

Research on the Reduction of Arsenic in Copper Ore

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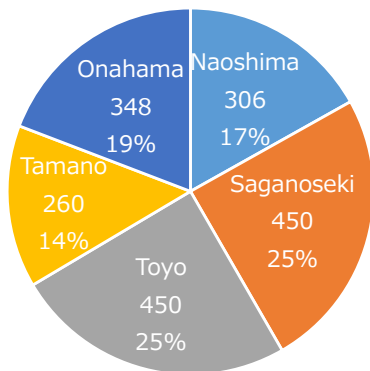
Japan Oil, Gas and Metals National Corporation

4th International Seminar on Arsenic Stabilization and Management
April 8th, 2022

- 1. Copper Production in Japan**
2. JOGMEC's Activities
3. Technical development in arsenic reduction in copper raw materials

Copper smelters in Japan

Capacity [thousand t]



Source: JOGMEC

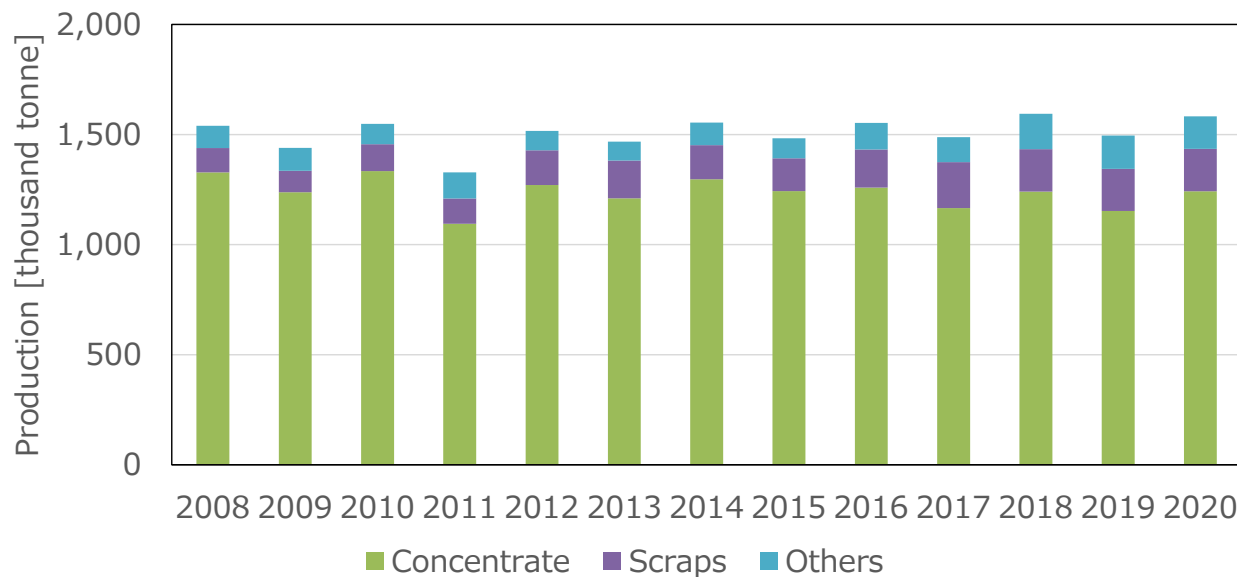
Total 1,814 thousand t



Source: Website

Copper Production in Japan by source

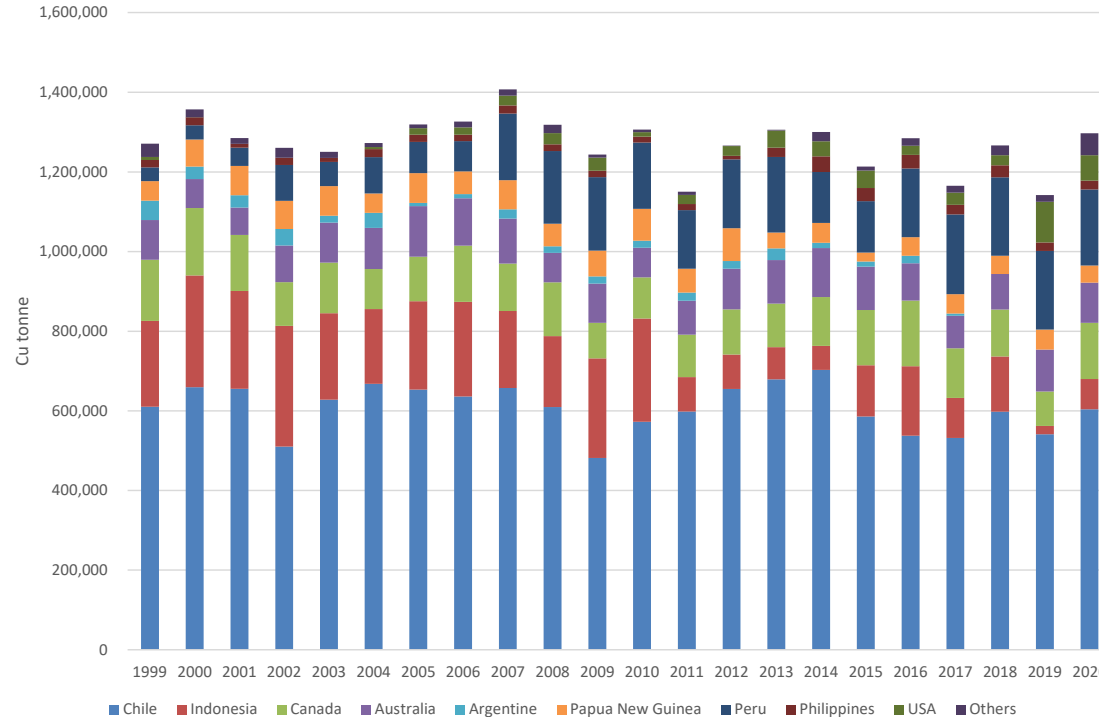
- Japanese refineries produce around 1.5 million tonnes of copper annually.
- Production from scraps are increasing, but copper concentrate is still the main feedstock.



