

MULTI - LINE 2D SEISMIC DATA PROCESSING

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looking ^{for} challenges

MULTI-LINE 2D SEISMIC DATA PROCESSING

by

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INTRODUCTION

Coherent statics solution is especially important, where the near surface zone is complicated and varying across the project. The problem was faced in areas of various environments:

- Mountains Andes in Colombia,
- Sand dunes covering smooth or rough surface of hard rocks- deserts of Libya, Algeria,
- Post glacial rough topography Poland,
- Transition zone India, Poland,
- Permafrost Siberia.

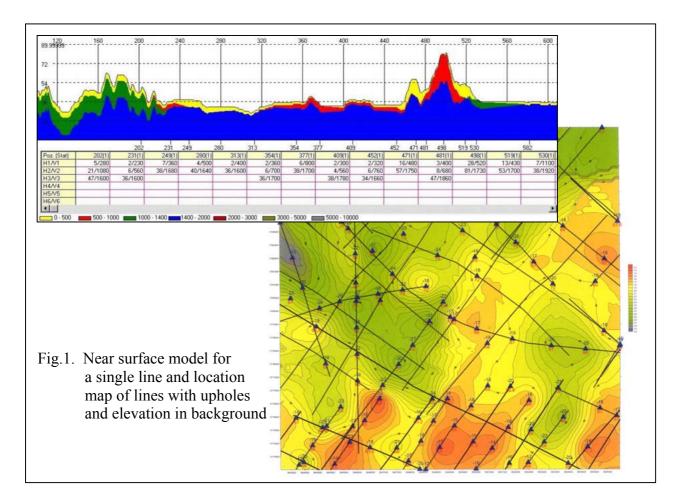


Processing and re-processing of seismic data from these areas forced use of multi-lineconsistent static solution for 2D seismic surveys.

In order to have satisfactory procedure for land seismic data processing, a package of interactive software tools for multi-line consistent statics estimation and correction was designed and next turned out to be a success.

PROCESSING STAGE

At the earliest stage of statics calculation, field statics are computed from shallow refraction, uphole as well as production uphole measurements in dynamite wells. For that purpose, GT proprietary software, SEISDAT is used. The system enables to calculate multiline consistent statics for the project using the field measurements and makes possible very easy QC with displays of various maps including plots of in-field parameters, displays of near surface model, statics vs. elevation, comparison of statics on the intersections etc.



All the programs are applied before starting the processing, so homogenous statics for the whole project can be used from the beginning of processing. Some intermediate results are used for refraction statics calculation.



Fig.2. Display of receiver statics vs. elevation along with intersections marked

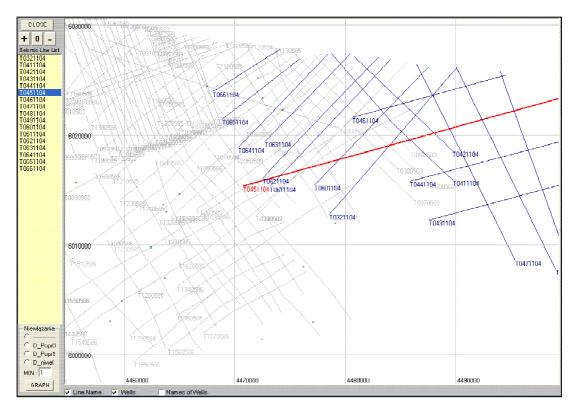


Fig.3. Map of lines of interested project with analysed line highlighted

As the next step, refraction statics calculation is performed. In this case multi-line commercial packages are applied. Statics are calculated with coherent parameters to get uniform solution for the whole project. Results are QC-ed using displays of near surface models, maps of statics, comparison of the statics to uphole times, etc. and the best solution is selected.

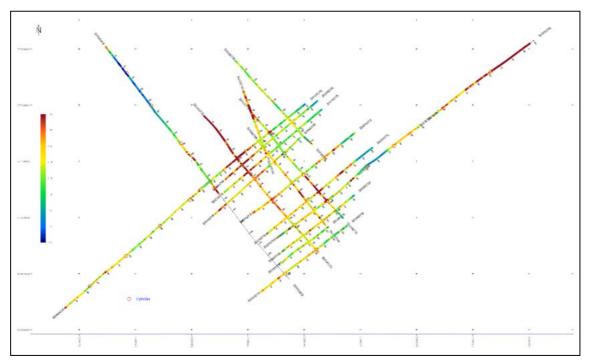


Fig.4. Location map with receiver refraction statics

MULTI-LINE SEISMIC DATA PROCESSING

PROCESSING STAGE

Processing is being carried out as multi-line project and consistency of statics is QC-ed at minimum three levels:

- at the early stage of processing,
- after residual statics,
- at the final stack stage.

