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POLITICS OF MINING: TOXIC HERITAGE IN THE ATACAMA DESERT

Marina Weinberg and Valentina Figueroa

Introduction

Most planetary technologies to reduce emissions and tackle climate change would be impossible without materials such as copper and lithium. Although the development of new technologies seems to justify the increasing demand for these metals, global dependence on these resources is actively and profoundly reshaping societies and ecologies in the places from which they are extracted. Copper is essential for the development of massive infrastructure projects, maritime, terrestrial and air transportation as well as for the manufacture of countless products used in contemporary life. Lithium has also stood out in the last decade as a key element due to the growing demands of the electromobility innovation, which seeks to replace fossil fuels and thus reduce carbon emissions. Both play a fundamental role in the development of different types of renewable energy and clean storage technologies; thus they are central to energy transition projects that push towards a so-called green future.

Copper and lithium mining in the Atacama Desert has produced high levels of toxicity that threaten local ecologies. Although the copper extraction process has intensified and is currently removing unprecedented volumes of material, and the extraction rate of brine to process lithium into lithium carbonate and hydroxide is also increasing steadily, extractive activities in the Atacama Desert are not new. Chile's Norte Grande, in particular the desert region, has been the scene of industrial mining-related processes for more than a century. In the context of the socio-environmental conflicts originating in the Atacama Desert, it is essential to think about these conceptualizations within the frame of politics of toxic heritage. This proposal considers the importance of power relations, tensions produced through access, and unequal use of natural resources and lands (Bebbington, 2009;

Perreault, 2013, Prieto, 2015), the uneven distribution of the impacts, and therefore the different capacities of stakeholders to operate within the extraction system.

The impact of the saltpetre–copper–lithium mining cycle has had different material correlates over the last hundred years, but it has crystallised into its contemporary form of exploitation by dispossession since the installation of the neoliberal model during the dictatorship of Augusto Pinochet (1973–1990). Deforestation, desiccation, hydrocide, accumulation and dispossession, proletarianisation, pollution and environmental violence have become widespread in most parts of Chile (Prieto, 2016a, 2017; Bolados, 2016; Aránguiz y Prieto, 2021). In these genealogies of mining cycle technologies, some pride and collective memories have been reclaimed, and discourses about the future have been also shaped. Thus, the progression of mining operations is constantly transforming the present, reifying the past and building upon the illusion of a ‘better’ future. In the most recent mining cycle, which has witnessed unprecedented levels of extraction and production over the last decade, the incessant growth of infrastructure that supports the constant development of these extractive activities, continues to produce mining heritages under promises of futuristic desires pushed forward by the global energy transition paradigm.¹ Under this context, we consider mining heritages a diverse compound that entails manifestations both tangible and intangible.

Throughout the essay, we identify diverse mining traditions in the region that materialise through objects, practices, narratives, rituals, affections and claims, based on the need to reinforce a mining worker, regional and/or national identity (which is also passed on generationally) and creating and embracing a mining heritage alongside the complexities created by the same activity (Baird, 2022). The patrimonialisation of mining is heterogeneous since it refers to different phenomena: the nationalist narrative of Chilean copper, the representation of the mining worker, the tradition of mining cults, the authorised mining heritage centred on architecture, the musealisation of contemporary work sites, and toxic heritage, are some of the cases we observe.

Establishing a dialogue between archaeology and anthropology, this chapter reflects on past and present toxic impacts of mining activities in the Atacama Desert by following their tangible and intangible traces and remains since the establishment of the Chilean neoliberal dictatorship in 1973. While these marks, or collateral effects, are sometimes perceived and observable, at other times they act so intimately in everyday practices and even at a cellular level that they become part of a local biopolitical heritage (Galaz-Mandakovic, 2013; Weinberg, 2021). However, following Murphy’s (2017) observation in the context of related studies in North America, it is not our intention to pathologise already dispossessed communities. As she points out, ‘it is hard to perceive the infrastructures of chemical violence in the world at the same time that research attends to molecular manifestations in bodies and communities already living in hostile conditions’ (Murphy, 2017: 496).

In the Atacama Desert, as we will illustrate by exploring the cases of copper and lithium extraction, many of the marks produced by the development of these mining activities are enacted, appropriated, and contested as situated heritage by

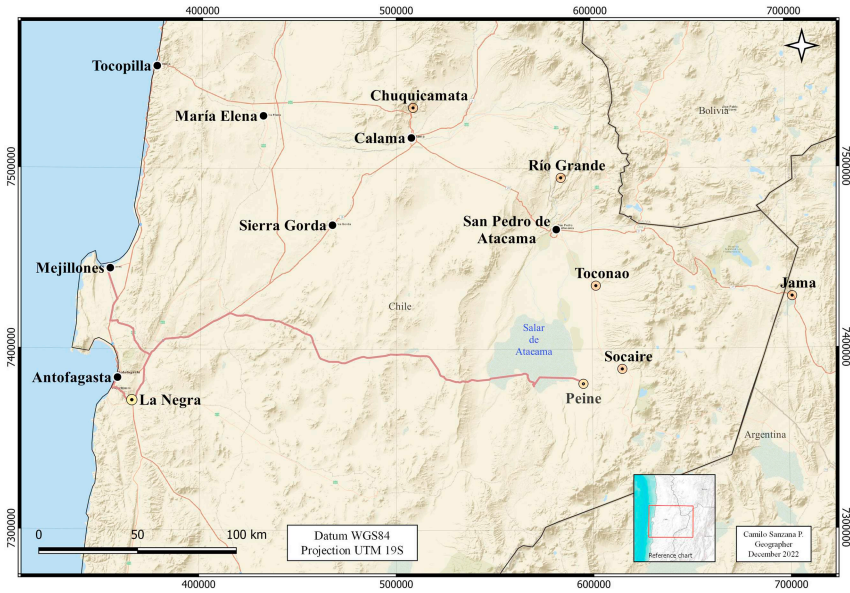


FIGURE 7.1 Map of the studied area.

