Center for Climate Crime Analysis

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Report to the Council on Ethics

of the Norwegian Government Pension Fund Global

on the situation in Cerro de Pasco

28 June 2019

Principal project partner:

source

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I. Introduction and summary

1. Cerro de Pasco is a mining town located on the high plateau of central Peru. Numerous Peruvian governmental authorities and NGOs, as well as international organizations, have reported that Cerro de Pasco is exposed to extreme levels of environmental pollution caused by mining which impacts on the health of the town's inhabitants. Cerro de Pasco's mines are owned and operated by the Peruvian company Volcan Compañía Minera S.A.A. ("Volcan").[1] In November 2017, Glencore acquired additional shares from Volcan and is now holding 55,03% of Volcan's voting shares.[2]

2. In 2012, the Council on Ethics ("Council") recommended that Volcan be excluded from the Norwegian Government Pension Fund Global.[3] Based on a number of scientific studies that were available at the time and its direct exchange with Volcan, the Council found that rivers and the soil in residential areas of Cerro de Pasco were contaminated with lead. It also found that half of Cerro de Pasco's children had high concentrations of lead in their blood.[4] However, the Council neither assessed nor made findings on responsibility for this contamination. It merely concluded that, since Volcan's business includes the processing of lead ore and the storing of waste rock in the middle of the city, there is a future risk that it contributes to the exposure of the residents of Cerro de Pasco to high concentrations of lead. It also noted that Volcan failed to conduct sufficient studies to clarify the causes of lead contamination in Cerro de Pasco and to identify any measures that would be necessary to prevent and reduce the risks resulting from its activities.[5]

3. In February 2019, the Council invited the Center for Climate Crime Analysis ("CCCA") to provide a report on the situation in Cerro de Pasco, including an analysis of any "responsibilities of the company" for the human and environmental harm caused. CCCA intends this report to inform the Council's position on whether the Norwegian Government Pension Fund Global should divest from Glencore. It complements the recently reported decision by the Norwegian Parliament that the Pension Fund should no longer invest in companies that mine more than 20 million tonnes of coal annually or generate more than 10 gigawatts of power from coal, which may also affect the Pension Fund's investments in Glencore.[6]

4. CCCA used its law enforcement expertise to direct and coordinate the information collection of a consortium of organizations and individuals with access to relevant information or expertise. Source International is CCCA's principal partner in this project. CCCA conducted a thorough analysis of all the available information and ensured that

[1] The Cerro de Pasco mining unit is a subsidiary of Volcan Compañía Minera S.A.A. and is referred to as Empresa Administradora Cerro S.A.C. *See* Volcan's website.
[2] *See* Gelencore's website: Glencore completes acquisition of voting shares of Volcan Compañia Minera S.A.A.
[3] Council, Recommendation on the exclusion of Volcan Volcan Compañia Minera SSA from the Government Pension Fund Global, to the Ministry of Finance, 21 June 2012 (unofficial English Translation) ("Council Recommendation"). Based on this Recommendation, the Ministry of Finance excluded Volcan from the Norwegian Government Pension Fund Global in October 2013.
[4] Council Recommendation, p. 17.
[5] Council Recommendation, pp. 17-18.
[6] Reuters, Norway fund may have to offload $1 billion stake in Glencore in shift away from coal, 12 June 2019.

information relied upon in this report is credible and reliable. Based on that information it finds as follows:[7]

5. First, many of Cerro de Pasco's inhabitants are severely contaminated with heavy metals, including lead, arsenic, chrome, manganese, iron and aluminium—all heavy metals that are related to the mining activities in Cerro de Pasco. This contamination severely impacts on the physical and mental health of many people of Cerro de Pasco, especially the children of the neighbourhood of Paragsha.

6. Second, the contamination with heavy metals is caused primarily by the ingestion of contaminated soil, water and food and through inhalation or ingestion of contaminated dust. The residential soil of Cerro de Pasco, including in children playgrounds, is contaminated with heavy metals. The water of the rivers around Cerro de Pasco and the city's drinking water is also contaminated with heavy metals. Some of the food supplies of Cerro de Pasco are directly impacted by contaminated water and soil, through which heavy metals enter the human food chain. In addition, dust particles produced by the mine deposit on the ground, crops, food and houses of the surrounding area, which increases the human intake of heavy metals.

7. Third, since Volcan acquired the Cerro de Pasco mine in 1999, it repeatedly introduced into the environment heavy metals, such as lead, arsenic, chrome, manganese, iron and aluminium in excess of maximum permissible levels established under Peruvian law. In so doing, it significantly increased previous levels of contamination of the soil, water, food and dust in and around Cerro de Pasco. It also significantly contributed to increasing levels of human heavy metal contamination from 1999 onwards.

8. As a result, Volcan is responsible for the environmental contamination in Cerro de Pasco and for the direct impact that this has on the physical and mental health of many people of Cerro de Pasco, and in particular of the children of Paragsha.

II. Methodology

9. The Center for Climate Crime Analysis is a non-profit organization of prosecutors and law enforcement professionals established to trigger and support judicial action against environmental destruction or other illegal activities that contribute to climate change.[8] CCCA uses its law-enforcement expertise to direct and coordinate other organizations and private citizens in their efforts to generate, preserve and collect reliable information. It then analyses that information and makes it available to the relevant authorities for enforcement or to other advocacy or litigation organizations.[9] CCCA does not replicate the work of other organizations. It is the link between existing investigative NGOs or entities with technological or scientific expertise on the one side, and law enforcement authorities on the other side. CCCA cooperates with, and is supported by, INTERPOL, Europol, the European Environmental Crimes Network ("EnviCrimNet") and the Office of the Prosecutor of the International Criminal Court.

[7] For the purposes of this report CCCA, did not assess the responsibility of any individuals, but focusses on the responsibility of Volcan as a legal entity.
[8] For more information, *see* CCCA website.
[9] For more information on the CCCA's approach to collecting and analysing information, *see* Law Enforcement Support Model.

10. CCCA has developed a case hypothesis and an information collection plan for Cerro de Pasco. These were further refined in consultation with members of its board of directors and advisory board, the Netherlands Forensic Institute and during the 2018 corporate crimes conference organized by Amnesty International and the International Corporate Accountability Round Table ("ICAR").

11. Source International—a non-profit organization of environmental scientists with over 10 years of experience in Cerro de Pasco—is CCCA's primary partner in this project. In addition, the following organizations and experts have cooperated with CCCA in collecting and analysing information relating to this project: the American Association for the Advancement of Science ("AAAS") provided expertise in multiple scientific fields, such as remote sensing, satellite imagery analysis and toxicology; Cyber Environmental Law Enforcement ("CybELE") provided Earth Observation services; the Human Rights Program of the University of Essex and the Human Rights Center at the University of California Berkeley School of Law conducted open source investigations and analysis; a team of experts in forensic medicine conducted medical examinations of affected children; the Sant'Anna School of Advanced Studies deployed scientific and legal experts in the field; Centro de Cultura Popular LABOR provided local expertise, logistical support and access to local information and persons affected by the mine; and the New York based architecture practice SITU produced a visual platform of the collected information, as well as some of the images used in this report.[10] In conducting its analysis, CCCA also took into consideration the Council Recommendation and the information underlying that Recommendation.

12. CCCA applied a standard analytical method for source evaluation to ensure that the information referred to in this report is credible and reliable. It tested each piece of information and sought to corroborate it with other credible information. CCCA further carefully checked the credentials of the scientific and technology experts who were involved in this project and assessed the authenticity of any open source information. For the factual findings in this report, CCCA was guided by the "reasonable basis" standard, as applied by the International Criminal Court to determine whether the opening of a formal investigation is warranted.[11]

III. Background

13. The city of Cerro de Pasco is the capital of the Pasco region and has about 70.000 inhabitants. It is located on the high plateau of central Peru at an altitude of 4.380 meters above sea level. Cerro de Pasco encircles a large open-pit mining crater and in its immediate vicinity are the mine's ore stockpiles, waste rock dumps and tailings impoundments. In recent decades, the open-pit mine has been exploited mostly for cooper, lead, zinc, silver, bismuth and gold.[12] Lead and zinc ore is crushed, ground and concentrated in a floatation plant. The concentrates are then transported to a loading zone for further freight by train.

[10] For more information about the CCCCA's project partners, *see* the websites of Source International; AAAS; CybELE, the Human Rights Program of the University of Essex; the Human Rights Center - UC Berkeley School of Law; the Sant'Anna School of Advanced Studies; PODER; the Centro de Cultura Popular LABOR; and SITU.

[11] *See*, *Situation in the Republic of Burundi*, Decision Pursuant to Article 15 of the Rome Statute on the Authorization of an Investigation into the Situation in the Republic of Burundi, ICC-01/17-9-Red, para. 30.

[12] Benavides QA (1990) Exploration and mining ventures in Peru, Econ Geol 85(7): 1296-1302; Bianchini et al., Elemental contamination of an open-pit mining area in the Peruvian Andes, Int. J. Environ. Sci. Technol. (2015) 12:1065–1074 ("Bianchini 2009 Study"), p. 1067.

Tailings from the process are deposited at a separate site west of the city. Ore with viable concentrations of gold and silver are stored in ore stockpiles at various sites in the city for further processing. Unviable rock and ore are stored in waste rock dumps in the northern part of the city.[13]

14. Mining in Cerro de Pasco started almost 400 years ago by Spanish colonialists. It intensified during the early 20th Century, when the North American Cerro de Pasco Investment Company acquired the mine. This period also marked the beginning of conflicts between the mining company and local communities over land and environmental pollution. In 1915 the mining company established itself as the Cerro de Pasco Cooper Corporation and later as Empresa Minera Paragsha, which started open-pit mining in 1956. The mine was nationalized in 1974. In 1999 Volcan acquired the mine from the state-owned company Centromin.[14] In November 2017, Glencore acquired the absolute majority of Volcan's voting shares.[15]

15. Numerous scientific reports conducted since the late 1990s by Peruvian government authorities and other organizations have established that soil, water and airborne dust in and around Cerro de Pasco were contaminated with lead and other heavy metals. Other studies have shown increased concentrations of lead and other metals in the blood, urine and hair of many of Cerro de Pasco's inhabitants, which constituted an alarming health situation of the affected people.[16]

16. While the environmental and human contamination with heavy metals affects the entire population of Cerro de Pasco, the neighbourhood of Paragsha is particularly impacted. It is situated in the north-west of Cerro de Pasco, surrounded by the Rumiallana stockpile to the north and the Paragsha stockpile to the south. Both stockpiles are used by Volcan to deposit discharged mining materials. To the east of Paragsha, the Miraflores area contains Volcan's mineral concentration plants, tailing ponds, workshops and deposits.[17]

17. In 2008, the Peruvian Congress legislated to relocate the city of Cerro de Pasco.[18] The draft bill that informed the Congress's legislative act refers explicitly to Volcan's notorious

[13] Ministerio de Vivienda, Construcción y Saneamiento, Plan de desarrollo urbano de la ciudad de Cerro de Pasco, setiembre del 2008, pp. 435, 439, 441. *See also* Council Recommendation, p. 5. The Council's findings are based on information directly provided by Volcan.

[14] Luis Vittor, Perú: Cerro de Pasco y la expansión minera, un conflicto infinito; Council Recommendation, p. 5.

[15] *See* Glencore's website: Glencore completes acquisition of voting shares of Volcan Compañia Minera S.A.A.

[16] The most relevant reports will be referred to in the analysis below.

[17] Ministerio de Vivienda, Construcción y Saneamiento, Plan de desarrollo urbano de la ciudad de Cerro de Pasco, setiembre del 2008, pp. 435, 439, 441.

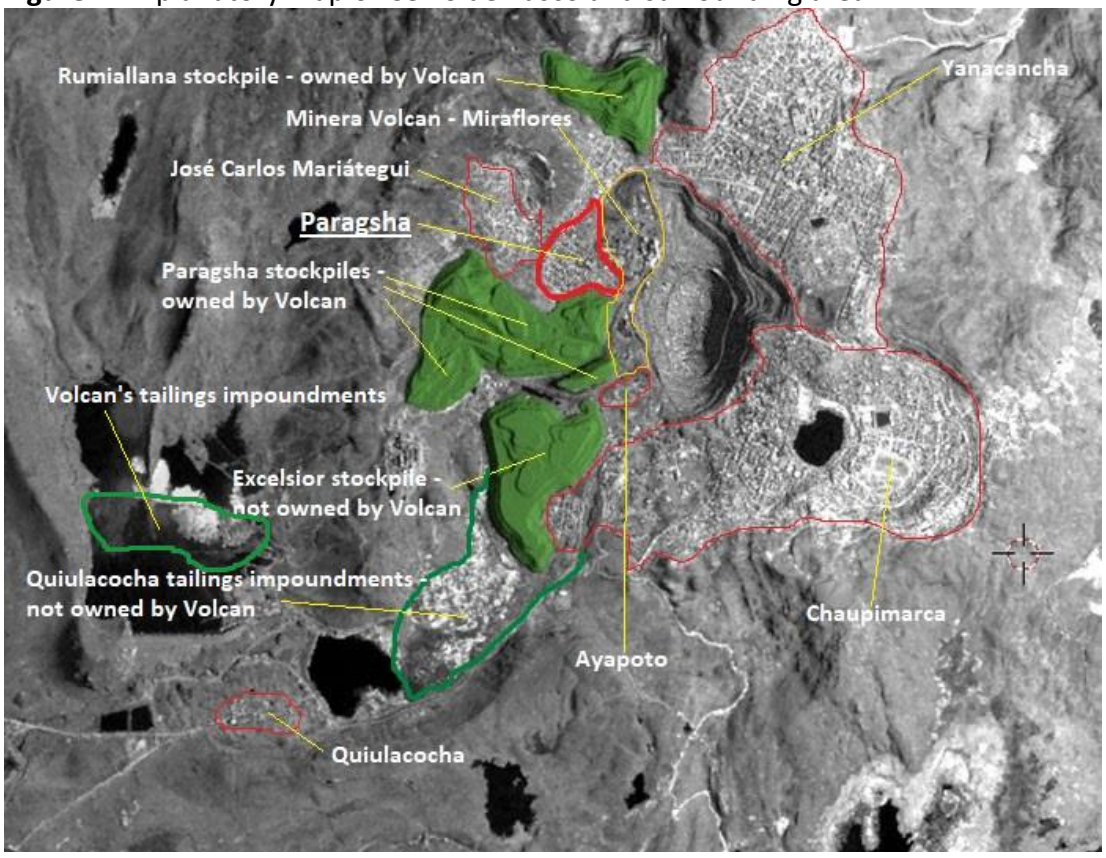
[18] Ley No. 29293. The law was adopted unanimously. The object of the law, is to relocate the city of Cerro de Pasco due to public necessity and national interest and to implement measures to achieve sustainable urban development (art. 1). Law 29293 specifically provides that the plan to control contaminating sources must permit: (a) the reduction of emissions, vibrations and effluents to the levels established in the environmental quality standards and the maximum permissible limits; (b) sealing the stockpiles and dumps; and (c) reducing the impact of percolation of contaminants to the underground waters (art. 4). Further, its provision on the health care plan explicitly requires that the said plan guarantee the analysis and monitoring of the population's levels of heavy metals, the support to be given to children suffering heavy metals or metalloids poisoning, and the identification of the sources and causes of the heavy metal contamination (art. 5).

