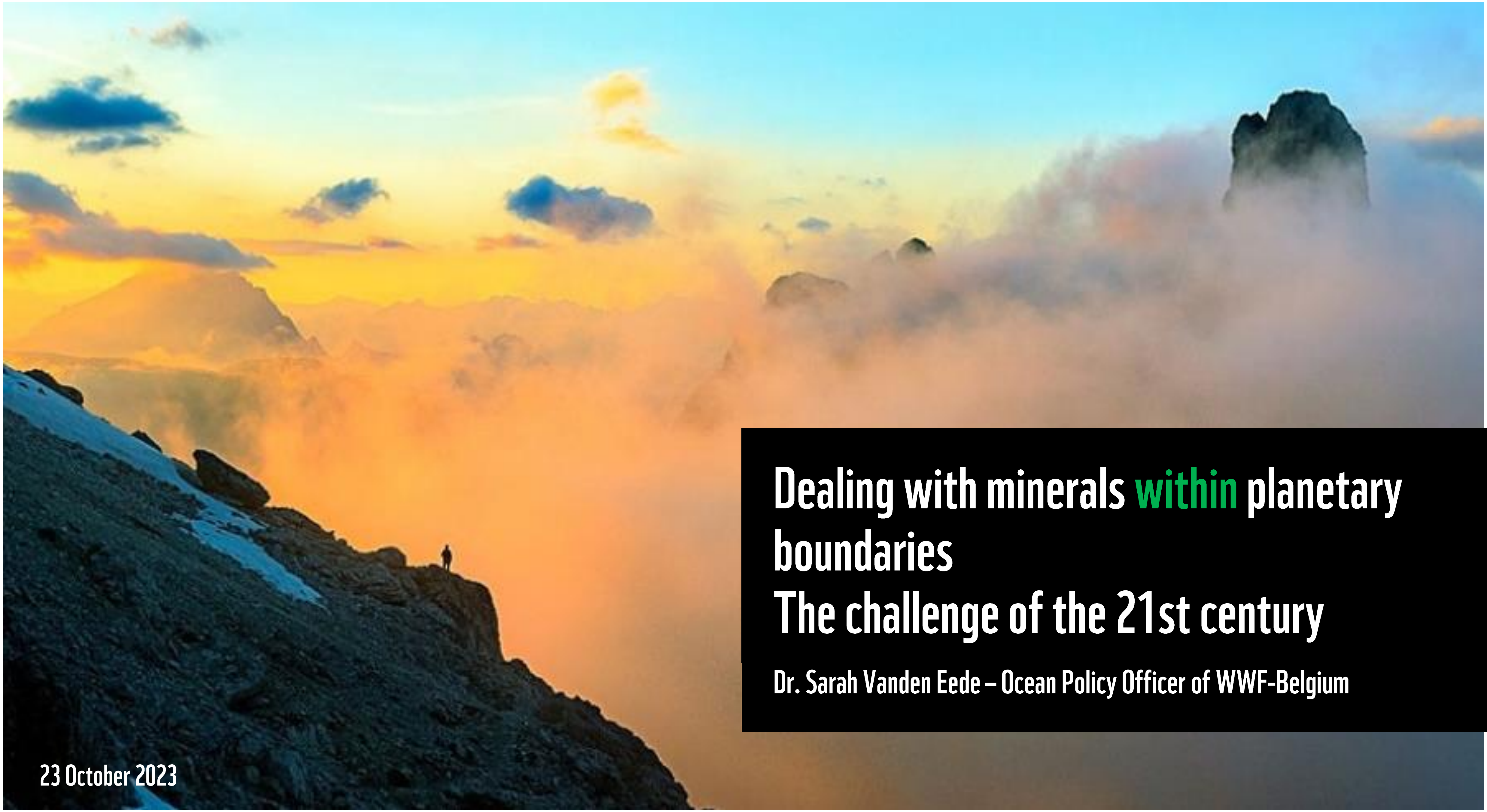
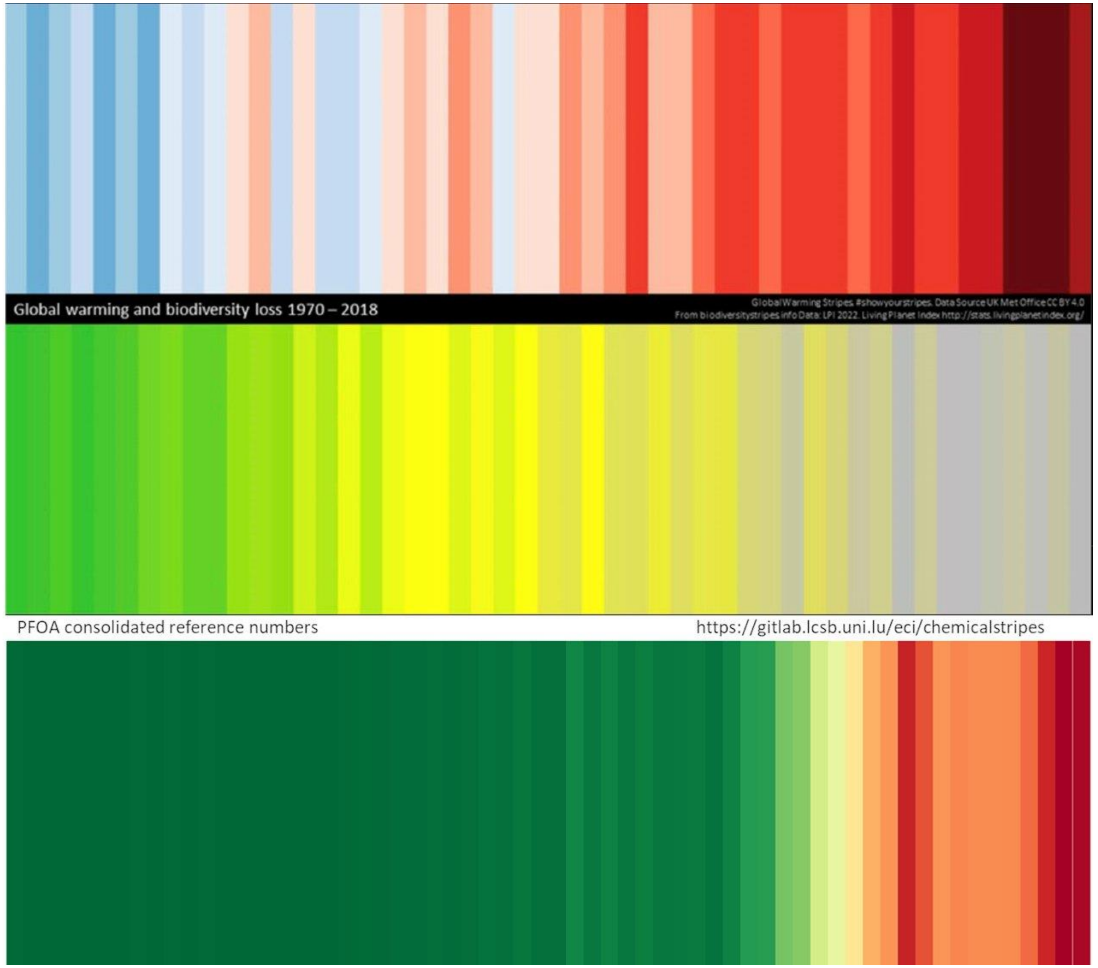


Dealing with minerals within planetary boundaries
The challenge of the 21st century

