

Medallion Resources: Our Top Stock For 2016



By Ben Kramer-Miller | December 9, 2015



This report should be read in conjunction with [my audio interview](#) with CEO Don Lay and Chief Technical Adviser Bill Bird. I suggest you read my article "[What the Rare Earth Industry Faces](#)" as well.

1: Overview

Medallion Resources (TSX.V: MDL) (OTCPK: MLLOF) has the lowest risk non-producing project in the REE-space, and we believe that it is the only viable project in the REE-space that isn't dependent on new technology or by-product credits.

Medallion is developing a business based on extracting REEs from the monazite sand found in heavy mineral sands tailings. Monazite sand is a rich source of REEs, yet large mineral sands mining companies don't find it worthwhile to extract the REEs themselves because the market is small and specialized (such a pursuit would be akin to BHP pursuing a \$50 million project that takes years to develop—it simply won't happen). So it makes perfect sense for small entrepreneurs to come in to do this processing.

Despite this observation, the proposed strategy is uncommon among REE juniors, who are exploring and developing hard rock deposits. Nevertheless it should be: generally speaking, **the monazite sands strategy is superior to the conventional mining strategies**. We cite the following reasons:

- Monazite sand has a very high REE content relative to every single known REE deposit. While grade doesn't correlate exactly with operating costs it is a very good indicator.

- Medallion can be flexible in ways one cannot be when mining a deposit. First, the company can source monazite from several sources. Second, it can locate its processing plant based on the relative ease with which it can comply with regulations, hire qualified workers, easily obtain reagents...etc. Practically speaking, this last point means that it can place its plant in an area where it is easy and cost-effective to comply with radioactive waste disposal regulations (This should be far and away the top deciding factor). Meanwhile, mining companies cannot simply ship raw 1-3% TREO Eq. ore across the world without one or more beneficiation steps, which greatly restrict where they can do their mineral processing. Third, Medallion can scale its project according market conditions when it looks for financing. This last point reveals a source of hidden leverage that is limited when operating a mine.
- The strategy is less expensive to finance than mining projects since it requires no mining or beneficiation. These initial steps are carried out by the supplying parties as a part of their other operations (the monazite ore will be delivered to Medallion as a high grade sand).
- The operations can be expanded very easily because the proposed project is more akin to a chemical plant than a mine. While a mining company can develop a second mine, it will have to go through the entire process (exploration, resource definition, PEA, PFS, FS, advanced engineering and then development). All Medallion has to do is secure an additional monazite sand supply and permit/build the second facility (and there's no reason why it can't be next door working with the same engineers, regulators, construction workers etc.). This provides incredible optionality that goes well beyond REE-price leverage and that is unique to Medallion's monazite strategy.

While Medallion is not the only company claiming to be pursuing this strategy it has a tremendous advantage over neophyte competitor Pele Mountain given its 3+ year head start. Numerous conversations with CEO Don Lay and Chief Technical Adviser Bill Bird have revealed that over these years the company has acquired both knowledge and contacts that will be essential to developing the business. Such hurdles can only be overcome with time and effort, regardless of how much money one has at one's disposal. The importance of this can only be factored in when we consider that REE companies in the West understand very little relative to the Chinese, and the development of even what are relatively simple projects come with the added difficulties that come with inexperience.

The company's stock is also relatively inexpensive with a price of just C\$0.03/share and 73.9 million shares outstanding. While REE stock prices have lost tremendous value Medallion's valuation is particularly low. We're not sure why people are buying particular REE-stocks, but if there is any logic behind most of the bullish cases for these stocks it is the perceived embedded optionality in the in-ground ore. Medallion isn't developing a deposit (it actually has an early exploration project in Labrador whose optionality value is negligible) yet we will see it's model incorporates other forms of optionality that are arguably greater than that realized by owning in-ground ore. More importantly, the company has an economic project in today's market environment. There is a lack of such projects, yet for some reason there are plenty of investors willing to put their money in clearly uneconomic projects (e.g. Northern Minerals, which has the highest valuation of any REE-junior, and which is likely going much lower).