local communities, who live in contested socio-environmental places (Figure 7.1). Moreover, this heritage-making process can be observed as complex, relational and in constant transformation. In particular, the prevalent technical-engineering narrative tends to support the idea of a successful technology and is less condescending than other ways of perceiving mining in the Atacama Desert. In this region, the long-term entanglement between the extractive industry activity, toxicities and climatic and geochemical conditions has created and sustained particular habitats and species, while others have been lost, adaptively transforming the socio-ecological heritage of the desert landscape.

Through engaging with decolonial feminism and eco-feminism (Bidaseca & Vázquez, 2011; Segato, 2011; Svampa, 2015; Ulloa, 2016) we develop our concept of toxic heritage, highlighting care practices (Ureta & Flores, 2018; see also Mol, 2002, 2008; Bellacasa, 2017; Biskupovic et al., 2023). In its attention to care, this reflection allows us to analyse copper and lithium extraction not only through the traditional frameworks of environmental decay and political action, but also by considering ways of life intrinsic to the domestic spaces most affected by extractivism. Given the power of massive industrial intervention, these domestic spaces often go unnoticed in academic research (Salinas et al., 2012; Segovia & Salinas 2020; Segovia et al., 2023). In its exploration of practices typically ignored by hegemonic discourses, our framework is inspired by feminist research that deconstructs the masculinised, technocentric and geoengineered armours (Haraway, 1995; Haraway, 2016) that are built on discourses of ‘innovation’ and ‘development’ (Biskupovic et al., 2023).

Politics of Toxic Heritage

We live in a world in which it is no longer possible to find a human or non-human community or even an individual exempt from toxic traces. This condition, described as a ‘new age of toxicity’ (Walker, 2011: xi), is unevenly shared across the length and breadth of the planet (Liboiron et al., 2018: 333). The Atacama Desert, with just over a century of sustained mining activities that have intensified in recent decades, can be identified as a large toxic zone. Regardless of its meanings, this conceptualisation allows for the framing, identification, and classification of a place for the purpose of questioning extractivist productive activities perceived as destructive (Bolados, 2016; Holifield & Day, 2017; Hormazabal-Poblete et al., 2019; Galaz-Mandakovic, 2021). In this sense, it is important to identify a politics of toxic heritage that has been sustained and is constantly updated in order to maintain a dominant structure that requires sustaining the modern capitalist system (Figure 7.2).

Markets, mining operations, tailings, smelters and human and non-human communities are structurally intertwined. The relationship we seek to delve into in this work is that between the alleged concern about the levels of toxicity within the mining environment on the one hand and the constant promotion of the mining industry on the other. The large data bank of techno-engineering advances, which overlaps with many forms of biocitizenship, is far removed from inhabitants’ ability to respond.² In this context, Murphy’s (2004, 2008, 2017) work is enlightening for



FIGURE 7.2 Tocopilla, by the authors.

considering the political dimensions of toxicity and the privilege of imperceptibility. Society is set up to protect its privileged sectors from toxic events. In fact, if we map chemical violence in the Atacama Desert, the relationship between chemical violence and dispossession is located precisely in areas where other forms of dispossession have long existed, such as migrant neighbourhoods, slums and indigenous communities. It is crucial to keep in mind the political dimension of toxic mining waste. Its location in itself represents a political cartography (Hecht, 2018). One of the best examples involves the waste from the Swedish company Boliden³, which was transported by ship during the Chilean dictatorship and deposited in a northern Chilean coastal city's central sector, on which houses were built and residents were affected by various diseases due to exposure to the toxic waste.⁴

Although in recent years, important waste management measures have been taken in Chile to address toxicity and toxic waste in mining–metallurgical contexts, focusing on the daily practices of the affected subjects, a blind eye is still turned to the eco-feminist/indigenous critique which perceives that those affected are still victimised. In the same sense, in a more recent work, Murphy (2017) notes that despite the good intentions of studies on harm in affected communities, they often 'resurrect racist, misogynistic, and homophobic portrayals of poor, black, indigenous, female, and queer lives and communities as damaged and doomed, as inhabitants of irreparable states' (2017: 496). In this sense, in the present chapter, we are interested in problematising the conceptualisation of these areas as toxic in a polysemic manner that not only considers these zones undeniable toxicity but also brings attention to the politics that have portrayed them as toxic without paying attention to local complexities, and especially to the people living in those areas.

