



## **REEs Up Close and Personal: A Visit to the Silmet Plant, Estonia**

**A Monday Morning Musing from Mickey the Mercenary Geologist**

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I got lucky on my birthday this year but not in the traditional American single male sense.

February 3 found me in mid-town Manhattan for a presentation at [Murdock Capital Partners Rare Earth Symposium](#). The event was held at a posh mid-town club venue, and rest assured my friends, this was not how I typically celebrate my birthday. I gave the keynote luncheon presentation, answered numerous questions from high net worth, hedge fund, and institutional investors, and hung around to hear Don Lay's presentation on sponsor company Medallion Resources, Ltd ([Mercenary Musing, February 28, 2011](#)).

Shortly thereafter I was picked up by a car from Fox Business and whisked a few blocks away to an interview with Liz Claman on her [Countdown to the Closing Bell](#) show. After the usual pancake makeup application to take shine off my bald pate, I retired to the green room and waited for the call to appear. There I met Kevin Kerr face-to-face for the first time.

Kevin is a well-known commodities trader, newsletter writer, and fellow television talking head with whom I had previous written correspondence. After our respective quick flicks with the stunningly red-headed Liz, Kevin and I proceeded to the ubiquitous mid-town Irish bar to quaff a couple of Brooklyn lagers and shoot the breeze.

Our conversation was about all things commodities. Eventually we got around to the rare earth elements and their unique backend-loaded value chain. Kevin mentioned he had recently toured Silmet in northeastern Estonia, one of only three currently operating light rare earth separation plants outside of The Peoples' Republic of China. I expressed interest in seeing the plant up front and personal and Kevin indicated a tour was possible. Later that day he forwarded me a [video of his tour](#).

Thus the stage was set for my email introduction by Kevin to David O'Brock, the CEO of privately-held AS Silmet. David was cordial and happy to accommodate my request, and we scheduled a tour of the Silmet facilities in conjunction with my field tour of the Baltic region of northern Europe in late May.

Meanwhile on April 4, 2011, Molycorp announced 90% acquisition of Silmet in a mostly stock deal valued at \$90 million at the time. With the purchase, Molycorp established a European base of operations, the capacity to double its current annual output of separated light rare earth products, and a circuit

producing substantial tonnages of pure niobium and tantalum metals. Silmet has a well-established market for customized products to end-user REE and Nb-Ta customers in North and South America, Europe, and Asia.

My tour of Silmet commenced in the early Sunday morning of May 29 from the medieval, Soviet, and modern city of Tallinn, located on the Baltic Sea of northwest Estonia. Accompanying me were the aforementioned American ex-pat Kevin Kerr, who lives in Tartu two hours to the south, Aussie geologist and businessman Mike Hudson who is director of REE explorer Tasman Metals Ltd ([Mercenary Musing, May 31, 2010](#)), and Swedish geologist Magnus Leijd, who heads Tasman's Norra Karr HREE project.

We were met at the plant headquarters in mid-morning by David O'Brock, Managing Director of Molycorp-Silmet who afforded us a comprehensive and interesting tour of the facilities. We appreciated David's willingness to accommodate us for a Sunday morning tour since he had a late Saturday night with the annual appreciation party for Sillamae-area chemical industry workers.

Here's a photo of our group outside the Molycorp-Silmet office:



**Magnus Leijd, Yours Truly, Mike Hudson, David O'Brock, and Kevin Kerr**

This is the view upon entering the Silmet administration building: Note the Stalin-era Soviet architecture and the hammer and sickle carved into the top of the doorway columns inside the renovated building. Although there is no love lost between the Estonian people and the Russian "Motherland", all workers feel it is important to preserve relics from the Cold War era when Estonia was subjugated by the Soviets:



