ROM

Friends of Earth and Space

Winter Newsletter 2021

Comments from the Chair

It's hard to believe that the holiday season is upon us – and it's been over a year since we last met in person. Hopefully, that will soon be possible again.

While not physically engaged at the ROM, we have tried to stay in touch with our members through newsletters, emails sharing updates and various articles of interest. Thanks to members Doug Gibson and Gilles Huot, several enjoyable Zoom Talks were held again this past year.

We had an extensive and impressive update from our curator, Dr. Kim Tait, at our Annual General Meeting in October 2021, the draft minutes of which have been sent out for all to read. Thanks to monies raised from the Scotia Bank Charity Run, FES was happy to be able to pay for a veszelyite mineral, which has been described in one of our articles. Via Zoom, we also recently met and heard from Dr. Soren Brothers, the inaugural curator of climate change. An article on this informative and interesting presentation is also included.

Thank you all for your continued interest and support of Earth and Space sciences through your membership and generous donations. Stay safe – and Happy Holidays. May the New Year bring you peace, good health, and happy times.

Toni Fiore Lisi, FES Chair

Thank you to Katherine Dunnell, Dr. Soren Brothers, and Doug Gibson for contributions to this newsletter.

New Mineral Acquisition, thanks to the Friends of Earth and Space

By Katherine Dunnell, Mineralogy Technician, ROM

Veszelyite [$(Cu,Zn)_2Zn(PO_4)(OH)_3 \cdot 2H_2O$] is a rare secondary copper and zinc mineral that is found in the oxidation zones of base metal (copper, lead, nickel, and zinc) deposits. Crystals of veszelyite are typically emerald-green, blue or a mixture of the two. They can be found as small clusters that are peppered across other minerals or as crusts. Our newly acquired sample is 14 x 18 x 3 cm and displays mostly dense aggregate clusters with associated minerals of kipushite (phosphate) and hemimorphite (zinc silicate).

The specimen is from the Republic of Congo, which is a country just west of the Democratic Republic of Congo and north of Angola. The Palabanda quarries were mined in the early 1940s and 1960s with the last mining company leaving the area in 2018.

Figure 1 Palabanda Quarries, 2018. © Spirifer Minerals.

The minerals found in Palabanda are diverse, secondary zinc and copper minerals found in brecciated zones within the carbonate (dolomite) host rock. The most interesting mineral species from Palabanda is veszelyite. The mineral dealer who extracted this specimen noted: “It was found in only one small area of the hemimorphite mineralized zone and only over a distance of 1 meter.”

Figure 2 Brecciated dolomites in situ with cracks by blue veszelyite and green zincolibethenite. © Spirifer Minerals.

This acquisition is a significant upgrade to any of the current veszelyite we have in the ROM collection (8 currently in the collection). The size alone of this specimen makes it our best veszelyite and from a new locality not represented currently in the ROM mineral collection.

