

VISUALIZING COPPER'S GLOBAL SUPPLY-CHAIN



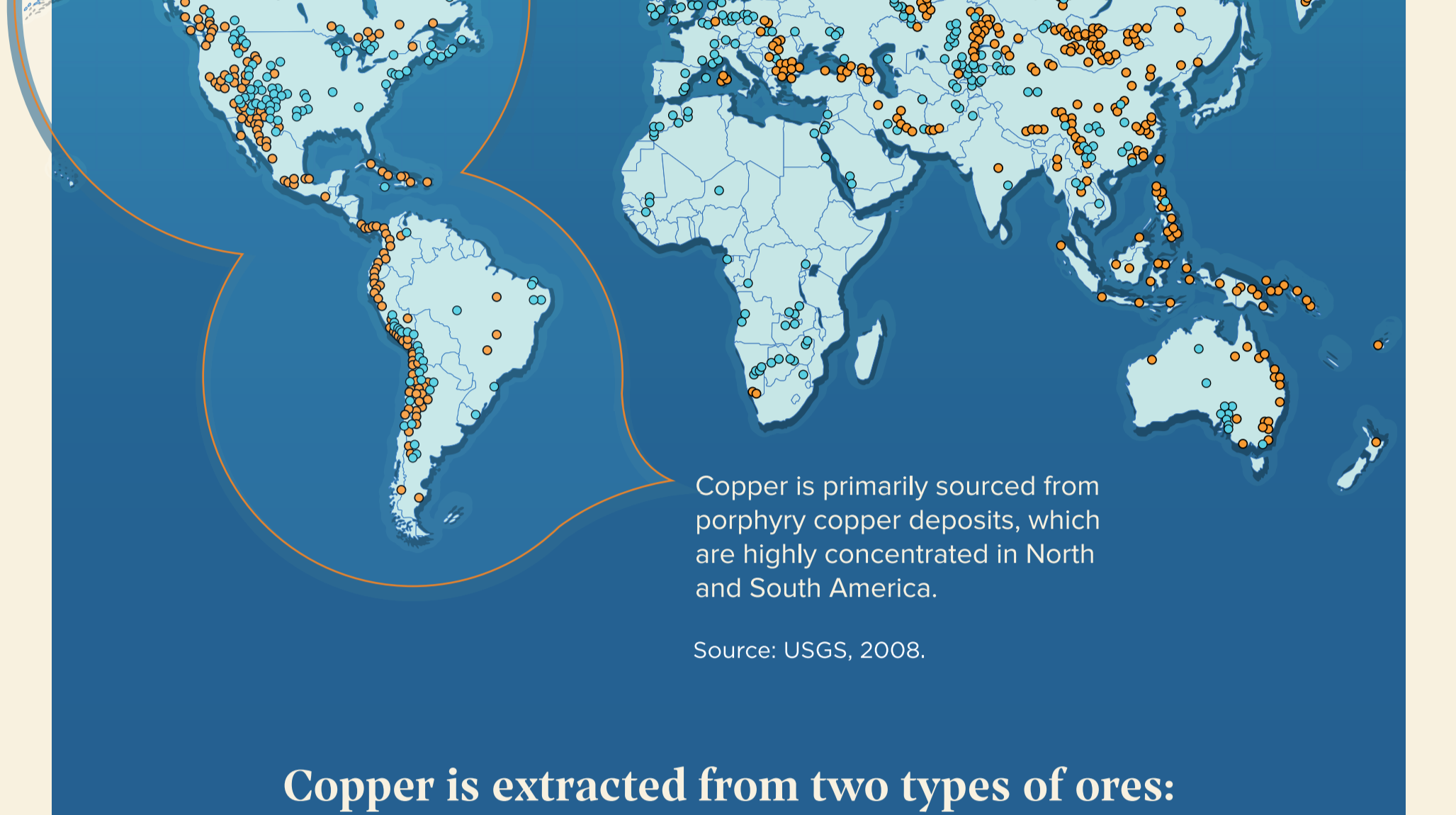
CRITICAL COPPER
POWERING DAILY LIFE
 Copper is an essential part of our daily-lives in more ways than one:

- Electric vehicles
- Smartphones
- Buildings and roofs
- Pipelines
- Household appliances
- Dietary supplements

COPPER DEPOSITS AROUND THE WORLD

Before copper ends up in homes, cars and electronic devices, copper is mined, refined, and transported all over the globe.