The market valuation reflects the fact that investors do not understand the incredible advantage that Medallion has with respect to its peers given these attributes. In fact, it has the lowest valuation of any REE company. Once investors realize that Medallion is a front-runner rather than a laggard the stock price will rise to reflect this reality. It is safe to say that the potential return on an investment today is extraordinary. **Note that most REE companies are trading at valuations that are 5-10 times higher despite the fact that they have relatively high risk projects that don't make sense given current prices.** Even the most valuable companies—Ucore and Northern Minerals—are all working on projects whose economics are horrific in today's market environment. There's no reason why Medallion should trade at a discount to virtually all of its peers, yet several justifying a premium valuation for the space

2: Management

REE management teams in the West face an incredible challenge of competing with the Chinese, who conscientiously manage a global RE value-chain oligopoly. This oligopoly is more than just the result of a geological accident (even though the Chinese are well-endowed with rich REE-resources). It comes from decades of industrial development, no doubt through countless iterations of trial and error. Few people outside of China have built or operated an REE processing facility, and many of those who have did so decades ago.

Therefore it is critical that any REE management team be armed with as much experience and technical knowledge as possible. Technical Adviser Bill Bird has over a decade experience in the REE space from the industrial side as well as added experience/interest in REEs as an academic. The team of advisers he has chosen is weighted towards scientists with expertise in geology and mineralogy, including specialization in REEs.

Evidence that the company has built a quality team goes beyond generic “experience” and academic accolades. The company has been developing the monazite sands strategy for more than 3 years, and while this period is peppered with missteps we’ve seen tremendous progress that has led to a barrage of recent accomplishments that go unacknowledged by the market. These include: (1) the appointment of a company to [source monazite](#) in southeast Asia, (2) the [production of a REE concentrate](#) at bench-scale starting with the sourced monazite and using techniques that have been proven at commercial scale, and (3) the [acceptance](#) of this REE concentrate product by potential clients in the solvent extraction business, and (4) the [production of a phosphate by-product](#) that will add a cost-free revenue stream.

3: Strategy

The company’s strategy is as follows:

1. Buy monazite sand
2. Extract a RE-concentrate from the monazite sand
3. Sell the RE-concentrate
4. Dispose of radioactive waste

Buy Monazite Sand

Medallion Resources isn’t mining a deposit—it is buying the monazite tailings of another mine or group of mines. Monazite doesn’t occur in mineral sands at an economic grade: it requires the beneficiation of another mineral sands mining operation. The monazite occurs in the mineral sand at ~0.05%, it follows the zircon, which is an economic product itself, through beneficiation. An 80% zircon/20% monazite product (with some trace minerals, including REE-mineral xenotime) is disposed of, although it is effectively stockpiled, and the mining companies in the heavy mineral sands world are well aware of the potential value of this tailings.

The company hasn’t yet picked a source of monazite, although it has appointed a company—GHC Minerals—to source monazite tailings from southeast Asia. When choosing sources the companies will be focused on long-term source security, REE concentration/distribution, and cost.

The most important aspect of choosing a monazite source is supply security: management needs to be sure that the chosen supply sources can last for a long period of time and come with minimal supply disruption risk (e.g. as a result of political tension). It follows that the selection should be located in a relatively stable jurisdiction, and it should have a long life. Specifically, the company has decided to look for sources of monazite tailings from operating mines that have long lives, and this makes sense given that the monazite stockpile doesn’t deplete.

Regarding REE distribution, monazite is 50-60% REEs. It mostly contains LREEs, with ~65% lanthanum and cerium (borderline waste and waste, respectively) and maybe 20% – 25% praseodymium and neodymium. These two are much more valuable at \$50/kg and \$40/kg for the oxides, and will comprise the bulk of Medallion’s revenue. They are also among the most marketable REEs given that they are essential in neodymium-iron-boron permanent magnets. Dysprosium and terbium—which are added to NdFeB permanent magnets in order to increase their coercivity—will also generate a fair amount of revenue for Medallion (~20%). These materials come in small amounts but have high values. There is almost no production of either element outside of China, meaning that these are at risk of a supply shock more so than the LREEs, which are produced by Lynas.

The REE distributions of different monazites will vary only slightly, but REE distribution is important considering the potential value of a small increase in the four main elements in Medallion’s prospective revenue stream.

To get a general idea of a realistic monazite REE distribution we can look pro forma REE distribution data [compiled by the USGS](#).

REE	Pro forma Distribution
La	24.40 %
Ce	46.55 %
Pr	5.77 %
Nd	18.02 %
Sm	2.37 %
Eu	0.03 %
Gd	1.01 %
Tb	0.10 %
Dy	0.42 %
Y	1.26 %
Er	0.08 %

Note that negligible amounts of the other REEs (Ho, Th, Yb, Lu) and similar element Sc do not appear in significant quantities in most monazite deposits. They are also extremely difficult to sell except in small quantities.

