Response of Russian Team

to "Response to IUCN regarding Dr. Avilov's modelling results".

Prepared and submitted to SEIC by Roberto Racca of JASCO Research Ltd on 22 August 2008 Reviewed and revised for release on 6 November 2008"

In the "Response..." JASCO has singled out one factor as having the greatest impact on the resulting estimates. This factor is the lack of modelling, in the Russian team's approach, of losses due to acoustic energy conversion to shear waves at the seafloor interface.

The Russian Team (RT) is pleased to cite in this connection the "GEOACOUSTIC SENSITIVITY STUDY" by DRDC (attached) pp. 7-8, reflecting fully the RT's opinion:

2.2 Geophysical Database (GDB)

The Geophysical Database (GDB) is a database of geophysical properties of the seafloor being developed by the Naval Oceanographic Office (NAVOCEANO) to support prediction of transmission loss in shallow water. My reference to this database is a critique written by Paul Vidmar [1]. In his critique he describes GDB as containing thickness, density, compressional velocity, compressional attenuation, shear velocity and shear attenuation for each layer above geologic basement. He was tasked to evaluate its performance in Martha's Vineyard, and he employed a normal mode program KRACKENC, a full physics model that includes shear.
Vidmar's conclusions were that the GDB did not provide a gradient for the compressional velocity or attenuation, and therefore would not properly allow energy to refract with a layer. It also assumed a linear dependence on frequency for its attenuations whereas his research has shown that the frequency dependence could be as high as quadratic in shallow water areas. Finally, Vidmar found the shear velocity values in GDB were too large.
His suggestions for GDB improvement can be taken as **general guidelines for any geoacoustic profile**:

- Include parameters affecting acoustics. **Parameters such as the velocity gradient are needed to model major acoustic processes. Others such as the shear velocity of the substrate are not needed because they have little impact on the acoustic field.**
- **Increase the level of detail.** Increase the number of layers in the profile to the maximum extent supported by the travel time and other data. Collapsing smaller layers into a larger layer implements an assumption that the smaller layers do not have a major effect on the acoustics at frequencies of interest. In essence, it imposes an unknown maximum frequency for reliable acoustic predictions. Leaving the smaller layers in the profile allows the acoustic model to make that determination on the basis of the bottom interaction mechanisms.

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1 Vidmar, Paul J., "An evaluation of the NAVOCEANO Geophysical Database for the area south of Martha's Vineyard," SAIC-95/1373, Naval Oceanographic Office, Stennis Space Center, MS, December 1995

The RT's results take into account bottom velocity gradients and complicate frequency dispersion, which is not the case for JASCO code. We think that this is the main cause of SEL underestimation.

Secondary, the air guns battery acoustic source characterization with the directedness diagramm is assuming the water and bottom to be uniform to the distances much more than the battery maximal diameter and, moreover, to the extent of the first Fresnel zone of the battery. This assumptions are, evidently, not valid for our very shallow sea basin.

JASCO also wrote

Contrary to the assessment made by the Russian team regarding the relevance of shear wave effects in the acoustic environment of the Piltun region, JASCO does consider these effects to be critical to the correct mathematical representation of the physical reality. This position arises from the model validation work that was performed by JASCO against direct transmission loss measurements conducted in that region, which showed that shear wave parameters are essential to the good matching of the model predictions. The JASCO model, which accounts for the loss of waterborne acoustic energy due to shear wave coupling into the seafloor, also yields estimates of the 2001 Odoptu seismic survey acoustic levels that are in good agreement with measurements.

The RT's results of the stage 1 an 2 of validation also were in good agreement with experimental and, moreover, JASCO's results. In some circumstances the both codes are in agreement, in the others – no. “The broken watch shows the correct time twice a day”.

Based on the previous text RT is viewing its SEL estimation results more reliable than JASCO's ones, but lacking in massivity.

The contradictions in sound propagation modeling methods may be fully solved by the production of computer code taking into account the space-frequency structure of the bottom including the shear properties of its sediments. The RT is capable for this, but such a work requires both more time and more essential finance support.