Source: JMIA

Copper Concentrate Import by country

- Half of the concentrate are imported from Chile and Peru.



Source: METI

Japan Oil, Gas and Metals National Corporation

Established : February 29, 2004
Capital : 1,122 Billion Yen (9.3 Billion US\$ (1US\$=121 Yen)
Chairman & CEO : Mr. Tetsuhiro Hosono
Employees : 637 (as of July 1st , 2021)
Head Office : Minato-ku, Tokyo, Japan



Head Office(Tokyo)



Technology & Research Center
(Makuhari, Chiba Prefecture)



Metals Technology Center
(Kosaka, Akita Prefecture)

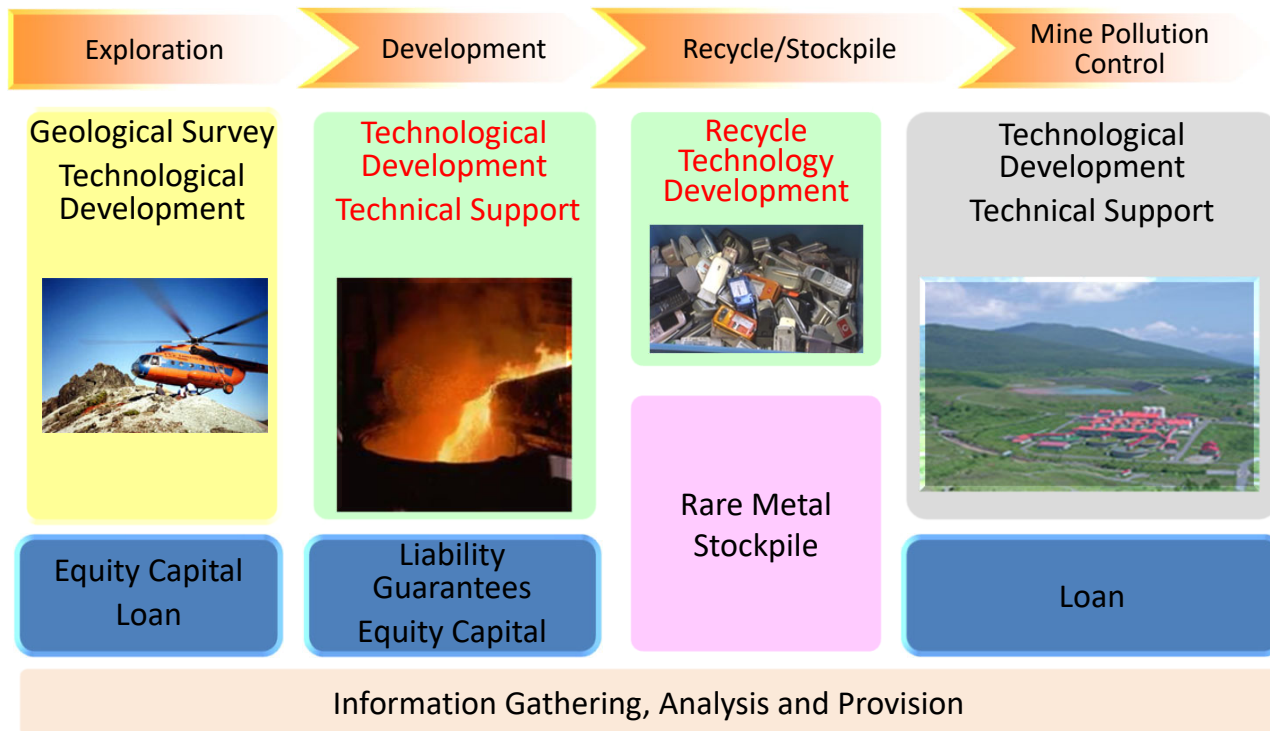
Mission



JOGMEC Overseas Offices



Support for Mineral Resources Development



A history of the efforts of JOGMEC toward environment / climate change



- **JOGMEC's initiative for Achieving Sustainable Development Goals (SDGs)** (December 2018)

2018

2019

2020

2021

Accelerating global trends on climate change issues, increasing social demands

Japan's 2050 Carbon Neutral Declaration

- **Establishment of Carbon Neutral Promotion Headquarters** (April 1, 2021)

Newly established for initiatives as an entire organization, including metal and geothermal fields.