Regarding the monazite price, the company will be paying a small amount relative to the REE-value of the monazite—let’s say 15%. The effective rate rises to ~16.5% when we consider that the company’s recovery rate is estimated to be 91%. This will cover the cost of beneficiating the 80% zircon/20% monazite to a relatively pure monazite sand with some zircon, xenotime, and trace amounts of other minerals. At current prices this basket has a fully separated value of \$13.16/kg., meaning that Medallion should expect to pay **\$2.14/kg.** of TREO equivalents.

The company will also have to pay to have the monazite sand shipped. I estimate that this will cost ~\$800/t or \$1.70/kg. of TREO, bringing the total cost of monazite to **\$3.84/kg.** of TREO. This assumes shipment by boat from SE Asia and then by truck to the plant which will be in the central part of North America. However, this shipping cost estimate may be conservative given the company’s flexibility to locate its processing facility near a rail line (rail is much cheaper than truck).

Extract REEs From the Monazite Sand

Medallion has an enormous advantage in that it doesn’t have to mine. This eliminates costly pre-mine development, permitting, and mining equipment expenses. Furthermore, since the company is buying sand it doesn’t need to crush ore prior to leaching. Finally, it doesn’t have to beneficiate the ore, which is already high grade. So Medallion investors can fast-forward through the drill-blast-haul-

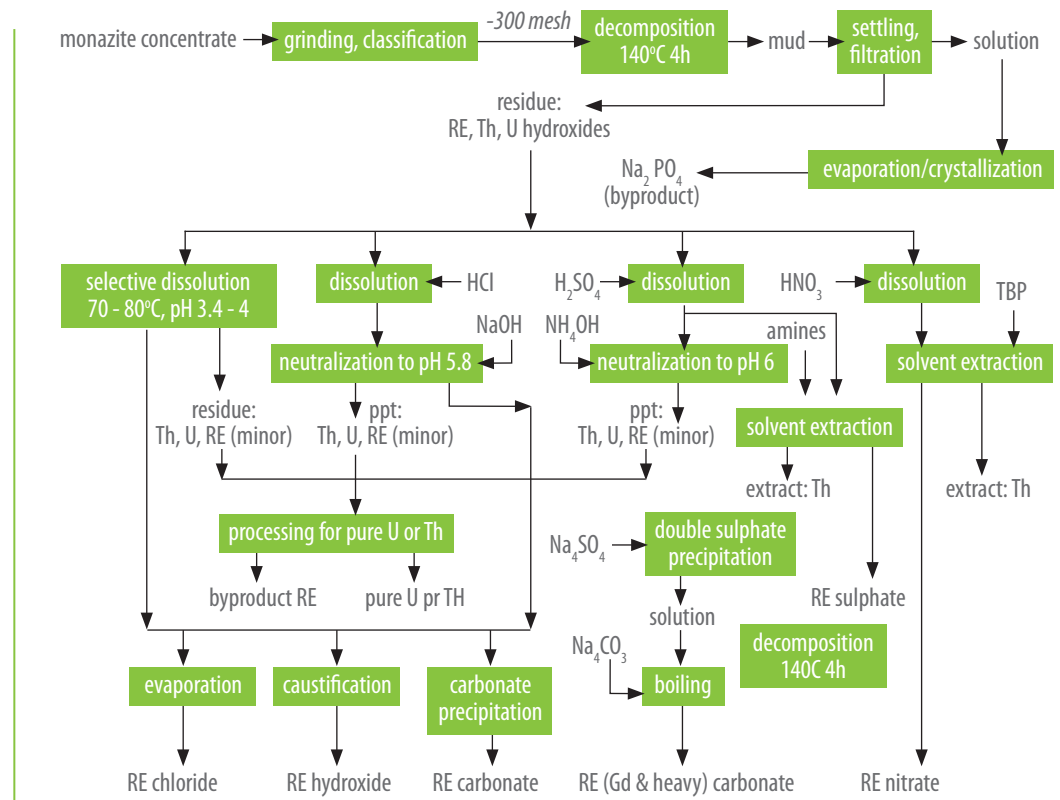
crush-beneficiate part of the process and start at monazite cracking. The REEs will be extracted from monazite sand using readily available reagents and technology that has existed and been used to economically extract REEs since the 1950's. The process is **alkaline digestion**, which basically means that the company will take the monazite and dissolve it in sodium hydroxide (NaOH) at an elevated temperature (~140 degrees Celsius). Monazite is a REE phosphate (REE-PO₄) (with REE being a rare earth element (or yttrium) with some thorium substitution (about 5% of the time)), and when alkaline digestion occurs the REE/Th ions are dissolved in the alkaline solution while sodium phosphate is precipitated. From here it can easily be removed, and by introducing lime a calcium phosphate animal feed product can be produced that is worth ~\$400/tonne.

