Copper production in Chile requires 500 million cubic metres of water

Assessing water use by Chile's copper mining industry

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Metal mining has an important impact on the local water availability and scarcity. Chile as the world largest copper producer is a front-runner regarding the reporting of water use by mining. In this Brief, we describe the main aspects to be taken into consideration when accounting for water use in mining and quantify the water use by the Chilean copper industry in 2018. We also provide an outlook to the FINEPRINT approach to estimating water use in global copper mining.

Since 1970, global raw materials extraction has grown by more than a factor of 3, and the extraction of metal ores even by a factor of 3.6. This development also has strong implications for global water use, as the extraction and processing of raw materials require vast amounts of water. While crop production is still the largest consumer of water worldwide, industrial processes, such as energy production, pulp and paper production or mining are catching up. Projections show that until 2050 global water use will increase by 55%, and industrial water use will have outpaced agricultural water use, with industry-related abstraction levels more than tripling between 2000 and 2050 [1].

In comparison to other sectors, the metal mining industry plays a minor role in terms of overall water quantities used. Nonetheless, the sector is of outstanding hydrological significance. In their specific areas mines are often the dominant local water consumer with large impacts on water availability and scarcity, as well as water quality. Rivers are diverted, groundwater bodies diminished, and the chemicals used for processing and concentration pollute down-stream water bodies. All these environmental impacts result in a competition between the respective mines and the local population. If not managed well, this competition can lead to social conflicts. However, understanding the mining sector's role in the hydrological cycle is not only important for local water management, but also for the analysis of global supply chains, as metals and minerals are the basis for a large variety of consumer goods.

Accounting for water use in the mining sector

Water is used at multiple locations in a mine, including for dust suppression during mining activities, in froth flotation, or to separate valuable minerals from the non-valuable minerals. Depending on the geographical location of the mine, the sources of water can vary considerably and typically encompass surface water, groundwater, seawater, rainwater, recycled water (i.e. mine water), or water stemming from public water supply. Figure 1 (adapted from [2]) depicts the different stages of water use in a mine. The above-mentioned impacts of mining on the local water resources are closely related to the overall water availability as well as to the source of water in use.

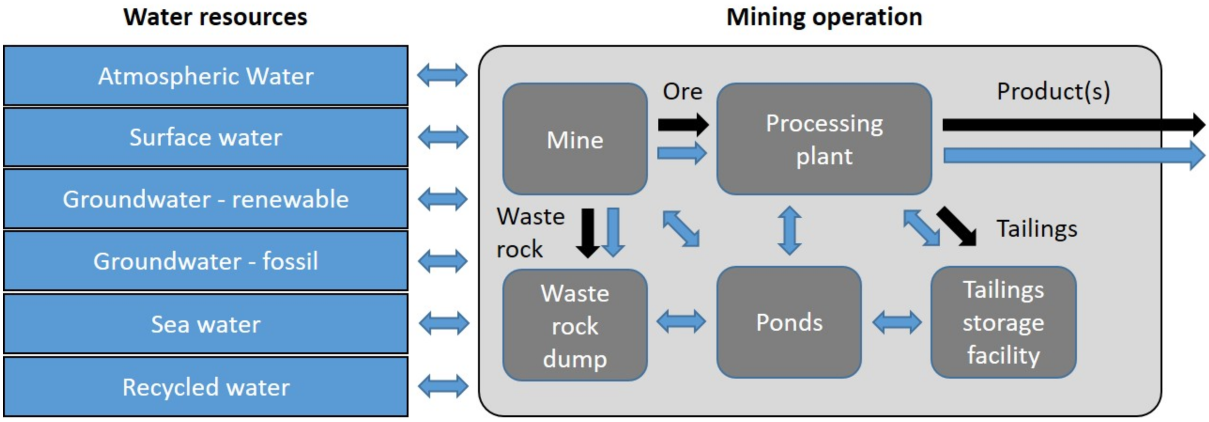

Figure 1: Water resources and uses for mining operations

The quantification and official reporting of water use by the mining industry gained momentum in recent years only. This was supported by the establishment of a water working group by the International Council of Metals and Mining (ICMM). In 2017, it published a "Practical guide to consistent water reporting", which aims at supporting the industry in compiling consistent and transparent water reports, based on key elements of existing accounting systems [3]. While data availability is improving over time, actual reporting by mining companies is still lagging behind, and robust and comprehensive data are scarce.

Water use in the Chilean copper production

The global front-runner regarding reporting of water use is the copper sector in Chile. In 2017, the mining sector accounted for 11.2% of GDP and 51.6% of total exports. In that year, Chile produced 5.5 million tonnes of copper, which accounted for approximately 27.5% of global production. It also holds the largest copper reserves with a worldwide share of around 20.5%. The main player is the state-owned company CODELCO (Corporación Nacional del Cobre), which is the largest copper producer world-wide. Due to its economic importance, copper is key to the socio-economic development of Chile. However, the close international ties mean that the Chilean economy is heavily dependent on the development of the world economy.

Due to the geological setting of the country, copper mines are mainly located in the Andean mountain range in the dry north of the country. The vast majority of copper production (around 54%) takes place in the province of "Antofagasta", a water scarce region close to the Atacama dessert. Consequently, copper production is among the main water users in the region. To manage water use adequately, in 1981 the Water Code was published, which implemented a water permit trading scheme in Chile. The importance of the mining sector in Chile on the one hand and water scarcity on the other are among the main reasons why Chile has become the front-runner regarding the accounting for water use in the mining sector. The Copper Commission of the Chilean government (Comisión Chilena del Cobre – COCHILCO) reports data on water extraction for the years 2012-2018 for 31 copper mines and also identifies the watersheds the mines are located. The quantities are further disaggregated into six different types of water: surface water, groundwater, mine water (i.e. recycled water), non-/desalinated seawater, and water from public supply. Figure 2, based on [4] and [5], shows water abstraction levels in the 31 Chilean copper mines, grouped according to the regions they are located in and disaggregated into the different types of water.