- **Technical Business Strategy for a Low-Carbon Society** (oil and gas sector) (July, 2020)

- Emphasis on SDGs by supporting a stable energy / resource supply
1. Ensuring a stable supply of energy and resources to support industry and everyday life
 2. **Measures aimed at tackling climate change and contributing to the establishment of a recycling-based society**
 3. Environmental conservation activities related to resource projects
 4. Regional revitalization through partnerships with stakeholders
 5. Empowering of all people



① Contributing to establishing a low-carbon society

② Pursuing new possibilities for oil and gas field development

③ Strengthening foundation technologies for technical evaluation, exploration, and development projects

Three central pillars of the novel technical business strategy

- **JOGMEC Carbon Neutral Initiative** (announced on April 20, 2021)

Formulate an organizational initiative policy.

Three basic policies

Action plans

Three basic policies

JOGMEC will contribute to achieving a carbon-neutral society by securing a stable resource / fuel supply and strengthening initiatives that are consistent with climate change.



(4) Promotion of metal / mineral resource development and decarbonization

Strengthening of financial and technical support and promotion of the development of marine mineral resources within the EEZ for securing a stable supply of in-demand minerals is expected to increase due to the increased demand for electric vehicles and renewable energy (carbon neutral (CN)-relevant minerals). Support for decarbonizing measures at mines will also be provided.

Examples of equipment required to achieve carbon neutrality

Image figure



Lithium-ion battery
(lithium, nickel, cobalt)



Electric vehicles



High-performance magnets for
generators and drive motors
(rare earths)



(Source: created by JOGMEC based on materials from the Mining Subcommittee of the Ministry of Economy, Trade and Industry)

Strengthen support for proposals on CN-relevant minerals with a high supply risk and a rapid increase in demand.

Current financial support system and conditions

System	Overview
Exploration loans	Loan ratio: Base metal: max 70%; rare metal / uranium: max 80%
Equity Investments	Investment ratio: max 50%
Liability guarantees	Guarantee ratio: max 90%, Guarantee fee rate: 0.4-1.55% (guarantor: 0.1%)
Equity investments for developments and production	Investment ratio: max 50%

Strengthening financial support (direction of strengthening support)

- Considering the expansion of support to reduce corporate resource investment risk by raising the investment ratio of the organization in investments (e.g., exploration investments, international metal mining).
- Considering the review of the fee rate for international development fund guarantees.

Promoting production technology for CN-relevant minerals

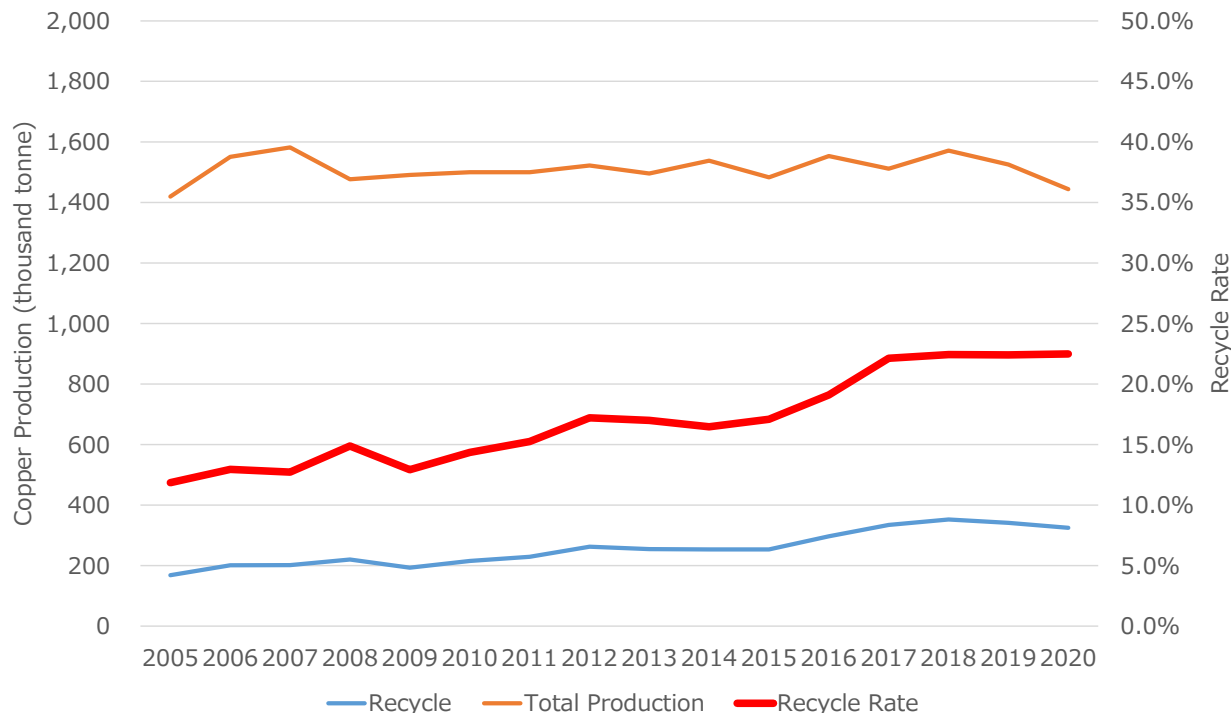
- Promoting the diversification of supply sources for CN-relevant minerals by utilizing unused resources such as the recovery of rare metals from tailings and developing production technology that is more efficient.