The dissolved Th (with small amounts of uranium) then needs to be removed, and so hydrogen chloride is added in order to precipitate the Th/U. Depending on the final desired REE concentrate product the remaining REE chloride solution can be further treated. Medallion likely intends to market a REE-carbonate concentrate, as this is the standard intermediate feedstock product of separation companies with which management has spoken. Therefore, I suspect that the current plan is to precipitate the REEs by adding sodium carbonate (Na₂CO₃).

Again, this process is nothing new: in fact, a more generalized version of this process is illustrated in a flow-sheet found in the canonical Extractive Metallurgy of Rare Earths (Gupta and Krishnamurthy, 2005).

Monazite Processing by Alkali Treatment

Generalized flow diagram for solvent extraction of REE, Th and U from monazite using ALKALINE decomposition (140°C) followed by separate treatments for insoluble precipitates by CCl₄ (left leg) and NaOH solutes by nitric acid (right leg), where phosphate content of monazite is recovered as a byproduct of trisodium phosphate (Gupta and Krishnamurthy 2005).



Processing monazite should cost ~\$3.3/kg. given estimated costs for labor, reagents, power, SG&A, and a 10% contingency. We should note that the most recent testwork has been more focused on making the process work than on optimizing it, and there are places where the company may be able to reduce costs. For instance, Bill mentions that Medallion might be able to cut reagent costs by recycling them. Since reagents should account for nearly half of the total operating costs, there may be significant room for savings.

Cerium Removal

Cerium's value has fallen so dramatically since the 2010/11 peak that it has essentially become a waste product: it costs more to extract and process than what it is worth on the market. Cerium also happens to be relatively easy to separate early from the other REEs. If the company takes the extra effort to remove cerium from its REE concentrate its basket value will rise considerably. Ce removal can easily be achieved through oxidation of Ce(III) to Ce(IV) and then selective precipitation. We don't have an opex estimate for this process, although it is considerably simpler and probably cheaper than solvent extraction, meaning that this extra effort could be extremely worthwhile. Note that the company has not publicly addressed this issue, yet cerium removal is such a trivial notion at this point that we speculate that Medallion is certain to explore this possibility.

Lanthanum removal is another option, although this is a less attractive proposition than cerium removal based on every major metric (metal value, ease of extraction, concentrate volume reduction etc.). This doesn't mean it isn't an attractive proposition.

Sell an REE Concentrate

The final step is selling an REE concentrate to a separation company, or to have the refining company carry out the separation on a tolling basis. Given that the bulk of Medallion's revenues will presumably come from the most marketable REEs (Pr, Nd, Tb, Dy) the difference between the two should be relatively negligible, since no tremendous marketing effort will have to be made by the selling party.

Medallion is exploring potential business relations with companies that are capable of separating REEs using solvent extraction, the primary technology used to separate REEs. We note several potential customers for Medallion's concentrate:

- Molycorp, which has spare capacity at its Oxides and Chemicals division given that Mountain Pass is in care and maintenance.
- Lynas could potentially increase LAMP capacity, and we suspect that Medallion's approach produces a concentrate more efficiently than Mt. Weld.
- Solvay likely has spare toll separation capacity.

Medallion is also exploring alternatives, although none of these has been developed to the point where they have sufficiently proven quantifiable inputs for Medallion's low-risk model. It is worth noting that if any of these companies develops a substantially cheaper separation process that Medallion is a potential beneficiary, since it should be able to realize more for its concentrate relative to its fully separated REO-equivalent value. For instance, if an SX company has costs plus margins of \$5/kg. for Medallion's concentrate and a company using a new technology can get this down to \$3, the latter company can pay a higher price to Medallion in a give REE-price scenario.

