EGU21-6606
https://doi.org/10.5194/egusphere-egu21-6606
EGU General Assembly 2021
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

# Making a mine invisible: the coming challenge for geoscientists for sourcing critical raw materials

**Vitor Correia**[1], Julian Hilton[2], Hari Tulsidas[3], Michael Neumann[4], and Balazs Bodo[5]
[1]International Raw Materials Observatory, Brussels, Belgium (vcorreia@intraw.eu)
[2]United Nations Economic Commission for Europe
[3]Aleff Group
[4]European Federation of Geologists
[5]La Palma Research Centre

Converging technologies in robotics, miniaturisation, and cost-efficient drilling are already being used by European researchers to create a robot-miner prototype[1] for small and difficult to access mineral deposits. This will certainly trigger more research and innovation in scalability, resilience, reconfigurability, collective behaviour and operation of the robot(s) in harsh environments, alongside ore metallurgy and processing close-loop systems. The combination of these technologies and the robotisation of underground mining enables the creation of **invisible mines. Invisible mines** have the potential to reduce the environmental impacts of mines and their footprint while increasing the social acceptance of mining.

A recent United Nations[2] paper emphasises the need of innovation as a critical pathway to achieving the objectives in the 2030 Agenda for Sustainable Development and makes an urgent call for new business models in the mining industry. One of the principles it advocates is 'comprehensive extraction', also called 'comprehensive and integrated resource recovery'. This new paradigm rests on the key assumption that a mine site should be disturbed only once, in the process recovering useful materials in an optimised integrated flowsheet and future-proofing any resources that are not of immediate interest rather than discarding them as wastes. The implementation of 'comprehensive and integrated resource recovery' can be pulled by the combination of current progress in three areas: a) research and innovation; b) investment activities; and c) skills, education and knowledge. All three, alone or in combination, have a role to play in developing invisible mines.

Despite efforts to reduce the environmental impacts of mines and their footprint, and to increase the social acceptance of the activity, a conventional economic rationale underpins economic feasibility studies. Under that logic, many minerals are either not extracted or are considered 'waste' an end-up being discarded. Advances in mining and ore processing methods designed to maximise robotic mining will create a fundamental shift in traditional business models since the extraction and maximisation of the value of all extracted materials increases the number of interactions in downstream industries. This will change traditional feasibility assessments, calling

for the development of **intelligent business models**, capable of delivering sophisticated, comprehensive analysis, integrating a range of different value streams.

The unfolding of invisible mines combined with intelligent business models will shift skills and competencies of the mining workforce towards more complex cognitive categories with increased requirements in digital literacy, alongside a holistic understanding of the value chains that are using mining outputs and enhanced expertise on communication and stakeholder engagement. This entails the urgent alignment of **education and training contents** and the continuous review and update of the international sectoral qualifications framework for the raw materials sector[3].

[1] Robominers H2020 project. See https://cordis.europa.eu/project/rcn/223247/factsheet/en

[2] Hilton et al. (2018). Transforming our world's natural resources: A step change for the United Nations Framework Classification for Resources? https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc_egrm/egrc9_apr2018/ece.energy.ge.3.2018.7_e.pdf

[3] Intermin H2020 project. See https://interminproject.org/