

From a white desert to the largest world deposit of lithium: symbolic meanings and materialities of the Uyuni salt flat in Bolivia

Abstract

The Uyuni salt flat (*Salar de Uyuni*) in Bolivia possesses the largest lithium deposit in the world. Over the past 40 years, this location has been commodified and radically transformed. This paper examines how a landscape, understood from its material attributes and qualities, shapes and is shaped by social relations unfolding in a process of commodification and mining expansion. Based on primary qualitative data, the paper explores two elements: i) how the symbolic meaning of this landscape has changed over time for the surrounding indigenous communities and ii) how the different materialities of the salt flat as landscape, as ulexite and as lithium allow understanding the drivers of socio-environmental change and conflict in this region. The paper argues that social relations and governance frameworks are interlinked with changing symbolic meanings and the different materialities of the Uyuni salt flat.

Keywords: Uyuni salt flat, lithium, materiality, commodification, Bolivia.

I. Introduction

The Uyuni salt flat (*Salar de Uyuni*) is located on the Bolivian Andean plateau; it is the largest salt flat on earth, and a natural wonder. The largest lithium deposit in the world is found in its brines, along with important resources of potassium, magnesium, and ulexite (a structurally complex mineral extracted from the salt crust perimeter and mostly used as fertilizer). Collectively these minerals are known as ‘evaporite resources’.

Lithium – the lightest metal on earth – has become a coveted commodity in high global demand. From mobile phones to lithium-ion batteries in electric vehicles and energy storage systems, lithium is central in new technologies (Zicari, 2015).

The extraction and evaporation entail a complex process from brines, mostly located in the so-called ‘Lithium Triangle’ in the South American salt flats of Chile, Bolivia and Argentina. The region accounts for 55% of the world reserves and 85% of the lithium sourced from brines. Resource estimates suggest that the Uyuni salt flat in Bolivia possesses the largest world resource (10.2 million tonnes of lithium, equivalent to 38% of global resources) (Grosjean et al., 2012; Munk et al., 2016).

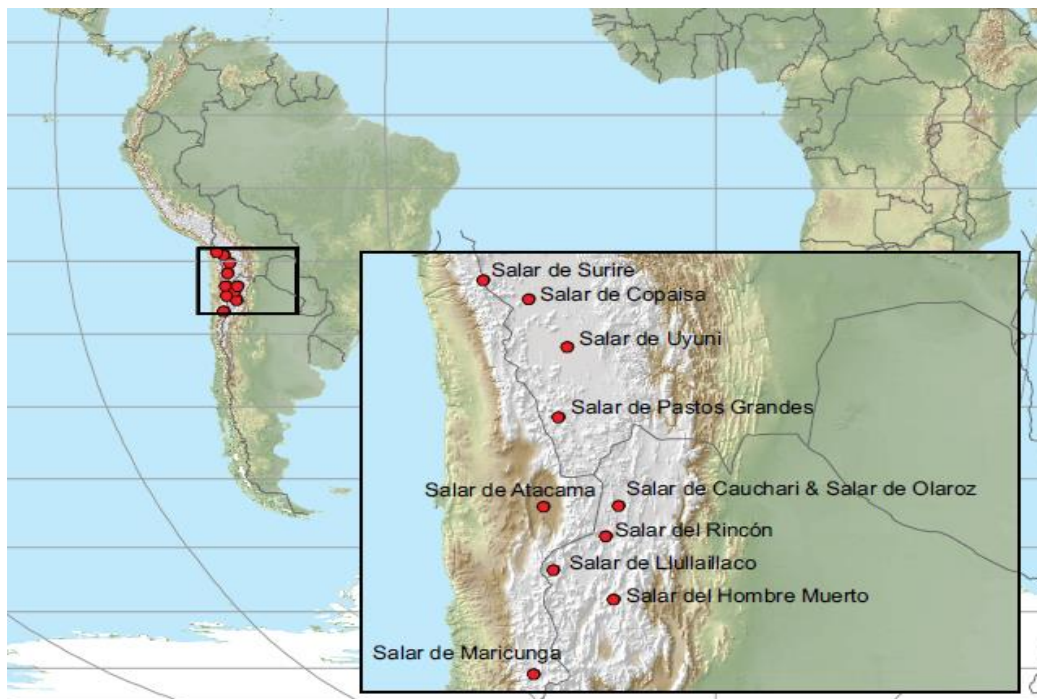


Figure I. The lithium Triangle (Source: Munk et al., 2016)

The Uyuni salt flat – once known as the white desert – was an isolated location largely unused by the government until 1976, when the Geological Service of the United States found lithium in its brines and began the process of identifying and quantifying its evaporite resources (Aguilar-Fernandez, 2009; Ballivian & Risacher, 1981; Espinoza, 2010). This was the beginning of a long and conflictive process of commodification and transformation of the

Uyuni salt flat and marked a change in the symbolic meanings of this landscape for the surrounding communities.

Kopytoff (1988, p. 73) highlights that commodification is not a single ended process, but rather a “process of becoming of a commodity”. A biographical approach to commodities, not only provides a historical perspective of the commodification process, but also allows for different social relations to be revealed over time, since commodities are not only material things, but are also culturally distinct as certain kind of things in different contexts and for different groups of people. Similarly, Bridge (2009) asserts that in this process of becoming, resources are dynamic and relational, since changes over time and space are linked to technology, culture (in its broader sense) and political constructs since different groups and interests compete for accessing them. This approach is at the heart of the material culture debate in anthropology and resource geography. Material aspects of nature not only shape, constrain or encourage social relations, but also set the opportunities and obstacles in defining the governance of resources (Valdivia 2008). In this vein, materiality emerged as a field of exploration seeking to reconcile the multiple ways in which material things play important roles in the constitution of social relations and discursive practices. In particular, materiality opens up the incorporation of nature’s agency, power relations and plurality in the analysis (Bakker & Bridge, 2006; Davidov, 2014; Latour, 2005).

