relationship between the environmental and people. Some of CEDHA's focus areas are: climate change, right to water, corporate accountability, participation and access to information, forests and mining. Over the last several years, he's focused personally on the impacts of mining to glacier and periglacial environments.

In 2007, CEDHA wins Sierra Club's prestigious [Earth Care Award](#) grounded on CEDHA's innovative approach to pushing for greater accountability, human rights and environmental protection in the corporate world, in the well known pulp mill sector case involving the companies, Botnia and Ence. A year later, his spouse and Co-Founder of CEDHA, and former Secretary of Environment of Argentina (2006-2008), Romina Picolotti won the acclaimed "[the Sophie Prize](#)" for CEDHA's innovative contributions to linking human rights and the environment.

Daniel has dedicated the last 5 years to studying the impacts of mining on glaciers, particularly in the high Andes Mountains. He is also pushing for greater transparency, access to information and participation in the extractive sector. This work has looked carefully at the impacts of mining operations on glaciers and periglacial environments, including the launching of the "Democratizing Glaciers Initiative", which aims to construct more civic engagement around environmental protection through glacier protection. He is developing scholastic materials on glacier protection and vulnerability and is helping educate communities about the vulnerability of glaciers and the many important contributions they make to local ecosystems.

En 2012, CEDHA organized a conference at Rio + 20 called [Glaciers and Sustainability in the Anthropocene](#).

In the context of his work on mining and glaciers, CEDHA is conducting a national glacier inventory, focusing on glaciers in mining regions. CEDHA already has registered over 3,000 glaciers in provinces such as San Juan, Catamarca, La Rioja, Jujuy, Salta and Tucumán. This is a direct contribution to the implementation of the National Glacier Protection Law.

Daniel is the author of numerous publications on the impacts of mining on glaciers.

ONLINE Glacier Bibliography / Mining Impacts

- [Ahumada et.al. Caminos de Alta Montaña en un Ambiente de Criósfera Puneña](#)
- [Ahumada, et.al Periglacial Phenomena in the High Mountains of Northwestern Argentina.](#)
- [Ahumada, et.al. El Permafrost Andino ... de la Puna NO Argentino. 2009](#)
- [Ahumada, Paez y Palacios. Los Glaciares de Escombros en la Alta Cuenca el Río Andalgalá, SE de la Sierra del Aconquija, Catamarca 2011.](#)
- [Ahumada, Ibañez y Paez. Glaciares de Escombros Sierra Santa Victoria. 2011.](#)
- [Arenson, L & Jacob, M. A new GIS based Mountain Permafrost Distribution Model. 2010](#)
- [Arenson & Pastore. Periglacial Investigations ... South American Perspective. 2011.](#)
- [Arenson, Pastore, Trombotto. Characteristics of Two Rock Glaciers in the Dry Argentinean Andes \(on El Pachon\)](#)
- [Azocar & Brenning. Intervenciones de Glaciares Rocosos en Minera Los Pelambres, Chile](#)
- [Bahr, D & Radic, V. Significant Total Mass Contained in Small Glaciers. 2012.](#)
- Barsch, Dietrich. Rock Glaciers: Indicators for the Present and Former Geoecology in High Mountain Environments. Springer. 1996.
- Benn, D I. and Evans, David J.A. Glaciers and Glaciation. Arnold. 1998
- Bodin X, Rojas F, & Brenning A. Status and Evolution of the Cryosphere in the Andes of Santiago Chile.
- [Borquez, Larraín, Polanco y Urquidi, Glaciares Chilenos: Reservas Estratégicas de Agua Dulce.](#) Eds. Larrain y Schauenburg. Chile Sustentable. LOM Ediciones. 2006.
- Brenning, Alexander. [The Impact of Mining on Rock Glaciers and Glaciers: Examples from Central Chile.](#) In B.S. Orlove, E. Et.al (eds.). Darkening Peaks: Glacier retreat, science, and society. University of California Press, Berkeley. Chapter 14. Pp.196-205.
- Brenning & Azocar. Minería y Glaciares Rocosos: Impactos Ambientales, Antecedentes Políticos y Legales, Perspectivas Futuras
- [Caine, N. Recent Hydrological Change in a Colorado Alpine Basin: ... Permafrost](#)
- Carey, Mark. In the Shadow of Meeting Glaciers: Climate Change and Andean Society. Oxford University Press. 2010.
- Centro de Estudios Científicos. [Informe de Balance de Masa. \(Informe Anual Hidrológico 2011-2012\). Proyecto Pascua Lama.](#) 2012.
- Centro de Estudios Científicos. [Informe de Temperatura de Suelo. Año 2011-2012 Proyecto Pascua Lama.](#) 2012.
- Centro de Estudios Científicos. [Mediciones de Material Particulado Sedimentable \(MPS\) y Polvo Contenido Sobre Glaciares \(PCG\) Proyecto Pascua Lama.](#) 2012.
- Chile Sustentable. Glaciares Andinos: Recursos Hídricos y Cambio Climático. 2012 (partes: [I](#), [II](#), [III](#))
- Corte, Arturo E. Geociología: El Frio en la Tierra. Ediciones Culturales de Mendoza. 1983.
- Espizúa, Lydia. [Ambiente y Procesos Glaciales y Periglaciales en Lama-Veladero, San Juan Argentina.](#) IANIGLA. 2006.
- [Fauqué & Azcurra. Condiciones Periglaciales ... Aconquija, Catamarca. 2009](#)

