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On Maximizing Value for Small 3D Seismic Survey Acquisition in the WCSB

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Summary

Recently faced with the requirement to shoot a low unit-cost small 3D survey Talisman considered numerous potential survey designs in order to deliver on the unit-cost requirement. It was determined that current seismic acquisition technologies and cost structures favor orthogonal survey design over the megabin design, often thought of as the most cost efficient method to acquire seismic.

Introduction

In this study, several fit for purpose survey designs are considered for a particular imaging requirement. In addition to meeting imaging requirements the surveys are also designed to a benchmark AFE cost estimate. Three survey designs were considered for detailed analysis. These consisted of an orthogonal design, a megabin design, and a slimbin design.

It has been traditionally accepted that megabin seismic survey are cheaper alternatives to Orthogonal seismic surveys in the WCSB for several logistical reasons. Additionally there has been a long standing dichotomy in industry with respect to the technical merits of a megabin and its ability to satisfy the technical objectives of exploration companies for a reduced cost.

This analysis comes from a slightly altered perception; for a given AFE, or budget, what is the best orthogonal and the best megabin design achievable and how do they compare.

Theory and/or Method

Working from first principles the minimum requirements for imaging the Zone Of Interest are established. Using these requirements several 3D survey designs were designed. Within this set of designs a mega-bin and an orthogonal design were considered in detail. Slimbin was not analyzed in detail since it is considered to be an extension of megabin.

Each design covers the same surface area (5.9 square kilometers), has the same number of shots, same number of receivers, same amount of surface preparation (line kilometers), and the same area of full-fold sub-surface coverage. The similarity in effort is reflected in similarity of cost estimates. In fact cost estimates for acquiring each survey are within a few percent.

Trace statistics for each design are considered from the view point of suitability for PSTM, which in the current processing situation means suitability for 5D regularization. It has been noted that randomization of the spatial distribution helps the 5D interpolation process. Such randomization is easy to accomplish in an orthogonal design, in fact in practice is difficult to keep from occurring. The same type and level of randomization in mega-bin requires a dithering of the mega-bin lines which drives the surface preparation requirement (line kilometers) up considerably.

As a note, when each survey is aperture binned by Fresnel Zone it is difficult to see any difference in trace statistics at all from any viewpoint at ZOI level.

A cost estimate was calculated for each design. Not surprisingly each design has essentially the same estimated cost. However logistical options in the orthogonal design reduce the perceived contingency reserve and provide more available in-field options to keep post-plot statistics near pre-plot expectations.

Conclusions

Normalizing the survey designs on equivalent costs provides a focused analysis of the strengths of the 2 designs. Comparison is further simplified by analysing pre-stack trace statistics on the same cdp grid, essentially shifting the metric to trace density rather than fold.

It is not surprising that the same number of shots recorded by the same number of receivers produces very similar surveys. The differences between the survey designs comes down to how the traces are spatially distributed. The orthogonal design is more conducive to diversifying the spatial diversity. On the assumption that spatial diversity enhances noise reduction, imaging techniques and 5D regularization the orthogonal survey design is the best value for a given budget.

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