Walter says, “Our consultants Montgomery & Associates first introduced us to Leapfrog. We could quickly appreciate the advantages of the easy file exchange with the flow and transport modelling software. This saves considerable time and enables us to easily incorporate valuable geological data, generating a better model and reducing our exposure to risk.”

THE PROJECT:

The Ratones and Centenario salars in the Salta Province of Argentina have deep lithium-bearing brine resources. Eramine Sudamerica, a wholly owned Argentinean subsidiary of ERAMET and a world leader in alloying metals, identified the lithium brine resource potential of the salars. They have been actively pursuing project development for production of commercial-grade lithium carbonate.

Since 2013, the geological team at Eramine, headed by Walter Rojas (Regional Geologist) in collaboration with Montgomery & Associates, has used Leapfrog to build the geologic model of the Centenario-Ratones project. They use Leapfrog Hydro to generate the grids, layers and hydraulic properties to be exported into their groundwater flow and transport modelling software MODFLOW and FEFLOW.

SITUATION

Lithium carbonate is an important industrial chemical compound with a number of applications. It is one of the primary materials used in the production of lithium-ion batteries, the dominant battery technology in electric vehicles. With an increase in electric vehicle sales, associated resource prices may well rise without new, cheaper lithium processing methods. The more economical extraction of lithium from brine has already dropped
the production costs of lithium-ion batteries by 65 percent since 2010. If this trend continues, by 2040, long-range electric cars will cost less than $22,000 USD, according to the projections, which could mean that 35 percent of new cars worldwide will have electric plug-in capability.

**Characterising lithium brine deposits**

In collaboration with Eramine, Montgomery & Associates - water resource and mining hydrogeology consultants, developed methodology to estimate the drainable brine resource using Leapfrog Hydro with groundwater model simulation results and GIS software. The subsurface brines in the basin are essentially liquid ore reservoirs (aquifers) that may contain economic concentrations of certain dissolved salts, such as lithium, potassium, manganese, zinc and boron. The brine aquifers are generally found associated with closed, arid basins in regions of playa lakes, known as salars in the South American altiplano “Lithium Triangle” region of Argentina, Chile and Bolivia.

Characterising a lithium brine deposit involves fewer steps, roadblocks, delays, time, surprises and capital compared to a typical hard rock deposit, which is estimated to cost double. However, unlike a hard rock lithium resource, a lithium brine resource is subject to aquifer properties parameters such as drainable porosity, storativity, and hydraulic conductivity that may limit its extraction potential. As first steps to characterise the drainable resource potential of a lithium brine aquifer, Montgomery & Associates developed methodology to characterise the brine resource using Leapfrog Hydro with groundwater model simulation results and GIS software.

**Dynamic 3D modelling**

Leapfrog assists with the early identification of a lithium brine deposit by modelling drilled intercepts of hydrostratigraphic units in 3D. Leapfrog also incorporates surface geophysical surveys for incorporation of basin boundaries, structure, and aquifer salinity relationships. Its dynamic engine facilitates incorporating new geological and geophysical data quickly and efficiently.

Prior to Leapfrog the Eramine team had used another geological modelling package that wasn’t implicit or dynamic. Explains Walter, “We quickly abandoned our earlier methodology in favour of Leapfrog. We felt that with Leapfrog we had increased confidence in our modelling.”

Walter Rojas, Regional Geologist, Eramine Sudamerica

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Walter continues, "We are currently simulating a production using FEFLOW and MODFLOW. Both software uses a grid, layers and hydraulic properties generated and exported from Leapfrog."

As experienced users of Leapfrog, Montgomery & Associates provide Eramine with model quality control, assurance, and verification. Daniel Weber and Megan Zivic, Project Manager and Project Hydrogeologist explain, "We've used Leapfrog for several years now. We find it to be an excellent tool for the early development of a numerical groundwater model that can easily interface and migrate into groundwater models such as MODFLOW and FEFLOW. We've used it on three separate lithium brine projects now and it's a tool we routinely incorporate in work plans as additional projects develop."

Since Eramine Sudamerica has used Leapfrog the geologic modelling is faster and more intuitive compared to previous methods. Walter explains, "Our flow and transport modelling grids are built in Leapfrog Hydro. We use its specialist tools to discretize our geologic units and define thickness and hydrostratigraphy. We are also able to upload key aquifer parameters such as hydraulic conductivity and drainable porosity. The grid edition is very simple and allows us to adapt, upgrade or refine the model many times. We did a very simple comparison between the same grid created in specialised gridding software and Leapfrog Hydro and in general it looks very similar and the exportation and importation process from and to FEFLOW (fem or dac files) is very fast."

Walter continues, "One of the most useful features of Leapfrog it that it only needs the contact type data between the different lithological units to generate a volume. The top, bottom or lateral contacts can then be easily modified using polylines. The linking with GIS files as shp. format also lets us share information with the main GIS platform. All the geology units were modelled based on the logs information data which allows many different text formats files. We also used Leapfrog Geo tools to solve some complex problems regarding the wedge shape of lithological units. FEFLOW grid and layering was automatically adapted in Leapfrog Hydro obtaining a good correlation regarding its thickness and areal distribution."

Walter adds, "Leapfrog is adding significant value to our modelling and we can see huge potential for Leapfrog in characterising lithium brine deposits for mineral resource and reserve estimation."

Leapfrog’s Latin American Regional Director, Ignacio Torresi concludes, "Leapfrog is a highly flexible modelling solution that is designed specifically for the geologist. Leapfrog allows users to better understand the underlying geology and its effect on flow. Leapfrog data can then be easily migrated into groundwater models to improve modelling. We're delighted that Eramine and Montgomery & Associates are experiencing these benefits using Leapfrog and we'll continue to work with them to help improve their geological modelling."

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Walter Rojas, Regional Geologist, Eramine Sudamerica