Dr. Sarah Vanden Eede – Ocean Policy Officer of WWF-Belgium

23 October 2023

State of the plane

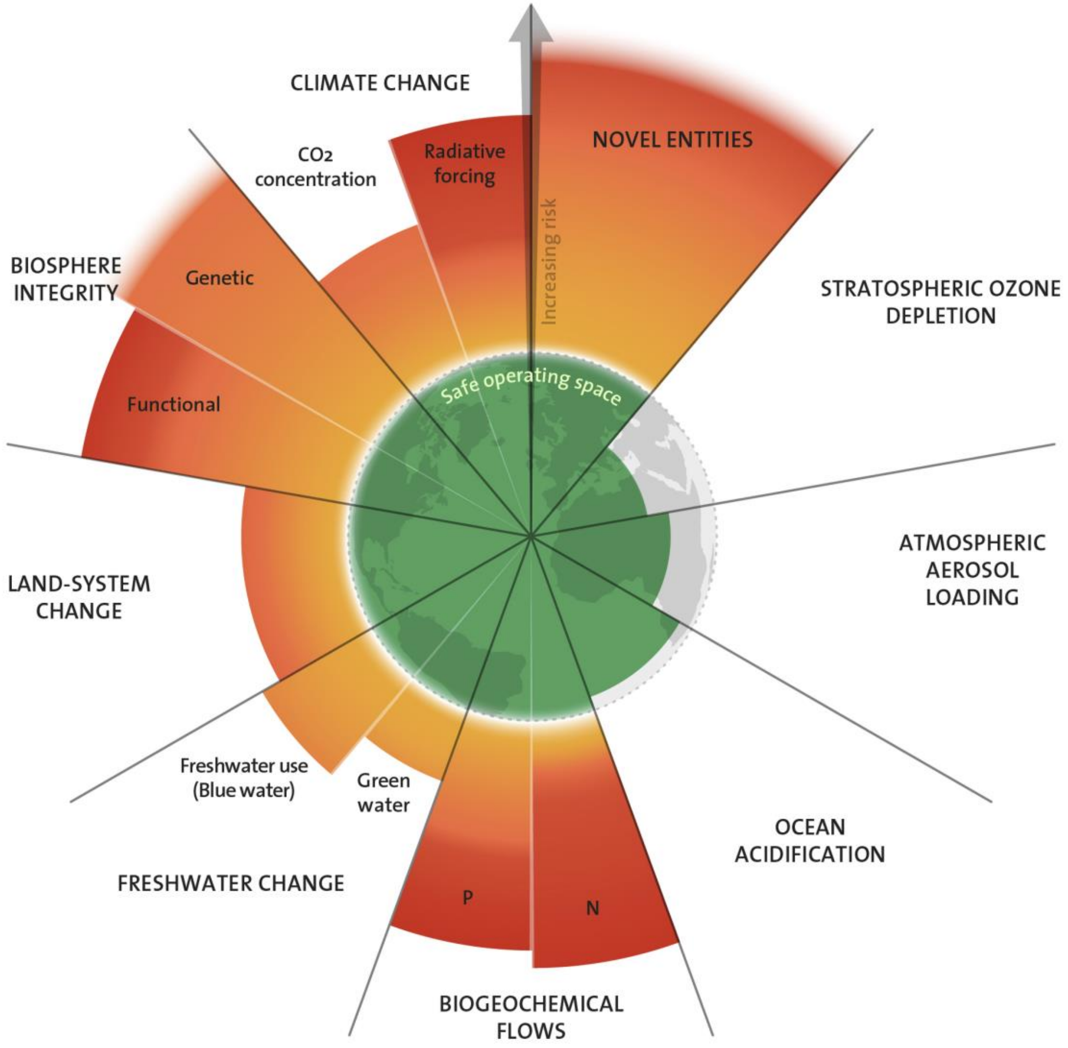


Climate stripes

Biodiversity stripes

Chemical stripes

The planetary boundaries



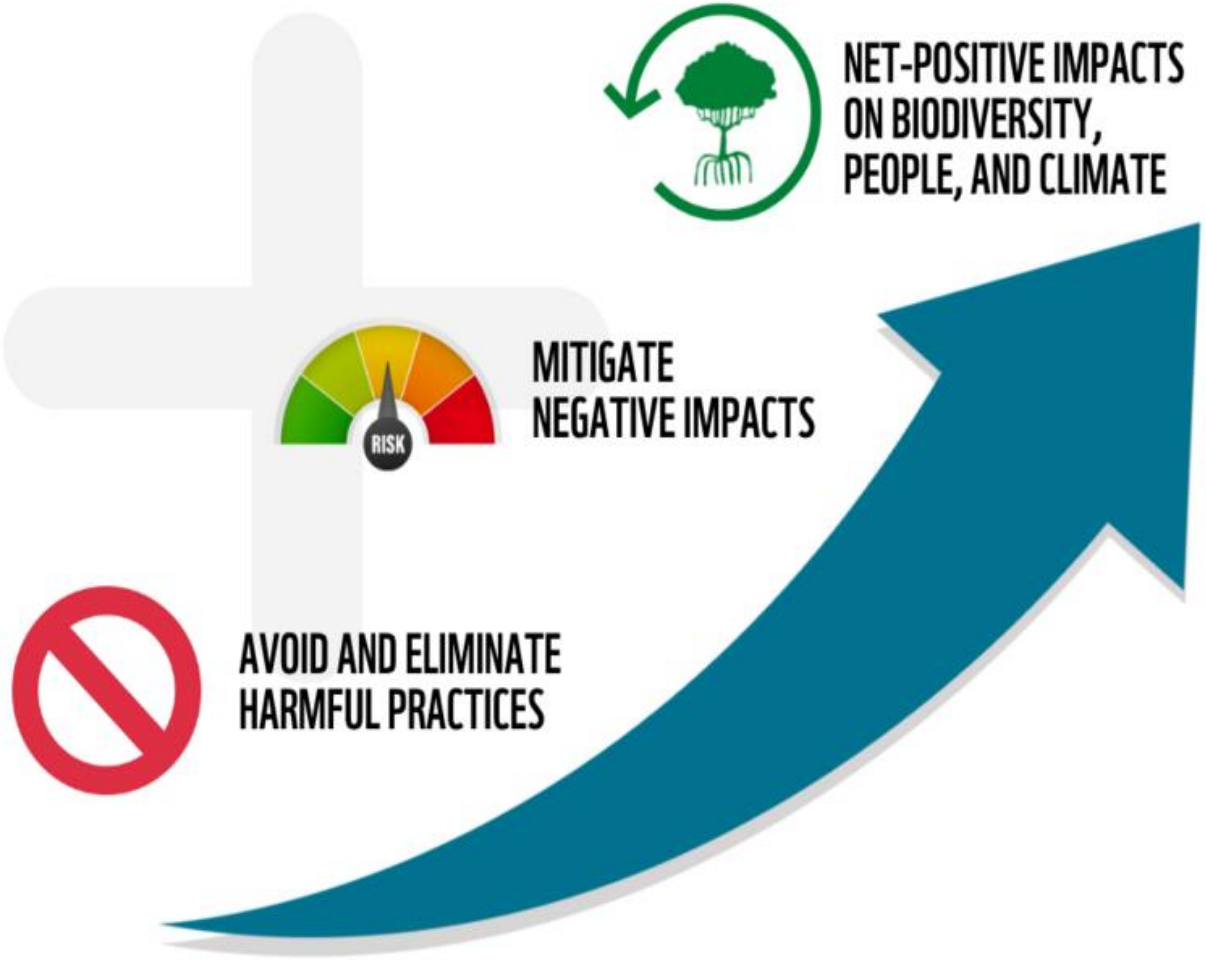
Publication 13/09/2023:

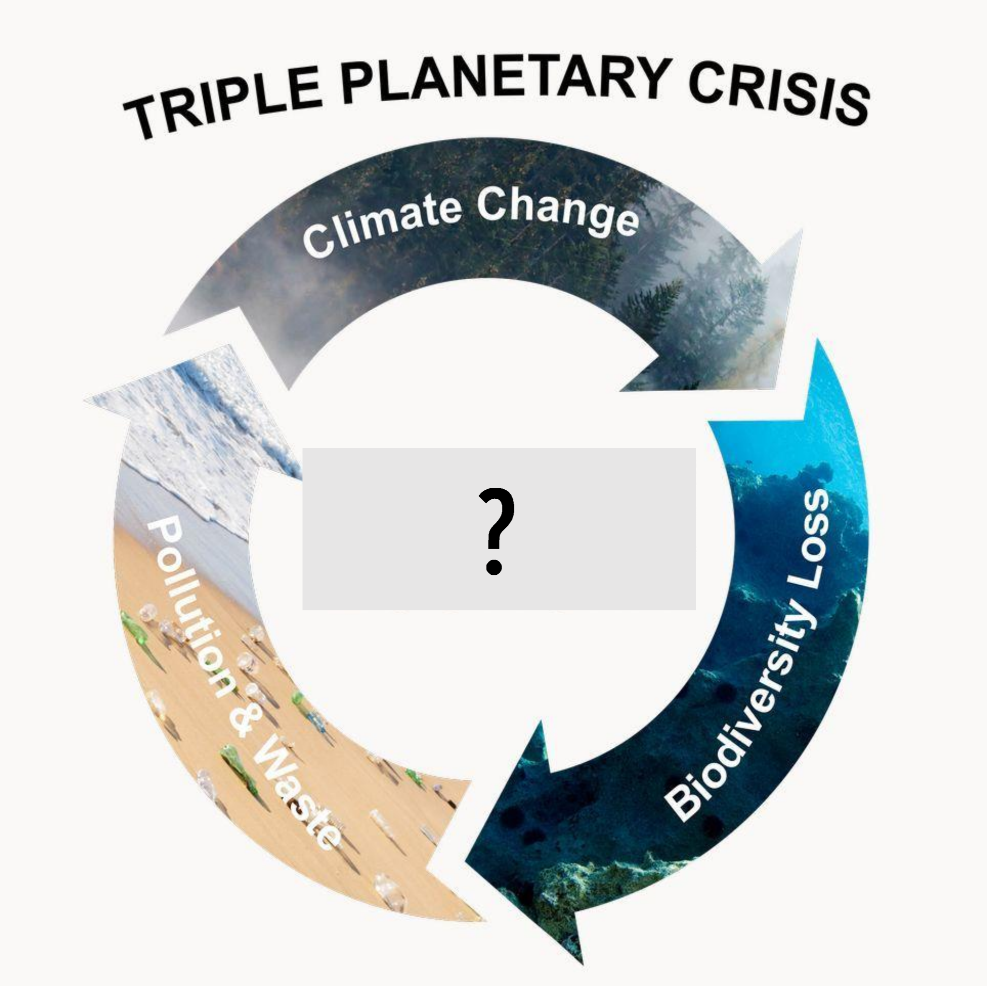
- Human activity affects the Earth's climate and ecosystems more than ever which risks the stability of the entire planet
- For the first time ever all nine planetary boundaries have been assessed
- Six of the nine boundaries are now transgressed