Toxic Mining Heritages: Between Effects and Affection

In this analysis, we want to discuss two regimes. The first has to do with mining heritage, and the second relates to perceptions and management of toxic mining heritage. Although these are deeply linked, we can recognise their different trajectories. In the first regime, a historical relationship exists between heritage, progress and national identity in Chile, which materialise through the patrimonialisation of mining operations. These processes have reified the hegemony of the monumental heritage of Chile '*como país minero*' (as a mining country), creating a narrative that portrays mining technology as part of the national ethos. This is evident in the abandoned mining sites that are part of visiting circuits, mining museums, the musealisation of contemporary mines and company towns and technological mining devices, a real aesthetic that materialises in male workers and technologies (Weinberg, 2021). Although few examples of critical museography on mining heritage exist, we can cite some museum narratives that show the poor working conditions of the proletarianised workers in the saltpetre mines (e.g. the Augusto Capdeville Museum in Taltal, the Regional Museum of Antofagasta), or of several saltpetre mining enclaves that were used as torture centres during the dictatorship, such as Chacabuco

(Vilches, 2011). These examples offer a critical understanding of the complexities of mining heritage at a local level; this heritage distances itself from the dominant idea of mining patrimonialisation, which has been related to techno-progressive, hetero-normative and patriarchal discourses (Barrientos et al., 2009; Silva, 2008; Pavez y Hernández, 2014; Silva y Salinas, 2016). In short, while on the one hand, we can easily observe that Chilean mining aesthetics are based on the progress of mining cycles, on the other hand, there is a mining space that is unknown and outside the authorised heritage discourse and that relates to the intangible heritage of mining, which we found in the duality consisting of the ‘negative’ effects of mining and the affection for mining.

To address the second regime, it is necessary to situate the discussion of toxic mining heritages in broader critical heritage debates. Regarding the ‘toxic’ dimension of mining and its link with the notion of heritage, we are interested in its contemporary political dimension. Our interest focused on the recent past, the present and the near future. Wollentz et al. (2020) point out that the toxicity of heritage is not so much related to its level of life or death, but rather to its management and the narratives in which it is used. Returning to the case of the Atacama Desert, no discussion has been held around managing toxic mining heritages (similar to the debate on nuclear waste in Europe, for example). What has prevailed is the management of toxicity through the prism of risk technologies and corporate social responsibility.

In mining, there are different levels, categories, scales and natures of toxicities. We have focused on the understanding of toxic mining heritages as a form of material/immaterial environmental violence that became naturalised in the Atacama Desert with the military dictatorship and that has become a *habitus* of large-scale mining since then. One of the most representative examples of the material culture of mining extractivism is tailings. The geo-engineering management of tailings categorises them into active, non-active and abandoned sites (Sernageomin⁵). This distinction between the different natures of the ‘lives’ of toxic wastes is a provocation that makes the complexity of these wastes invisible (Hetch, 2014). This situation evokes not only the relationship between these mining landscapes and local communities, but also with their global character, considering that in this radicalised modernity, technologies bring together communities separated by time and space (Arboleda, 2021).

While there is a socio-political dimension that has traces in the miningscapes (Méndez et al., 2020), the accumulation resulting from this dispossession is currently nourishing univocal green narratives that feed the energy transition paradigm. As we will present in the next two sections (Copper and Lithium), in the Atacama Desert, we see a crucial tension: while local and regional identities mobilise mining heritage as a form of recognition and belonging, the mining industry is simultaneously creating dramatic traces and evidence of destruction and new dystopian socioscapas. We can observe friction between the local need to create and embrace mining heritage as a way of embodying identity politics and (regional and national) belongings, and the traces of toxicity and destruction that are produced by the same activities in the spaces of extraction that allow for these notions of belonging to exist.



FIGURE 7.3 Transporting a windmill blade of a wind turbine generator, by the authors.



FIGURE 7.4 Solar panels of a wind turbine generator, by the authors.

In addition, in recent years, these scenarios have been affected not only by mining ventures but also by a massive energy infrastructure that has been fundamental to the maintenance and development of extractive industries in northern Chile, and that has once again affected heritage–construction processes (Figures 7.3 and 7.4).

Copper

Despite the relevance of copper to the Chilean national economy and identity, no significant funding exists for the field of mining heritage in its most classical sense. In fact, the most important projects have been local initiatives started by former workers, their families, unions and local associations as a way of maintaining the

sites (as in the cases of Chuquicamata and Sierra Gorda, for example). However, it is not the case that no funds are earmarked for heritage, but simply that they are elsewhere. Although it may seem paradoxical, large-scale mining is a major producer of heritage (Baird, 2022). Although it may seem paradoxical, large-scale mining is a major producer of heritage. In the context of mining, a huge market exists for contract archaeology and heritage management associated with environmental impact assessments. This market is even bigger if we also include the infrastructure that supports large-scale mining, such as roads and renewable energies projects. In this setting, the most common development in recent years, apart from the expansion of mining districts, involves foreign investment in Chile in ‘clean’ energies such as photovoltaic panels and wind farms. We do not yet know the exact percentage, but the Chilean heritage management model must be similar to the one described by Zorzin (2015) in his analysis of the Canadian model, where private archaeology represents 95% of the occupation.

The Antofagasta Region is a quintessential leader in Chilean copper extraction, yielding 2.88 million tons of fine copper, representing 52% of national production (Cochilco, 2018). This copper is extracted from one of the driest places on Earth: the Atacama Desert (Jordan et al., 2014), home to the largest porphyry copper deposits in the world (Sillitoe, 2010). Over the past fifty years, the Chilean state has exploited these deposits through Codelco (the National Copper Corporation of Chile), a public copper company considered fundamental to the Chilean state. In the current context of climate crises and political transformations, the strategic role of Codelco is increasingly relevant to Chilean social and economic organisation and has major implications for global energy supply chains. Under the prevailing logic that more mining is required to guarantee global energy transitions, Chuquicamata – one of the oldest and most important divisions of Codelco – transitioned its open-pit production to underground mining in 2019. Chuquicamata has played a fundamental role in organising social, political, and economic life in northern Chile.