history of deadly accidents and environmental offences.[19] The draft bill also links the population's health problems in Cerro de Pasco to the mining activity.[20]

18. In 2012, the Peruvian Ministry for Environment declared an environmental emergency in six neighbourhoods of Cerro de Pasco, including in Paragsha, based on the high lead levels in the blood of people from the affected areas.[21]

19. In 2017, the Government of Peru declared a health emergency in Cerro de Pasco's districts of Chaupimarca and Simón Bolívar (which includes Paragsha).[22] The Government noted that there was an elevated risk to human health due to the presence of excessive levels of lead, arsenic and other contaminants in the water for human consumption and in the soil of residential areas and parks.[23] In 2018, at a time when Glencore already owned the absolute majority of Volcan's voting shares, the Government issued a second Supreme Decree declaring a health emergency, including in Cerro de Pasco's districts of Chaupimarca, Simón Bolívar and Yanacancha.[24]

Figure 1: Explanatory map of Cerro de Pasco and surrounding area



[19] Proyecto de Ley No 1244/2006, pp. 2-3. The complete file on law 29293 is available here.
[20] Proyecto de Ley No 1244/2006, pp. 8-10.
[21] Resolución Ministerial No 117-2012-MINAM. The resolution is in large part based on information referred to in the Informe Técnico No 185-2012-MINAM-VMGA-DGCA.
[22] Decreto Supremo No. 020-2017-SA. The supreme decree is in large part based on information referred to in Informe No. 020-2017-JCCF-DENOT-DGIESP/MINSA; Nota Informativa No. 109-2017-DG-DIGERD-MINSA; Nota Informativa No. 239-2017-CDC/MINSA; Informe No. 532-2017/DCOVI/DIGESA.
[23] Decreto Supremo No. 020-2017-SA.
[24] Decreto Supremo No. 005-2018-SA. The supreme decree refers *inter alia* to Informe N° 1595-2017/DCOVI/DIGESA, Informe N° 009-2018-RABA- DENOT-DGIESP/MINSA, Informe Técnico IT-CDC N° 012-2018; and Informe N° 018-2018-COMITÉ TÉCNICO DS N° 007-2014-SA.

Figure 2: Cerro de Pasco & open pit

Figure 3: Paragsha & Volcan's stockpiles

IV. Heavy metal contamination of Cerro de Pasco's inhabitants and other health impacts

20. Many of Cerro de Pasco's inhabitants, especially the children of the neighbourhood of Paragsha, are highly contaminated with heavy metals, including lead, arsenic, chrome, manganese, iron and aluminium—all heavy metals that are related to the mining activities in Cerro de Pasco. As a result, their health is compromised.

21. As noted by the Council, since the mid-1990s, several studies have been conducted showing that residents of Cerro de Pasco had high blood lead levels ("BLL") and high concentrations of other heavy metals in their blood. The Council noted that according to four such studies[25] that examined nearly 1.300 children from Cerro de Pasco, 849 children (65%) had a BLL above 10 µg/dl, which is the upper limit set by the applicable Peruvian standard.[26] 90% of the children had high concentrations of at least one heavy metal in their blood. These studies also indicate that contamination was more common near mining facilities such as the open-pit mine, waste rock dumps and ore stockpiles.[27] Other studies, including more recent ones, corroborate these results.[28]

22. These high concentrations of lead and other metals in the children's bodies are sufficient to establish that the children are injured, irrespective of whether they have

[25] Centers for Disease Control and Prevention, Reporte Final, Exposiciones a metales pesados en niños y mujeres en edad fértil en tres comunidades mineras Cerro de Pasco, Perú, 21 de Mayo–4 de Julio de 2007 ("CDC Study 2007"); Astete, Jonh et al. (2006): Niveles de plomo en sangre y factores de riesgo asociados a la exposición a este metal en niños de 1 año a 12 años de edad y mujeres en edad fértil – Distrito de Yanacancha. Instituto Nacional de Salud, Cerro de Pasco; Astete, Jonh et al. 2005: Determinación de plomo en sangre y factores asociados en niños y mujeres gestantes de las poblaciones de Quiulacocha y Champamarca – Cerro de Pasco; Dirección General de Salud Ambiental del Ministerio de Salud (DIRESA) 1999: Estudio de plomo en sangre en la población seleccionada de Cerro de Pasco.

[26] Guía de Práctica Clínica para el Manejo de Pacientes con Intoxicación por Plomo, Resolución Ministerial N° 400-2017/MINSA. Some organizations, like the US Centers for Disease Control and Prevention have recently lowered the maximum BLL to 5 µg/dl, because "a growing body of studies concluding that blood lead levels (BLLs) lower than 10 µg/dL harm children", *see* here and here. *See* also WHO, Childhood Lead Poisoning, 2010.

[27] Council Recommendation, pp. 10-13.

[28] *See e.g.* Ministerio de Salud, Nota Informativa No 239-2017-CDC-MINSA (15 June 2017); Ministerio de Salud, Informe No. 004-2017-DIPREN/DIGIESP/MINSA (20.02.2017); Bianchini 2009 Study; INSO-INAPMAS, Determinación de efectos adversos sobre órganos blancos en población expuesta a emisiones de plomo, Cerro de Pasco (2002).

already developed specific medical symptoms linked to the contamination. Proof of injury is to be assessed on an objective basis and should not be dependent upon evidence of existing medical symptoms.[29]

23. In any event, a 2018 study conducted by Source International in cooperation with three medical doctors and forensic scientists shows that children in Paragsha have developed symptoms associated with heavy metal poisoning. The 2018 study followed an earlier study by Source International in 2016. These two studies examined the progression of human heavy metal contamination over time and assessed its wider impact on human health. They also compared the results found in the children of Paragsha to a control sample of children from Carhuamayo—a village 43 km from Cerro de Pasco—who were subjected to identical testing. Carhuamayo was selected as the referencing location because it has the same climatic conditions as Cerro de Pasco, it is approximately at the same level of altitude, and the nutrition and socio-economic conditions of its inhabitants are similar to those of Cerro de Pasco.[30]

24. Source International focused on heavy metal accumulation in hair, because unlike blood, heavy metals accumulate in hair. Therefore, hair is a more stable long-term bio-indicator of a person's exposure to heavy metals.[31]

25. The 2016 study tested 82 children from Paragsha and 20 children from Carhuamayo for the presence of 21 heavy metals and compared the results with standards set by the German scientific laboratory Micro Trace Minerals.[32] It found that the hair of 100% of the children from Paragsha contained lead which was eight times above the reference level. On average, it was four times higher than the average of the lead level measured in the hair of the children from Carhuamayo. In addition, between 86% and 97,5% of the children from Paragsha had values that exceeded the reference levels for arsenic, chrome, manganese, iron and aluminium. On average, the level of these heavy metals measured in the hair of the children from Paragsha was double the levels measured in the hair of the children from Carhuamayo, whose average levels were around the reference levels.[33]

26. The 2018 study tested 79 children between the ages of 3 and 16 from Paragsha and 16 children from Carhuamayo. About half the children from Paragsha had also participated in the 2016 study. All children underwent a complete physical examination and analysis of their medical history. The hair of the children was tested for the presence of 21 heavy metals. The results were then compared to those of the 2016 study.[34] The 2018 study found that the hair of the children from Paragsha contained significantly higher concentrations of

[29] For a compendium of health risks associated with lead, *see e.g*. World Health Organization, Lead Poisoning and Health, 23 August 2018.

[30] Source International, Source International, Biomonitoreo de los metals en niños del Centro Poblado de Paragsha Cerro de Pasco, Perú, Abril 2017, Abril 2017 ("Source International, 2016 Hair Study"), p. 56.

[31] Source International, 2016 Hair Study, p. 55. According to the US Environmental Protection Agency, hair is a reliable tissue for the biological monitoring of most toxic metals (*see* Jenkins, D. Toxic Trace Metals in Mammalian Hair and Nails. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/4-79/049 (NTIS PB80103997), 1979).

[32] Source International, 2016 Hair Study, p. 57. *See also* website of Micro Trace Minerals. Peruvian law does not provide for standards of heavy metal concentration in hair.

[33] Source International, 2016 Hair Study, pp. 58-66.

[34] Source International-Universidad de Santiago de Compostela, Exposición a metales pesados: un estudio poblacional, 14 Junio 2019 ("2018 Health Study").

heavy metals than the children from Carhuamayo.[35] In addition, in relation to those children from Paragsha who had participated in the 2016 study, the 2018 study found that the concentrations of heavy metals in the hair of these children had significantly increased from September 2016 to July 2018. For instance, the manganese, iron and chrome content had more than doubled, the lead content increased by 47%, and the aluminum content increased by 54%.[36] This indicates that the children from Paragsha were exposed to significantly higher heavy metal concentrations in July 2018—at a time when Glencore controlled the majority of Volcan's voting shares—than they were in September 2016, when Volcan's mining activities were temporarily suspended.[37]

27. As noted above, the 2018 study also focused on symptoms that are typical for heavy metal poisoning: nose bleeding,[38] chronic gastrointestinal diseases,[39] constipation,[40] reduced vision,[41] dermatological alterations,[42] depression and other behaviour disorders.[43] While 67 of the 78 children from Paragsha (78%) were diagnosed with at least one of these symptoms that could clearly be related to heavy metal poisoning, only two children from Carhuamayo had one of these symptoms. These two children were sisters who were born in Cerro de Pasco and had moved to Carhuamayo with their family approximately a year before they were examined. This further corroborates that the children from Cerro de Pasco developed symptoms related to heavy metal poisoning, which those in Carhuamayo did not.

28. The findings from the 2018 Study regarding medical symptoms are corroborated by statistical data on mortality, morbidity and mental health in Cerro de Pasco and the Pasco region. The data collected by Source International from the regional health authorities, local hospitals and the Peruvian Ministry of Health indicate symptoms that are typically related to the exposure of heavy metals. Indeed, among the main causes for mortality and morbidity are digestive and respiratory problems, including lung and stomach cancer. In addition, the mental health statistics show very high levels of depression including suicidal tendencies, as well as of aggression contributing to domestic violence.[44]

29. Overall, the health situation in Cerro de Pasco is dire. This is also shown by the fact that in 2015, life expectancy in the Pasco region—158.429 inhabitants, out of which almost half live in Cerro de Pasco—was 72,5 years. This is five years less compared to life expectancy in Peru's regions of Ica or Lima.[45] In addition, according to statistics of the Peruvian Government, in the Pasco region, Cerro de Pasco is the only urban area where all

[35] 2018 Health Study, apartados 1 y 5, tablas 2-3 y 18.
[36] 2018 Health Study, apartado 2, table 4.
[37] Volcan's mining activities in Cerro de Pasco were temporarily suspended between December 2015 (Volcan Memoria Anual 2015, p. 65) until November 2016 (Volcan Memoria Anual 2016, p. 67).
[38] 2018 Health Study, apartados 3 y 6, tablas 6 y 21.
[39] 2018 Health Study, apartado 3, tabla 8.
[40] 2018 Health Study, apartado 3, tabla 9.
[41] 2018 Health Study, apartado 3, tabla 10.
[42] 2018 Health Study, apartado 3, tabla 14.
[43] 2018 Health Study, apartado 3, tabla 13.
[44] 2016 Hair Study, pp. 71-86.
[45] Dirección General de Epidemiología, Análisis de situación de Pasco, 2015.

indicators of infant mortality were much higher than in rural areas between 2001 and 2011.[46]

V. Causes of human contamination with heavy metals

30. According to scientific literature, human intake of lead and other heavy metals may occur, among others, through ingestion of contaminated soil, water and food and through inhalation or ingestion of dust particles containing heavy metals.[47] Indeed, the Peruvian Ministry of Health has concluded that the health of Cerro de Pasco's population is at risk due to their exposure to heavy metals contained in soil, drinking water and air.[48]

A. Contaminated soil

31. According to the World Health Organization ("WHO"), where mine tailings enriched in lead or other toxic metals are in close vicinity to population centres, it is common for children to ingest large quantities of lead by playing in contaminated soil or ingesting lead-laded dust.[49] Young children are particularly vulnerable to lead poisoning because they absorb 4–5 times as much ingested lead as adults from a given source. Moreover, children's innate curiosity and their age-appropriate hand-to-mouth behavior result in their mouthing and swallowing lead-containing or lead-coated objects, such as contaminated soil or dust.[50]

32. For the purposes of its 2012 Recommendation, the Council considered four studies of the lead content of Cerro de Pasco's soil. Three were produced by the Peruvian Ministry of Health,[51] while the other one was conducted by the US Centers for Disease Control and Prevention (CDC).[52] It also considered an environmental impact assessment commissioned by Volcan.[53] In sum, the Council found that these sources showed that Cerro de Pasco's soil contains high lead concentrations in school yards, playgrounds and other areas to which children might have access. Paragsha was one of the areas assessed.[54]

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[46] INEI, Encuesta Demográfica y de Salud Familiar, Departamento de Pasco, 2012. Neonatal mortality: 20,2 urban, 11,8 rural; post neonatal mortality: 9,9 urban, 5,4 rural; infant mortality: 30,1 urban, 17,2 rural; children mortality: 35,3 urban, 25,1 rural (all numbers in thousand).

[47] World Health Organization, Lead Poisoning and Health, 23 August 2018; J. Żukowska and M. Biziuk, Methodological Evaluation of Method for Dietary Heavy Metal Intake, Journal of Food Science, 31 January 2008; XingmeiLiu[a] et al., Human health risk assessment of heavy metals in soil–vegetable system: A multi-medium analysis, Science of The Total Environment, Volumes 463–464, 1 October 2013, Pages 530-540.

