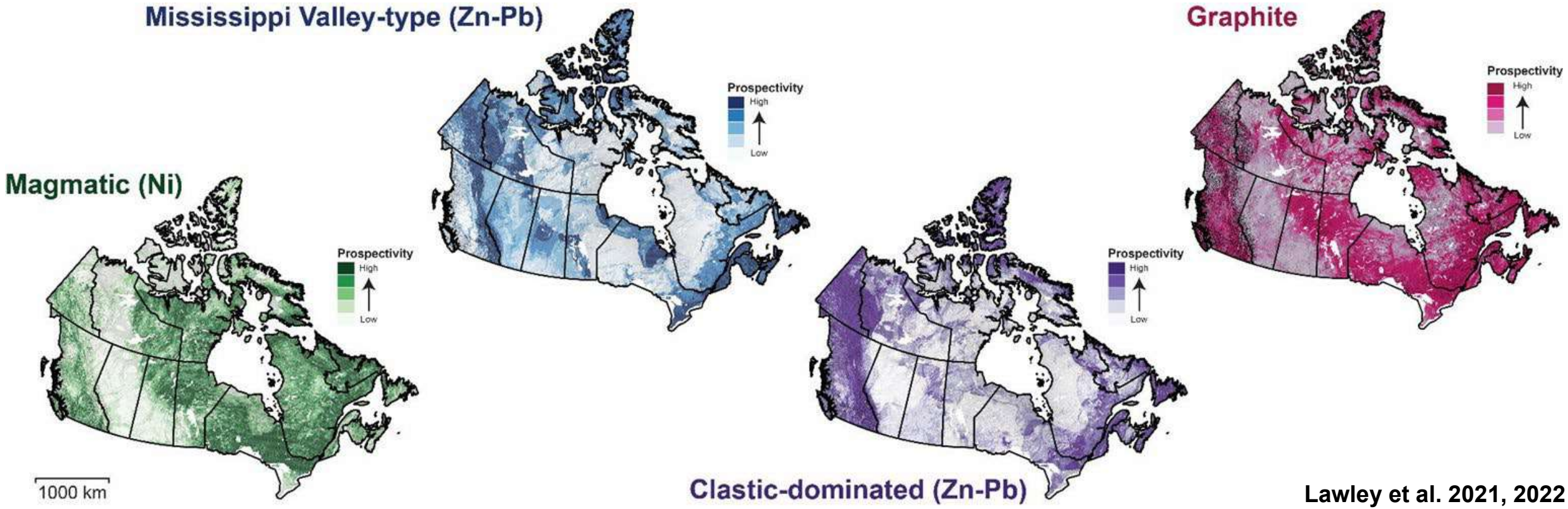
Mineral intelligence

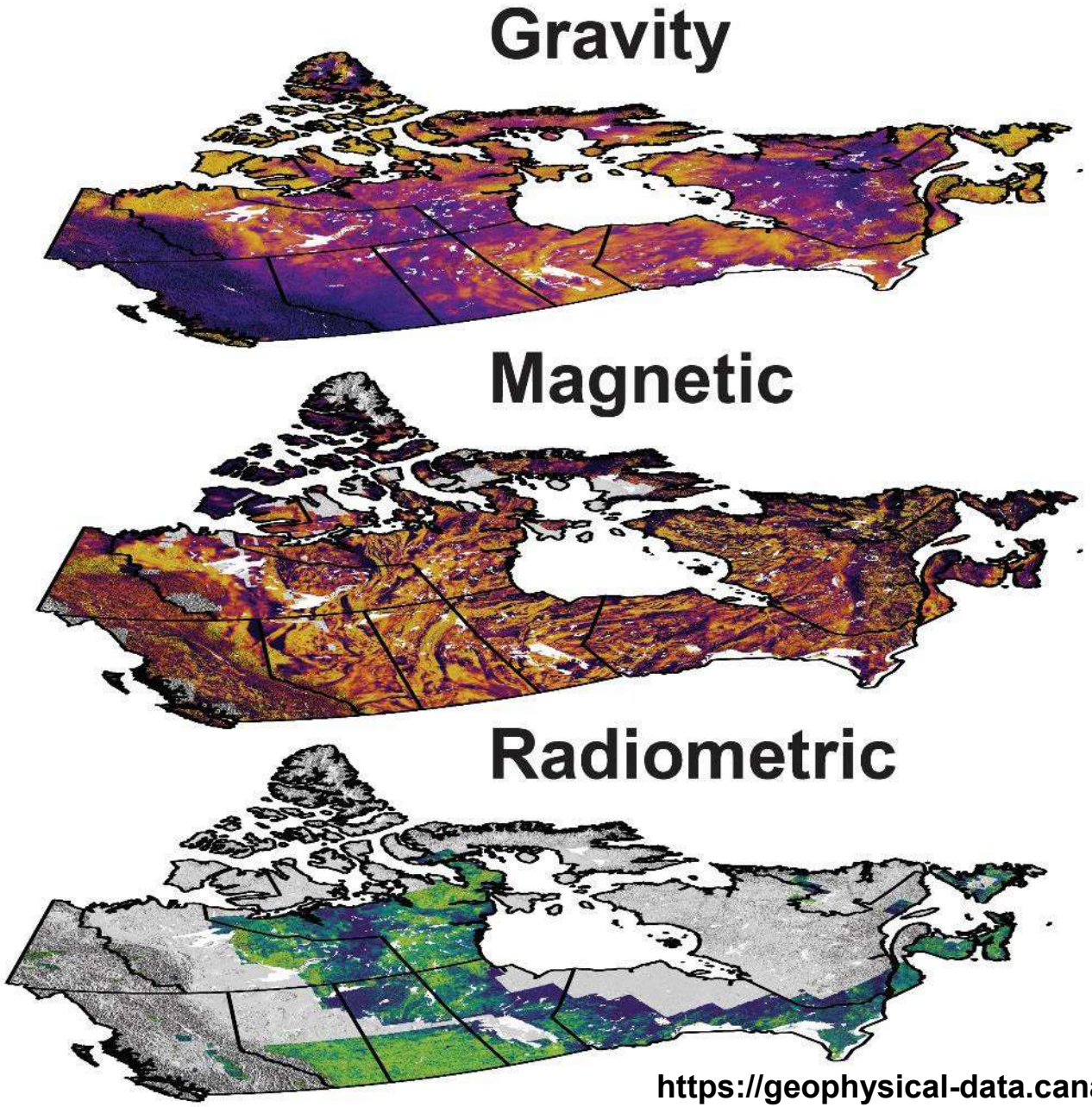
- Building families of national-scale prospectivity models based on public geoscience
- Interactive versions are available on www.geo.ca
- Other AI research is focused on 3D modelling, geophysical and geochemical data processing, natural language processing (NLP), ESG, and AI method development



