REVUE INTERNATIONALE DE POLITIQUE DE DÉVELOPPEMENT

International Development Policy | Revue internationale de politique de développement

16 | 2023
The Afterlives of Extraction

The 'Alterlives' of Green Extractivism: Lithium Mining and Exhausted Ecologies in the Atacama Desert

Les 'alter-vies' de l'extractivisme vert : L'extraction du lithium et l'épuisement des écosystèmes dans le désert d'Atacama

Las 'altervidas' del extractivismo verde: Minería del litio y ecologías agotadas en el desierto de Atacama

James J. A. Blair, Ramón M. Balcázar, Javiera Barandiarán and Amanda Maxwell

OpenEdition Journals

Electronic version
URL: https://journals.openedition.org/poldev/5284
DOI: 10.4000/poldev.5284
ISSN: 1663-9391

Publisher
Institut de hautes études internationales et du développement

Printed version
ISBN: 978-2-940600-49-6
ISSN: 1663-9375

Brought to you by Geneva Graduate Institute

GENEVA GRADUATE INSTITUTE
KATHRYN AND SHELBY CULLOM DAVIS LIBRARY

Electronic reference
James J. A. Blair, Ramón M. Balcázar, Javiera Barandiarán and Amanda Maxwell, "The 'Alterlives' of Green Extractivism: Lithium Mining and Exhausted Ecologies in the Atacama Desert", *International Development Policy | Revue internationale de politique de développement* [Online], 16 | 2023, Online since 19 June 2023, connection on 19 June 2023. URL: http://journals.openedition.org/poldev/5284 ; DOI: https://doi.org/10.4000/poldev.5284

The ‘Alterlives’ of Green Extractivism: Lithium Mining and Exhausted Ecologies in the Atacama Desert

Les ‘alter-vies’ de l'extractivisme vert : L'extraction du lithium et l'épuisement des écosystèmes dans le désert d'Atacama

Las ‘altervidas’ del extractivismo verde: Minería del litio y ecologías agotadas en el desierto de Atacama

James J. A. Blair, Ramón M. Balcázar, Javiera Barandiarán and Amanda Maxwell

1. Introduction

1 A global transition from fossil fuels to renewable energy is underway to mitigate climate change (Bridge and Gailing, 2020; Newell and Mulvaney, 2013). Such climate action policies are centred on electrified transportation and energy storage that currently depend on batteries, which is accelerating the extraction of critical materials. Lithium—in addition to copper, nickel, graphite, manganese and cobalt—is a key component of lithium-ion batteries that store energy for electric vehicles, smart devices and renewable power plants. Lithium is mined from three main sources: (1) hard rock pegmatites, especially in Australia, (2) sedimentary rock, particularly clay, under development in Nevada in the United States and other locales worldwide, and (3) brine pumped from beneath arid salt flats, primarily in Chile and Argentina (USGS, 2021). The last of these three methods, lithium brine evaporation, has become controversial due to legal disputes over water depletion and Indigenous rights violations in South America (Babidge et al., 2019; Blair et al., 2022; Bustos-Gallardo, Bridge and Prieto, 2021; Flexer, Baspineiro and Galli, 2018). Nonetheless, mining

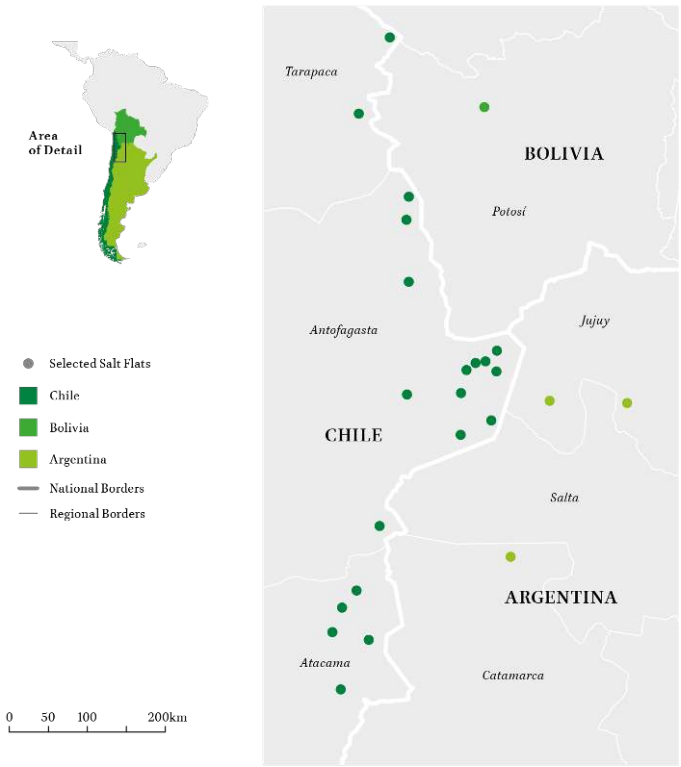
companies have tried to greenwash the environmental injustices inherent in lithium extraction by associating solar evaporation with climate change mitigation and disassociating brine from water (Voskoboynik and Andreucci, 2021). This critical conjuncture of global climate action and local environmental injustice has operated under a paradoxical regime of 'green extractivism' that has made the expansion of mining and other extractive industries a prerequisite to sustainable development (Dunlap and Jakobsen, 2019; Jerez, Garcés and Torres, 2021; Riofrancos, 2019).

2 Drawing on collaborative, engaged and policy-oriented research for the Natural Resources Defense Council (NRDC) and the Plurinational Observatory of Andean Salt Flats (OPSAL), this chapter interrogates how the reliance on brine evaporation as an extraction method for lithium mining has exacerbated conditions of 'ecological exhaustion' and undermined Indigenous sovereignty in South America (Babidge et al., 2019).[1] Our study is primarily based on ethnographic and historical research conducted in the period 2014–19, including participant observation, document analysis and workshops and interviews with environmental activists, Indigenous leaders, international scientists and policy practitioners in the Puna de Atacama from across Chile, Argentina and Bolivia, with a particular focus on northern Chile (see figure 1).[2] Drawing on the interdisciplinary fields of political ecology and science and technology studies, or STS (Bustos-Gallardo, Prieto and Barton, 2015; Goldman, Nadasdy and Turner, 2011; Peet, Robbins and Watts, 2011; Sultana, 2020; 2021), we analyse how the 'slow violence' (Nixon, 2011)—the uneven effects that take place gradually and often invisibly—of lithium brine evaporation has transformed Andean wetland ecologies into what decolonial feminist STS scholar Michelle Murphy (2017) calls 'alterlives', or 'collectivities of life recomposed by the molecular productions of capitalism in our own pasts and the pasts of our ancestors, as well as into the future' (Murphy, 2017, 497). While Murphy developed this concept to refer to the alteration of life through exposures to downstream chemicals in the built environment, here our focus is on the in situ alteration of life at extraction sites upstream in the chemical supply chain.[3] In the instance of intensive lithium mining in the Puna de Atacama, green extractivism has had wide-ranging effects across multiple scales of life in relation to water: from Indigenous agropastoralists who have established irrigation practices and customs based on local knowledge over millennia (Babidge and Bolados, 2018; Prieto, 2016) to charismatic megafauna such as flamingos, and unique biodiverse microorganisms that have adapted to the extreme environments of ancient palaeolakes and are now facing extirpation or extinction (Bonelli and Dorador, 2021; Gutiérrez et al., 2022).

3 The urgency of confronting hydrosocial impacts that transcend spatio-temporal scales of life has inspired many environmental movements throughout Latin America to protect their territories from immediate threats of development by extractive industries.[4] Here, we consider under what conditions Indigenous and local participation may contribute new models and standards for monitoring ecological exhaustion, and we encourage concrete policy alternatives to lithium brine evaporation—the dominant method of lithium extraction used in the Puna de Atacama. We conducted 41 interviews and organised 13 workshops or public events with Indigenous leaders and those involved in environmental defence and campaigning in the region, from 2014 to 2019. Some community members feel they are benefiting from lithium development; some do not. Some mining operations have the support of local and/or national governments, while others do not. These communities are not monolithic, and relations with the

mining industry are complex (Carrasco, 2020; Johnson et al., 2021). Informed by these heterogeneous local experiences with green extractivism, we argue that the intensive use of water and land for lithium mining through brine evaporation has altered life in and around salt flats, and we offer policy recommendations to prevent further social and environmental damage. Before presenting our policy recommendations, in section 2 we provide a historical background of the role of neo-liberal statecraft in resource development, as well as ethnographic and analytical perspectives on the slow violence of lithium brine evaporation and the upstream alterlives of green extractivism in the Puna de Atacama.

Figure 1 Selected salt flats in Argentina, Bolivia, and Chile



Source: Authors, based on Brenda J. Rojas (Blair et al., 2022)

2. Historical, Ethnographic and Analytical Perspectives

2.1 Neo-liberal Statecraft and Resource Development

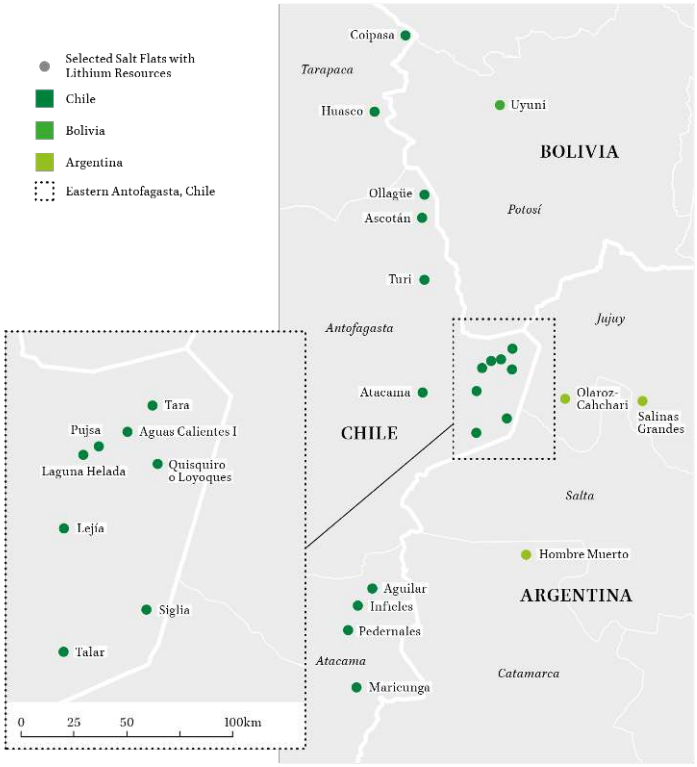
4 The Puna de Atacama—a high, arid desert region that spans northern Chile, north-western Argentina and south-western Bolivia—is known for vast, mineral-rich salt flats as well as for wetlands.[5] The hypersaline lakes of this stretch of the Andes host three of the world's six species of flamingo, an array of endemic mammals, and unique communities of microorganisms (Contador et al., n.d.; Dorador et al., 2018b; Dorador et al., 2013; Gajardo and Redón, 2019; Marambio-Alfaro et al., 2017). Yet, many of these lagoons are adjacent to or overlap with mining projects (see figure 2). Mining has long occurred in Chile's Atacama salt flat, dating back to before the Inca or the Spanish

conquests. From the Spanish colonial era and into the twentieth century, the authorities argued that the Atacama Desert was empty and arid, and used this as the rationale for erasing and marginalising Indigenous peoples living there (Mendez, Prieto and Godoy, 2020; Saldivia Maldonado, 2003). This belies the contemporary formation of an Atacameño/Lickanantay ethnopolitical movement (Bustos, 2014; Carrasco, 2020; Gundermann, 2004; Morales Morgado, 2013). After World War II, the United States and other wealthy nations began stockpiling strategic resources like uranium and lithium for the development of nuclear energy and weapons, as policies of resource nationalism became foundational to the consolidation of global power (Black, 2018; Hecht, 2012; Mitchell, 2011). The governments of Chile, Argentina and Bolivia have developed lithium mining by pursuing extractivist and neo-extractivist policies that have at times envisioned lithium as a banal commodity, at times as a strategic resource; more recently, lithium has animated green extractivism as part of a 'sociotechnical imaginary' of future sustainable development (Barandiarán, 2019; Jasanoff and Kim, 2015).

