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3D Seismic Acquisition-Complexities In Geometry Check.

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Summary:

A complete quality control of field data includes geometry check, equipment test and seismic signal quantification. Only geometry check is address in this study.

Field data is checked for geometry errors before sending it to the processing center. It is necessary to verify/check the geometry to identify the errors in geometry and to rectify them. Generally adopted method is to apply LMO and check for the departures from the LMO. These departures signify the error in the location of, the receivers or shot point. We explore some geological situations where a single set of LMO velocity cannot address the changes in sub weathering. Varying LMO takes care of the variations related to geology. Example of some of the problems and the effect of suggested approach are presented.

Introduction:

3D seismic acquisition involves high number of active channels spread in a swath of parallel lines. With huge number of channels and the need to provide efficient collection of data the shot position continuously changes and, this change is not always as systematic as planned or envisaged. In spite of all the precautions taken to avoid mistakes in the layout, errors do creep in. Recorded 3D seismic data is checked for geometry to identify and rectify these errors. This procedure helps in verifying the coordinates of the receivers next day by the crew should the need arise.

One error most commonly encountered is the mistake in identification of shot point location. It can also be possible that the wrong receivers are active. The other possible error can be the wrongly identified location of the receivers. The process commonly used to identify the errors in the geometry is called Linear Move Out (LMO). LMO compares arrival times recorded for the given source receiver geometry to those calculated assuming a constant velocity surface. Abdelmoneam Raef (2009) studied the Preprocessing Quality control utilizing survey design Specifications, noise properties, Normal Moveout, First Breaks, and Offset for Land 3D seismic data. Preprocessing Quality control should include geometry check, equipment performance test and these aspects were addressed by Burger et al., 1998 with special focus on seismic data quality in preprocessing. Chris Beckett et al., 1995 have pointed out the use of LMO to identify geometry errors at the preprocessing stage to reduce turnaround time. Ran Bachrach, Tapan Mukerji., 2004, have presented a strategy for 3D seismic reflection imaging of shallow and very shallow targets utilizing a portable dense geophone array. They have presented data acquisition quality control and processing aspects for very shallow seismic investigations.

We present a geological situation with varying velocity of sub weathering and with exposed older formations in part of the area under survey. The apparent problem of geometry error is actually a case of varying velocity. Similarly the suspected geometry error is the effect of change in velocity due to geological formations exposed at the surface.

Method with examples:

The shot record in Fig. 1. When applied LMO with velocities picked on the other lines within the swath shown in Fig. 2 gives the appearance of geometry error in receiver locations. LMO velocity is re-picked to accommodate the changes in velocity and applied on the same record is shown in Fig. 3. which is confirming the geometry. This is

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supported by the near surface velocity model obtained from Uphole and LVL studies.

Another interesting situation wherein one limb of split spread is over alluvium and other part is over exposures of older formations (Fig. 4).

LMO application with higher velocity of older exposed beds does not fit low velocity portion. LMO application with lower velocities gives the impression of possible geometry error on the exposed older beds. Both LMO applications with two different velocities (lower and higher) confirm the geometry in the respective part of the data (Fig. 5 and 6