Statics, phase and amplitude misties are calculated on each intersection of the project/vintage in batch mode and then can be interactively checked.

SPECIAL PROPRIETARY PROGRAMS SERVE TO EXAMINE LINES' INTERSECTIONS

MISTIE ANALYSIS

Mistie Analysis computes amplitude, time and phase misties for a set of 2D lines and calculates constant corrections for each line to minimize misties.

ile Edit Versions					Help	File Edit Versions				Hel
Base line = 10014							Line Gain factor Bulk static shift Phase rotation and			1e
Base Crossing line line CDP	line CDP	(dB)	Time difference (ms)	(degrees)	Crosscorr. value (A/Amax)	00001 00002 00003	0.94636 1.01490 0.97968	7.452 -1.891 -8.294	-83 334 -57 213 -21 110	
627 D0020 829 D0021 915 D0022 1030 D0023	2995 3167 2732 340	-0 08905 -0 07425 -0 00921	-1.673 7.315 -7.731	-1.247 30.631 -31.015	0.8710201 0.6303193 1.0000000	00004 00005 00006 00007 00008	1,00900 1,01048 0,97057 0,99769 1,01873	13.071 11.953 7.394 -5.953 1.869	70.694 70.752 97.428 -76.572 -54.293	
						D0009 D0010 D0011 D0012 D0013	1.07446 1.02935 0.97397 0.99660 0.97411	-0.108 -3.190 -0.968 1.659 -4.811	-15.078 -70.361 -0.398 9.982 -2.055	
***** Base line	= E0015					D0014 D0015 D0016 D0017	0.97907 1 00165 0 96270 1 02212	0.189 5.390 0.326 7.361	9 675 3 481 -20 125 6 228	
Base Crossing line line CDP	Crossing line CIP	(dB)	Time difference (ms)	Phase difference (degrees)	Crosscorr. value (A/Amax)	D0016 D0019 D0020 D0021	0.98423 1.07936 0.98918 0.98744	-14.267 -1.037 -3.891 -1.924	9 340 -16 461 13 610 1 495	
490 D0018 671 D0019 823 D0029 875 D0020 1097 D0021 1265 D0022	2369 2409 634 2244 2414 1976	0 14736 -0 65455 -0 12747 0 11471 0 12950 0 19455	13 030 6.832 11 992 23 609 4 384 -0 230	1.508 16.601 -15.806 -32.115 27.966 -10.231	0.8217263 0.6028743 0.2717279 PRJECTED ! 0.5535829 0.8660808 0.6352341	10022 10023 10024 10025 10026 10026	0.98002 0.98449 1.03165 0.97523 0.96595 1.02589	8 480 -0 100 -1 894 -6 933 0 358 2 627	15.800 33.721 -48.013 3.741 107.553 21.956	
	1916					00028 00029	0, 98688 1, 01518 Up, Dawn, End, Home or use th	9.723 -1.316	54.344 33.843	

Fig.5. Screed displays of Mistie Analysis results

LINE MAP

Line Map uses data generated by the Mistie Analysis process and displays location map of the 2D lines and respective intersection information. A user can interactively modify time and phase shifts and compare pieces of stacked sections closest to a particular intersection.

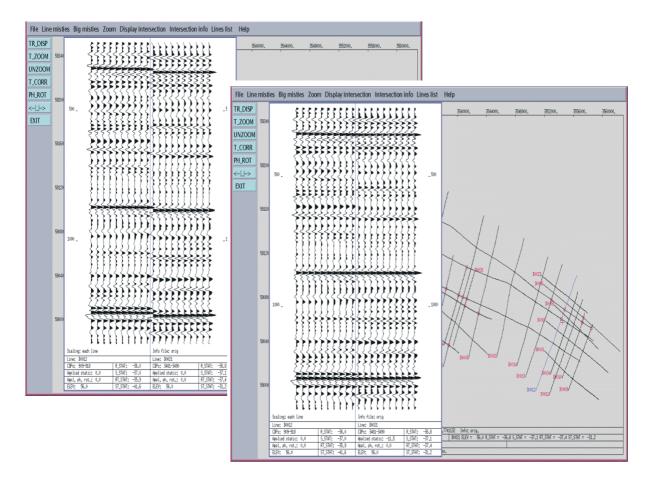


Fig.5. Screen displays of Line Map with intersection traces displayed before and after interactive correction