5 While Chile and Argentina have been exporting lithium for several decades, Bolivia has sizeable reserves that remain largely unexploited due to technical and political hurdles, including higher levels of precipitation, greater concentrations of magnesium and more stringent state intervention (Narins, 2017; Sanchez-Lopez, 2019). Nonetheless, Bolivia has formed new alliances with China, Russia and US entrepreneurs, proposing new global production networks (Bos and Forget, 2021; Perreault, 2020). Argentina's provincial governments have sought to leverage lithium mining as a source of foreign currency and economic growth with limited oversight (Nacif, 2015). The modern Chilean state, meanwhile, was built on revenue from nitrates and copper from this area, and some Indigenous communities welcomed mining (Carrasco, 2020). However, in the 1980s and 1990s when neo-liberalism took hold under the dictatorship of Augusto Pinochet, there was a rapid development of large-scale mining for gold and copper, as well as for brine-based fertiliser and lithium extraction, among other privatised resources (Arboleda, 2020; Barandiaran, 2018; Carrasco, 2020; Fermandois, Bustos and Schneur, 2009; Tironi and Barandiarán, 2014). In the Salar de Atacama basin (see figure 3), two large copper mines from this period, Minera Escondida and Minera Zaldívar, have overused fresh water and devastated the environment (OPSAL, 2020b). Adjacent to these, Chile's two current major lithium mining operations—Sociedad Química y Minera de Chile (SQM) and Albemarle—began operating thanks to contracts brokered by state institutions, specifically the Corporación de Fomento de la Producción (Production Promotion Corporation, or CORFO). Benefit-sharing agreements exist between Albemarle and the Community of Peine, as well as between Albemarle and the broader Indigenous association, Consejo de Pueblos Atacameños (CPA), which represents 18 Atacameño/Lickanantay Communities. SQM has begun to establish direct benefit-sharing agreements with 23 separate communities under the Indigenous Law, but the company has been in a protracted legal dispute with the CPA over its proposed compliance plan in the context of a sanctioning process filed by the Superintendency of Environment (SMA) of Antofagasta (Sherwood, 2020b). Despite corruption scandals and controversies over data transparency, SQM's and Albemarle's operations have expanded (*CIPER Chile*, nd; Sherwood, 2021). A new round of licenses was issued in 2021, with new, additional projects in exploration by BYD Chile SpA, Cosayach Caliche S.A., and Servicios y Operaciones Mineras del Norte S.A (Balcázar, 2022). However, in 2022, Chile's Supreme Court suspended those licenses because they

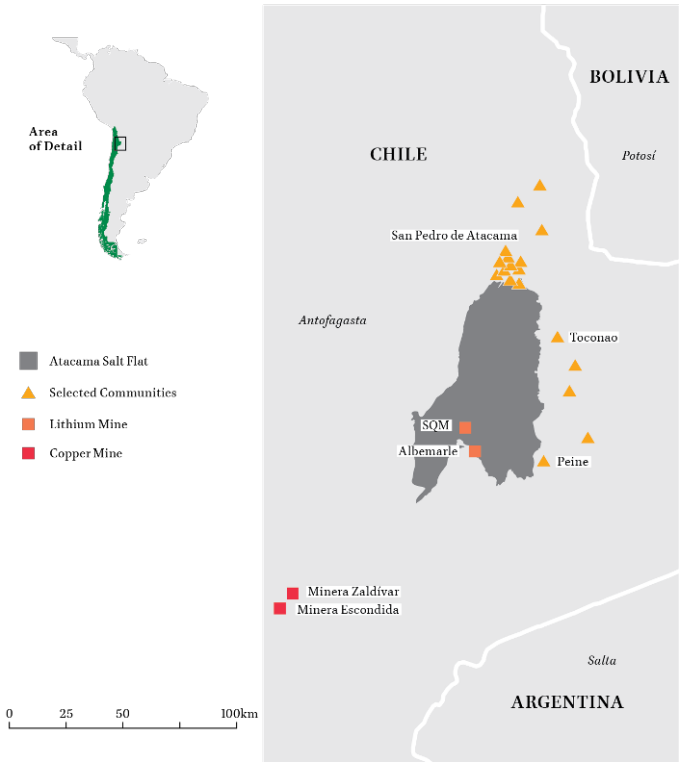
failed to identify specific mining sites, making timely consultation of Indigenous peoples impossible. As several studies have demonstrated, lithium mining has become a force of green extractivism that has thrived under neo-liberal regimes of resource governance at a considerable cost to front line communities, water resources and biodiverse wetlands (Jerez, Garcés and Torres, 2021; Riofrancos, 2019; Voskoboynik and Andreucci, 2021).

Figure 2 Selected salt flats with lithium resources



Source: Authors, based on Brenda J. Rojas (Blair et al., 2022).

Figure 3 18 Selected Indigenous communities and the four largest mining operations



Source: Authors, based on Brenda J. Rojas (Blair et al., 2022).

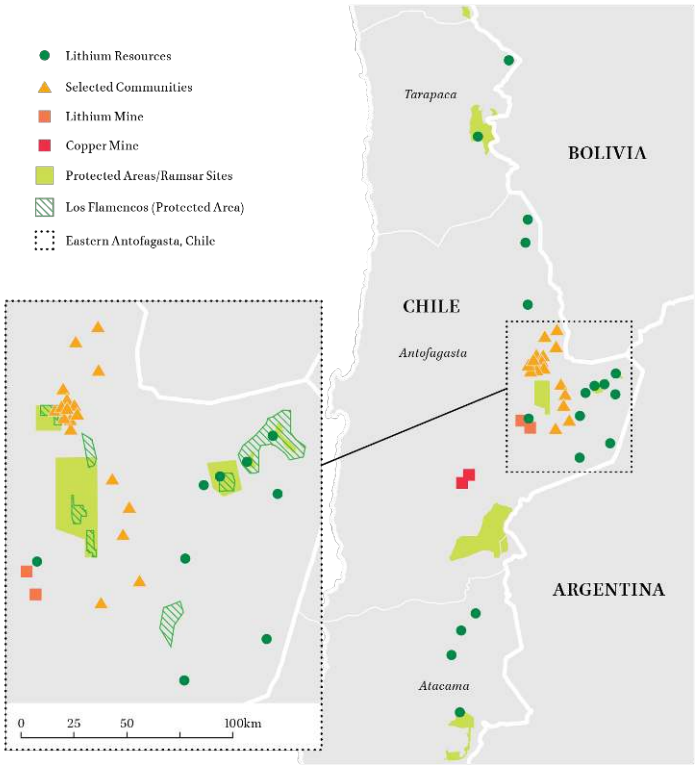
2.2 The Slow Violence of Lithium Brine Evaporation

6 Bustos Gallardo et al. (2021) point out that the lithium extraction process is more akin to industrial harvesting than mining, presenting a particular set of socioecological contradictions that result in overall water depletion. To remove lithium from brine, operators drill the crust of the salt flat and pump the salty water out from underneath at a rate of up to 1,700 litres per second.[6] The subsurface minerals are then distributed into a series of cascading evaporation pools. These vast bodies of mineralized groundwater soak up the desert sun and undergo chemical treatment before separation and transfer to a processing plant to produce lithium carbonate. The evaporation process takes up to 18–24 months, and 95 per cent of water from brine evaporates in the process, exacerbating conditions of 'ecological exhaustion' (Babidge et al., 2019). This water depletion is gradual, cumulative, and difficult to represent, as captured by Nixon's notion of slow violence. It is also enabled by Chile's 1980 Constitution, together with the Mining and Water Codes, which respectively privatised access and use of minerals and water under the then dictatorship (Hervé, 2015; Prieto, 2015b). Chile began to regulate water consumption by copper mines in 2009 (Babidge, 2019). However, regulators only track usage of surface water, freshwater aquifers, and ocean water, and not the extraction of brine in lithium mining because brine is treated as a mineral rather than as water. Permits are required from the environmental authority, but these restrictions do not account for physical conditions and externalised processes such as the hydrogeology of brine, variations in lithium content, or the solar insolation rate (Bustos-Gallardo, Bridge and Prieto, 2021). Lithium mining operates under the assumption that the brine extracted from the salt flat is separate from the adjacent

wetlands and aquifers, but scientists are not in full agreement about how fresh groundwater connecting distant wetlands across the region interacts with brine (see figure 4) (Amphos 21, 2018; Frau et al., 2021; Garcés and Alvarez, 2020; Liu, Agusdinata and Myint, 2019; Marazuela et al., 2019; Munk et al., 2021; Riofrancos, 2019).

7 Resource extraction's stressors with regard to water availability and quality pose a significant threat to the area's wildlife. The most immediately impacted life forms are unique species of microorganisms, including diverse archaeal and bacterial communities that are at risk of extinction due to brine evaporation (Cubillos et al., 2018). Scientists are concerned that this may have knock-on effects for more charismatic megafauna higher up the food chain (Dorador et al., 2018a). The collective memory of local residents suggests that flamingos are disappearing, and this perception is supported by scientific modelling that shows a reduction in two of the three local species of flamingo due to lithium mining and declining surface water (Gutiérrez et al., 2022). At the same time, climate change is hastening the retreat of glaciers and the disappearance of lakes from the landscape (Babidge et al., 2019; Garcés, 2011; Garcés and Alvarez, n.d.; Garcés, Alvarez and Marambio, 2017). As a result, the area has been suffering from the slow violence of 'extractivist droughts' in an ongoing water crisis (Nixon, 2011; Acuña and Tironi, 2022).