Support for decarbonization activities at mines and smelters

- Actively providing financial support for efforts such as the introduction of renewable energy, electrification, and fuel cell conversion at mines and smelters.
- Providing support through joint studies for technical activities relating to decarbonization of companies.

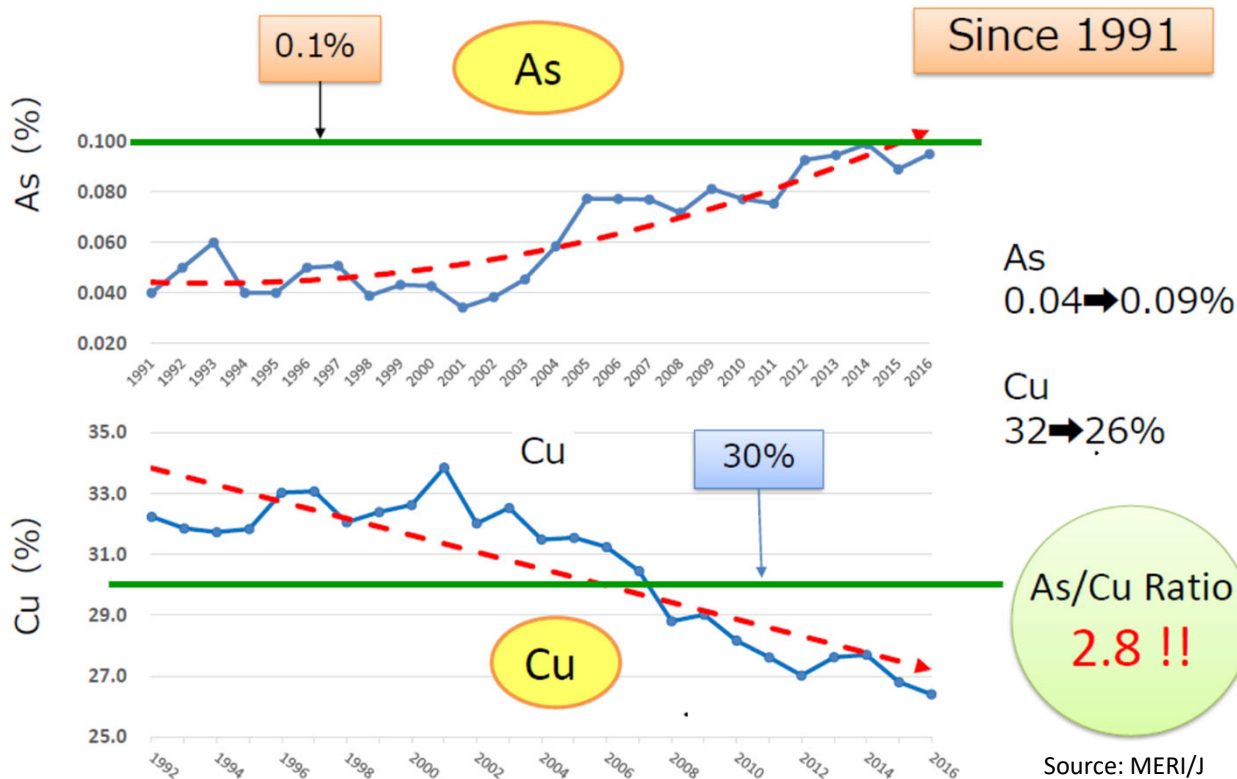


Copper Recycle in Japan



- Ration of recycled material in total feedstock is increasing to over 20 % in Japan and expected more to achieve carbon neutral society.
- Recycle material contains more impurities than concentrate.
- Cleaner concentrate is needed than ever.