[48] Informe Técnico No 185-2012-MINAM-VMGA/DGCA, p. 9.

[49] Bulletin of the World Health Organization, Lead exposure from soil in Peruvian mining towns: a national assessment supported by two contrasting examples, A. van Geen et al., 10 October 2012 ("WHO 2012 Study"); *see also* authorities in footnotes 10, 16-19 of this WHO publication.

[50] World Health Organization, Lead Poisoning and Health, 23 August 2018. *See* also Source International, 2016 Hair Study, p. 56.

[51] Dirección Regional de Salud Pasco (DIRESA) 2008: Resultados de los análisis de suelos – Ciudad de Cerro de Pasco y sus distritos Simón Bolívar, Yanacancha y Chaupimarca, DIRESA 2007: Vigilancia sanitaria de suelos superficiales – Chaupimarca y Quiulacocha, Centers for Disease Control 2007: Final Report: Heavy metals exposures among children and women of childbearing age in three mining communities and Centro Nacional de Salud Ocupacional y Protección del Ambiente Para la Salud (CENSOPAS) 2006: Niveles de plomo en sangre y factores de riesgo asociados a la exposición de este metal en niños de 1 año a 12 años de edad y mujeres en edad fértil, distrito de Yanacancha, Cerro de Pasco - mayo 2006.

[52] CDC Study 2007, p. 34, *see also* mapa 1 at p. 37.

[53] Minera Interandina de Consultores S.R.L., Estudio de Impacto Ambiental Ampliación Paragsha - San Expedito (2007), p. 199.

[54] Council Recommendation, pp. 7-8.

33. These findings are further corroborated by a subsequent study conducted by the WHO. It concluded that the geographic association between the high blood lead levels of children and the high soil lead content, and the absence of a similar association in women of child-bearing age, suggests that the primary pathway of lead exposure in children in Cerro de Pasco is the ingestion of soil and soil dust.[55]

34. In 2013, the Centro de Cultura Popular LABOR published the most comprehensive soil study for Cerro de Pasco yet.[56] Unlike other soil studies that provided the results of the soil studies in defined areas and within a certain range of contamination, this study published the precise results of 31 specific locations in and around Cerro de Pasco. These locations include three children playgrounds and one school yard in Paragsha.[57] In addition, this study does not only examine lead contamination, but also the soil content of other heavy metals, namely arsenic, cadmium, mercury, antimony, zinc, copper, iron, manganese, rubidium and chrome.

35. The results of this study show a picture of widespread contamination: for instance, 30 of the 31 samples exceeded[58] the limits in soil quality standards for lead content in residential areas, which is 140 mg/kg.[59] The lead level in the soil of the playgrounds and the school yard of Paragsha (reference points 1-4 at Figure 4) were among the highest with levels between 3.785 and 6.000 mg/kg. This means that the lead levels in sites in Paragsha most frequently accessed by children exceeded the legal limits by between 26 and almost 42 times. The levels of other heavy metals are similar. The arsenic levels in Paragsha were between 765 and 1.245 mg/kg, compared to the maximum permissible level of 50 mg/kg; and all probes taken in Paragsha far exceeded the maximum permissible levels under Peruvian soil quality standards for mercury and cadmium.

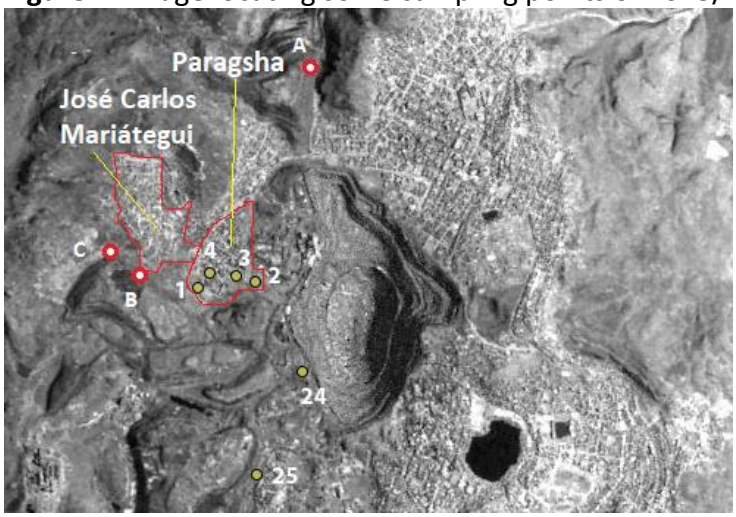
36. In 2016, the Ministry of Health conducted two further soil studies in residential areas and playgrounds in Cerro de Pasco. Both studies concluded that in all three districts of the town (Simón Bolívar, Chaupimarca and Yanacancha), the lead, arsenic, cadmium and mercury levels exceeded soil quality standards. It concluded that this constituted an elevated risk to human health.[60]

37. The Rumiallana and Paragsha stockpiles (Figure 1) are a principal source of pollution for soil and water in Paragsha and other areas of Cerro de Pasco located in close vicinity to these stockpiles. Heavy metals are not biodegradable; they persistently remain in the environment.[61] Soil samples taken by Source International in February 2019 from the

[55] WHO 2012 Study.
[56] Centro de Cultura Popular LABOR, Análisis participativo de la calidad de suelos en poblaciones afectadas por la actividad minera en Pasco, Boletín Participación 36, Octubre 2013 ("LABOR 2013 Soil Study").
[57] The soil samples were taken in December 2011.
[58] The only sample that did not exceed regulatory limits (El Pilar, reference #28) was taken dozens of km away from Cerro de Pasco.
[59] Decreto Supremo No 002-2013-MINAM, 25 marzo 2013; *see also* Decreto Supremo No 011-2017-MINAM, 2 December 2017.
[60] Ministerio de Salud, DIGESA, Informe No 532-2017/DCOVI/DIGESA, 15 de julio del 2017, referring to Informe No 1819-2016/DEPA/DIGESA (8/3/2016), and Informe No 5401-2016/DSA/DIGESA (27/9/2016). *See also* OEFA Informe No 119-2015-OEFA/DE-SDLB-CEAI, (referred to in Municipalidad Simón Bolívar, Oficio No. 052-2018-ALCALDÍA-MDSB-PASCO, 2/3/2018).
[61] Source International, Environmental analysis on mine waste disposals in Cerro de Pasco, June 2019.

Rumiallana and Paragsha stockpiles show extremely high metal concentrations.[62] For instance, the lead levels were between 7.300 and 18.000 mg/kg. Similarly, the arsenic levels were between 760 and 1.100 mg/kg.[63] The levels of iron, zinc, copper and manganese were also found to be extremely high.[64] During the rainy season, rainwater flowing off the stockpiles can contain high heavy metal concentrations and pollute areas in close proximity to the stockpiles through a process called acid rock drainage. On the basis of these three soil samples, Source International estimated the acid production potential of the Rumiallana and Paragsha stockpiles by applying the recognized EPA Method.[65] It concluded that for all three soil samples the acid production potential is extremely high, namely between 82,3 and 425.[66] This is corroborated by a previous study conducted by four Swiss and German scientific institutions published in 2006. That study examined the acid rock drainage of the Excelsior stockpile (Figure 1). The study found that Excelsior produced acid rock drainage rich in iron, manganese, copper, zinc, cadmium, arsenic and sulphur.[67] Given the similar chemical composition of the Rumiallana and Paragsha stockpiles—storing waste rock from the same mine[68]—it can be inferred that the acid rock drainage effects of those stockpiles are similar to those of Excelsior.

Figure 4: image locating some sampling points of 2013/2019 soil studies



1 Children playground (Pb: 5.368; As: 1.263; Cd: 15; Hg: 39); 2 football field (Pb: 3.792; As: 765; Cd: 25); **3** interior courtyard of primary school (Pb: 3.785; As: 1.065; Cd: 15); **4** children playground (Pb: 6.000; As: 1.245; Cd: 21; Hg: 40); **24** road immediately next to open pit (Pb: 2.011; As: 199; Cd: 11); **25** road next to Excelsior stockpile (Pb: 3.251; As: 457; Cd: 20); **A** Rumiallana stockpile (Pb: 18.000; As: 76); **B** Paragsha stockpile (Pb: 18.000; As: 1.600); **C** Paragsha stockpile (Pb: 7.300; As: 1.100).

[62] Peruvian law does not provide for standards that regulate the heavy metal concentration of stockpiles. For the applicable Peruvian standards for industrial or extractive soil, *see* Decreto Supremo No 011-2017-MINAM, 2 December 2017. *See further* ECA Suelo Peru. However, the stockpiles are not strictly considered industrial or extractive soil.

[63] Source International, Environmental analysis on mine waste disposals in Cerro de Pasco, June 2019, Table 1. Laboratory chemical results.

[64] Iron: 140.000-290.000 mg/kg; zinc: 3.300-51.000 mg/kg; copper: 450-2.000 mg/kg; manganese: 26-41.000 mg/kg.

[65] U.S. Environmental Protection Agency, EPA 1994 -530-R-94-036: Technical Document – Acid Mine Drainage Prediction. See in particular the Coastech 1989 method and the Caruccio et al, 1981 method referred to in this document.

[66] Source International, Environmental analysis on mine waste disposals in Cerro de Pasco, June 2019, Table 1. Laboratory chemical results.

[67] Smuda et al., Geochemistry and secondary mineralogy at the sulphide-rich Excelsior waste rock dump from the polymetallic Zn-Pb-(Ag-Bi-Cu) mineralization Cerro de Pasco, Peru, published by American Society of Mining and Reclamation (ASMR), pp. 2084-2089.

[68] Like Source International's 2019 soil sampling from the Rumiallana and Volcan stockpiles, the Excelsior stockpile was found by the Swiss-German study to contain high concentrations of Fe, Pb, Zn, Cd, As, Cu and Mn.

B. Contaminated water and food

38. Mining activities in Cerro de Pasco contaminate water primarily through discharges from the mines processing facilities, the underground mine and the treatment plants, through its waste rock dumps, as well as through the deposition of polluted dust on water. This affects the water quality of rivers and lakes, as well as some of the food consumed in Cerro de Pasco and Cerro de Pasco's drinking water.[69]

i. Contamination of rivers

39. Scientific studies show that there are at least three rivers in the area around Cerro de Pasco that are affected by mining activities: the Ragra, San Juan, and Tingo Rivers.

40. The Ragra River is the recipient of discharge waste waters from Volcan's processing facility, underground mine and the treatment plant that treat leachate from dumps and piles, among other things.[70] About 3 km west of Quiulacocha, it flows into the San Juan River. For the purpose of its 2012 Recommendation, the Council considered Volcan's monitoring reports for the Ragra River for the period between January 2009 and March 2011. The results of the measurements showed that the water in the Ragra River contained high concentrations of lead, and that these increased downstream of Volcan's discharge points. At the first measurement station downstream of the discharge points, all measurement values reported for the period between January 2009 and March 2011 exceeded the maximum permissible levels for water quality (0,05 mg/l),[71] and the average lead concentration during the period was 0,885 mg/l. The maximum value was reported in September 2009 (4,046 mg/l) and the minimum value in December 2010 (0,180 mg/l).[72] Measurements conducted by the Peruvian authorities (DIRESA) in March 2010 at the same location showed similar results, with a maximum lead concentration of 8,0 mg/l and an average of 1,3 mg/l.[73] These exceed the maximum permissible level for lead in rivers by up to 160 times. Other measurements taken by Volcan also confirm these results.[74]

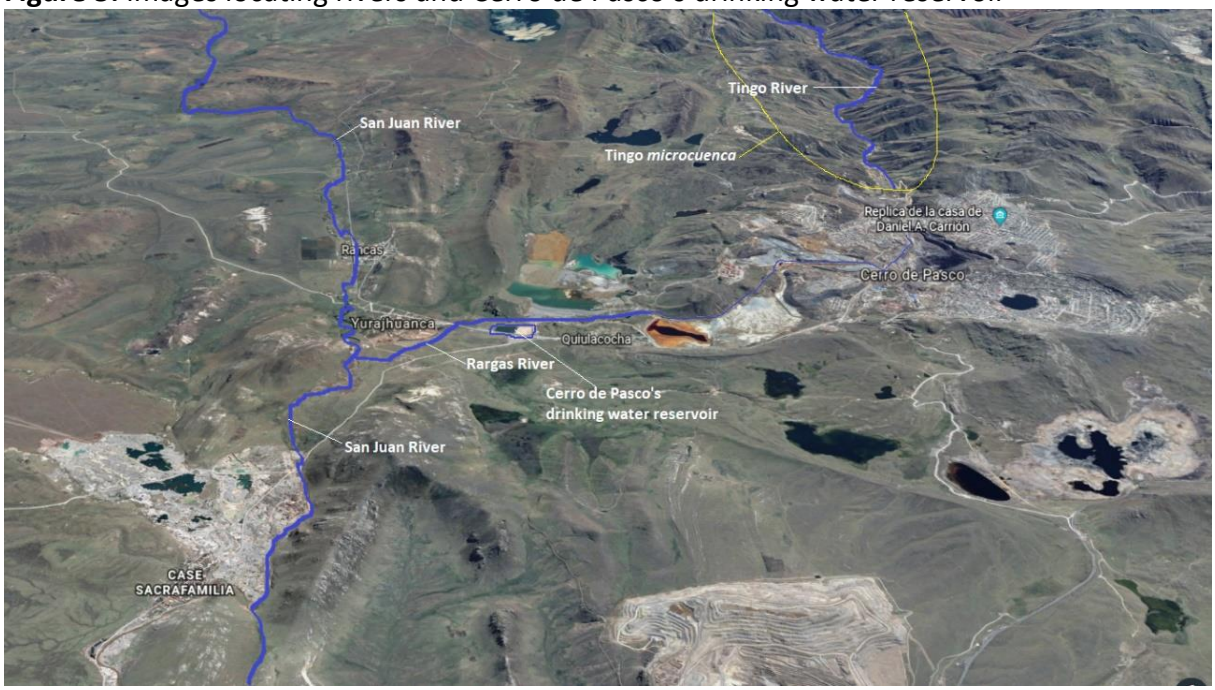
41. The San Juan River springs in the north-west of Cerro de Pasco and flows in the southern direction until it reaches the Junin Lake. In 2009, Source International conducted a study of the water quality of the San Juan River, finding that downstream of the Cerro de Pasco mine it was highly contaminated with heavy metals, such as lead, cadmium, manganese, copper, zinc and iron. Upstream the mine, the water contained much lower levels of heavy metals.[75] A government study also concluded that the water of the San Juan River was contaminated with heavy metals exceeding maximum permissible water quality

[69] Bianchini 2009 Study, p. 1074.
[70] Council Recommendation, p. 9.
[71] Decreto Supremo No 002-2008 MINAM- Categoría 3.
[72] Council Recommendation, p. 9.
[73] DIRESA - Unidad Ecología y Protección del Ambiente, Protección de los recursos hídricos, 2010; *see also* Council Recommendation, p. 9.
[74] Volcan's 2009 monitoring results show values for lead as high as 4,046 mg/l for monitoring point E-02A, 200m downstream from the three discharge points, *see* MONITOREO – AGUA, tab Setiembre. *See also* MONITOREO - AGUA – 2009.
[75] Bianchini 2009 Study, p. 1071, Table 5 references SJ1, SJ2, SJ3 and SJ4.

standards and that this is the result of metal-mining activities.[76] Volcan's internal monitoring reports further confirm these results.[77]

42. The Tingo River flows from the northern part of Cerro de Pasco in a northerly direction. Its source emerges from water tubes that come out from underneath the Rumiallana stockpile, which Volcan uses as its waste rock dump site. In 2009, Source International measured the water quality at the source of the Tingo River and found that it vastly exceeded applicable water quality standards for many heavy metals, such as lead, arsenic, cadmium, copper and zinc.[78]

Figure 5: images locating rivers and Cerro de Pasco's drinking water reservoir



ii. Contamination of food

43. Through agriculture, contaminated water from the San Juan and Tingo Rivers enters into the human food chain.[79] Some communities of Cerro de Pasco breed livestock (cattle, alpacas, llamas and sheep) along the San Juan River. It is not uncommon that this livestock drinks water directly from the river.[80]

44. The area immediately north of the source of the Tingo River is referred to as the Tingo *microcuenca*. According to a study conducted by Bianchini et al., the water and sediment of the Tingo River are contaminated with lead and other heavy metals. This

[76] OEFA Informe No 034-2015-OEFA/DE-SDCA-CEAI, p. 205 (referred to in Municipalidad Simón Bolívar, Oficio No. 052-2018-ALCALDIA-MDSB-PASCO, 2/3/2018.