Figure 4 Mining activities overlapping with salt flats, protected wetlands and communities.



Sources: Authors, using Brenda J. Rojas with data from Esri, USGS and NOAA (Blair et al., 2022).

2.3 The Alterlives of Green Extractivism

8 Water relations have long been crucial to Atacameño/Lickanantay Indigenous peoples' efforts to adapt to one of the driest deserts in the world (Neville and Coulthard, 2019;

Prieto, 2015a; 2016; Yáñez and Molina, 2011). Water from springs allowed the first human settlements to take root perhaps earlier than 10,000 BCE.[7] Atacameño/Lickanantay culture and livelihood adapted to the seemingly hostile high desert environment through local agropastoral practices such as growing maize, quinoa, alfalfa and fruit, as well as raising llamas and other livestock. 'We are grateful for every drop of water and understand its cycles', said Jorge Muñoz Coca, of the Atacameño/Lickanantay Community of Solcor and member of OPSAL. Much like the emancipatory potential of 'the plot' as an oppositional mode of cultivating alternatives to the racialised oppression of the plantation for Black enslaved people and peasants around the world (Davis et al., 2019; Jegathesan, 2021; McKittrick, 2013; Wynter, 1971), agroecological gardening—an ancient practice threatened by water scarcity (Carrasco, 2020)—is providing Indigenous residents located on the margins of the salt flat a way to assert food sovereignty at the interstices of the lithium harvest (Altieri, 2002; Edelman, 2014; Grey and Patel, 2015; Wit, 2021).

9 However, in this area the availability of water for irrigation has decreased, in terms of both quantity and quality (Sepúlveda Rivera et al., 2015). This led the irrigation associations that have long stewarded the local San Pedro and Vilama rivers to limit water concessions by requesting a Declaration of Exhaustion (*agotamiento*), which was ratified by the government in 2017 (Ministerio de Obras Públicas, Dirección General de Aguas, 2016; 2017). The decision officially declared the watersheds 'exhausted', with insufficient surface water to allow for additional water rights to be granted. Local communities have received far fewer freshwater rights than mining companies have: about 92 litres per second compared to a combined 2,739 litres per second owned by the mining companies operating in the area (Babidge and Bolados, 2018, 176). In 2018 technical reports indicating ecological exhaustion led the General Water Directorate (DGA) to declare a prohibition on the use for extractive purposes of groundwater from the aquifer of the Atacama salt flat (Ministerio de Obras Públicas, Dirección General de Aguas, 2018). Moreover, in 2022 the government of Chile sued Albemarle as well as the two nearby copper mines for their over-use of the aquifer.[8] Nonetheless, lithium mining has already transformed modes of living and relations within local communities such as Toconao, as Indigenous activist Rudecindo Espíndola[9] explains in his own words:

> Development starts in Toconao, and the agriculture in that area begins to decay; craftwork starts to decay; customs start to go down. This monster is called 'mining with SQM or Albemarle'. It transforms the thoughts and way of life of Native people, in a way that causes division. They tell us lithium is clean. We can offer a way of life. But unfortunately, they're winning over there, and we're losing over here. They're drying up our waters. They're drying up the conscience we're lacking.[10]

10 Mining not only alters life directly through mining extraction, as Espíndola indicates, but also through the mining companies' sustainability programmes intended to compensate for impacts in the surrounding territory, such as SQM's Tierra Fértil programme and local wine production project Vino Ayllu. The latter initiative stands out as it has established one of the first Indigenous people's cooperatives dedicated to commercial wine production, making Toconao and other nearby areas the origin of one of the world's few wines produced at high altitude. These new wine production and related activities are, however, highly dependent on external support (Herrera, 2019). Contrary to the company's claims, for some local farmers Vino Ayllu has little to do with traditional practices and culture. To become grape producers, local farmers have

altered life near the salt flat by transforming their agroecological plots from biodiverse matrices into small monocultures. Moreover, farmers who join the cooperative must choose between preserving inherited old vines used for the traditional home-made *vino criollo* and opting for more commercial, introduced varietals such as Sauvignon Gris, Chardonnay and Pinot Noir, which are suitable for niche market demands (SQM, 2021, 208).[11] The growing aggregate surface area of vineyards requires even more water, producing new tensions between and among Indigenous farmers within and around the oasis of Toconao. Espíndola stresses how the introduction of commercial practices by SQM's Tierra Fértil is exacerbating conflicts around water, not just with the mining company, but also among Indigenous gardeners and winemakers:

> When we want to use water for our family gardens and see the winemakers are using the water to fill their accumulation tanks, we prefer to wait until the water is back in the canals just to avoid more arguments among farmers. So we don't ask in the WhatsApp group and we instead come every 30 minutes to check it out because this little trickle of water is not enough for us to irrigate our parcels. Anyway, it's better to avoid speaking of SQM or about the vineyards out loud because someone can hear us and that will cause us more problems.[12]

11 While corporate social responsibility programmes and community benefit agreements may, ironically, alter life and impede monitoring (Peterson St-Laurent and Le Billon, 2015), the CPA Indigenous association and broader alliances have not only established their own monitoring programmes but also taken action to regulate and limit mining expansion. The struggle for water resources has been especially contentious between SQM and local residents.[13] In 2020, OPSAL gathered more than 350 signatures from advocates and scientists in support of the CPA's demand that the company's operations be halted (OPSAL, 2020a). Atacameño leaders and community members from across Socaire, Toconao, Camar and Peine engaged in direct action protests, including road blockades and hunger strikes (Jerez Henríquez, 2018). In 2020, in the wake of the COVID-19 pandemic, the CPA sent a report to the United Nations demanding that SQM and Albemarle withdraw their collective workforce of up to 10,000 personnel (Comunidad Indígena Yagán de Bahía de Mejillones de Puerto Williams et al., 2020; Hitchcock Auciello, 2020). The CPA and OPSAL point out that these communities have not been properly consulted, and have not given their free, prior and informed consent as required by the guidelines contained in International Labour Organization Convention 169 (ILO 169) or the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Sergio Cubillos, former CPA president, has added:

> In fact, we have told the state: let's put together a working group through which we can first speed up the handing over of lands, as per the constitutional acknowledgment of our Native people. And then let's take a look at different ideas or interests that may exist regarding the law. But today, ideally, the most important things are those two things I just mentioned. Also much more important is to find solutions for issues as basic and tangible as drinking water, sewage, electricity, accessibility. I mean, right in the middle of the 21st century, a country that has come out to say they're at the threshold of development, of being a 'developed country', still has communities that lack these types of services. That speaks very poorly of an administration. And what's worse, the wealth in which the state lives, the wealth that the state has, which sustains the economy and the economic power of this country, comes precisely out of these communities . . .Chile, unfortunately, is a country that's still unable to see its Native people.[14]

12 In sum, green extractivism has not only exacerbated ecological exhaustion, it has also limited Indigenous peoples' access to basic necessities and contributed to their erasure

due to uneven development in the Puna de Atacama. In addition to such dispossession, mining is also often associated with toxic contamination (Hecht, 2012; Voyles, 2015). Murphy developed the concept of alterlives from their Indigenous feminist perspective, to re-conceptualise chemical pollution's negative impacts in the built environment. Yet there remains a need to develop 'alter-concepts of care and responsibility' (Murphy, 2017, 496) that grapple with other expansive problems across the battery chemical supply chain: from water depletion, land use and underdevelopment at extraction sites to market demand in the global North and China, where the social and ecological costs of individual car ownership may fall only marginally if electric vehicles replace internal combustion engines (Marx, 2022). In what follows, we take 'alterlife as a prompt' (Murphy, 2017, 497) and propose policy recommendations for alternatives that are designed to protect water and regenerate more just, sustainable and equitable conditions of living beyond green extractivism.

3. Policy Recommendations to Support Alterlife in Andean Salt Flats and Wetlands[15]

13 Lithium-ion batteries may be, in the short and medium term, a critical component of the global strategy to fight climate change and mitigate air pollution by electrifying vehicles and providing storage for intermittent renewable energy (Sanderson, 2022). Yet the ecosystems that contain lithium resources—and the humans and non-humans that live in them—should not be sacrificed to extract this material. Fortunately, there are several ways in which actors throughout the lithium-ion battery supply chain can mitigate or eliminate negative impacts of lithium mining in the Puna de Atacama and other environments (Greim, Solomon and Breyer, 2020).

3.1 Apply International Human Rights Principles and Adhere to Indigenous-Led Protocols

14 While existing benefit-sharing agreements in this region offer a foundation for corporate partnerships with communities, they should be understood as a floor, not a ceiling. Full participation of, and equal distribution of benefits among, Indigenous peoples and local communities have not been ensured in a democratic process because agreements with some communities have left others out, pitting communities against one another. Similar to other impact and benefit agreements, this has resulted in the silencing of dissent, state agencies' non-responsiveness to community needs, and an absence of regulation, monitoring and transparency (Peterson St-Laurent and Le Billon, 2015; Le Billon and Middeldorp, 2021). To operate in a more just, sustainable, and equitable way, the government should require and monitor—and companies should follow—the principles of international conventions such as:

. ILO 169,
. UNDRIP,
. The United Nations Declaration on the Rights of Peasants (UNDROP), and
. The Escazú Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean.

15 ILO 169 has already been ratified and in force in Chile since 2009, and Chile's President, Gabriel Boric, signed Escazú on March 18, 2022. Both should henceforth apply to all new mining projects and, ideally, apply retroactively to existing operations. In addition, while state agencies and corporations alike often ignore or only inconsistently adopt them, Indigenous-led protocols such as the Kachi Yupi Protocol, which applies in Salinas Grandes, Argentina, should be benchmarks for both governments and companies.[16] This includes recognising communities' rights to say no to mining proposals and instead continue making a living through established local economies, such as salt extraction, livestock raising and tourism.

3.2 Strengthen Environmental Standards to Reflect Local Demands and Needs

16 In addition to deeper engagement with Indigenous communities, mining activities should respect stronger environmental standards. Many organisations and institutions have produced recommendations that could be used to address waste streams, water use and contamination, and air pollution (Elkind, Heller and Lamm, 2020; Amnesty International, 2021; Gankhuyag and Gregoire, 2018). A combination of remote sensing, oral history and ethnography could help identify changes to water tables, shifts in the population dynamics of local plants and animals, and other environmental indicators, including climate change—a key variable in the environmental assessment of extractive projects in salt flats and wetlands (Babidge et al., 2019; Flexer, Baspineiro and Galli, 2018). Monitoring should happen in ways that build trust and produce meaningful data that communities and citizens can use to hold mining companies accountable. To this end, funding for monitoring efforts should be transparent and independent of these companies (Barandiaran, 2018). Monitoring practices could be carried out by universities or public agencies, as well as by community members recognised as knowledge producers. Moreover, authorities should reclassify brine as water so they are able to better monitor and safeguard this material. If not already in place, governments around the Puna de Atacama should also adopt legislation and regulations that enable them to study and measure available groundwater and brine resources, and/or provide funding to independent professionals who can do so. Governments should regulate the use of these resources and require companies to disclose data to the public in a transparent and consistent manner.