Separation pricing is a complicated issue for a couple of reasons. First, LREE separation is cheaper than HREE separation using SX (Y is classified here with the HREEs). Based on informal inputs from a few sources we're assuming that separation costs \$4/kg. for La-Nd and \$8/kg. for the rest of the REEs/Sc/Y. Second, the economics of separating individual elements varies, and an SX company is going to value a concentrate from Medallion or from any other company based on the value of separating each individual product. This means, for instance, that it is going to value a concentrate with a significant cerium component lower than the same concentrate minus the cerium—even though the cerium has market value—because separation costs more than this market value. This also holds true for lanthanum, samarium, and yttrium. Gadolinium is on the border.

Based on that we have come up with the following valuation estimate for the pro-forma monazite-derived RE-concentrate. We've shown both the value of the separated oxides (the prices that you see printed by Asian Metals, Metal Pages etc.) and our estimated value of the oxides in the concentrate given separation costs. The basket value here is more important than the oxide prices because this is Medallion's (or pretty much any monazite-derived REE-miner's) benchmark if its goal is to manufacture a mixed concentrate.

Phosphate By-Product & Radioactive Waste

The company will be producing a phosphate by-product. Phosphate makes up ~25-30% of monazite or roughly a third of the REE content. The product is worth ~\$400/tonne, and the company will be producing 4,150 tonnes in the 3,500 tonne of REO scenario, and 11,830 tonnes in the 10,000 tonne REE scenario.

The company will also be producing radioactive waste: mostly thorium with small amounts of uranium and radium. The company has not yet worked out the details, however management has decided to place its processing facility in central North America where there is a lot of uranium production and oil and gas processors that deal with such waste streams, meaning that there is preexisting infrastructure and policies in place that minimize the risk that Medallion won't be able to dispose of its radioactive waste safely and efficiently. Ideally Medallion can sell its waste stream to a company that can extract the uranium—a marketable product—thereby offsetting the cost of thorium disposal.

4: Project Size

Medallion's team has put forward a project size of 10,000 tonnes of TREO output per year (includes Ce, La). However the lousy market coupled with the project's flexibility means that management is likely considering a smaller—3,000 – 4,000 TREO output per year—project. Fortunately, this is not a big deal: the Medallion project is one that is relatively easy to scale up or down in response to changing market conditions. While smaller projects will generally have less attractive economics they will also attract financiers given that they require less capital. This is something that will be worked out between Medallion and its potential financiers. Since a small project is economical, and since the resource market is so lousy we assume that only the smaller project is viable at current prices from a practical standpoint. However, should the market recover, even just a little (We assume +30% after a 95% decline) both project sizes demonstrate robust economics, and financiers would be more willing to support the larger project.

5: Project Valuation

Medallion's proposed project is economic at today's REE prices. Given that we believe current prices are unsustainable for the long-term we have also taken into consideration the project's valuation with REE-prices 30% higher than today's prices.

REE	\$/kg	Distribution	ConValue/kg	RefinVal/kg	RefinConValue
La	\$2.44	24.40%	\$0.60	\$(1.56)	\$(0.38)
Ce	\$2.21	46.55%	\$1.03	\$(1.79)	\$(0.83)
Pr	\$64.35	5.77%	\$3.71	\$60.35	\$3.48
Nd	\$53.95	18.02%	\$9.72	\$49.95	\$9.00
Sm	\$2.54	2.37%	\$0.06	\$(5.47)	\$(0.13)
Eu	\$123.50	0.03%	\$0.03	\$115.50	\$0.03
Gd	\$14.95	1.01%	\$0.15	\$6.95	\$0.07
Tb	\$497.90	0.10%	\$0.51	\$489.90	\$0.50
Dy	\$283.40	0.42%	\$1.20	\$275.40	\$1.17
Y	\$5.33	1.26%	\$0.07	\$(2.67)	\$0.03
Er	\$40.30	0.08%	\$0.03	\$32.30	\$0.03
Total		100.00%	\$17.11		\$12.90

We've devised three scenarios that will help us better understand the project's valuation. The first assumes current prices, 3,500 tonnes of TREO Eq. production per year. The second two both assume that prices rise 30%: one assumes 3,500 tonnes of TREO Eq. production, and the other assumes 10,000 tonnes. We suspect that the hydrometallurgical plant cost estimate is conservative, and despite the fact that this figure is lower for Medallion than mining companies by a magnitude or more, keep in mind that it is only developing a chemical plant. We estimated \$1 million for a pilot plant and administrative expenses for 2016 and note the company's incredibly low burn rate as capital is scarce in this environment (figures are in Canadian Dollars).