Lawley et al. 2021, 2022

Public geoscience data and technology

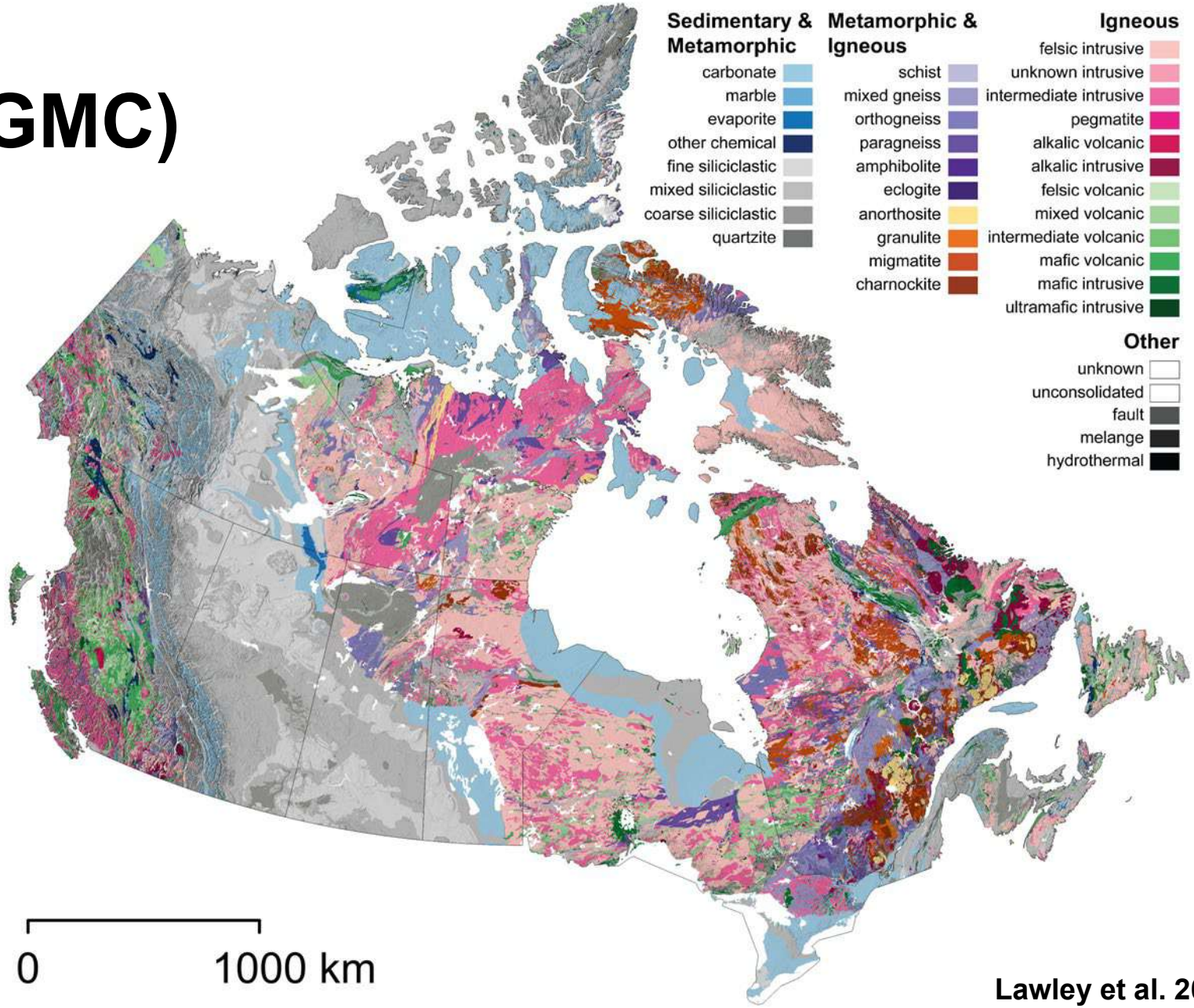
- Reliability of down-stream AI applications depends on the quality of the public geoscience used for training the models
- Other key data assets include seismic, magnetotelluric, radiometric, geology, geochemistry, geochronology, groundwater, permafrost, publications, and more!