3.3 Build Collaborative Monitoring Practices Based on Indigenous Knowledge and Science

17 The lithium sector has applied conventional business practices, including flawed Western science-based impact agreements that ignore the millennia of experience gained by communities that have deep knowledge of local ecology (Li, 2015; Lawrence and Kløcker Larsen, 2017; Perreault, 2020). Companies and governments should prioritise learning from local Indigenous peoples and earnestly centre that knowledge at the heart of their practices. Indigenous knowledge of local ecosystems may help with environmental monitoring, building local food production, and safeguarding biodiversity; for example, ethnobiological data on ancestral knowledge of watering sites for livestock herds may help identify monitoring locations and inform models of

the area's complex hydrogeological landscape (Geralda Armstrong and McAlvay, 2019). There are several models of Indigenous-led land-use planning, climate adaptation and environmental management to follow when seeking to protect biodiverse areas, and Indigenous knowledge and science may be complementary to the co-management of resources by local communities and governments (Wang et al., 2016; Whyte, 2013).

3.4 Enforce a Moratorium on Brine Evaporation through the Application of the Precautionary Principle

18 According to UNESCO's World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), 'When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm' (UNESCO, 2005, 14). This is known as the precautionary principle. Because brine evaporation is thought to exacerbate ecological exhaustion and alter life in the Puna de Atacama, and because the actors responsible for this activity have failed to disclose clear evidence establishing that it does not do so, precautionary measures should be taken. The burden of proof is on the industry to show definitively that water and life are not threatened by brine evaporation, and until it has done so, it is in the public interest to cease this activity in the Puna de Atacama. Following demands from the CPA, as well as the non-binding verdict of the International Rights of Nature Tribunal (2020), a moratorium should be enforced on lithium mining through brine evaporation in the Puna de Atacama.

3.5 Encourage Battery Recycling and Long-Term Planning for Alternative Transportation

19 At the international level, governments and institutions should encourage and invest in reducing the demand for minerals and implement alternative ways of obtaining lithium —other than onshoring more conventional mining to the global North or over-relying on direct lithium extraction technologies, for these approaches may risk increasing water use and waste streams (Riofrancos, 2022). Governments may engage in such efforts through educational programmes, infrastructure development, and industrial policy (e.g. cradle-to-cradle incentives to reconvert gas cars or establish battery recycling programmes). Several circular economy strategies and international standards may lengthen the life duration and life cycle of a lithium-ion battery or its components (Standridge and Corneal, 2014; Mulvaney et al., 2021). Once a lithium-ion car battery can no longer hold a sufficient charge to power a vehicle, it can still serve as an energy storage element in buildings. Recycling the pure chemical lithium contained in old batteries can reduce the need to mine more new materials (Xiong, Ji and Ma, 2020). Recent research for Earthworks found that recycling electric vehicle batteries at the end of their useful life can reduce primary demand for lithium by as much as 25 per cent, for cobalt and nickel by 35 per cent, and for copper by 55 per cent (Dominish et al., 2021). Recycling facilities are not yet focused on recovering the full range of materials in lithium-ion batteries (Gaines, Richa and Spangenberger, 2018). However, this could change with regulation and policy, as has been observed with lead acid batteries: recycling rates for these have climbed to upwards of 90 per cent in many countries, largely in response to regulation (Turner, 2015). Currently, recycling lithium

from discarded batteries is more expensive than extracting it from brine via evaporation. But lithium prices have increased and various types of recycling technologies are already in development with the aim of making the process more cost efficient and replicable, particularly in industrialised countries and regions—such as China, the European Union and the United States—where most lithium-ion batteries are currently consumed (Harper et al., 2019).[17]

20 Pressure to protect the alterlives of extractivism and reduce the long-term costs of lithium mining on salt flats and wetlands should come from downstream in the battery supply chain, including from battery manufacturers and vehicle makers, as well as from policymakers and urban and regional planners. Governments and third parties should support the corporate efforts of lithium purchasers to exert direct pressure on mining companies without letting certification standards amount to greenwashing. Policymakers, private companies, and citizens can help push forward a range of complementary strategies, including: (1) planning and policy tools to allow greater access to public transportation, bicycling, and walking to reduce long-term dependency on single-passenger vehicles; (2) retrofitting or building affordable, energy-efficient, regenerative homes and buildings for all; (3) investing in and adopting long-duration methods of renewable energy storage (e.g. gravity-based or iron flow) that minimise extraction and maximise efficiency over time. Such actions to reduce downstream reliance on lithium-ion batteries may play a critical role in supporting the regeneration of alterlife at extraction sites farther upstream in the global value chain.

4. Conclusion

21 Green extractivism threatens biodiverse life forms across multiple scales in the Puna de Atacama (Bonelli and Dorador, 2021; Flexer, Baspineiro and Galli, 2018; Gutiérrez et al., 2022). The slow violence of lithium brine evaporation, compounded by over-exploitation of water resources for copper mining, has contributed to conditions of ecological exhaustion. As Murphy suggests, we must go beyond conventional biological categories that separate non-human organisms from individual bodies, and instead 'situate life as a kind of varied enmeshment and enfleshment in infrastructures—as well as in water as a distributed being' (Murphy, 2017, 498). Brine is water. And if water is life, then brine evaporation for the production and distribution of lithium has seriously altered life. Yet, Murphy reminds us that alterlife also entails 'the potential to become something else, to defend and persist, to recompose relations to water and land, to become alter-wise in the aftermath' (Murphy, 2017, 500). Given the urgency of the climate and ecological crisis, this means embracing the possibility that the energy transition may be open to transformation and resistant to maladaptation: not just to be clean and green for consumers, but also for those living at extraction sites.

22 At Chile's Atacama salt flat and nationwide, activists and advocates have been calling for more just, sustainable and equitable mining policies, including by calls for constitutional reform (Barandiarán, 2021). In a referendum held on September 4, 2022 in Chile, 62 per cent of voters rejected a new Constitution drafted by a democratically elected Constitutional Convention. With regard to the environment, this result postponed potentially transformative changes, and environmental activists are adjusting their work and strategies accordingly. For many advocates—including we, the

authors—the proposed Constitution would have deepened democracy due to the process that brought it, and its content, about.

23 The Constitutional Convention commenced under the presidency of Dr Elisa Loncon, an Indigenous Mapuche linguist, with regional constituent representation of Antofagasta by Dr Cristina Dorador, a microbiologist with expertise in the biodiversity of salt flats. Dr Dorador joined OPSAL in launching the Plurinational Initiative for the Valorisation and Protection of Andean Salt Flats and Wetlands, a community-based participatory project that forms the basis for a bill to recognise the importance of defending these ecosystems against further industrial extraction. According to Dr Dorador, 'The north of Chile has been viewed by the country as an exploitable territory because "there is no life there." Deconstructing that image implies profound changes. The extraction of lithium is like taking the soul out of the salt flats' (OPSAL, 2021). To shift the narrative and raise awareness of overlooked alterlives at extraction sites, Dorador proposed and then led the Commission of Systems of Knowledges, Cultures, and Science—one of seven Commissions within the Constitutional Convention—which introduced articles that promoted epistemic justice, ethics in science, and integration of local knowledge into decision-making. Drawing on recent constitutional reforms in Bolivia and Ecuador, the Constitution would, if accepted, have established Chile as a plurinational, intercultural and ecological state, one that protects both human rights and the rights of nature (Barandiarán et al., 2022; Blair and Balcázar, 2022; Gudynas, 2014). These principles continue to resonate in ongoing debates about constitutional reform, and they remain critical for regenerating the alterlives of green extractivism.

BIBLIOGRAPHY

Acosta A. (2017) 'Post-Extractivism: From Discourse to Practice—Reflections for Action', *International Development Policy | Revue internationale de politique de développement*, 9, pp. 77–101, DOI : 10.4000/poldev.2356

Acuña, V. and M. Tironi (2022) 'Extractivist droughts: Indigenous hydrosocial endurance in Quillagua, Chile', *The Extractive Industries and Society*, 9(101027), DOI: 10.1016/j.exis.2021.101027

Altieri, M.A. (2002) 'Agroecology: The Science of Natural Resource Management for Poor Farmers in Marginal Environments', *Agriculture, Ecosystems & Environment*, 93(1), pp. 1–24, DOI: 10.1016/S0167-8809(02)00085

Amnesty International (2021) *Powering Change: Principles for Businesses and Governments in the Battery Value Chain*, No. ACT 30/3544/2021 (London: Amnesty International).

Amphos 21 (2018) *Modelo Hidrológico Consolidado Cuenca Salar de Atacama. Estudio de Modelos Hidrológicos Conceptuales Integrados Para Los Salares de Atacama, Maricunga y Pedernales*, Etapa III Informe Final (Chile).

Arboleda, M. (2020) *Planetary Mine. Territories of Extraction under Late Capitalism* (London: Verso).

Babidge, S. (2019) 'Sustaining Ignorance: The Uncertainties of Groundwater and Its Extraction in the Salar de Atacama, Northern Chile', *Journal of the Royal Anthropological Institute*, 25(1), pp. 83–102, DOI: 10.1111/1467-9655.12965

Babidge, S. and P. Bolados (2018) 'Neoextractivism and Indigenous Water Ritual in Salar de Atacama, Chile', *Latin American Perspectives*, 45(5), pp. 170–185, DOI: 10.1177/0094582X18782673

Babidge, S., F. Kalazich, M. Prieto and K. Yager (2019) '"That's the Problem with That Lake; It Changes Sides": Mapping Extraction and Ecological Exhaustion in the Atacama', *Journal of Political Ecology*, 26(1), pp. 738–760, DOI: 10.2458/v26i1.23169

Balcázar, R.M. (2022) 'Licitación del litio: el agua vale más que el Litio', *Revista de Frente*, https://www.revistadefrente.cl/licitacion-del-litio-el-agua-vale-mas-que-el-litio-por-ramon-morales-balcazar/ (accessed on 19 March 2022).

Barandiarán, J. (2021) 'Assessing 30 Years of Neoliberal Environmental Management in Chile: Effective, Democratic or Neither?', in J. Sowers, S. VanDeveer, and E. Weinthal (eds.) *The Oxford Handbook of Comparative Environmental Politics* (Oxford: Oxford University Press).