Living on this planet can only be done within planetary and justice boundaries

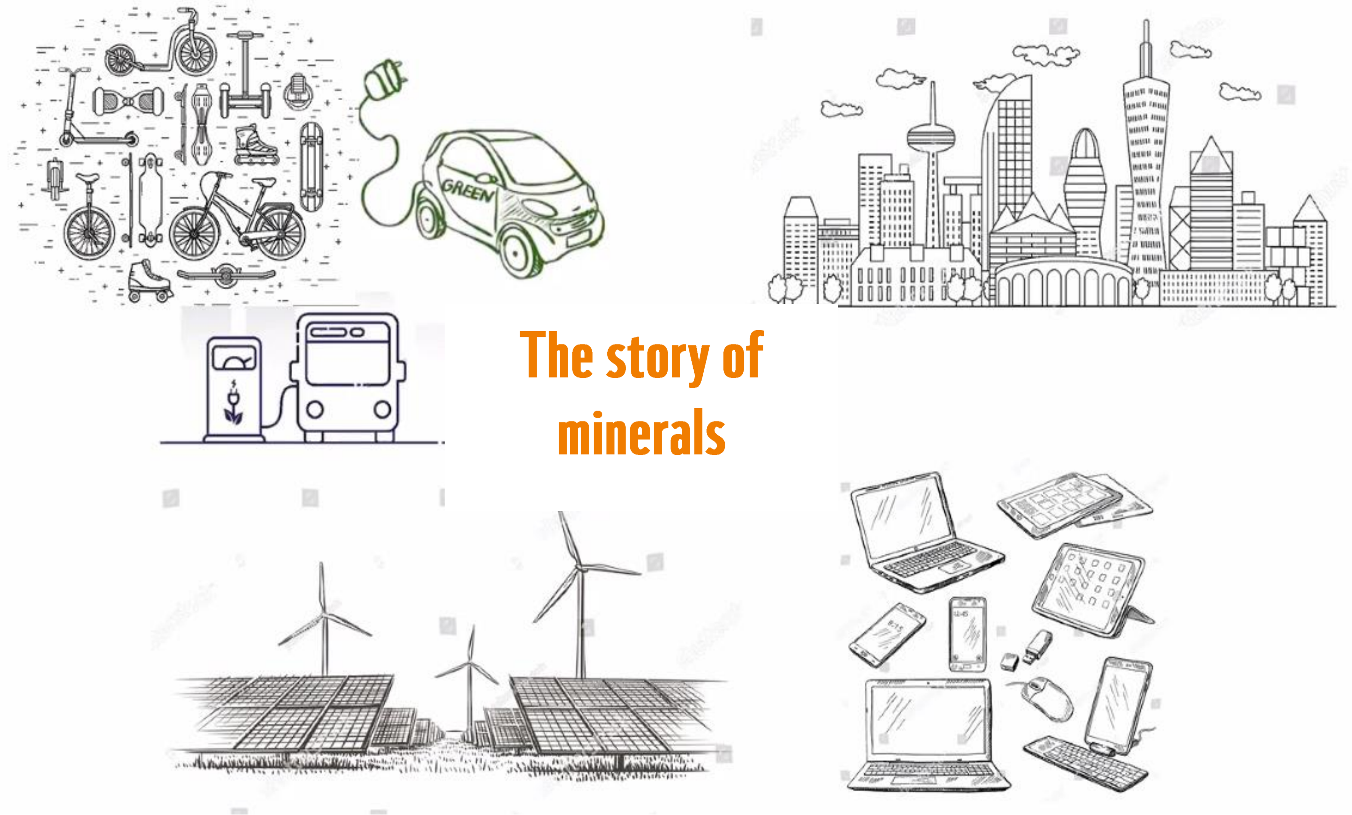
→ Watch video (5'05" - 11'55")

