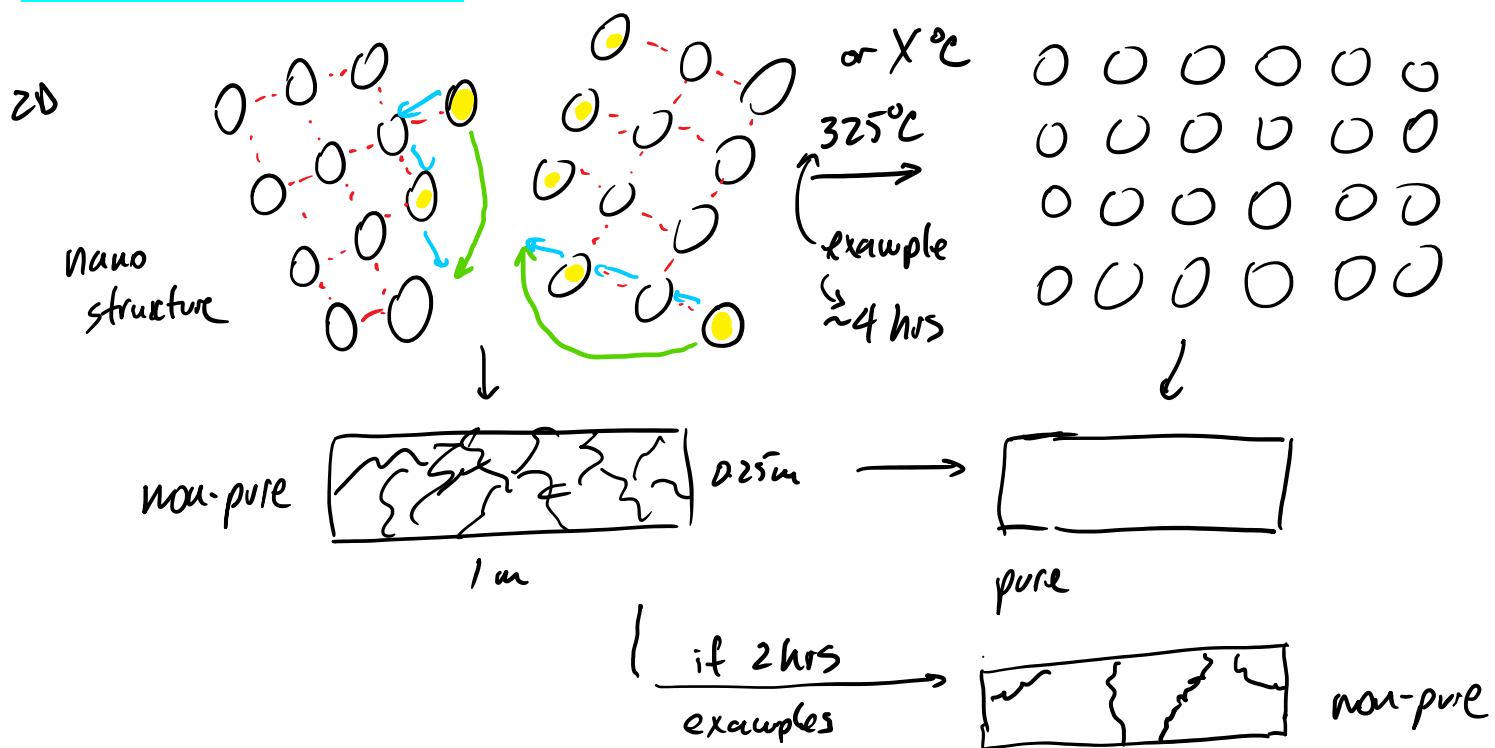
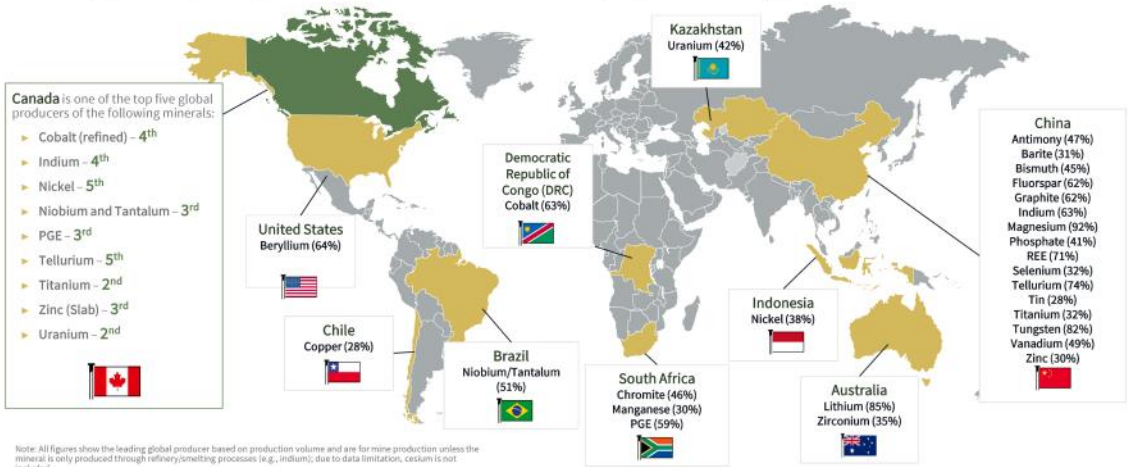