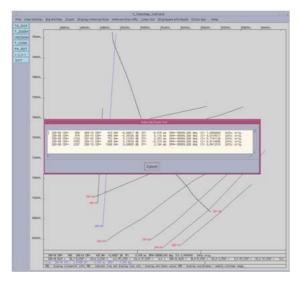


Fig. 6 List of intersection details for the chosen line

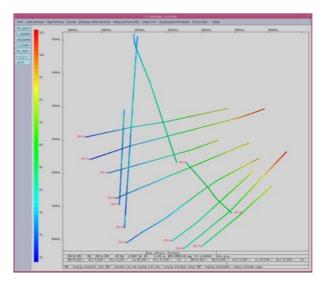


Fig. 7 Screen display of Line Map with elevation plot

SC VELOCITY EDITOR

SC Velocity Editor displays lines map, velocity (with or without traces), velocity gradient for a set of 2D-lines. It allows to define polygons in which velocities will be adjusted to other side on an intersection.

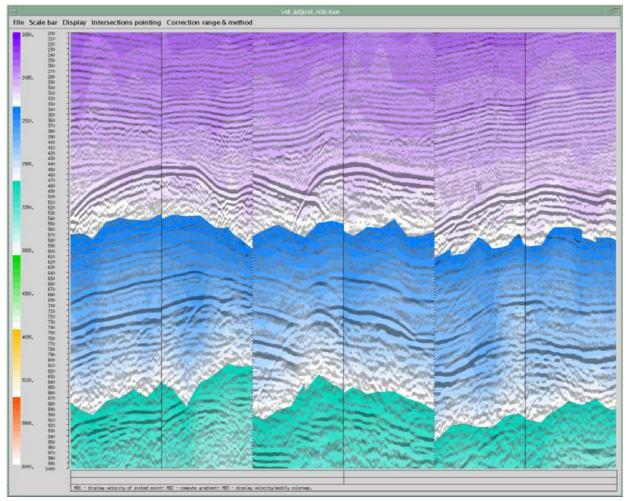
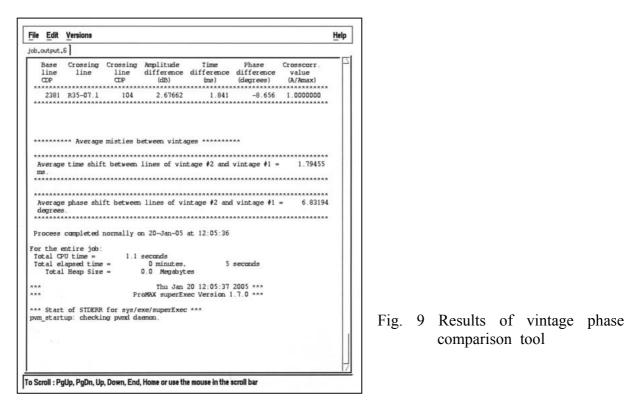


Fig.8. SC Velocity Editor - Comparison of velocities at three intersections

VINTAGE PHASE COMPARISON

Vintage Phase Comparison computes amplitude, time and phase differences between lines which belong to two vintages.



CONCLUSIONS

Multi-line consistent 2D statics are invaluable factor within the entire process of the whole volume consistent 2D seismic data processing.

Due to the multi-line consistent approach to processing of 2D seismic datasets reliable, sparse 3D volume of data is delivered to interpreter.

Reliable, consistent over a whole project, 2D static solution turned out to be a useful calibration information to many 3D seismic projects which usually suffer of insufficient near-surface fold.

References:

- 1. Mike Cox, 1999, Statics corrections for seismic reflection surveys, SEG
- 2. Thomas N. Bishop and Alan G. Nunns, 1994, Correcting amplitude, time, and phase mis-ties in seismic data: Geophysics, Vol. 59
- 3. Michael D. Harper, 1991, Seismic mis-tie resolution technique: Geophysics, Vol. 56
- 4. W. L. Bandy, A. F. Gangi, and F. D. Morgant, 1990, Direct method for determining constant corrections to geophysical survey lines for reducing mis-ties: Geophysics, Vol. 55