REPORT
//Rare Earths

STORMCROW

INITIATING WATCHLIST COVERAGE
Ucore Rare Metals Inc. – UCU:TSXV

March 8, 2021

- **Things Have Changed** – Not just the management team, but the focus of the Company has changed considerably over the last year or two. We will explain within.

- **New Focus, Faster Revenue** – The old Ucore looked to build the Bokan Mountain Mine in Alaska to generate revenue, but we all know building mines takes a long time. The new Ucore has a plan to become integral to the rare earth industry outside of China without necessarily having to wait for a mine.

- **New Technology Means New Opportunity** – Ucore's new separation technology, via its wholly-owned subsidiary, Innovation Metals Corp., means that rare earths might not be the only critical material Ucore can become involved in processing.

- **We are Keeping a Close Eye on This One** – We don't, at present, have a share price target to offer for Ucore because we don't have a precise idea of what Ucore will produce in terms of revenues and on what time scale. But we like what we see in terms of the new direction of the Company, the new technology behind it, and the new members of the management team. We add Ucore to Stormcrow's "Watchlist".

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	New	Old
Recommendation	Watchlist	N/A
Target	Watchlist	N/A

Recent Px	**$1.75**
Shares O/S	**47.7M**
Shares O/S FD	**56.9M**
Market Cap	**$83.4M**
Est. Cash	**$8.6M**

See the end of report for important disclosures

Introduction

Ucore Rare Metals Inc. (TSXV:UCU, OTCQX:UURAF) (Ucore or the Company) has long been the rare earth company that the West likely needed, but which investors simply could not unanimously bring themselves to support. The Company's Bokan Mountain deposit in Alaska could serve as a source of magnet materials such as neodymium and praseodymium along with necessary supporting heavy rare earths such as terbium and dysprosium. The Bokan Mountain Complex has approximately nine different historical mineralization zones (Ucore has 100% mining rights to all of them) but only one of these, the Bokan-Dotson Ridge zone, has been a focus of Ucore's rare earth exploration efforts. To date, the Bokan-Dotson Ridge zone is relatively small (although remains open down-dip and on-strike), lower grade and likely would be running on slim profit margins so long as rare earth oxide (REO) prices remain low.

And since the end of 2011, those rare earth prices have remained stubbornly low. For all the nattering in the press and the keening of politicians about the supply risk from allowing these allegedly "irreplaceable" materials to be supplied by China to the US for various purposes including defense applications (and those defense applications are real), the closest most people will come to rare earth magnets are the tiny little vibrator in their cell phone, or maybe the electric motor in a remote-control car or drone. While it doesn't seem likely to us that we are on the verge of a demand-driven spike in all rare earth prices, we do foresee steady and robust price growth in the most critical rare earths, especially those related to making magnets.

This steady and robust price growth will result, we believe, from growing demand for the rare earths related to magnets. We are firm believers in vehicle electrification. Battery electric vehicles (BEVs) with huge batteries, *a la* the Tesla family of products, may not be able to win over mainstream global buyers anytime soon, but a BEV with a small battery and limited range is, by far, the cheapest way to motivate a light-duty passenger vehicle. One need only look to the current fastest-selling vehicle in China, the Wuling Hongguang EV. That market, properly supported in countries such as China, India, Malaysia and Indonesia can, indeed, afford a small BEV of limited range, even if they couldn't afford a small Honda sedan powered by an internal combustion (IC) engine. Easily the best architecture for such inexpensive vehicles, providing the prices for neodymium and dysprosium remain reasonable, is to combine that small battery with a rare earth magnet-based electric motor.

Exhibit 1 – The Wuling Hongguang Mini EV

Source: Wuling Auto

And if the buyer requires the vehicle to travel long to very long distances, then the combination of a small battery and a range extender in the form of either a fuel cell or, especially, an internal combustion engine turning an alternator (a gasoline- or diesel-powered generator) is a much cheaper and easier way to get all the range you would want, the ease of refueling of any IC-powered vehicle, and the power, efficiency and lower emissions of a BEV (for at least a good fraction of trips). These plug-in series hybrids (PISH?) or extended-range electric vehicles (EREVs) are capable of removing almost all the impediments to EV adoption. They are also a much smarter way to handle a problem such as long-distance trucking than the phenomenally ridiculous Tesla Semi. Once again, the lightest and most efficient alternator out there is one that utilizes rare earth magnets, but its cost is highly dependent on the price of rare earths like neodymium and dysprosium.

