Post-stack Seismic Headers Standardization – QC Tools

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Summary

The E&P data storage has been taken up by ONGC through EPINET Project. Of this, the seismic data storage is through SeisDB. Seismic data in SEGY format with the headers properly updated enables the interpreter to directly import seismic data into their projects. Therefore, the EPINET seismic task force standardized the content of the EBCDIC header and identified the mandatory locations in the binary header and trace header needed for describing the data correctly as envisaged in SEGY revision 1.0. However, the challenge was to validate and update the SEGY headers in the time frame set for populating the SeisDB, as there was no customized solution. This paper describes the software tools developed for QC and updating of EBCDIC, Binary and Trace headers for 2D and 3D seismic data in SEGY format.

Introduction

A large amount of seismic data was collected in the different basins of India and processed by different agencies in last three to four decades. Different processing agencies adopted different internal formats for processing seismic data. Many times even the minimum required information is not exported/validated while generating the standard SEGY tapes for archival. In the absence of validated information in the SEGY format, the data cannot be directly used to populate the database.

Additionally, the SEGY data is recorded in different media like IBM3490, IBM3590, DLT, 4mm DAT, 8mm Exabyte, LTO, CDs, and old data not already archived in 9 track round reels. It is impractical to attach all varieties of tape drives to the EPINET server, besides the robotic library, for reading the data from different type of cartridges. The socket based software modules 'Tape Read and Write', developed earlier by IIWS group at SR, Chennai (1), came in handy to overcome the problem. These modules allow reading of input tape mounted on one system and writing on another system via LAN. Therefore, different kinds of input media do not pose a problem as long as the different kinds of tape drives are connected with some system on the LAN.

The information that is required in SEGY data for auto loading the seismic data to interpretation project is given below.

EBCDIC header

Name of the Survey, Name of the Line;

Starting Shot Point, Ending Shot Point, Start CMP, End CMP;

Relation of Shot Point with CMP; Cartographic reference like CM, Spheroid, datum; Acquisition and processing parameters (helps in making reprocessing requests).

Binary header

Trace sort code (shot, cdp or stack etc)

Number of samples, Sample format code, Sample interval

Fixed data length code, Start time

Trace header

Trace code (dead/live), Trace start time, Number of samples for this trace

Trace number, CMP number, Shot number, X, Y coordinates

For 3D data, the four grid corner XY coordinates are needed instead of navigation data, and the trace headers should contain the In-Line and X-Line information instead of SP and CMP Trace information.

Entering the required information in the EBCDIC header and updating the binary and trace headers for each line manually is time consuming and laborious. Therefore, some kind of automation is needed that avoids typographical errors and speed up the population of SeisDB with proper QC.

The idea behind the development of software modules

In phase-I, EPINET, seismic navigation data has already been populated in Finder database. Therefore, the information regarding the survey name, UTM zone and

spheroid available in the navigation header and the shot point and coordinates information available for each of the 2D lines can be automatically picked up for updating the EBCDIC and trace headers.

Providing acquisition parameters and processing sequence in EBCDIC header is also important as it helps the interpreter and processor to plan the re-processing and special processing flows. The acquisition parameters and processing sequence adopted for a seismic investigation can be entered once and used for updating the EBCDIC header for all of the lines of that investigation.

The main link needed is the CMP trace number versus SP number without which the data definition is incomplete. Most of the times, the appropriate SP number is not present in the trace header. This is where user interaction is needed. The relation entered needs to be checked and validated before using. Many times, the CMP number is not uniquely related to SP even within the same investigation (for example, lines shot through spread and the regular lines) and number of CMP traces per shot is also not the same. Incase of 3D data, the 3D grid needs to be defined in EBCDIC header and the In-line and X-line numbers are to be updated. The 3D grid corners are to be checked for their consistency before use.

After updating the 2D data with SP and XY coordinates, display of a small portion of data about the line crossing will ensure the correctness of navigation data merging with seismic data.

These measures not only reduce typographical errors, but also ensure that the seismic data is consistent with the navigation data already stored. User can spend more time in validating the data and still maintain the productivity,

The customized software modules

'EpinetSgycpy2D', 'lineCross2d' and 'EpinetSgycpy3D' are the three modules developed based on the above concept using Motif X-Windows environment and "C" programming language on SUN platform. These are interactive user-friendly Menu-Driven Modules whereby the 2D and 3D Seismic Data can be Read, Checked, Updated and Saved onto a New file, as per the standards set by the task force, for further loading into SeisDB of the EPINET system. The workflows are divided in to sub tasks and each subtask is linked to a menu. These are described below.