	2015	2014	2015	2014
Expenses:				
Consulting Fees	\$26,688	\$34,480	\$94,555	\$97,280
Depreciation	\$39	\$108	\$118	\$216
Investor Relations	\$30,276	\$33,751	\$69,286	\$68,706
Management Fees	\$55,821	\$67,719	\$123,557	\$134,974
Office and General	\$4,653	\$20,437	\$24,011	\$57,911
Professional Fees	\$24,587	\$24,842	\$41,785	\$39,289
Project Investigation	\$19,112	\$35,865	\$24,621	\$129,436
Rent	\$3,465	\$3,465	\$6,930	\$9,831
Share-based Compensation	-	\$442	\$4,034	\$11,514
Transfer Agent and Filing Fees	\$7,794	\$12,535	\$16,162	\$23,312
Total	\$172,455	\$233,644	\$405,059	\$572,469

The actual cost of the pilot plant will vary depending on the various scenarios management wishes to analyze.

We didn't calculate the project's value in a lower price environment: despite the fact that the project is economic in the current market environment it is highly sensitive to REE prices, meaning that a small decline could put the project on hold. We will therefore factor in a zero-valuation scenario when valuing the company below.

	Scenario 1	Scenario 2	Scenario 3
Basket Value (kg)	\$13.16	\$17.11	\$17.11
Revenue (kg)	\$8.95	\$12.90	\$12.90
REE-Revenue	\$31,328,438	\$45,148,312	\$128,995,178
Costs:			
Monazite (kg)	\$(2.17)	\$(2.82)	\$(2.82)
Shipping	\$(1.70)	\$(1.70)	\$(1.70)
Processing (kg)	\$(3.30)	\$(3.30)	\$(3.30)
OCF/kg.	\$1.78	\$5.08	\$5.08
OCF	\$6,227,508.00	\$17,767,102.00	\$50,763,150.00
Phosphate			
\$/tonne	\$400.00	\$400.00	\$400.00
Cost	\$90.00	\$90.00	\$90.00
OCF/tonne	\$310.00	\$310.00	\$310.00
Volume	4150	4150	11830
Phosphate OCF	\$1,286,500.00	\$1,286,500.00	\$3,667,300.00
Total	\$7,514,008.00	\$19,053,602.00	\$54,430,450.00
Initial Capex	\$(20,000,000.00)	\$(20,000,000.00)	\$(50,000,000.00)
Project Life (years)	25	25	25
Discount Rate	10%	10%	10%
Pre-tax NPV	\$38,929,709.00	\$125,496,126.00	\$366,088,737.00
IRR	35%	87%	105%

We should note that there are additional sources of cash-flow that are not factored into this model.

- Reagent recycling: I estimate reagent costs to be ~\$1.30/kg. TREO Eq. on reagents (sodium carbonate, hydrochloric acid...etc.). If the company can reduce reagent consumption via recycling (a hypothesis that hasn't yet been tested) then it can reduce its operating costs.
- Cerium removal, which we've discussed above.
- Lanthanum removal: Lanthanum is another waste product that costs more to separate from a concentrate than it is worth. Medallion could find a way to remove it from the concentrate that is cheaper than sending it to the SX facility.

6: Risks

We've seen that the monazite strategy is less risky than competing strategies for many reasons. Nevertheless, Medallion faces many challenges going forward.

Financing: The company is going to have a difficult time raising pre-development funds given weakness in the resource space. Furthermore, any capital raise at or near the current valuation is going to be highly dilutive. The company will need to raise money for a prefeasibility study (or equivalent), a pilot plant, and a full feasibility study (equivalent).

REE Pricing: Prices remain in a cyclical bear market. While the recent Mountain Pass shutdown could catalyze prices higher, overcapacity and economic weakness could continue to pressure them. The good news is that Medallion's costs will be among the lowest in the industry, but even this isn't necessarily enough to ensure the project's viability.

Concentrate Value: Note that this is different from REE-values, since the concentrate value is a function of both REE-prices and separation costs. Separation costs could rise if REE-prices rise (a good scenario but Medallion's leverage is diminished) or if input costs rise.

