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Recovery planning for non-seismic objects (SO) encountered in Land 3D survey - A Case Study

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Summary

The villages, industrial campus, water logged areas are the common obstacles encountered almost everywhere in land acquisition works. Presence of such obstacles in land seismic surveys are characterized by NSO (Non Seismic Objects) and create difficulties in placing source and receivers along the desired location which ultimately leads to loss in foldage and source-receiver offsets and azimuths. However, these losses can be minimized up to some extent by modifying the layout for missing shots and receivers within certain limits. The most common NSO types i.e. water logged and populated regions were encounter in the present 3D block. An effective approach to negotiate with fold, associated offsets, and azimuth is explored and discussed.

Introduction

The surface topography encountered in the most of the 3D blocks surveyed in Assam and Arunanchal Pradesh is riverprone and full of inhabited regions. Such surface features encountered during the land seismic are characterized as nonseismic objects (NSO), and creates exclusion zones for shots and/or receivers. The boundary of exclusion zone depends on the NSO type, environmental issues, safety constraints and administrative norms. Regardless of the type, shape and size of the exclusion zone, the ultimate loss in fold and offsets must be minimized by modifying the source and/or receiver layouts within the limit. A number of recovery approaches like smooth detouring, linear shifts, and under-shooting or broad shooting are effective for specific NSO type and its shape and size.

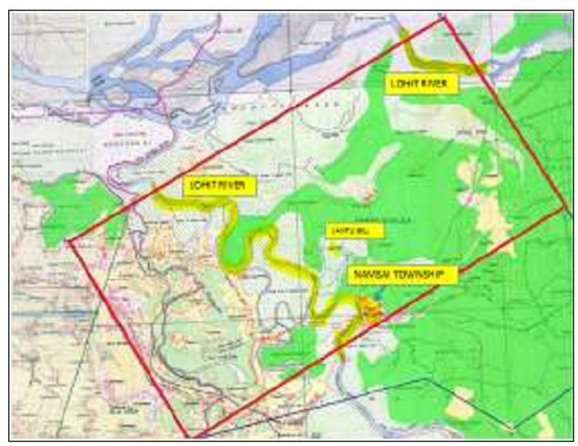

Fig 1: Base map and boundary of proposed amsai 3D block, onSeismic Objects are highlighted in yellow;

The present study is carried out in the proposed Namsai 3D block. The surface topography consists of dense jungles and tea gardens along with the identified NSOs viz. river Lohit, Junta swamp and populated Namsai Township (Fig.1). The planned source and receiver layouts are modified accordingly to minimize the foldage, offset and azimuth irregularities around the NSOs.

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Methodology:

The obstacles encountered in the prospect were two different types of non seismic objects. Water logged areas are classified as type-I NSO in which source and receivers both were restricted. Secondly, Namsai town is classified as type-II NSO in which receiver layout was possible but shots were prohibited. The planned layout (Fig.2) was overlaid on the base map and sufficient number of shots and receivers was found to be inside the river, swamp and town (Fig.3). Cancellation of these source and receivers (Fig.4) according to NSO type lead to a remarkable loss in fold (Fig.5).

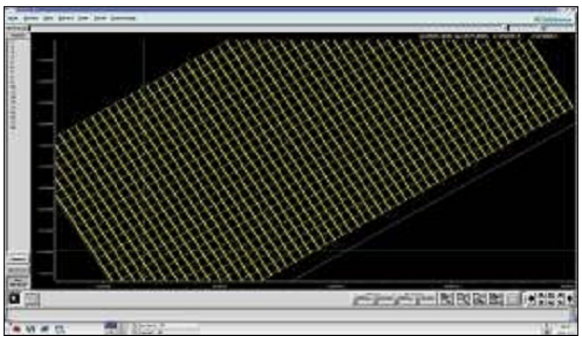

Fig 2: Layout diagram source showing theoretical source and receiver;

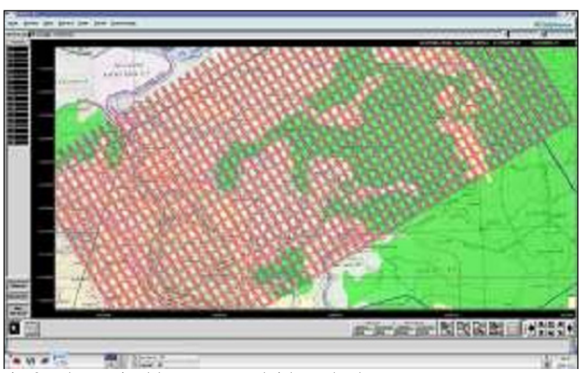

Fig 3: Theoretical layouts overlaid on the base map;