Barandiarán, J. (2019) 'Lithium and Development Imaginaries in Chile, Argentina and Bolivia', *World Development*, 113, pp. 381–391, DOI: 10.1016/j.worlddev.2018.09.019

Barandiarán, J. (2018) *Science and Environment in Chile* (Cambridge, MA: The MIT Press).

Barandiarán, J., V. Belemmi, G. Burdiles, and C. Ezio (2022) *Derechos de la Naturaleza en Chile: Argumentos para su desarrollo constitucional* (Santiago, Chile: Ocho Libros).

Black, M. (2018) *The Global Interior* (Cambridge, Massachusetts: Harvard University Press).

Blair, J.J.A. (2021) 'Extractivismo Del Litio y El Problema de La Escala: Acción Climática Global y Justicia Ambiental Local', in B. Jerez Henríquez, S. Uribe Sierra, and R.M. Balcázar (eds.) *Salares Andinos: Ecología de Saberes Por La Protección de Nuestros Salares y Humedales* (Santiago: Fundación Tantí).

Blair, J.J.A. and R.M. Balcázar (2022) 'Plurinational Climate Action: Environmental Governance Beyond Green Extractivism', *Cultural Anthropology-Hot Spots*, 23 June, https://culanth.org/fieldsights/plurinational-climate-action-environmental-governance-beyond-green-extractivism (accessed on 24 June 2022).

Blair, J.J.A., R.M. Balcázar, J. Barandiarán and A. Maxwell (2022) *Exhausted: How We Can Stop Lithium Mining from Depleting Water Resources, Draining Wetlands, and Harming Communities in South America*, No. R: 21-10-A (New York: Natural Resources Defense Council (NRDC)).

Bonelli, C. and C. Dorador (2021) 'Endangered Salares: Micro-Disasters in Northern Chile', *Tapuya: Latin American Science, Technology and Society* (London: Routledge), 4(1), p. 1968634, DOI: 10.1080/25729861.2021.1968634

Bos V. and M. Forget (2021) 'Global Production Networks and the lithium industry: A Bolivian perspective', *Geoforum*, 125, pp. 168–180, DOI: 10.1016/j.geoforum.2021.06.001

Bridge, G. and L. Gailing (2020) 'New Energy Spaces: Towards a Geographical Political Economy of Energy Transition', *Environment and Planning A: Economy and Space,* 52(6), DOI: 10.1177/0308518X20939570

Bustos, C. (2014) 'La Producción de "Etnomercancias" En El Contexto Turístico Atacameño', *Revista Lider*, 25, pp. 9–31.

Bustos-Gallardo, B., G. Bridge and M. Prieto (2021) 'Harvesting Lithium: Water, Brine and the Industrial Dynamics of Production in the Salar de Atacama', *Geoforum*, 119, pp. 177–189, DOI: 10.1016/j.geoforum.2021.01.001

Bustos-Gallardo, B., M. Prieto and J. Barton (2015) *Ecología Política En Chile* (Santiago: Editorial Universitaria).

Carrasco, A. (2020) *Embracing the Anaconda* (Lanham: Lexington Books).

CIPER Chile (Centro de Investigacion Periodística) (n.d.) 'Archivos De SQM', *CIPER Chile*, https://www.ciperchile.cl/tag/sqm/ (accessed on 30 March 2022).

Comunidad Indígena Yagán de Bahía de Mejillones de Puerto Williams, Consejo de Pueblos Atacameños, Mesa de Coordinación de Pueblos Originarios del Budi, Municipalidad de Saavedra and Observatorio Ciudadano and Plataforma Política Mapuche (2020) *Emergencia Sanitaria En El Contexto de La Pandemia Por COVID-19 En Chile y Su Impacto En Los Derechos de Los Pueblos Originarios* (Santiago, Chile: Observatorio Ciudadano) https://observatorio.cl/wp-content/uploads/2020/06/emergencia-sanitaria-en-el-contexto-de-la-pandemia-por-covid-19-en-chile-y-su-impacto-en-los-derechos-de-los-pueblos-originarios-11.pdf (accessed on 7 November 2022).

Comunidades de la Cuenca de Salinas Grandes y Laguna de Guayatayoc (2015) *Kachi Yupi - Huellas de La Sal: Procedimiento de Consulta y Consentimiento Previo, Libre e Informado Para Las Comunidades Indígenas de Las Salinas Grandes y Laguna de Guayatayoc*, https://cl.boell.org/sites/default/files/protocolo_final.pdf (accessed on 7 November 2022).

Contador, C.A., L. Veas-Castillo, E. Tapia, N. Antipán, B. Miranda, B. Ruiz-Tagle, J. García Araya, B.A. Andrews, M. Marín, C. Dorador and J.A. Asenjo (n.d.) *Atacama Database: A Platform of the Microbiome Diversity of the Atacama Desert* (Santiago: Universidad de Chile), https://www.atacamadb.cl/#/ (accessed on 7 November 2022).

Cubillos, C.F., P. Aguilar, M. Grágeda and C. Dorador (2018) 'Microbial Communities From the World's Largest Lithium Reserve, Salar de Atacama, Chile: Life at High LiCl Concentrations', *Journal of Geophysical Research: Biogeosciences*, 123(12), pp. 3668–3681, DOI: 10.1029/2018JG004621

Davis, J., A.A. Moulton, L.V. Sant and B. Williams (2019) 'Anthropocene, Capitalocene, … Plantationocene?: A Manifesto for Ecological Justice in an Age of Global Crises', *Geography Compass*, 13(5), e12438, DOI: 10.1111/gec3.12438

Del Bene, D., A. Scheidel and L. Temper (2018) 'More Dams, More Violence? A Global Analysis on Resistances and Repression around Conflictive Dams through Co-Produced Knowledge', *Sustainability Science*, 13(3), pp. 617–633, DOI: 10.1007/s11625-018-0558-1

Dominish, E., N. Florin and R. Wakefield-Rann (2021) *Reducing New Mining for Electric Vehicle Battery Metals: Responsible Sourcing Through Demand Reduction Strategies and Recycling* (Sydney: Earthworks and Institute for Sustainable Futures, University of Technology Sydney), https://earthworks.org/assets/uploads/2021/04/UTS-EV-battery-metals-sourcing-20210419-FINAL.pdf (accessed on 7 November 2022).

Dorador, C., P. Fink, M. Hengst, G. Icaza, A.S. Villalobos, D. Vejar, D. Meneses, V. Zadjelovic, L. Burmann, J. Moelzner and C. Harrod (2018a) 'Microbial Community Composition and Trophic Role along a Marked Salinity Gradient in Laguna Puilar, Salar de Atacama, Chile', *Antonie Van Leeuwenhoek*, 111(8), pp. 1361–1374, DOI: 10.1007/s10482-018-1091-z

Dorador, C., D. Meneses, V. Urtuvia, C. Demergasso, I. Vila, K.-P. Witzel and J.F. Imhoff (2018b) 'Diversity of Bacteroidetes in High-Altitude Saline Evaporitic Basins in Northern Chile', *Journal of*

Geophysical Research: Biogeosciences, DOI: 10.1029/2008JG000837@10.1002/(ISSN)2169-8961.HIGHLAKES1

Dorador, C., I. Vila, K.-P. Witzel and J. Imhoff (2013) 'Bacterial and Archaeal Diversity in High Altitude Wetlands of the Chilean Altiplano', *Fundamental and Applied Limnology / Archiv Für Hydrobiologie*, 182, pp. 135–159, DOI: 10.1127/1863-9135/2013/0393

Dunlap, A. and J. Jakobsen (2019) *The Violent Technologies of Extraction* (Cham: Palgrave Pivot).

Edelman, M. (2014) 'Food Sovereignty: Forgotten Genealogies and Future Regulatory Challenges', *The Journal of Peasant Studies*, 41(6), pp. 959–978, DOI: 10.1080/03066150.2013.876998

Elkind, E.N., P.R.P. Heller and T. Lamm (2020) *Building a Sustainable Electric Vehicle Battery Supply Chain: Frequently Asked Questions* (Berkeley, New York: Natural Resource Governance Institute and Center for Law, Energy and the Environment, UC Berkeley), https://www.law.berkeley.edu/wp-content/uploads/2020/04/Building-A-Sustainable-Electric-Vehicle-Battery-Supply-Chain.pdf (accessed on 7 November 2022).

Fermandois, J., J. Bustos, and M.-J. Schneur (2009) *Historia política del cobre en Chile*. (Santiago, Chile: Centro de Estudios del Bicentenario).

Flexer V., C.F. Baspineiro, C.I. Galli (2018) 'Lithium recovery from brines: A vital raw material for green energies with a potential environmental impact in its mining and processing', *Science of The Total Environment*, 639, pp. 1188–1204, DOI: 10.1016/j.scitotenv.2018.05.223

Frau D., B.J. Moran, F. Arengo, et al. (2021) 'Hydroclimatological Patterns and Limnological Characteristics of Unique Wetland Systems on the Argentine High Andean Plateau', *Hydrology,* 8(164), DOI: 10.3390/hydrology8040164

Gaines, L., K. Richa and J. Spangenberger (2018) 'Key Issues for Li-Ion Battery Recycling', *MRS Energy & Sustainability*, 5(1), p. 12, DOI: 10.1557/mre.2018.13.

Gajardo, G. and S. Redón (2019) 'Andean Hypersaline Lakes in the Atacama Desert, Northern Chile: Between Lithium Exploitation and Unique Biodiversity Conservation', *Conservation Science and Practice*, 1(9), e94, DOI: 10.1111/csp2.94

Gankhuyag, U. and F. Gregoire (2018) *Managing Mining for Sustainable Development: A Sourcebook* (Bangkok: United Nations Development Programme), https://www.undp.org/sites/g/files/zskgke326/files/publications/UNDP-MMFSD-HighResolution.pdf (accessed on 7 November 2022).

Garcés, I. (2011) 'Salar de Surire un ecosistema altoandino en peligro, frente a escenario del cambio climático', *Nexo Revista Científica*, 24(1), pp. 43–49.

Garcés, I. and G. Alvarez (2020) 'Water Mining and Extractivism of the Salar de Atacama, Chile', in J. Casares Long (ed.) *Environmental Impact V*, WIT Transactions on Ecology and the Environment (Southampton: WIT Press), pp. 189–199, DOI: 10.2495/EID200181 (accessed on 27 January 2021).

Garcés, I. and G. Alvarez (n.d.) *Implicancias del Cambio Climático Sobre la Biodiversidad del Salar de Aguas Calientes I, Chile*, https://bibliotecadigital.ciren.cl/handle/20.500.13082/26026 (accessed on 7 November 2022).

Garcés, I., G. Alvarez and Y. Marambio (2017) *Relevancia Del Salar de Atacama Frente al Escenario Económico*, non-published.