Chuquicamata is central to contemporary Chilean politics and development, and to global energy supply chains. It has also played a central role in the historic development of Chile as a ‘mining country’. More than one hundred years after the start of the industrial extraction process, the technology used continues to be modernised to increase the company’s performance, even to the detriment of the environment and the health of the miners and the local population (there are 180,000 inhabitants in Calama according to the 2017 census).

During the first decades of its operation (1915–1923) in the hands of the North American businessman Guggenheim representing the firm Chile Exploration Company (Chilex), and then until the end of the 1960s under the firm Anaconda Company (Carrasco, 2015, 2020), the political and economic logic from which the hegemonic administration was shaped, turned Chuquicamata into a bubble of privilege in the context of northern Chile, although it also fostered a space in which freedoms were compressed and restricted (Figueroa, 1928; Finn, 1998; Galaz-Mandakovic, 2013, 2017; Latcham, 1926). Some research has examined the internal

coercive practices and property regulation systems that not only guaranteed the appropriation of natural resources but also legalised the use of force against miners. Consequently, these ‘artificially stable conditions’ allowed the open-pit copper mining exploitation model to produce unequal territories in the region (Méndez et. al., 2020, 11).

In 1992, after nearly eighty years of existence, the Chuquicamata town was declared ‘a zone saturated by sulfur dioxide and breathable particles’ which residents had to evacuate. The entire population was moved to the city of Calama (Santolaya et al., 1995). The original strategy of setting up the camp in the extraction space – which promoted continuous relations between workers, families, and copper – was replaced by socioeconomic incentives when the town was moved to Calama, such as housing loans, scholarships and health insurance (Pérez-Bustamante & Wolf, 2014). For over a century, Chuquicamata has fostered an intriguing sense of belonging and pride among its workers, as well as in the larger Chilean imagination. To this day, the camp opens once a year to celebrate the anniversary of its inauguration with workers, former workers and their families (Weinberg, 2021). It is in this sense, we precisely pointed out the tensions. Whereas the mining camp was shut down given toxic reasons that made it unliveable, until this day ex-workers and their families, which used to live there and probably are sick or have lost some member of their families for this reason, have enormous affection and sense of belonging, and really treasure remembering and sharing with younger generations their past in Chuquicamata.

In Chuquicamata, we observe, working conditions and note the significant presence of diseases and deaths that have occurred in various periods in the history of the mine (Vergara, 2005; Galaz-Mandakovic, 2017, 2021). Biopower and necropolitics work together through control mechanisms that have been generated by the extractive companies. And over the decades these have also been internalised by the workers themselves. With the stark recognition that the miners and their families exchange ‘health for money’, the legitimacy of the biopower that can be seen in Chuquicamata, lies not only in its capacity to optimise life opportunities, but in how death is regulated (Foucault, 1976, 2008; Mbembe 2003; Galaz, 2013, 2021). In Chuquicamata, we observe control and co-optation of the population through their bodies, at a capillary, almost imperceptible level, using biopolitical surveillance mechanisms that have been internalised in an effective and complex manner over the decades (*sensu* Foucault, 1976). The corps are valued economically for their work by receiving good salaries, but they also get sick and, in some cases, die (Weinberg, 2021; Galaz-Mandakovic, 2021).

Lithium

The univocal assumption that the production of lithium and its by-products will yield a transition towards ‘clean–green energy’ erases the real environmental impacts of lithium mining in the regions of the planet from which this soft metal is extracted,

including the Atacama Desert. Several fundamental studies have detailed how this water-intensive extractive activity relies on fragile local ecologies (Aránguiz et al., 2020; Babidge, 2021; Bustos & Prieto, 2019; Göbel & Gundermann, 2018; Flores-Fernández, 2020; Garcés & Álvarez, 2020; Bonelli & Dorador, 2021; Prieto, 2016, 2017; Weinberg & Bonelli, 2021).

The widespread imaginary of brine extraction areas romanticises extensive salt flats and striking blue-green pools. However, extraction processes have also generated massive infrastructure, material systems, intangible damage, effects on human and non-human beings and the establishment of socio-technical imaginaries, which have been normalised over time. Undeniably, the further one moves away from the world-famous brine pools, the 'dirtier' the landscape becomes.

So far, no certified correlation has been established between exposure to lithium carbonate and human diseases, as has been done in the case of direct contact or inhalation of metallic particulate matter in the case of concentrated copper (Galaz Tapia, 2022; Vergara, 2005, 2008; Bernalles et al., 2008; Weinberg, 2021). However, 'the European Chemicals Agency (ECHA)'s Risk Assessment Committee (RAC) at the end of 2021 published its opinion that it agreed with French proposals to classify three lithium salts as Category 1A reproductive toxicants. This publication determined that lithium carbonate, lithium hydroxide and lithium chloride should be classified under the Classification, Labelling & Packaging (CLP) Regulation as substances that may damage fertility and unborn children. It also agreed that the substances may harm breastfed children'.⁶ Following this new potential harmful status for lithium salts, opens the possibility of undermining the European Union's attempt to create and support a local supply chain for battery materials. However, this same declaration does not seem to have had any impact on the policies in place in the north of Chile, once again revealing the 'unevenly toxic world', where 'toxic harm also maintains systems, including those that produce inequity and sacrifice' (Liboiron et al., 2018: 332).