- Important investments on developing new conceptual models for ore formation



https://geophysical-data.canada.ca/

Canada Geological Map Compilation (CGMC)

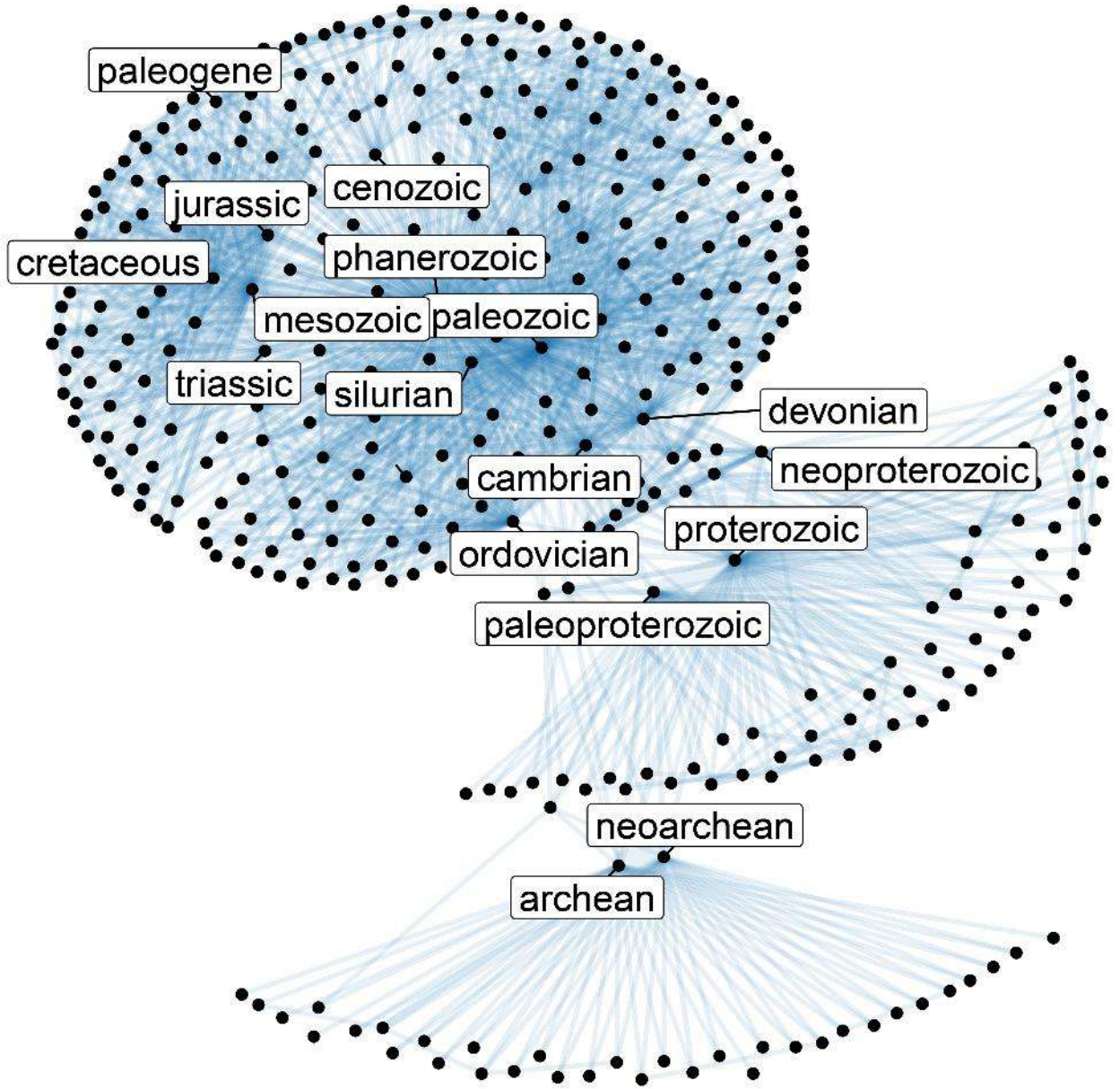
- Combined map data from 35 public geological maps
- Not a standard paper-based map
- Overlapping, multi-resolution, variable reliability
- Built for down-stream machine learning applications
- Free to download: https://doi.org/10.4095/pf995j5tgu



