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# Image Enhancement of OBC Data- A Case Study

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***Summary***

*The present study is carried out on a marine ocean bottom cable data which comprises of pressure (hydrophone) and velocity (Geophone) sensor data. After detail inspection of the raw shot gathers of both hydrophone and geophone, we found Geophone data is more noisy than that of hydrophone. Coherent noise typical of shallow marine records was recorded on both the hydrophone and geophone components.*

*As part of noise removal, the whole data was sorted into receiver domain, and applied different techniques in frequency domain for conditioning the gather of both hydrophone and geophone. For further conditioning, data was sorted in shot domain for the removal shot related noises.*

*After improving the quality of the gathers, Both hydrophone and geophone data were summed using deghost module in focus software for receiver ghost attenuation. All the three gathers viz., geophone, hydrophone and the summed data were stacked separately and their outputs were compared qualitatively.*

***Keywords:*** *OBC, Deghost, Mumbai offshore basin*

## Introduction

The main area of concern in marine seismic data is the presence of water column reverberations. As water column is bounded by high reflection coefficients above (air-water) and below (water- subsurface), multiples have significant energy which makes them prominent in the seismic data. Combining hydrophone and geophone data helps in attenuating water- column multiples.

The present area of study is about the data acquired by M/S PGS of Norway during April 1999 to June 2000 using ocean bottom seismic cables. The methodology of removal of the noise separately on geophone and hydrophone prior to summation was adapted in a 3D data sets pertaining to Tapti-Daman sector of Mumbai offshore block, Western offshore basin, India (location map shown in fig 1).

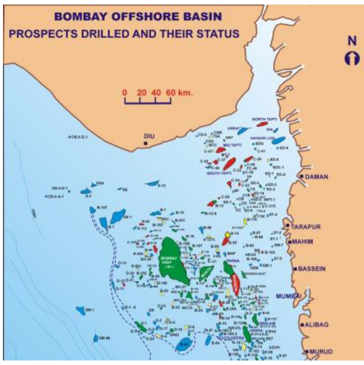


Fig. 1 Study area

## Theory

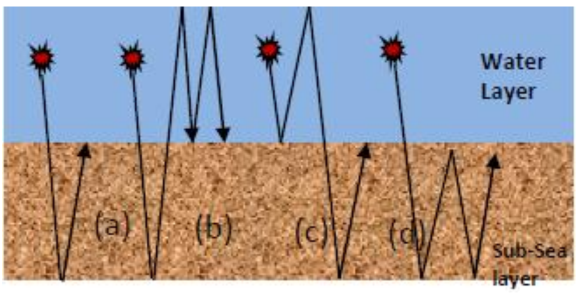


Figure:2 a) Primary reflection b) water column multiples (receiver ghost) c)Source-side multiple d) interbed multiple.

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The reflected energy coming from sub-surface will reach the water surface and get reflected back towards the ocean bottom. As it incidents at the ocean bottom it is partly reflected back to the water surface. This process continues and generates higher order water column multiples. These multiples lags the primary reflections by an amount raypath travelled in the water column.

From figure:2 it is evident that all the primary reflections are upgoing wavefields whereas all the water column reverberations are downgoing wavefields in the OBC data.

Geophone is sensitive to direction of the energy at which it reaches, i.e., its response will be different for the upgoing and downgoing wavefield. For example A same polarity reflection is reaching the geophone in two directions, one from top and other from bottom. Both reflections are recorded with opposite polarities to each other by geophone (Figure 3 ). In contrary hydrophone is insensitive to the direction of the energy reaching the sensor. Two sensors have a different response for the downgoing wavefield, this features enables us to separate the upgoing and downgoing wavefields. Summing of the both data will cancel the receiver ghost, and is called as dual sensor deghosting. OBC summing will cancel the multiples associated with receiver side (downgoing wavefield) and can not handle source side multiples.

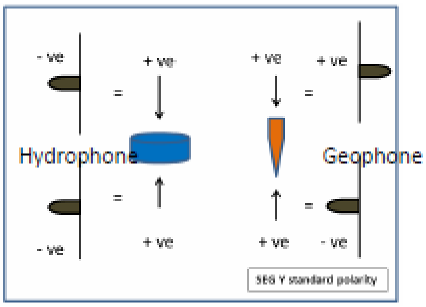


fig 3 : Response of geophone and hydrophone for the downgoing and upgoing wavefield.

## Methodology

Duel sensor deghosting will be carried out in two steps

First step involves shifting of the phase of the Geophone data, to match the phase of the hydrophone data. A 90 degree phase shift along with static shift has been applied.

Second step involves finding a scalar for geophone data. Usually hydrophone amplitudes are of higher magnitude than that of Geophone. It is necessary to calculate a scalar to bring the energy levels of the two traces to the same level for effective removal of ghost. For this purpose we divide the hydrophone trace with the corresponding geophone trace resulting a quotient trace.Applying a smoothing filter over a small window to this quotient trace will generate a scalar trace. The scalar traces so obtained are multiplied with the corresponding geophone traces. These geophone traces are then summed with the hydrophone traces.