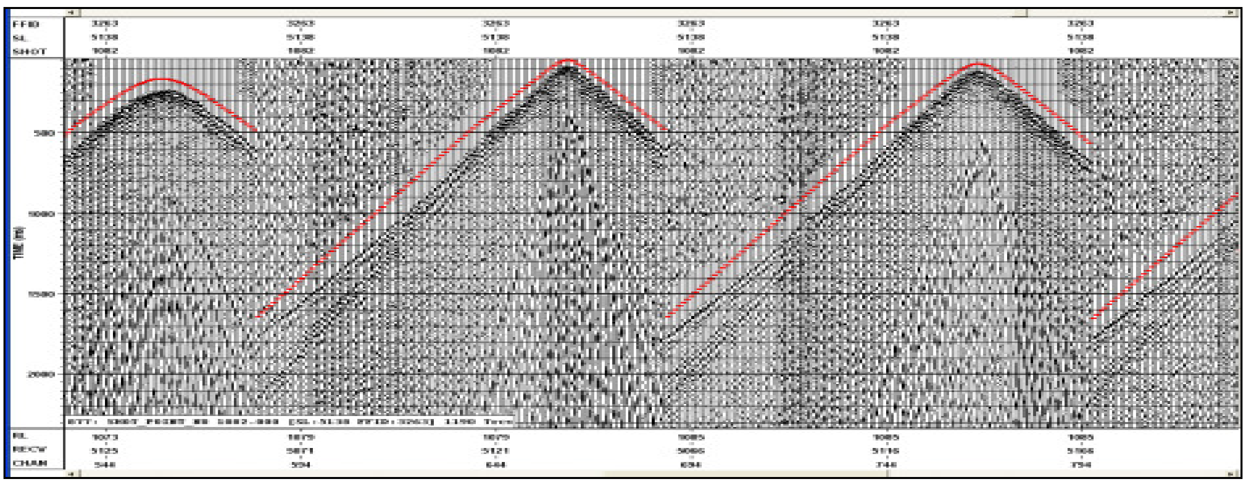

Figure 1: Raw Field Record with LMO (picked from other shots in red colour)

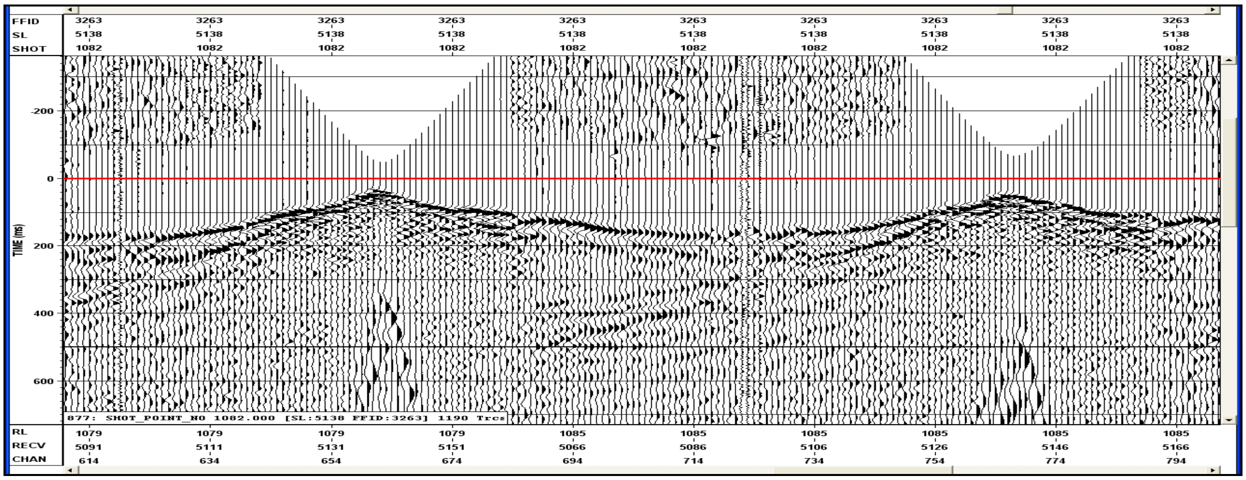

Figure 2: Field Record shown in Figure: 1 with flattened LMO (picked from other shots in red colour). The first breaks near the shot show a hump giving the impression of geometry error.