Lawley et al. 2024

Knowledge discovery

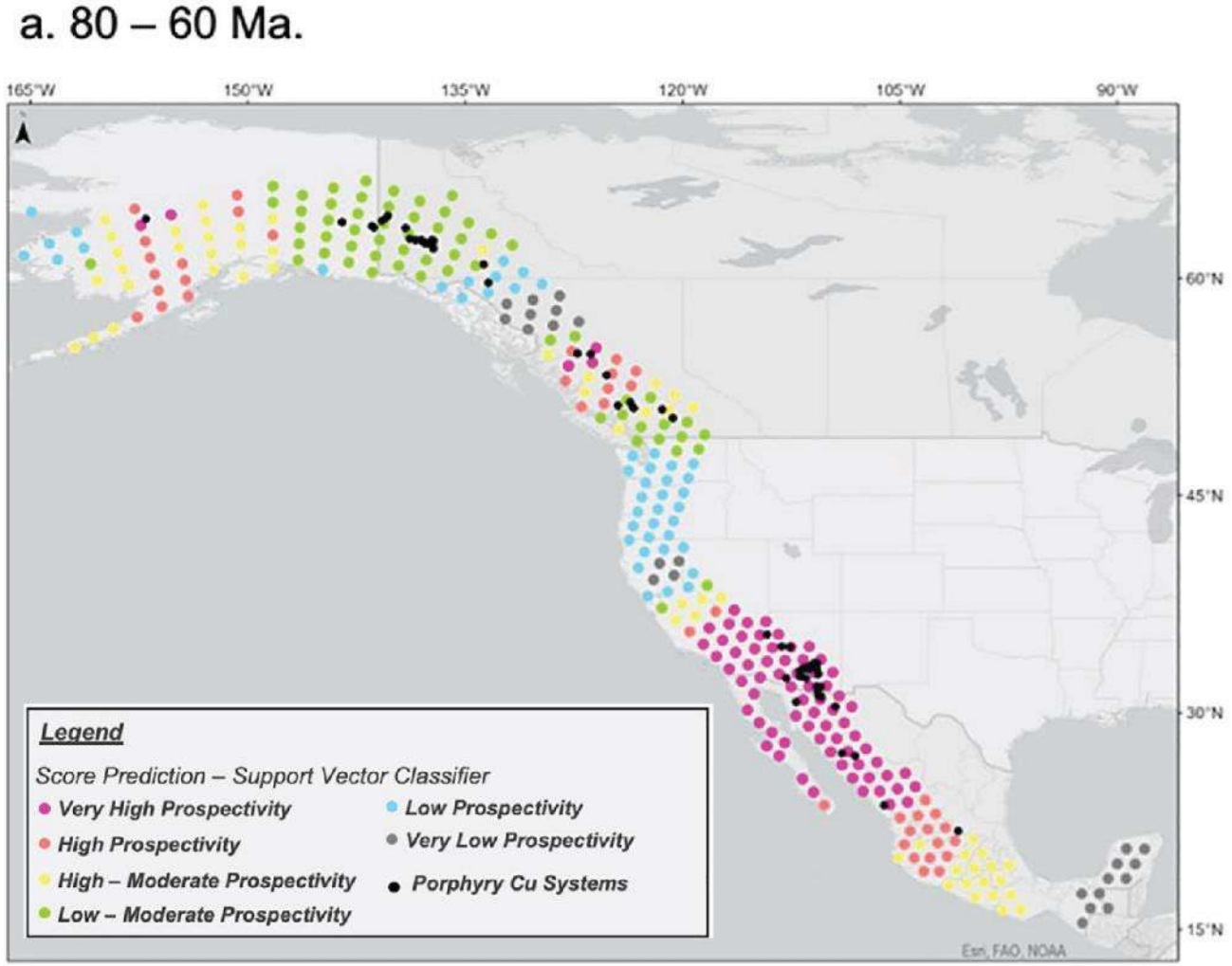
- Geological maps are important sources of lithostratigraphic information and other text data
- Each node on the network is an age or a geological name
- Each edge of the network reflects how often the two nodes co-occur
- New research is focused on whether these types of graphs can be used to predict associations between lithostratigraphic and lithodemic units