# Thermodynamics and Kinetics



2.3 Leading Critical Minerals Producers

- To understand the global market and supply chain for critical minerals, global mineral production data was assessed in order to identify the top producer for each mineral and their respective market shares. Based on 2019 production volumes, China dominates the global critical minerals mining market with the highest production share in 16 minerals included on Ontario's critical minerals list.
- Ontario's endowment with critical mineral deposits represents an opportunity for the province to produce and market responsibly procured natural resources to some of the major jurisdictions, including the US and the EU, whose advanced industries rely on global minerals' supply chains.



## 2.4 Substitutability and Importance in Major Jurisdictions

- Some industrial applications can use multiple source materials, while others require very particular and limited inputs. In order to assess the substitutability of each critical mineral, this report analyzes each mineral's applications and availability of alternative materials with comparable properties and performance for the most common industrial needs.
- Assessing substitutability with the mineral's criticality status in major jurisdictions (as defined by national critical minerals frameworks in each country included in the analysis) provides a view of the overall economic and strategic importance of these minerals on a global scale.

Table 7: Ontario's Critical Minerals: Substitutability and Importance in Major Jurisdictions

Mineral	Status in Ontario	Substitutability (Low-High)	Minerals Included on Critical Minerals List						
			EU	US	UK	Canada	Japan	Australia	Total Jurisdictions
Antimony	Exploration Project	Moderate	✓	✓	✓	✓	✓	✓	6/6
Barite	Advanced Mineral Projects	Moderate	✓	✓					2/6
Beryllium	Exploration Potential	Low	✓	✓	✓			✓	4/6
Bismuth	Exploration Potential	High	✓	✓		✓		✓	4/6
Cesium	Exploration Potential	Moderate		✓		✓			2/6
Chromite	Advanced Mineral Projects	Low		✓		✓	✓	✓	4/6
Copper	Produced and Processed	Low				✓		✓	2/6
Cobalt	Produced and Processed	Moderate	✓	✓	✓	✓	✓	✓	6/6
Fluorspar	Exploration Potential	High	✓	✓	✓	✓			4/6
Graphite	Advanced Mineral Projects	Moderate	✓	✓	✓		✓	✓	5/6
Indium	Produced	Low	✓	✓	✓	✓	✓	✓	6/6
Lithium	Advanced Mineral Projects	Moderate	✓	✓		✓	✓	✓	5/6

Note: Status in Ontario indicated the most advanced stage for a given mineral. Most minerals that are produced as of 2021 also have advanced mineral projects and exploration potential. Complete critical minerals lists of comparable jurisdictions are provided in [Appendix B](#).  
Sources: United States Geological Survey (USGS); Critical Minerals lists of the EU, the US, the United Kingdom (UK), Japan, Canada, and Australia (Critical mineral lists of major jurisdictions).

## 2.4 Substitutability and Importance in Major Jurisdictions (continued)

Mineral	Status in Ontario	Substitutability (Low-High)	Minerals Included on Critical Minerals List						
			EU	US	UK	Canada	Japan	Australia	Total Jurisdictions
Magnesium	Advanced Mineral Projects	High	✓	✓	✓	✓	✓		5/6
Manganese	Exploration Potential	Low		✓		✓	✓	✓	4/6
Molybdenum	Exploration Potential	Low				✓		✓	2/6
Nickel*	Produced and Processed	High		✓		✓		✓	3/6
Niobium/Tantalum	Advanced Mineral Projects/ Exploration Potential	Moderate	✓/✓	✓/✓	✓/✓	✓/✓	✓/✓	✓/✓	6/6
Phosphate	Exploration Potential	Low	✓						1/6
PGE	Produced and Processed	Moderate	✓	✓	✓	✓	✓	✓	6/6
REE	Exploration Potential	Moderate	✓	✓	✓	✓	✓	✓	6/6
Selenium	Produced and Processed	Moderate						✓	1/6
Tellurium	Produced and Processed	Moderate		✓		✓			2/6
Tin	Exploration Potential	High		✓		✓		✓	3/6
Titanium	Exploration Potential	Moderate	✓	✓		✓	✓	✓	5/6
Tungsten	Exploration Potential	Low	✓	✓	✓	✓	✓	✓	6/6
Uranium	Processed Only	Moderate		✓		✓			2/6
Vanadium	Exploration Potential	Moderate	✓	✓		✓	✓		4/6
Zinc*	Produced	High		✓		✓			2/6
Zirconium	Exploration Potential	Moderate		✓			✓	✓	3/6

Notes: \*Nickel and Zinc were added to the US Critical Minerals List based on the 2021 US Administration review. Complete critical minerals lists of comparable jurisdictions are provided in [Appendix B](#).  
Sources: USGS; Critical Minerals lists of the EU, the US, UK, Japan, Canada, and Australia (Critical mineral lists of major jurisdictions).