Companies like Lynas Corporation Ltd., MP Materials Corp. and Ucore could help supply the critical materials for these magnets, but there is a problem. In order to make magnets, which several companies outside China can do, they need rare earth metals. That metal-making capability is thin on the ground outside China, but it does exist. The feedstock to those rare earth metal-making operations is separated and purified REOs, but that separation capacity outside China is also not only very thin on the ground, it's likely not cost-effective compared to what is being done inside China. To serve as a viable alternative to Chinese supply today, a company must be able to produce rare earths at a cost that is competitive with what is being supplied by Chinese producers.

And maybe this is where Ucore now has an advantage. With its recent acquisition of Innovation Metals Corp. (IMC) and IMC's RapidSX™ process for separating and purifying REOs, there is a possibility that Ucore might become

able to separate large quantities of REOs at costs that are at least as good as those in China. That would be very good news for companies such as Ucore, but also MP Materials and Lynas in the United States and Australia, respectively, because others, too, could work with Ucore and IMC to bring down their own processing costs.

So we will now examine how likely and how difficult a task it might be for Ucore to fulfill this promise.

First, Put the Right People in Place

Ucore was under the direction of Jim McKenzie as CEO since 2007. But on June 15th of 2020 the Company announced that Mr. McKenzie was transitioning from President, CEO and Director of Ucore to a role as a Strategic Advisor to the Chairman of Ucore, Mr. Pat Ryan. In concert with this announcement, Mr. Ryan was announced as Interim CEO.

At this point, we believe there is no hurried search being conducted for the next CEO, and we are happy about that. Mr. Ryan is a recognized automotive industry engineer and businessperson and he is familiar with producing products to customer specifications and meeting schedules and budgets. Given, as we will describe below, Ucore's focus is widening to more than just mining and more than just rare earths, we see the changes in management that occurred, both with the change in CEO and as a result of the acquisition of IMC, as necessary and timely.

The current management team at Ucore includes:

Pat Ryan (Chairman and CEO, Ucore; and Director, IMC)

Mr. Ryan is the founder of Neocon International, a multi-million-dollar automotive OEM design and lean manufacturing company which he conceptualized in 1993. From the outset he was the strategic architect responsible for raising capital, procuring equipment and facilities, assembling and directing a team of R&D engineers and establishing niche product opportunities including light-weighting to improve fuel efficiency through to developing specialty polymers that outperformed various metals in specialty automotive product applications. He has amassed twenty-five plus years of business experience serving customers such as Honda, General Motors and Nissan/Renault with numerous team awards for stellar performance, including Toyota's Platinum Quality Alliance Award received in 2016. Mr. Ryan's understanding of complex supply chains across international markets from upstream material testing and compounding to expected QA/QC standards utilizing the discipline of lean manufacturing has led to a prime positioning as the global auto world transitions to vehicle electrification. Mr. Ryan began

serving as a Director of Ucore in 2014 after he developed a heightened interest in the critical metals needed to drive change through the technologies of the twenty-first century. Mr. Ryan frequently speaks publicly to business leaders looking for new insights and mentors MBA as well as graduating engineering students from Dalhousie University, from which he holds a Bachelor of Engineering degree. He is the recipient of the APENS Award from the Association of Professional Engineers of Nova Scotia as the most likely to serve society in an ethical manner.

Peter Manuel (VP, CFO and Corporate Secretary, Ucore)

Peter Manuel has been Vice President and Chief Financial Officer of Ucore for 12 years. Prior to joining Ucore, he practiced as a Chartered Accountant for more than 17 years providing consulting services to companies in a range of sectors, with a focus on financial services and resources. He spent 10 years in England and The Republic of Ireland providing assurance, strategic planning, corporate finance and other consulting services to a portfolio of both public and private entities including licensed banks, proprietary trading operations, and international corporate treasuries. Mr. Manuel holds a Bachelor of Commerce Degree from Dalhousie University.

Michael Schrider (VP and COO, Ucore)

Since 1989, Mr. Schrider has been involved in manufacturing, engineering and managing complex structural and mechanical systems projects. He is a multidisciplinary engineer and business leader who has led Ucore's project development efforts since joining the Company in 2016. Mike was the founder, president and chief engineer of Schrider & Associates, Inc. (SAi) and Alton Bay Design, LLC (ABD), both engineering services firms, for over 17 years. Before that, he held various engineering and management roles in several North American shipyards and a synthetic lubricant manufacturing facility. He received a Bachelor of Science in naval architecture and marine engineering from the University of New Orleans and is a registered Professional Engineer in the State of Louisiana. Mike also holds a Master of Engineering degree in mining, geological & geophysical engineering (mineral processing emphasis) from The University of Arizona.