Turn the tide

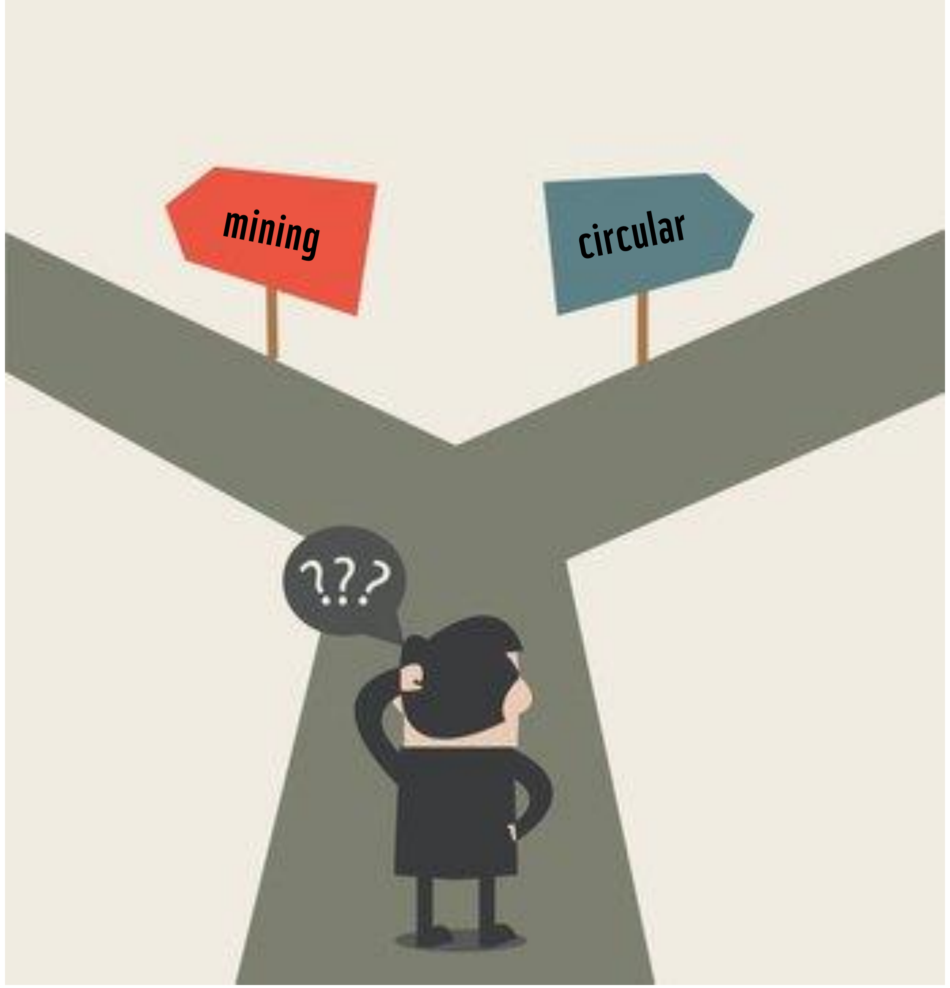


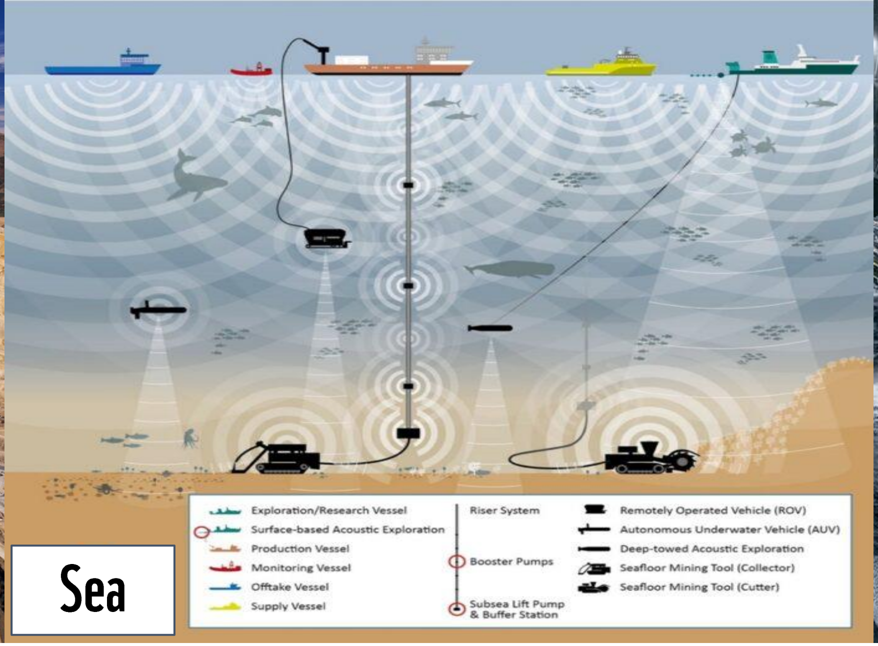


The 21st century dilemma



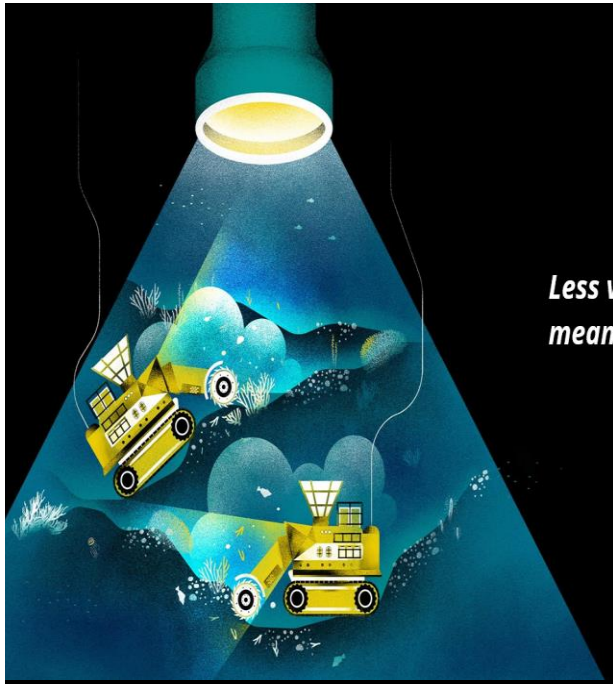
Ni	Cu	Co	Mn	Li





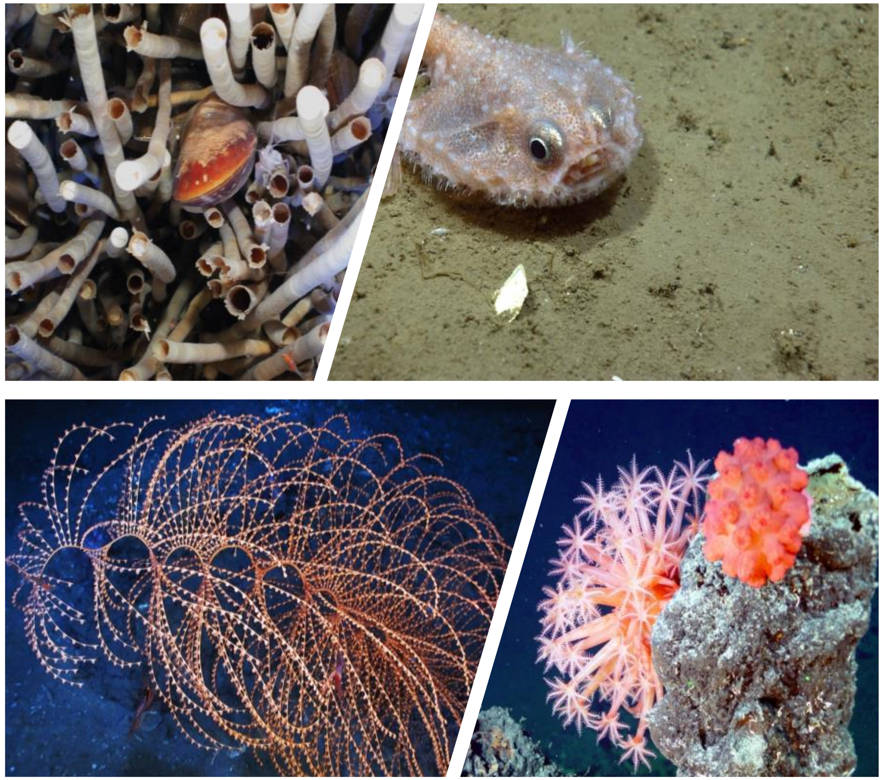
- Destruction of ecosystems + loss of biodiversity
- Pollution of air, water and soil
- Waste
- Disasters
- Emissions of CO2
- Water shortage

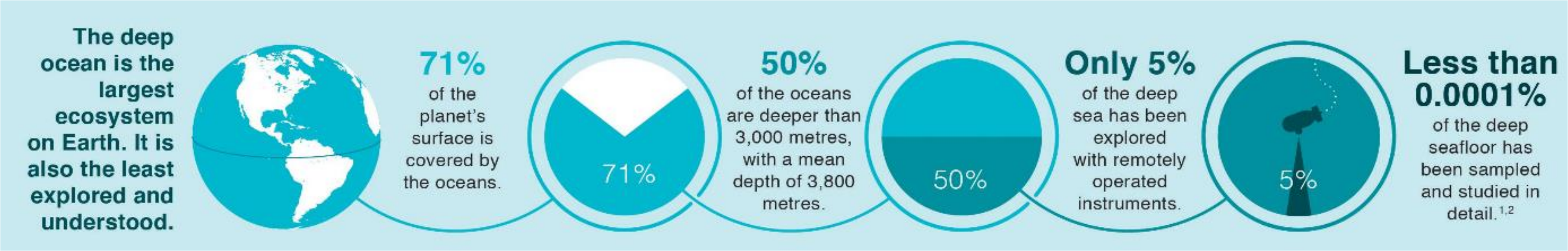
- Health
- Land rights
- Decent work?
- Prior, free and informed consent
- Freedom of association and expression
- ...



Less visible does not mean less destructive

Deep sea = fragile, old and unique ecosystems





1,000

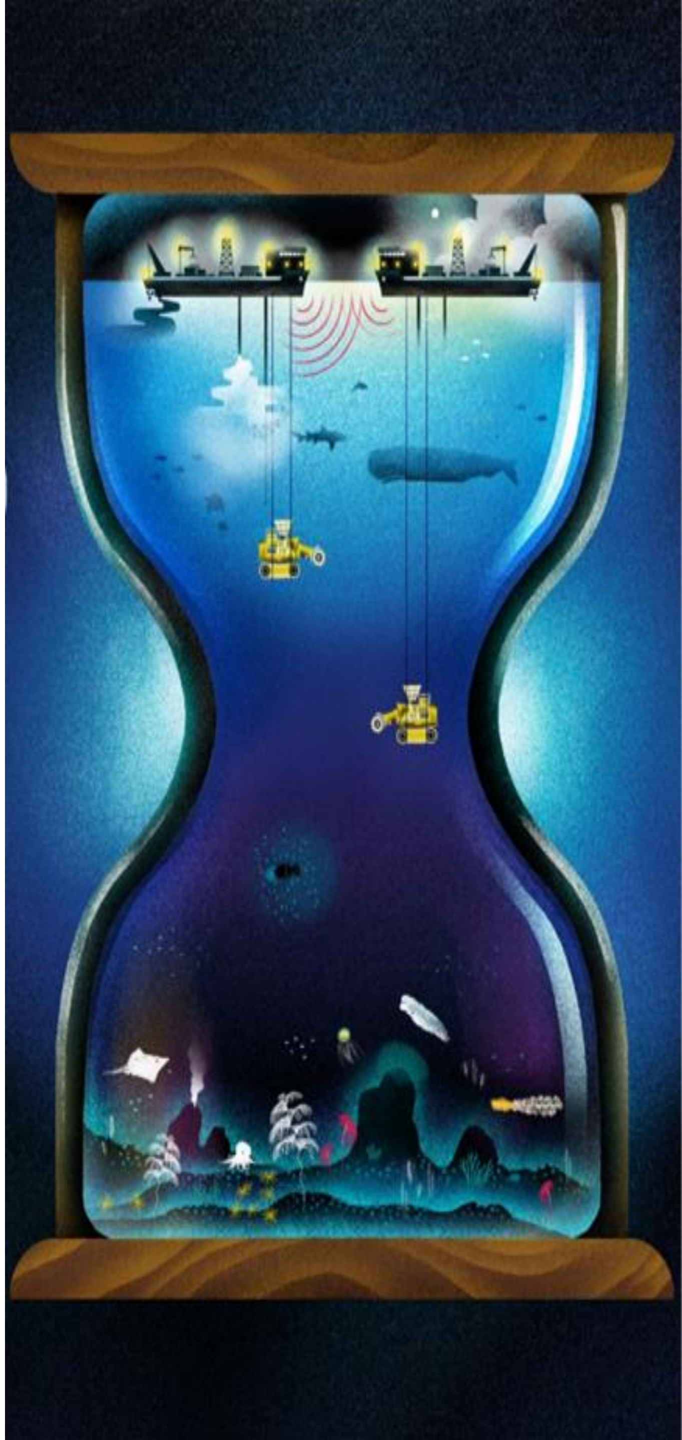
species discovered in a 30km² area of abyssal plain allocated for DSM