This paper examines how a landscape understood by its material attributes and qualities shapes and is shaped by social relations unfolding in a process of commodification and mining expansion. I argue that as a result of the commodification process and the expansion of mineral extraction, the value and symbolic meanings placed on the landscape by the communities surrounding the salt flat have changed from a ‘worthless space’ to the ‘world’s largest deposit of lithium’. Hand in hand with new meanings, ownership of the salt flat became central to territorial contestation in this region. This process of symbolic change is not external and solely concerned with economic aspects; on the contrary, it is coproduced by the social and biophysical elements that position the Uyuni salt flat, with a peculiar materiality shaping the social dynamics in the region.

Based on primary qualitative data, I explore how the different materialities of the salt flat as landscape, ulexite and lithium allow us to understand the drivers of socio-environmental change and conflict in this region. The empirical arguments are based on my fieldwork in Bolivia between 2014 and 2016 in the cities of La Paz, Potosí, and Uyuni, and the municipalities surrounding the Uyuni salt flat. The methods used include semi-structured interviews, focus groups and life histories of key informants.

This paper seeks to provide novel information about how the local people perceive and relate to this landscape and, most importantly, how this relationship has changed over time. Understanding the history and social dynamics of the Uyuni salt flat is intimately related to different forms of co-production between its materiality and its symbolic meanings for the surrounding communities. Beyond the case itself, the paper contributes to the understanding of the State’s instrumental use of strategic resources vis-à-vis the material and symbolic elements shaping socio-environmental changes at local level.

The paper is organized as follows: first, I draw on the literature on materiality and material culture, identifying gaps and outlining my argument. Then I present the key features of evaporite mining and the Uyuni salt flat in Bolivia. The subsequent section presents the empirical evidence and analysis of the multiple materialities in the case study. I conclude with a discussion on how materialities shape different social relations.

II. Materiality and Material Culture

In a literature review on materiality, Richardson and Weszkalnys (2014) highlight the interdisciplinary approach in political sciences, anthropology and human geography and the particular ontologies in relation to the processes, outcomes and interlinks of resource materiality, commodification and resource extraction developed in three main areas: firstly, in the field of material culture, there is an emphasis on resource exploitation interlinked with social relations and social structures (Ferguson, 1999; Miller, 2005; Nash, 1979; Taussig, 1980) and resource contestation, power and relational strategies embedded in cultural and symbolic meanings (Escobar, 1999; Gilberthorpe, 2007; Ingold, 2002). Secondly, in what is labelled as ‘resource materialities’ (plural), resources are in constant reworking between nature and culture and are inherently distributed things that in essence cannot be understood exclusively by biophysical characteristics nor through socio-cultural meanings (see Appadurai, 1988; Bakker & Bridge, 2006; Goldman et al., 2011; Kaup, 2008; Le Billon, 2001; Swyngedouw, 2007; Watts & Peet, 2004). Thirdly, the notion of the production of nature is transcended to “coproduction of socionature” in which the human and non-human actors are in a constant interplay (Bakker & Bridge, 2006, p. 19). In a similar perspective of co-constitution and mutual change, the concept of hybrid is introduced as the “perpetual metabolism in which social and natural processes combine in a historical-geographical production process of socio-nature” (Swyngedouw, 1996, p. 70).

Turning the discussion to the specific body of literature that focuses on materiality of nature in resisting or promoting mining activities, Peluso and Watts (2001) argue to move beyond deterministic approaches to resources and environmental processes since both shape and are shaped by the political economy of access to and control over resources. Le Billon (2001, p. 568) further explains that beyond conventional accounts of scarcity or abundance of resources in triggering conflicts, the lootability of resources due to biophysical characteristics, plays a key role in the way violent conflicts and actors define strategies. In his perspective, the transformation of nature into “tradable commodities” is a deeply political process in which definitions of property rights, labour relations and allocation of profits are interlinked with resource materiality. In a similar vein, Kaup (2010, p. 124) argues that the so-called “sociomaterial characteristics of primary commodities” (including their physical and chemical features, scarcity, different degrees of quality and distribution around the globe) are central to understanding the structure within which resource extraction operates, and the constraints and opportunities of different actors involved in the extractive activity.

Likewise, Bridge (2004) highlights that even the definition of mineral reserves is dynamic and its materiality (in terms of size, location, and availability) interlinks with societal demands and

changes in the market price, costs of extraction and development of new technologies. Bridge and Perreault (2009) draw our attention to an understanding of the biophysical characteristics of natural resources as distinct from a factor of production and commodity status; whereas Valdivia (2008) explored the materiality of petroleum and the social relations emerging with its molecular characteristics, and its properties of movement across space and time (i.e. pipelines) in order to make claims of nature, technology and development. In this sense, these authors agree with previous analyses about nature's features as barriers to or opportunities for capitalist accumulation; yet they argue that each resource possesses a particular problem in its metabolic interaction into capitalist production.

An examination of the materiality of resources thus moves beyond different forms and mechanisms for extractive expansion to investigate how nature is extrapolated into a political arena of contestation. This perspective is relevant to understanding more than a decade of socio-political transformations in many countries of Latin America, and Bolivia in particular. Under Evo Morales and his left-wing political party (Movimiento al Socialismo-MAS) the access to and control of natural resources are at the core of the so-called 'post-neoliberal model'. As such, the governance of resources is the base of a state-building project seeking to expand its role in the economy, social redistributive policies and political reforms such as a New Political Constitution and the recognition of indigenous rights and their territories. However, far from a different paradigm, post-neoliberalism is more a continuity with partial changes rather than the radical rejection of neoliberalism or capitalism itself (Grugel & Ruggirozzi, 2012; Peck et al., 2010). It exhibits the contradictions of the government's 'environmentalist indigenous' discourse as it clashes with the extractive development pattern that has deepened the dependence to international markets and it has expanded the mining and hydrocarbon activities to protected areas and many indigenous territories (Anthias, 2018). As the Bolivian sociologist, Rivera-Cusicanqui points out, the government's narrative of breaking with the old political system and neoliberal order is incoherent with the old fashion developmentalist policies implemented. Furthermore, behind the reloaded role of a strong State, there is a tendency to centralize decision-making and to promote a savage corporate capitalism through discursive legitimization and the subordination of grassroots organizations that in the past were contingent to neoliberal policies (Rivera-Cusicanqui, 2014).