[77] Volcan's 2009 monitoring results show values for lead as high as 3,85 mg/l for monitoring point 215, just before the effluent joins the San Juan River, *see* MONITOREO – AGUA, tab Agosto. *See also* MONITOREO - AGUA – 2009.

[78] Bianchini 2009 Study, p. 1071, Table 5, reference T1.

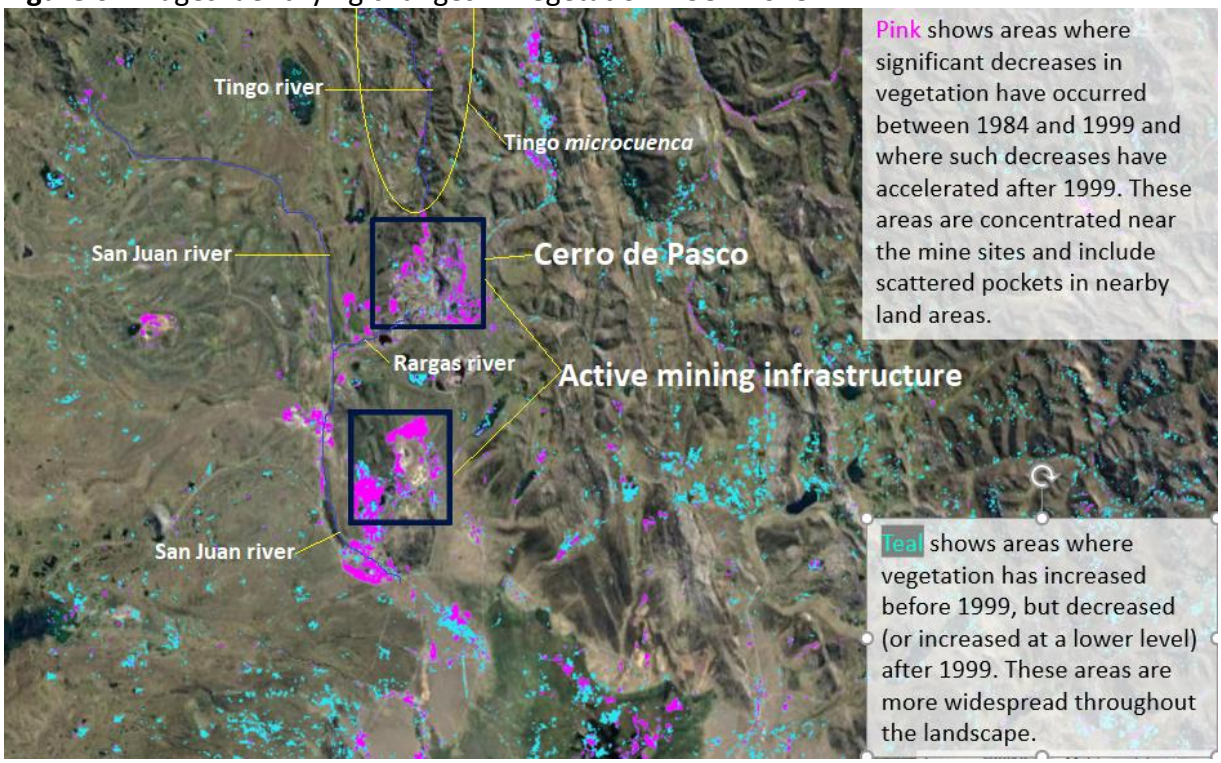
[79] Fisher, Heavy Metals in the Food Chain – Lead, Cadmium and Mercury in Foodstuff and Population Exposures, Proc. Indian Natl. Sci. Acad. B71, No. 3&4 (2005), pp. 109-143.

[80] *See e.g.* Source International, Análisis Ambiental de la Calidad de los Recursos Hídricos en la Zona Minera de Cerro de Pasco, Enero 2017 ("Source International 2016 Water Study"), p. 28 and Fig. 2.2.6. and 2.2.8.

contamination was measured as far downstream as 30 km.[81] In addition, the LABOR 2013 Soil Study established that the soil in the Tingo *microcuenca* contains high levels of lead and arsenic,[82] which far exceed the maximum permissible levels of heavy metals under applicable soil quality standards in agricultural soil.[83] The Tingo *microcuenca* has more vegetation than Cerro de Pasco and up to 80% of the economically active population make a living from agriculture. People plant crops such as potatoes, maize, beans, *oxalis tuberosa* (oca) and *ullucus*. The food that is not locally consumed is primarily sold on the markets in Cerro de Pasco.[84] Through this cycle, the heavy metals from the water of the Tingo River and the soil enter the human food chain.

45. Contaminated water runoff and dust related to mining can impact on agricultural and other vegetation and therefore enter into the human food chain. Nicholas Cuba from Clark University measured the change of vegetation around Cerro de Pasco from 1984 until 2018. He used the Normalized Difference Vegetation Index (NVDI), which approximates how "green" or photosynthetically productive vegetation is during an annual period. The study concluded that there were significant decreases adjacent to, downstream from, and near Cerro de Pasco. These decreases have accelerated after 1999,[85] when Volcan acquired the mine.

Figure 6: images identifying changes in vegetation: 1984-2018



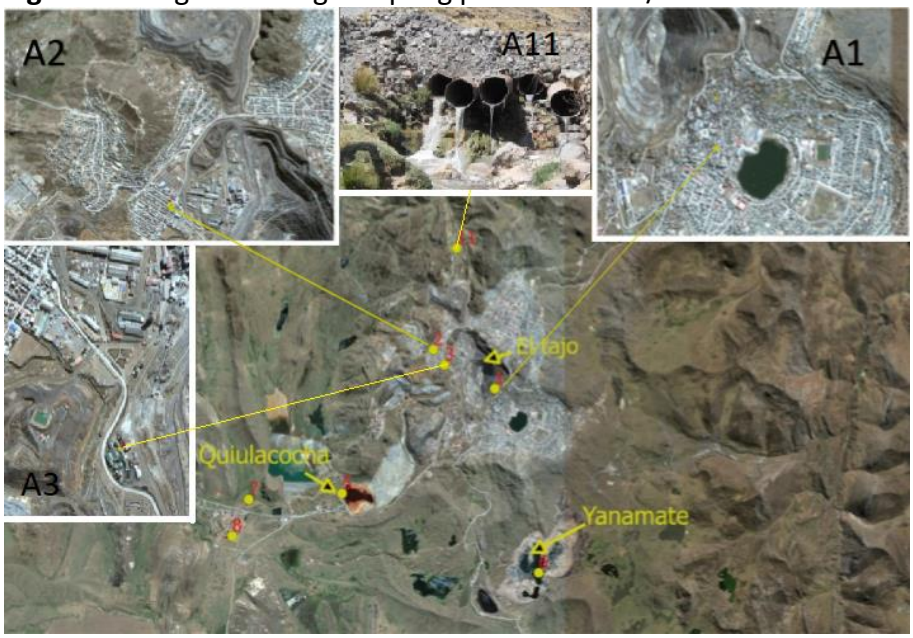
[81] Bianchini 2009 Study, p. 1071-1072, Tables 5 and 6, reference T2 and T3.
[82] LABOR 2013 Soil Study, pp. 10-11, sample # 28-31.
[83] Decreto Supremo No 002-2013-MINAM, 25 marzo 2013; *see also* Decreto Supremo No 011-2017-MINAM, 2 December 2017.
[84] Centro de Cultura Popular LABOR, Calidad de aguas en la microcuenca del río Tingo, Junio 2009, pp. 3-5, 8.
[85] Nicholas Cuba, Changes in vegetation around Cerro de Pasco, 1984-2018, December 2018. *See also* Nicholas Cuba, Measurements of the Normalized Difference Vegetation Index (NVDI) at three locations of the Tingo Valley, June 2019.

iii. Contamination of Cerro de Pasco's drinking water

46. In its 2012 Recommendation, the Council did not assess the quality of Cerro de Pasco's drinking water. There is information indicating that contaminated drinking water is an additional source of human intake of lead and other heavy metals.

47. The drinking water for Paragsha and some other parts of Cerro de Pasco derives from a reservoir which is located between Quiulacocha and Yurajhuanca, immediately below the Ragra River (Figure 5). From there the water is piped and distributed to various neighbourhoods of Cerro de Pasco, including Paragsha. The competent regional health authorities (DIRESA) found that in March 2007 and in 2009 the drinking water of Cerro de Pasco's districts of Quiulacocha and Chaupimarca contained lead above the limits recommended by WHO.[86] WHO's recommended lead limit is identical to the Peruvian limit established in 2008[87] and 2010,[88] namely 0,01 mg/l. Source International examined drinking water in Paragsha in 2009, and found that it drastically exceeded the applicable water quality standards for numerous heavy metals. For instance, it contained 0,039 mg/l of lead and 0,043 mg/l of arsenic (for which the upper limit is also 0,01 mg/l).[89] After Volcan was given the licence to provide drinking water to Cerro de Pasco in 2011,[90] Cerro de Pasco's drinking water continued to be contaminated. Testing conducted by the Ministry of Health in late November 2015 showed that the drinking water in 13 locations in Cerro de Pasco's districts of Simón Bolívar (which includes Paragsha), Chaupimarca and Yanacancha exceeded the maximum permissible levels of lead, arsenic, aluminium and iron.[91]

Figure 7: images locating sampling points of 2009/2016 water studies



1 Drinking water Chaupimarca;
2 drinking water Paragsha;
3 Volcan's water discharge point;
7 San Juan river, above its confluence with Rargas river;
8 San Juan river, below its confluence with Rargas river;
11 source of Tingo river.

[86] Ministerio del Ambiente, Informe Técnico, no 185-2012-MINAM-VMGA/DGCA, 20 April 2012, pp. 3-4. According to the 1993 regulation on environmental protection in metal-mining activities, if no maximum permissible levels exist under domestic law, standards set by international organizations may be taken into consideration (Reglamento para la protección ambiental en la actividad minero-metalúrgica, D.S. Nº 016-93-EM (1993), art. 24).
[87] Decreto Supremo No 0002-2008 MINAM- Categoría 1: Poblacional y Recreacional.
[88] Decreto Supremo No 031-2010, Anexo III.
[89] Bianchini 2009 Study, p. 1071, Table 5, reference point C.
[90] Administración Local de Agua Pasco, Resolución Administrativa, No 045-2011-ANA-ALA PASCO, 4 abril 2011.
[91] Ministerio de Salud, Informe No 532-2017/DCOVI/DIGESA; Informe No 1989-2016/DSA/DIGESA.

C. Contaminated dust and air

48. Several scientific studies have demonstrated the direct impact on human health of heavy-metals-rich dust or other mining dust provoked by metallurgical mines.[92] Dust particles produced by the mine deposit on the ground, on crops, on food and on houses of the surrounding area, which greatly increases the risk of heavy metal intake by the population,[93] including by entering into the human food chain.[94] Ongoing mining activities in Cerro de Pasco and in particular the crushing, grounding and transportation of ore and waste rock, as well as the stockpiles around the city generate dust that affects peoples' health. This is particularly so during the dry season.