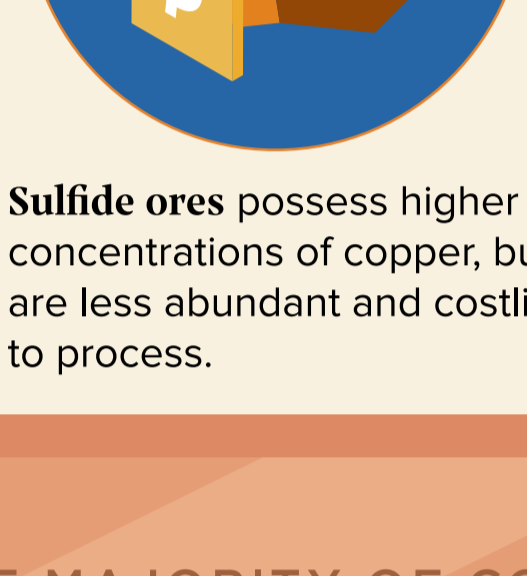
- Porphyry Copper Deposits**
Copper ore bodies formed through hydrothermal fluids from magma chambers that lie deep below the deposit.
- Sediment-hosted Copper Deposits**
Copper deposits in sedimentary rocks, formed through the cooling of copper-bearing hydrothermal fluids.



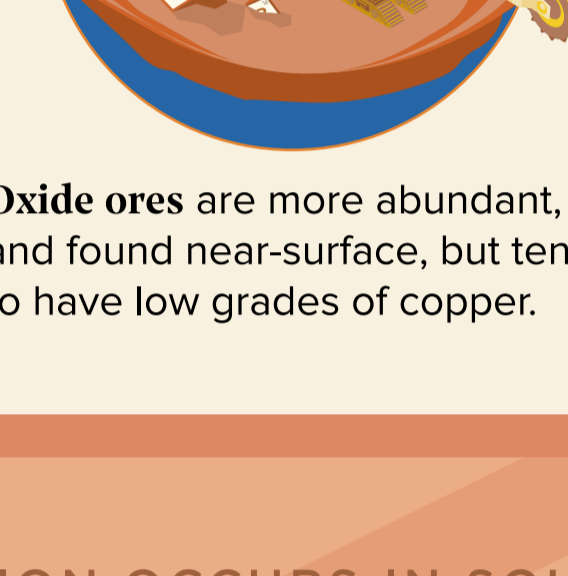
Copper is primarily sourced from porphyry copper deposits, which are highly concentrated in North and South America.

Source: USGS, 2008.

Copper is extracted from two types of ores:



Sulfide ores possess higher concentrations of copper, but are less abundant and costlier to process.



Oxide ores are more abundant, and found near-surface, but tend to have low grades of copper.

THE MAJORITY OF COPPER PRODUCTION OCCURS IN SOUTH AMERICA, FROM WHERE IT IS EXPORTED ALL ACROSS THE WORLD.

TRADE FLOWS OF MINED AND REFINED COPPER

- Flows of mined copper
- Flows of refined copper
- Smelters



Chile is a major source of copper for the world, exporting high amounts of both mined and refined copper.

11 of the **20** biggest copper mines in the world are located in Chile and Peru. In 2019, Chile and Peru collectively produced **40%** of global mined copper.

China is the leading importer and the biggest producer of refined copper. It is home to **9** of the **20** biggest copper smelters in the world.

*Based on data from 2018
 Source: International Copper Study Group (ICSG), United States Geological Survey

The supply of mined and refined copper is concentrated in Chile and China.

- MAJOR EXPORTERS OF REFINED COPPER, 2018**
- Chile
 - Russia
 - Japan
 - Kazakhstan
 - Australia
 - Netherlands
 - Zambia
 - Peru
 - China
 - South Korea

- MAJOR IMPORTERS OF REFINED COPPER, 2018**
- China
 - United States
 - Germany
 - Italy
 - Taiwan (China)
 - Thailand
 - Turkey
 - Netherlands
 - Malaysia
 - South Korea

- MAJOR EXPORTERS OF COPPER ORES AND CONCENTRATES, 2018**
- Chile
 - Peru
 - Australia
 - Mexico
 - Indonesia
 - Spain
 - Canada
 - Mongolia
 - Brazil
 - United States

- MAJOR IMPORTERS OF COPPER ORES AND CONCENTRATES, 2018**
- China
 - Japan
 - Spain
 - South Korea
 - Germany
 - Bulgaria
 - India
 - Russia
 - Zambia
 - Finland

COPPER SUPPLY: RISK FOR THE FUTURE?

DECLINING GRADES EXPENSIVE MINING

Average copper mining grades in Chile 1999-2016

Historically, Chile was one of the world's richest sources of copper in the world.

However, Chile's sources of copper have been exploited over time, resulting in falling ore grades.