This particular context builds on debates concerning the politicization of natural resources (and its multiple materialities) in conjunction and in opposition to the State. Drawing from Svampa's (2013:67) concept of "commodity consensus" and "neo-extractivismo" (Gudynas, 2010, p. 12) resources are central in an extractivist paradigm (either market-oriented or State-controlled) based on the dispossession, accumulation and economic dependency on commodity markets. Bebbington et al. (2017) argue the expansion of the extractive frontier raises power struggles in which particular elements of the materiality of nature are instrumentally used by different actors to claim rights or gain access to rents and other benefits. Based on the particular case of the Andes, de la Cadena (2010, 2014), highlights how the notion of indigeneity is strongly rooted in the visibility of earth-beings (mountains in particular) as political objects of contestation in an interplay with neoliberal capitalism and the State. On the question of a relational approach to the State and extractive resources dynamics, Andreucci and Radhuber

(2015) argue Morales' government has instrumentalized institutions and grassroots organizations for weakening social resistance to mining expansion. These perspectives highlight that in the neo-extractivist paradigm regardless of the ideology in place, nature is conceived as external, divisible and prone to be seized by capitalism and resources are framed in terms of political and economic gains for a multiplicity of actors interacting in their governance.

Perreault (2013, p. 1066), on the other hand, further expands on the idea of nature's materiality influencing processes of accumulation and dispossession in neoliberal capitalism through an analysis of mining impacts on communities' livelihoods in the Huanuni Valley in Bolivia. Accordingly, he identifies livelihood dispossession as driven by three factors: the accumulation of toxic sediments on agricultural fields, the accumulation of water and water rights by mining companies and the accumulation of territory by mining operators as the mining "spatial footprint" expands over time. Of particular relevance to my analysis is his argument that specific forms of nature (water, sediments, minerals, biotoxins) play an active role in shaping processes of dispossession. In this sense, his argument not only separates key elements of nature as functional but different in the process of capitalist expansion, but also, he expands the notion of materiality to sub-forms such as sediments and biotoxins as key elements to understand symbiotic relations in the production of nature-society relations. In a similar line of argument, Perreault (2006, p. 165) critically explores the social conflicts around resource governance of water and gas in Bolivia; both cases illustrating that popular protests are not only strongly rooted in past histories of contestation and conflict (at regional and national levels), but also, that the "physicality of the resource" and the mechanisms through which it operates in socio-economic relations is highly relevant to understanding drivers and strategies of environmental conflicts.

These explorations have added important angles to the debate about socioenvironmental changes and conflicts in the literature, yet there are some critical points to discuss. First, most of the analysis about materiality and extraction points to materiality as an obstacle to or facilitator of capital expansion. However, there is a significant gap in which to expand the analysis on how actors relate to particular materialities and the strategies that emerge in these processes (Kaup, 2008). Second, the frameworks of analysis tend to privilege the State and transnational actors, underexploring the relevance of the local context and social relations in their interaction with resource materialities (for exceptions see Perreault (2006, 2013)). Third, most of the research is focused on traditional mineral commodities such as oil, gas, gold, copper and diamonds. In this sense, this paper seeks to address some gaps in the debate through a micro scalar analysis of local communities interacting and managing the salt flat and its resources. From a theoretical point of view, two important links are to be raised here: i) materiality as an element resisting or facilitating capitalist expansion, and ii) materiality as a plural notion (or sub-forms of materiality) to explore how socio-environmental changes take place and how local actors relate to particular forms of materialities.

Moving now to the case study, most of the academic research about lithium is focused on the resource availability at the global level and the technical risks and constraints (Davis et al., 1982; Grosjean et al., 2012; Kushnir & Sandén, 2012; Mohr et al., 2012). From a broader

perspective, there is an ongoing debate about the economic and technical feasibility of lithium industrialisation in Bolivia as a State project in different reports, NGO publications, blogs and online articles with little emphasis on the communities of the salt flat (Aguilar-Fernandez, 2009; Calla et al., 2014; Hollender & Shultz, 2010; Montenegro, 2010; Nacif, 2012; Perrin, 2016; Ripley & Roe, 2012; Romero, 2009; Zuleta, 2018).

In the academic domain, a significant analysis and discussion on the lithium case from a social point of view has been presented by Ströbele-Gregor (2012) and Valle and Holmes (2013). Of particular relevance is the work of Olivera (2014) who explored the risks of lithium mining in Bolivia from two angles: the external risks linked to market constraints and the internal risks related to the governance in terms of institutional arrangements and the historic legacy of mineral extraction of the region. Another study by Revette (2016) states that the strong nationalist narrative of lithium mining echoes different beliefs and perceptions which are historically contingent and strongly rooted in past experiences of disadvantage and exploitation without benefits for local population. From her perspective, the lithium case proves the so-called ‘consent for extraction’ and its legitimacy at local level are based not only on economic rationalities or formal rights, but also, are sustained by conjoined interests of the State and local actors.

While these scholars usefully highlight governance and cultural elements for the lithium case, much of the research up to now has framed lithium as a disconnected element from the salt flat ignoring the multiple materialities found in the landscape and the different social implications each of these have at local levels.

How and why nature is transformed into a resource is inherently linked to historical processes of social construction where “resources are not; they become” (Zimmermann, 1933, p. 15). This transformation is intrinsically political in terms of the governance of resources, the processes of enclosure (via definition of property rights) and the social struggles emerging as a result. In my analysis, the way that local communities relate to things is a dynamic and complex process within which symbolic meaning can transmute and become interdependent on a commodification process. How the salt flat has changed and how local communities relate to the landscape reveals different symbolic meanings that have evolved over time: the salt flat as an obstacle and useless for agriculture that later became a tourist attraction; and the salt flat as the deposit of lithium and mineral resources.

In my argument, these new meanings are linked to the peculiar materiality of this landscape and have contributed to articulating political strategies to consolidate particular forms of governance in the Uyuni salt flat as I will now proceed to explain.