49. The Peruvian Ministry of the Environment, through the *Dirección General de Salud Ambiental* (DIGESA) examined the air quality in Paragsha in 2007 and 2008. On both occasions it found that the air quality exceeded legally established air quality standards. In 2007 and 2008, the concentration of particulate material less than 10 microns (PM-10) exceeded the regulatory standard of 150 µg/m³ per 24 hours.[95] PM is a common proxy indicator for air pollution. The major components of PM are sulphate, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water. It consists of a complex mixture of solid and liquid particles of organic and inorganic substances suspended in the air. PM-10 particles can penetrate and lodge deep inside the lungs.[96]

50. In 2008 the airborne lead particles measured in Paragsha also exceeded[97] both the Peruvian standard of 1,5 µg/m³,[98] as well as Ontario's Ambient Air Quality Criteria from 2001 of 2,0 µg/m³.[99] The airborne lead particles eventually deposit in the homes of Paragsha's residents. The 2007 study by the US Centers for Disease Control examined dust samples taken from kitchen floors of dwellings in Paragsha. It found that they included very high levels of lead contamination, reaching more than 400 µg/ft² (37,16 µg/m²). This exceeded the CDC's reference level for lead in dust by four times,[100] and was the highest level of lead contamination in dust measures in all of Cerro de Pasco.[101]

51. In 2008, the air quality in Quiulacocha and Chaupimarca also exceeded air quality standard limits—both with respect to PM-10 and airborne lead particles—and, according to DIGESA, it was at a level that impacts human health.[102] However, the air in those

[92] Tayler et al. Environmental arsenic, cadmium and lead dust emissions from metal mine operations: Implications for environmental management, monitoring and human health, Environmental Research, Volume 135, November 2014, Pages 296-303.
[93] Bisquert et al. The impact of atmospheric dust deposition and trace elements levels on the villages surrounding the former mining areas in a semi-arid environment (SE Spain) Atmospheric Environment, Volume 152, March 2017, Pages 256-269.
[94] Pruvot et al. *Heavy Metals in Soil, Crops and Grass as a Source of Human Exposure in the Former Mining Areas*, Journal of Soils and Sediments October 2006, Volume 6, Issue 4, pp 215–220.
[95] Decreto Supremo No 074-2001-PMC, anexo 1; Informe Técnico No 185-2012-MINAM-VMGA/DGCA, p. 5. *See also* DIGESA, Monitoreo de calidad del aire "Cerro de Pasco", Junio 2007.
[96] *See* Source International, Evaluation of OEFA dataset for MP-10 and SO2 in Paragsha Station, June 2019.
[97] Informe Técnico No 185-2012-MINAM-VMGA/DGCA, p. 5.
[98] Decreto Supremo No 074-2001-PMC, anexo 1.
[99] DIGESA, Monitoreo de calidad del aire "Cerro de Pasco", Junio 2007, p. 9.
[100] The CDC Study 2007 applies the reference value of 100 µg/ft² (9,29 µg/m²).
[101] CDC Study 2007, Tabla 7, p. 33.
[102] Ministerio del Ambiente DIGESA, Informe Técnico No 185-2012-MINAM-VMGA/DGCA, pp. 4-8.

neighbourhoods of Cerro de Pasco was generally better than in Paragsha.[103] The environmental monitoring authority (OEFA) further found in 2017 that the air quality in Cerro de Pasco exceeded the maximum permissible levels of PM-10.[104]

52. Volcan's own monitoring reports show that values in Chaupimarca exceeded the maximum permissible levels for mining operations for PM-10 (with values as high as 416,29 µg/m³)[105] and lead (as high as 1,779 µg/m³).[106] The reports also show that Volcan measured values exceeding national air quality standards for PM-10 on at least two additional occasions[107] and exceeding lead annual average standards in thirteen additional occasions.[108]

VI. Volcan significantly contributed to environmental and human contamination with heavy metals

53. Volcan does not dispute the dire environmental situation in Cerro de Pasco, including the high lead content in the soil and the human blood.[109] However, it denies any responsibility. Volcan argues that its operations have not contributed in any way to the environmental contamination and human harm in Cerro de Pasco. According to Volcan, the environmental situation is largely a result of previous mining activities (prior to Volcan's acquisition of the mine) as well as a number of other factors outside its control, such as the naturally high mineral content in rocks.[110]

54. This section addresses each of these arguments. In so doing, it shows that Volcan's mining operations, although not the only cause, have significantly contributed to contaminating the soil, water, food and dust in Cerro de Pasco, and accordingly to the human contamination and the related harm to their physical and mental health. This section should be read together in particular with section VII below which sets out the findings of the competent regulatory authority according to which Volcan is responsible for violating environmental regulations in Cerro de Pasco in dozens of instances.

A. Volcan significantly contributed to contaminating Cerro de Pasco's soil

55. Although the soil in and around Cerro de Pasco was already contaminated with heavy metals when Volcan acquired the mine in 1999, Volcan has significantly contributed to increasing the soil contamination between 1999 and today.

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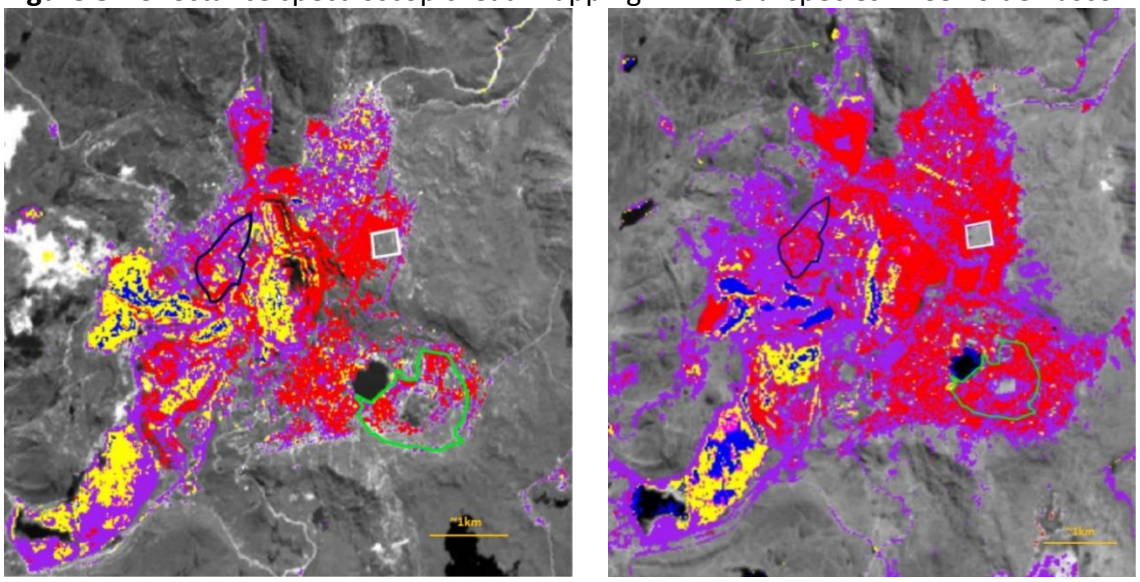
[103] DIGESA, Monitoreo de calidad del aire "Cerro de Pasco", Junio 2007, p. 21.
[104] OEFA Informe No 094-2017-OEFA/DE-SDCA-CMVA, (referred to in Municipalidad Simón Bolívar, Oficio No. 052-2018-ALCALDIA-MDSB-PASCO, 2/3/2018.
[105] 2do Trimestre 05, monitoring point 204, value for May 2005.
[106] 2do Trimestre 06, monitoring point 204, value for June 2006.
[107] August and September 2009, monitoring points 210 and 206. *See* Muestreo Ambiental de Calidad de Aire-Julio-Set-2009.
[108] June 2005, monitoring point 206, Tablas Aire I 2005 Abril-Junio; June 2006, monitoring point 202, Tablas Aire 2006 ABR- JUN[1]; June 2007, monitoring points 201, 204 and 206, Tabla Aire 2007 Abril-Junio; July and August 2007, monitoring points 201 and 204 respectively, Tablas Aire 2007 JULIO-SEPT; December 2007, monitoring points 201 and 205, Tablas Aire 2007 OCT-DIC; June 2008, monitoring points 202 and 204, Tablas Aire Abr-Jun 2008; July 2008, monitoring points 202 and 204, Tablas Aire Jul-Set 2008.
[109] Council Recommendation, pp. 8, 14-16.
[110] Council Recommendation, p. 15.

56. To measure the areal expansion of the lead contamination between 2001 and 2018, Chad Melton and David Hughes, two remote sensing scientists conducted a study in cooperation with AAAS. They applied reflectance spectroscopic mapping to quantify the estimated percent abundance of lead based mineral species in and around Cerro de Pasco.[111] The study concluded that while in 2001 18,29% of the region of interest ("ROI", see Figure 8) contained lead bearing mineral species, in 2018, lead bearing minerals were detected in 36,16% of the ROI. This corresponds to an increase of 97,70%. The same study separately examined the neighbourhood of Paragsha. It concluded that in 2001, 73,50% of the area of Paragsha was classified as containing lead bearing minerals, while in 2018, it was 84,89%. This corresponds to an increase of 15,50% (Figure 9). A change in the distribution of mineral species within both ROIs can be observed as well.

57. According to the study, it is likely that the redistribution and increase in lead bearing mineral species detection during the 2001-2018 period is primarily anthropogenic in nature and related to mining (i.e., material removing, tailing dumping, human foot print and automobile traffic). This conclusion is supported by a visible increase in lead bearing minerals spectra that can be observed along highways and roads not only in the city of Cerro de Pasco, but along roadways throughout the entire region. To a lesser extent, the expansion of lead bearing minerals may be attributed to meteorological phenomena, such as wind and rain.

Figure 8: reflectance spectroscopic lead mapping in mineral species in Cerro de Pasco



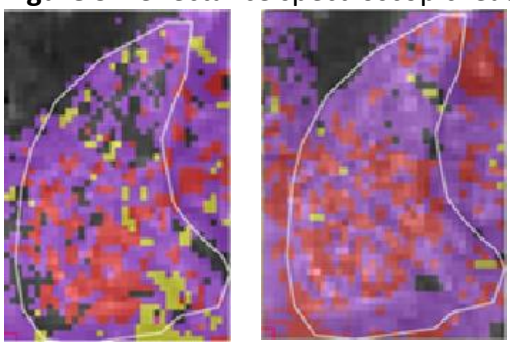
ASTER image from 2001 of Cerro de Pasco

Sentinel2 image from 2018 of Cerro de Pasco

The colours represent detected lead bearing mineral species. **Red** represents anglesite, **magenta** represents cerussite, **blue** represents galena, **yellow** represents mimetite, **purple** represents plumbojarosite. The blue polygone outlines Paragsha. The area depicted on each of the images defines the ROI examined in the study.

[111] Melton, C.A., Hughes, D.C., Spectral detection of Pb contamination at Cerro De Pasco, Peru with ASTER and Sentinel-2 imagery, May 2019 (Melton et al Study). Due to differences in VNIR (15 m) and SWIR (30 m) spatial resolution, the output image was down-sampled to 30 m. Sentinel bands 5 (0,705 µm), 6 (0,740 µm),7 (0,865 µm), 11 (1,610 µm), and 12 (2,190 µm) were chosen due to corresponding band coverage with ASTER. The Sentinel-2 bands used have a spatial resolution of 20 m. After images were preprocessed, the forward Minimum Fraction Noise Transform (MNF) tool in ENVI was used to visually and quantitatively inspect the fidelity of the data (www.harrisgeospatial.com/docs). All bands displayed Eigenvalues greater than five therefore none were discarded in these analyses.

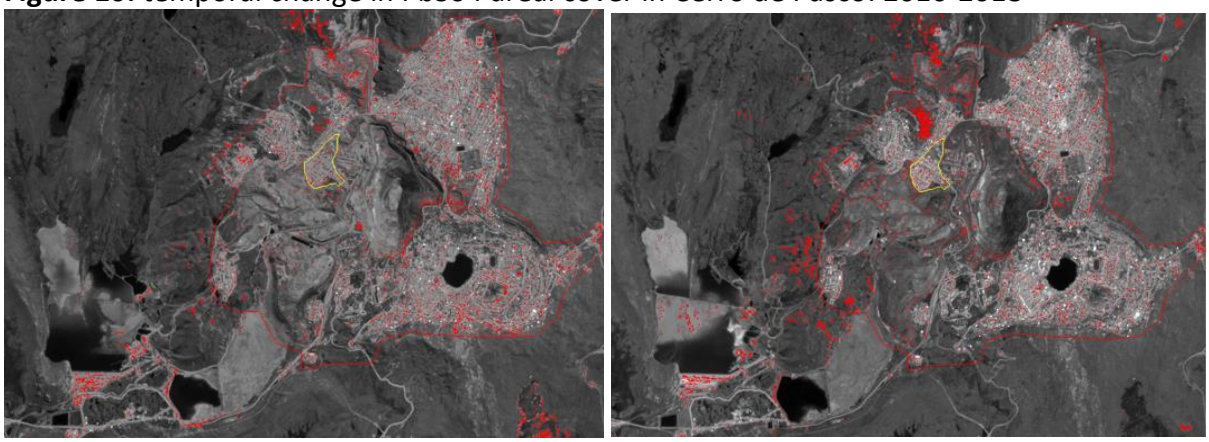
Figure 9: reflectance spectroscopic lead mapping in mineral species in Paragsha



2001 ASTER and 2018 Sentinel 2 images of Paragsha

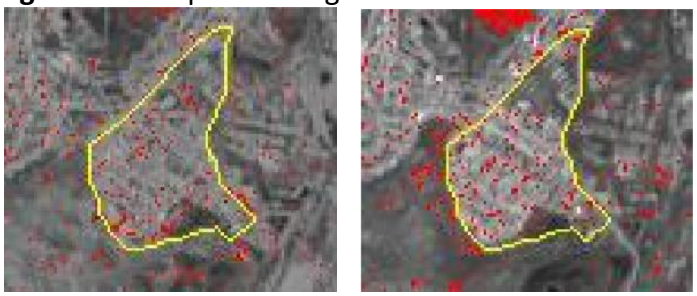
58. A separate remote sensing study conducted by CybELE further demonstrates that an increase of lead pollution in the soil of Cerro de Pasco (Figure 10), and in particular in Paragsha (Figure 11), can also be observed for the more recent period. It compared spectral indexes of two Sentinel 2 images, focussing on anglesite (PbSo4). The first image was taken on 26 April 2016, the second one on 27 November 2018—one year after Glencore acquired the majority of Volcan's voting shares. The study concluded that in the area of Paragsha alone, there was an overall increase of 2.700² in the area covered with anglesite (despite some confined areas where the contamination decreased). Significant further increases during this time period can also be observed in the immediate vicinity of Paragsha.[112]

Figure 10: temporal change in PbSo4 areal cover in Cerro de Pasco: 2016-2018



PbSo4 conditions 2016 (red) PbSo4_conditions 2018 (red)

Figure 11: temporal change in PbSo4 areal cover in Paragsha: 2016-2018



PbSo4 conditions 2016 (red) PbSo4_conditions 2018 (red)

PbSo4 (anglesite)	pixels	m²
area coverend 2016	102	10.200
area coverend 2018	129	12.900
change 2016-2018	27	2.700

[112] CybELE, Lead pollution in Cerro de Pasco, Ref. File N° 1021, 10 April 2019, Annex 1, p. 31; Annex 2, pp. 44-45. To exclude false positives, this study must be read together with the above in-situ soil studies.