The "EpinetSgycpy2D"

1. SEGY Input file: The validation and updating of headers is done seismic investigation wise. Once the data is transferred from tape to disk using TapeRead and Write programs, one 2D seismic line data File is selected through a dialog. If the selected file is not a SEGY file, the user is prompted with a message for proper selection. The EBCIDIC Header and important Binary Header Location information are shown to the user (figure 1) along with the selected File-Name and number of Traces in the file. It also gives a message regarding invalid and duplicate CMP numbers and checks whether the range of CMPs tallies with the physical traces in the segy file.

2. NAV Input file: This menu is used to select the navigation data file, exported from Finder database in UKOOA format, corresponding to the seismic investigation of the line selected. A message is flashed if the required header information is not available in the navigation file. A line selection list appears showing the seismic lines in the navigation file along with the first and last shot point and the number of entries (figure 1).

Fig.1. The main menu of 'EpinetSgycpy2D'. The insets displayed are popup menus for selecting the navigation input file and the seismic line from the list of lines within the navigation file selected.

Once the user selects the line name corresponding to the segy file selected, another dialog appears for entering the SP-CMP relation. The default relation is computed based on the earlier entries and checks for the SP/CDP ratio. A CDP-SP ratio Check Pop-up is displayed if the CDP-SP ratio doesn't seem to be correct. Any correction, if required, can be incorporated at this stage (figure 2). Provision is provided to enter adequate number of SP-CMP pairs for describing the crooked profiles.

Fig. 2. Dialog showing the available range of CDP values from seismic and available SP values from navigation data. The inset shows that directly relating the CDP range with SP range is incorrect. User needs to provide correct relation considering the spread geometry with respect to shot point.

3. Acquisition Parameters: is the next menu, which the user has to complete by filling in the details like the Recording year, Agency, Instrument, Recording format, No. of Channels, Fold, Source, Sample Intervals, Recording length in MS, Record start time in MS, the Shot Interval in Meters, Group interval, Near offset, etc as per the task force recommendations (figure 3). The Acquisition Parameters of the seismic investigation are stored in the selected directory path for the seismic investigation.

4. Processing Parameters: The next Popup is the Processing parameters. Dropdown buttons are provided for selection of Reprocessing, Basic Processing, the type of the processed output that is stored in tape like DMOSTK, FMIG, etc and for the selection of Domain i.e. TIME or DEPTH. Other descriptive details have to be filled to complete the information on the Processing (figure 4).

The acquisition and processing information entered for the first line of the investigation are stored and prompted for all the lines of the investigation and changes, if any, only are to be entered for subsequent lines.

Fig.3. Dialog box for entering acquisition parameters. Entry is done once for the first line in each investigation. The values entered are stored and prompted and alteration, if any, only need to be done for subsequent lines

Fig.4. Dialog box for entering processing sequence. Similar to acquisition parameters, processing parameters are also need to be entered once.

5. Update: pressing the UPDATE button shows the updated EBCDIC header in the main window as per the format and information standardized by the seismic task force. The Line name, Lat Longs of First and Last shots, survey and area names are taken as per the navigation data in finder data base and the validated SP-CDP relation given by the user and the acquisition and processing details stored, are used to update the EBCDIC header. In the example shown in figure 5, a popup message is displayed due to incorrect trace sort code which gets updated to 4 while saving. (figure 5).

6. Save: During the save operation, the X,Y coordinates for the CMPs, computed using the SP-CDP relation and the shot point XY coordinates stored in the navigation file, are

Fig.5. Updated EBCDIC header. The inset popup shows that the trace sort code in the binary header is incorrect and will be set to 4 on save.

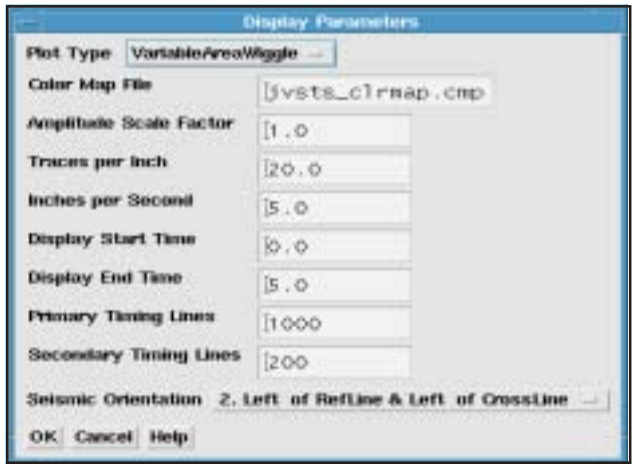

Fig.6. The display parameters for seismic data.

updated in the trace header. The recommended locations of binary and trace headers are also updated as per the standards of SEGY revision 1.0. The output segy file name is created as the concatenated name of seismic investigation, line name and the data type stored in the file.