III. The Uyuni salt flat

The Uyuni salt flat is located in the southwest region of the department of Potosí. Historically known in colonial times for its silver mines, Potosí is now the poorest department of Bolivia (around 59% of the population lives in extreme poverty) but paradoxically, it is still one of the most important locations for mineral extraction in the country.

The Uyuni salt flat is the largest salt flat on earth, it covers an area of 10,582 km² and reaches an altitude of 3,653 meters above sea level. Due to its size and remarkable flatness, it is considered as an ideal reference surface for NASA and its satellite-based altimeters (Aguilar-Fernandez, 2009; Borsa, 2005).

The salt flat is surrounded by the Municipality of Uyuni (Antonio-Quijarro Province), Municipality of Colcha-K and San-Pedro de Quemes (Nor-Lipez Province), Municipalities of Llica and Tahua (Daniel-Campos Province), and to the north the Municipality of Salinas de Garcia-Mendoza (Cabrera Province in the department of Oruro). These six municipalities contain 329 communities of Quechua and Aymara ethnic origins (GNRE, 2012; Poveda, 2014).

The livelihoods are mostly concentrated on agriculture – especially quinoa – mining, artisanal salt production and tourism, the latter being, currently, the most important income generating activity. These economic activities are central to understanding the history of the salt flat and each of them is linked to a tangible materiality, a form of social organization and a symbolic meaning.

Bolivia was the first country in South America to begin scientific research and the measurement of evaporite resources in the salt flats. Between 1973 and 1981 agreements between the public university UMSA, the French ORSTOM mission and NASA carried out studies in the salt flats. As a result, the ORSTOM report was published and claimed that Bolivia had a large concentration of lithium in addition to potassium and ulexite in the Uyuni salt flat near the area of Rio Grande in Nor-Lipez province (Nacif, 2012).

The transformation of the Uyuni salt flat over time is intrinsically linked to a political process involving the enclosure of this landscape and territory. From 1973 to 2014, this landscape was at the core of social conflicts for its delimitation as a Fiscal Reserve on four separate occasions. The first two delimitations (1974 and 1986), the salt flat and surrounding areas were enclosed as Fiscal Reserve. Later in 1998, the Fiscal Reserve was radically reduced to the salt crust perimeter and in 2003, most of the original delimitation of 1986 was restored (Nacif, 2012)

A Fiscal Reserve is a demarcated area with exclusive access for the State to quantify mineral resources and define a strategy for extraction either prioritizing State mining companies or giving concession to private actors. According to the new mining law (approved in May 2014), all the salt flats of the territory (nine in total) are Fiscal Reserves open to State initiatives or public-private partnerships. This secures the State's monopoly over evaporite resources through the State mining company Yacimientos del Litio Boliviano-YLB as the only entity in charge of the management and extraction of resources in these areas. In this sense, the Uyuni

salt flat as a Fiscal Reserve is part of a changing history in terms of resource governance both in neoliberal (1985-2005) and post-neoliberal times (2006 to the present).

The southwest region has a complex history of territorial configuration. Considered an autonomous territory during colonial times, the so-called territory of Lipez was incorporated as a province in Republican times and later still was fragmented into four different provinces. Since 2010, three of these provinces (Nor-Lipez, Enrique Baldiviezo and Sud-Lipez) were recognised by the State with the titling of *Tierra Comunitaria de Origen* (Native Community Land – TCO) representing the largest TCO in the country (Macro-TCO of Lipez). Through each of these changes, the Uyuni salt flat has been central in terms of symbolic meanings and territorial claims for the people in the southwest region. Although the Macro TCO of Lipez did not incorporate the Uyuni salt flat as part of its delimitation since it is a Fiscal Reserve, there is a permanent struggle between the provinces. For instance, Daniel Campos province actively opposed the titling of the TCO arguing that 16% of the territory requested overlapped with the Uyuni salt flat; which they claim it belongs to them according to the official cartography (Gysler, 2011). This struggle is also translated into the different names the salt flat has (*Salar de Uyuni, Salar de Tunupa and Salar del Gran Lipez*) and the strong discourses local people have in relation to ownership of this landscape. These elements show the State has fragmented this territory exacerbating intra-societal struggles for land and the territorial claims now follow a strategic goal of appropriation of revenue and governance of lithium in particular. As one interviewee stated: [...] *the name matters now because the municipalities will get royalties* (Member quinoa-association, Llica).

In 2008, the debate about lithium gained media momentum. For many experts, lithium was to become the next ‘big resource’ in the face of an oil crisis and concerns about climate change. Bolivia was portrayed as the future ‘Saudi Arabia of lithium’ and the government of Morales was courted by different countries and transnational companies seeking to consolidate a partnership (Romero, 2009; Wright, 2010; Yarow, 2009). In the country, the population had big expectations about the new government and perceived that lithium could be an opportunity to do things differently (Revette, 2016).

For the government of Evo Morales, lithium represents its best example of post-neoliberalism (as an economic and political model with a strong involvement from the State) and the entry point to modernity, technological knowledge and global insertion. As the following statements illustrate: “the export of raw materials is over, we seek not only lithium carbonate but to produce cars made in Bolivia” (President Evo-Morales) (El-Mundo, 2011); and “we are going to invest in lithium, Bolivia will regulate the price worldwide” (Vice-president Alvaro García-Linera) (Cambio, 2016). These media and discursive elements contributed to making lithium a strategic resource and in people’s imaginary the next big resource of the country and the jewel of the salt flat.

However, almost a decade later, lithium has become the centre of controversy due to massive delays in the project planning, the direct invitation to foreign companies (Chinese in particular) to build the infrastructure, a lack of transparency and debate in relation to the technology

selected, the possible environmental impacts and the social conflicts about future distribution of benefits and employment prospects for local communities.

Over time, the Uyuni salt flat has been mostly portrayed as an unproblematic and homogenous space, external to communities and the traditional livelihoods and prone to be seized by capitalist expansion. However, to understand the socio-environmental changes in its history, the different materialities -understood as the material attributes and qualities of the salt flat- allow to explore the different ways in which physical and cultural elements simultaneously influence in the process of capitalist expansion. Rather than analysing nature as a neutral input to the economy, materiality allows an exploration of how resources become and how the biophysical heterogeneity interacts and shapes social institutions and relations (Bakker & Bridge, 2006). As I will proceed to explain now, the Uyuni salt flat has three main materialities: as a landscape, as ulexite and as lithium. In each of these, materiality interlinks with changeable symbolic meanings and socio-economic dynamics.

