TEMPLATE FOR COMMENTS

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General Comments

When preparing the general comments, stakeholders are invited to consider the following:

1) The structure and layout of the draft REMP.
2) The level of detail of the draft REMP, while avoiding being too prescriptive.
3) The goals and objectives in the draft REMP in providing for long-term, effective protection of the marine environment in the Area of the northern Mid-Atlantic Ridge.
4) The management measures and their ability to achieve the goals and objectives in the draft REMP.

From: David Mosher, Geological Survey of Canada at Natural Resources Canada (David.mosher@nrcan-rncan.gc.ca)

Spreading ridges and subduction zones represent the most dynamic geological regions on earth. While subduction margins are relatively well studied, spreading ridges are not, largely because they are inaccessible and because they generally have little direct impact on humankind.

Less than half of the REMP area of the northern MAR has modern multibeam bathymetric coverage. Even with this coverage, multibeam data acquired from surface vessels in these water depths is limited in resolution to >100 m grid spacing. Given what is known of the complexity of spreading ridges, and the known high degree of variability, knowledge of even the ridge's surficial morphology is greatly limited, therefore.

The reference to variability in habitat using the Harris et al (2014) citation (Paragraph 21), is hardly adequate to capture local or even regional variability; particularly for highly dynamic areas such as a spreading ridge. This reference is a global map with great inadequacies in its classification scheme.

Observations of active venting and vent communities is restricted to direct observation by ROV, thus precious little of the ridge's biological competence is known. Dives on active spreading ridges have universally surprised researchers by their complexity, variability and diversity of living and non-living forms.

In this context, it would seem that the area within 100 km of the ridge axis is the very region where the precautionary principle should be applied due to great uncertainties. While the text (paragraph 22) indicates spacing of PMS (presumably along axis), it does not specify off-axis distribution. This leads to the question: Are polymetallic sulphides restricted to this region within 100 km of the ridge axis? If they occur outside of

the 100 km buffer, then these are the areas that should be targeted. If not, then clearly any exploration and in particular exploitation should proceed with caution.

While operational objectives and management measures for the REMP area and for contract areas seem well thought out, it seems impractical that these can be implemented to the full northern MAR region; particularly without significant directed funding.

While recognizing that there is a high degree of variability, it may be more practical to establish a smaller prototype case study area or areas for detailed study. The full diversity of geological and biological forms within this area could be sampled, and monitoring of the site could capture transient events and species could be implemented. Prototype exploitation could illuminate issues of particular concern, such as increased turbidity or release of geochemical constituents that may have negative consequences. Perhaps this could be made a requirement of the three existing licensees in the northern MAR region; otherwise, it seems challenging as to whom would fund and undertake these investigations.

From: David J. W. Piper, Geological Survey of Canada at Natural Resources Canada (David.Piper@nrcan-rncan.gc.ca)

My expertise generally is in deep-water sedimentology, including the transport of fine-grained sediments by oceanic currents to produce what are known as contourites. I have some experience with evaluating environmental impacts of petroleum exploration on the deep continental margin of eastern Canada. I am not an expert on the mid-ocean ridge, but was very familiar with the literature prior to 2015.

The mid-ocean ridge is an area of very complex morphology, not well known from modern multibeam mapping. The Atlantic Ocean has a dynamic deep-water circulation that in places scours the seabed, particularly in large fracture zones and around seamounts. There is little published work on current influence on seafloor sediments around any mid-ocean ridge, let alone the MAR, particularly under present post-glacial conditions. Neither am I aware of work on the rate and dispersion of potential contaminants, particularly any far-field cumulative effects, around MAR topography. High-latitude glaciation in the past 2.5 million years led to the rapid growth of sediment drifts over wide areas of the Atlantic Ocean. Clearly the plume discharge from mining sites is many many orders of magnitude less, but the sediment drifts on oceanic crust such as the Eirik and Gloria drifts and those around the Vema Gap provide clear evidence for far-field transport by bottom currents (Faugeres et al. 1993, *Sedimentary Geology*. 82, 189-203).

I am not a biologist, but it seems to me that there has been a simple transfer of continental margin/seamount concerns over VMEs to the deep-water MAR, based on slow growth rates of corals and sponges. As one of the few people privileged to see in 1985 and 86 the destruction caused by the 1929 Grand Banks turbidity current on the deep seafloor off eastern Canada (e.g. Piper, 1989, *GSC Paper* 88-20), I have the vivid impression that the regeneration of any deep water ecosystem is an extremely slow process. Corals and sponges in deep water, together with vent tube worms, seem like baby harp seals in shallow water: they excite the public but are not the only aspects of the ecosystem biodiversity that needs to be protected. Even with high surface productivity, deep-water benthic recolonization is extremely slow. Do we really know the tolerance of deep-water benthos to elevated levels of metals entrained in plumes? Studies of sediment flux in surface plumes suggest significant transport over distances up to 1000 km (de Gelleke et al., 2013, *Marine Geology*, 336, 160–169). Environmental destruction by mining on land generally does not extend more than 100 km down rivers; in the deep sea, and particularly the Atlantic Ocean with its vigorous circulation, the effects of mining are potentially much more widespread.