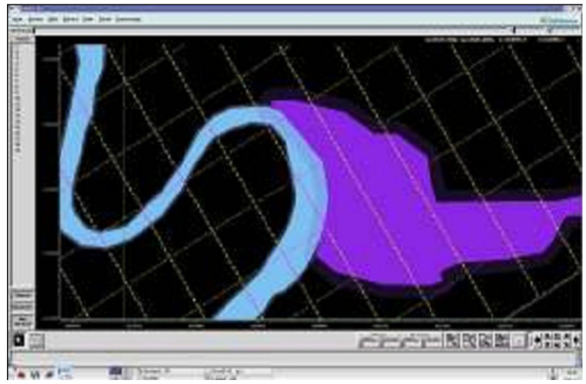

Fig 4: Source and receiver locations inside exclusion zone;

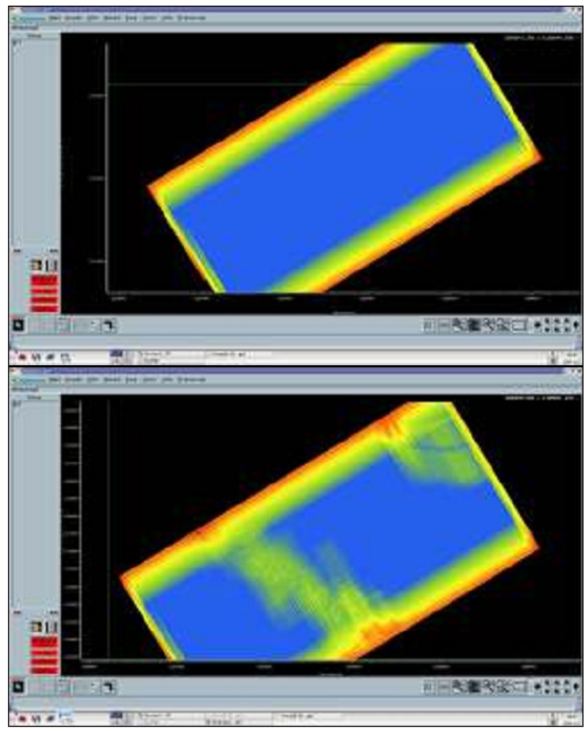

Fig 5: Loss in the fold due to SO;

In order to recover the fold surrounding the NSO, the adopted approach is described one by one -

Step: 1; The NSOs encountered in the area are digitized with the help of base map (Fig.6); exclusion radius is defined as 30 m for water logged areas and 100m for the township.

Step: 2; Source points inside the exclusion zones are investigated carefully to shift in the inline directions at the predefined grids (multiple of receiver interval). The maximum allowable shift is kept less than the source line interval. Most of the shots were moved outside the exclusion zone (Fig.7).

Step: 3; Active patches for shifted shots were extended in the opposite direction of the source movement by the same amount.

Step: 4; Receiver points then allow to shift along the crossline direction as a multiple of source interval. The maximum limit of shifting was fixed as half of the receiver line interval (Fig.8).

The recovered fold, offset and azimuth diagrams are displayed and compared with the original ones (Fig.9 & Fig 10).

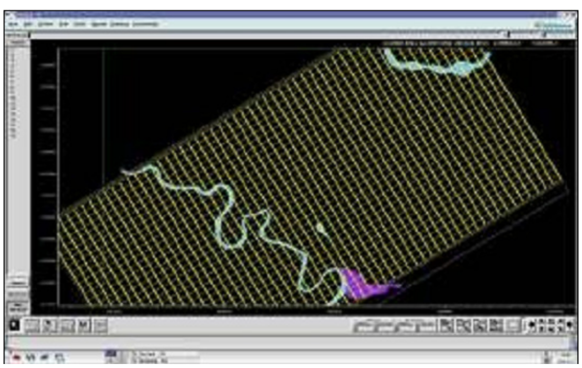

Fig 6: Digitized non-seismic objects along with exclusion zone;

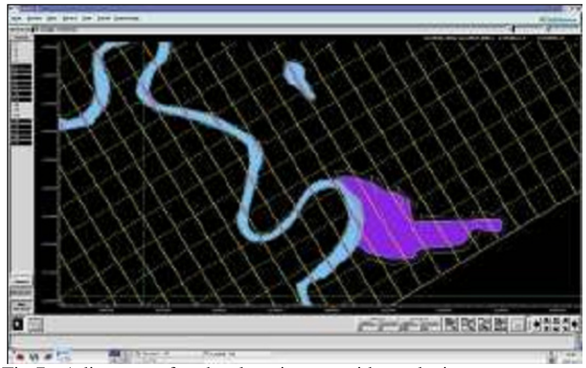

Fig 7: Adjustment for shot locations outside exclusion;