Various noise removal techniques have been applied to the data before summation. Noise present in the data will not only degrade the summation result but also generates a spurious noises.

## Results

Figure: 4 shows the receiver gathers of geophone and hydrophone at same location. It is evident that Geophone data has high frequency content when compared to that of Hydrophone but at the same time it is more noisy. Carried out several noise removal techniques in the frequency domain, for both hydrophone and geophone data. After conditioning receiver gathers visibility of the events improved.

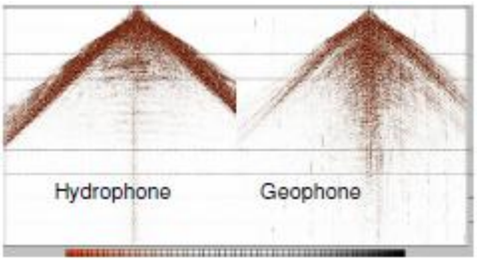


figure 4: Reciever gathers of hydrophone and geophone

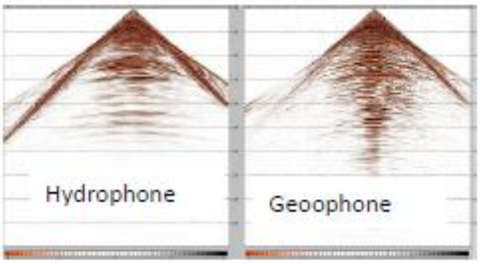


figure 5: Reciever gathers of hydrophone and geophone after noise removal.

Data was sorted in the shot domain for removal of shot related noise. In figure 6 it shows the gathers after noise removal in receiver domain. Even though gathers are conditioned in the receiver domain, they require further conditioning in the shot domain. Quality of the gathers improved remarkably after noise removal in shot domain.

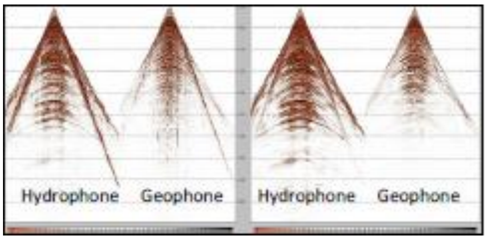


Figure 6: hydrophone and geophone gathers before and after noise removal in shot domain.

Figure:7 represent the conditioned gathers of Hydrophone, geophone and summed (geophone + hydrophone) gathers.

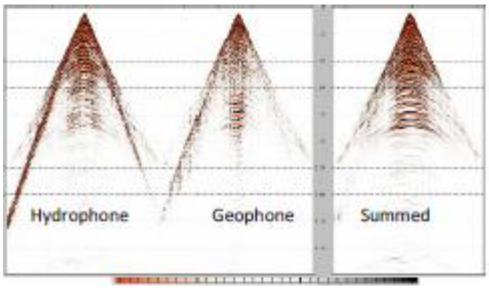


Figure 7: Hydrophone , Geophone gathers and Summed gathers.

Figure 8 shows the decon gathers of hydrophone, geophone and summed gathers with frequency spectrum. Frequency spectrum of the summed gather is improved and become flat in the higher frequency region among the three gathers.

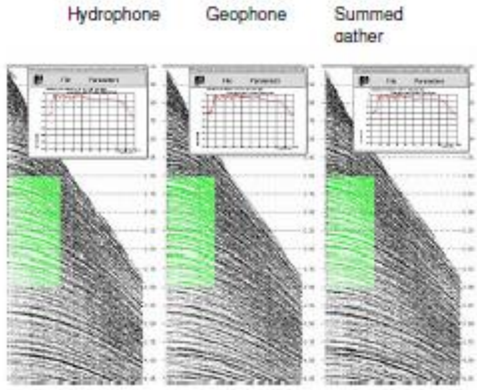


Figure: 8, comparison of spectrum of the hydrophone , geophone and summed gathers.

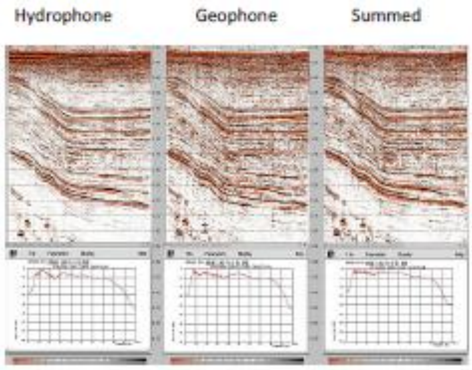


Figure: 9, comparison of stacked sections of the hydrophone , geophone and summed gathers.

## Conclusions

Data conditioning in both shot and receiver domain prior to summation has improved the data quality in pre- processing stage. Frequency spectrum of the summed data has broadened as compared to individual (hydrophone, geophone) data. Notches in hydrophone and geophone data due to reverberations have been adequately tackled in the summed output. The continuity and resolution of the summed output shows a remarkable improvement and will be usefull in further reservoir attribute analysis

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