59. A comparison of in situ soil studies further indicates an increase in the degree of pollution. For instance, the lead contamination in the playgrounds of Paragsha has worsened between 2007 (when the CDC study was conducted) and 2013 (the date of the LABOR study). In 2007, all soil probes taken from playgrounds of Paragsha indicated lead levels between 1.200 and 4.999 mg/kg,[113] while in 2013 two of the four samples from playgrounds in Paragsha had lead levels that exceeded 5.000 mg/kg. See Figure 4. The soil quality standards set the limit for lead content in residential areas at 140 mg/kg and at 50 mg/kg for arsenic.[114] In addition, as part of the 2013 soil study, Centro de Cultura Popular LABOR tested four reference points in the neighbourhood of José Carlos Mariátegui in the immediate vicinity of Volcan's Paragsha stockpile. All four samples showed highly elevated levels of lead and arsenic.[115]

60. Historic contamination does not account for this increase. This is also shown by a more detailed analysis of the in-situ soil studies: The highest concentration of lead and other heavy metals can be found in playgrounds and school yards in Paragsha and in the neighbourhood of José Carlos Mariátegui.[116] These places are relatively remote from the Excelsior stockpile, which according to Volcan is the primary source of historic contamination.[117] See Figure 1. Because the Paragsha stockpile is between the Excelsior stockpile and the villages of Paragsha and José Carlos Mariátegui, and because the Excelsior stockpile is located downstream from those villages,[118] acid rock drainage or other runoff from Excelsior do not account for the soil contamination in Paragsha, José Carlos Mariátegui, Yanacancha and most parts of Chaupimarca.

61. However, acid rock drainage and other runoff from Volcan's Paragsha and Rumiallana stockpiles are a significant source of contamination in Paragsha, José Carlos Mariátegui and other areas of Cerro de Pasco that are located in the immediate vicinity and downstream from those stockpiles. Based on soil samples from the Paragsha and Rumiallana stockpiles, Source International's study of 2019 referred to above,[119] concluded the estimated acid production potential of both stockpiles is extremely high.[120] A study commissioned by Volcan in 2006 further indicates that there is significant runoff of heavy metals from waste-rock dumps and ore stockpiles.[121] Another study commissioned by Volcan in 2007 concludes that *ongoing* mining activities account for runoff of polluted soil from waste rock dumps and stockpiles, as well as from the city's soil that is polluted due to the *ongoing* transport of waste rock. According to the study, these are important sources of pollution.[122]

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[113] CDC Study 2007, Mapa 1 y Tabla 8.
[114] Decreto Supremo No 002-2013-MINAM, 25 marzo 2013; *see also* Decreto Supremo No 011-2017-MINAM, 2 December 2017.
[115] LABOR 2013 Soil Study, p. 10, soil samples #5, 6, 7, 9.
[116] LABOR 2013 Soil Study, soil samples #1-9.
[117] Council Recommendation, p. 9 and fn. 34, p. 15 and fn. 60.
[118] *See* SITU's 3D model of Cerro de Pasco and surrounding area.
[119] *See* para. 37 and fn. 63 above.
[120] Source International, Environmental analysis on mine waste disposals in Cerro de Pasco, June 2019, Table 1. Laboratory chemical results.
[121] Ground Water International (2006), Investigación Hidrogeológica de la Mina Subterránea y de las Facilidades Superficiales de la Unidad Minera Cerro de Pasco (referred to in Council Recommendation, p. 10).
[122] Minera Interandina de Consultores S.R.L. (2007), pp. 199, 213 (referred to in Council Recommendation, p. 10 and fn. 38).

62. Even if the Paragsha and Rumiallana stockpiles existed to some extent already in 1999 when Volcan acquired the mine,[123] any contamination derived from those stockpiles is attributable to Volcan, because Volcan owns and operates those stockpiles. These stockpiles were used by Volcan since 1999 to deposit discharged mining materials. According to volume estimates from the photogrammetrically derived point cloud (stereo imagery) the Rumiallana stockpile increased in volume by approximately 46.000.000 m^3 and in surface area by approximately 190.000 m^2 between 2001 and 2018. In 2018, Rumiallana's total volume was approximately 100.000.000 m^3, which means that it almost doubled in size since Volcan acquired the mine.[124]

63. If historic contamination or the naturally high mineral content in rocks were the primary sources for the present levels of contamination, it could be expected that sites in the immediate vicinity of the Excelsior stockpile or the open pit mine would exhibit the highest degree of pollution. This is not the case. The 2013 study tested the soil in those locations (Figure 4, reference points 24 and 25). Although the soil was significantly contaminated, especially with lead and arsenic, the levels of contamination were far below all those measured in the playgrounds and school yards of Paragsha, and on average below those of José Carlos Mariátegui.[125]

64. As described in more detail below,[126] the relevant authority found that Volcan repeatedly violated applicable environmental regulations by discharging minerals and waste rock from its activities in a manner that contaminated soil and water, for conducting certain operations without the approval of the relevant authorities; for failing to take preventive environmental measures in the exploitation of the mine; and for failing to comply with its commitments under the environmental impact assessment. These are only some examples demonstrating how Volcan contributed to the increased soil contamination.

65. Based on the above, it can be concluded that Volcan significantly contributed to Cerro de Pasco's soil contamination, including that in Paragsha.

B. Volcan significantly contributed to contaminating Cerro de Pasco's water and food

i. Volcan contaminated the rivers

66. As shown below, the competent regulatory authorities found on dozens of occasions that Volcan violated the maximum permissible levels in its discharge effluent waters from the Paragsha Concentrating Plant, the Neutralization Plant, and from mining waters of the Cerro de Pasco Mining Unit. The offences concerned exceeding maximum permissible levels for lead, arsenic, zinc, copper, iron, pH parameters and Total Suspended Solids (*Sólidos Totales en Suspensión* or STS).[127]

67. The high concentration of lead and other heavy metals in the Ragra and San Juan Rivers can be directly attributed to Volcan and in particular to Volcan's discharge waters. This is demonstrated by two studies conducted by Source International in 2009 (when the

[123] AAAS Landsat Imagery analysis of development of Cerro de Pasco's stockpiles from 1984 until 2016.
[124] Chad Melton, Cerro de Pasco Tailing Stockpile Volume Analysis, 17 June 2019. Volume calculations were conducted with QT Modeler.
[125] LABOR 2013 Soil Study, p. 10 soil samples #24 and 25.
[126] *See* Section VII below.
[127] *See* Section VII below.

Cerro de Pasco mines were operational) and in September 2016, when Volcan's mining activities in Cerro de Pasco were temporarily suspended.[128] The reference points referred to in this section are visualized in Figure 7, while the location of the rivers is visualized in Figure 5.

68. In early 2009, Source International measured the mine's waste water at one of Volcan's three discharge locations directly at its exit point and before it flows into the Ragra River (SM). The water contained 4,31 mg/l of lead. This value is consistent with the measurement reported by Volcan's monitoring report for September 2009[129] and with other measurements of these waters.[130] These values far exceed the maximum permissible levels of lead for liquid effluents of metal-mining activities applicable at the time.[131] Most other values measured, including cadmium, manganese, copper, zinc and iron were also extremely high and exceeded applicable maximum permissible levels.[132] Very high values of lead and other metals were also measured in the sediment of the mine's discharge point. In addition, there is not a single one of Volcan's monthly measurements between January 2005 and December 2009, where Volcan does not exceed the maximum permissible level for Total Suspended Solids on at least one monitoring point.[133]

69. Source International then measured the San Juan River's water values, before (SJ1) and after (SJ2) its confluence with the Ragra River which carried the waste water from the mine. While SJ1 showed some values that exceeded the limits set by national water quality standards, most of SJ2's values hugely exceed those limits.[134] For instance SJ1 had a lead level of 0,037 mg/l, while SJ2's lead level was 4,451 mg/l. To put this in context, this level exceeds the Peruvian maximum permissible level for lead in rivers of 0,05 mg/l[135] by more than 89 times and it exceeds the lead contamination measured in Flint, Michigan by 166 times.[136] The increasing trend of pollution between measurements point SJ1 and SJ2 could also be observed for many other heavy metals and it is also visible from the metal values in the sediment of SJ1 and SJ2. This demonstrates that the pollution of the San Juan River is mostly caused by its confluence with the Ragra River that carried the mine's discharge waters. The San Juan River remained highly polluted even 30 km downstream, even if the level of pollution gradually diminished due to the dilution effect of clean water from other

[128] Volcan's mining activities in Cerro de Pasco were temporarily suspended between December 2015 (Volcan Memoria Anual 2015, p. 65) until November 2016 (Volcan Memoria Anual 2016, p. 67).
[129] *See* Volcan's measurement reports for the period between January 2009 and March 2011. The average lead concentration during the period was 0,885 mg/l. The maximum concentration that was registered at this point was 4,046 mg/litre (September 2009). *See* Council Recommendation, p. 9, fn. 32. *See also* para. 40 above.
[130] *See* para. 40 above.
[131] Resolución Ministerial N° 011-96-EM/VMM. The maximum permissible level for lead at the time was 0,4 mg/l. In 2010, this standard was lowered to 0,2 mg/l (*see* Decreto Supremo No 010-2010 MINAM).
[132] Bianchini 2009 Study, p. 1071, Tables 5, reference point SM.
[133] *See* Volcan's motoring reports from January 2005 until December 2009.
[134] Decreto Supremo No 002-2008 MINAM- Categoría 3.
[135] Decreto Supremo No 002-2008 MINAM- Categoría 3.
[136] 4,541 mg/l measured at SJ2, compared to the 26,8 µg/l (=0,0268 mg/l) measured in Flint Michigan (*see* Pieper et al., Evaluating Water Lead Levels During the Flint Water Crisis, Environ. Sci. Technol. 2018, 52, 8124−8132).

rivers in the area.[137] These findings are corroborated by a government study and Volcan's internal monitoring reports referred to above.[138]

70. In September 2016, Source International again measured the water values at the same locations and applied the same methodology. With Volcan's mining activities in Cerro de Pasco being temporarily suspended, most water values had significantly improved. At the mine's discharge point, the lead level was well below the 0,2 mg/l maximum permissible level for mining discharge water.[139] The same applies to all other values, except for iron and zinc that still exceeded those levels.[140] Similarly, while the measurements at the San Juan river upstream of its confluence with the Ragra River in 2016 are comparable to those in 2009, all measurements below its confluence with the Ragra River have significantly improved. For instance, the lead level below the affluence point changed from 4,451 mg/l in 2009 to 0,04 mg/l in 2016. Similarly, the arsenic level changed from 0,3 mg/l to 0,03 mg/l, the cadmium level changed from 0,046 mg/l to the legal limit of 0,003 mg/l and the manganese level changed from 21 mg/l to 2,99 mg/l.[141]

71. This leads to the conclusion that Volcan's discharge waters that were released while the mine was active, were the main source of pollution for the Ragra and San Juan Rivers.

72. Similarly, the pollution of the Tingo River can significantly be attributed to Volcan's mining activities, and in particular to Volcan discharging of waste rock at the Rumiallana stockpile, which is located above the source of the Tingo River (Figures 1 and 7). In early 2009, Source International measured the water quality at the source of the Tingo River and found that it vastly exceeded WHO water quality standards for many heavy metals, such as lead, arsenic, cadmium, copper and zinc.[142] In September 2016, when Volcan's mining activity in Cerro de Pasco was temporarily suspended, Source International again measured the water quality at the source of the Tingo River. It found that all values had significantly improved compared to 2009. The levels of arsenic, cadmium, cooper and zinc were within maximum permissible levels, while the level of lead—although significantly improved—still exceeded water quality standards[143] by a large margin.[144] This again demonstrates a direct link between Volcan's operation of the mine and the contamination of the water of the Tingo River.

73. The residual contamination both of the San Juan and the Tingo Rivers—even during the time when the mining activities in Cerro de Pasco were suspended—is, to some extent, also attributable to Volcan. This is because, as found by the 2007 study commissioned by Volcan, ongoing mining activities account for runoff of polluted soil from waste rock dumps and stockpiles, as well as from the city's soil, which is polluted due to the ongoing transport of waste rock. According to the study, these are important sources of pollution of rivers that

[137] Bianchini 2009 Study, pp. 1071-1072, Tables 5 and 6.
[138] *See* para. 41 above.
[139] Decreto Supremo No 010-2010 MINAM.
[140] Source International 2016 Water Study, p. 31, reference A3. The lead level measured at the mine's discharge point in 2016 was 0,04 mg/l.
[141] Source International 2016 Water Study, p. 35, reference A7 and A8.
[142] Bianchini 2009 Study, p. 1071, Table 5, reference T1. Due to dilution with other waters, the quality of the Tingo River gradually improved downstream (see references T2 and T3).
[143] Decreto Supremo No 0002-2008 MINAM- Categoría 3.
[144] Source International 2016 Water Study, p. 37, reference A11.

are in the area of influence from the city and the mine's stockpiles.[145] Volcan's Rumiallana and Paragsha stockpiles have also been found to have an extremely high acid production potential.[146]

ii. Volcan contaminated some of the food

74. As shown above, the contamination of some of Cerro de Pasco's food supplies—the cattle grazing next to the San Juan River and the vegetables grown in the Tingo *microcuenca*—is caused among others by use of contaminated water from the rivers and by contaminated soil. Because Volcan has significantly contributed to contaminating the river waters and the soil around Cerro de Pasco, the food contamination can equally be attributed to Volcan.

iii. Volcan contaminated the drinking water

75. The drinking water reservoir for Paragsha and some other parts of Cerro de Pasco is located to the west of Quiulacocha and immediately below the highly contaminated Ragra River (Figure 5). A comparison between the 2009 and 2016 studies on drinking water further leads to the conclusion that the contamination of drinking water can be attributed to Volcan's mining activities. As noted above, in 2009, Source International examined the drinking water in Paragsha; it found that this water exceeded the WHO drinking water standards for lead and arsenic by about four times, for aluminum by about two times and for tin by about thirteen times.[147] These results are consistent with the findings of the local health authorities in 2007, 2009 and 2015.[148] In September 2016—at a time when Volcan's mining activities in Cerro de Pasco were suspended[149]—Source International again tested the drinking water in Paragsha and in Chaupimarca (Figure 7). All measurements for the 12 tested heavy metals were within water quality standards for drinking water.[150] This demonstrates a causal link between the mine's operations and the contamination of Cerro de Pasco's drinking water.