Geralda Armstrong, C. and A.C. McAlvay (2019) 'Introduction to Special Section on Action Ethnobiology', *Journal of Ethnobiology*, 39(1), p. 3, DOI: 10.2993/0278-0771-39.1.3

Goldman, M., P. Nadasdy and M. Turner (eds.) (2011) *Knowing Nature* (Chicago: University of Chicago Press).

Greim, P., A.A. Solomon and C. Breyer (2020) 'Assessment of Lithium Criticality in the Global Energy Transition and Addressing Policy Gaps in Transportation', *Nature Communications* (Nature Publishing Group), 11(1), p. 4570, DOI: 10.1038/s41467-020-18402-y

Grey, S. and R. Patel (2015) 'Food Sovereignty as Decolonization: Some Contributions from Indigenous Movements to Food System and Development Politics', *Agriculture and Human Values*, 32(3), pp. 431–444, DOI: 10.1007/s10460-014-9548-9

Gudynas, E. (2018) 'Extractivisms', in R. Munck and R. Delgado Wise (eds.) *Reframing Latin American Development* (New York: Routledge Critical Development Studies), pp. 61–76.

Gudynas, E. (2014) *Derechos de La Naturaleza Ética Biocéntrica y Políticas Ambientales*, Primera edición peruana (Lima: Programa Democracia y Transformación Global).

Gundermann K., H. (2004) 'Inicios de Siglo En San Pedro de Atacama: Procesos, Actores e Imaginarios En Una Localidad Andina', *Chungará: Revista de Antropología Chilena,* 36(1), pp. 221-239, DOI: 10.4067/S0717-73562004000100007

Gutiérrez J.S., J.N. Moore, J.P. Donnelly, et al. (2022) 'Climate change and lithium mining influence flamingo abundance in the Lithium Triangle', *Proceedings of the Royal Society B: Biological Sciences*, 289(1970), pp. 1–11, DOI: 10.1098/rspb.2021.2388

Harper, G., R. Sommerville, E. Kendrick, L. Driscoll, P. Slater, R. Stolkin, A. Walton, P. Christensen, O. Heidrich, S. Lambert, A. Abbott, K. Ryder, L. Gaines and P. Anderson (2019) 'Recycling Lithium-Ion Batteries from Electric Vehicles', No. 7781, *Nature* (Nature Publishing Group), 575(7781), pp. 75–86, DOI: 10.1038/s41586-019-1682-5

Hecht, G. (2012) *Being Nuclear* (Cambridge, Mass: The MIT Press).

Hernando-Arrese, M. and M. Tironi (2019) 'Worlding Hydropower: River Realities in the Chilean Patagonia', *Tapuya: Latin American Science, Technology and Society*, 2(1), pp. 295–309, DOI: 10.1080/25729861.2019.1675955

Herrera, I. (2019) 'De la vinificación a la etnomercancía. Proceso de conversión de actividades agrarias en propuesta turística en Toconao, Norte de Chile.', *Antropologías del Sur*, 6(12), pp. 283–305, DOI: 10.25074/rantros.v6i12.1157

Hervé, D. (2015) *Justicia Ambiental y Recursos Naturales* (Santiago: Ediciones Universitarias de Valparaíso).

Heubl, B. (2019) *Lithium Firms Depleting Vital Water Supplies in Chile, Analysis Suggests*, (Stevenage: E&T Engineering and Teachnology) https://eandt.theiet.org/content/articles/2019/08/lithium-firms-are-depleting-vital-water-supplies-in-chile-according-to-et-analysis (accessed on 22 September 2019).

Hitchcock Auciello, B. (2020) 'Indigenous Communities in Chile Raise Concerns about Public Health Risks Posed by Mining Operations During the COVID-19 Pandemic', *Earthworks*, 28 July, https://www.earthworks.org/blog/indigenous-communities-in-chile-raise-concerns-about-public-health-risks-posed-by-mining-operations-during-the-covid-19-pandemic/ (accessed on 18 January 2021).

Hommes, L., R. Boelens, S. Bleeker, D. Stoltenborg, B. Duarte-Abadía and J. Vos (2019) 'Water Governmentalities: The Shaping of Hydrosocial Territories, Water Transfers and Rural–Urban Subjects in Latin America', *Environment and Planning E: Nature and Space*, p. 2514848619886255, DOI: 10.1177/2514848619886255

Hoogesteger, J. and A. Verzijl (2015) 'Grassroots Scalar Politics: Insights from Peasant Water Struggles in the Ecuadorian and Peruvian Andes', *Geoforum*, 62, pp. 13–23, DOI: 10.1016/j.geoforum.2015.03.013

International Rights of Nature Tribunal (2020) 'Launch of the Verdict, 5th International Rights of Nature Tribunal' (Santiago: Global Alliance for the Rights of Nature), https://www.garn.org/press-release-verdict-5th-international-rights-of-nature-tribunal-chile/ (accessed on 29 November 2022).

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) (2019) *Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* (Bonn: IPBES secretariat), DOI: 10.5281/zenodo.5517154

Jasanoff, S. and S.-H. Kim (eds.) (2015) *Dreamscapes of Modernity* (Chicago: University of Chicago).

Jegathesan, M. (2021) 'Black Feminist Plots before the Plantationocene and Anthropology's 'Regional Closets'', *Feminist Anthropology*, 2(1), pp. 78–93, DOI: 10.1002/fea2.12037

Jerez, B., I. Garcés and R. Torres (2021) 'Lithium Extractivism and Water Injustices in the Salar de Atacama, Chile: The Colonial Shadow of Green Electromobility', *Political Geography*, 87, DOI: 10.1016/j.polgeo.2021.102382

Jerez Henríquez, B. (2018) *Impacto Socioambiental de La Extracción de Litio En Las Cuencas de Los Salares Altoandinos Del Cono Sur* (Santiago: Observatorio de Conflictos Mineros de América Latina, OCMAL).

Johnson, O.E.A., A. Zalik, C.S. Mollett, F. Sultana, E. Havice, T. Osborne, G. Valdivia, F. Lu and E. Billo (2021) 'Extraction, Entanglements, and (Im)Materialities: Reflections on the Methods and Methodologies of Natural Resource Industries Fieldwork', *Environment and Planning E: Nature and Space*, 4(2), pp. 383–428, DOI: 10.1177/2514848620907470

Lawrence, R. and R. Kløcker Larsen (2017) 'The Politics of Planning: Assessing the Impacts of Mining on Sami Lands', *Third World Quarterly*, 38(5), pp. 1164–1180.

Le Billon, P. and N. Middeldorp (2021) 'Empowerment or Imposition?: Extractive Violence, Indigenous Peoples, and the Paradox of Prior Consultation', in J. Shapiro and J.-A. McNeish (eds.) *Our Extractive Age: Expressions of Violence and Resistance* (London: Routledge).

Li, F. (2015) *Unearthing Conflict* (Durham: Duke University Press).

Lins Ribeiro, G. (1994) *Transnational Capitalism and Hydropolitics in Argentina* (Gainesville: University of Florida Press).

Liu, W., D.B. Agusdinata and S.W. Myint (2019) 'Spatiotemporal Patterns of Lithium Mining and Environmental Degradation in the Atacama Salt Flat, Chile', *International Journal of Applied Earth Observation and Geoinformation*, 80, pp. 145–156, DOI: 10.1016/j.jag.2019.04.016

Marambio-Alfaro, Y., G. Álvarez, M.C. Araya and A.E. Serrano (2017) *The Salt Flats Fighter: Agonistic Survival of Liolaemus Fabiani in the Salar de Atacama*, No. e2891v1 (PeerJ Inc.), DOI: 10.7287/peerj.preprints.2891v1

Marazuela M.A., E. Vázquez-Suñé, C. Ayora, et al. (2019) 'Hydrodynamics of salt flat basins: The Salar de Atacama example', *Science of The Total Environment*, 651, pp. 668–683, DOI: 10.1016/j.scitotenv.2018.09.190

Marx, P. (2022) *Road to Nowhere: What Silicon Valley Gets Wrong about the Future of Transportation* (London, Brooklyn: Verso).

Matteucci, S. (2012) 'Ecorregión Puna', in J. Morello, S.D. Matteucci, A. Rodriguez, and M. Silvia (eds.) *Ecorregiones y Complejos Ecosistémicos Argentinos* (Orientación Gráfica Editora S.R.L.), pp. 87–127.

McKittrick, K. (2013) 'Plantation Futures', *Small Axe*, 17(3), pp. 1–15.

Mendez, M., M. Prieto and M. Godoy (2020) 'Production of Subterranean Resources in the Atacama Desert: 19th and Early 20th Century Mining/Water Extraction in The Taltal District, Northern Chile', *Political Geography*, 81, p. 102194, DOI: 10.1016/j.polgeo.2020.102194

Ministerio de Obras Públicas, Dirección General de Aguas (2018) Resolución 13: Declara Como Zona de Prohibición Para Nuevas Explotaciones de Aguas Subterráneas en el Sector Hidrogeológico de Aprovechamiento Común Denominado C2 de la Cuenca del Salar de Atacama, Región de Antofagasta, August (Santiago: Gobierno de Chile), https://www.leychile.cl/Navegar?idNorma=1121804&idVersion=2018-08-16 (accessed on 7 November 2022).

Ministerio de Obras Públicas, Dirección General de Aguas (2017) Resolución 3: Declara el Agotamiento de la Cuenca del Río Vilama y sus afluentes, Provincia de El Loa, Región de Antofagasta, June (Santiago: Gobierno de Chile), https://www.leychile.cl/Navegar?idNorma=1103421 (accessed on 7 November 2022).

Ministerio de Obras Públicas, Dirección General de Aguas (2016) Resolución 44: Declara el Agotamiento de Cuenca del Río San Pedro y Sus Efluentes, Provincia de El Loa, Región de Antofagasta, July (Santiago: Gobierno de Chile), https://www.leychile.cl/Navegar?idNorma=1092006 (accessed on 7 November 2022).

Mitchell, T. (2011) *Carbon Democracy* (New York: Verso).

Morales Morgado, H. (2013) 'Génesis, Formación y Desarrollo Del Movimiento Atacameño (Norte de Chile)', *Estudios Atacameños*, 1, pp. 110–128, DOI: 10.4067/S0718-10432014000300007

Mulvaney, D., R.M. Richards, M.D. Bazilian, E. Hensley, G. Clough and S. Sridhar (2021) 'Progress towards a Circular Economy in Materials to Decarbonize Electricity and Mobility', *Renewable and Sustainable Energy Reviews*, 137, p. 110604, DOI: 10.1016/j.rser.2020.110604

Munk L.A., D.F. Boutt, B.J. Moran, et al. (2021) 'Hydrogeologic and Geochemical Distinctions in Freshwater-Brine Systems of an Andean Salar', *Geochemistry, Geophysics, Geosystems*, 22(3), DOI: 10.1029/2020GC009345

Murphy, M. (2017) 'Alterlife and Decolonial Chemical Relations', *Cultural Anthropology*, 32(4), pp. 494–503, DOI: 10.14506/ca32.4.02

Nacif, F. (2015) 'El Litio En Argentina: De Insumo Crítico a Commodity Minero', in *El ABC Del Litio Sudaméricano* (Quilmes: Universidad Nacional de Quilmes Editorial), pp. 219–92.