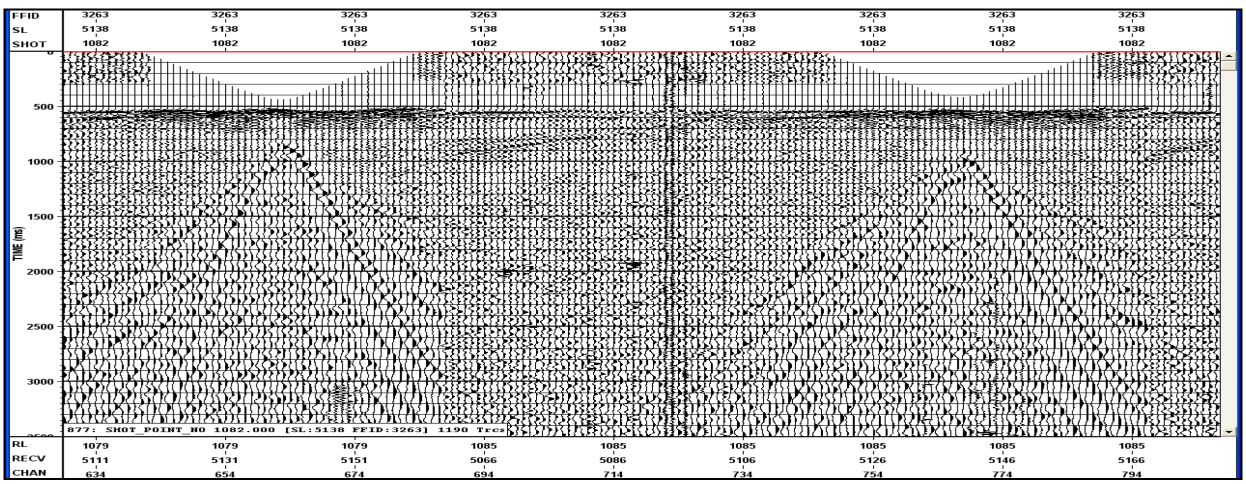

Figure 3: Field Record shown in figure 1 with flattened LMO (repicked velocity in red colour). The first breaks are parallel to the LMO confirming the geometry.

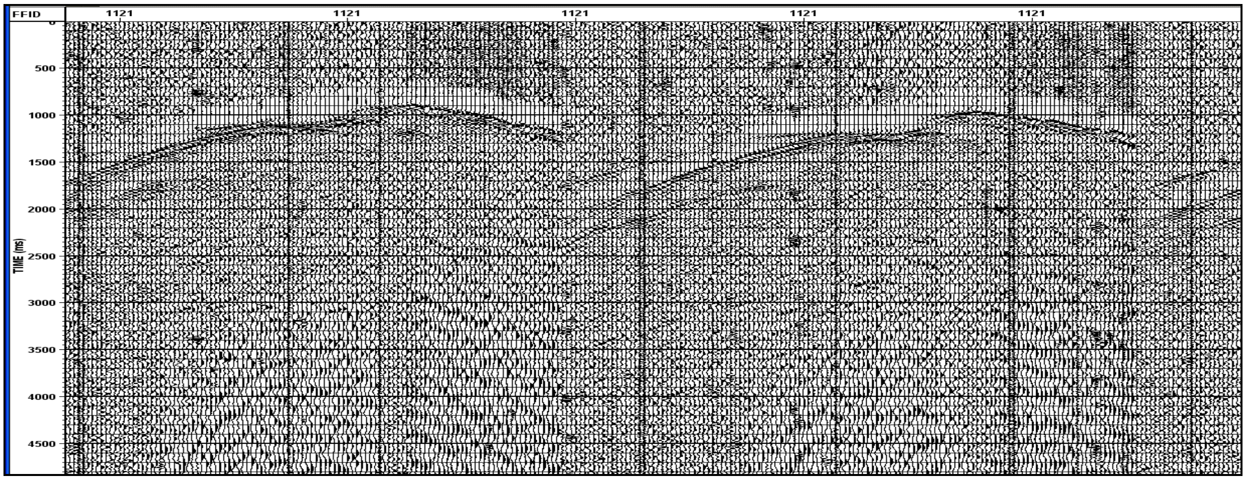

Figure 4: Field Raw Record from a geologically complex area with one part of the split spread over exposure of older beds and the other part of the spread on alluvium covered area.