90%

of recently studied deep ocean animal species are new to science

1.2 million km²

area of ocean floor already licensed for mining by the ISA



The ocean is ***worth more*** *than its finite resources*

Environmental risks

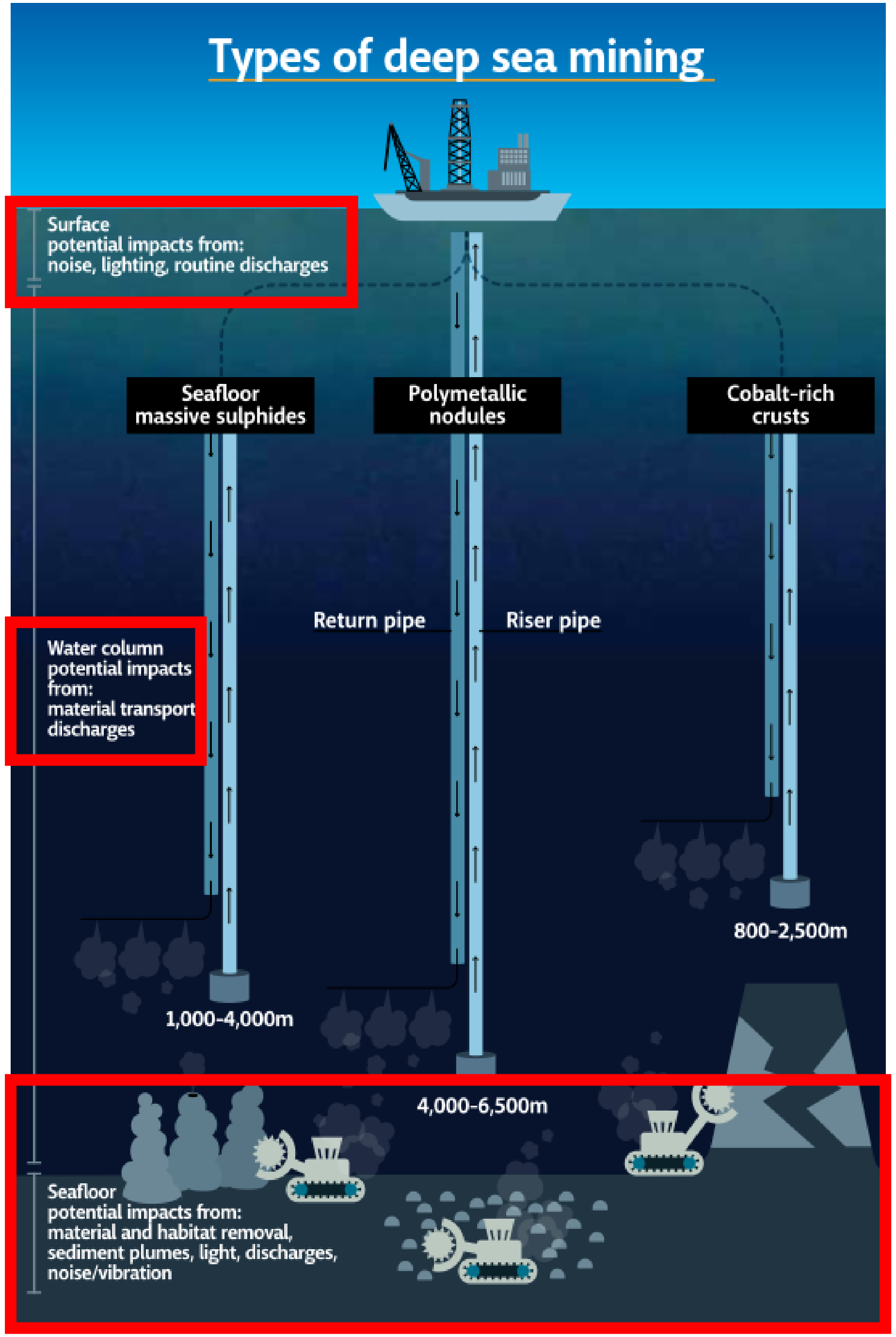
- Extremely vulnerable and slow growing ecosystems, rich in biodiversity
- Irreversible loss of biodiversity, disturbance by light and noise, toxic sediment plumes spread over vast areas
- Recovery of ecosystems = very slow (if at all)
- Restoration impossible
- Huge gaps in scientific knowledge

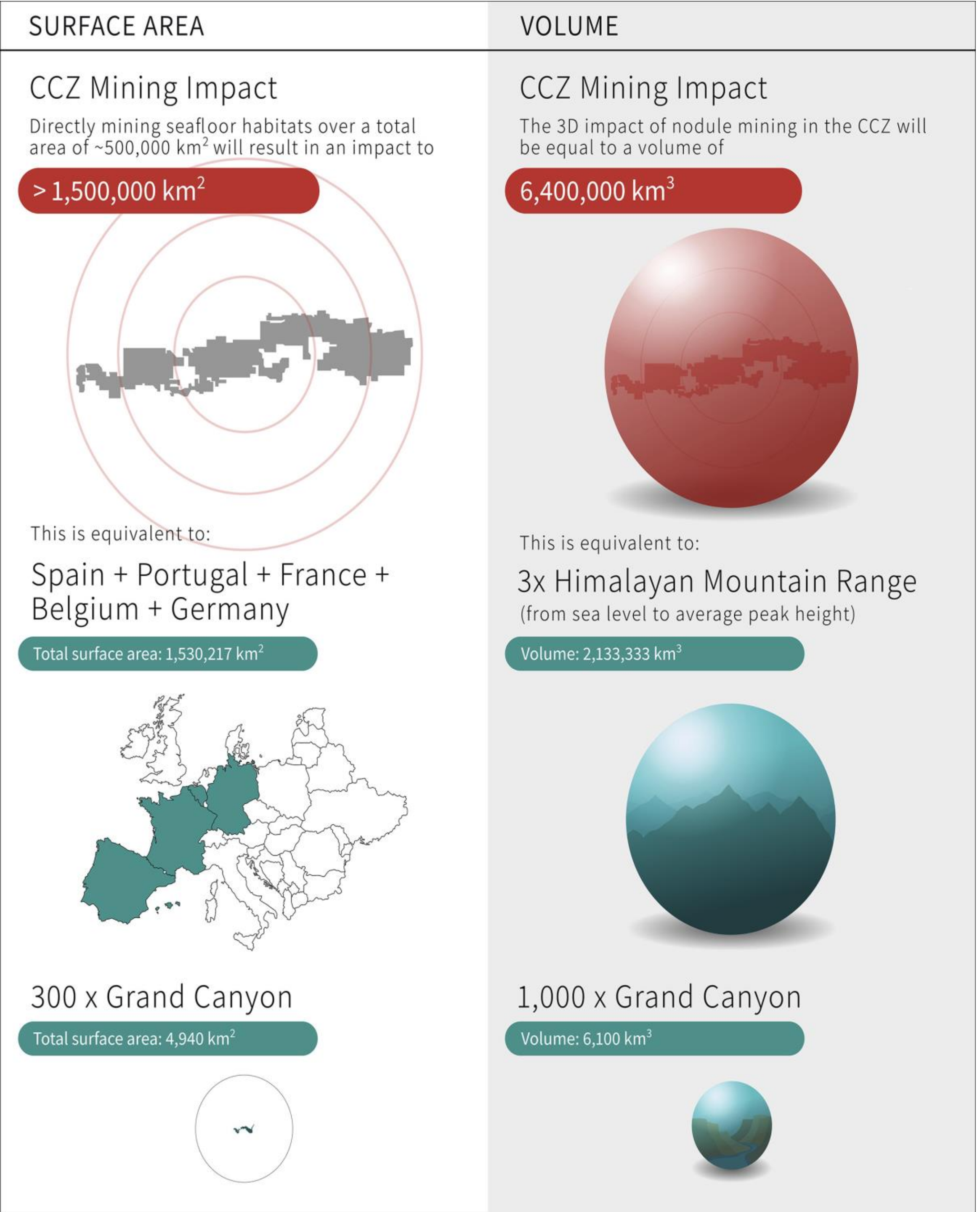
Economic risks

- Employment effects minimal
- Economic profitability: doubtful
- Impacts on fisheries, tourism, marine genetic exploration and other maritime sectors?
- Will enforce unsustainable consumption and production patterns

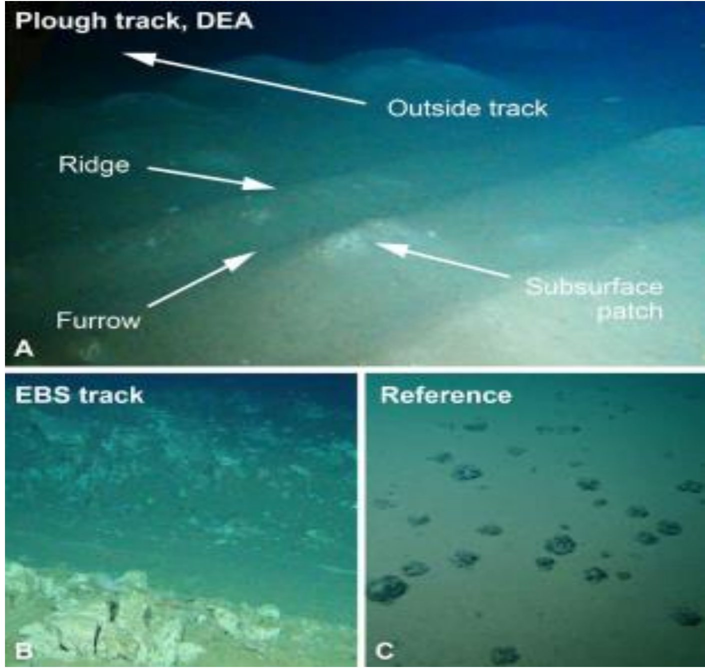
Social risks

- Impacts on local communities
- Involvement of citizens in decision making? Interest of future generations? Benefit sharing?





"German researchers dragged a sled over the seabed ±4150m deep in 1989. When revisited 26 years later, in 2015, the tracks looked perfectly fresh"



SCIENCE ADVANCES | RESEARCH ARTICLE

APPLIED ECOLOGY

Effects of a deep-sea mining experiment on seafloor microbial communities and functions after 26 years

T. R. Vonnahme[1]*[†], M. Molari[1], F. Janssen[1,2], F. Wenzhöfer[1,2], M. Haeckel[3], J. Titschack[4,5], A. Boetius[1,2,4]

Future supplies of rare minerals for global industries with high-tech products may depend on deep-sea mining. However, environmental standards for seafloor integrity and recovery from environmental impacts are missing. We revisited the only midsize deep-sea disturbance and recolonization experiment carried out in 1989 in the Peru Basin nodule field to compare habitat integrity, remineralization rates, and carbon flow with undisturbed sites. Plough tracks were still visible, indicating sites where sediment was either removed or compacted. Locally, microbial activity was reduced up to fourfold in the affected areas. Microbial cell numbers were reduced by ~50% in fresh "tracks" and by <30% in the old tracks. Growth estimates suggest that microbially mediated biogeochemical functions need over 50 years to return to undisturbed levels. This study contributes to developing environmental standards for deep-sea mining while addressing limits to maintaining and recovering ecological integrity during large-scale nodule mining.