IV. The salt flat as an isolated landscape and natural wonder

As a visitor to the Uyuni salt flat, the most immediate feeling is the remoteness that the salt flat provokes. During the interviews in the communities but in particular in Llica in the northern part of the salt flat, all people talked about the isolation of this landscape and the coping strategies they have developed over generations. For example:

[...] The Salar was almost inexistent when I was a kid. There was no economic relation with agriculture or cattle. There was only one truck per week to connect Llica with Uyuni city and nothing during rainy season. The people used to move and to travel to Chile to buy basic things to trade. We used to go in llamas there. Even today, the youth here know more about Chile than about Bolivia. (Member of the Quinoa-Association, Llica).

[...] The Salar was an obstacle years ago, no one knew about lithium. Before the rainy season, people had to cross it and go to Uyuni to buy things in advance because later it was impossible to cross the Salar, Chile was closer to us [...] Once professionals came to explain the Salar was important. An astronaut came because he saw it from space and then the tourism started. It became famous (Member civic-committee Daniel Campos province, Llica).

The salt flat used to be detrimental for communities, particularly in the rainy season (December-March) during which the salt flat is cover by a layer of water reflecting the sky. The transport during this season is difficult; before the use of jeeps 4x4 (mostly used in private tourism) accessing the salt flat was virtually impossible. The dry season (April-November), the salt flat offers a different scenery with polygonal figures formed by the wind and salt molecules (Perrin, 2016).

In this sense, the geographical location and physical characteristics of the salt flat determined a pattern of migration in the community of Llica that is still evident today. One of the

informants describes the ‘non-existence’ of the landscape since it did not have an economic link with people’s livelihoods and the salt flat was seen as an obstacle both for its location and for its lack of transport. Tourism gave the Uyuni salt flat an important use and a new value for the local people.

Tourism has become a major activity in the Southwest region. Between 2004-2014 the influx of tourists increased from 524,000 to 1.18 million at the national level (La-Razón, 2015), and the Uyuni salt flat and the Eduardo Abaroa National Reserve represented the most visited ecotourism attractions in the country with an estimated 185,320 annual visitors (Aguilar-Fernandez, 2009; Viceministerio de Turismo, 2011). From a critical geography perspective, tourism is a multifaceted phenomenon connecting people and spaces at different scales and with different social, cultural and economic implications on the landscape and local people (Galafassi, 2010; Hall, 2013). According to Galaz-Mandakovic (2017), tourism in the Uyuni salt flat has radically changed the local and regional economy of the southwest region of Potosi in the past 20 years. It is estimated that around 76% of people in the municipality of Uyuni and surrounding areas are directly and indirectly linked to the tourist industry. This transformation follows a private-oriented and capitalist logic and generates an uneven development between urban-rural areas, unequal redistribution of income and the appropriation of the culture and nature according to foreigner standards of consumption.

In my analysis, tourism is an important mechanism for the commodification of the salt flat in two ways: i.) the profits derived from the economic activity and the touristic routes are in constant struggle with local communities that demand to be part of the touristic circuit and ii) the magnificent ‘spectacle of nature’ this landscape provides, has been symbolically and materially appropriated and inserted into a market circuit for private tourist operators.

The materiality of the salt flat as a landscape has two key elements to understand the social relations emerging: its physical characteristics and the hydrological cycle which previously was seen as an obstacle by the communities (Llica in particular) shaped human migration patterns. And nowadays, this hydrological cycle has acquired a particular relevance and market value for the tourist industry that promotes the Uyuni salt flat in dry and rainy season (Perrin, 2016).

A second recurrent theme among interviewees was the perception of the salt flat as ‘worthless’ in relation to the traditional economic activities of the region: quinoa and cattle. A variety of perspectives were expressed as the following extracts illustrate:

[...] The Salar wasn’t richness; the richness for us was in the land for quinoa. It is now that people started looking at the Salar when we knew about the minerals it has underneath. Before it used to be seen as just salt (Member civic-committee Daniel Campos, Llica).

[...] Before... the Salar was a situation. A richness that was sleeping there. We did not know what it had. In Sud-Lipez province they used to trade the salt in the valleys long ago. We thought it was going to be like that always, then people that know chemistry came in the eighties said there was gold and then lithium [...] Around the Salar we are

focused on quinoa. People like to be in peace, they are naive, they don't understand what lithium is about. (Representative-FRUTCAS, Uyuni city).

[...] Before the Salar was only salt. We did not even consume the salt from there; it was brought from somewhere else. People did not think much about the Salar; it was just another place of the landscape here. It used to be an obstacle in the rainy season. [...] It became famous for the lithium and also because it is a nice landscape for tourists. But for us it was not extraordinary, we've seen it always. But now I realise it is extraordinary (Group interview, Members of the Municipal Council-Llica, Llica).

These iterations highlight two elements: first, the commodification process of the Uyuni salt flat is relatively recent, and it was mostly triggered by lithium expectations. Second, one of the informants expressed that the salt flat as 'a situation', as a still point until resources were discovered by outsiders and even now, there is little relation with the traditional agricultural activities and the local dynamic.

In relation to this last point, some participants expressed the belief that outsiders have placed a monetary value on the landscape with tourism and the scientific narrative about evaporite resources (lithium in particular). This may suggest that the process of the commodification of the Uyuni salt flat was an external and imposed process through which the economic and symbolic value of this landscape changed over time.

V. The salt flat and ulexite mining

Ulexite is central to understanding the social and political dynamics emerging in the Uyuni salt flat and the southwest region in Bolivia. Ulexite is a mining activity done by the surrounding communities since the decade of the eighties. There are five mining operators in the Uyuni salt flat (mostly located in the community of Rio Grande in the southern part of the salt flat), but *Sociedad Colectiva Minera Rio Grande* SOCOMIRG and *Cooperative Estrella del Sur* are the most relevant in terms of production levels and both are directly linked to different social conflicts in this region for the definition of a Fiscal Reserve over time, the consolidation of their own extractive rights and the opposition to private concessions in the salt flat.

