Fractures, lithium battery minerals and analytics

As society marches steadily in the direction of battery powered vehicles the demand for battery minerals such as lithium is rising. The "conventional" source of these minerals is from hyper-saline brines such as those of the Salar de Atacama in Chile. However evaporate deposits are not the only source. The other main source is lithium hosted in pegmatite deposits, with examples such as Bikita in Zimbabwe and King's Mountain in North Carolina, USA.

There is however a third way. For example, in the United Kingdom, metal rich saline brines are associated with the granites Cornubian batholith. These present an entirely different challenge in regard to characterization and extraction. The problem is one of hydrogeology and hydrogeochemistry rather than one of mine engineering. In terms of hydrogeology, the problem is actually one of flow in fractured rock rather than porous media. To adequately characterize these resources requires an understanding of natural fracture networks and fluid flow in fractured rocks. We can characterize these hydrogeological regimes through a conventional mixture of surface geological mapping, geophysics and borehole drilling combined with wireline geophysics and hydraulic testing. This data is then used to develop a geological model and a discrete fracture network (DFN) model using WSP's FracMan® code. Having developed the FracMan DFN model we can then start modeling flow and geochemistry to determine the optimum abstraction regime to pump the metal rich saline brine to surface from where the metals of interest, such as lithium, can be extracted.

FRACTURES

Why is understanding the fractures so important? Simply put, without understanding the groundwater regime and the water rock interactions any assessment of mineral reserve will be flawed. Understanding fluid flow in fractured rocks and characterizing the resource and reserve through the combination of DFN flow modeling and hydrogeochemistry is vital. Vital to quantifying the reserve and vital for designing the abstraction bores and pumping systems necessary.

Data analytics

So, what has data got to do with it? Defining an ore body traditionally relies on drilling thousands of metres of core, taking samples and assaying them with the limits of the ore body being defined by grade. A different approach is necessary for hyper saline brines in fractured rocks as the resource is a fluid. The optimal approach is envisaged to combine conventional hydrogeological and hydrogeochemical methods combined with big data analytics to draw together apparently disparate datasets relating to, for example, hydrogeological, geochemical, geomechanical, mineralogical and structural properties to provide confidence in our resource estimates.

The opportunities are there to be developed.

The WSP team would be pleased to hear your thoughts and continue the discussion.

CONTACT US

For more information about how we can help you deliver your next project, contact:

Mark Cottrell, PhD, MSc, BEng
Technical Director
Earth and Environment

mark.cottrell@wsp.com