Natural Resources Canada's comments on the proponent's response to our comments on the draft environmental assessment report for the proposed Exploratory Drilling Program in the Orphan Basin.

Reviewer A – Marine Geologist – GSC-Atlantic

NRCan-1, 2, 3, and 5 are well dealt with. NRCan understands the response to NRCan-4 and agrees that deep-water benthos was considered as a VEC (but inadequately), so technically this has been dealt with.

NRCan-6 and NRCan-7 are still inadequately satisfied, and should be considered in the context of NRCan-4, which provided a clear rationale for why this issue is important. Perhaps NRCan's original request for considering the timescale of mass-mortality in NRCan-6 could have been better expressed.

NRCan's concern remains that the impact of drilling discharges on deep-water benthos has not been adequately considered, either in terms of immediate discharge from the well (NRCan-7) or the longer term cumulative effects, which were well expressed in NRCan's original request under NRCan-4. In the response to NRCan-6, the proponents miss the point: recovery of benthos on Laurentian Fan is limited to chemosynthetic communities and has not occurred with "normal" benthos. Their conclusion that "this paper ... indicate[s] that deepwater benthic communities will recover from disturbance" is wrong - this paper shows that benthic communities other than chemosynthetic communities have NOT recovered from disturbance after 57 years. The sentence also includes the statement "and others" referring to papers, but none are cited. NRCan does not believe that there is not literature somewhere in the world on the effects of deep-water drilling on benthos.

Reviewer B – Habitat Ecologist – GSC-Atlantic

Reviewer B has examined the environmental assessment information and addendum, fully supports the position of Reviewer A and provides the following comments with respect to the proponent's response to NRCan's comment on the impacts to benthic communities.

There are several important issues in trying to 'guess' recovery time for the Orphan basin benthic fauna. The proponent's EA and EA Addendum do not provide the sought answers.

Statements like "benthic communities appear to return to baseline conditions within one year of cessation of drilling discharges" (EA, p 5-21) or "any cumulative effect … is

predicted to be additive, low magnitude, small geographic extent, and thus not significant" (EA p 5-23) are misleading. Here is why:

The EA (p. 5-22) correctly states that "Benthic communities of the Project Area are not well-studied but in general are probably similar to other areas of the North Atlantic with equivalent oceanographic conditions, substrates, and depths". The problem is that NRCan could not find descriptions of benthic communities in 2000 - 3000 m water depth (representing the major part of the area) in the EA. Porcupine abyssal plain studies may shed some light on this.

Four core stations can not possibly provide adequate representation for benthos in the huge study area. Many reviewers noted that already. However 21 - 29 species of macrofauna on 0.25 m2 of seabed (or more than a 100 species per square meter of seabed) may or may not be indicative of potentially high biodiversity of the area. No discussion is given to how this compares to other similar habitats. No information is collected on the expected megafauna (animals larger that 1 cm) of the area. Are there other structure-forming organisms in this area?

In the statement "benthic communities appear to return to baseline conditions within one year of cessation of drilling discharges" NRCan wonders what are the 'baseline conditions' and where the observations were made? Brooks et al (in press) report that from the limited studies on disturbance in Gulf of Mexico and US East Coast continental shelf, it appears that ''recovery'' by benthic assemblages from disturbance linked to sediment removal occurred within 3 months - 2.5 years and elsewhere from <1 to >15 yr, depending on latitude, sediment type and source-community characteristics (Collie et al, 2000). At least 7 yr was needed for abyssal benthos in the Peru Basin to recover following seabed ploughing to simulate deep-sea mining (Bluhm 2001). For Arctic benthic communities recovery from natural physical impacts may take 15 yr (Conlan and Kvitek 2005) to 30 yr to full recovery (Conlan, pers. comm.). Gutt et al. (1996) estimate a recolonization time of >230 yr for Antarctic benthos at 100 to 500 m depth. Many of these figures are optimistic, because most studies are looking at general abundance of organisms. Those evaluating entire communities often indicated that while abundances of organisms may increase to background levels relatively quickly, community structure may remain altered for some time, and, in repetitively disturbed areas may have difficulty ever recovering to the original state (Brooks et al, in press).

More importantly, recovery of benthic species depends on their life history traits, such as growth rates, maximum age, fecundity, reproduction mode etc. If one were to consider that recolonization is not complete until all organisms reach full size, it would be necessary to base recolonization rate on the slowest-growing organism. The deep-sea coral occurring in the area, *Primnoa resedaeformis*, for example, can reach the age of 112 years (Andrews et al., 2002) and grows at a rate of millimetres a year. This means that the recovery of individual mature colonies would take a century. Nesis (1962) reports that on the eastern slope of Flemish cap, at water depths 1000 - 1200 m the biomass of sponges is conspicuously high - up to 2 kg/m2. If these species occur in the Orphan basin, they provide secondary habitat for coexisting fauna, which will depend on the recovery of sponges.

The effects are going to be additive, indeed and this is negative. In addition to possible mortality of benthic fauna deterioration of benthic habitat is to be expected. Deep-water habitats are generally stable and once disturbed are not likely to return to previous state.

Habitat disturbance will be a direct effect of the discharge of mud and cuttings, which will remain for a long time where initially deposited. This is in fact supported by the proponent's statement (EA page 5 -15) that "there is no information to suggest that this material would be moved by currents at such great depths". Deposition of solids over the large area will lead to hypoxic conditions in the already oxygen-starved upper layers of sediment. Hypoxia, associated with high organic flux to the seabed is the most consistent ecological factor associated with depressed diversity in bathyal soft-sediment habitats (Rex et al., 2000). Due to the additive effects on benthos and habitats the expected impacts are very long term.

The lack of knowledge on the structure and function of benthic assemblages of the Orphan Basin prevents understanding of their role in ecological processes and precludes decision on the safety of the proposed operations in the area. Furthermore the value of this ecosystem component (or the lack thereof) can not be scientifically demonstrated with the information provided in the EA. Considering likely long-term effects NRCan would suggest using Precautionary Approach rather than VEC approach in this case. Alternatively a more rigorous study of benthic communities and habitats of the area is required.

Reference

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