Ulexite extraction comprises the removal of the salt crust in the surrounding area of the salt flat. Next it is dried, powdered and mixed with sulphuric acid to remove impurities; then the boric acid is crystallised by cooling, separating and drying with hot air to obtain a 99% degree of purity (Ballivian & Risacher, 1981). Ulexite is used in agricultural fertilisers, ceramics, glass, fiberglass and also is an input for casting of metals (foundry).

In 1990, the Lithium Corporation of America (LITHCO – nowadays known as FMC Corporation) received a direct invitation from the Government to extract the resources of the Uyuni salt flat. The contract established an investment of USD 40 million with full rights of exploration and exploitation for 40 years.

However, the contract triggered immediate opposition from the communities and Potosi city organizations. The main arguments focused on the conditions of the contract and the lack of transparency for the direct invitation to the transnational without an international bid.

However, in the communities of the salt flat, there were multiple narratives much more complex than the simple opposition to transnationals as this conflict is sometimes portrayed (Pozzo, 2010; Ströbele-Gregor, 2012; Wright, 2010). When the LITHCO conflict emerged, most people in Rio Grande were already extracting ulexite in a rudimentary and manual way. As expected, the contract did not consider either other mining actors or the impacts on local livelihoods. When it was announced that the transnational corporation would get exclusive rights of access and management, local people organised themselves to defend their own rights of access to the salt flat (and ulexite) and eventually managed to stop the signing of the contract.

As a result, the people of Rio Grande formally created SOCOMIRG in 1991 as a community mining company, legally obtained leasing rights and consolidated their ulexite extraction rights in the region. However, in 1998 following the privatizing logic in mining that characterised the neoliberal model, the Fiscal Reserve of the salt flat was modified for a third time (Law 1854). In this case, the original area was drastically reduced to the ‘salt crust perimeter’ opened and incentivised the expansion of private concessions in the Uyuni salt flat.

A common perception identified during fieldwork was the new delimitation of the salt flat was a nasty political manoeuvre that reduced the size of the Fiscal Reserve, so the border previously defined was no longer a Fiscal Reserve and people closed to the spheres of power (Government of MNR – Movimiento Nacionalista Revolucionario political party) acquired the concessions as favours. In one informant’s words from Rio Grande community: the concessions were *‘corrupt and a political favouritism process; therefore, illegitimate’* and were a setback in the battle won against LITHCO and the leasing rights SOCOMIRG had.

The company Non-Metallic Minerals SA (majority owned by Quiborax S.A) acquired many concessions and started extracting ulexite in 1998 juxtaposing these areas with the communal company SOCOMIRG in Rio Grande. After years of grievances, in 2003 and following the violent events of the Gas War¹ and the resignation of President Sanchez de Lozada, the community of Rio Grande with other grassroots and civil society organizations started a protest demanding the reconstitution of the original area of the Fiscal Reserve and a reversal of the increasing number of private concessions in the salt flat.

Eventually both demands were successful and Quiborax lost its concession rights. However far from over, the conflicts in the salt flat are still present. After years of legal arguments in an International tribunal, in June 2018, the Bolivian Government agreed to pay a compensation of US\$ 42.6 million to Quiborax (ICSID, 2012).

These conflicts illustrate that the Uyuni salt flat is a contested space with different forms of materiality unfolding social relations. For instance, during the fieldwork a variety of informants from Rio Grande confirmed that ulexite was the first resource to be extracted in the salt flat in most cases by *de facto* rights of access outside the control of the State. As one interviewee stated:

[...] The ulexite was extracted first here, there was almost no control; from there lithium emerged in people's curiosity (Member Departmental-Assembly of Potosí, Potosí city).

[...] At that time, we were demanding areas to extract ulexite. But then we had the news that the government was going to give the salt flat to LITHCO, we were after ulexite, lithium was not our thing, we did not understand what it was. [...] There was a rumour that all the salt flat was going to be conceded to LITHCO and we would end up with nothing, so we started the protest. The main motivation for us was ulexite. We thought we would have nothing to survive (Community Council representative, Rio Grande).

The relevance of ulexite is twofold: ulexite was the first resource to be inserted into a local mining dynamic of evaporite mining and it was the catalyst of a common perception about the Uyuni salt flat as the richest and largest deposit of lithium. The comments below illustrate:

[...] We used to think the Salar it was an unproductive plateau. Before we used to think about cattle and agriculture. In 1988 people started extracting ulexite. My dad worked on that. We knew about the resource, but we didn't know what type of mineral it was, then people of the communities got involved in ulexite and then it came lithium and the conflicts with transnationals. (Member SOCOMIRG, Rio Grande).

[...] It became famous; people opened the eyes because of the borax/ulexite in the 90s. In Rio Grande they started extracting and then people discovered more minerals there. The ulexite is extracted on the surface surrounding the Salar. (Local resident Colcha-K).

The narrative in relation to the discovery of evaporite resources is consistent with the idea that ulexite is a particular form of materiality that created social relations when local communities organised and started extracting it. The expression of 'opening the eyes' used by one of the informants exemplifies that for local people, the discovery of mineral resources made them aware of the economic potential of the brine and the role they could play in this. For the first time, the Uyuni salt flat stopped being a desert of salt to become a coveted resource, a treasure to be protected from foreigners.

[...] When I was young, nothing was known about the Salar until 1990 when the transnational wanted to establish. For us, for our parents it was a history: there was the exchange of salt in the valleys for other products, but it never represented a livelihood alternative. So much has changed since then. The Salar is a tourist attraction, it has history and above all, it has mineral resources but also there are internal struggles for its ownership among the provinces of the southwest (representative-FRUTCAS and former Deputy)

In the narrative of this informant, the Uyuni salt flat was a '*history, not a livelihood option; nothing was known until 1990*'. Precisely the year that the first concession to the transnational LITHCO was awarded to extract lithium. From this point onwards, the Uyuni salt flat was transformed from a desert of salt to a resource worth fighting for. In his understanding, the Uyuni salt flat has changed to become many things: a tourist attraction, a history that for many

people is an identity; but most importantly, the rich deposit of evaporite resources that has contributed to changing the local dynamic and has also exacerbated internal territorial struggles.