When we look at the Atacama Desert, it becomes evident that to guarantee the transition to 'clean energy', not only will local ecologies within the salt flats continue to be affected, but the infrastructure throughout the desert will continue to expand. These material arrangements have a much wider geographical coverage than the extraction area itself, including workers' camps, company offices, processing plants, ports, electric power lines, land, rail, air and water routes, and so on. These historically disputed extractivist territories, marked by socio-environmental conflicts, are now being reshaped by the installation of energy enterprises. Due to the rising prices of hydrocarbons in neighbouring countries and to the 'natural' advantages of northern Chile (with its high direct solar radiation and atmospheric attenuation), the country is presented as a laboratory, as one of the region's areas with the greatest promise of successfully transforming its energy matrix. But for now, what we see is a renewable energy generation model whose only aim is to power mining industries; thus, we are witnessing the production of a variety of

clean energy materials that maintain an extractive mining model, which continues to be sustained mainly by fossil fuels.

In the global south, what energy transitions really do is produce new energy expenditures that continue to ensure the expansion of capital produced by resource extraction. Green moralities imposed as a counterpart to the paradigm of energy transitions seem to develop in those planetary spaces and socioeconomic sectors that require mining development to ensure prevailing inequality. However, in local communities, the only choices available are to work in a toxic environment or to not work at all.

Conclusions: After Mining?

The proliferation of hegemonic discourses describing green utopias makes invisible the catastrophe and urgency of the present impacts on the territories of extraction. The north of Chile appears in this scenario as a space that struggles between life and destruction. It is a vital, necessary and sacred space for many, and a natural and pristine place for others, but it has become mostly a subaltern place, subalternised at the service of global capital. The micro-politics of mining are concerned with production costs, in which the so-called 'liabilities' and 'assets', both social and environmental, are completely monetised. But this cost of production certainly does not include infinite concerns such as death.

Lithium and copper mining have developed vis-à-vis explanations of inevitability, but mainly as a way to achieve a future for the few. While uninterrupted economic growth in the global north promises a chimaera of green horizons, we see that in the region where lithium, copper and so many other elements are obtained, massive extraction exacerbates inequality, dispossession and the destruction of ecosystems and ways of life. The mining boom that has accelerated in the last decade is based on potentialities: paradigms of not *yet* green-transitions pronounce a future that *will arrive*. Not only has this future not yet arrived, but it is also likely to be a future that is inaccessible to many. Conceptualizing the future has become a commonplace of diverse and heterogeneous narratives (public, private, political, associative, individual) that support green morality as an ideology that corrects, remedies and repairs socio-environmental problems. However, access to material existence in different types of future would require the security of capital in the present, which would ensure some kind of link with the future.

In the quotidian experience of living in the Atacama Desert, we observe that there is a distance bordering perversion between assessments and concerns over futures. On the one hand, the overvaluation of a futuristic metaphysics mobilised by companies, state bodies, and expert knowledge, concerned with scenarios and communities of the future in unknown territories. On the other, actors whose future is less aesthetic, their future is an immediate one, worrying about household subsistence contingencies that must find strategies to access clean air, water and food to get through the day. Moreover, the governance of the future only makes

invisible the communities affected by toxic air poisoning and lack of clean water in the present, and in this sense, we believe that issues related to energy transition and future sustainability should be carefully invoked from the social sciences, as they often contribute to abandoning the contradictions of the present.

The politics of toxic heritage conceptualization we have proposed, invite us to think about the processes of this work from a perspective that considers power relations and the uneven distribution of the impacts of mining activities at the forefront. The toxicity of mining can be thought of as a part of capitalism's legacy, but not necessarily analysed as binary from a moral perspective. As we have shown by paying attention to the multiplicity of experiences in mining territories, toxic heritage might be approached as a multivocal concept. While sustaining the modern capitalist system, it is also a way of life (and sometimes the only option) for most of the population in the Atacama Desert. It turns out that extractivism in northern Chile is much more than a mode of production; it is also a way of life, a heritage for many, a dependence for others and one of the few livelihoods that has allowed people far from the centre of the country to feel some kind of national belonging. This paradox is difficult to unravel, as the people have affection for their territories even though these have been labelled as toxic. It could be thought of as a kind of 'conflicted subjectivity' (*sensu* Navaro-Yashin, 2009), or it could be concluded that the Cornelian dilemma of producing a toxic environment and living in it, is unavoidable in a mining space where mining *is* life.

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Notes

- 1 With the establishment of the Intergovernmental Panel on Climate Change (IPCC), created by the World Meteorological Organization and the United Nations Environment Programme in 1998, and the organisation of the United Nations Conference on Environment and Development, or the Earth Summit, in Rio de Janeiro in 1992, a new era of climate change awareness began. Since then, environmental deterioration has been unstoppable as the result of large-scale industrial development vis-a-vis the constant implementation of policies and protocols that have been unsuccessful at tackling the crisis.
- 2 In spite of our pessimistic hypothesis on the supremacy of techno-engineering expertise, we can point out, following Murphy (2008), that 'since there is a regime of imperceptibility that has been purposively assembled around synthetic molecular relations, efforts to render visible such relations – by scientists, by bureaucrats, by community groups, or by NGOs – are political acts'.

