

## **Additional Questions & Answers from the Americas Session**

**Could we get the reference for the nickel model? It is mostly hidden on this slide.**

The data is free for download from GEOSCAN: <https://doi.org/10.1016/j.oregeorev.2021.103985> and the paper reporting the model was just released in Ore Geology Reviews: <https://www.sciencedirect.com/science/article/abs/pii/S016913682100010X>

**What methods are being used to support transdisciplinary communications across work streams, and how is the overall predictive geoscience strategy managed/orchestrated (i.e., staffing, budget)?**

The GSC is also only one part of the much larger Natural Resources Canada. We are lucky to have colleagues at CANMET and policy experts to work on critical minerals across the supply chain.

Communication is one of the main pillars of the Critical Mineral Mapping Initiative. Forums like this allow us to talk about our science and make connections across work streams. Genevieve may want to add more. But the predictive geoscience strategy is integrated within our geoscience programs like GEM and TGI. One of the major projects under TGI is Digital Geoscience. We hope to make our data and models easier to access for predictive modelling.

For the USGS Earth MRI effort we're working across 4 USGS programs that focus on mineral resources, geologic mapping, lidar data acquisition, and data preservation that traditionally work independently to enhance transdisciplinary communication. As well, we're working with across several federal agencies to address the criticality issue. And, we're working with approximately 37 State geological surveys to exchange ideas and prioritize needs at the more local level.

**The conversion from airborne mag to long wavelength mag anomaly was very interesting. Have you considered using satellite mag such as the MF7 that provides similar insights?**

Yes, that was my first thought when considering looking at deep mag boundaries but there are challenges related to shifting those satellite long wavelength anomalies to their correct positions that aren't present in working with the airborne data.

**Will there be a WCOGS effort to create a "data lake", or perhaps data ocean that will bring together all of the amazing internationally sourced CMR data so it can be studied and leveraged by the global geoscience community using AI/ML?**

Yes, one of the projects underway is to create a datacube for five of the datasets that we have prioritized. The group is focusing initially on basin-hosted mineral systems.

**If these deep crustal boundaries deducted from the continental scale geomagnetic data are first order controls on MVT Mineralisation would you recommend this as an exploration tool? Also, maybe you have published this work already?**

The connection between the deep crustal boundaries and the MVT mineralization has been a bit of a surprise but welcome. Yes, I would say these boundaries could be evaluated as a first order control on MVT mineralization. Publication is in preparation.

**I was noticing the pattern of mineral systems in the mid-continent of the US and their proximity to some meteorite impact structures along the 38th parallel. I wondered what your thoughts on the potential contribution of impacts on these mineral systems.**

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The connection between meteorites and mineral systems is so interesting either from the melts that they generate (Sudbury) or the hydrothermal systems that they drive! The deep mag boundaries have been shown to be related to major tectonic features and so far, there hasn't been evidence for impact related structures controlling the boundaries.

### **What is being planned to understand the resource of mine waste/tailings materials?**

The USGS has made this an important focus. Mine waste may also be included within a geochemical portal being developed as part of CMMI.

### **I want more information on how to classify metals as CM, and what are the criteria for that?**

Critical minerals are often defined nationally and the criteria used by each country are often different. The definition of critical minerals can also change through time. That being said there is remarkable agreement between different critical mineral lists, suggesting that many countries are exposed to the same supply risks. They usually involve some kind of mix national security, economic significance, natural scarcity, and demand.

### **Regarding challenges in the longer term, what are your thoughts on geoscience workforce sustainability and how to address it?**

The sustainability of the geoscience workforce with knowledge of economic geology in the US is facing a crisis caused by demographics and lack of funding for university programs specializing in economic and field geology and applied geophysics. The future deficient in young geoscientists to fill the near term needs of industry, academia, and government agencies is real and will need a sustained effort to support education and government's abilities to fund salaries.

### **We saw in Dr. Labbe's presentation the wonderful new database for Quebec that is easily accessible online and provides lots of geological information at the scale of deposits with a nice map interface. Do the USGS or individual US state surveys maintain similar user-friendly data portals?**

Yes, a lot of the USGS data is online. One good link is: <https://mrdata.usgs.gov/> and <https://usgs.gov/earthmri>.

### **When and where will there be an update to this current status. Will the next meeting be a special meeting such as this or at some national meeting?**

Thanks for the great feedback. I think based on the positive response we may do this again. We have also described some of the work as part of CMMI in an AGU article and an SGA newsletter. The link to the EOS article <https://eos.org/science-updates/geological-surveys-unite-to-improve-critical-mineral-security>, and the link to the recent SGA article is [https://e-sga.org/fileadmin/sga/newsletter/news\\_48/SGANews48\\_low.pdf](https://e-sga.org/fileadmin/sga/newsletter/news_48/SGANews48_low.pdf)

### **Since Critical Minerals associate themselves as traces within deposits is there a interest to work alongside current mining projects that are IOA/IOCG and Pb/Zn deposits that contain mineable precious and base metals to leverage side production of these materials?**

Yes, the CMMI is very interested in critical minerals that occur as byproducts. One of the challenges is that we don't have a lot of good quality data because the concentrations are so low. As part of CMMI we are collecting data from mineralized rocks and some mine wastes to determine their critical mineral content. The results of that work will be published as an online portal sometime this year.

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**How do seafloor minerals, like ferromanganese crusts, manganese nodules, and seafloor massive sulfides fit into the critical mineral strategies for Surveys of North America? And can they offer smaller footprint mining operations that may be less impactful to earth surfaces in the long run?**

All critical mineral-bearing deposit types are of interest in the US and those that are both critical mineral- and base metal-bearing are being considered in the USGS Earth MRI effort. However, development of such deposits comes down to the economics of ore grades, tonnage, and extractability, issues of which are the purview of private industry.

In the marine zones of national jurisdictions, it will largely depend on their local policies, and degree of research on each type of deposit, technology development for both, exploration and exploitation, and geological conditions for the occurrence of the three types of deposits (polymetallic nodules, crusts, and sulphides), and even the participation, or not, of contractors. On the other hand, in international waters deep sea mineral resources are administered by the International Seabed Authority (ISA), who through its Legal and Technical Commission and technical groups have produced or drafted regulations and the generation of standards and guidelines for prospection to exploitation, and environmental aspects. The information produced by the ISA may be a good reference material for the implementation of national initiatives, policies and practices on marine mining of the deep sea.

**How are geological surveys and mining companies communicating with academic departments to emphasize the need for educating students in traditional geology in combination with new technology/modeling/machine learning, etc.?**

Such an important point. Training is probably one of the most important legacies of geological survey organizations. Many students that work with the GSC go on to work in industry.

Numerical literacy will have to be an important part of that training.

Agreed, excellent point. The USGS is working with Colorado School of Mines, for example, on geophysical problems but more of that needs to occur.

**I understand the criticality of the various minerals is really at the final product level and not at the exploration level. Will some strategies be developed to discourage the acquisition of critical mineral projects by "developers" who will make them scarce?**

Most of our focus is on geoscience. The strategic acquisition of critical mineral resources is being discussed by policy experts.

**What potential do you see in use of spectroscopy and hyperspectral imaging of critical mineral resources in your countries? How do you envision multinational collaborative efforts support these needs?**

Hyperspectral imaging is a great tool in Canada's north and new activities are being proposed as part of the Targeted Geoscience Initiative to map the footprints of mineral systems remotely.