The "lineCross2d"

Once the merging of navigation data with seismic data is done, the display of seismic trace data about the line crossing between two seismic lines, completes the QC before loading to SeisDB. The lineCross2d module is developed for this purpose.

The NAV Input File menu prompts for the selection of the navigation data file for the required seismic investigation and lists the seismic lines. The list of crossing lines with the reference line selected for QC are computed from navigation data and one line crossing can be selected for display.

The SEGY File Selection menu prompts the SEGY versions available for the reference line and the crossing line. The traces from the selected segy versions from the two lines are shown as a composite line about the line crossing.

The display parameters (figure 6) can be selected from the display menu. One such display is shown in figure 7. The Line name, CMP, SP, X, Y, Time and amplitude corresponding to the cursor location are also displayed. Any miss-match of events at the line crossing is due to improper navigation merge with seismic data and needs to be corrected before loading to SeisDB.

The "EpinetSgycpy3D"

EpinetSgycpy3D is developed in the lines of EpinetSgycpy2D. Instead of navigation data file, the Grid

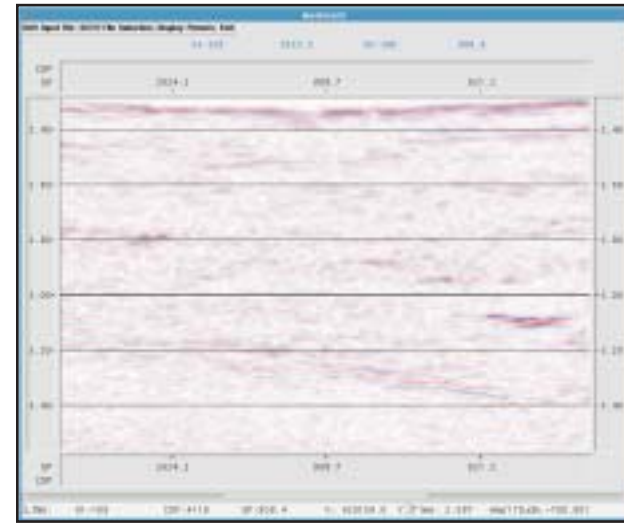

Fig.7. Seismic data displayed through the line crossing of two lines. Mismatch on this display will be due to incorrect SP-CDP relation or wrong line name chosen form navigation data to merge with seismic data.

Fig. 8. The main window for EpinetSgycpy3d. Insets show the segy file selection dialog and trace header location definition dialog.

definition is used for updating the XY coordinates in the trace headers.

1. SEGY Input file: Seismic 3D file is selected thru this menu. The EBCIDIC Header and important Binary Header Location information are shown to the user (figure 8) along with the selected File-Name and number of Traces in the file.

A popup **Trace Header Locations** displaying the default values for Starting Position of Line No, Trace No, X-Coordinate, Y-Coordinate, Coordinate Scalar and Composite CMP. The user can choose the correct values of starting byte position and also whether the value is stored as 4 Byte Integer, 2 Byte Integer, IEEE or IBM float. The Number of CMPs per Line is needed, if only composite CMP is available in the trace headers which are the case in the earlier 3D data sets. The input header location available for computing the Line, Trace, X, Y values can be Line & Trace pair, X & Y pair or Composite CMP.

2. 3D Grid definition: This menu opens a popup for entering information like Area, Survey Name, Prospect name, Spheroid, Projection, Start Line and its In-Line and X-Line, Last Line and its In-Line and X-Line, Prospect Corners,. The **Grid Corners Information** defining the 3D grid i.e the X, Y, Line and Trace Values for three grid corners and the Bin size along In-line direction and X-Line direction are also to be given. A Popup displays all the computed Grid Corners, trace-to-trace distance in a Line, Line to Line distance and Line Azimuth (figure 9). This information allows the user to cross-check that the entries for grid definition are correct.

Fig.9. 3D grid definition. The inset shows the four computed grid corners, line and trace number increments and azimuth for QC check.

3. Acquisition Parameters and Processing Parameters are similar to that of "EpinetSgycpy2D".

4. Update: Once all the details are entered, click on the update button updates the information in the EBCDIC header and displayed for the user (figure 10) before saving.

5. Save: During the save operation, the trace headers of line, trace, x, y are updated using the Grid definition and all the other mandatory parameters as per the SEG standards are saved to output file. Concatenating the names of seismic investigation, prospect name and the data type stored in the file, the output file name is internally generated.

Conclusion

The SEGY data stored in SeisDB now becomes consistent with the navigation data already stored in Finder database.

The automation reduces typographical errors and speeds up the population of SeisDB with proper QC thus enabling the completion of targets well ahead of time.

As the SEGY data stored in SeisDB is self-describing, the goal of auto-loading to interpretation projects is achieved.

Fig.10. EBCDIC header for 3D data as per taskforce recommendations

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