VI. The salt flat and lithium

In 2008, Evo Morales' government began the ambitious process of extracting and industrializing evaporite resources in the Uyuni salt flat. Based on a strong nationalist political discourse against foreign companies, the Bolivian Government decided to finance 100% of the two initial phases (representing an investment of 1 billion U.S. dollars) and the state mining company *Yacimientos de Litio Bolivianos* (YLB) is in charge of the management and operations of three different phases (pilot, industrial scale extraction and industrialization of batteries) (Montenegro & Montenegro, 2014).

To date, YLB has made substantial advancements in building infrastructure, including a pilot plant of lithium carbonate (1,500 tonnes/year); thirty hectares of evaporation pools, a pilot and industrial plants of potassium chloride (12,000 tonnes/year), located in the south part of the salt flat. However, both pilot plants are far from reaching its full productive capacity: in 2017, YLB reported that total sales of potassium chloride reached 2,119 tonnes/year to the internal market and around 60 tonnes of lithium carbonate from which 24 tonnes were sold to the a Chinese company (YLB, 2017).

The last phase is the most ambitious of all; YBL seeks to undertake the industrialisation of lithium-ion batteries and cathode materials under the modality of public-private partnership with the State having a majority stake in the profits. Between 2014 and 2017, two pilot plants for cathode and battery assembly were inaugurated in La Palca, near Potosí city (Figure 2). Both were built by foreign companies (French and Chinese). In 2018, YLB announced the German company ACI Systems GmbH will be the strategic partner for an industrial complex of lithium hydroxide, cathodes and lithium-ion batteries with an approximate investment of 1,300 million U.S. dollars. It is yet to be seen, how this partnership develops.

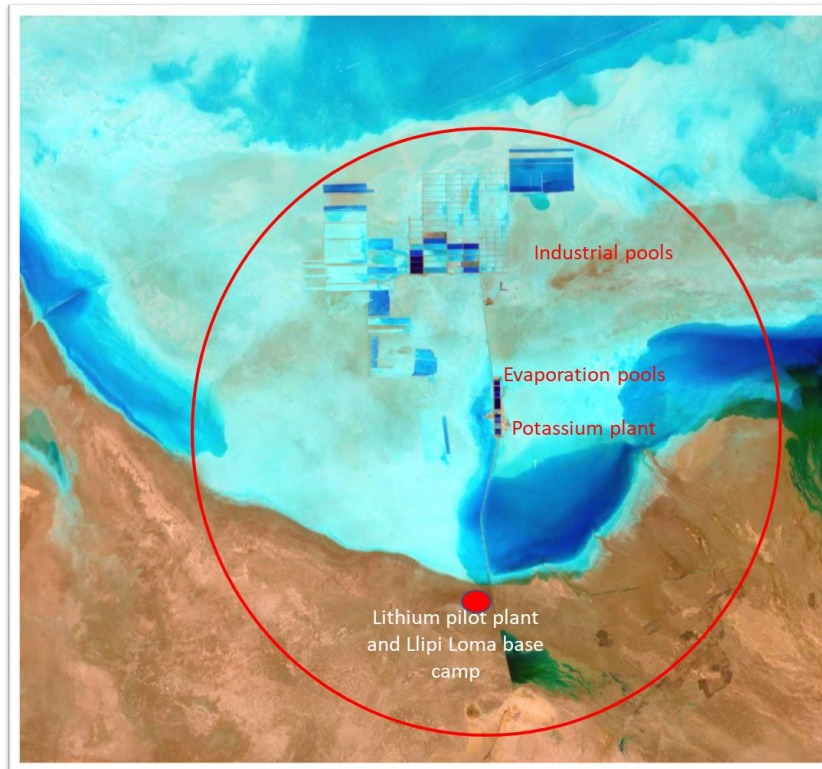


Figure 2. Location of pilot plant and evaporation pools (Source: Own based on United-States Geological Survey)

Lithium from brines has a peculiar process of extraction. The most common method is through solar evaporation and chemical processes. The brine contains high concentrations of minerals (lithium, magnesium, potassium, sodium) that emerge once the evaporation of water has taken place. The first step is the perforation of brines under the salt flat's crust by water pumps to deposit them into different pools for solar evaporation. Subsequently, the various elements are separated through the adding of chemicals. In total, this process takes between 18-24 months. Depending on the concentration levels in the brines, potassium, lithium and other elements are obtained. In a final step, after lithium has been separated, it is then transferred to a processing plant where lithium carbonate is produced (GNRE, 2013; Moreno, 2013).

In terms of materiality, the brine of the Uyuni salt flat has three times the concentration of magnesium in relation to lithium (18 g Mg per 1 g lithium) compared to the brine of the salt flat of Atacama in Chile (6.4 Mg per /1 g lithium) (Montenegro & Montenegro, 2014). In the same way as Kaup (2008, p. 1736) claims that “natural gas is an uncooperative commodity”; in my perspective, lithium is an ‘intricate commodity’ for its chemical materiality in terms of Magnesium/lithium concentration added to the meteorological conditions of the salt flat during the rainy season. These particular physiochemical characteristics are highly relevant to determine the type of technology to extract lithium, a higher cost of production and longer periods for evaporation compared to Chilean and Argentinean salt flats and the sub-forms of materiality (sediments) emerging as a result.

YLB claims it made significant progress in developing a Bolivian technology to obtain lithium carbonate through two methods: the technology of chlorides, and the technology of sulphur

(GNRE, 2015). The technology of chlorides currently used in the evaporation pools to separate the magnesium requires adding large amounts of quicklime, producing residues of magnesium-hydroxide and calcium-sulphate. According to Calla (2014) in the industrial phase of the project, 4,000 tonnes/per day of these residuals would be generated, representing one of the most significant environmental problems of the lithium project. Furthermore, considering the strong winds of this semi-desert area, without an adequate planning to manage and store these residuals, the alkalinity of the soil in the region could be negatively modified affecting the quinoa producers and the biodiversity (the Uyuni salt flat is one of the 34 biodiversity Hot-Spots of the world for the population of flamingos, birds and camelids breeding near the river Rio-Grande)(Aguilar-Fernandez, 2009).