- [Ferrando-Acuña, Francisco. Aspectos Conceptuales y Genético-Evolutivos de los Glaciares Rocosos: Análisis de Caso en los Andes Semiaridos de Chile.](#) Geográfica Terra Australis 48: 43-74, 2003.
- [Francou, B. Montaña y Glaciares, 2011](#)
- French, Hugh M. The Periglacial Environment. 3rd Edition. Wiley. 2008
- [Gascoin et.al. Glacier Contribution to Streamflow \(Huasco River\) \(2011\)](#)
- Gestión Ambiental Consultores, SA. [EIA Impacto en Glaciares - Expansión Andina, Codelco, Chile.](#)
- Gruber S. Derivation and Analysis ... global permafrost zoning. 2012.
- Gruber S, & Haeberli W. [Mountain Permafrost](#). Chapter 3 in Margesin (ed.) Permafrost Soils. Soil Biology 16. Springer-Verlag Berlin. Heidelberg 2009.
- Higuchi, K. Nepal-Japan Cooperation in Research on Glaciers and Climate of the Nepal Himalayas (inquire to: glaciares@cedha.org.ar)
- Humlum. The Climate and Palaeoclimatic Significance of Rock Glaciers. 2010.
- Humlum. Geomorphic Significance of Rock Glaciers: Rock Glacier Debris Volume ... (inquire to: glaciares@cedha.org.ar)
- [Iribarren Anaconda, PR. Glaciares Rocosos en el Semiarido Chileno.](#) Su Significado Climático y Geomorfológico. Análisis de Caso: Cuenca Superior del Río la Laguna. Universidad de Chile. 2008.
- [Kaab & Haeberli. Mapping of Rock Glaciers w/Optical Satellite Imagery](#)
- [Kaab. Rock Glaciers and Protalus Forms](#)
- [Kronenberg, Jakub. Global Warming, Glaciers and Gold Mining.](#) University of Lodz. Poland 2010?
- Kronenberg, Jakub. [Linking Ecological Economics and Political Ecology to Study Mining, Glaciers and Global Warming.](#) Environmental Policy and Governance. 2013.
- [Kumtor Commission Report](#)
- Kuzmichenok. [Ice and Snow](#) (regarding Kumtor Glacier in Kyrgystan). 2012
- Lliboutry, L. Nieves y Glaciares de Chile: Fundamentos de la Glaciología. Ediciones de la Universidad de Chile. Santiago. 1956
- Masokias, et.al. [Glacier Fluctuations in Extratropical South America during the past 1000 years.](#) 2009
- Milana, JP. Hielo y Desierto: Los Glaciares Áridos de San Juan. Elite Ediciones. 2010.
- [Milana, JP. Predicción de Caudales de Ríos Alimentados por Deshielo](#)
- Ochsenius, Felipe. Aspectos Físicos para una Valoración Ambiental en el Sector del Cerro Yutuyaco en la Sierra del Aconquija, Catamarca. Movimiento de Profesionales para los Pueblos. 2011.
- Owen & England. Observation of Rock Glaciers in the Himalayas and Karakoram. (inquire to: glaciares@cedha.org.ar)
- Paul F, Kaab A, Haeberli W. Mapping of Rock Glaciers with Optical Satellite Imagery.
- [Perucca, L. Esper M, & Martos L. Inventario de Glaciares de Escombros en el Area del Proyecto del Carmen, Andes Aridos de San Juan](#)
- [Picolotti, Juan M. La actividad minera y la protección de los Glaciares en la República Argentina](#)
- [Rabatel et.al. Current State of Glaciers in the Tropical Andes.](#)
- [Rabatel et.al. Glacier changes in the Pascua-Lama region, Chilean Andes \(29° S\): recent mass-balance and 50-year surface-area variations](#)
- [Raub, William et.al. Inventory of Glaciers in the Sierra Nevada, California. 2006.](#)

