Do we have enough copper to decarbonise society? An overview of resources/production from porphyry ores/E-wastes

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ABSTRACT

The World Bank identified copper as one of the 17 critical metals/materials necessary for the clean energy transition's success. Copper is essential in at least 8 clean storage and renewable energy technologies and by 2050, the demand for this metal is forecasted to increase to ~29 Mt from 2019 values of ~20 Mt assuming the 2-degree scenario (2DS). To put this increase in demand into perspective, ~550 Mt of copper has been produced for the last 5000 years and this amount is needed in the next 25 years.

Two of the most important copper-bearing materials on the planet are porphyry ores and E-wastes. Porphyry copper ores are low-grade deposits containing 0.2–1% copper and are economically important because of the billions of tonnes of minable ore they contain. Meanwhile, E-wastes—known technically as waste electrical and electronic equipment (WEEE)—is globally the largest copper-bearing waste category since the 1980s and its generation is projected to reach 243 Mt by 2050.

In this mini-review, copper resource availability and challenges/opportunities in copper processing from porphyry ores and E-wastes are explored. As of 2020, the global copper reserve stands at 870 Mt while the average global end-of-life (EoL) E-wastes recycling rate is around 43%. By assuming copper consumption of 29 Mt/year, the current global copper reserve will likely be depleted after 53 years. Meanwhile, challenges in copper extraction due to arsenic-rich/"dirty" concentrates and loss of fine copper-bearing minerals to tailings during flotation have become commonplace. Some strategies proposed to address these issues include pretreatment/direct leaching of "dirty" concentrates and agglomeration-flotation. Finally, recycling of E-wastes using existing smelter facilities is efficient, but this approach is difficult to implement in low- and middle-income countries because of economic and specialised know-how constraints, so alternative, less costly and more environmentally friendly strategies need to be developed.

Keywords: Copper; Porphyry copper ores; E-wastes; Mineral processing; Dirty concentrates; Recycling