Lawley et al. In prep

Space-time models for critical minerals

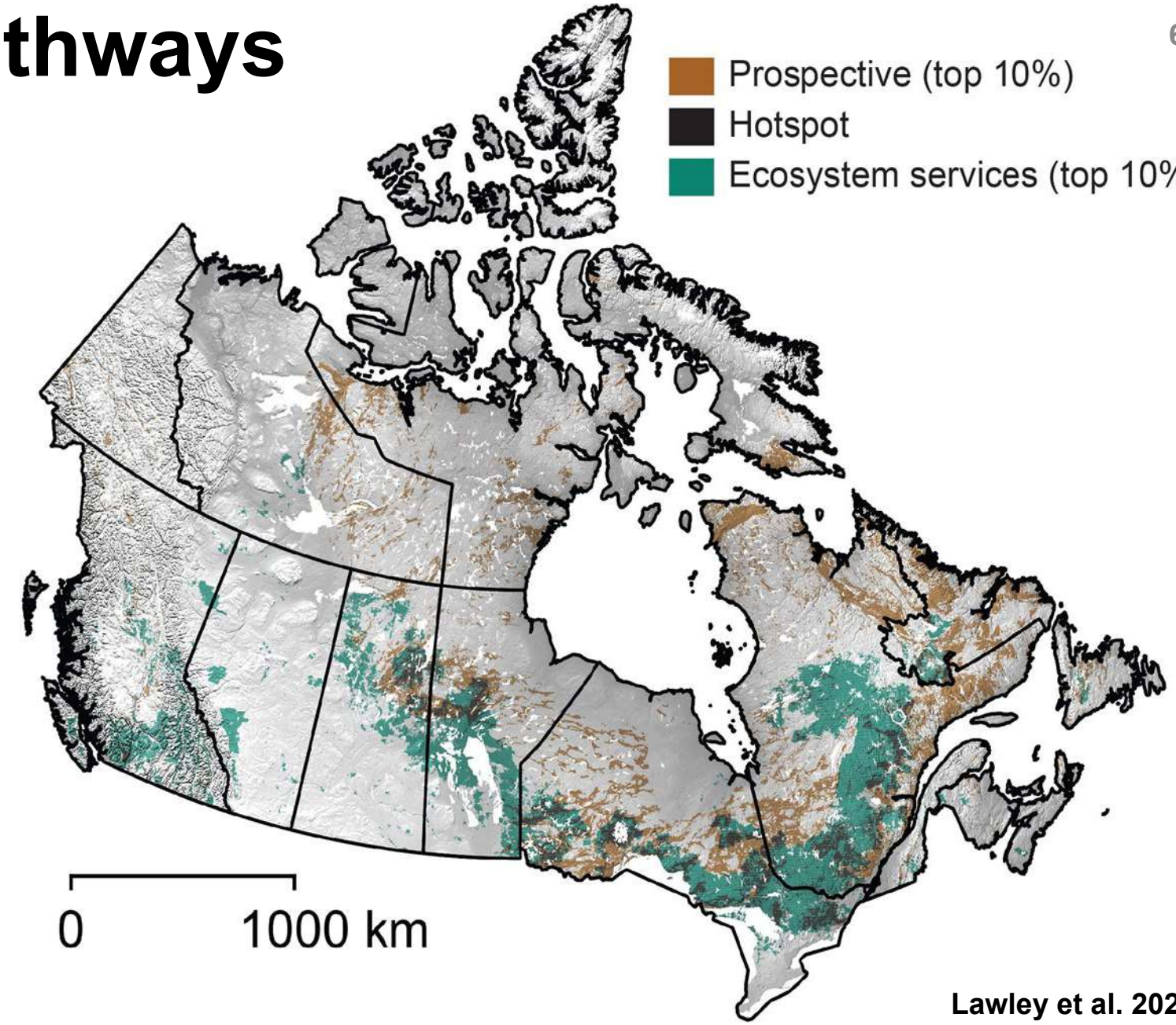
- Incorporating geological time is critical for assessing mineral potential;
- New research focus on paleo-tectonic re-constructions provide more accurate proxies for the sources of mineral systems (e.g., brine-generating regions across Canada the U.S.)
- Other examples could include the impact of convergence speed for porphyry mineral systems (left)
- These types of continent-scale datasets provide an excellent opportunity for collaboration



