V23D-3010:

Lithium and Beryllium By-product Recovery from the Round Top Mountain, Texas, Peraluminous Rhyolite Heavy Rare Earth Deposit

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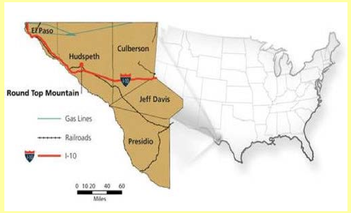

Rationale

The technology metals Li and Be combine low mass and unique desirable electronic properties. Li batteries are critical in applications at scales from micro-electronics to automotive and grid storage. Most Li is sourced from desert salars in the "Lithium Triangle" of Argentina—Bolivia—Chile. Low mass Be structural components are essential in aerospace/defense applications and in non-sparking BeCu alloy oilfield and industrial tools for use in ignitable atmospheres. In contrast to Li, Materion Corporation mines >80% of global Be at the aging Spor Mountain, Utah deposit.

Li and Be at Round Top Mountain

The massive peraluminous rhyolite heavy rare earth deposit at Round Top Mountain, TX is also enriched in Li, 500 ppm, and Be, 50 ppm. 2016 prices of $ 7000/ tonne Li_2CO_3 (19% Li) and $ 1000/kg Be metal suggest favorable economics to extract Li and Be as by-products of heavy rare earth element mining (HREE). Li and some Be are hosted in annite biotite that comprises up to 5% of the rhyolite. Texas Mineral Resources Corp. proposes to heap leach crushed rhyolite with dilute H_2SO_4 to release the yttrofluorite-hosted HREEs. At bench scale the annite biotite dissolves (as do yttrofluorite, cryolite, magnetite, hematite and other minor phases) but not the quartz and feldspars that comprise 90-95% of the rock.

Be mineralization zone at rhyolite-carbonate country rock contact. 300,000 tonnes @ 2% BeO. Photo of 300 m shaft from earlier study. Zone is distinct from Be extraction from bulk rhyolite in this poster.

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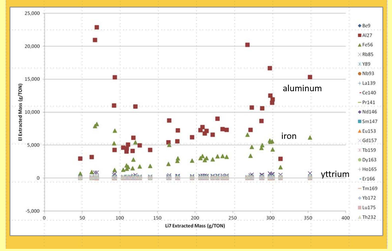
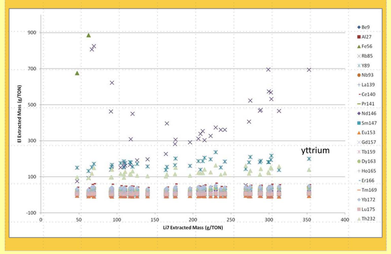
Lithium

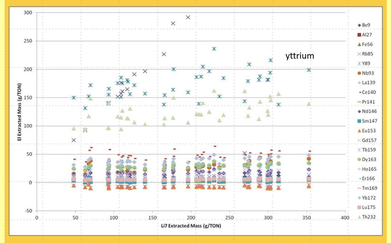


Li recovery into leach solution plotted against recoveries of other elements, some valuable, others gangue. Successive plots exhibit elements at lower concentrations.

Lithium



Lithium



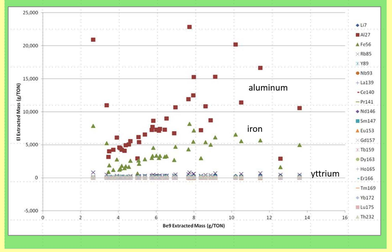
Round Top Mountain, virtually all of which is mineralized rhyolite

Leach Technique & Results

A series of 40 high-yield laboratory bench scale leach tests at various acid strengths, particle sizes, and exposure times released up to 350 ppm (70%) of the Li and 14 ppm (30%) of the Be. For a 20,000 tonne/day operation, these recoveries correspond to optimal daily production of >7 tonnes Li (35 tonnes Li_2CO_3) and 250 kg Be.

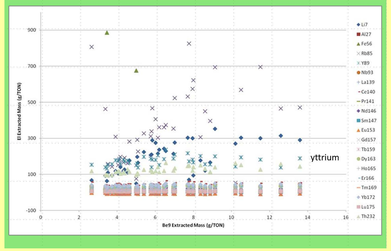
Higher Li and Be recoveries also increased yields of gangue elements, principally Fe and Al, into solution. This complicates subsequent separation of Li, Be, and HREEs from the pregnant leach solution (PLS). Recovery of target YHREEs did not increase beyond conditions yielding ~ 200 ppm Li and 8 ppm Be recovery. Higher Li and Be recoveries increased acid consumption. Thus the "sweet spot" economics for a heap leach is likely under conditions of acid strength, grain size, and exposure time that do not maximize by-product Li and Be recoveries. Evolving market prices for the full target element suite and added costs to recover the Li and Be from the PLS and purify them must also be considered.

Beryllium

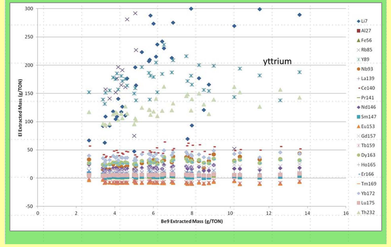


Be recovery into leach solution plotted against recoveries of other elements, some valuable, others gangue. Successive plots exhibit elements at lower concentrations.

Beryllium



Beryllium



About the Round Top Deposit

Round Top Mountain is a massive peraluminous rhyolite, exposed at the surface in Sierra Blanca, Hudspeth County, west Texas, USA. The rhyolite is enriched in yttrium and heavy rare earth elements (YHREEs), with other potentially valuable elements including Be, Li, U, Th, Sn, F, Nb, and Ta. The deposit is some 2 km in diameter and nearly 300 m in height, with an estimated mass of 1.6 billion tonnes (Texas Bureau Economic Geology). The grade of the deposit is just over 0.05% total Y+REEs of which an extremely unusual 72% is YHREEs. Although some might consider this grade sub-economic, it is in the range of the South China ionic clay deposits that supply essentially all of the global YHREEs. Reverse circulation cuttings from some 100 drill holes, two drill cores, and outcrop and trench observations suggest striking physical homogeneity through the deposit. This would ensure a constant feedstock for mining and extraction, an important economic advantage since mining and separation procedures would need to be developed and optimized only once.

Texas Mineral Resources Corp. proposes to extract the YHREEs from the host mineral variety yttrofluorite by inexpensive heap leaching with dilute sulfuric acid, which also releases some of the Be, Li, U, F, and Th from other soluble minor minerals. This drives our interest in the potentially valuable byproduct critical elements Li and Be.

"Unlocking a National Treasure"