Narins, T.P. (2017) 'The Battery Business: Lithium Availability and the Growth of the Global Electric Car Industry', *The Extractive Industries and Society*, 4(2), pp. 321–328, DOI: 10.1016/j.exis.2017.01.013

Neville, K.J. and G. Coulthard (2019) 'Transformative Water Relations: Indigenous Interventions in Global Political Economies', *Global Environmental Politics*, 19(3), pp. 1–15.

Newell, P. and D. Mulvaney (2013) 'The Political Economy of the 'Just Transition'', *The Geographical Journal*, 179(2), pp. 132–140, DOI: 10.1111/geoj.12008

Nixon, R. (2011) *Slow Violence and the Environmentalism of the Poor* (Cambridge: Harvard University Press).

OPSAL (Observatorio Plurinacional de Salares Andinos) (2021) 'OPSAL invitó a definir cómo avanzar en protección de salares y humedales andinos en el nuevo contexto constituyente – Salares Andinos', *Salares Andinos*, 14 July, https://salares.org/2021/07/14/opsal-invito-a-definir-como-avanzar-en-proteccion-de-salares-y-humedales-andinos-en-el-nuevo-contexto-constituyente (accessed on 25 October 2021).

OPSAL (2020a) 'Declaración por el Salar de Atacama y los Humedales Altoandinos de Chile frente al Avance del Extractivismo Minero', *Observatorio Plurinacional de Salares Andinos*, 26 August, https://observatoriosalares.wordpress.com/2020/08/26/declaracion-por-el-salar-de-atacama-y-los-humedales-altoandinos-de-chile-frente-al-avance-del-extractivismo-minero/ (accessed on 8 September 2020).

OPSAL (2020b) 'Minera Escondida / BHP Billiton, un 'buen vecino' en el Salar de Atacama...', *Observatorio Plurinacional de Salares Andinos*, 14 January, https://observatoriosalares.wordpress.com/2020/01/14/minera-escondida-bhp-billiton-un-buen-vecino-en-el-salar-de-atacama/ (accessed on 8 September 2020).

Peet, R., P. Robbins and M. Watts (eds.) (2011) *Global Political Ecology* (London and New York: Routledge).

Perreault, T. (2020) 'Bolivia's High Stakes Lithium Gamble', *NACLA Report on the Americas,* 52, pp. 165–172, DOI: 10.1080/10714839.2020.1768739

Peterson St-Laurent, G.P. and P. Le Billon (2015) 'Staking claims and shaking hands: Impact and benefit agreements as a technology of government in the mining sector', *The Extractive Industries and Society*, 2(3), pp. 590–602.

Prieto, M. (2016) 'Practicing Costumbres and the Decommodification of Nature: The Chilean Water Markets and the Atacameño People', *Geoforum*, 77, pp. 28–39.

Prieto, M. (2015a) 'Privatizing Water in the Chilean Andes: The Case of Las Vegas de Chiu-Chiu', *Mountain Research and Development*, 35(3), pp. 220–229.

Prieto, M. (2015b) 'La Ecología (a)Política Del Modelo de Aguas Chileno', in B. Bustos-Gallardo, M. Prieto and J. Barton (eds.) *Ecología Política En Chile* (Santiago: Editorial Universitaria), pp. 143–164.

Riofrancos, T. (2022) 'The Security–Sustainability Nexus: Lithium Onshoring in the Global North', *Global Environmental Politics*, pp. 1–22, DOI: 10.1162/glep_a_00668

Riofrancos, T. (2019) 'What Green Costs', *Logic Magazine*, https://logicmag.io/nature/what-green-costs/ (accessed on 20 January 2020).

Riofrancos, T. (2017) 'Scaling Democracy: Participation and Resource Extraction in Latin America', *Perspectives on Politics*, 15(3), pp. 678–696, DOI: 10.1017/S1537592717000901

Saldivia Maldonado, Z. (2003) La Visión de La Naturaleza En Tres Científicos Del Siglo XIX En Chile: Gay, Domeyko y Philippi. (Santiago, Chile: Universidad de Santiago de Chile).

Sanchez-Lopez, M.D. (2019) 'From a White Desert to the Largest World Deposit of Lithium: Symbolic Meanings and Materialities of the Uyuni Salt Flat in Bolivia', Antipode, 51(4), DOI: 10.1111/anti.12539

Sanderson, H. (2022) Volt Rush: The Winners and Losers in the Race to Go Green (London: Oneworld Publications).

Secretariat of the Convention on Biological Diversity (2011) *The Tkarihwaié: RI Code of Ethical Conduct to Ensure Respect for the Cultural and Intellectual Heritage of Indigenous and Local Communities* (Montreal: Secretariat of the Convention on Biological Diversity).

Secretariat of the Convention on Biological Diversity (2004) *Akwé: Kon Voluntary Guidelines for the Conduct of Cultural, Environmental and Social Impact Assessment* (Montreal: Secretariat of the Convention on Biological Diversity).

Sepúlveda Rivera, I., R. Molina Otárola, M. del M. Delgado-Serrano and J.E. Guerrero Ginel (2015) 'Aguas, Riego y Cultivos: Cambios y Permanencias en los Ayllus de San Pedro de Atacama', *Estudios Atacameños*, 51, pp. 185–206, DOI: 10.4067/S0718-10432015000200012

Sherwood, D. (2021) 'Inside Lithium Giant SQM's Struggle to Win over Indigenous Communities in Chile's Atacama', *Reuters*, 15 January, https://www.reuters.com/article/us-chile-lithium-sqm-focus-idUSKBN29K1DB (accessed on 18 January 2021).

Sherwood, D. (2020a) 'Chilean Regulators Scrap Lithium Miner SQM's Environmental Plan', *Reuters*, 1 August, https://uk.reuters.com/article/us-chile-lithium-sqm-idUKKBN24X3Q6 (accessed on 8 September 2020).

Sherwood, D. (2020b) 'Indigenous Groups in Chile's Atacama Push to Shut down Top Lithium Miner SQM', *Reuters*, 14 August, https://www.reuters.com/article/us-chile-lithium-sqm-idUSKCN25A2PB (accessed on 19 August 2020).

Standridge, C.R. and L. Corneal (2014) *Remanufacturing, Repurposing, and Recycling of Post-Vehicle-Application Lithium-Ion Batteries*, No. 12–20 (San José: Mineta National Transit Research Consortium), https://transweb.sjsu.edu/sites/default/files/1137-post-vehicle-Li-Ion-recycling.pdf (accessed on 7 November 2022).

Sultana, F. (2021) 'Progress Report in Political Ecology II: Conjunctures, Crises, and Critical Publics', *Progress in Human Geography*, p. 03091325211028665, DOI: 10.1177/03091325211028665

Sultana, F. (2020) 'Political Ecology 1: From Margins to Center', *Progress in Human Geography*, p. 0309132520936751, DOI: 10.1177/0309132520936751

Svampa, M. (2013) 'Consenso de Los Commodities y Lenguajes de Valorización En América Latina', *Nueva Sociedad*, 244.

Swyngedouw, E. (2004) *Social Power and the Urbanization of Water* (Oxford: Oxford University Press).

SQM (Sociedad Química y Minera de Chile) (2021) *Reporte de Sostenibilidad* (Santiago: SQM) https://www.sqm.com/wp-content/uploads/2022/05/reporte-de-sostenibilidad-2021-v15_compressed.pdf (accessed on 7 November 2022).

Tironi, M. and J. Barandiarán (2014) 'Neoliberalism as Political Technology: Expertise, Energy, and Democracy in Chile', in E. Medina, I. da C. Marques and C. Holmes (eds.) *Beyond Imported Magic: Essays on Science, Technology, and Society in Latin America* (MIT Press), pp. 305–330.

Toscano, A. (2018) 'Antiphysis/Antipraxis: Universal Exhaustion and the Tragedy of Materiality', *Mediations*, 31(2), pp. 125–144, http://mediationsjournal.org/articles/antiphysis-antipraxis (accessed on 7 November 2022).

Turner, J.M. (2015) 'Following the Pb: An Envirotechnical Approach to Lead-Acid Batteries in the United States', *Environmental History*, 20(1), pp. 29–56, DOI: 10.1093/envhis/emu128

UNESCO (2005) *The Precautionary Principle* (Paris: UNESCO, World Commission on the Ethics of Scientific Knowledge and Technology), https://unesdoc.unesco.org/ark:/48223/pf0000139578 (accessed on 7 November 2022).

UNESCO (1998) *San Pedro de Atacama*, (Paris: UNESCO, World Heritage Centre) https://whc.unesco.org/en/tentativelists/1191/ (accessed on 25 October 2021).

USGS (U.S. Geological Survey) (2021) 'Lithium', *Mineral Commodity Summaries*, https://pubs.usgs.gov/periodicals/mcs2021/mcs2021-lithium.pdf, (Washington D.C.: USGS) (accessed on 7 November 2022).

Voskoboynik, D.M. and D. Andreucci (2021) 'Greening Extractivism: Environmental Discourses and Resource Governance in the 'Lithium Triangle'', *Environment and Planning E: Nature and Space*, DOI: 10.1177/25148486211006345

Voyles, T.B. (2015) *Wastelanding: Legacies of Uranium Mining in Navajo Country* (Minneapolis: University of Minnesota Press).

Wang, G., S. Mang, H. Cai, S. Liu, Z.-Q. Zhang, L. Wang and J. Innes (2016) 'Integrated Watershed Management: Evolution, Development and Emerging Trends', *Journal of Forestry Research*, 27, DOI: 10.1007/s11676-016-0293-3

Whyte, K.P. (2013) 'On the Role of Traditional Ecological Knowledge as a Collaborative Concept: A Philosophical Study', *Ecological Processes*, 2(7), DOI: 10.1186/2192-1709-2-7

Wit, M.M. de (2021) 'What Grows from a Pandemic? Toward an Abolitionist Agroecology', *The Journal of Peasant Studies*, 48(1), pp. 99–136, DOI: 10.1080/03066150.2020.1854741

Wynter, S. (1971) 'Novel and History, Plot and Plantation', *Savacou*, 5, pp. 95–102.

