ROM

Friends of Earth and Space

Spring 2023

Message from the Chair

We are pleased to offer you this spring newsletter – although it has been feeling more like fall than spring this past while.

FES has been a little more active this past year – a welcoming break from the challenging times of the past couple of years. We organized a ROM Quest for the holiday season in December and supported the staff with their glaciation activation during March Break. It is our hope that soon we will be meeting up in person. Our AGM scheduled for June 16th at ROM will be our first attempt to come together as a group. More details will be forthcoming.

Our group enjoyed a most interesting presentation recently by Dr. Soren Brothers on Crawford Lake and the evidence from a core drilling of the geological epoch we may be in. More information will be available to us later in the year and a visit to Crawford Lake may be organized in the fall.

After five enjoyable years, I will be leaving the Chair's position for the coming year. I have appreciated your ongoing support and engagement and have thoroughly enjoyed working with you all. It's also truly been an honour to work with Dr. Kim Tait and her team, namely technicians Katherine Dunnell and Veronica Di Cecco.

All the best – and do plan to join us on June 16th for our AGM. Thank you for your continued support.

Toni Fiore Lisi

Chair of the Friends of Earth and Space

Doug Kirwin Donates Again: Mineralogy and Geology Goes to Thailand

By Katherine Dunnell, Technician

In July 2014, ROM acquired the Kirwin collection, a suite of 14,000 rocks and ores, and 5,000 mineralogy specimens collected predominantly in the Asian-Pacific rim. This collection was the lynchpin in a larger fund-raising project to upgrade storage in the 3B mineral collection room and to process, register and image a large portion of the incoming ore collection to make it available to the public, researchers and to other geologists. The funding also included a display in the gallery on what a geologist does, in hopes of spurring interest as a career path for future geoscientists. The initial Kirwin project started in late 2013 and was almost complete in Fall 2022, with the imaging of 3000+ specimens available on the ROM Images website.

Figure 1: Doug showing us one of the more important textural specimens from Utah to be used in future short courses. © Katherine Dunnell.

During the Prospectors' and Developers' Annual Conference (PDAC) in the summer of 2022, donor Doug Kirwin visited ROM and indicated he had more samples that he had collected that he wanted to donate to the museum. ROM's team of Katherine Dunnell and Veronica Di Cecco flew to Bangkok, Thailand, in August of 2022 to pack up the donation of material for shipment to ROM.

After a 26-hour travel day, the team landed in Bangkok and got right to work at Doug's house packing up and documenting the ores for shipment to Canada.

There were 163 boxes of material to be documented ensuring Canadian customs compliance, packaged, and numbered into blue crates that awaited a 20-foot shipping container to be delivered at the end of the week. It took the team 5 days to pack up and document 1,500 ore specimens for shipment back to ROM. Doug is an avid naturalist and

during our stay at his home he mentioned he was also trying to downsize his book collection. After a quick email to all the Department of Natural History (DNH) colleagues back in Toronto with images of the many bookshelves of material, 162 books were identified by other curatorial staff as important and were added to the manifest and shipment back to the museum.

Figure 2: Veronica, Doug, and Katherine in the midst of wrapping and documenting the samples for the shipping manifest. © V. Di Cecco.

Figure 3: One hundred and sixty-three crates ready to be shipped back to ROM. © V. Di Cecco.

In Thailand, Mother's Day is a national holiday. It fell on Friday, August 12, 2022, so the shipping container could not be delivered until the following day. The team had a day to explore a couple of Buddhist temples, bringing offerings to the monks, and to visit Ayutthaya historical park, a UNESCO world heritage centre.

The shipping container arrived mid-morning on Saturday, August 13th and the team packs up just before the afternoon rain. Due to the backlog created by COVID, the shipping container containing ROM specimens was held in Thailand awaiting an available slot to ship via boat to Canada. We are awaiting news from Shipping as to when we can expect this new shipment to arrive. The shipment was delivered November 27th, 2022, and the team bagged the crates and are letting them sit for 6 months as a passive pest treatment. The books were frozen as a pest treatment and disseminated to our DNH colleagues.

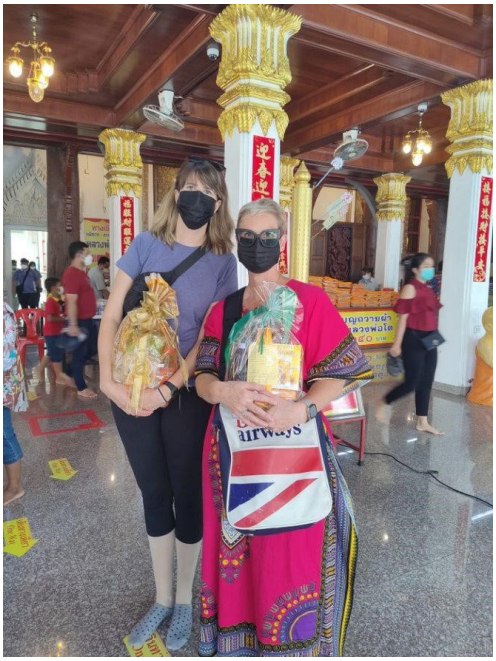


Figure 4: Veronica and Katherine bring gifts to the monks at a Buddhist temple in Ayutthaya.