JPI OCEANS

MiningImpact

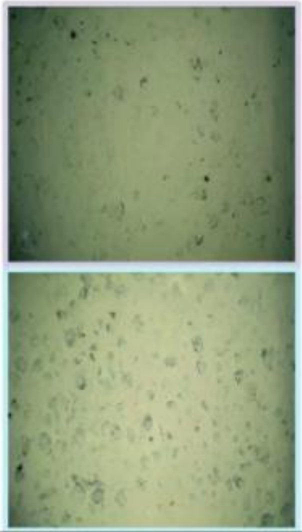
Environmental Impacts & Risks of Deep-Sea Mining

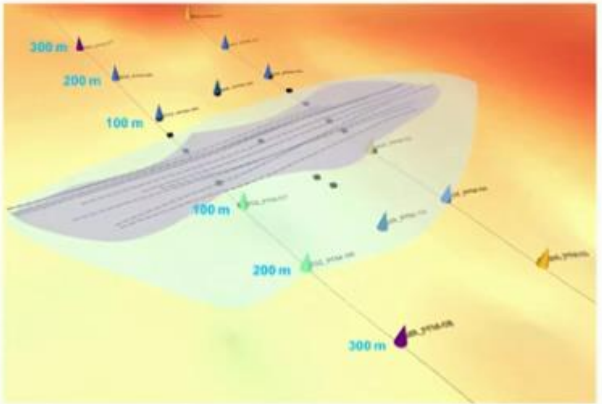
Coordinator: Matthias Haeckel, GEOMAR

Belgium: UGent, RBINS
France: IFREMER
Germany: GEOMAR, MPI, SGN, JUB, UBremen, AWI, BGR, UBielefeld, CAUKiel
Italy: UNIVPM
Norway: DNVGL, NIVA, UNEP GRIDA, UResearch, NTNU, SNF, IRIS, UiB
Poland: ULodz, USzczecin
Portugal: UAveiro, IMAR, CIIMAR, UAlgarve, IPMA
Romania: Geoecomar
Sweden: UGothenburg
The Netherlands: NIOZ, UUtrecht, TUDelft
United Kingdom: USOU, NHM, NOCS, HWU
The International Seabed Authority

Sediment plume dispersal

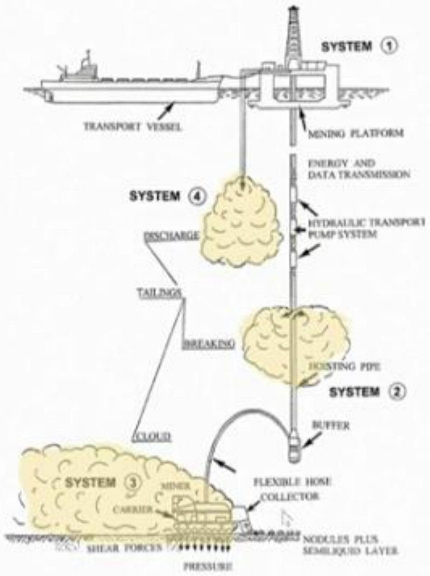
- Sediment plumes will blanket considerable seafloor areas outside the mined area => **impact area >> mining area**





Plume monitoring: Array of 14 platforms with 29 optical and acoustic sensors quantifying sediment particle concentrations in the bottom water

Impacts of Polymetallic Nodule Mining



- Removal of nodules + 10 cm of seafloor
- Generation of sediment plume that will resettle & blanket the seafloor
- Discharge of sediment waste from surface platform / riser pipe

- Loss of habitat
- Loss of species & genetic diversity
- Loss of ecosystem structure & functions
- Change of surface sediment characteristics & processes

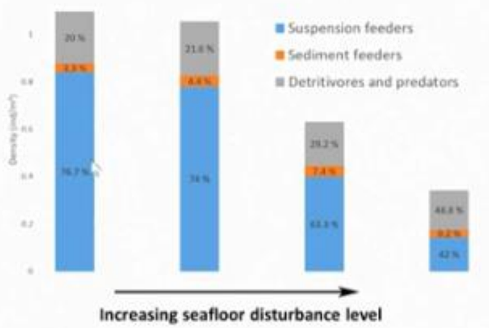
Oebius et al. (2001) DSR II 48

Boetius & Haeckel (2018) Science 359

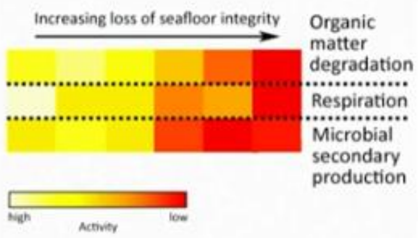
Disturbance effects on fauna

- Disturbance impacts on nodule ecosystems last for many decades and affect numerous ecosystem compartments and functions
- Loss of seafloor integrity by nodule and sediment removal generally reduces population densities and ecosystem functions, such as biogeochemical remineralization processes and the productivity of the benthic community

Megafauna density decrease & community shift



Biogeochemical activity



Marcon & Purser (unpublished)

Vonnahme et al. (2020) Science Advances 6

Science = More science is needed

The elongated bristlemouth (*Sigmops elongatus*) is abundant in the oceans' twilight zone.

Study the twilight zone before it is too late

Even the number of organisms that live there remains a mystery, let alone their diversity and function.

It is alarming, then, that this vast ocean domain is at risk in three ways – even before any of the potential consequences are understood[1]. First, the world's growing population has an increasing need for food. Second, seafloor mining for minerals and metals could release waste into the region[2]. And third, climate change is altering temperature, acidification and oxygen levels in ways that are likely to affect life there[3].

The twilight zone is hard to study. Its organisms are difficult to sample and analyse, being sparsely distributed, elusive and often fragile. They also live at pressures of up to 100 atmospheres, which poses problems for laboratory-based investigations.

Critics might argue that waters near coasts and above shelves are more deserving of study, given the huge environmental pressures there, as well as their importance to societies. And, of course, they need attention. Sadly, however, it is too late to avoid widespread environmental damage to these inshore regions. Instead, research efforts and local policies must aim at mitigating the worst effects.

By contrast, the twilight zone is almost pristine. Moreover, the majority of it lies beyond national jurisdiction. This makes it of common interest and responsibility, and means that global agreement is necessary to manage it.

Here, we outline the steps needed to ensure

CellPress
REVIEWS

Science & Society

Deep-Sea Misconceptions Cause Underestimation of Seabed-Mining Impacts

Craig R. Smith,[1,*] Verena Tunnicliffe,[2] Ana Colaço,[3] Jeffrey C. Drazen,[1] Sabine Gollner,[4] Lisa A. Levin,[5] Nelia C. Mestre,[6] Anna Metaxas,[7] Tina N. Molodtsova,[8] Telmo Morato,[3] Andrew K. Sweetman,[9] Travis Washburn,[1] and Diva J. Amon[10]

Scientific misconceptions are likely leading to miscalculations of the environmental impacts of deep-seabed mining. These result from underestimating mining footprints relative to habitats targeted and poor understanding of the sensitivity, biodiversity, and dynamics of deep-sea ecosystems. Addressing these misconceptions and knowledge gaps is needed for effective management of deep-seabed mining.

Has Phytodetritus Processing by an Abyssal Soft-Sediment Community Recovered 26 Years after an Experimental Disturbance?

Tanja Stratmann[1*†], Lisa Mevenkamp[2†], Andrew K. Sweetman[3], Ann Vanreusel[2] and Dick van Oevelen[1]

[1] Department of Estuarine and Delta Systems, NIOZ Royal Netherlands Institute for Sea Research, Utrecht University, Yerseke, Netherlands, [2] Marine Biology Research Group, Ghent University, Ghent, Belgium, [3] The Lyell Centre for Earth and Marine Science and Technology, Heriot-Watt University, Edinburgh, United Kingdom

The Community Structure of Deep-Sea Macrofauna Associated with Polymetallic Nodules in the Eastern Part of the Clarion-Clipperton Fracture Zone

Bart De Smet[1*], Ellen Pape[1], Torben Riehl[1,2], Paulo Bonifácio[3], Liesbet Colson[1] and Ann Vanreusel[1]

[1] Marine Biology Research Group, Department of Biology, Ghent University, Ghent, Belgium, [2] CeNak, Center of Natural History, University of Hamburg—Zoological Museum, Hamburg, Germany, [3] IFREMER, Institut Carnot, EDROME, Centre Bretagne, REM EEP, Laboratoire Environnement Profond, Plouzané, France

---

Deep-Sea Mining With No Net Loss of Biodiversity—An Impossible Aim

Holly J. Niner[1*], Jeff A. Ardron[2,3], Elva G. Escobar[4], Matthew Gianni[5], Aline Jaeckel[6], Daniel O. B. Jones[2], Lisa A. Levin[7], Craig R. Smith[8], Torsten Thiele[9], Phillip J. Turner[10], Cindy L. Van Dover[10], Les Watling[11] and Kristina M. Gjerde[12]

Deep-sea mining is likely to result in biodiversity loss, and the significance of this to ecosystem function is not known. "Out of kind" biodiversity offsets substituting one ecosystem type (e.g., coral reefs) for another (e.g., abyssal nodule fields) have been proposed to compensate for such loss. Here we consider a goal of no net loss (NNL) of biodiversity and explore the challenges of applying this aim to deep seabed mining, based on the associated mitigation hierarchy (avoid, minimize, remediate). We conclude that the industry cannot at present deliver an outcome of NNL. This results from the vulnerable nature of deep-sea environments to mining impacts, currently limited technological capacity to minimize harm, significant gaps in ecological knowledge, and uncertainties of recovery potential of deep-sea ecosystems. Avoidance and minimization of impacts are therefore the only presently viable means of reducing biodiversity losses from seabed mining. Because of these constraints, when and if deep-sea mining proceeds, it must be approached in a precautionary and step-wise manner to integrate new and developing knowledge. Each step should be subject to explicit environmental management goals, monitoring protocols, and binding standards to avoid serious environmental harm and minimize loss of biodiversity.

