good enough all the calibration could come from the reflection records.

(f) Errors in the data can be detected easily.

Reference

Gardner, L. W. (1939), 'An areal plan of mapping subsurface structure by refraction shooting', *Geophysics* **4**, 247-59.

A post-stack method for 3-D cross-line statics estimation*

Philip S. Schultz and August Lau Digicon Inc., 3701 Kirby Dr, Suite 1144, Houston, TX 77098, USA

A method has been derived for the estimation of cross-line statics in which we perform the best possible stack of the data using whatever statics corrections are needed to optimise the stack response, followed by an estimation of the cross-line statics corrections using the stacked data only. The method makes use of several assumptions regarding the stacked data:

(1) We have correctly estimated and removed the high wave-number statics in the in-line direction.

(2) We have remaining the low wave-number statics in the in-line direction, since the low wave-numbers are indeterminate using any of the standard residual statics methods on real data.

(3) We have remaining much, if not all, of the high wave-number statics in the cross-line direction.

(4) We cannot separate low wave-number cross-line statics from low wave-number cross-line structure.

(5) There are no vertical faults parallel to the in-line direction.

(6) We can adjust the low wave-number statics within any and all lines in the in-line direction to correct for high wave-number statics in the cross-line direction.

The need for such a procedure is seen on a 3-D land survey. All pre-stack information was used to obtain best estimates of statics corrections, but the post-stack cross-line sections show clearly that high wave-number cross-line statics components remain uncorrected in the stacked data. Such remnant static distortions of the stacked data can and should be corrected by some post-stack method, such as the one suggested here.

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Opseis telemetry

H. A. Tims Exploration and Production Group, Phillips Petroleum Company, Bartlesville, Oklahoma 74004, USA.

The elimination of the heavy cumbersome multi-pair cables between the geophone stations and the recording unit has been long awaited. Stepped-up exploration activity for new oil and gas reserves has made the industry more sensitive to this need, primarily since the search leads increasingly toward difficult areas where cable recording systems are less economically feasible. Reliable, high-fidelity two-way radio links were required that would allow command-response operations. Only as state-of-the-art advancements occurred in digital radio frequency (RF) techniques in the last few years has transmission of seismic data with the dynamic range and resolution qualities demanded by today's needs been possible.

Consider the freedom a wireless recording system offers the user: easier access into jungle, swamp and mountainous terrain; no geometric restrictions on spread configuration, e.g. 3-D or areal coverage; multiple line recording with one source; fewer logistic recording problems with rivers, lakes, highways and no-permit areas. Such a system, named OPSEIS (Tm) 5500, has been developed by the Phillips Petroleum Company of Bartlesville, Oklahoma.

Two-way digital frequency modulation (FM) radio transmission links are used between the spread deployed units called remote telemetry units (RTU) and the central recording station (CRS) located at any convenient point within radio range. A repeatable command-response mode of operation and data error checking techniques ensure data integrity even under poor signal conditions.

The OPSEIS (Tm) 5500 system gives rise to many novel features:

(1) The system utilises high quality, narrow band two-way digital FM radio links for transmission of command and seismic data between the central recording station and the remote telemetry units. The choice of narrow band FM conserves RF spectrum while providing a highly reliable, noise-free data communication medium.

(2) Seismic waveform data is stored in memory at the RTU and is available for re-transmission if transmission errors are sensed by the CRS. Data stacking and editing is performed by the remote units when surface energy source techniques are utilised.

(3) Microprocessor control in both the CRS and the RTU provide for an extremely reliable and flexible system. Only software changes are required to change the mode of operation.

(4) A CRS controls and records data from four seismic lines either simultaneously or one at a time.

(5) Two spread configurations can be used for each of four prospect lines, which permits the use of two shooters on each line for increased productivity.

(6) Up to 200 channels can be recorded on each spread with the standard system. This feature can be expanded to 1016 channels per spread with full dynamic range and resolution qualities.

(7) Spread and equipment parameters are tested prior to data recording to insure system reliability and data integrity.

(8) A full day of shooting can be recorded from a single recording location. The microprocessor controls the spread advance after each shot and is accomplished by simply pushing a button. The operator's roll-along display panel keeps him totally informed of his current spread configuration and status of roll-along capabilities.

(9) There are no geometric restrictions for an RF linked recording system. The standard line shooting technology of today can be easily changed to the simultaneous recording of multi-lines from one energy source. This capability readily lends itself to 3-D coverage.