Diaz-Rodriguez et al. 2021

Green economic pathways

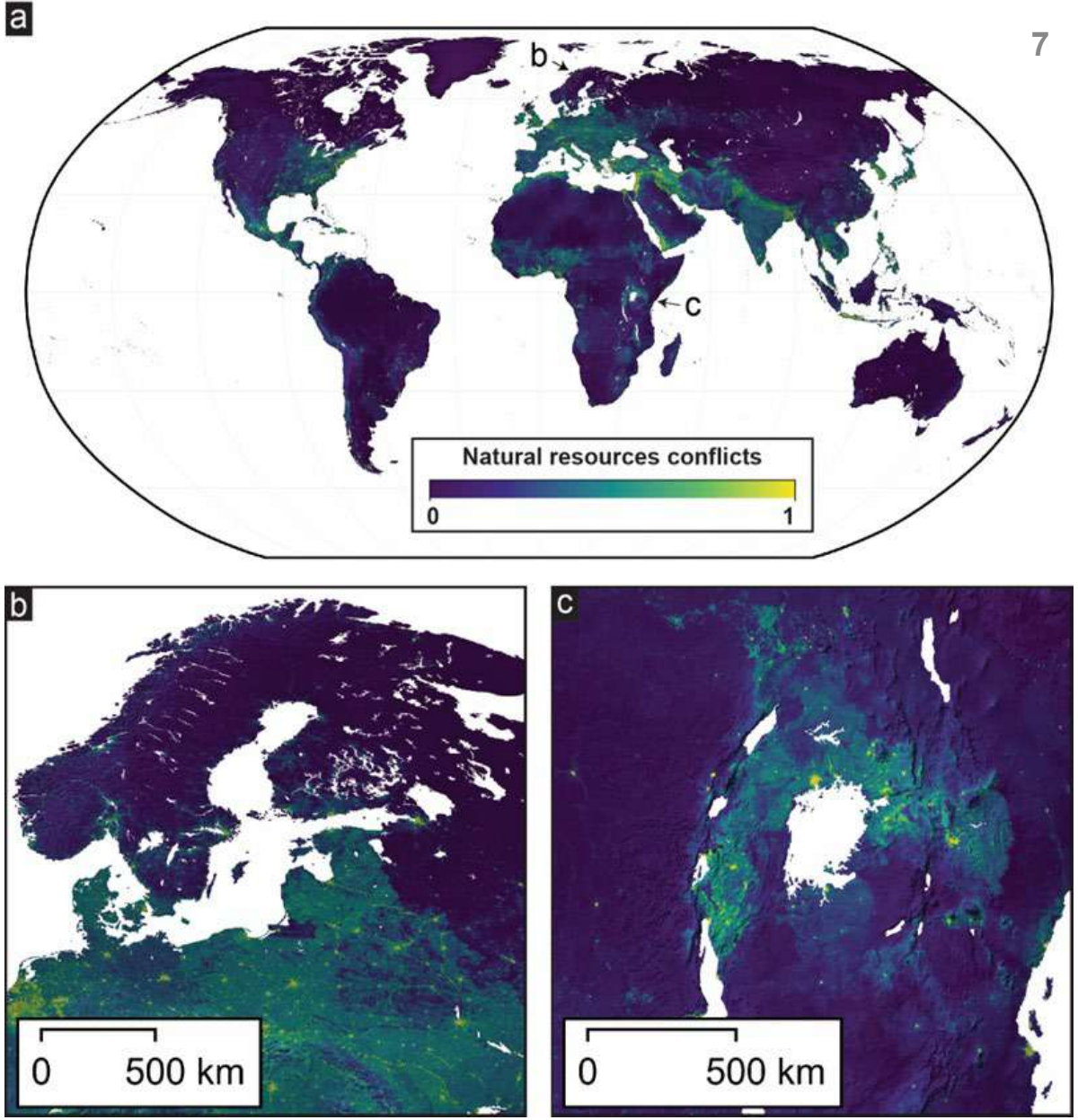
- Canada set to double its protected areas by 2030
- Combine public geoscience data with ecosystems services to predict areas that are prospective for critical minerals (Ni) and are ecologically important
- Working with Parks Canada to integrate prospectivity modelling into land-use planning
- Must balance critical mineral exploration with conservation and biodiversity values