- [Robinson & Dea. Quaternary Glacial and Slope Failure Deposits of the Crested Butte. Area ... Robinson & Dea 1981.](#)
- Romanovsky V. et.al. Frozen Ground.
- Ruiz L & Trombotto D. Descubrimiento de Glaciares de Escombros Fósiles ... Chubit.
- Taillant, JD (CEDHA). 14 Lies on Barrick Gold's Impacts to Glaciers at Pascua Lama. 2012
- [\(Spanish\) \(English\)](#)
- [Taillant, JD \(CEDHA\). A Definition of the Glaciosystem - English \(Spanish\)](#)
- [Taillant, JD \(CEDHA\). El Ambiente Periglacial y la Minería en la República Argentina: La Ley de Glaciares y Los Suelos Congelados. 2012.](#)
- [Taillant, JD \(CEDHA\). Impact to Rock Glaciers and Periglacial Environments by Los Azules \(Minera Andes\)](#)
- [Taillant, JD \(CEDHA\). Impacts to Rock Glaciers and Periglacial Environments by the Filo Colorado \(Xstrata\) and Agua Rica \(Yamana Gold\) Projects \(5.6mg\)](#)
- [Taillant, JD \(for Rio +20\) The Human Right ... to Glaciers?](#)
- [Taillant, JD. \(CEDHA\). Impact to Glaciers by El Pachon \(Xstrata\) - \(English\) \(Spanish\)](#)
- Taillant, JD (CEDHA). Informe Sobre el Ambiente Periglacial y la Minería en Argentina. 2012 ([Español](#) - [English](#))
- Taillant, JD (CEDHA). [Informe Sobre Glaciares y Ambiente Periglacial en el Territorio Indígena Diaguita-Huascoaltino, Chile 2012](#)
- Taillant, JD (CEDHA). [Informe: Los Glaciares y la Minería en la Provincia de La Rioja; 2012. \(English Summary\)](#)
- [Taillant, JD. La Democratización de los Glaciares. En Hydria, No.41, 2012. pp.17-19.](#)
- [Taillant, JD, \(CEDHA\). The Periglacial Environment and the Mining Sector in Argentina: The National Glacier Law and Frozen Grounds. 2012](#)
- [Taillant, JD. \(CEDHA\). Preliminary Report: Glaciers, Rock Glaciers and Permafrost in the Del Carmen \(Malbex of Canadá\) Project Area, San Juan Argentina \(CEDHA\). 2011](#)
- Trombotto, D. Survey of Cryogenic Processes, Periglacial Forms and Permafrost Conditions in South America. *In* Revista do Instituto Geológico, Sao Paulo. 21. (1/2), 33-55, 2000.
- [Trombotto & Borzotta. Indicators Global Warming - Rock Glaciers Central Andes. 2008](#)
- [Vatican. Report by the Vatican on the Melting of Glaciers in the Anthropocene](#)
- [Vallon, Michel, y Vincent Christian. Balance Invernal 2005 de los Glaciares Esperanza, Toro 1, Toro 2 y Guanaco. Université Joseph Fourier. 2005.](#)
- [Vick. Morphology... Rock Glaciers - Mosquito Range - Colorado \(USA\) \(1981\)](#)
- [Vivero Andrade. Inventario Glaciares Cuenca del Copiapo \(Chile\) \(2008\)](#)