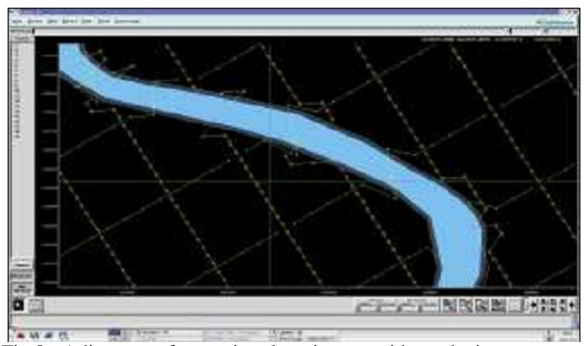

Fig 8: Adjustment for receiver locations outside exclusion;

Results and Discussions

The above example shows clearly that non-seismic objects encountered in 3D land data acquisition can affect the fold and offset considerably. The losses in the fold inside the exclusion zone are recovered significantly with the adopted methodology. Besides the regularization of the fold, associated offsets and azimuths are recovered (Fig.10), which is the one most important aspect of the recovery planning.

However, no recovery plan can resume the attribures completely, but a good approach can minimized the gap between origional and recovered . Least allowable shifts in the shots and receivers locations from the desirable location provides the best recovery results, but the constraints are the safety distances, envoinmental issues and administrative guidelines.

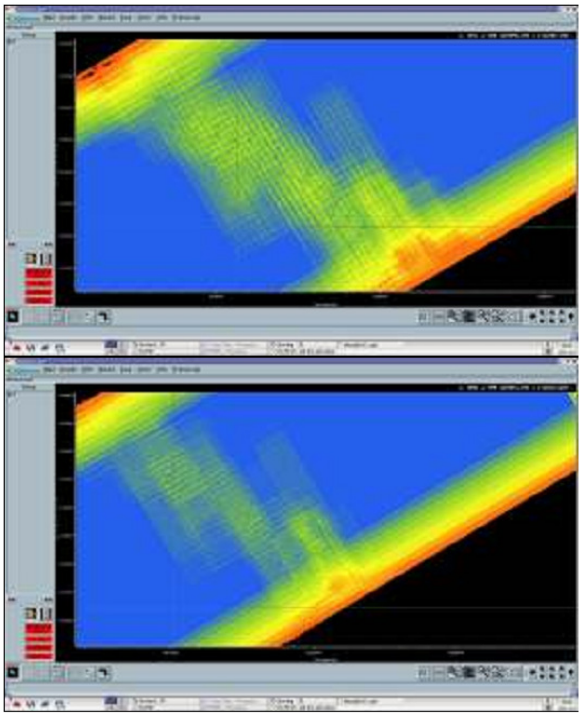

Fig 9: Recovered folds by the adopted methodology;

Conclusion:

During a land seismic project, non seismic objects like water logged areas, inhabited regions encountered almost everywhere. The irregularities are observed in the form of variations in the fold coverage, irregular offset which can manifest itself as an acquisition footprint on pre-stack data or even the stacked image. This needs to be studied before geometry optimization as surface topography is altering at a rapid pace with urbanization. Precise knowledge about the type and dimension of NSO and selection of appropriate negotiating technique are the most important aspects to recover the attributes. A proper recovery approach at the preplanning stage can minimize the loss in the fold and offsets.

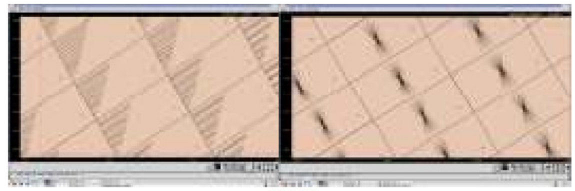

Fig (a)

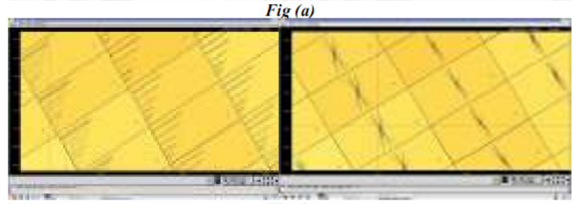

Fig (b)

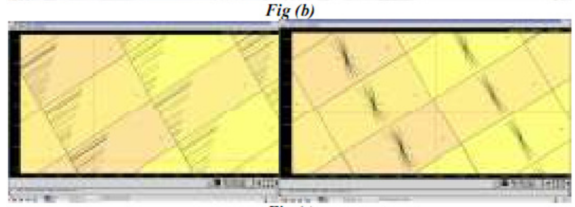

Fig (c)

Fig 10: Offset and azimuth distribution in the bins lying inside exclusion zone (a) theoretically planned (b) without any recovery (c) after recovery;

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