

Field Exclusions and the Impact of Receiver Infill Lines

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Summary

Seismic acquisition is frequently being conducted in areas with extensive infrastructure as well as numerous environmental restrictions. As industry becomes more focused on shallower geophysical targets, the detrimental impact of source exclusion zones on data continuity becomes more apparent. Although mixed source surveys (dynamite with vibroseis infill) can partially mitigate the problem in areas with relatively flat terrain, gaps in the dataset remain. An alternative approach, based on the reciprocity of sources and receivers, is to infill the source gaps with additional receiver lines.

Introduction

Source exclusions are a common problem on all geophysical surveys and are traditionally mitigated by offsetting and/or skidding the source points to create stub lines. For deeper targets where the maximum width of the source exclusion zone is less than the length of the offset mute at target, it is possible to undershoot the exclusion zone. Although the dataset will remain continuous at the target, it will have reduced fold and missing near offsets.

As exploration targets become increasingly shallow, the impact of several overlapping source exclusions becomes significant. For example, based on the 180m AB explosives setback distance, a single concrete structure will result in a 360m source gap. Multiple structures with overlapping exclusion zones combined with environmental setbacks of 45 to 90m for riparian areas and fish-bearing waterways, quickly add up to significant source gaps often greater than 500m across.

For seismic surveys with shallow geophysical targets, gaps in the dataset start to appear when the target offset mute is less than the maximum width of the source exclusion. The traditional method of skidding and offsetting source points to build fold at the edges of the exclusion area is used for jump-correlating across the data gap, but this method does not reduce the size of the gap and continuous attribute analysis becomes impossible.

Receiver Infill Lines

Receiver points are not impeded by the same restrictions as source points and can be placed in areas of high infrastructure and within environmentally restricted areas. Typically, receiver infill lines consist of one or more additional receiver lines placed between each existing receiver line within the exclusion zone. The receiver infill line placement can be optimized based on azimuth and near offset distribution. Unlike source stub lines, receiver infill lines can add unique offsets within an exclusion zone thus increasing fold, reducing the size of the dataset gap and improving attribute analysis (Fig. 1). Although receiver infill lines cannot completely restore dataset continuity, they can reduce the zero-fold area and improve processing interpolation.

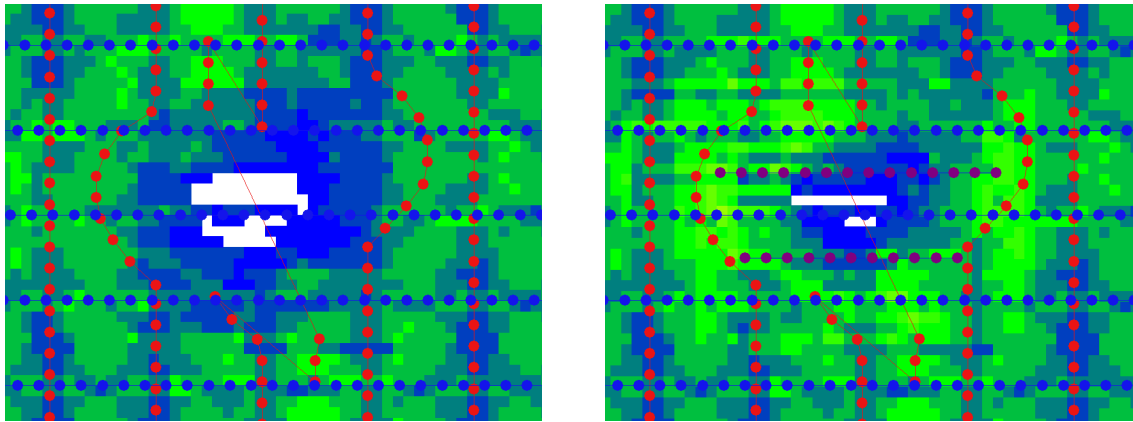


Figure 1: Offset limited fold plots illustrating how receiver infill lines improve data continuity and reduce gaps caused by source exclusions (Left: Without Receiver Infill Lines, Right: With Receiver Infill Lines).

It is recognized that additional receiver lines add complexity to the field operations. More surveying and line clearing may be required. However, by pre-modeling potential exclusion areas prior to the start of field operations, a decision on the applicability of infill receiver lines can be made early and the costs can be included in the initial budget.

A key consideration to be made prior to adding infill receiver lines is the amount of equipment required to record the extra stations. Depending on the size and number of infilled exclusion zones, higher channel counts and more cable may be required for recording. However, these limitations may be mitigated by infilling with autonomous recording stations.

Conclusions

Regardless of the survey parameters, source exclusion zones cause data continuity issues on seismic surveys designed for shallow geophysical targets. Receiver infill lines can be used to improve data continuity by increasing fold within the source exclusion area and reducing the size of the data gap.