Lawley et al. 2022

Deep learning to predict supply chains disruptions

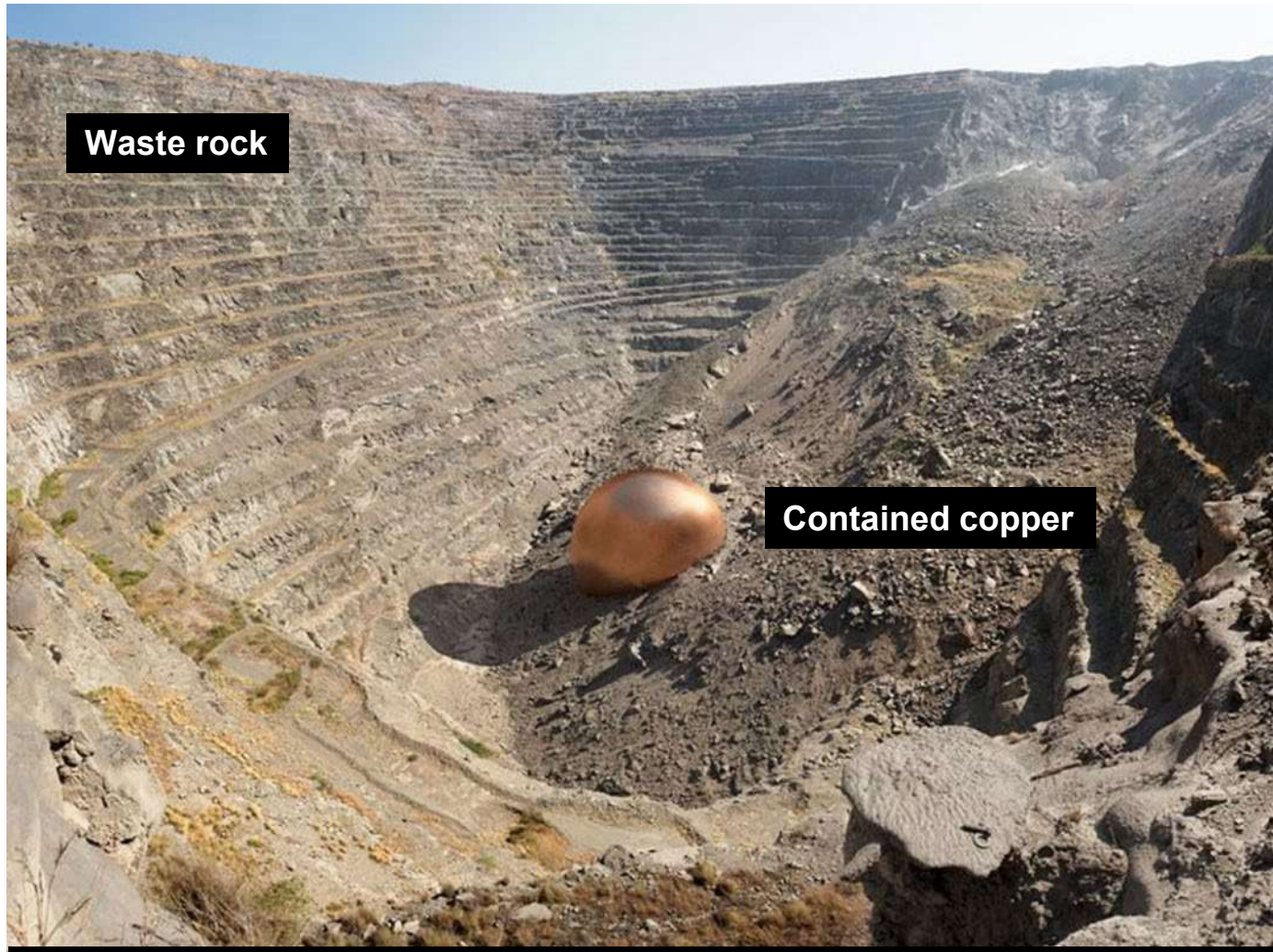
- Conflict events identified through news stories using AI (Halterman et al. 2023) and deep learning used to process public ESG data and predict disputes, protests, and other "conflict" events related to minerals
- Results reveal land access as a major source of conflict
- Part of an emerging field of geospatial ESG mapping (pre-competitive)
- ESG is ultimately about sustainability and that means doing things better with less