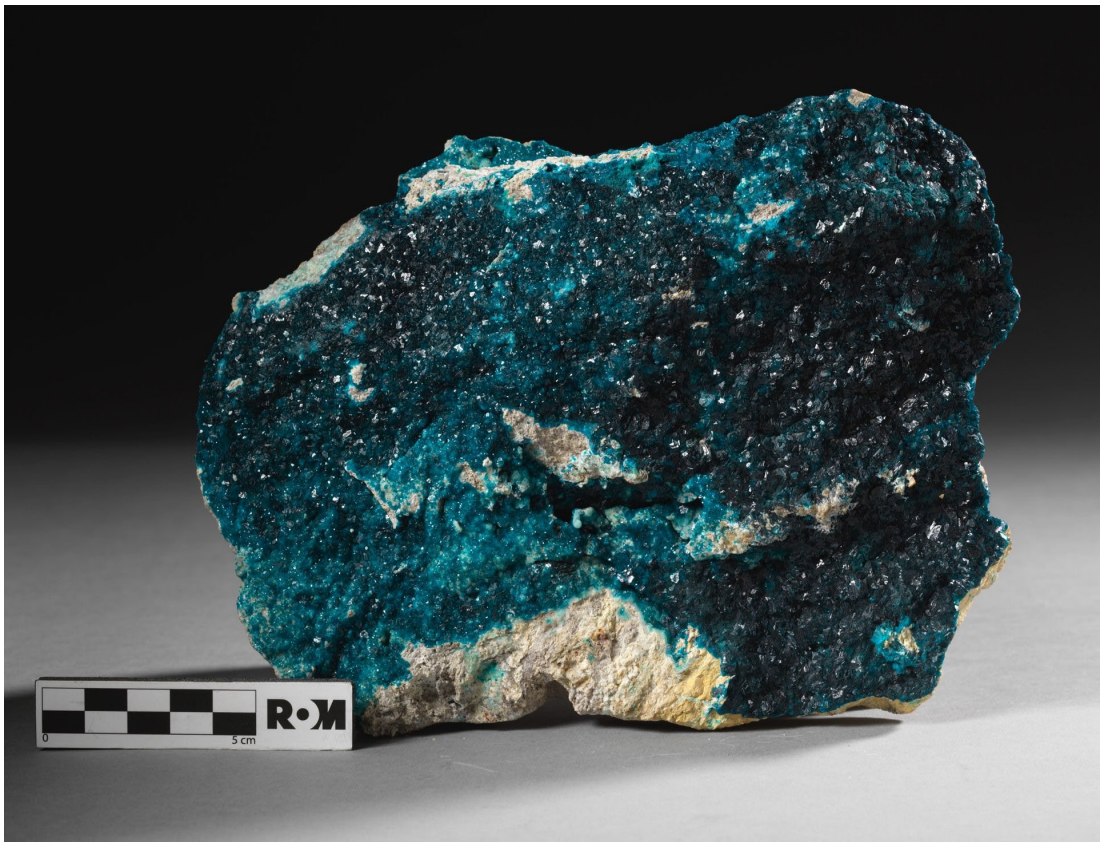

Figure 3 Veszelyite with kipushite on dolomite, Palabanda Quarries, M'Fouati District, Bouenza Department, Republic of Congo, ROMESM60238. © Royal Ontario Museum.

The First Step in Planetary Defense

By Doug Gibson, FES member

As there are thousands of small asteroids 100-200 meters in diameter crossing Earth's orbit, the time has come to think of planetary defense. A 100-200 meter asteroid could decimate a city, and we simply cannot track them all. Many of these come within a few million kilometres of Earth, and we would likely have time to compute their orbits and develop an action plan for an asteroid in a collision orbit.

The DART Mission, (Double Asteroid Redirection Test) was launched on a SpaceX booster from Vandenburg Air Force Base in California on November 24. The purpose of the mission is to deliver a direct blow to a near-Earth asteroid, Dimorphos, in September of 2022 in order to change its orbit. Though this asteroid poses no threat to us, this method could be applied to an asteroid on a collision course with Earth. The spacecraft is furnished with solar panels which will provide the electricity to run an ion engine that

will propel the 500 kg DART into a 160-meter-diameter asteroid at a speed of 6.6 km/second. In size, the collision has been likened to a golf cart crashing into a stadium. The resultant force should change the orbit of the asteroid which orbits a larger 700-meter asteroid. Scientists will observe the effects by telescope to determine how effectively the orbits are changed. A European Spacecraft named HERA will visit the asteroid pair in 5 years for a final analysis of the change.

Figure 4 DART spacecraft and the Italian Space Agency's (ASI) LICIACube.
© NASA/Johns Hopkins, APL/Steve Gribben.

Hopefully, this method could alter the course of an incoming asteroid enough to avoid a potential collision with Earth. The scenario in the 1998 movie "Deep Impact" involved the use of nuclear weapons to fragment an asteroid on such a collision course. In the movie, the collision fragmented the asteroid into smaller bodies but did not change the orbit. The impact of an asteroid cloud was less damaging but still severe. It would be preferable to change the orbit of the whole asteroid with a non-nuclear impact to avoid potential collision altogether. This is the object of the DART Mission.

FES Meets Dr. Soren Brothers

By Doug Gibson and Toni Fiore Lisi, FES members, with contributions by Dr. Soren Brothers.