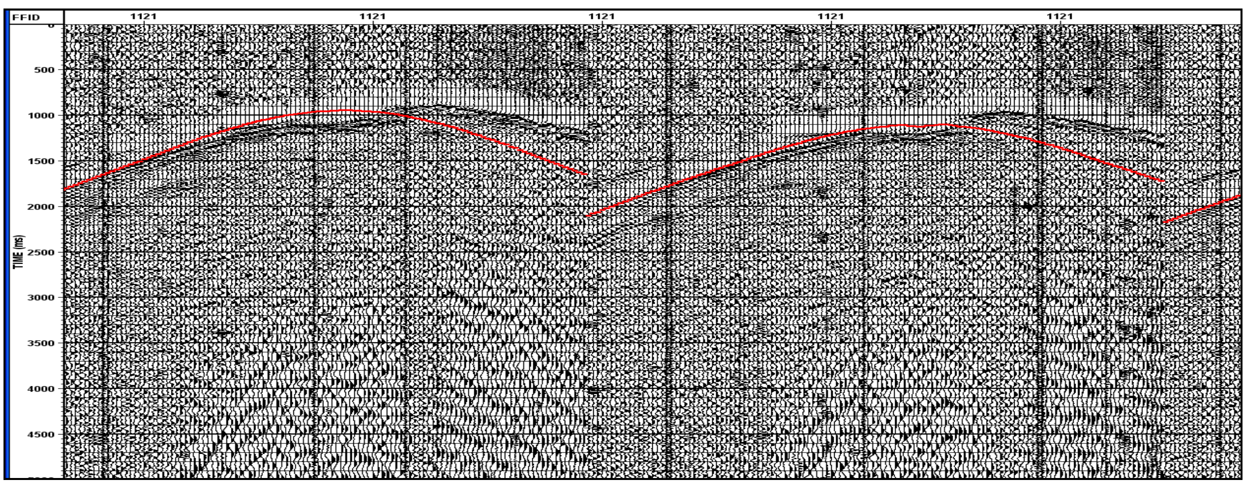

Figure 5: Field Raw Record shown in figure 4 with LMO (in red) picked with lower velocities confirming the geometry on the left part of the split spread.

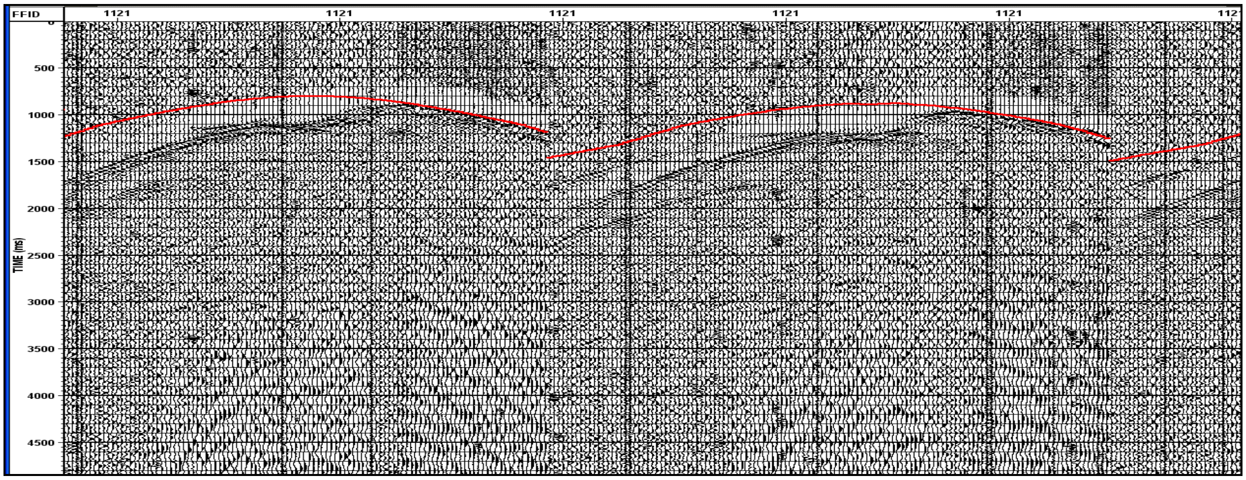

Figure 6: Field Raw Record shown in figure 4 with LMO (in red) picked with higher velocities confirming the geometry on the right part of the split spread.

Conclusions:

LMO is generally applicable in most of the situations with an average velocity surface. If near surface velocities in the area are varying, it is necessary to re pick the LMO velocity relevant to the field condition. In more complex geological situations more than one LMO velocity may have to be used to check corresponding segments. Near surface velocity model obtained from LVL, Uphole studies may be used to model the first breaks and pick LMO.

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