



Our **SOLUTIONS**

BIOLEACHING:

a key technology to recover metals from low-grade ore and waste

Do you want to recover certain low-grade metals from mining or electronic waste? BRGM offers you its innovative bioleaching solutions, based on 30 years of experience.



*Bioleaching for the recovery of cobalt from cobalt-bearing pyrite (KCC Project, Uganda).
© BRGM – Dominique Morin*





*Preparation of 5 tonnes of mining waste from the copper industry for bioleaching recovery tests (France).
© BRGM - Anne-Gwenaëlle Guézennec*

YOUR ISSUES AND NEEDS

Bioleaching—also called biomining—is the extraction of metals using microorganisms. In the last decades it has garnered growing interest from both the academic community and the mining industry, who increasingly consider biomining to be an ecologically acceptable and economically sound alternative to conventional processes such as pyrometallurgy or conventional hydrometallurgy.

Compared to these technologies, bioleaching processes have relatively low capital costs. An additional advantage is their flexibility, offering the possibility for small-scale installations, as well as selective extraction of base and precious metals for interest. Bioleaching is also well suited to the treatment of metallic resources with complex composition and/or declining metal content (low-grade ores).

Bioleaching is thus envisaged as a viable option to treat materials that in the past would have been considered as waste and to exploit primary deposits that were previously not economically profitable.

OUR ADDED VALUE

For more than 30 years, BRGM has been involved in bioleaching field and offers process solutions based on a multi-disciplinary team and a multi-scale approach. Its expertise covers a wide spectrum of activities and services from bioprospecting to process development, from laboratory to pilot experiments and *in-situ* demonstration.

BRGM offers innovative tools and approaches to support partners and clients in the development of bioleaching processes, from very preliminary pre-feasibility tests up to pilot scale demonstration:

- Bioprospecting, selection and adaptation of microbial consortia, microbes collection and conservation.
- Bioleaching pre-feasibility and feasibility tests.
- Solid (ore, concentrate, waste, etc.) sampling and preparation (crushing, grinding, physical separation, heat treatment, etc.) from 1 kg up to 10 tonnes.
- Multi-scale process development (bioreactors from 1 L. to 2 m³).
- Process optimization and demonstration.
- Bioreactor design.
- Numerical modeling (bioreactor hydrodynamics, heat and mass balances, process flowsheet, process integration and upsacing).
- Environmental assessment, LCA.
- A multidisciplinary team involving experts in various fields: (bio)hydrometallurgy, process engineering, microbiology, molecular biology, mineral processing, chemistry, LCA.



Multi-scale process development: : 2 L bioreactors. © BRGM



Multi-scale process development: : 100 L. bioreactors. © BRGM

MEANS OF ANALYSIS AND PLATFORMS

- PLAT'INN: 2 000 m² experimental facility containing multi-scale equipment (catalogue available on request) for sampling, mineral processing, (bio)-hydrometallurgy, residues management. <https://www.brgm.fr/en/laboratory-technological-platform/plat-inn-experimental-pilot-facility-treatment-mineral-raw>.
- Analytical tool : chemical analysis of major and trace elements, mineralogy (SEM, XRD, etc.), DNA analysis (TRFLP, PCR, qPCR, DGGE). <https://www.brgm.fr/en/activities/analysis-experimentation>.
- Numerical tools : CFD, USIMPAC, HSC.



Multi-scale process development: "Pond bioleaching" pilot (2000 L.) in BRGM laboratories. © BRGM

PATENTS

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- NEMO: Near-zero-waste recycling of low-grade sulphidic mining waste for critical-metal, mineral and construction raw-material production in a circular economy. Project R&I Horizon 2020 <https://h2020-nemo.eu>
- CROCODILE: First of a kind commercial Compact system for the efficient Recovery Of CObalt Designed with novel Integrated LEading technologies. Project R&I Horizon 2020 <https://h2020-crocodile.eu>
- CEReS: Co-processing of Coal Mine and Electronic Wastes. Project Research Fund for Coal and Steel <http://ceres.biohydromet.net>



EDUCATION & TRAINING, one of BRGM's missions

BRGM helps to develop scientific and technical skills through both "off-the-shelf" and "tailor-made" training courses, provided by its specific professional training branch: BRGM Formation.

Training course themes:

Geology | Sustainable management of groundwater resources | Mineral resources and circular economy | Environment, land-use projects | Energy transition and underground space | Natural risks, impacts of climate change.



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