The Friends of Earth and Space had the pleasure of listening to a most interesting talk by Dr. Soren Brothers, ROM's inaugural curator of climate change – the first position of its kind within museums in N. America and possibly in the world.

Figure 5 Dr. Soren Brothers in the field. © Wayne Wurtsbaugh.

Originally from Toronto, Dr. Brothers comes to us most recently from Utah State University where he was involved in research projects and fieldwork as well as in designing and teaching courses in Fundamentals of Watershed Science, Aquatic

Ecology and Advanced Limnology. He has been involved in numerous publications, and his research and fieldwork span several countries within N. America and beyond.

As Dr. Brothers' specialty is limnology (the study of inland aquatic systems), the presentation focused on some of his research, in particular, the manner in which water and carbon interact in a climate change context. He began by talking about freshwater ecosystems – and surprising to us, he indicated how much CO_2 they produce. An overview of Earth's water situates 96% in oceans, 3% in ice and snow, 1% in groundwater, .02% in lakes, .001% in water vapor in the atmosphere and only .0001% in biomass (plants and animals). Although representing a small percentage, the latter three drive the hydrological cycle, and play a huge role in global carbon cycling as well. Lakes 'punch above their weight' in the carbon cycle, for example, by globally sequestering as much organic carbon as the ocean. But Dr. Brothers also pointed out that lakes are also natural net emitters of CO_2 to the atmosphere.

How much greenhouse gas is emitted from inland waters?

Current estimates suggest that lakes and rivers globally emit between 2 and 3 gigatons of carbon as CO_2 to the atmosphere each year. The burning of fossil fuels, by comparison, annually liberates roughly 10 gigatons of carbon as CO_2.

Dr. Brothers also discussed how the way we interact with lakes can influence the carbon cycling within them. For instance, a satellite view of Lake Erie was used to show the multiple ways that humans affect the lake, including eutrophication (nutrient loading from agriculture, visible as green algal blooms in the image), sediment loading from erosion (visible as brown areas), and calcite precipitation events in the lake (resulting from reduced acidity of the water, and visible as white areas of the lake). He then discussed how each of these might be expected to alter the lake's carbon sequestration and emission rates. For instance, Dr. Brothers pointed out that eutrophication promotes algal blooms in the lake, which take up CO_2 and can turn the lake from a source into a sink for atmospheric CO_2.

However, he warned that a byproduct of algal blooms can be the development of anoxic conditions (when the lake waters lose all oxygen). In addition to producing large fish kill events, anoxic conditions also promote the production of methane in lakes. Dr. Brothers pointed out that such other greenhouse gases produced by lakes can have much higher global warming potential than CO_2. For instance, methane is more than 25 times more powerful as a greenhouse gas than CO_2, and nitrous oxide (N_2O) is almost 300 times more powerful than CO_2. Finally, Dr. Brothers touched on some of his new research that

shows how water diversions resulting in lowered lake levels can also produce massive CO_2 emissions from exposed lake beds, constituting a potentially important and overlooked source of anthropogenic CO_2 emissions in arid parts of the world.

The major threat from increased CO_2 is **the greenhouse effect**. As a greenhouse gas, excessive CO_2 creates a cover that traps the sun's heat energy in the atmospheric bubble, warming the planet and the oceans. An increase in CO_2 plays havoc with the Earth's climates by causing changes in weather patterns.

Why is this important?

Link to external article here: Is CO_2 Bad for the Planet?

Dr. Brothers has long been interested in both Science and Politics - and as written in the *Globe and Mail* article, "he has a strong desire not only to understand the world's diverse ecosystems – but to be part of the conversation around managing them."

Link to external article here: ROM's first-ever climate curator

Thank you, Soren, for a most informative and interesting presentation – and all the best as you work to fulfill your mandate at the ROM. May your goal to educate using a more positive approach succeed in inspiring and creating hope.

FES Membership

If the facts and articles in this newsletter have piqued your interest, we hope you will consider becoming a member with a $50.00 tax-receipted donation. For more information, contact us at fes@rom.on.ca.

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Contact FES: fes@rom.on.ca
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