Mark MacDonald (VP Investor Relations, Ucore)

Mr. MacDonald has over 25 years of experience implementing award-winning business development and marketing programs at a regional and national level. As Vice President of Sales, Mr. MacDonald was responsible for Mediapro Communication's growth as AT&T Canada's leading Canadian Business-to-Business sales partner. Mr. MacDonald subsequently assumed all responsibilities of the Atlantic Regional Vice President of AT&T Canada Corp. As VP of Operations for Premier Executive Suites Mr. MacDonald consolidated four business units into one regional operation that was recognized as Atlantic

Canada's top company in "Best Places to Work" in 2009-2011. He holds a Bachelor of Commerce degree from Dalhousie University.

The current management team at Innovation Metals Corp. includes:

Dr. Gareth Hatch (Executive Chairman, CEO and Co-founder, IMC)

Dr. Gareth Hatch, CEng, FRSA, FIMMM, FIET began his career at US-based Dexter Magnetic Technologies, Inc., where he was Director of Technology. He is the Advisory Board Chair for the Belgium-based Rare Earth Industry Association (REIA), co-Chair of the NATO Science and Technology Organization strategy team on rare earths, and is a member of the British ISO TC/298 Mirror Committee on standards for rare earths. Dr. Hatch is a named inventor on five U.S. patents and also serves as an expert advisor to companies in the rare earth permanent magnet supply chain. Dr. Hatch holds a B.Eng (Honours) degree in materials science & technology and a Ph.D. in metallurgy & materials, both from the University of Birmingham, with research focused on rare earth-based permanent magnet alloys.

Tyler Dinwoodie (Executive Director, President and Corp. Secretary, IMC)

A senior corporate strategic advisor and marketing professional with an extensive background in market and industry analysis for the global critical-minerals/critical-materials sectors, Mr. Dinwoodie specializes in rare earths and lithium battery materials, with a particular focus on North American security of supply and downstream transformational installed capacity. He has served as an executive officer for, and senior advisor to, several private and public technology and advanced materials companies, including IMC, in North America, Europe and Australia.

Dr. Kurt Forrester (COO and VP Metallurgy, IMC)

Dr. Kurt Forrester, CEng, MIChemE, MAusIMM(CP) is a Chartered Chemical Engineer and Chartered Professional Metallurgist. During his 15-year career, Dr. Forrester has been professionally engaged as an engineering consultant in the metals and minerals, environmental and applied-research domains. His work includes process development, feasibility assessment, as well as detailed engineering design. Dr. Forrester has a broad experience base across several commodities including rare earths and industrial minerals. A two-time graduate of the University of Sydney, Dr. Forrester holds a B.Eng. degree (First-Class Honours) in Chemical Engineering and a Ph.D. in Engineering.

Alexandra Dawes, CPA (CFO and VP Finance, IMC)

Alexandra Dawes was appointed CFO of IMC in December 2020. A Chartered Professional Accountant (CPA), Ms. Dawes began her accounting career working in public practice in Victoria, British Columbia, specializing in Canadian and cross-border corporate tax matters. She eventually moved into a senior role

with a chartered accounting firm where she found her unique passion and talent for helping technology companies grow and flourish.

Other noteworthy persons involved with Ucore include:

Randy Johnson (Director, Ucore)

Mr. Johnson is the President of Tyler Rental Inc., an Alaska-based enterprise with over 75 employees, which he founded as a start-up in 1989 and subsequently grew to a multi-state enterprise. Mr. Johnson formed Alaska Ship and Drydock ("ASD") to operate the Ketchikan Shipyard under contract with the State of Alaska Department of Transportation and Public Facilities in 1993. Working in conjunction with the Alaska Industrial Development and Export Authority (AIDEA), he guided an $80 million shipyard expansion project at ASD, including a new 2,500 ton dry-dock, upland ship berthing and an 80,000 square foot ship assembly hall and production support complex. He sold the company to Vigor Industrial in 2012, having grown it into a thriving enterprise with annual revenues of $35 million and up to 200 employees. In addition to Tyler and ASD, Mr. Johnson's business operations and ownership experience includes such Southeast Alaska enterprises as Ty-Matt Construction and Ketchikan Ready Mix and Quarry. Mr. Johnson currently serves on the Board of Directors for Alaska Power and Telephone (AP&T) and has resided in Ketchikan, Alaska, for 40 years.

Dr. Jarda Dostal, P.Geo. (Director, Ucore)

Dr. Dostal is Professor Emeritus of Geology at Saint Mary's University in Halifax. He obtained a Ph.D. in Geology from McMaster University (Hamilton, Ontario). He has over 40 years of experience in geology, ore deposit studies, and geochemistry. He has published more than 300 scientific papers and is a widely acknowledged expert on rare metal mineralization in granitoids and volcanic rocks. His research has been recognized by scientific awards including the Distinguished Scientist Award of the Atlantic Geoscience Society (Gesner Medal), the Career Achievement Award of the Volcanology and Igneous Petrology Division of the Geological Association of Canada and the Hawley Medal, Mineralogical Association of Canada.

