A Novel Form of "Mine Water": A Lithium Brine Deposit Under Dry Salt Lakes (Salars) in the Puna Region of Argentina

Mark King[1], Waldo Perez[2], John Kieley[2], Frits Reidel[2], Eduardo Peralta[2]

[1]*Groundwater Insight Inc., 30 Oceanview Drive, Halifax, Nova Scotia, B3P 2H3, Canada, king@gwinsight.com*
[2]*Lithium Americas Corp., Ricardo Videla 8046, La Puntilla Lujan de Cuyo – Mendoza CP 5505 , Argentina*

Abstract This paper presents a unique form of mineralization, where reserve estimation and "ore" recoverability are determined by hydrogeological methods. At the subject site, lithium will be mined through the extraction of brine from two dry salt lakes (salars). The majority of lithium mining conducted in the world today is done in this type of setting, although there are relatively few active mines. The site is located in a desert environment in the Puna Region of Argentina, on the east side of the Andes mountain chain. This paper describes the unique hydrogeological aspects of this project, including: the geological setting, methods for calculating lithium reserves, and ongoing work at the site.

Key Words lithium, brine, salar, dry salt lake

Introduction

This paper summarizes an inferred resource estimate for a lithium and potassium in brine underlying the Olaroz and Cauchari Salars, two dry salt lakes in Jujuy Province in northwestern Argentina. The location of the salars is shown in Figure 1 and general morphology is shown in Figure 2. A full description of the site and the inferred lithium and potassium resource estimate is provided in the National Instruments (NI) 43—101 Report prepared by King (2010), and filed at sedar.com on behalf of Lithium Americas Corp.

Site Geology

The Olaroz and Cauchari Salars are contiguous (Figure 1), with a total length of approximately 150 km and a maximum width of approximately 25 km. The Cauchari Basin (which includes both the Olaroz and Cauchari Salars) is a horst and graben feature formed by high angle north-south regional faults, as shown conceptually in Figure 3. This fault system has also formed several other salars in the region. The bedrock in the vicinity of the Cauchari Basin is primarily composed of Lower Ordovician turbidites (shale and sandstone) intruded by Late Ordovician granitoids.

The sediments within the Cauchari and Olaroz Salars are "Silver Peak, Nevada" type terrigenous deposits. They consist of inter-bedded units of clays, salt (halite), sands and gravels, with a total thickness of up to 600 m. The salars contain the following three primary sedimentary units, as shown conceptually in Figure 3:

- Upper Mixed Sequence ("UMS") – This is the surface unit in the salars. It includes clays, thin evaporite facies (sodium chloride, mirabilite, soda ash, etc.), carbonate facies, ulexite facies and the coarse clastic sediments from the alluvial cones encroaching on the salars.
- Thin Bedded Sequence ("TBS") – This unit is at intermediate depth and is composed of thinly bedded clay, silt, sand and evaporite facies (mostly halite and gypsum). This sequence is coarser grained than the UMS which is dominated by clay.
- Coarse Bedded Sequence ("CBS") – This is the bottom salar unit and is the target aquifer for lithium brine recovery; it consists of thick inter-layered sand and evaporite (mostly halite) beds.

The groundwater within the salar sediments has become highly enriched in lithium and other salts, during arid climatic periods. The typical total dissolved solids content of the salar brine is on the order of 27% (324—335 g/L), with an average density of approximately 1.215 g/cm^3 Significant brine components include sodium, chloride, potassium, lithium, magnesium, calcium, sulphate and boron.