Macrostylis metallicola spec. nov.—an isopod with geographically clustered genetic variability from a polymetallic-nodule area in the Clarion-Clipperton Fracture Zone

Torben Riehl[1,2,3] and Bart De Smet[4]

[1] Department of Marine Zoology, Section Crustacea, Senckenberg Research Institute and Natural History Museum, Frankfurt am Main, Germany
[2] Institute for Ecology, Evolution and Diversity, Johann Wolfgang Goethe Universität Frankfurt am Main, Frankfurt am Main, Germany
[3] Centre for Natural History, Zoological Museum, Universität Hamburg, Hamburg, Germany
[4] Department of Biology, Marine Biology Research Group, Ghent University, Ghent, Belgium

markers point in a similar direction. *M. metallicola* appears to be amongst the more common and widely distributed components of the benthic macrofauna in this region which may suggest a resilience of this species to future mining activities because of its apparent potential for recolonization of impacted sites from adjacent areas of particular environmental interest. The genetic data, however, show geographic clustering of its genetic variability, pointing towards a limited potential for dispersal. Local extinction of populations could potentially not be compensated quickly and would mean a loss of genetic diversity of this species.

Biogeochemical Regeneration of a Nodule Mining Disturbance Site: Trace Metals, DOC and Amino Acids in Deep-Sea Sediments and Pore Waters

Sophie A. L. Paul[1*], Birgit Gaye[2], Matthias Haeckel[3], Sabine Kasten[4,5] and Andrea Koschinsky[1]

[1] Department of Physics and Earth Sciences, Jacobs University Bremen, Bremen, Germany, [2] Institute of Geology, University of Hamburg, Hamburg, Germany, [3] GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany, [4] Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany, [5] Faculty of Geosciences, University of Bremen, Bremen, Germany

The disturbed sites exhibit various disturbance features: some surface sediments were mixed through, others had the top layer removed and some had additional material deposited on top. Pore water constituents have largely regained pre-disturbance gradients after 26 years. The solid phase, however, shows clear differences between disturbed and undisturbed sites in the top 20 cm so that the impact is still visible in the plowed tracks after 26 years. Especially the upper layer, usually rich in manganese-oxide and associated metals, such as Mo, Ni, Co, and Cu, shows substantial differences in metal distribution. Hence, it can be expected that disturbances from polymetallic nodule mining will have manifold and long-lasting impacts on the geochemistry of the underlying sediment.

Science — Current Issue | First release papers | Archive | About | Submit

HOME > SCIENCE > VOL. 379, NO. 6636 > DEEP-SEA IMPACTS OF CLIMATE INTERVENTIONS

POLICY FORUM | MARINE SCIENCE

Deep-sea impacts of climate interventions

Ocean manipulation to mitigate climate change may harm deep-sea ecosystems

LISA A. LEVIN, JOAN M. ALFARO-LUCAS, ANA COLAÇO, ERIK E. CORDES, NEIL CRAIK, ROBERTO DANOVARO, HENK-JAN HOVING, JEROEN INGELS, NÉLIA C. MESTRE, [...], AND MORIAKI YASUHARA +3 authors Authors Info & Affiliations

SCIENCE • 9 Mar 2023 • Vol 379, Issue 6636 • pp. 978-981 • DOI: 10.1126/science.ade7521

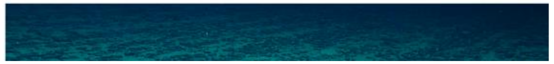
---

eos WETENSCHAP

UMMER • NATUUR & MILIEU • TECHNOLOGIE • GEZONDHEID • RUIMTE • NATUURWETENSCHAPPEN • GESCHIEDENIS • PSYCHE & BREIN • BLOGS • PODCAST • AGEND

Natuur & Milieu

Meer dan 5000 nieuwe soorten ontdekt in gebied bestemd voor diepzeemijnbouw



Deep sea nature-based solutions to climate change

Nathalie Hilmi[1*] Michael Sutherland[2] Shekoofeh Farahmand[3] Gunnar Haraldsson[4] Erik van Doorn[5] Ekkehard Ernst[6] Mary S. Wisz[7] Astrid Claudel Rusin[8] Laura G. Elsler[7] Lisa A. Levin[9]

[1] Environmental Economics, Centre Scientifique de Monaco, Monaco, Monaco
[2] Department of Geomatics Engineering and Land Management, Faculty of Engineering, The University of the West Indies, St. Augustine, Trinidad and Tobago
[3] Department of Economics, University of Isfahan, Isfahan, Iran
[4] Intellecon, Reykjavik, Iceland
[5] Walther Schücking Institute for International Law, Kiel University, Kiel, Germany
[6] International Labor Organization, Geneva, Switzerland
[7] Sasakawa Global Ocean Institute, World Maritime University, Malmö, Sweden
[8] Département de l'Equipement, de l'Environnement et de l'Urbanisme, Direction de l'Environnement, Monaco, Monaco
[9] Center for Marine Biodiversity and Conservation and Integrative Oceanography Division, Scripps Institution of Oceanography, UC San Diego, La Jolla, CA, United States

The deep sea (below 200 m depth) is the largest carbon sink on Earth. It hosts abundant biodiversity that underpins the carbon cycle and provides provisioning, supporting, regulating and cultural ecosystem services.

Article | Open access | Published: 24 July 2023

Carbonate compensation depth drives abyssal biogeography in the northeast Pacific

Erik Simon-Lledó, Diva J. Amon, Guadalupe Bribiesca-Contreras, Daphne Cuvelier, Jennifer M. Durden, Sofia P. Ramalho, Katja Uhlenkott, Pedro Martinez Arbizu, Noëlie Benoist, Jonathan Copley, Thomas G. Dahlgren, Adrian G. Glover, Bethany Fleming, Tammy Horton, Se-Jong Ju, Alejandra Mejía-Saenz, Kirsty McQuaid, Ellen Pape, Chailinn Park, Craig R. Smith & Daniel O. B. Jones

Nature Ecology & Evolution 7, 1388–1397 (2023) | Cite this article

Science = More science is needed

WWF

One Earth

CellPress

Volume 5, Issue 3, 18 March 2022, Pages 220-223

Commentary

Heading to the deep end without knowing how to swim: Do we need deep-seabed mining?

Diva J. Amon[1 2], Lisa A. Levin[3], Anna Metaxas[4], Gavin M. Mudd[5], Craig R. Smith[6]

The deep seafloor is regarded as a potentially large source of the minerals needed for producing batteries to fuel the transition to a low-carbon energy system, but rapid, unrestrained mining would have severe impacts on deep-ocean ecosystems and should be avoided. We propose alternative pathways forward.

*A synthesis of the peer-reviewed literature and consultations with deep-seabed mining stakeholders revealed that, **despite an increase in deep-sea research, there are few categories of publicly available scientific knowledge comprehensive enough to enable evidence-based decision-making regarding environmental management, including whether to proceed with mining in regions where exploration contracts have been granted** by the International Seabed Authority.*

ELSEVIER

Marine Policy

Volume 138, April 2022, 105006

Assessment of scientific gaps related to the effective environmental management of deep-seabed mining

Diva J. Amon[a], Sabine Gollner[b], Telmo Morato[c], Craig R. Smith[d], Chong Chen[e], Sabine Christiansen[f], Bronwen Currie[g], Jeffrey C. Drazen[d], Tomohiko Fukushima[h], Matthew Gianni[i], Kristina M. Gjerde[j], Andrew J. Gooday[k], Georgina Guillen Grillo[l], Matthias Haeckel[m], Thembile Joyini[n], Se-Jong Ju[o p], Lisa A. Levin[q], Anna Metaxas[r], Kamila Mianowicz[s], Tina N. Molodtsova[t]...Chris Pickens[ad]

ORIGINAL RESEARCH article

Front. Mar. Sci., 01 August 2022
Sec. Marine Affairs and Policy
Volume 9 - 2022 |
https://doi.org/10.3389/fmars.2022.898711