Frank Högel (Advisory Board Member, Ucore)

Mr. Högel has served as CEO at Peter Beck Performance Fonds GbR, bringing with him over 20 years of experience in the financial sector. He is an Asset Manager actively involved in the financial evaluation of companies and convertible debenture structuring. Mr. Högel has international financing experience, the ability to analyze expansion and acquisition opportunities, and expertise with Canadian and Australian resource companies. He has a broad base of involvement in global investments, primarily focused on the structuring, initiation, and completion of international convertible debenture financings. His

background includes more than 20 years of direct experience in the mining industry, expertise as an international financier / investor and a successful track record as a consultant and stockbroker in London, England. He serves on the Board of Directors of numerous public companies and is a Member of the Advisory Board of Concept Capital Management Ltd. Mr. Högel earned a Master of Business Administration (FH) degree from a University in Germany, with a focus on Financial Management, Banking, and International Business & Management.

Second, Find the Right Partners

It isn't easy for any junior company to develop a business producing critical materials. If it were, we would be hip-deep in success stories instead of finding the road to mining success littered with the bodies of the fallen. But you can do a lot worse than finding a company that has successfully built a critical materials business to be your partner. That's why it was as encouraging as it was (and is) that Ucore signed an agreement with Materion Corporation (NYSE:MTRN) in late December 2019. The agreement outlined that the two companies would work together to seek US government financing to build a rare earths business, but both companies believe that there is business to be done between them in the rare earths space even without receiving government funding and therefore it seems likely that further plans will be announced. Management at Ucore has repeatedly suggested in its MD&A that such plans are being developed and will be forthcoming.

Materion was formerly known as Brush Wellman Inc. It is easily the largest and most integrated producer of beryllium in the world. Beryllium is itself a critical material, a metal that is often alloyed with copper to produce strong, light and extremely stiff alloys. This is of particular importance to the aerospace industry. If you need to build, for example, wing elements that provide lift to a military aircraft, it helps a lot to ensure that the wing doesn't bend under high aerodynamic loads, losing its designed shape and derived lift. Very stiff materials like beryllium help to keep that from happening. These parts are used within the aerospace, military component and even automotive industries. Obviously, those are many of the same markets needed by Ucore or any rare earths producer.

And there are other initiatives within Ucore that have not changed even with the change in management. For example, Ucore continues to pursue the potential for its Strategic Metals Complex (SMC) in Alaska, hopefully to be developed with the full cooperation of the Alaska Industrial Development and Export Authority (AIDEA). One of the current key areas of focus for AIDEA is to move Alaska into the next phase of industrial development and to diversify beyond oil and gas. Certainly, Ucore and its plans for rare earth development in Alaska can play a meaningful role in that diversification. And if Ucore can gain access to inexpensive capital to help make that happen, then we are in

favor of taking advantage of that capital even if the initiative has to be situated in Alaska, which arguably may not be the #1 preferred location for rare earth metal making or magnet manufacturing.

So, to our way of thinking, both AIDEA and Materion are the right sort of partners for a company like Ucore. AIDEA can help Ucore with the capital required to minimize dilution while pursuing complementary initiatives, while Materion knows how to build a very reliable Western supply chain for a scarce and valuable critical material. Materion also has a contact list populated with customers that require these sorts of obscure materials in order to fabricate their products, including buyers and suppliers within both the military equipment and automotive industries. There are probably few better partners for Ucore, outside of the existing rare earth supply chain. What investors truly need to understand, though, is what Ucore is bringing to its relationship with partners like Materion.

The Answer Probably Isn't Bokan Mountain

The last full NI 43-101-compliant technical report regarding the Bokan-Dotson Ridge zone at Bokan Mountain was released in March of 2013 as a PEA. At the time of the PEA the inferred resource at the Bokan-Dotson Ridge zone was 5,228,200 tonnes of rock at a grade of 6,530 ppm total rare earth oxide (TREO) with a cut-off grade of 4,000 ppm.