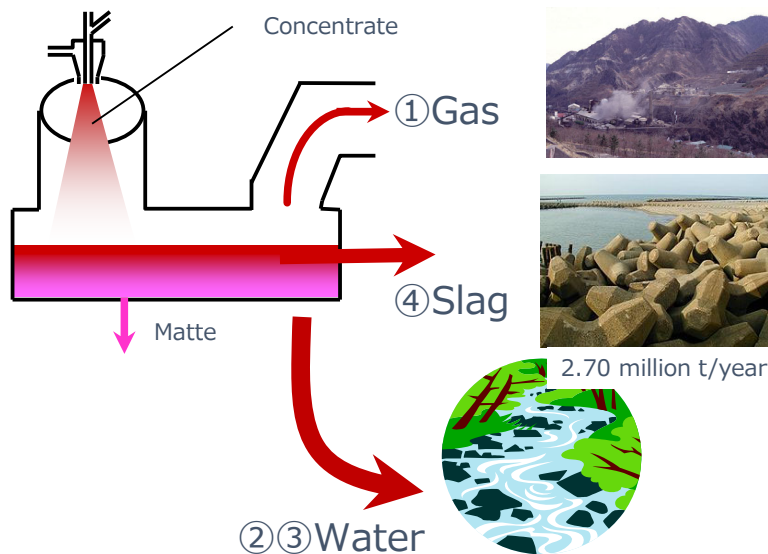
Trend of arsenic in Japan



Source: MERI/J

Background of the technical development

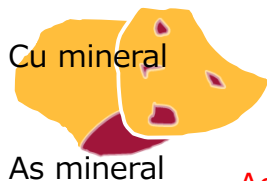
Japan imports all of copper concentrates from overseas while the arsenic content in copper concentrate is increasing. At present, the Japanese smelters fix almost all arsenic in slag. However, the more arsenic in concentrate increases, the more difficult treating arsenic would be at the smelters.



Environmental regulation related to arsenic in Japan

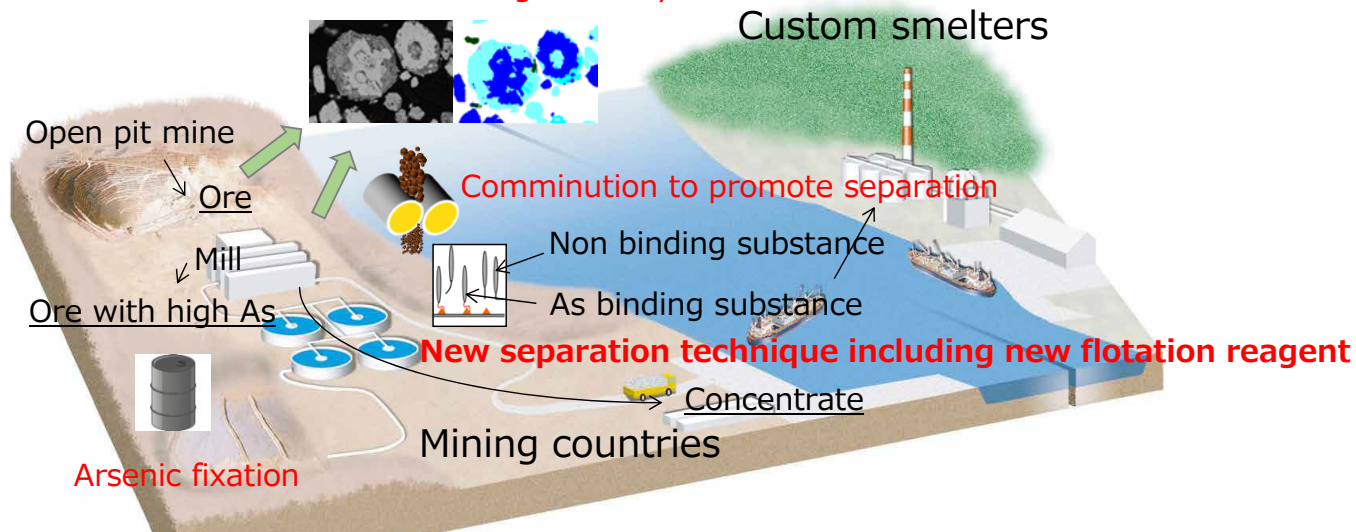
Regulation	As limit
① Air (Guideline)	6 ng/m ³ (Annual average)
② Surface water	0.01 mg/L
③ Underground water	0.01 mg/L
④ Slag (Standard)	Elution: 0.01 mg/L Content: 150mg/kg