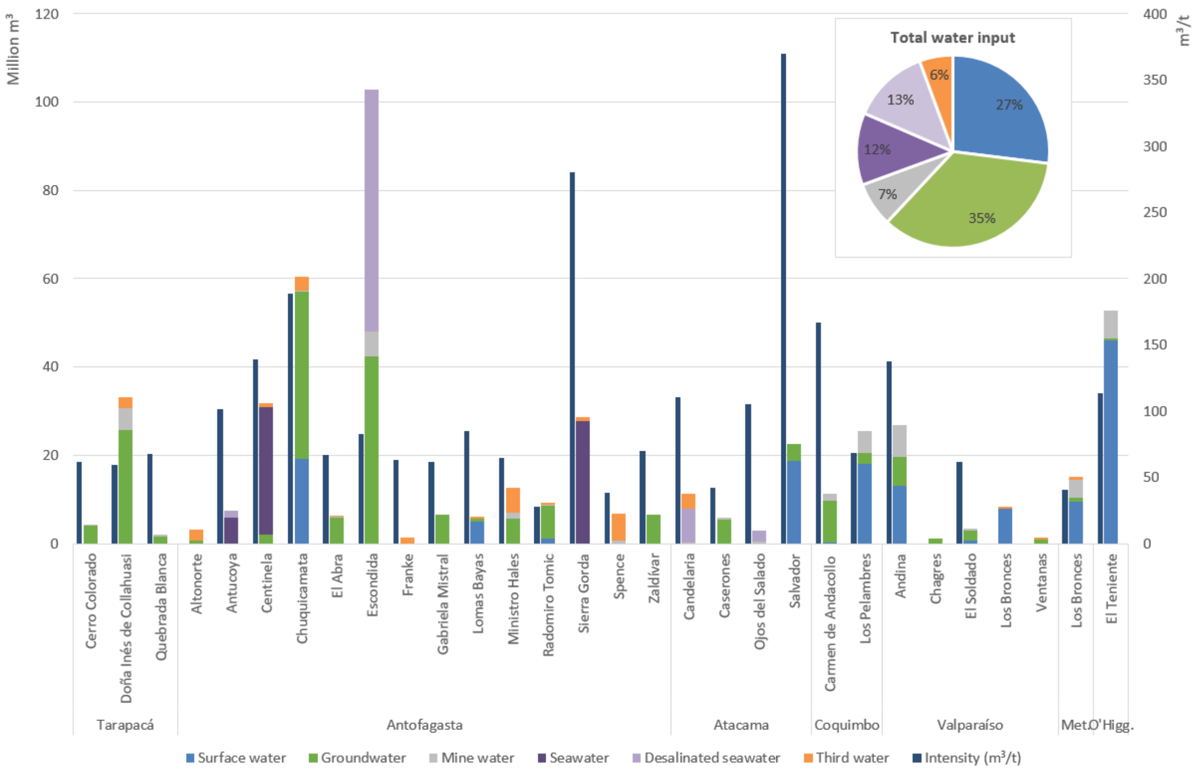

Figure 2: Water abstraction by water source and water intensity, in the 31 copper mines in Chile in 2018 – Note that intensities are calculated only for sites with mine production in 2018.

Two patterns can be depicted from this graph. First, in the dry north, copper mining heavily depends on groundwater and (desalinated) seawater, while in the more humid regions further down south, surface water is the predominant type of water in use. Overall, more than 516 million m^3 were abstracted for copper mining in 2018, of which 37% stem from groundwater sources, followed by surface water (29%), and desalinated seawater (14%). Second, in generalised terms a correlation between the size of a mine and the amounts of water in use can be observed. The by far biggest copper mine in Chile, Escondida, produces about 20% of overall Chilean copper production and is also the largest water user. Also the rest of the top-five water users Chuquicamata, El Teniente, Doña Inés de Collahuasi, and Centinela are all among the top-ten copper producers [4]. When calculating water intensity levels the picture becomes more diverse. The dark blue columns in Figure 2 show that Escondida with 82.7 m^3 per tonne copper metal produced is below the national average of 92.9 m^3/t, while Salvador (369.8 m^3/t), Sierra Gorda (280.7 m^3/t) and Chuquicamata (188.4 m^3/t) have the highest rates of water use per tonne of metal produced.

Water intensity depends on a number of factors, such as the type of production process applied, the available ore grades at the different mines, the level of implemented water recycling, the technical equipment in use. Further, the numbers reported do not provide the detail regarding how much of the abstracted water was incorporated into the product throughout the processes, evaporated or returned to the groundwater or surface water bodies. Ideally, a mine would manage to minimise evaporation and (often polluted) return flows. To quantify these water flows, more detail regarding the specific mine sites is needed.

Outlook: estimating water use in mining

As mentioned above, Chile is the front-runner for reporting water use in copper mining. In many other countries, companies or state organisations report very patchy data. For example, reported water quantities often refer to a company as a whole that is operating a number of mines and producing different metals. As discussed, the situation is improving, but still far away from achieving comprehensive data for worldwide copper production. To bridge this gap, we currently explore options to use available numbers on water use, in combination with proxy data such as production type, ore grade and climatic conditions to estimate water quantities used by mines, for which no data on water use is available. By that means water abstraction levels could be estimated for all copper mines worldwide, which would allow a solid assessment of the impacts of global copper demand on the worldwide water resources.

Citation

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