- 3 We thank Anders Berglund for sharing the “Sveriges ansvar för giftigt avfall i Chile” Interpellation (https://www.riksdagen.se/sv/dokument-lagar/dokument/interpellation/sveriges-ansvar-for-giftigt-avfall-i-chile_H810772)
- 4 ‘Boliden decided to ship 20,000 tons of toxic mining waste to Chile in the mid-1980s. In this way, the company could circumvent Swedish environmental requirements and save money. Boliden sent the waste to the Chilean company Promel in Arica’ (Delgado Varas, 2020).
- 5 <https://www.sernageomin.cl/datos-publicos-deposito-de-relaves/>
- 6 realclearenergy.org/2022/06/22/energy_transition_goals_at_risk_eu_label_lithium_as_toxic_838018.html

References

- Aránguiz-Acuña, Adriana, José A. Luque, Héctor Pizarro, Mauricio Cerda, Inger Heine-Fuster, Jorge Valdés, Emma Fernández-Galego yVolker Wennrich. 2020. “Aquatic community structure as sentinel of recent environmental changes unraveled from lake sedimentary records from the Atacama Desert, Chile.” *PLoS ONE* 15(2): e0229453.
- Aránguiz-Acuña, Adriana yManuel Prieto. 2021. “Justicia ambiental en Chile: ¿La última oportunidad?” *Cuadernos Médico-Sociales* (Chile) 61(3): 53–57.
- Arboleda, Sebastián. 2021. *Planetary Mine: Territories of Extraction Under Late Capitalism*. Verso.
- Babidge, Sally. 2021. “Seeing water slow resistance and the material enigma of extractive effects on society and ecology.” *HAU: Journal of Ethnographic Theory* 11 (2): 395–411. 10.1086/715788
- Baird, Melissa. 2022. “Waste Sits in Places. Post-Extractive Landscapes as Heritage.” In Giacomo Pettenati (Ed.), *Landscape as Heritage. International Critical Perspectives*. London: Routledge, 204–205.
- Barrientos Delgado, Jaime, Paulina Meruane, Pablo Rojas Varas, and Patricio Meza Opazo. 2009. “Minería, género y cultura. Una aproximación etnográfica a espacios de esparcimiento y diversión masculina en el norte de Chile.” *Revista Antropológica Iberoamericana* 4 (3): 385–408.
- Bebbington, Anthony. 2009. “The New Extraction: Rewriting the Political Ecology of the Andes?.” *NACLA Report on the Americas* 42 (5): 12–20.
- Bellacasa, María Puig de la . 2017. *Matters of Care: Speculative Ethics in More Than Human Worlds*. Minneapolis and London: University of Minnesota Press.
- Bernales, Bélgica, Juan Alcaíno yRodrigo Solís. 2008. “Situación de exposición laboral a sílice en Chile.” *Ciencia y Trabajo* 10 (27): 1–6.
- Bidaseca, K., and Vazquez Laba, V. (comps). 2011. *Feminismos y poscolonialidad : descolonizando el feminismo desde y en América Latina*. Buenos Aires: Ediciones Godot.
- Biskupovic, Consuelo, Marina Weinberg, Adriana Aranguiz, Jimena Cruz, Valentina Figueroa, Fernanda Kalazich, and Paulina Salinas. 2023. “Territorios de cuidado. Propuestas desde un enfoque feminista ante el extractivismo en el desierto de Atacama, Chile.” *Latin American Perspectives*.
- Bolados, Paola. 2016. “Conflictos socio-ambientales/territoriales y el surgimiento de identidades post neoliberales (Valparaíso-Chile).” *Izquierdas* 31: 102–129.
- Bonelli, Cristóbal yCristina Dorador. 2021. “Endangered Salares: micro-disasters in Northern Chile.” *Tapuya: Latin American Science, Technology and Society* 4(1): 1–21.
- Bustos, Beatriz yManuel Prieto. 2019. “Ecología Política en (desde y por) Chile: Posibilidades, desafíos y contribuciones.” In A. Núñez, E. Aliste yR. Molina (Eds.), *(Las) Otras Geografías en Chile. Perspectivas sociales y enfoques críticos*. Santiago de Chile: LOM, 85–104.