Project outline

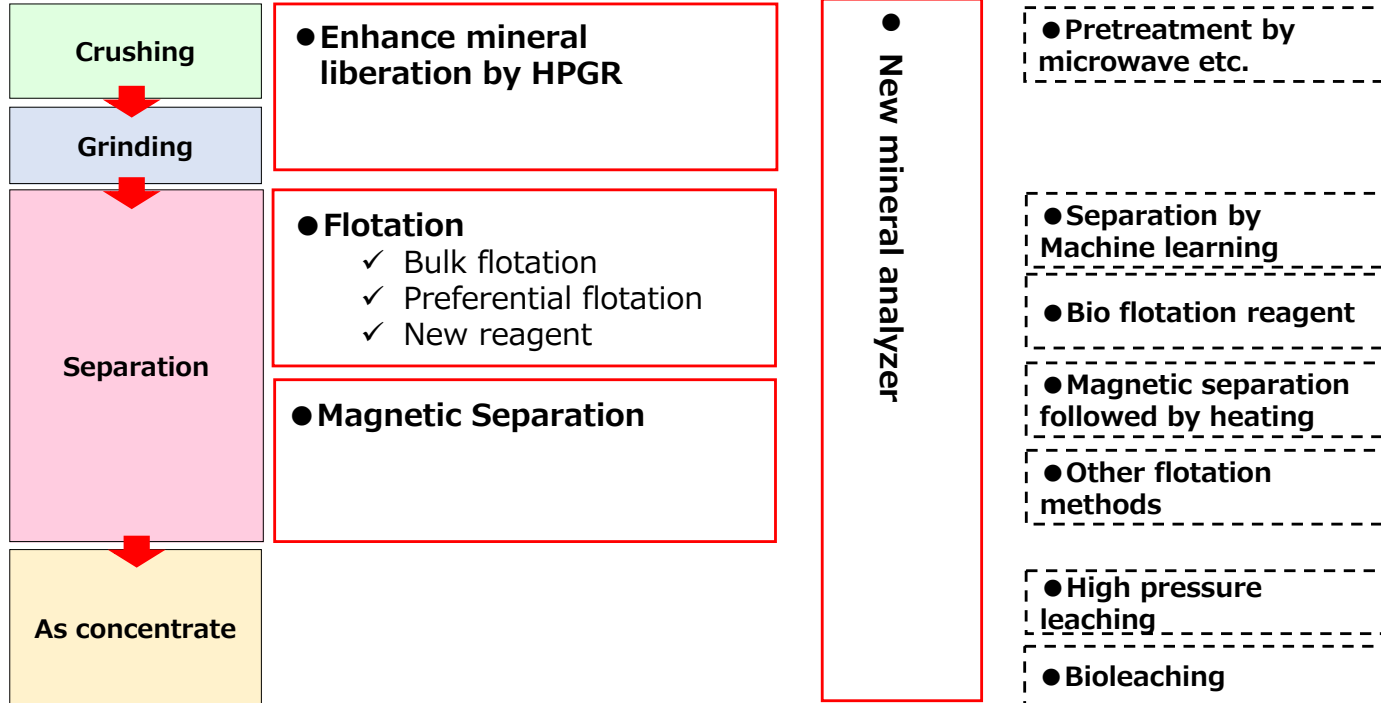


- have similar properties
 - As mineral is finely disseminated in Cu mineral
- ⇒ Difficult to separate by conventional techniques