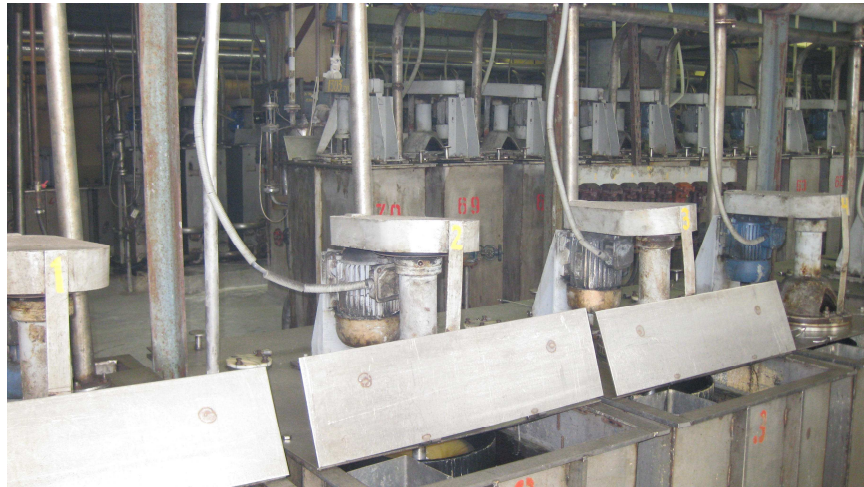
### **Silmet Administration Building Foyer**

The Silmet plant in northeastern Estonia has an interesting and varied history. It was built in 1927 by the Swedes as an oil shale production plant that was largely destroyed during World War II. In 1945 the Soviets re-commissioned the facility for uranium processing and enrichment and named it “Factory nr 7”. During this era the surrounding town of Sillamae was forbidden to enter. In 1970, the plant started production of rare earth and specialty metals products and uranium processing ceased in 1990 concurrent with the fall of the USSR. In 1997, the formerly state-owned plant was privatized and restructured as Silmet AS under leadership of current Managing Director David O’Brock. It currently employs 550 people in three operating factories, is organized into 25 divisions, and has capacity to supply 3000 tonnes of separated light rare earth element products, 700 tonnes of specialty metals, and substantial fertilizer and chemical by-products per year.

According to the USGS, Silmet’s rare earth element separation factory can produce fluorides, hydroxides, oxides, carbonates, and solutions, as well as liquid nitric fertilizers. The specialty metals factory can produce metals, hydroxides, oxides, and ammonium bi-fluoride. The metallurgical factory can produce metallic niobium and tantalum chips, metallic powders and hydrides, neodymium metal ingots, neodymium-iron-boron alloys, and mischmetal, a mixture of light rare earth elements in the proportion contained in the host mineral. In 2008, about 99% of the raw materials used in production at Silmet were imported and 99% of the products sold were exported.

Our first tour stop was the rare earth element separation plant. Silmet currently takes in mixed light rare earth concentrates originating from the Lovozero mine on the Kola Peninsula via a magnesite production facility in eastern Russia and Molycorp's Mountain Pass mine in southeastern California. The Silmet facility utilizes nitric acid-based solvent extraction to produce high purity cerium, lanthanum, neodymium, and praseodymium chemical products and "didymium", a mixture of the latter two metals.

In the particular iterative process below, cerium oxide and lanthanum oxide separation are achieved by nearly 300 sequential separation cells or "cameras". Cerium and lanthanum are the two most abundant REEs and have increasing demand and rapidly escalating prices. Ce is used in the lighting, glass, polishing, and water purification industries and La is largely consumed for petroleum cracking and batteries:



### **Lanthanum and Cerium Oxide Solvent Extraction Facility**

Our second stop was the neodymium and praseodymium separation floor where products are produced by a similar nitric acid-based solvent extraction process. In this case there are 200 sequential cameras required to achieve the final products. Nd and Pr are currently in very high demand and short supply by the permanent magnet industry:





### **Neodymium and Praseodymium Oxide Solvent Extraction Facility**

The next visit was to the niobium-tantalum production building. Like the REEs, Silmet currently receives niobium and tantalum oxide concentrates from the aforementioned Lovozero mine via the Russian magnesite plant and from the Pitinga mine in the Amazon Basin of Brazil. Extremely pure tantalum metal is produced from this +3000 degree C electron beam furnace. The highly purified metal is so valuable that a worker is removing slag off the inside walls of the furnace. The slag is gathered in the bin shown just below and is reprocessed for recovery of additional tantalum.