- Carrasco, Anita. 2015. "Jobs and Kindness: W. E. Rudolph's Role in the Shaping of Perceptions of Mining Company-Indigenous Community Relations in the Atacama Desert, Chile." *The Extractive Industries and Society* 2: 352–359.
- Carrasco, Anita. 2020. *Embracing the Anaconda: A Chronicle of Atacameño Life and Mining the Andes*. Lanham, Maryland: Lexington Books.
- Cochilco. 2018. *Balance de gestión integral 2018*. Cochilco: Gobierno de Chile.
- Figueroa, Marcial. 1928. *Chuquicamata. La tumba del chileno*. Antofagasta: Imprenta Castellana.
- Finn, Janet L. (1998). *Tracing the Veins of Copper, Culture and Community from Butte to Chuquicamata*. Berkeley: University of California Press.
- Flores-Fernández, Cristián. 2020. "The Chilean energy "transition": between successful policy and the assimilation of a post-political energy condition." *Innovation: The European Journal of Social Science Research* 33(2): 173–193.
- Foucault, Michel. 1976. *Historia de la sexualidad*. México: Siglo XXI.
- Foucault, M. 2008. *The Birth of Biopolitics*. Nueva York: Picador-Palgrave Macmillan.
- Galaz-Mandakovic, Damir. 2013. *Migración y Biopolítica. Dos escenas del siglo XX tocopillano*. Tocopilla: Retruécanos Ediciones.
- Galaz-Mandakovic, Damir. 2017. "Turbinas y electricidad para lamina, lámparas a parafina para la población. Crónica de una asimetría del capitalismo minero en Tocopilla (1914–1942)." *Estudios Atacameños* 54: 179–200.
- Galaz-Mandacovic, Damir. 2021. "La necroeconomía de la generación de electricidad para la minería. El impacto comunitario del uso del petcoke en Tocopilla (Chile, 2000–2015)." CUHSO. 10.7770/cuhso-v31n2-art2155
- Galaz-Mandakovic, Damir y Víctor Tapia Araya. 2022. "El panteón de la montaña de cobre. Trabajo, ambiente y causas de muerte en la mina de Chuquicamata durante la etapa Guggenheim. (Chile, 1915–1923)." *Historia Unisinos* 26(2): 312–329.
- Garces, Ingrid and Gabriel Alvarez. 2020. "Water mining and extractivism in the Salar the Atacama." *WIT Transactions on Ecology and the Environment* 245: 189–199. 10.2495/EID200181
- Gundermann, Hans y Barbara Göbel. 2018. "Comunidades indígenas, empresas del litio y sus relaciones en el Salar de Atacama." *Chungará*. 10.4067/S0717-73562018005001602
- Haraway, D. 2016. *Staying with the Trouble: Making Kin in the Chthulucene*. Durham, NC: Duke University Press.
- Haraway, Donna. 1995. *Ciencia, cyborgs y mujeres: la reinención de la naturaleza*. Madrid: Cátedra.
- Hecht, Gabrielle. 2018. "Interscalar vehicles for an African Anthropocene: On waste, temporality, and violence." *Cultural Anthropology* 33(1): 109–141.
- Hecht, Gabrielle. 2014. "Invisible Production and the Production of Invisibility: Cleaning, Maintenance, and Mining in the Nuclear Sector." In Daniel Kleinman and Kelly Moore (Eds.), *Handbook on Science, Technology and Society*. Routledge, 346–361.
- Holifield, Ryan and Michael Day. 2017. "A framework for a critical physical geography of 'sacrifice zones': Physical landscapes and discursive spaces of frac sand mining in western Wisconsin." *Geoforum* 85: 269–279.
- Hormazabal-Poblete, Nina, Sandro Maino, Magdalena Herrera, and Matias Vergara. 2019. "Habitar en una zona de sacrificio: Análisis multiescalar de la comuna de Puchuncaví." *Revista Hábitat Sustentable* 9: 6–15. 10.22320/07190700.2019.09.02.01
- Jordan, Teresa, Kirk-Lawlor, Naomi, Blanco, Nicolás, Rech, Jason, and Nicolás Cosentino. 2014. "Landscape modification in response to repeated onset of hyperarid paleoclimate states since 14 Ma, Atacama Desert, Chile." *Geological Society of America Bulletin* 126, 1016–1046. 10.1130/B30978.1

- Latham, Ricardo A. 1926. *Chuquicamata. Estado Yankee*. Santiago: Editorial Nascimento.
- Liboiron, Max, Manuel Tironi, and Nerea Calvillo. 2018. "Toxic Politics: Acting in a Permanently Polluted World." *Social Studies of Science* 48(3): 331–349.
- Mbembe, Achille. 2003. "Necropolitics". *Public Culture* 15 (1): 11–40.
- Méndez, M., Prieto, M., and D. Galaz-Mandakovic. 2020. "Tele-production of Miningscapes in the open-pit era: The case of low-grade copper, Bingham Canyon, US and Chuquicamata, Chile (1903–1923)." *The Extractive Industries and Society*. <https://doi.org/10.1016/j.exis.2020.10.013>
- Mol, A. 2002. *The Body Multiple: Ontology in Medical Practice*. Durham, NC and London: Duke University Press.
- Mol, Annemarie. 2008. *The Logic of Care: Health and the Problem of Patient Choice*. London: Routledge.
- Murphy, Michelle. 2004. Uncertain Exposures and the Privilege of Imperception: Activist Scientists and Race at the U.S. Environmental Protection Agency. *Osiris*, 2nd Series, Vol. 19, Landscapes of Exposure: Knowledge and Illness in Modern Environments, pp. 266–282.
- Murphy, Michelle. 2008. "Chemical Regimes of Living." *Environmental History* 13 (4): 697–703.
- Murphy, Michelle. 2017. "Alterlife and Decolonial Chemical Relations." *Cultural Anthropology* 32(4): 494–503.
- Navaro-Yashin, Y. 2009. "Affective Spaces, Melancholic Objects: Ruination and the Production of Anthropological Knowledge." *Journal of the Royal Anthropological Institute* 15 (1): 1–18.
- Pavez, Jorge y Gerardo Hernández. 2014. "Regímenes de trabajo, relaciones laborales y masculinidades en la gran minería del cobre (norte de Chile)." *En Trabajos y familias en el neoliberalismo: Hombres y mujeres en faenas de la uva, el salmón y el cobre*, X. In L. Valdés et al., Santiago: LOM, 169–263.
- Pérez-Bustamante, Leonel, and Wolf. 2014. "Chuquicamata: crónica de un desalojo / cierre, despedida y últimos años de funcionamiento." In María Isabel López & Leonel Pérez-Bustamante (ed.), *Patrimonio minero y sustentabilidad: propuestas y experiencias de reutilización* (pp. 34–47). Concepción: Ediciones Universidad del Bío-Bío & CYTED.
- Perreault, Tom. 2013. "Dispossession by Accumulation? Mining, Water and the Nature of Enclosure on the Bolivian Altiplano." *Antipode* 45 (5): 1050–1069.
- Prieto, Manuel. 2015. "Privatizing Water in the Chilean Andes: The Case of Las Vegas de Chiu-Chiu." *Mountain Research and Development* 35: 220–229. 10.1659/MRD-JOURNAL-D-14-00033.1
- Prieto, Manuel. 2016a. "Transando el agua, produciendo territorios e identidades indígenas: El modelo de aguas chileno y los atacameños de Calama." *Revista de Estudios Sociales* (55): 88–103.
- Prieto, Manuel. 2016b. "Practicing costumbres and the decommmodification of nature: The Chilean water markets and the Atacameño people." *Geoforum*.
- Prieto, Manuel. 2017. The irrigation system that market doesn't want to see: the history of the water's dispossession in the communities of Lasana and Chiu-Chiu (Atacama Desert, Chile)
- Salinas Meruane, Paulina, Barrientos Delgado, Jaime, and Rojas Varas, Pablo. 2012. "Discursos sobre la discriminación de género en los trabajadores mineros del norte de Chile." *Atenea* 505: 139–158.
- Santolaya Biondi, R., L. Salazar Corco, R. Santolaya Cohen, M. Sandoval Martínez, and R. Alfaro Torrico. 1995. "Arsénico. Impacto sobre el hombre y su entorno. II Región de Chile (Antofagasta). Chuquicamata: Programa Ambiente 02 (1992–1993)." Centro de Investigaciones Ecobiológicas y Médicas de Altura C.I.E.M.A.