Advanced Mineralogical Analysis

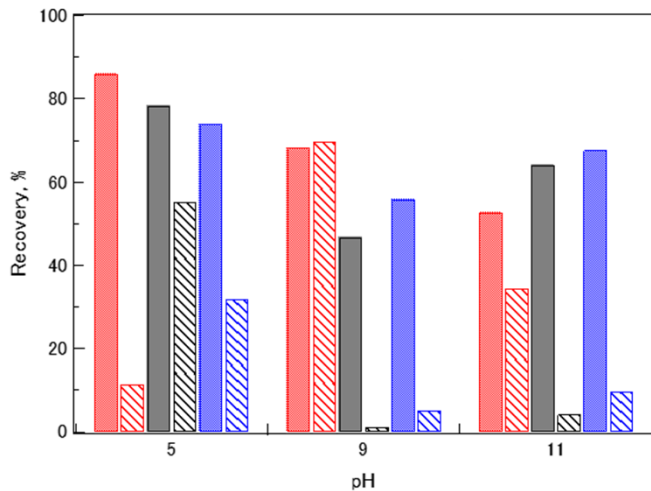


Project Outline

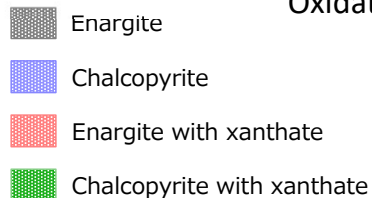
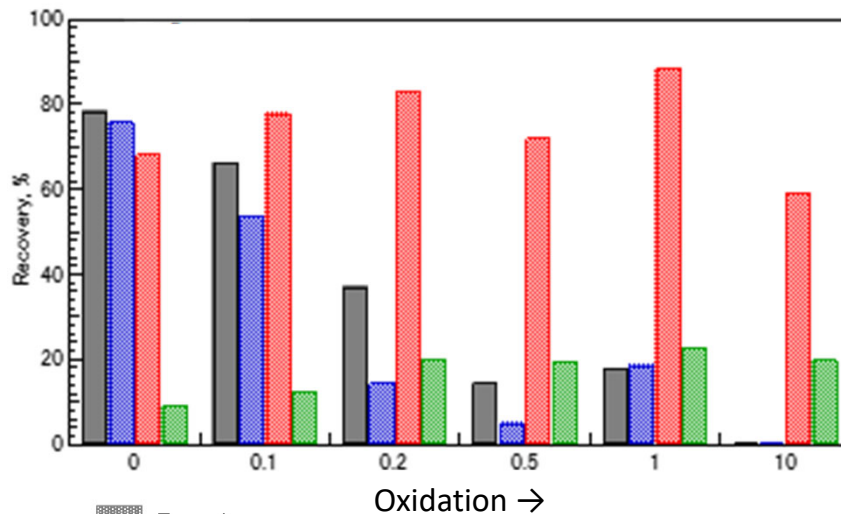


Surface oxidation treatment

Enargite was more depressed than chalcopyrite when oxidized in single mineral tests.

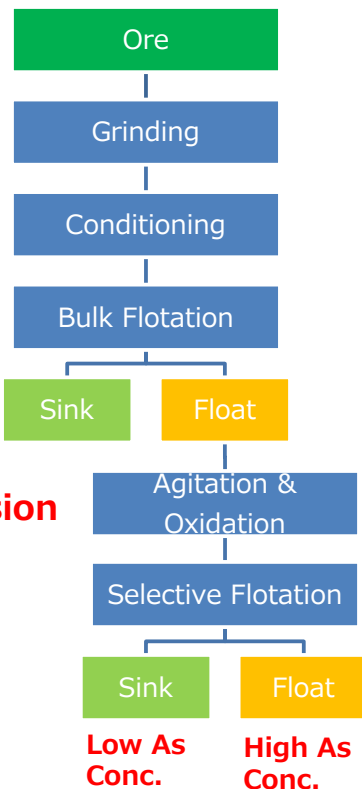


But chalcopyrite was more depressed than enargite in mixed mineral test.



Research by Sumitomo
Metal Mining & Kyushu
University

Depression of Cu mineral without As



Ore A

Gangue	54.4
Other Sulfide Minerals	0.1
Pyrite	35.8
Tennantite	0.1
Enargite	2.6
Other Cu Sulfide	0.0
Bornite	4.3
Chalcocite	1.7
Chalcopyrite	1.0

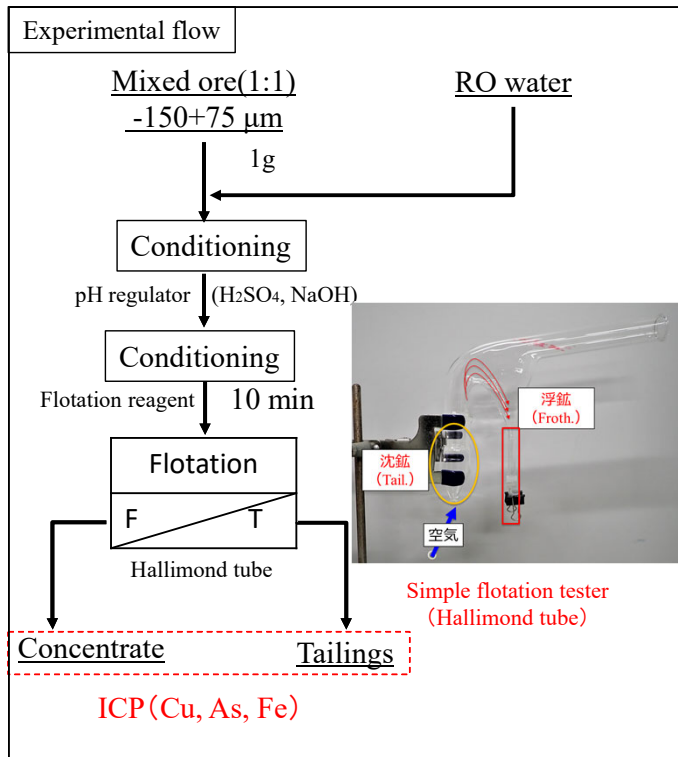
Research by Sumitomo
Metal Mining & Kyushu
University