The alternative technology is a sulphur precipitation process that would greatly reduce the quantity of quicklime required and would produce potassium-chloride and potassium-sulphate as by-products. However, this technological option was still in the process of being researched (Montenegro & Montenegro, 2014) and will gradually replace the adding of quicklime in the industrial phase of extraction.

This particular issue highlights how the physical features of the salt flat can influence technological decisions and the environmental consequences these decisions will have for both the landscape and the people interacting in it. Far from being a mere technicality, the technology selected will generate considerable chemical residues that will affect the landscape. To date, there is a lack of a serious debate about the environmental consequences of lithium extraction in the Uyuni salt flatⁱⁱ. Furthermore, the industrial extraction phase has already began without a critical analysis of the constraints emerging from the materiality of the Uyuni salt flat and the low levels of production in both pilot plants (potassium-chloride and lithium-carbonate).

The notion of materiality contributes to my argument in different ways: i) what we know about nature is not complete. Physical properties and generative capacities of nature (including landscapes and resources) might not only be changeable over time; but also, their relevance can be context-dependent; ii) different natural events can evolve in unexpected ways reflecting a partial control of humans in relation to nature; in some cases, nature might resist processes of capitalist expansion. In this regard, the biophysical characteristics and capacities (the materiality of resources) are plural and diverse; and the unpredictability of nature is not simply “capriciousness” but an important factor in the dynamics of human-nature relationships (Bakker & Bridge, 2006, p. 18) as the Uyuni salt flat in its three different materialities illustrates. This approach of multiple and dynamic materialities in constant interplay with changing social relations resonates with Bridge’ (2009:1220) idea that “what makes a resource (or not) tell us more about society than it does about the substance itself”. In the case of the Uyuni Salt flat, its history tells us how in its process of commodification and enclosure as a Fiscal Reserve, the way local communities and the State relate, contest and negotiate their interests is linked to different biophysical elements found in the salt flat. It also tells us about an extractivist legacy embedded in how this landscape is conceived and culturally and politically appropriated.

VII. Final remarks

This paper examined how the value and symbolic meaning of the Uyuni salt flat has changed over time in the communities of the southwest-region of Potosi. From perceptions of a worthless and isolated landscape to one of a vast richness of lithium, the way local people relate to the landscape is the result of the co-production of social relations in which the Uyuni salt flat and its materialities play a central role. The paper argues the Uyuni salt flat needs to be understood in three different forms: landscape, ulexite and lithium, since each specific materiality including its chemical features that form its mineral resources and its spatiality (isolated location and its geopolitical limits) are essential elements to understanding the social relations emerging and shaping this landscape.

Turning now to the empirical evidence, there is not a unified materiality in the salt flat. Both ulexite and lithium exist and are extracted from this landscape yet, the social relations emerging as a result are different. In the case of ulexite, mining has local relevance, its extraction can be cooperatively organised; whereas lithium is a State-controlled initiative based on advanced technological forms of extraction with little room for local interactions.

Second, with ulexite, the historical absence of the State has contributed to a peculiar form of resource governance that prioritises local arrangements with the less possible involvement from the State. By contrast, with lithium (considering its form of extraction and the strong nationalist narrative that sustains a state-managed governance) the different communities of the Uyuni salt flat seek to capture future revenues from its extraction rather than being involved in the extractive activity itself.

Third, in the interplay of society/nature production, symbolic meanings and cultural associations are essential in the reification of a thing to become a commodity. In the case of the Uyuni salt flat, the shift in the symbolic meanings attached to the landscape in the communities suggest that the commodification of a landscape and the discovery/making of evaporite resources is not isolated from past and present territorial configurations. Furthermore, the way local communities perceive and relate to this landscape is intrinsically linked to notions of securing access rights and claiming sovereignty.

These findings have implications for developing an argument about materiality of nature in socio-environmental changes. In the process of becoming a resource, there is not a singular nor indivisible nature. Each materiality presents different values and symbolic meanings for communities, mining actors and the Government, as well as different forms of contestation to manage and control of resources. The Bolivian lithium case provides a specific contribution to look beyond State capitalist expansion to examine more thoroughly the relationship between the State's instrumental use of natural resources to assert its dominance (Asher & Ojeda, 2009) and the symbolic and material elements shaping socio-environmental changes at local level.

In this sense, in what Bridge (2009) identifies as a tension between a subsistence versus an extraction logic, different stakeholders follow economic, political and cultural mechanisms according to how they relate to a particular aspect of materiality. The Uyuni salt flat illustrates

that as a landscape, the surrounding communities established a relation of subsistence that was later transformed with tourism. Following a commodification process, the landscape has been fragmented into touristic routes that include/exclude communities shaping social and power relations. Whereas with ulexite and lithium, the salt flat has been enclosed and is in permanent dispute as a Fiscal Reserve. The delimitation of the space, hand in hand with these materialities simultaneously shapes and is shaped by social relations following extractivist and nationalist logics to legitimized private forms of capitalist expansion (as in the case of ulexite) or a state capitalist project with lithium.

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Endnotes

ⁱ In October 2003, the Guerra del gas, or 'gas war' started when citizens' groups, the neighbourhood association FEJUVE (*Federación de Juntas Vecinales*) El Alto and other grassroots organisations opposed to the government's plan to export natural gas to the USA and Mexico via a Chilean port (Hinojosa et al., 2015).

ⁱⁱ The Environmental-Impact-Assessment is defined in the Mining Law and the RAAM (Mining-Environmental-Regulation). Only the Potassium-chloride plants have environmental licences and followed a consultation/information process with the communities of the salt flat. The lithium pilot-plant was defined as a

minor-impact mining activity and its licence followed an administrative procedure (Certificado-Dispensación Categoría-3) given by the Departmental Government in 2009.