Exhibit 1 – Resource at Bokan Mountain's Dotson Ridge Zone

Type	Tonnes	LREE (ppm)	HREE (ppm)	TREE (ppm)	LREO (%)	HREO (%)	TREO (%)
Inferred	5,228,200	3,368.77	2,113.50	5,482.25	0.394	0.259	0.653

Source: Company NI 43-101 PEA (March 2013)

The PEA indicated that the project could produce, over an 11-year life-of-mine, the following quantities of REO:

Exhibit 2 – Projected Total REO Production from Bokan Mountain's Dotson Ridge Zone

Total Production (kg)	
Ce_2O_3	6,096,947
Dy_2O_3	889,121
Er_2O_3	388,222
Eu_2O_3	75,537
Gd_2O_3	778,320
Ho_2O_3	149,377
La_2O_3	2,009,622
Lu_2O_3	25,126
Nd_2O_3	2,940,686
Pr_2O_3	758,162
Sm_2O_3	771,549
Tb_2O_3	133,350
Tm_2O_3	48,958
Y_2O_3	4,782,634
Yb_2O_3	256,441
TREO	20,104,052

Source: Company NI 43-101 PEA (March 2013)

In 2015, the Company published the upgraded results from its 2014 drill program which upgraded the Bokan-Dotson Ridge zone resource estimate by about 12%. The resource estimate now stands at 82% indicated and 18% inferred and it remains open down-dip and on-strike. The Company subsequently published studies regarding some co-product materials that also exist within the Bokan-Dotson Ridge zone; however, neither of these updates or studies resulted in a material change in the property or the Company and thus did not trigger or result in a new or updated NI 43-101 technical report for Bokan Mountain.

Stormcrow last published a full update regarding our long-term views on the rare earths industry in 2019; however, we have recently updated our price deck for REOs. In spite of a recent surge in some prices that seems to relate to rumors of potential supply disruption, we do not see any massive increase in prices occurring before 2030. However, based on continuing demand growth from the global new energy vehicle industry we foresee relatively steady improvements in pricing (barring the occasional reset as new sources of supply enter the market). Our current price-deck is:

Exhibit 3 – Stormcrow REO Price Deck

Element (all as REO)	2020	2021e	2022f	2023f	2024f	2025f	2026f	2027f	2028f	2029f	2030f
La (USD/t)	$ 1,643	$ 1,638	$ 1,670	$ 1,650	$ 1,630	$ 1,650	$ 1,630	$ 1,620	$ 1,610	$ 1,600	$ 1,590
Ce (USD/t)	$ 1,663	$ 1,685	$ 1,675	$ 1,655	$ 1,740	$ 1,660	$ 1,635	$ 1,625	$ 1,615	$ 1,605	$ 1,610
Pr (USD/t)	$ 45,763	$ 58,400	$ 57,500	$ 60,100	$ 70,200	$ 94,500	$ 57,500	$ 58,000	$ 58,500	$ 59,000	$ 59,500
Nd (USD/t)	$ 49,144	$ 66,200	$ 55,400	$ 50,000	$ 56,500	$ 77,500	$ 43,500	$ 44,000	$ 44,500	$ 45,000	$ 45,500
Sm (USD/t)	$ 1,756	$ 1,755	$ 1,710	$ 1,660	$ 1,640	$ 1,620	$ 1,600	$ 1,580	$ 1,560	$ 1,540	$ 1,520
Eu (USD/kg)	$ 30	$ 30	$ 28	$ 27	$ 27	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28
Gd (RMB/t)	169,576	177,280	171,000	169,500	172,500	175,000	177,500	180,000	182,500	185,000	187,500
Tb (USD/kg)	$ 671	$ 923	$ 770	$ 610	$ 700	$ 850	$ 600	$ 610	$ 620	$ 630	$ 700
Dy (USD/kg)	$ 260	$ 302	$ 300	$ 310	$ 420	$ 530	$ 340	$ 350	$ 360	$ 370	$ 440
Ho (RMB/kg)	402.1	531.0	410.0	290.0	270.0	290.0	260.0	260.0	260.0	250.0	250.0
Er (USD/kg)	$ 23	$ 24	$ 21	$ 18	$ 17	$ 18	$ 16	$ 16	$ 16	$ 16	$ 16
Tm	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Yb (RMB/kg)	101.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Lu (RMB/kg)	4,271.0	4,686.0	4,480.0	4,220.0	4,300.0	4,300.0	4,300.0	4,300.0	4,300.0	4,400.0	4,400.0
Y (USD/kg)	$ 2.94	$ 3.45	$ 3.05	$ 2.80	$ 2.70	$ 2.75	$ 2.70	$ 2.60	$ 2.60	$ 2.60	$ 2.60
Sc (RMB/kg)	6,451.6	6,525.0	6,830.0	7,000.0	7,000.0	6,300.0	7,000.0	7,000.0	7,000.0	7,000.0	6,300.0

Source: Stormcrow (2021)

Based on the above price deck, the annual potential revenue from Bokan-Dotson Ridge in 2030 would be roughly USD$73.4 million. Unfortunately, the expected life-of-mine (LOM) operating costs for the mine are USD$636 million, or roughly USD$57.8 annually. This leaves a slim profit margin (without attributing any value to resource expansion or the co-product materials that are available, which we can't at this time without additional metallurgical work). Therefore, in our view, Bokan Mountain, using the processing methodology and associated costs assumed in the PEA, is currently less than exciting. Thankfully Bokan is no longer the primary value-driver within Ucore. Ucore has long been examining better methods to separate and purify the rare earth elements than the current incumbent technology. Enter the RapidSX™ technology developed by Innovation Metals Corp. (IMC).