### **Electron Beam Furnace Recovers High Purity Tantalum**

Molten tantalum is crystallized into a cylinder-shaped ingot by a skilled worker operating a joystick controller then the ingot can be cut into wafers for delivery to the customer. Ta produced at Silmet is used in special alloy applications:



### **Hydraulic Press Slicing Tantalum Ingot into Wafers**

We then went two floors down to see the niobium extraction process. This is also an electron beam process but these furnaces operate at a lower temperature of about 2300 degrees C. Here's a vertical furnace showing an operator monitoring crystallization of molten niobium into an ingot via video screen:



### **Electron Beam Furnace Recovering High Purity Niobium**

The final product is the ingots shown below. This is what Clint Cox previously referred to as “the money rack”. Based on MetalPrices.com, each ingot contains about \$80,000 worth of niobium. However, I dare say Silmet commands a very hefty premium for its high purity Nb metal and currently supplies about 40% of the world's demand:





**The Money Rack: High Purity Niobium Ingots**

The Silmet chemical plant has processed 12 different rare earth and specialty-bearing minerals in its history and produced over 30 different chemical and elemental products. A partial list and representative samples are shown below:



**Chemical Products Produced at Silmet**

It can produce the following separated rare earth element and specialty metal powders:



### **Rare Earth and Specialty Metal Powders Produced at Silmet**

Following our tour of the Silmet facilities we proceeded to northern Europe's only duty free port immediately north of the plant. Here's the beautiful view from the capped, remediated, and reclaimed uranium-thorium tailings pile originating from Soviet days:



### **Estonia Free Port Facility and Reclaimed Tailings Pile**

Despite Soviet occupation starting in 1941 with its forced mass emigration, collectivization of farms, Stalin-era genocide, and repopulation with Russians, Estonia has progressed rapidly since independence in 1991. It is a full member of the European Union, has the highest GDP per person of any country that was part of the USSR, a flat personal tax rate of 21%, and no corporate income tax on retained earnings. Estonia ranks high in all world metrics rating economic development, business opportunity, and personal freedom. The tax-free port at Sillamae is centrally located for business between the European Union and Russia, is linked by rail and modern highways to both areas, can handle all cargo vessels entering the Danish Straights, has a local power plant, and requires no ice-breaking in an average winter.



Our tour concluded with a one hour drive followed by lunch in a local restaurant in expatriate American David O'Brook's adopted home town of Rakvere. On the drive and at lunch I was able to learn more about his fascinating career.

David is a farm boy from northeast Ohio who graduated from *The Ohio State University* with a degree in international relations. He first went to Estonia thru a 4H exchange program in 1994 and has spent most of his adult in this tiny Baltic country. David has an Estonian wife and two young children, speaks fluent Estonian and Russian, and is committed to his adopted country's future.

He specializes in taking over management of distressed companies in this former Soviet republic and turning their operations to capitalist-style profitability. His original success was with the Silmet privatization in the late 1990s and he followed that up with success at the state-owned oil shale company beginning in 2001. David's second stint at Silmet started in 2007 and he has rewarded its private shareholders handsomely with the recent Molycorp equity buy-out.

We all were impressed with the process plants at Silmet and the goals that David has set for the new company as an integral part of REE giant Molycorp's corporate strategy. I expect Silmet to aggressively expand and diversify as a producer of separated rare earth oxide and metal products in the near future.

Finally, thanks David for your American-style hospitality, willingness to host us on a Sunday morning, and openness in showing us the Silmet operations.

I wish you the best of luck in future endeavors.

Ciao for now,

Mickey Fulp  
Mercenary Geologist



The [Mercenary Geologist Michael S. "Mickey" Fulp](#) is a Certified Professional Geologist with a B.Sc. Earth Sciences with honor from the University of Tulsa, and M.Sc. Geology from the University of New Mexico. Mickey has over 30 years experience as an exploration geologist searching for economic deposits of base and precious metals, industrial minerals, uranium, coal, oil and gas, and water in North and South America, Europe, and Asia.

Mickey has worked for junior explorers, major mining companies, private companies, and investors as a consulting economic geologist for the past 23 years, specializing in geological mapping, property evaluation, and business development. In addition to Mickey's professional credentials and experience, he is high-altitude proficient, and is bilingual in English and Spanish. From 2003 to 2006, he made four outcrop ore discoveries in Peru, Nevada, Chile, and British Columbia.

Mickey is well-known and highly respected throughout the mining and exploration community due to his ongoing work as an analyst, writer, and speaker.

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