Locked Cycle Test

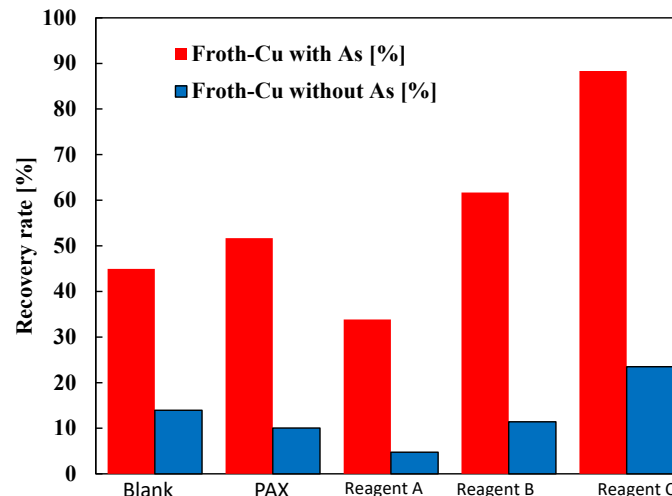
	Feed	Low As conc.	High As conc
Cu Recovery	100	58.58	28.00
Cu Grade	4.80	26.01	38.40
As Recovery	100	3.32	89.39
As Grade	0.30	0.09	7.63

New Flotation Reagent

Research by JOGMEC & University of Miyazaki

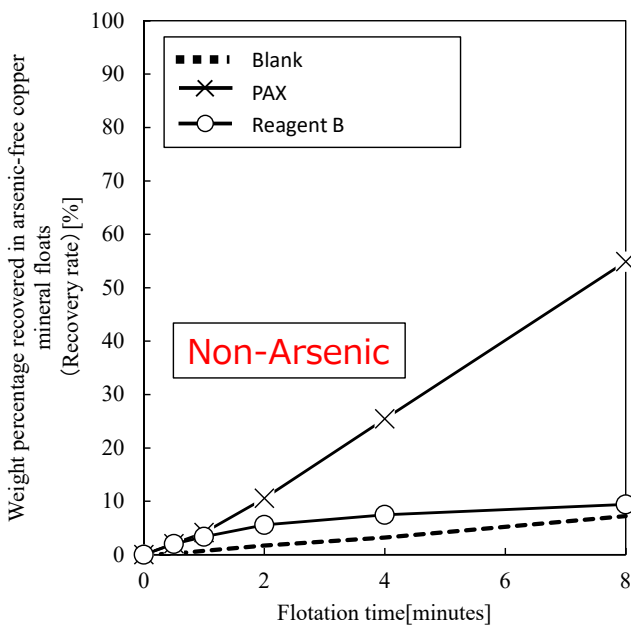
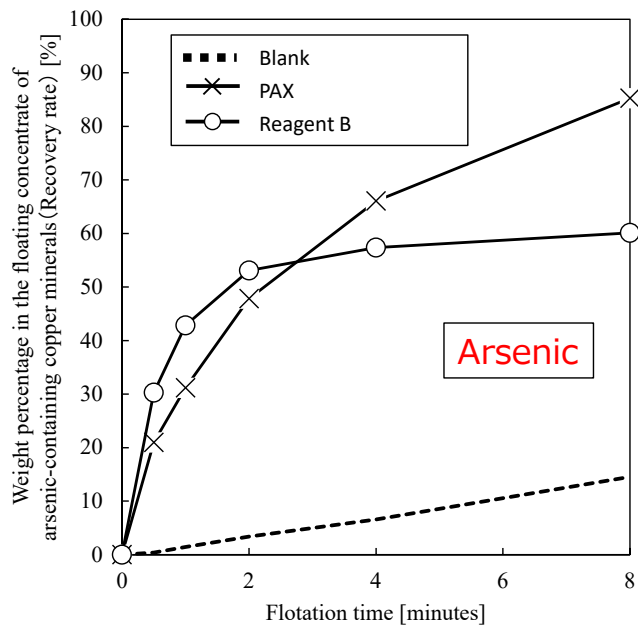


Chalcopyrite vs Enargite



	(1) Recovery of arsenic-copper minerals in floating concentrate[%]	(2) Recovery of arsenic-free copper minerals in floating concentrate[%]	(1) - (2) Separation efficiency[%]	As grade in tailing[wt%]
Blank	44.95	13.96	30.99	4.69
PAX	51.68	10.06	41.62	4.88
Reagent A	33.87	4.74	29.13	5.20
Reagent B	61.68	11.44	50.24	4.45
Reagent C	88.32	23.51	64.81	1.78

Flotation of real concentrate



Research by JOGMEC & University of Miyazaki

Next Step

- Discovered ways to separate As minerals using real ores or concentrates.
- But more examples are needed to establish As separation process.

For the new flotation reagent:

- More experiments using real ore needed to determine optimal flotation condition (pH, amount, pretreatment etc)
- How do the new reagent work to separate arsenic mineral and non-arsenic mineral?
- Search for more effective reagents

Thank you for your attention