A Brief Detour Discussing the Separation of Rare Earths…

The rare earths are not rare. Readers, please repeat this phrase to yourselves several times, for emphasis. The fact that the media consistently reprints the line fed to it by junior mining companies about how the rare earths are scarce and Western civilization will collapse without them doesn't make that line any more true than the line that Chicken Little kept repeating about the sky. But we firmly believe that a low-cost, reliable supplier of rare earths and REOs can make very good financial returns in this business. As we've said repeatedly, these are very valuable engineering materials, if the price is right and the supply is consistent.

One of the keys to producing that consistent supply is the ability to separate and purify rare earths from whatever source the company plans to exploit. In China, the dominant global source of supply, the rare earths are separated using a process called solvent extraction (SX). The rare earths are dissolved in some acid and then this solution is rapidly mixed with an organic fluid, a hydrocarbon, which also contains an extractant. In essence, this is something like mixing oil and vinegar to create a salad dressing, creating a mixture of tiny droplets of oil temporarily suspended in the vinegar. And like anyone who has made a homemade salad dressing knows, those two liquids will eventually separate back into a layer of oil on top of the heavier vinegar.

In the case of using SX to purify the rare earths, that separation of the organic fluid and acid solution is a good thing. SX might best be thought of as a combination of physical and chemical techniques. The extractant compound in the organic phase will preferably grab some of the rare earth elements in the solution, heavier elements first. Which ones are determined by process conditions including pH and the delineation between these groups isn't perfect, so there is a need to scrub out and reinsert the contaminants from each step for further processing. Typically, the first division in the separation of rare earths is made between elements lighter than promethium and heavier than promethium, because promethium does not occur naturally and provides a convenient and easy place to break the rest up. Then those two separate groups of rare earths are separated into whatever products might be sold. For example, in real life we might use chemistry to remove the bulk of cerium from the rare earth mixture before we start SX, then break La, Ce, Nd and Pr away from the rest, then separate La and Ce from Nd and Pr, and so on. What we can't do is rely solely on chemistry to complete the separation, because the rare earths are, generally speaking, too chemically similar, the reason they all show up in deposits together in the first place.

The downside to conventional SX is that mixing all that organic fluid and acid solution and waiting for it to separate out takes time. The degree to which lighter and heavier rare earths separate from one another depends on properties related to the reagents and extractants being used, and on things like the ratio of flow rates of the two phases, temperature and pH, which all affect the separation factors, the measure of the ability to effectively separate these rare earths with the desired purity and yield. Because the rare earths chemically resemble one another to such a high degree, separation factors for adjacent rare earths on the periodic table are typically pretty low. This means that SX plants can be large, they can take weeks to months to separate rare earths completely and if anything untoward happens during the process, like a large temperature change occurs in the plant, then substantial amounts of work might have to be redone in order for the products to meet specification.

In 2013, Ucore's PEA contemplated using a new REO separation and processing technology known as solid-phase extraction (SPE) that involved a Montana-based company, Intellimet LLC. Ucore had correctly concluded, even

then, that simply doing the same thing as the Chinese do in terms of separation of rare earths (i.e., utilizing traditional SX) was not going to allow Ucore to develop a highly profitable business because the Chinese industry, while globally dominant, is not highly profitable.

In 2015, Ucore started working with a different company, IBC Advanced Technologies, Inc., in an attempt to continue to develop the Bokan Mountain project and enter the downstream REO separation business through a potential joint venture. IBC utilized another alternative to SX called molecular recognition technology (MRT). MRT is a clever and effective selection and purification approach that can be thought of as crafting a very precise lock that only the correctly shaped molecular "keys" will fit. MRT is used, for example, to very precisely extract a specific pharmaceutical compound as a molecule from solution. It has various commercial applications in industry to generate very pure and valuable chemicals and elements. At the time, IBC already had existing mining-industry clients, too.