Operations: We cannot stress the extent to which Medallion's project has been de-risked from an operations standpoint both on a relative basis and in general. First, we've seen how the company can avoid several steps to which mining companies will have to devote a substantial amount of time and capital with no guarantee of success. Mining, more generally, is risky given that while you could think you have a good understanding of the geology you may not (think Midway Gold). Monazite is a mineral with highly predictable attributes (and Medallion's contracts will guarantee that any monazite it buys meets certain specifications, no doubt in part complying with metallurgical standards that minimize uncertainties with respect to REE-distribution and deleterious material composition (e.g. minimize Th-content)). Second, the monazite strategy utilizes only technologies that have been proven at scale and that are being used today. Third, Medallion will likely be able to recruit experienced individuals for select key positions. Fourth, even for those without direct experience REEs and uranium have similar metallurgy, meaning that those metallurgists in central North America from the uranium industry should be qualified to operate and/or oversee the plant. We have to note, however, that there are going to be operational uncertainties with any start-up operation, and that cash-flow figures during the first several quarters could be disappointing when we compare them with estimates.

Medallion Doesn't Actually Own REEs: This is really just a perceived risk but it is worth discussing. Investors might mistakenly believe that just because Medallion doesn't own a deposit of REEs that it is missing out on leverage. After all the cost of monazite rises if the contained REE-prices rise, and in a price spike we could see a mineral sands company demand a larger percentage of the REE value, especially since Medallion's failure to comply could open the door for a competitor willing to accept a smaller margin. Nevertheless we've seen that the company has tremendous leverage if prices rise even a modest 30%. We will see that there are other ways for the company to leverage a stronger REE-market. Some are unique to Medallion precisely because it doesn't own a mine. We have also seen that the attractiveness of the business at first glance masks the underlying difficulties that face newcomers, meaning that any prospective competitors are likely years away from being able to enter the market. Where there is risk regarding this is that REEs and REE-bearing minerals are considered strategic resources by governments, meaning that we could see monazite export restrictions (we already have these in India and Brazil) that directly impact Medallion, whose strategy is to export monazite from one or more of the few countries that have a lot of it. Even then there is monazite in several countries, including the United States.

Monazite Sources



7: Company Valuation

Investors need to consider three factors when valuing a company such as Medallion. The first is the project's valuation, which I calculated to be \$43.8 million at today's prices. The NEV/NPV ratio is going to vary widely with each trade in Medallion's stock since it trades with such a wide bid/ask on a percentage basis, but it is roughly 5%. The second consideration consists of the intangible factors: project optionality and the potential for expansion once the first plant is up and running. Finally, we need to figure out the risk that the stock is worthless. This is an "all or nothing" bet, meaning there's no reasonable scenario in which Medallion can be a viable business and be worth less than it is today, so all scenarios that aren't successes will be valued at zero.

If we assume today's REE prices, then Medallion's project has a pre-tax NPV (10%) of \$43.8 million. We would like to be highly confident in this figure but admittedly have to be presumptuous with some of our inputs since we don't really know what things will cost until the company actually pays for them. Still, several inputs were conservative. Meanwhile, there are ways in which the company can improve its margins. With that in mind, and given the other project advantages discussed above, a 5% NEV/NPV multiple is too low. If this were a project focused on a more common resource such a low-risk project in the development stage would be at least trade at half of its project's NPV. Given that this is the rare earths space and that there is a presumed "opacity discount," I'm using a 25% multiple, or \$11 million.

Regarding the project's optionality, let's first take a step back to observe that virtually all of the real value in the REE-junior sector is in this optionality. The mining projects are generally uneconomic as a group considering the precipitous decline in REE-prices. Consider that most of these companies saw their largest two products—lanthanum and cerium—become waste (for HREE projects yttrium is also a waste product at \$4.10/kg.). But because REEs are so critical—especially in the West—there is a firm belief among remaining investors that prices will rebound.

Given the fact that in recent years no market has suffered as large a decline as the REE-sector, and given its criticality, we believe the presence of discounted optionality is a legitimate reason to bet on the REE-space. However, the real potential is misunderstood: the market has mistakenly placed its bets on mining companies to get this leverage. Investors assume that if REE-mines have stable costs and if REE-prices rise that they will get a leverage that is correlated to the project's costs (which are, at

this point, only hypothetical). Based on companies' various economic assessments, if we take prices meaningfully higher from here these projects are worth hundreds of millions, if not billions of dollars vs. today's valuations of \$10-\$20 million. Assuming these guys do what they say they can there is incredible leverage here.