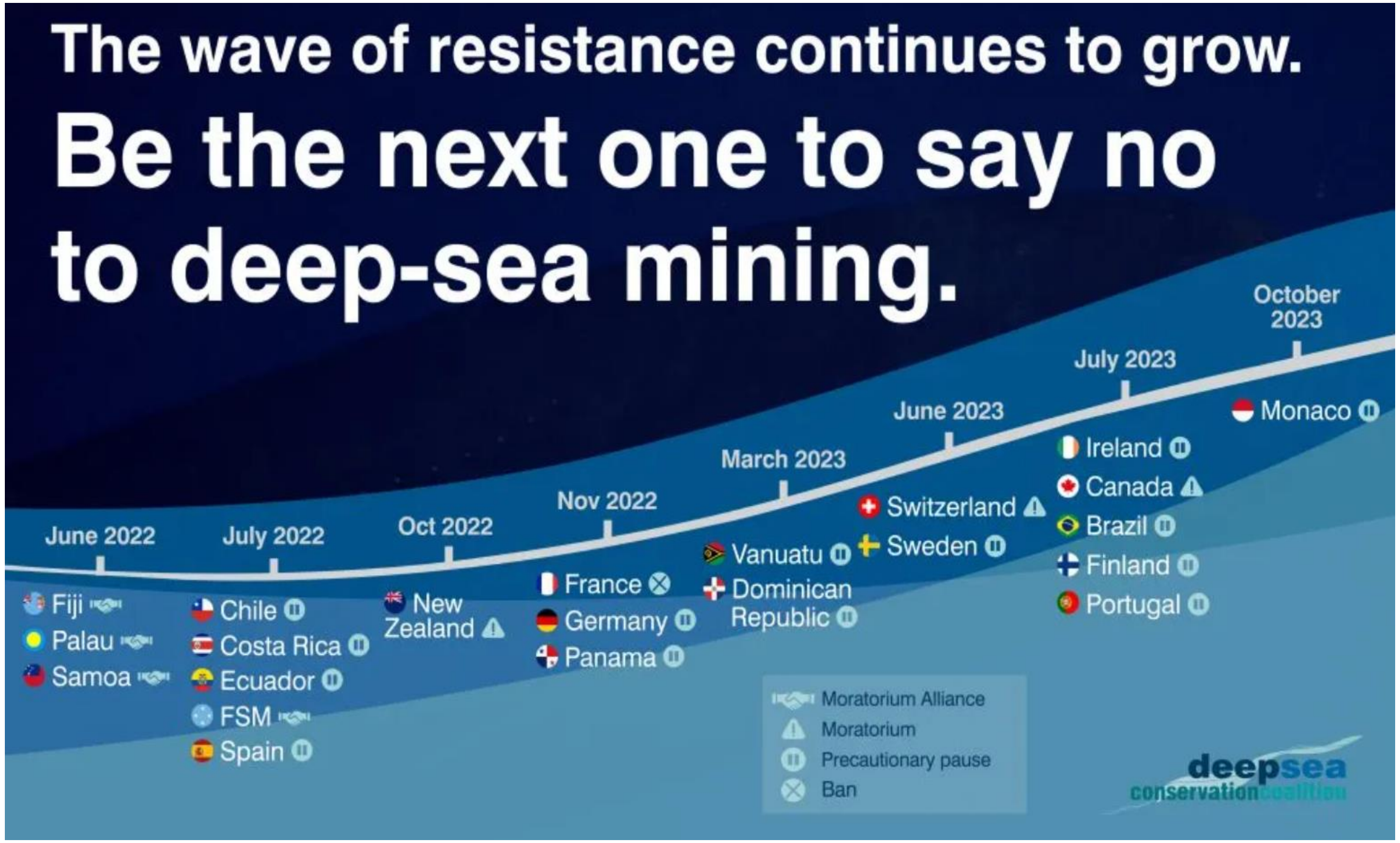
This article is part of the Research Topic
Contemporary Marine Science, its Utility and Influence on Regulation and Government Policy
View all 6 Articles >

Evaluating the quality of environmental baselines for deep seabed mining

Sabine Christiansen[1*], Stefan Bräger[2] and Aline Jaeckel[1,3]

[1] Institute for Advanced Sustainability Studies (IASS), Potsdam, Germany
[2] BioConsult SH, Husum, Germany
[3] Australian National Centre for Ocean Resources and Security (ANCORS), University of Wollongong, Wollongong, NSW, Australia

Generating environmental baseline knowledge is a prerequisite for evaluating and predicting the effects of future deep seabed mining on the seafloor and in the water column. Without baselines, we lack the information against which to assess impacts and therefore cannot decide whether or not they pose an acceptable risk to the marine environment. At present, the International Seabed Authority (ISA), which is the



Growing movement for a moratorium:

- Business Statement Supporting a Moratorium
- Scientists supporting a pause
- Everyone else saying no to deep-sea mining

WWF

Retail & others

BREITLING 1884 · CARS OF THE FUTURE · featurebank · FUTURE PROOF. · OCEANOGAMI Build your Ocean Responsibility · OxidaneX · patagonia · Searious BUSINESS

Mobility & Energy

BMW GROUP · CHARGE ENTERPRISES, INC. · ecotricity · Manta Ray EV · northvolt · Renault Group · SCANIA · VOLKSWAGEN AKTIENGESELLSCHAFT · VOLVO · VOLVO VOLVO GROUP

Technology

eOceans · Google · PHILIPS · RAZER · salesforce · SAMSUNG SAMSUNG SDI · shift · TOOL

Financial institutions

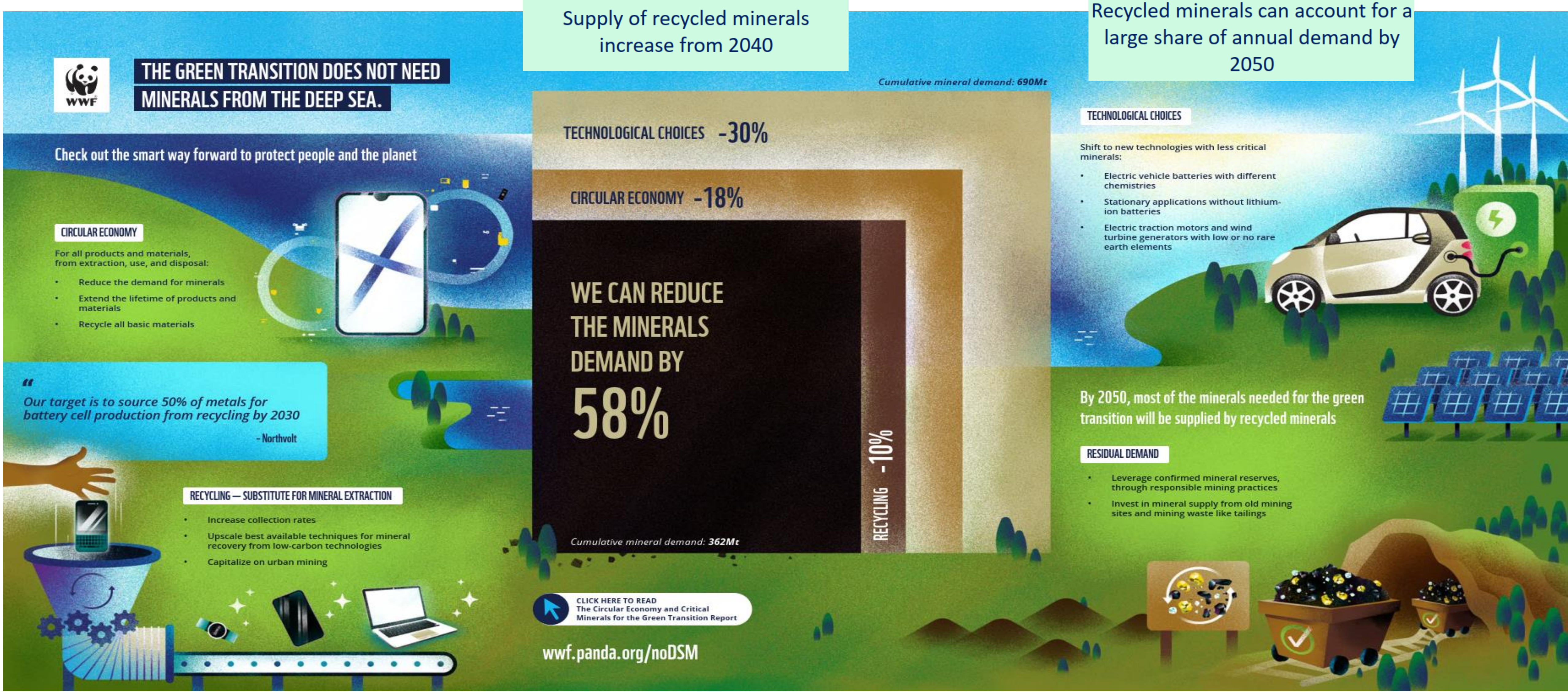
asn bank · FAMA Investimentos · FARVATN · generation · Globalance · GOODLANDER INVESTMENT MANAGEMENT · Katapult Ocean · Planet Ocean Fund · storebrand · Triodos Bank

Circular economy

[The Future is Circular – Circular Economy and Critical Minerals for the Green Transition]

Supply of recycled minerals increase from 2040

Recycled minerals can account for a large share of annual demand by 2050



= True Blue visionary leader

Deal with minerals within planetary boundaries = work towards a closed-loop economy:

1. Reduction in material use through innovation in efficiency and applications of finite natural resources
2. Sharing models for cars, electrical appliances, batteries, renewable energy systems…
3. Product standards for circularity and climate → life-long products with repair and lifetime score
4. Resources, climate change and conflict
5. Sustainable and responsible finance

Potential emergence of deep-sea mining = counterintuitive to a closed-loop economy:

1. Deep-sea mining operations would create significant pollution and environmental destruction
2. Deep-sea minerals are finite resources and essential to the functioning of deep sea ecosystems
3. Deep-sea mining would compromise ocean carbon, metals and nutrient cycles
4. Deep-sea mining would undermine efforts to increase the recycling of minerals and metals
5. Deep-sea mining would undermine efforts to reduce material intensity in design and production

CIRCULAR & RESPONSIBLE MINERALS

+

OCEAN PROTECTION, CONSERVATION & RESTORATION

Belgium MFA 🇧🇪
@BelgiumMFA

🌊 Today's #WorldOceansDay reminds us of the key role the oceans have in everyday life.

💙 Belgium is internationally one of the driving forces to #SaveOurOcean.

✍️ In February, we signed the Brussels Declaration on the Ocean and #ClimateChange, pledging urgent #ClimateAction.

didier reynders and 9 others

9:59 AM · Jun 8, 2019 · Twitter Web App

WWF

Thank you for your attention