In 2019, Ucore initiated an option to acquire IBC Advanced Technologies. However, what had been hoped to have been a collaborative joint venture and then M&A process involving the parties did not materialize. Eventually, both companies filed suit against each other. We are not going to waste time rehashing this legal conflict, but the presence of lawsuits always represents an overhang and impediment to a development-stage company such as Ucore. Fortunately, on February 19th of 2021, it was jointly announced that Ucore and IBC Advanced Technologies had reached an amicable settlement. We now know that there will be no acquisition of IBC Advanced Technologies by Ucore and we know that IBC Advanced Technologies will purchase the MRT pilot plant from Ucore for the sum of CAD$1.5 million. We know that all other agreements between IBC and Ucore have been terminated, and we know that all of the litigation has ceased. While other terms of the settlement remain undisclosed, those four key, material terms effectively eliminate any legal concerns regarding lawsuits between Ucore and IBC.

However, this settlement with IBC obviously doesn't remove Ucore's continuing need for a separation technology that can do a better job at separating and purifying rare earths than conventional SX can. So, enter IMC and its RapidSX™ technology.

RapidSX™ – A Potential Game Changer

On May 11, 2020, Ucore announced that it had completed its acquisition of Innovation Metals Corp. (IMC) for a deemed aggregate purchase price of $5.8 million, consisting of 4.538 million common shares of the Company (adjusted for the Company's 1-for-10 share consolidation in Dec. 2020) plus $1,000 in cash. IMC had previously developed and pilot-plant trialed a new version of separation technology that is applicable to rare earths and other metals called

RapidSX™. Last month, we were fortunate enough, under NDA, to visit the latest version of IMC's pilot plant at the company's RapidSX commercialization and development facility located in Kingston, ON. We are not often pleasantly surprised, but we were on this occasion.

We can't provide significant details of what we saw in terms of the specific technology and applied science, of course, since we signed an NDA. However, we can say this: We have no doubt that the proprietary RapidSX™ technology will function effectively, since it is, at its core, conventional solvent extraction. Regarding IMC's version of SX, we are tempted to use the worn-out expression "on steroids", but that doesn't really capture the major benefits of RapidSX™. One significant advantage to SX for companies that need reliable rare earth separation technology is that there is a depth of understanding regarding both how SX works and how it fails. Companies relying on new technology for separating rare earths, whether that technology involves chromatography-like processes or electrochemical approaches or anything else, do not necessarily have a detailed understanding of how and why the process can fail for REOs. If a separation plant, based on new technology, suddenly begins failing to meet product specification, then it might be days or weeks before a solution is identified and implemented. Those weeks would mean, at minimum, a lot of missed revenue but might also mean some cancelled contracts. Solvent extraction, whether conventional or an advanced form like RapidSX™, is solvent extraction, especially when it uses the same reagents and extractants as conventional SX. Using RapidSX™ should give users a significant degree of comfort about the reliability and quality of the resulting product supply.

The major advantage of RapidSX™ over conventional SX is that a commercial separation plant based on this approach should be physically much smaller than a conventional SX plant. The technology is very likely, in our view, to require fewer and smaller separation stages than a conventional SX plant. It's also likely, given that there are fewer stages and faster processing times, that the operating costs per day will be lower than for a conventional SX plant, but we don't believe that difference will necessarily be large. So RapidSX™ might well have a significant capital cost advantage and a small operating cost advantage. That means that while a current SX plant operator in China or anywhere else might not need to knock down their current plant and replace it, anyone contemplating building a new REO separation plant should probably consider RapidSX™.

To put this in perspective, a 5,000-tonne conventional SX plant built in North America would likely have a capital cost of between USD$60-85 million, with a cost per kg for separating what is normally thought of as a "light" rare earth mixture (such as the one coming from the California Rare Earth Mine, for example) of a blended USD$3.50-5.00 per kg. We believe there is a good chance that a RapidSX™ plant to perform the same function would have a capital cost of USD$18-25 million, maybe less, with a cost per kg of separating that same "light" rare earth mixture of perhaps USD$3.25-4.50 per kg. The

RapidSX™ plant uses the same reagents as traditional SX, but has fewer stages and lower residence time, so there are lower energy, personnel and reagent costs, per kg of produced product, associated with the use of the new technique.

Note that there are other advantages, too. Much quicker processing time means a much lower working capital requirement as there is far less tonnage of valuable rare earth sitting within the system at any one time given the same annual throughput. In addition, all SX plants suffer issues that cause the steady-state conditions at which the plant runs to be perturbed, and this can include anything from unexpected variations in feedstock to an electrical power failure. With conventional SX, returning the plant to its expected, steady-state conditions can take days to even weeks, meaning the specification of at least some products will not be met during that period and revenue will be lost. With a full-scale RapidSX™ plant, steady-state operation is expected to be regained in hours to days, based on IMC's previous test results. This can avoid a significant amount of lost revenue and, potentially, even lost customer contracts.