76. The above studies show that the contamination of the rivers and Cerro de Pasco's drinking water is not caused by historic pollution or the naturally high mineral content in rocks. This is further corroborated by a study conducted by the company TRC HYDRO GEO for a Peruvian government authority. The study examined the ground water under the mining stockpile in the area of Quiulacocha in 2000 and 2008. The Quiulacocha tailings impoundments are not owned by Volcan and they are in the direct area of influence of the Excelsior stockpile (Figure 1), which, according to Volcan, is the primary source of historic pollution.[151] The study concluded that the ground water under the tailings impoundments was not affected by the stockpile and that both in 2000 and 2008 the water quality was within regulatory limits.[152] Accordingly, the impact of both the Excelsior stockpile and the

[145] Minera Interandina de Consultores S.R.L. (2007), pp. 199, 213 (referred to in Council Recommendation, p. 10 and fn. 38).
[146] *See* para. 37 above.
[147] Bianchini 2009 Study, p. 1071, Table 5, reference C.
[148] *See* para. 47 above.
[149] Volcan's mining activities in Cerro de Pasco were temporarily suspended between December 2015 (Volcan Memoria Anual 2015, p. 65) until November 2016 (Volcan Memoria Anual 2016, p. 67).
[150] Source International 2016 Water Study, pp. 30-31, reference A1 and A2.
[151] Council Recommendation, p. 9 and fn. 34, p. 15 and fn. 60.
[152] Ministerio del Ambiente, Informe Técnico, no 185-2012-MINAM-VMGA/DGCA, 20 April 2012, p. 6.

Quiulacocha tailings impoundments—at least on ground water pollution in Cerro de Pasco—is limited.

77. Based on the above, it can be concluded that Volcan significantly contributed to the contamination of the Ragra, San Juan and Tingo Rivers, as well as the contamination of some of Cerro de Pasco's food supplies and its drinking water.

C. Volcan significantly contributed to contaminating Cerro de Pasco's dust and air

78. The contamination of Cerro de Pasco's dust and air can directly be linked to Volcan's ongoing mining activities and in particular to the crushing, grounding and transportation of ore and waste rock. A 2007 study commissioned by Volcan found that the ongoing transport of waste rock is a major source of pollution in Cerro de Pasco.[153] Open source video material demonstrates how Volcan's mining operations produce dust through mining and the transportation of ore and waste rock.[154]

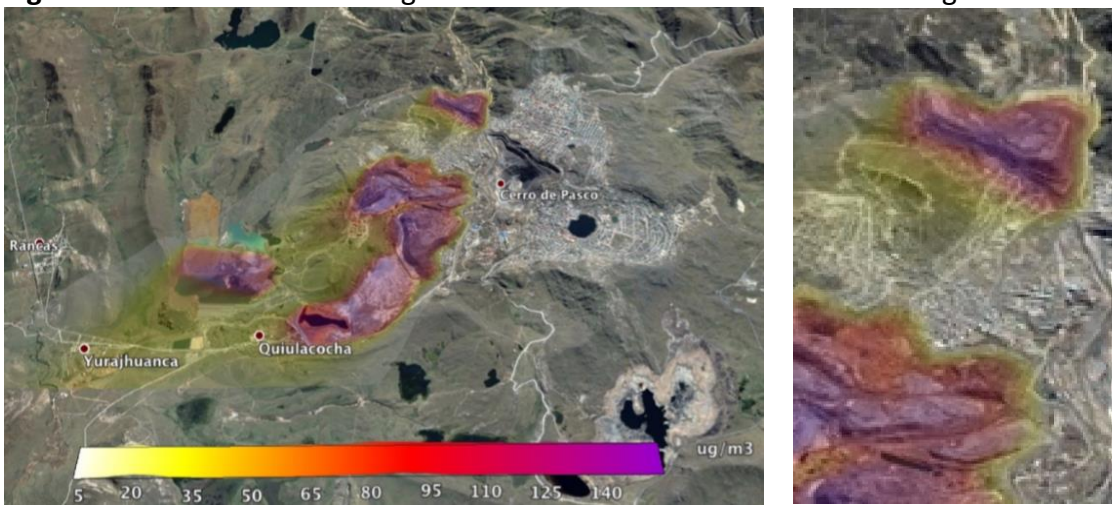
79. In addition, because the waste rock stored in Cerro de Pasco's stockpiles contains high concentrations of heavy metals,[155] these stockpiles are a constant source of air-borne pollution through the emission and dispersion of contaminated particles.[156] Source International, in cooperation with PM_TEN SRL[157] conducted an atmospheric pollution dispersion simulation study. This study estimated the impact of the stockpiles on the atmospheric dispersion of PM-10, lead and arsenic in and around Cerro de Pasco.[158] Because the prevailing wind direction in Cerro de Pasco is from north-east to south-west, Volcan's Rumiallana stockpile is the main source of atmospheric pollution in the inhabited area of Cerro de Pasco. Paragsha, which lies to the south-west of the stockpile, is most affected. The study concluded that the 2018 average simulated values of lead concentrations in the north-west of Cerro de Pasco are typically between 0,1 and 1,5 µg/m³, with some areas reaching values above 2,0 µg/m³. The maximum permissible level under Peruvian air quality standards for annual average lead concentration is 0,5 µg/m³.[159] The average simulated arsenic and PM-10 levels were also very high reaching values up to 60 ng/m³ and 80 ng/m³ respectively.[160]

80. Historic pollution in Cerro de Pasco, and in particular the Excelsior stockpile and the Quiulacocha tailings impoundments, are not the main source for atmospheric pollution dispersion in Cerro de Pasco and in particular in Paragsha. As shown in Figure 12 the wind carries lead, arsenic and PM-10 particles from north-east to south-west, therefore from Volcan's Rumiallana stockpile to Paragsha. Any air pollution from the Excelsior stockpile is

[153] Minera Interandina de Consultores S.R.L. (2007), pp. 199, 213 (referred to in Council Recommendation, p. 10 and fn. 38).
[154] *See e.g.* El Tajo de Cerro de Pasco, time stamps 5:00 and 7:04; Tajo Raul Rojas - Cerro de Pasco, time stamps 2:56, 9:55, 11:07, 15:02.
[155] *See* para. 37 above.
[156] Source International, Environmental analysis on mine waste disposals in Cerro de Pasco, June 2019.
[157] For more information about PM_TEN SRL, *see* its website.
[158] The study was refined by taking into consideration the analysis of the PM-10 fraction of particulate matters identified in recent soil tests from the Paragsha and Rumiallana stockpiles (*see* Figure 4 and para. 37 above).
[159] Decreto Supremo No 074-2001-PMC, anexo 1 (as amended by Decreto Supremo Nº 069-2003-PCM). *See also* Decreto Supremo Nº 003-2017-MINAM, which repealed the previous supreme decrees.
[160] PM_TEN SRL, Atmospheric dispersion simulation study aiming at estimating the impact of mining waste deposit in the urban area of Cerro de Pasco and surroundings (Peru), 19 June 2019.

generally carried in the same direction, namely from the Excelsior stockpile, which lies to the south-west of Cerro de Pasco to south-western direction and away from the city (see also Figure 1).

Figure 12: 2018 summer averages of PM-10 concentrations at 2 m from ground level



81. Finally, contrary to the claim by the Peruvian Ministry of Energy and Mining,[161] the high blood lead levels of the inhabitants of Cerro de Pasco are not caused by road traffic and the related inhalation of gasoline fumes, as Peru phased out lead gasoline in 2004.[162]

82. Based on the above, it can be concluded that Volcan significantly contributed to contaminating the dust and air in Cerro de Pasco.

D. Volcan significantly contributed to the heavy metal contamination of many inhabitants of Cerro de Pasco

83. As shown above, many inhabitants of Cerro de Pasco, and in particular the children of Paragsha, are highly contaminated with heavy metals. Volcan significantly contributed to this, primarily because it contaminated the soil, water, some food, the air and dust of Cerro de Pasco, which its inhabitants either ingest or inhale.[163] Because the soil, water air and dust of Cerro de Pasco are contaminated with heavy metals far beyond the quality standards established under Peruvian law and the WHO, their ingestion and inhalation severely compromises human health.

84. A causal link between Volcan's conduct and the human heavy metal contamination is further shown by a comparison of Source International's 2016 and 2018 hair studies of children from Paragsha. When Source International conducted the first of these studies in

[161] OSINERGMIN, Informe No 004-2012-GO, 12 marzo 2012; *see also* Ministerio del Ambiente DIGESA, Informe Técnico No 185-2012-MINAM-VMGA/DGCA, pp. 5-6.
[162] WHO 2012 Study.
[163] *See* sections VI(A)-(C) above. *See also* Informe Técnico No 185-2012-MINAM-VMGA/DGCA, p. 9. For sources of human heavy metal intake in general, *see* World Health Organization, Lead Poisoning and Health, 23 August 2018; J. Żukowska and M. Biziuk, Methodological Evaluation of Method for Dietary Heavy Metal Intake, Journal of Food Science, 31 January 2008; XingmeiLiu[a] et al., Human health risk assessment of heavy metals in soil–vegetable system: A multi-medium analysis, Science of The Total Environment, Volumes 463–464, 1 October 2013, pp. 530-540.

September 2016, Volcan's mining operations were temporarily suspended.[164] As shown above, this suspension significantly impacted the contamination of Cerro de Pasco's drinking water and the water in the rivers of the area. By July 2018, when Source International conducted the second study, Volcan's mining operations had again resumed. According to the 2018 study, the heavy metals in the hair of the children from Paragsha had significantly increased compared to the 2016 levels. For instance, the manganese, iron and chrome content had more than doubled, the lead content increased by 47%, and the aluminum content increased by 54%.[165] In the 2018 samples of the children from Paragsha, the heavy metal concentrations were also significantly higher in the tip of the 20-cm-long hair, compared to the root. The tip of the hair is indicative of the exposure to heavy metals at the time of its growth. This means that sometime between November 2016 and March 2017, the children were exposed to even higher levels of heavy metals.[166] This coincides with the period when Volcan resumed its mining activity in November 2016 after it was suspended for about 11 months.[167]

85. Studies conducted by the Peruvian government authorities further indicate that the health situation in Cerro de Pasco has worsened during the time that Volcan operated the mine and that it can therefore not be entirely attributed to historic sources of contamination. In 2005, the regional health authorities conducted an extensive study of the blood lead levels of children from Cerro de Pasco and its impact on their health. Although that study concluded that over 82% of the examined children had a blood lead level above the legally permissible limit of 10 µg/dl, it also concluded that up to 82,9% of these children (depending on the neighbourhood) did not have anaemia, that up to 87,5% exhibited a normal physio-motoric development and that the intellectual development of up to 92,9% of these children is normal or above average.[168] In 2016, the Ministry of Health conducted a study to determine the prevalence of anaemia among the children in Cerro de Pasco. It concluded that among the children from the district of Simón Bolívar that are under three years of age, the percentage suffering of anaemia is significantly above national average.[169] Source International's Health Study of 2018 further demonstrates a worsening of the health situation compared to 2005. It demonstrates that in 2018, not only do the children of Paragsha have very high concentrations of heavy metals in their bodies, but most of them have developed clinical symptoms that can be directly related to their heavy metal intoxication.[170]

86. Based on the above, it can be concluded that the high level of heavy metal contamination of the inhabitants of Cerro de Pasco, and in particular of the children from Paragsha, as well as the related health problems can significantly be attributed to Volcan.

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[164] Volcan's mining activities in Cerro de Pasco were temporarily suspended between December 2015 (Volcan Memoria Anual 2015, p. 65) until November 2016 (Volcan Memoria Anual 2016, p. 67).
[165] 2018 Health Study, apartado 2, table 4.
[166] 2018 Health Study, apartado 2, tabla 5; *see also* apartado 4, table 17.
[167] Volcan's mining activities in Cerro de Pasco were temporarily suspended between December 2015 (Volcan Memoria Anual 2015, p. 65) until November 2016 (Volcan Memoria Anual 2016, p. 67).
[168] DIRESA PASCO, CENSOPAS 2005, Puestos de Salud Chaupimarca y Quiulacocha, Ministerio del Ambiente DIGESA, Informe Técnico No 185-2012-MINAM-VMGA/DGCA, p. 8.
[169] Ministerio de Salud, Informe No. 030-2017-ESNANS-DINEV-DGIESP/MINSA (16.02.2017).
[170] *See* paras. 26-27 above.

VII. Volcan violated environmental regulations

87. Volcan argues that its activities comply with the applicable law and with the company's environmental adjustment and management plan (PAMA),[171] which had been approved by the relevant government authority.[172] According to Volcan, as long as its activities are conducted in compliance with the requirements imposed by the government, it cannot be held responsible for contributing to the severe environmental situation in Cerro de Pasco.[173] These arguments are unsupported and must be rejected.

88. The Peruvian regulation on environmental protection in metal-mining activities defines as "environmental pollution" any conduct that results in the direct or indirect introduction into the environment of pollutants which are harmful to nature, health or property, in excess of maximum permissible levels.[174] The maximum permissible levels are established by the competent government authorities and they are legally enforceable.[175] The owners of a metal-mining activity are responsible for the emissions, discharges and disposal of waste to the environment that are produced as a result of the processes carried out in their facilities. It is their obligation to avoid and prevent those elements and/or substances that may have adverse effects on the environment and exceed the legally established maximum permissible levels.[176]

89. Throughout the years, Volcan's activities resulted in the introduction of pollutants into the environment, especially by emitting effluent discharge waters that exceeded maximum permissible levels and through other conduct that violated applicable environmental regulations.[177] This resulted in the contamination of the water, soil, dust and air in and around Cerro de Pasco[178] and caused harm to nature and human health.[179] Accordingly, Volcan is responsible for the environmental pollution in and around Cerro de Pasco within the meaning of the Peruvian regulation on environmental protection in metal-mining.

90. Volcan's argument declining responsibility for environmental pollution in Cerro de Pasco and its consequences because it allegedly acted in accordance with its PAMA,[180] fails to appreciate the scope of a PAMA. It further disregards the fact that over the years Volcan has on many occasions been found by the relevant authorities to exceed maximum permissible levels of pollution or to otherwise breach its obligations set out in the PAMA.