- Segato, R. L. 2011. Género y colonialidad: en busca de claves de lectura y de un vocabulario estratégico descolonial. In K. Bidaseca and V. Vazquez Laba. (comps). *Feminismos y poscolonialidad : descolonizando el feminismo desde y en América Latina*. (pp. 11–40). Ediciones Godot: Buenos Aires.
- Segovia, Jimena Luz, and Paulina, Salinas. 2020. ““Me canso de ser hombre” Paternidad periférica en el trabajo minero chileno.” *Sociología, Problemas e Prácticas* 93: 31. 10.7458/SPP20209312014
- Segovia, Jimena Luz, Paulina, Salinas, and Estefany Castillo Ravanal. 2023. “Habitus of Masculinity in Chilean Miners: Efficiency, Control, and Consumption of the Bodies.” *Social Sciences* 12: 119. 10.3390/socsci12030119
- Sillitoe, R. H. 2010. “Porphyry Copper Systems.” *Economic Geology* 105 (1): 3. <https://doi.org/10.2113/gsecongeo.105.1.3>
- Silva, Jimena *et al.* 2008. “Tacones cercanos. Diagnóstico y situación de la mujer que ejerce comercio sexual, región de Antofagasta, Chile.” Servicio Nacional de la Mujer, Chile.
- Silva, Jimena y Paulina Salinas. 2016. “With the Mine in the Veins: Emotional Adjustments in Female Partners of Chilean Mining Workers.” *Gender, Place & Culture* 23 (12): 1677–1688.
- Svampa, M. 2015. “Feminismos del Sur y ecofeminismo.” *Nueva Sociedad* 256: 129, 130.
- Ulloa, Astrid. 2016. “Feminismos territoriales en América Latina: defensas de la vida frente a los extractivismos.” *Nómadas* 45: 123–139.
- Ureta, S., and P. Flores. 2018. “Don’t wake up the dragon! Monstrous geontologies in a mining waste impoundment.” *Environment and Planning D: Society & Space* 36 (6): 1063–1080.
- Vergara Marshall, Angela. 2005. “The Recognition of Silicosis: Labor Unions and Physicians in the Chilean Copper Industry, 1930s–1960s.” *Bulletin of the History of Medicine* 79 (4): 723–748.
- Vergara Marshall, Angela. 2008. *Copper Workers, International Business, and Domestic Politics in Cold War Chile*. University Park, PA: The Pennsylvania State University Press.
- Vilches, F. 2011. “From nitrate town to internment camp: The cultural biography of Chacabuco, northern Chile.” *Journal of Material Culture* 16 (3): 241–263.
- Walker, Brett. 2011. *Toxic Archipelago. A History of Industrial Disease in Japan*. Washington: University of Washington Press.
- Weinberg, Marina. 2021. “Cuerpos de cobre: Extractivismo en Chuquicamata, Chile.” *Journal of Latin American and Caribbean Anthropology* 26(2): 200–218.
- Weinberg, Marina and Cristóbal Bonelli. 2021. “Lithium: Towards a Theory of Bipolar Transitions (Litio: hacia una teoría de las transiciones bipolares).” In Francisco Díaz, Anastasia Kubrak, and Marina Otero Verzier (Eds), *Lithium: states of exhaustion (Litium: Estados de agotamiento)*. Rotterdam: het Nieuwe Instituut; Santiago: Ediciones ARQ, 52–55.
- Wollentz, Gustav, May, Sarah, Holtorf, Cornelius, and Anders Högberg. 2020. *Toxic heritage: Uncertain and unsafe*. 10.2307/j.ctv13xps9m.25
- Zorzin, Nicolas. 2015. “Dystopian archaeologies: the implementation of the logic of capital in heritage management.” *International Journal of Historical Archaeology* 19: 791–809.