Ucore is Much More than Rare Earths

With their wholly-owned subsidiary, IMC, Ucore is now free to apply RapidSX™ to more than rare earths. One of the major advantages to RapidSX™ is that it is really an augmented form of conventional SX. Whatever reagents are used in conventional SX processing can also be used with RapidSX™. So the immediate reaction (we know, because it was ours) might be to try and apply RapidSX™ to the SXEW processing of copper. After all, the copper industry is much larger than the rare earths industry, and even if the saving is only at the level of capital cost it would likely be welcome when copper plants are as big and as expensive as they are.

The answer, for a variety of esoteric reasons, is that RapidSX™ would not provide a really marked advantage in the SX processing of copper leach liquor. Basically, the more difficult and complex the SX task is, the larger the advantage RapidSX™ can provide. Using SX in the copper industry is simple and straightforward, and the advantage RapidSX™ would have over the completely tried-and-true conventional SX would be small.

But there are some other materials that are near and dear to our hearts where RapidSX™ might be able to play an important role. Several groups have, over the years, tried to develop solvent extraction as a method of extracting and processing lithium, especially from shallow brines in places like Nevada or South America. If the SX were developed far enough, SX might even be able to pull small amounts of lithium from under the mountain of contaminants that exist in brines from deep underground.

The problem is that a conventional SX settler/mixer tank is not small and not cheap, but you can only extract whatever lithium is contained in the acidic phase within the volume of the tank. Both shallow and deep brines have fairly low levels of lithium content, at best about 1,000 mg/l and at worst a whole lot lower than that. If you are planning to make, say, 40,000 tonnes of lithium carbonate a year, then even at 100% rates of recovery and with a 1,000 mg/l brine we are going to have to process 3.8 billion liters of brine a year. SX processing is not fast. This is going to result in a very, very large plant, probably a plant that is uneconomical from the point of view of return on investment.

RapidSX™ is likely to be much faster and require a much smaller plant. Now, it isn't proven or clear that RapidSX™ can be used to process lithium, but our immediate reaction is that it is a problem worth studying. If RapidSX™ can be used to strip very clean lithium out of contaminated brine, there are a very large number of brine resources that this could be applied to.

In addition, the environmental-remediation industry has a large number of ongoing projects that require large volumes of wastewater to be processed, cleaned of one or more problematic contaminants and then disposed of. Conventional SX can be used to do this contaminant removal, but the required plants have been shown to be too expensive to build or to use, for the same reasons as above. The same might not be true for RapidSX™. While this application is likely to be more dependent on the circumstances surrounding each individual project, we believe that it, too, is more than worth studying.

So, through the use of RapidSX™, IMC and Ucore can be much more than just a rare earth story.

A Watchlist Name

For more than 10 years, we have been on the lookout for a new processing technology for rare earths that can dramatically improve on standard SX. RapidSX™ seems to fit the bill. Ucore, via its wholly-owned subsidiary, IMC, may have found a treasured and sustainable niche in what should be a growing industry outside China. However, we do not yet have a 12-month share price target to attach to Ucore's stock. As yet, we don't have a targeted annual output for any first RapidSX™ separation plant, whether it's Ucore's possible Alaska SMC or a hypothetical joint-venture facility with Materion or some new plant built by a potential customer of IMC, nor do we know what the first RapidSX™ separation plant will be expected to produce in terms of the amounts of specific individual rare earths.

One thing that is certain, however, is that there is no present need for Ucore to first build its own mine to create rare earth feedstock. Sources of rare earth feedstock already exist. For example, there are stockpiles of waste monazite at various heavy mineral sands operations around the world. Like all monazite,

there are issues around the disposal of thorium and uranium once this feedstock is processed, but it is possible to find monazite with good fractions of the most prized rare earths such as neodymium and praseodymium in it, along with acceptable grades of dysprosium. We do not believe that Ucore will be delayed in pursuing this market until such time as REO prices rise to the point that Bokan Mountain is confidently made economically viable via large expected profit margins pursuant to the business of mining. The business of REO separation itself can first be made into a viable and valuable business before a Ucore-owned mine such as Bokan Mountain needs to come into production to satisfy the world's growing needs for rare earths.

So, as a result, we are placing Ucore on our "Watchlist" and will keep a close eye on announcements from the Company. When, and we believe it is 'when' and not 'if', the Company unveils plans for production, we will be able to apply our price decks and estimates on costs to determine a price target for the Company's stock based on a traditional valuation model for a revenue-generating company. But, so far, we are very intrigued by what we have seen.

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