91. According to the applicable regulation on environmental protection in metal-mining activities, the purpose of a PAMA is to assist holders of mining activity to reduce their levels

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[171] PAMA stands for "*Programa de Adecuación y Manejo Medioambiental*".
[172] Council Recommendation, pp. 6-7, 13-14.
[173] Council Recommendation, pp. 2, 16.
[174] Decreto Supremo Nº 016-93-EM (1993). D.S. Nº 016-93-EM (1993) was repealed and replaced by Decreto Supremo Nº 040-2014-EM (2014). While the inspection and sanction procedures initiated under the repealed norm continue to be conducted under the 1993 legislation until their conclusion, the new provision includes similar definitions and concepts. For the definition of environmental pollution see Decreto Supremo Nº 040-2014-EM, art. 4.8.
[175] Decreto Supremo Nº 016-93-EM (1993), art. 1.
[176] Decreto Supremo Nº 016-93-EM (1993), art. 5. *See* also Decreto Supremo Nº 040-2014-EM, arts. 16, 19-20.
[177] *See* paras. 40, 68 above and paras. 95-96 below.
[178] *See* sections V and VI above.
[179] *See* sections IV and VI(D) above.
[180] Council Recommendation, pp. 6-7, 13-14.

of environmental contamination until reaching the maximum permissible levels.[181] The PAMA does not legalize or condone infringements of maximum permissible levels, even if the program is approved by the Ministry for Energy and Mining. Rather it is an action plan through which the Ministry intends to ensure that the companies that are violating maximum permissible levels—such as Volcan—reach those limits in the future. Because a PAMA requires a company, among other things, not to exceed maximum permissible levels of pollution, any violation of those levels automatically constitutes a violation of a PAMA.

92. The regulation on environmental protection in metal-mining activities provides that the competent government authority may find that a company is violating its PAMA and sanction the company accordingly. This provision expressly stipulates that any such findings and sanctions are without prejudice to other legal actions that may arise.[182]

93. Throughout the years, Volcan has repeatedly been found to exceed maximum permissible levels of pollution or to otherwise violate its duties under the PAMA and it was sanctioned accordingly.[183]

94. The competent Peruvian authority to oversee compliance of metal mining companies with environmental regulations is the Agency for Environmental Assessment and Inspection (Organismo de Evaluación y Fiscalización Ambiental, "OEFA"). According to the records provided by OEFA, 21 administrative procedures against Volcan and two such procedures against its Cerro de Pasco mining unit (Empresa Administradora Cerro S.A.C.) are completed and resulted in finding that the company violated environmental regulations in its mining activities in Cerro de Pasco. Many procedures found multiple such violations, amounting to a total of 57 violations by Volcan and 4 violations by Empresa Administradora Cerro S.A.C. These findings and sanctions were based on inspections carried out between July 2007 and March 2010. This is not an exhaustive list of findings and sanctions, as a number of procedures from subsequent inspections are still pending and therefore remain confidential.

95. About two thirds of Volcan's established offences relate to violations of the maximum permissible levels in its discharge of effluent waters from the Paragsha Concentrating Plant, the Neutralization Plant, and from mining waters of the Cerro de Pasco Mining Unit. The offences concerned maximum permissible levels of lead, arsenic, zinc, copper, iron, pH parameters and Total Suspended Solids.[184] In this context it is worth

[181] Decreto Supremo Nº 016-93-EM (1993), arts. 1, 9, 25.
[182] Decreto Supremo Nº 016-93-EM (1993), art. 48.
[183] In its communications with the Council, Volcan has admitted that by 2010 it had been fined by the competent mining authorities 23 times for different violations of environmental provisions, including discharges to water in excess of maximum permissible levels, the processing of greater amounts of ore than permitted, building a processing plant without assessing the environmental impact and failing to implement measures it had been ordered to complete (Council Recommendation, pp. 6-7, 10, referring to Appendix M to Volcan's letter to the Council dated 12 July 2010).
[184] File Number 2007-066, inspection: 9-13 July 2007, Resolution Nº 29-2011-OEFA/DFSAI, Appeal resolution Nº 176-2012-OEFA/TFA; File Number 065-08-MA/E, inspection: 27-30 April 2008, Resolution Nº 054-2012-OEFA/DFSAI, Appeal resolution Nº 069-2012-OEFA/TFA; File Number 098-08-MA/E, inspection: 17-20 June 2008, Resolution Nº 096-2012-OEFA/DFSAI, Appeal resolution Nº 103-2012-OEFA/TFA; File Number 087-08-MA/E, inspection: 3-4 July 2008; Resolution Nº 191-2012-OEFA/DFSAI, Appeal resolution Nº 174-2012-OEFA/TFA; File Number 186-08-MA/E, inspection: 18-24 August 2008, Resolution Nº 179-2012-OEFA/DFSAI, Appeal resolution Nº 171-2012-OEFA/TFA; File Number 034-08-MA/E, inspection: 4-10 October 2008, Resolution Nº 318-2012-OEFA/DFSAI, Appeal resolution Nº 014-2013-OEFA/TFA; File Number 191-08-MA/E, inspection: 21-24 October, Resolution Nº 376-2012-OEFA/DFSAI, Appeal resolution Nº 163-2013-OEFA/TFA;

pointing out that in early December 2008, the authorities measured that the water at one of the mine's discharge points contained 6,68 mg/l of dissolved lead, 80,97 mg/l of dissolved arsenic and 103,96 mg/l of dissolved copper, among others.[185] These results are extremely high compared to maximum permissible levels for liquid effluents of metal-mining activities (lead: 0,40 mg/l; arsenic: 1,0 mg/l; copper: 1,0 mg/l).[186] However, they are consistent with other available measurements.[187]

96. OEFA also imposed sanctions on Volcan for discharging minerals and waste rock in a manner that contaminated soil and water,[188] for conducting certain operations without the approval from the relevant authorities;[189] for failing to take preventive environmental measures in the exploitation of the mine;[190] and for failing to comply with its commitments under the environmental impact assessment.[191] Empresa Administradora Cerro S.A.C. was

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File Number 197-08-MA/E, Inspection: 3-6 December 2008, Resolution Nº 019-2013-OEFA/DFSAI, Appeal resolution Nº 125-2013-OEFA/TFA; File Number 027-09-MA/E, inspection: 23-25 April 2009, Resolution Nº 151-2013-OEFA/DFSAI, Appeal resolution Nº 154-2013-OEFA/TFA; File Number 027-09-MA/E, inspection: 8 May 2009, Resolution Nº 051-2013-OEFA/DFSAI, Appeal resolution Nº 202-2013-OEFA/TFA; File Number 259-09-MA/E, inspection: 13-17 July 2009, Resolution Nº 408-2013-OEFA/DFSAI, Appeal resolution Nº 292-2013-OEFA/TFA; File Number 062-09-MA/E, inspection: 24-27 August 2009; Resolution Nº 261-2013-OEFA/DFSAI, Appeal resolution Nº 228-2013-OEFA/TFA; File Number 013-09-MA/R, inspection: 26-30 August 2009, Resolution Nº 489-2013-OEFA/DFSAI, Appeal resolution Nº 012-2014-OEFA/TFA-SEM; File Number 191-09-MA/E, inspection: 6-9 October 2009, Resolution Nº 215-2013-OEFA/DFSAI, Appeal resolution Nº 229-2013-OEFA/TFA; File Number 198-09-MA/E, inspection: 27 February 2013, Resolution Nº 105-2013-OEFA/DFSAI, Appeal resolution Nº 157-2013-OEFA/TFA.

[185] File Number 197-08-MA/E, Inspection: 3-6 December 2008, Resolution Nº 019-2013-OEFA/DFSAI, Appeal resolution Nº 125-2013-OEFA/TFA.

[186] Resolución Ministerial N° 011-96-EM/VMM. The maximum permissible level for lead at the time was 0,4 mg/l. In 2010, this standard was lowered to 0,02 mg/l (*see* Decreto No 010-2010 MINAM).

[187] *See* paras. 40, 68 above.

[188] File Number 053-08-MA/E, inspection: 6 June 2008, Resolution Nº 146-2012-OEFA/DFSAI, Appeal resolution Nº 166-2012-OEFA/TFA, infringement: spillage of hydrocarbons on soil during diamond drilling works; File Number 027-09-MA/E, inspection, 25 May 2009, Resolution Nº 222-2013-OEFA/DFSAI, infringement: tailings spill in the tailings pipeline to the Ocroyoc deposit, which produced soil contamination; File Number 259-09-MA/E, inspection: 13-17 July 2009, Resolution Nº 408-2013-OEFA/DFSAI, Appeal resolution Nº 292-2013-OEFA/TFA, infringement: Failure to avoid water leaks from the circuit's decanting pond, which would be in contact with the ground.

[189] File Number 085-08-MA/E, inspection: 26 July 2008, Resolution Nº 015-2011-OEFA/DFSAI, infringement: Failure to comply with Recommendation regarding the stoppage of work in the Complementary Oxidized Mineral Benefit Plant; File Number 090-08-MA/E, inspection: 4-13 November 2008, Resolution Nº 290-2012-OEFA/DFSAI, Appeal resolution Nº 013-2013-OEFA/TFA, infringement: failure to comply with the corrective measures ordered by the environmental authority, related to refrain from operating their benefit plants of Paragsha and San Expedito over the current installed volume capacity; File Number 049-08-EO, inspection: 29 September 2009, Resolution Nº 219-2012-OEFA/DFSAI, Appeal resolution Nº 141-2013-OEFA/TFA, infringement: carrying out mining exploration activities in the "Cerro de Pasco – Dos" Mining Concession without having an approved environmental study.

[190] File Number 013-09-MA/R, inspection: 26-30 August 2009, Resolution Nº 489-2013-OEFA/DFSAI, Appeal resolution Nº 012-2014-OEFA/TFA-SEM infringements: failure to implement measures to remedy the presence of animals and people in the Rumiallana landfill, storage and disposal of hazardous waste inside the mine in breach of the provisions of the Environmental Impact Assessment, absence of a drainage system at the base of the slopes of the Rumiallana dump in breach of the provisions of the Environmental Impact Assessment, failure to undertake necessary precautionary and control measures to prevent the spillage of oils and fats in the "Bahía" fuel dispatch zone.

[191] File Number 057-10-MA/E, inspection: 25-26 March 2010, Resolution Nº 242-2014-OEFA/DFSAI, Appeal resolutions Nº 029-2014-OEFA/TFA, Nº 308-2016-OEFA/DFSAI, and Nº 1538-2016-OEFA/DFSAI, infringements: 1-Presence of water in the bottom of the open pit "Raúl Rojas", generating acid waters that would not have

sanctioned for failing to take preventive measures[192] and for failing to provide complete information to the relevant authority in relation to its solid waste management.[193]

97. The quantity of Volcan's infringements, the degree to which Volcan exceeded legally maximum permissible levels for pollutants in soil, water and air, the quantity and nature of Volcan's other violations of environmental regulations and the extensive period of time over which Volcan violated environmental regulations establish a pattern of conduct. From this it can be inferred that Volcan's conduct was not accidental or occasional.

VIII. Conclusion

98. Since Volcan acquired the Cerro de Pasco mines in 1999, it has introduced heavy metals, including lead, arsenic, chrome, manganese, iron and aluminium into the environment. In so doing, it has substantially contributed to polluting soil, water, food and dust in and around Cerro de Pasco. As a result of the ingestion or inhalation of contaminated soil, water, food and dust, many inhabitants of Cerro de Pasco, and in particular the children of Paragsha, are severely contaminated with heavy metals and their health is compromised.

99. Volcan's conduct was not accidental or occasional, but part of a policy to conduct its operations in disregard of applicable and enforceable environmental standards. Volcan is therefore responsible for the pollution of the environment in and around Cerro de Pasco and for the direct impact that this has on the health of many people from Cerro de Pasco.

100. The WHO found that, given the degree of pollution in Cerro de Pasco, the use of costly large-scale soil removal or the resettlement of the community may be necessary to

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been sent to the plant neutralization; what would constitute the breach of a commitment contained in the Environmental Impact Assessment of the project "Expansion of the Concentrating Plants Paragsha 8,500 to 9,500 MT - San Expedito 450 to 650 MT of the UEA Cerro de Pasco"; 2-The west side of the Rumiallana waste deposit did not count with coronation channels; which would constitute a breach of a commitment contained in the Environmental Impact Assessment of the project "Expansion of the Concentrating Plants Paragsha 8,500 to 9,500 MT - San Expedito 450 to 650 MT of the UEA Cerro de Pasco"; 3-Presence of stripping mineral material at the bottom of the "Raúl Rojas" pit, which would constitute the breach of a commitment contained in the Environmental Impact Study of the project "Expansion of the Paragsha and San Expedito Concentrating Plants"; 4-The sliding of the slope of the waste deposit in the ravine Rumiallana, impacted the soil of the ravine; 5-The collapse of the coronation channel located to the left margin of the Rumiallana ravine, impacted the wetlands; 6- Tailings spill on the sludge conduction channel built on natural soil; 7-Presence of a mining - metallurgical effluent from the Winze 98 pumping station, which discharges to the drainage channel located on the right margin of the city Cerro de Pasco (affluent of the San Juan River) and does not have an approved monitoring point in an Environmental Impact Assessment; 8-Non-compliance with the implementation measures for the remediation of impacted areas as a result of the tailings spill; 9- Failure to implement an inspection procedure for the tailing system; 10-Failure to carry out a training course aimed at the personnel responsible for monitoring the operations in the tailing system, on the execution of contingency measures in the event of a spill, which must be directed by a specialized instructor who certifies knowledge in the topics of: tailing system, impacts to the environment due to tailings spill.

[192] File No 270-2013-OEFA/DFSAI/PAS; inspection: 16 January 2012; Resolution Nº 276-2014-OEFA/DFSAI; Appeal resolution Nº 020-2014-OEFA/TFA-SEP1. Infringements 1-The pipes that transport tailings from the Paragsha and San Expedito Concentrating Plants and the pipeline that transports the sludge from the Neutralization Plant to the Ocroyoc tailings deposit did not have a contingency system for possible spills; 2-Inadequate disposal of domestic solid waste generated and exposed to the environment at the Rumiallana waste deposit; 3-In the sector Ocroyoc and Rumiallana, the containers of temporary disposal of solid waste were not labeled.

[193] File No 340-2013-OEFA/DFSAI/PAS; inspection: 16 January 2012; Resolution Nº 426-2014-OEFA/DFSAI.

reduce mining-related lead exposure.[194] Accordingly, unless drastic measures are taken to address it—such as implementing the law enacted by the Peruvian Congress in 2008 to relocate the city of Cerro de Pasco—there is a risk that current levels of environmental contamination will continue to severely impact on the physical and mental health of many people of Cerro de Pasco in the future.

101. Volcan states that it is one of the world's largest producers of zinc, lead and silver at one of the lowest costs in the industry.[195] For the zinc, lead and silver that Volcan produces in Cerro de Pasco, a good part of the cost is borne by others, namely the people of Cerro de Pasco who pay for it with their health.

[194] WHO 2012 Study.
[195] *See* Volcan's website: Volcan at a glance.