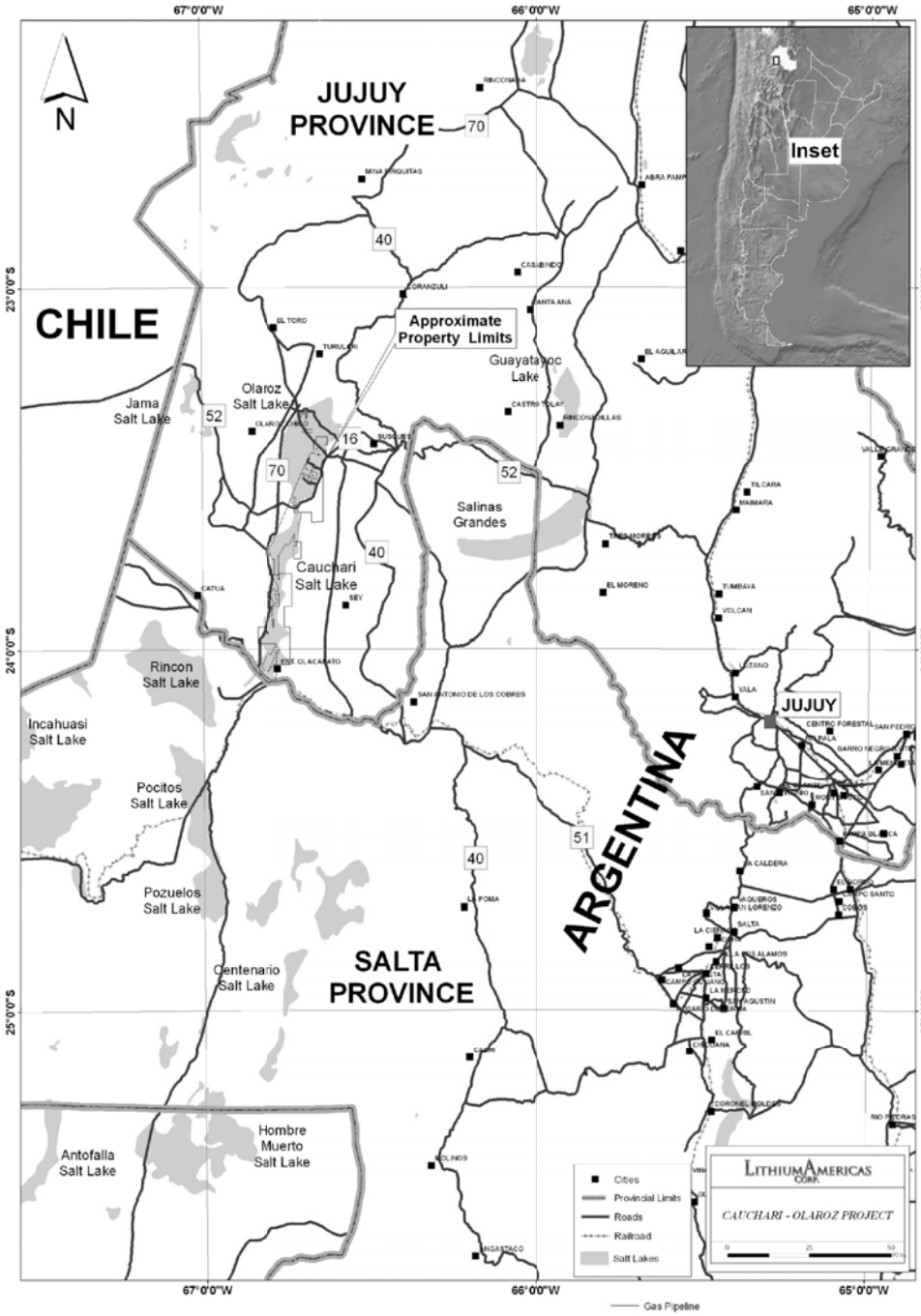

Figure 1 *Location map of the Olaroz and Cauchari Salars*

Figure 2 *Sodium chloride facies in the Olaroz Salar*

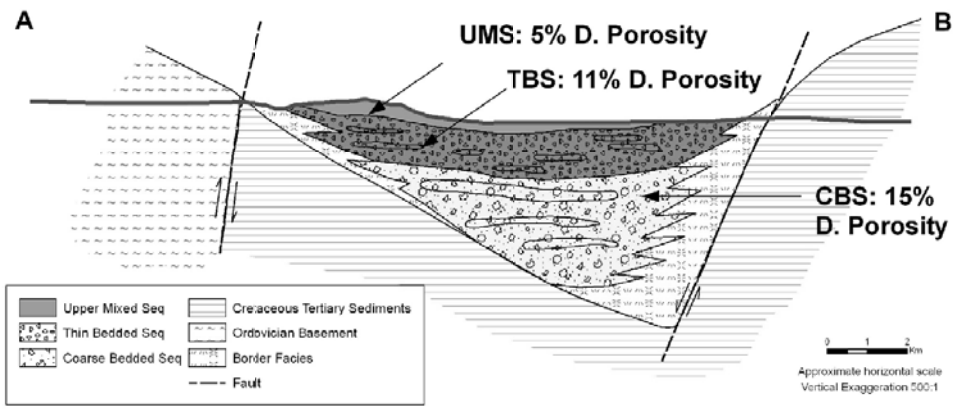

Figure 3 *Conceptual section of the Olaroz and Cauchari Salars*

Exploratory Methods

The following exploration programs were conducted in 2009, to evaluate the lithium development potential of the salars:

- Surface Brine Program – Brine samples were collected from shallow pits throughout the salars to obtain a preliminary indication of lithium occurrence and distribution. A total of 55 samples were collected for laboratory analyses.
- Seismic Geophysical Program – A seismic survey was conducted to support delineation of basin geometry, mapping of basin-fill sequences, and locating future borehole sites. A total of 24.7 km of seismic data have been acquired along seven lines.
- Reverse Circulation (RC) Borehole Program – Dual tube reverse circulation drilling is being conducted to develop vertical profiles of brine chemistry at depth in the salars and to provide geological and hydrogeological data. Nine RC boreholes have been drilled to date, for a total of 1 333 m of drilling. 760 brine samples were collected from the boreholes, for laboratory analyses.
- Diamond Drilling (DD) Borehole Program – This program is being conducted to collect continuous cores for geotechnical testing (porosity, grain size and density) and geological characterization. Five DD boreholes have been drilled to date, for a total of 1 280 m of drilling. Geotechnical analysis has been conducted on 113 undisturbed DD samples. The boreholes were completed as observation wells for future brine sampling and monitoring.

Conclusions

An inferred in situ resource estimate was prepared, based on analysis and interpretation of results from the exploration programs noted above. The following resource tonnages are indicated within the 1.6 billion m^3 of brine in the resource estimate zone:

- 926 000 tonnes of lithium metal or 4.9 million tonnes of lithium carbonate; and
- 7.7 million tonnes of potassium.

The north and south lateral boundaries of the resource estimate (i.e., along the longitudinal axis of the basin) have been constrained to north central zone of the Cauchari Salar, around the main cluster of existing boreholes. Since relatively high lithium concentrations occur at both ends of this zone, some extension of the resource is possible, based on future drilling.

Similarly, the bottom boundary of the resource estimate has been constrained to the depths of existing boreholes. These boreholes range in depth from 176 to 249 m, but have not yet encountered the bottom of the basin. Estimates from individual seismic lines indicate that the basin is between 300 and 600 m deep, depending on location. Consequently, the resource also remains open at depth.

Ongoing Investigations

A detailed follow-on work program is in progress and consists of the following key components:

- hydrogeological field investigations (drilling, sampling and pump tests) to further refine lithium and potassium distributions and to evaluate brine recoverability and long-term aquifer hydraulics;
- groundwater modelling of variable-density flow, to develop brine recoverability estimates and to support the design and operation of the brine extraction well field; and
- pilot-scale metallurgical assessment to support the design of the lithium refining process.

The goal of Lithium Americas Corp. is to begin construction of extraction and processing facilities at the site in 2012.

Acknowledgements

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References

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