It has been shown that microplastics are locally concentrated by deep-sea currents (Kane et al. 2020 S*cience, 368*(6495), pp.1140-1145). Particular attention needs to be paid to use of plastics in any mining operations.

Is the restriction to the axis of the MAR of sites in need of precaution due to lack of data in off-axis areas?

My gut feeling, having spent a 45-year career trying to understand the outer continental margin off southeastern Canada, is that there will need to be a large investment in new science on the whole MAR system for a couple of decades before mining can safely go ahead. That will require research ships capable of working far offshore and deploying heavy instrumentation including ROVs and corers in deep water, without too much time waste steaming to do crew rotations. With the loss of the *Hudson*, Canada has no such capability at present. The last significant Canadian work on the MAR was in the mid 1970's; since then, the focus has been very much on the Canadian marine landmass. It will require a change in mindset from policy makers.

Specific Comments

Page	Line	Comment
4	6	Put ISA in brackets at first use "International Seabed Authority (ISA)"
4	42	Define REMPs in quote using square brackets as: "*regional environmental assessments and management plans [REMPs]"*
6	93	Make it clear that the overarching goals of the REMPs are with respect to the pressures imposed by the activity, that is, seabed mining. Bullets 'a' to 'f' only relate to the authority of the ISA and the pressures imposed by mining and not to all activities in the area such as fishing in the water column above the sea bed. The ISA activities may also have far field effects on fishing or the ecosystem through water column connectivity.
6	117	The geographic scope of the REMP does not include the many fracture zones that extend out from the MAR axis as noted on line 132 (p7).
7	126	This section does not present a balanced overview of the area as there is no mention of knowledge gaps and it reads as if this is a well-studied region where the physical and biological setting is known. That is not the case, is deeply misleading, and it should be made clear from the outset. This has a large influence on the REMP as often the only data that will be relevant will come from the stakeholders.
7-8	132-176	The confidence in these statements for this whole section should be included. For example here the percentages of hard and soft substrate must have a high level of uncertainty. Many of the statements have only one supporting citation and the Data Report does not summarize the native resolution of the data layers.
9	190	It would be helpful to see a map of the areas where these contracts have been granted.

9	207	Again, this REMP only concerns itself with the pressures imposed by the activity, that is, seabed mining. It does not fulfil the objectives with respect to any other pressures, anthropogenic or otherwise.
9	207	Define 'regional scale'.
9	215	Not sure that we can realistically set cumulative impact thresholds. We have difficulty setting these in well-studied systems. If we are unable to set cumulative impact thresholds how will cumulative impacts be assessed?
9	216	It is highly unlikely that the objectives outlined will be achievable given the knowledge gaps that exist in this remote area. Some of them are not even known for well-studied areas such as continental shelves (e.g.,'b' and 'h').
9	217	Who is responsible for delivering on the operational objectives?
10	263	I'm not sure why this statement is included about ensuring that the implementation of spatial management measures does not interfere with the implementation of environmental baseline studies or monitoring by contractors. If the spatial management measures are necessary then shouldn't they take priority?
10	240	What is the environmental baseline? That is important to document.
11	276	There is no mention of areas put in place to protect vulnerable marine ecosystems in EU/NEAFC waters by competent authorities, or of OSPAR MPAs.
11	292	What is the basis for selecting only these three areas over others? A bit more elaboration on their selection is needed. They seem only to capture the fracture zones and not the other areas listed in point 21.
11	297	Unclear what is meant by "protected as an integrated system"?
11	302	Why is the focus only on the spatial scale of transportation of fine particles from mining plumes? What about impacts from other sources?
12	351	This is the first mention of "precaution" despite it being a central tenant on line 82. I see no inclusion of the Precautionary approach to this point. Given the high uncertainties associated with this region this must be corrected.
13	385	This statement should include far field effects. Serious harm to what – specify.
13	389	It should be clear how such thresholds will be established. As these will be critical to the management plan they need to meet scientific standards.
14	402	Hydrothermal vent sites ARE vulnerable marine ecosystems (UNGA 61/105, FAO 2009, ICES VME Database). They are subject to protection

		under international law. It is contrary to those statements to suppose that you can mine on them and just manage the plumes.
15	447	Here is a different meaning of threshold. What is this exactly?
16	522	Thresholds are meaningless if they are not tightly linked to a change in activity. There is no mention of what happens if thresholds are crossed, if unexpected events occur, or if cumulative impacts do not follow modelled predictions. This is an unacceptable omission. There need to be rules and consequences related to environmental protection as for other aspects of mining (safety, for example). There should also be an acknowledgement that we may not have enough information to develop thresholds in all cases. How will we deal with cases where we cannot develop thresholds?