There are very few well-curated geology collections in the world. Currently, ROM has one of the most active, well-curated and extensive geology collections within the museum community. ROM has recently expanded the collection with the acquisition of the Kirwin ore collection, and it has attracted considerable attention from colleagues and industry, as ROM is seen as a place where we are actively curating the geology of our planet. Look for more updates after the second wave of material comes out of pest treatment.

Critical Minerals: Moving to Net Zero

By Veronica Di Cecco, Technician

The world's climate is changing, and the burning of fossil fuels is directly contributing to our planet's increasing temperature. Burning fossil fuels creates carbon dioxide, a greenhouse gas, which traps the Sun's heat and increases the atmospheric temperature. This in turn impacts many aspects of the Earth, including changing weather patterns and ocean currents, worsens air pollution, causes higher wildlife extinction rates, acidifies the oceans, and raises sea levels. According to the Energy Information Administration, 73% of greenhouse gas emissions in the United States resulted from fossil fuel combustion in 2020. We need to divest from fossil fuels to protect Earth, our only home. Our immediate need is to reach a point where our actions do not result in any increase in atmospheric CO_2 – "net zero."

Shifting from fossil fuels means we need to find alternative sources of energy. This includes renewables, like solar and wind, hydroelectric power, and nuclear reactors. Moving to these energy sources means increased demand in different types of metals and minerals, such as copper, lithium, graphite, nickel, cobalt, and rare-earth elements. Therefore, recycling and mining of these materials needs to increase to meet demand. However, we must act in both an environmentally and socially responsible way as we move forward with this green energy transition.

Ontario and the Canadian government, among others, have created strategies around these "critical minerals" to develop the supply chains needed to support the switch to net zero.

Copper

Demand for copper, which is used for wires to transmit electricity, is expected to double in the next twenty years. The largest producers of copper are Chile, Peru, and China. Canada produces 3% of the world's copper, with most of this coming from British Columbia and Ontario. In Ontario, much of our copper comes from massive sulfide deposits such as the Sudbury Impact Structure. If all the world's energy was to come from electricity, we would need to double the rate at which we mine copper, providing enough copper to fill the Rogers Centre 3.2 times per year.

Figure 5: Massive sulfide (chalcopyrite), Mount Elliott Mine, Queensland, Australia, ROMESG60699.

Lithium

Lithium is mainly used in rechargeable batteries. Most lithium is extracted from brines, saline groundwater, and the world's largest producers are Argentina, Chile and China. However, in Canada, lithium is most commonly found in the ore minerals spodumene and petalite. Demand for lithium is expected to rise 40-fold from 2020 to 2040. Recycling of the metal is currently negligible but needs to increase to meet demand.

Figure 6: Spodumene, Montgary Mine, Bernic Lake, Manitoba, Canada, ROMESM43117.

Graphite

Graphite, a mineral, not an element, is made of stacking sheets of carbon atoms. In our daily lives it is most visible as pencil “lead.” In green energy it is used in electrodes, refractories, batteries, and lubricants. China produces almost two-thirds of the world’s graphite, followed by Brazil and Russia. Graphite recycling is negligible, though more is needed to increase our dependence on this material. Demand for graphite is expected to increase 25-fold from 2020 to 2040.

Figure 7: Graphite, Buckingham, Quebec, Canada, ROMESM47442.

Cobalt

Cobalt is used in lithium-ion batteries and superalloys. Nearly 70% of global production comes from the Democratic Republic of the Congo (DRC), followed by Australia and Russia. Demand for cobalt is expected to increase 20-fold from 2020 to 2040. Currently recycling accounts for 25% of current production. The main ore minerals are cobaltite and smaltite.

Figure 9: Cobaltite, Hakansboda, Vastmanland, Sweden, ROMESM47409.

Nickel

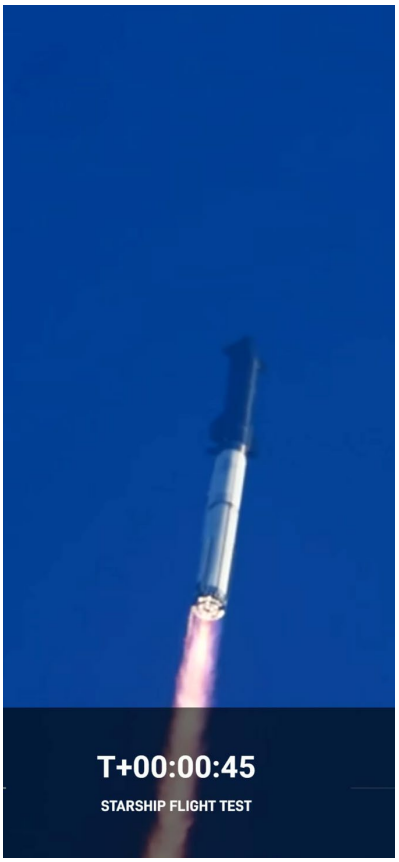
Nickel is used in steels, electroplating, catalysts, and chemicals. Indonesia produces 30% of the world's nickel, with the Philippines and Russia as other major producers. Canada is the sixth largest producer, with much coming from the Sudbury Impact Structure. Demand for nickel is expected to increase 20-fold from 2020 to 2040. Recycling of nickel accounts for 50% of global production. The main ore minerals are pentlandite and limonite.