Falling grades suggest that mining costs are likely to increase in the future, potentially making copper production more expensive.

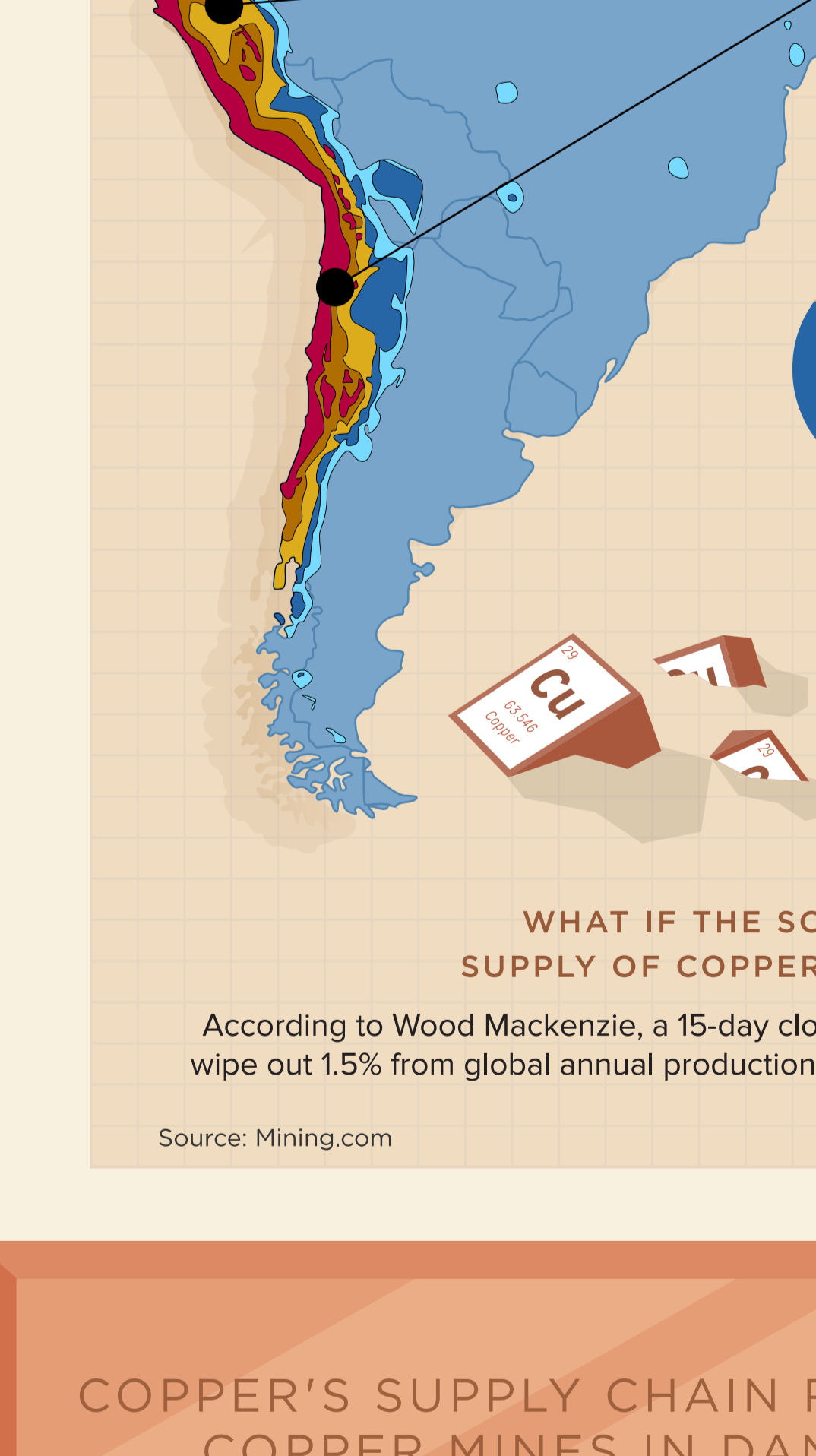
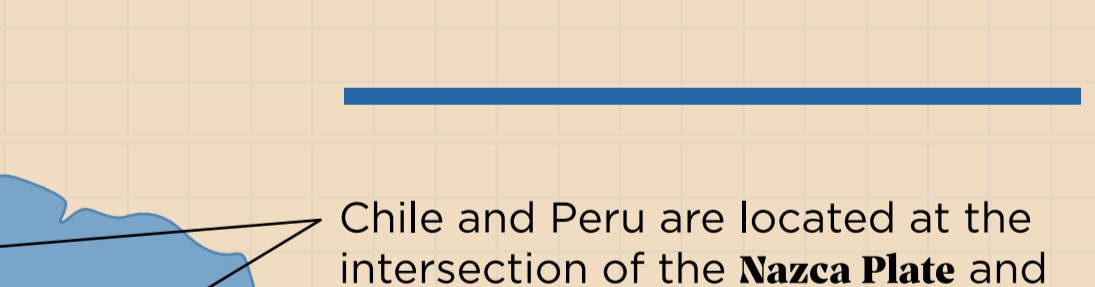