Xiong, S., J. Ji and X. Ma (2020) 'Environmental and Economic Evaluation of Remanufacturing Lithium-Ion Batteries from Electric Vehicles', *Waste Management*, 102, pp. 579–586, DOI: 10.1016/j.wasman.2019.11.013

Yáñez, N. and R. Molina (eds.) (2011) *Las Aguas Indígenas En Chile* (Santiago: LOM Ediciones), http://www.digitaliapublishing.com/a/18267/las-aguas-indigenas-en-chile (accessed on 30 September 2019).

NOTES

1. In this study, 'exhaustion' is an emic term from Chilean environmental law and policy declaring that a basin does not have enough surface water to allow additional water rights to be granted. For an exploration of exhaustion from critical Western philosophical perspectives on energy, see Toscano (2018).

2. The Puna de Atacama is a geographical term defined by the characteristics of the ecoregion such as its flora, fauna, elevation and geology (Matteucci, 2012). In contrast to the Puna, the term 'Lithium Triangle' just distils the region to its extractive potential (Jerez Henríquez, 2018).

3. We thank Philippe Le Billon for pointing out this distinction between Murphy's use of the concept to refer to exposures to chemicals in buildings and its use to refer to alteration of water- and landscapes by extraction.

4. See Acosta (2017); Acuña and Tironi (2022); Blair (2021); Del Bene, Scheidel and Temper (2018); Gudynas (2018); Hernando-Arrese and Tironi (2019); Hommes et al. (2019); Hoogesteger and Verzijl (2015); Li (2015); Lins Ribeiro (1994); Riofrancos (2017); Svampa (2013); Swyngedouw (2004).

5. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Global Assessment has identified wetlands as the world's most threatened ecosystems (IPBES, 2019). Many of the lagoons in this area host migratory and native wildlife, and several are already designated as Ramsar Wetlands of International Importance or nature reserves and/or have some sort of national protected status.

6. This rate is for SQM (Heubl, 2019). In 2016, Albemarle gained approval to increase brine pumping from 142 to 442 litres per second.

7. The R.P. Gustavo Le Paige Archaeological Museum in San Pedro states that archaeologists have found arrowheads or '*colas de pescado*' for hunting large animals that have been extinct for 12,500 years. See also UNESCO (1998).

8. Cecilia Jamasmie, "Chile sues BHP, Albemarle, Antofagasta over water use," *Mining.com*, April 8, 2022 https://www.mining.com/chile-sues-bhp-albemarle-antofagasta-over-water-use/ (accessed on 7 November 2022).

9. Espíndola is a member of the Atacameño/Lickanantay Community of Toconao, the Association of Irrigators and Farmers of Quebrada de Soncor, and OPSAL.

10. Rudecindo Christian Espíndola, 'Proyecto Paloma', Presentation at 2019 workshop, Fundación Tantí, OPSAL, San Pedro de Atacama, transcribed by Bianca Delgado and translated by Amanda Maxwell and Language Divas.

11. *Vino criollo* is a local wine produced in Toconao with grapes introduced by the church during the Spanish colonisation for use during Catholic mass. It is also used during other celebrations and ritual processes, such as carnival or the San Lucas celebration.

12. Rudecindo Espíndola, from the fieldnotes of Ramón Balcázar M., 2021.

13. In 2019, Chile's Superintendency of Environment (SMA) approved SQM's USD 25 million compliance plan for the expansion of its operations, but later that year the CPA filed a successful lawsuit in a regional court that paused the approval process due to the 'particular fragility' of the Atacama salt flat (Sherwood, 2020a). In 2020, the SMA decided instead to develop its own comprehensive management plan, which would assess impacts of all four of the mega mining projects at the Atacama salt flat. Following its successful litigation campaign, the CPA went further, demanding that SQM's environmental permits be revoked (Sherwood, 2020b).

14. James J. A. Blair, personal communication with Sergio Cubillos, 2019, transcribed by Bianca Delgado and translated by Amanda Maxwell and Language Divas.

15. This recommendations section is adapted with permission from Blair et al., 2022.

16. For example, see Comunidades de la Cuenca de Salinas Grandes y Laguna de Guayatayoc (2015); Secretariat of the Convention on Biological Diversity (2004); and Secretariat of the Convention on Biological Diversity (2011).

17. See, for example, 116th Congress, 2nd session, S. 3356: To support the Reuse and Recycling of Batteries and Critical Minerals, and for Other Purposes, February 27, 2020, https://www.congress.gov/116/bills/s3356/BILLS-116s3356is.pdf (accessed on 7 November 2022).

ABSTRACTS

Green technologies designed to mitigate climate change through renewable energy and zero-emissions transportation currently depend on lithium-ion batteries, which require 'critical materials'. Like nickel, graphite, manganese and cobalt, lithium is a key component of batteries that store energy for electric vehicles, smart devices and renewable power plants. Although lithium is present all over the globe, one of the main commercial lithium reserves is in the Puna

de Atacama, a desert region at the borders of Chile, Argentina and Bolivia. Resulting from a collaborative study for the Natural Resources Defense Council and the Plurinational Observatory of Andean Salt Flats, this chapter examines how the reliance on brine evaporation as an extraction method for lithium mining exacerbates conditions of ecological ‘exhaustion’ in the Puna de Atacama. The study is based on ethnographic and historical research primarily conducted in Chile with environmental activists, Indigenous leaders, scientists and policy practitioners. Furthering the concept of ‘alterlives’ to examine not only exposure to downstream chemicals but also the in situ alteration of life at mining sites upstream in the chemical supply chain, the chapter analyses environmental injustices inherent to green extractivism across multiple scales. It considers under what conditions Indigenous and local participation may contribute new models and standards for monitoring and offers policy recommendations to prevent further social harm and environmental damage.

Les technologies vertes conçues pour atténuer le changement climatique grâce aux énergies renouvelables et aux transports à zéro-émissions dépendent actuellement des batteries lithium-ion qui nécessitent des ‘matériaux critiques’. Tout comme le nickel, le graphite, le manganèse et le cobalt, le lithium est un composant clé des batteries qui stockent l'énergie pour les véhicules électriques, les appareils intelligents et les centrales électriques renouvelables. Bien que le lithium soit présent sur tout le globe, l'une des principales réserves commerciales de lithium se trouve dans la Puna de Atacama, une région désertique aux frontières du Chili, de l'Argentine et de la Bolivie. Issu d'une étude menée en collaboration avec le Natural Resources Defense Council et l'Observatoire plurinational des salines andines, ce chapitre examine comment le recours à l'évaporation de la saumure comme méthode d'extraction pour l'exploitation du lithium exacerbe les conditions d'épuisement écologique dans la Puna de Atacama. L'étude se fonde sur des recherches ethnographiques et historiques menées principalement au Chili auprès d'activistes environnementaux, de leaders indigènes, de scientifiques et de politiques. En approfondissant le concept d''alter-vies’ pour examiner non seulement l'exposition aux produits chimiques en aval mais aussi l'altération in situ de la vie sur les sites miniers en amont de la chaîne d'approvisionnement chimique, le chapitre décrit les injustices environnementales inhérentes à l'extractivisme vert et ce, à plusieurs niveaux. Les auteurs analysent aussi les conditions pour que la participation autochtone et locale puisse contribuer à l'élaboration de nouveaux modèles et de nouvelles normes de surveillance et proposent des recommandations politiques pour prévenir de nouveaux dommages sociaux et environnementaux.

Las tecnologías verdes diseñadas para mitigar el cambio climático mediante energías renovables y transportes con cero emisiones dependen actualmente de las baterías de ion de litio, que requieren "materiales críticos". Al igual que el níquel, el grafito, el manganeso y el cobalto, el litio es un componente clave de las baterías que almacenan energía para vehículos eléctricos, dispositivos inteligentes y centrales eléctricas renovables. Aunque el litio está presente en todo el planeta, una de las principales reservas comerciales de litio se encuentra en la Puna de Atacama, una región desértica en las fronteras de Chile, Argentina y Bolivia. Fruto de un estudio collaborativo realizado para el Natural Resources Defense Council y el Observatorio Plurinacional de los Salares Andinos, este capítulo examina cómo la dependencia de la evaporación de salmuera como método de extracción para la minería del litio agrava las condiciones de "agotamiento" ecológico en la Puna de Atacama. El estudio se basa en investigaciones etnográficas e históricas realizadas principalmente en Chile con activistas medioambientales, líderes indígenas, científicos y responsables políticos. Profundizando en el concepto de "altervidas" para examinar no sólo la exposición a las sustancias químicas aguas abajo, sino también la alteración in situ de la vida en las explotaciones mineras aguas arriba en la cadena de suministro de sustancias químicas, el capítulo analiza las injusticias medioambientales inherentes al extractivismo verde en múltiples escalas. Examina en qué condiciones la participación indígena y local puede aportar nuevos

modelos y normas de monitoreo y ofrece recomendaciones políticas para evitar más daños sociales y medioambientales.

INDEX

Keywords: renewable energy, mining, lithium, extractivism, critical materials (nickel, graphite, manganese, cobalt, lithium), civil society, participation, inclusive development, health, environment
Geographical index: Chile, Argentina, Bolivia

AUTHORS

JAMES J. A. BLAIR

James J. A. Blair is assistant professor of Geography and Anthropology at California State Polytechnic University, Pomona. Blair holds a PhD in Anthropology from The Graduate Center, City University of New York. His work centers on energy, water and environmental justice in the Americas. In addition to his research, Blair has professional experience in environmental policy as an international advocate for the Natural Resources Defense Council (NRDC).

RAMÓN M. BALCÁZAR

Ramón M. Balcázar is a PhD candidate in Rural Development at the Autonomous Metropolitan University of Mexico - UAM and Coordinator at OPSAL (the Plurinational Observatory of Andean Salt Flats). Taking a participatory approach, his militant research is situated at the intersection of multilateral climate policies and the subsequent expansion of green extractivism throughout Indigenous/rural territories in the Andean puna. His expertise lies in rural development, agroecology, neo-extractivism, climate justice, socio-environmental movements, just transition and post-development.

JAVIERA BARANDIARÁN

Javiera Barandiaran is associate professor in Global Studies at the University of California, Santa Barbara. Her work explores the intersection of science, environment, and development in Latin America. Her research on lithium has been awarded support from the Mellon Foundation and the National Science Foundation, and has been published in *World Development*. In 2022, she received the Berlin Prize from the American Academy in Berlin for her lithium work.

AMANDA MAXWELL

Amanda Maxwell is managing director of the International Program at NRDC. Maxwell's work focuses on promoting clean energy, cleaning up dirty fuels, improving air quality, and protecting wildlife and wildlands throughout Latin America. She received her Bachelor's degree in History and Spanish from Middlebury College and her Master's in International Politics and Economics from Charles University in Prague. She has also studied at the Universidad de Buenos Aires.