Lawley et al. submitted

Nature positive vision requires mineral intelligence

- Resources extraction linked to 90% of biodiversity loss globally (IRP, 2019)
- Industry moving to "nature positive" vision (i.e., reverse biodiversity decline by 2030)
- Public geoscience can help achieve ESG goals through re-purposing of existing research (e.g., geometallurgy, geo-environmental models, traceability, mine waste inventory) and new science (e.g., life cycle analysis, geospatial ESG)



Artist's impression of contained copper within an open pit mine; Dillon Marsh

Stronger supply chains requires mineral intelligence

Diversification is a key strategy for securing the supply chains of critical minerals:

(1) Identify new ways of mining secondary sources (e.g., recycling; waste)

(2) Apply artificial intelligence to discover substitute materials

(3) Support the mineral exploration industry to find new primary sources of critical minerals with higher ESG

Szymanski et al. 2023

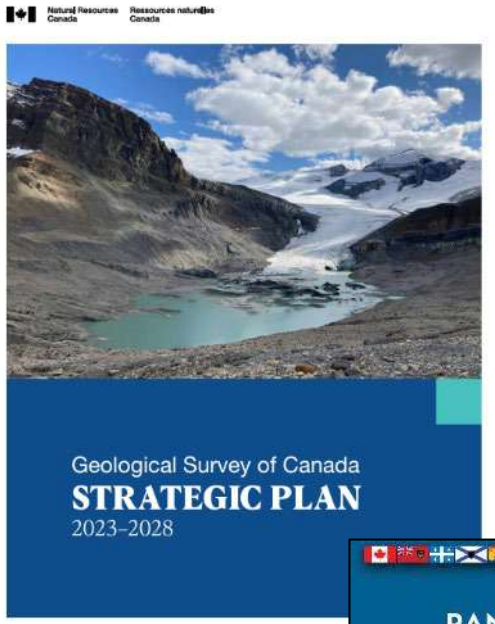
For more information

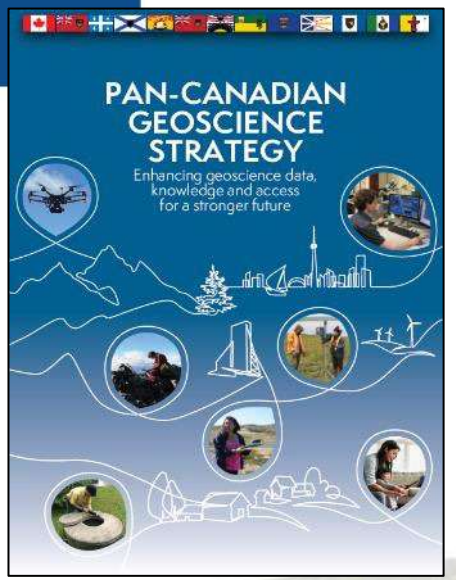
- **Website** (includes links to databases, publications, program information, contacts, and more) – https://natural-resources.canada.ca/science-and-data/research-centres-and-labs/geological-survey-canada/17100

  Plus https://geo.ca/initiatives/critical-minerals

- **GSC 2023-2028 Strategic Plan:** https://natural-resources.canada.ca/sites/nrcan/files/earthsciences/pdf/GSC2023-2028_acc_e.pdf

- **Pan-Canadian Geoscience Strategy** (collaborative endeavour with provinces and territories) – https://www.geologicalsurveys.ca/pan-canadian-geoscience-strategy





Canada