CODELCO, the world's largest producer of copper-based in Chile, needs to spend \$40B by 2027 to maintain current production—10% of the global supply.

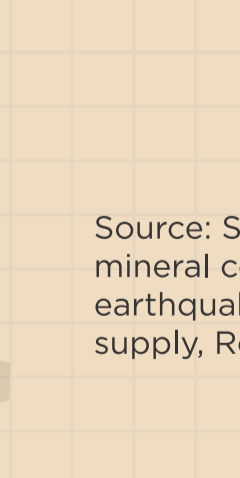
Source: Cochilco

VOLATILE GROUND EARTHQUAKES AND LABOR DISRUPTIONS

CHANCE OF SLIGHT (OR GREATER) DAMAGING EARTHQUAKE SHAKING IN 50 YEARS



Chile and Peru are located at the intersection of the **Nazca Plate** and **South American Plate**.
 Movement in these tectonic plates produce powerful, damaging earthquakes.



According to a study, regions in Chile and Peru face a **>85%** chance of a damaging earthquake in the next 50 years—potentially disrupting several large copper mining operations.

Source: Schnebele et al., Natural hazards and mineral commodity supply: Quantifying risk of earthquake disruption to South American copper supply, Resources Policy, Vol. 63, 2019.

WHAT IF THE SOUTH AMERICAN SUPPLY OF COPPER GETS DISRUPTED?

According to Wood Mackenzie, a 15-day closure of copper mines in Chile and Peru can wipe out 1.5% from global annual production. That's a whopping 300,000 tons of copper.

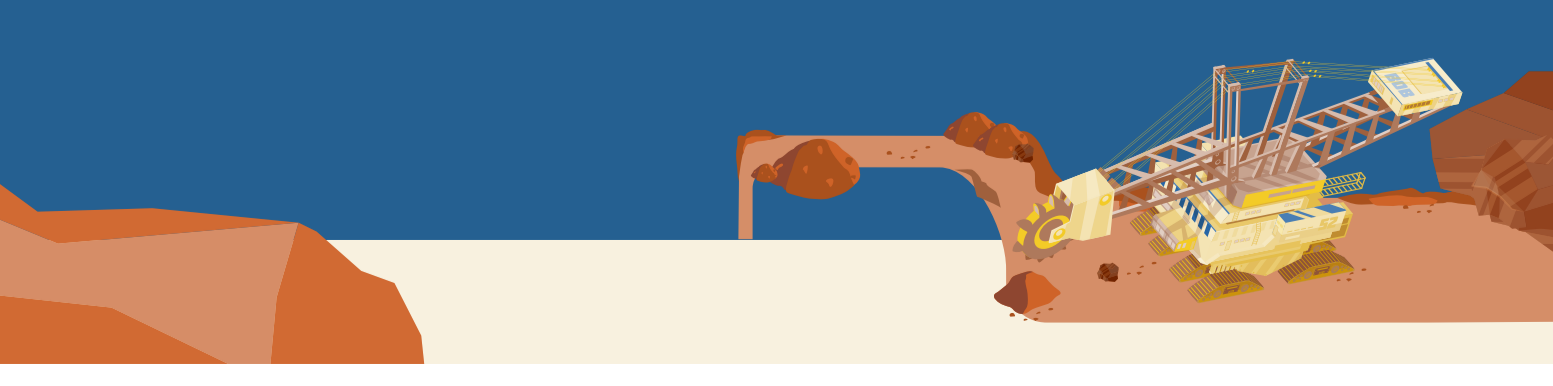
Source: Mining.com

COPPER'S SUPPLY CHAIN RELIES HEAVILY ON AGING COPPER MINES IN DANGEROUS LOCATIONS.

COPPER FOR THE FUTURE? NEW DISCOVERIES NEEDED

As supply grows and infrastructure needs increase, the demand for copper will grow. However, without new discoveries and sources of production, the world could face a shortage of copper as early as 2023.

The gap between committed mine output and primary copper demand opens up almost immediately and grows rapidly during the 2020s



Source: CRU