Figure 10: Pentlandite, Sudbury, Ontario, Canada ROMESM25971.

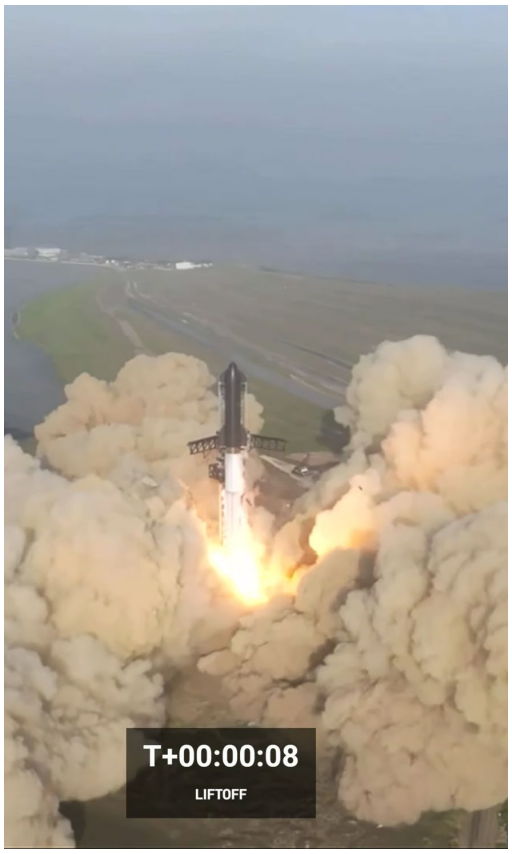
Musk’s Starship Superheavy Launch: Why is an explosion a success?

By Doug Gibson, FES Member

Many of you will have watched the 4-minute flight of Starship on April 20 and asked that very question. The answer lies in the way Elon Musk handles research and development. Early failures of Musk’s Falcon rocket ten years ago brought him close to bankruptcy. The success of the Falcon 9 rocket booster since has made his rocket the most economical and most used launch vehicle on the planet. It is 70% reusable. However, Elon’s goal has always been 100% reusability: that is the task for the bigger Starship.



Launch of SpaceX's Starship during its Integrated Flight Test from Boca Chica, Texas. © Wikimedia.



Starship Test Flight Mission. © SpaceX.

When Musk started to experiment with Starship 4 years ago, his aim was to develop a rocket that could be boosted to orbit by one large booster and return to Earth and land tail down like a Falcon 9 booster. He achieved the goal of landing the upper stage called Starship two years ago and started building the booster called Superheavy. Because he

is wealthy, he can afford to develop in a different way – by building a large number of prototypes and testing them. NASA, which is funded by government, cannot afford this method. Because NASA cannot afford failures, they have had to do years of studies and experiments: the result is 14 SLS rockets for the Artemis Program. The loss of even one of these rockets would cost $4 billion and endanger the entire program.

As Musk has shown, cost can only be decreased by reusability, and the SLS boosters, like Saturn V's before them, are not reusable. The test of Starship-Superheavy April 20 ended in explosion. There is no flame diverter for the exhaust, and the huge thrust of 16 million pounds striking the ground 50 feet below the booster fragmented large sections of concrete, which likely damaged some of the 33 Raptor rocket engines. Despite the failure to stage and orbit, there were important discoveries that made the flight a greater success than even Musk had expected. First, the two-stage rocket was stable and flew well up to the point of staging. It survived the most turbulent part of the flight at around 1 to 2 minutes when there is a lot of atmospheric buffeting. Indeed, it was so stable that it flew as a unit through two loops before being destroyed. Elon Musk already knew that flying concrete might damage engines: he was starting work to solve this problem before the recent test flight and will complete the work now. I think he will succeed in orbiting this monstrous rocket by the end of the year. Despite failure, the first flight enters the record book as the largest rocket with the largest thrust ever to fly.

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Contact FES: fes@rom.on.ca
Become a ROM member

We hope this newsletter has piqued your interest and that you will consider becoming a member. A tax-receipted minimum donation of $50 is required for a 1-year membership. For more information visit our website or contact us at fes@rom.on.ca.

Friends of Earth and Space is organized by the ROM's Department of Museum Volunteers to provide support for the Museum.

ROM is an agency of the Government of Ontario.

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