However, these companies simply don't have the leverage that Medallion does, although it isn't immediately apparent. We will note four sources of "optionality" or financial benefits from a rising REE-price.

First, Medallion will directly benefit as REE-prices rise in that it will see its margins rise, although the benefit is dampened somewhat by the floating cost of monazite. The dampening effect is minimal however: if REE-prices rise just 30% from here the project's NPV grows nearly 4-fold.

Second, as REE prices rise Medallion's project is more likely to succeed, meaning that it makes sense for the market to ascribe a higher NEV/NPV multiple. This is a function of market sentiment so it is difficult to predict. We're assuming 40%, which is low for a project such as Medallion's.

Third, the probability that Medallion will develop the larger project grows as REE-prices rise: the economics of the project improve so financiers feel more comfortable lending them money and more eager to own the options and warrants that will be tacked on as a bonus. If management pursues the 10,000 tpa. project—which would be preferable given its higher NPV and IRR with respect to the 3,500 tpa. project—the value of the project grows 11-fold. This is a source of optionality that is largely unavailable to mining companies, who are restricted in their production by constricting geologic, infrastructural, and permitting factors.

Before discussing the fourth source of optionality let's look at the incredible value potential we've just revealed. If we increase the NEV/NPV multiple to 40%, increase REE-prices 30%, and grow the project to 10,000 tpa. the project is worth \$146 million. This is hardly an unlikely scenario given everything we've just seen, yet even if we ascribe just a 5% probability to it we get \$7.3 million in value.

Finally, if the company is able to successfully develop its first facility it will be well positioned to develop more of them. Given the advantages of the monazite sands strategy it is feasible that Medallion could set up several of these facilities over time (the company has shown preference for horizontal vs. vertical integration). As this happens the market could easily grow to consider Medallion as the preeminent North American RE-concentrate producer. Needless to say that this is a very long-term goal, and despite the relatively clear path to such a scenario we have to consider it as low-probability given everything mentioned above plus timeline risk.

But market perception is everything. Keep in mind that many investors are convinced that another company—Ucore—can achieve something similar with respect to the REE-separation technology it is pursuing, and the market has ascribed a whopping \$34 million valuation on this stock given this conviction (of which we're highly skeptical) (note that, like with most other projects Ucore's Bokan is well under water with price assumptions at a sizable multiple to current levels.). I'm not saying that Medallion should be worth \$34 million, but it is worth pointing out how the market's perception of who the "winners" are can have a tremendous impact on valuations.

If we assign a 40% probability of failure (0 valuation), a 49% of the base case assuming an NEV/NPV multiple of 25% (\$4.8 million in valuation), a 5% probability for each of scenarios 2 and 3 assuming an NEV/NPV multiple of 40% (\$2.5 million and \$7.3 million in respective valuations) and a 1% probability of the company developing 3 10,000 tpa. facilities using a 60% NEV/NPV multiple and valuations in scenario 3 (\$6.6 million), then we get an **estimated valuation of \$21.2 million, or \$0.287/share (C\$28.6 million, or C\$0.388/share).**

8: Investment Thesis

It is rare to see a company trade at such a low valuation despite the fact that its project is so attractive. The projected returns are staggering for investors who purchase shares at or near today's price. We believe that these projections aren't outlandish and that they can be realized as the market re-rates Medallion shares. This re-rating doesn't require any fundamental improvements to the story as we present it above, but rather a reevaluation of Medallion on the part of REE investors as the most advanced and knowledgeable company developing the simplest, least expensive project.

The attractiveness of the project—the sum of all of the advantages stated above—is a function of its simplicity, and the project's simplicity is a product of management's acute understanding of the REE-industry. After all, we've seen that there has been an enormous amount of planning that has gone into this strategy as it exists today, and we can conclude that right now what is so valuable about Medallion is something most REE-companies lack, which is intellectual capital. It is this intellectual capital, more so than anything else, that has convinced us that the sizable returns discussed above are well within reach.

We can make all of these points with respect to Medallion Resources in spite of the relentless bear market we've seen in REE-prices. Prices are unsustainable at these levels since the vast majority of the industry is uneconomical. Yet this market reality doesn't change the fact that there is very little REE-production outside of China. All of these factors combine to create a strong fundamental bull case for REEs, along with the real possibility for a shortage to develop should geopolitical tensions escalate. By extension the bullish factors that will drive REE prices higher longer term also serve to strengthen the bull case for Medallion Resources.

Ben owns shares of Medallion Resources.

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