Source-geophone rotation has now become a conventional procedure for processing four-component (two-horizontal sources and two-horizontal receivers) shear-wave reflection data, as demonstrated by Alford (1986), and Squires et al. (1989) and among others. To apply source-geophone rotation, a post-stack rotation analysis (Alford 1986; Squires et al. 1989), or a least square fitting procedure (Murtha 1989) is required to determine the optimum rotation angle. Since it is computing intensive and time consuming, pre-stack rotation is an unwelcome additional procedure (Sriram et al. 1990).

We present a processing sequence for implementing pre-stack rotation for four-component data based on complex component analysis (Li and Crampin 1990). We add two further procedures to a conventional stacking sequence, These are a complex component analysis (CCA) and a polarization angle correction (PAC). We apply complex component analysis to pre-stack data: shot records and CMP gathers. We find that, if shear-wave splitting occurs, there is a coherent source-independent polarization in the colour sections of complex components. This sauce-independent polarization is the optimum angle for rotation. The results are then used to carry out polarization angle corrections. Since complex component analysis only involves the simple arithmetic of coordinate transform, this processing sequence to implement pre-stack rotation is much more efficient and practical than pre-stack rotation analysis.

Two reflection datasets will be presented and compared to illustrate this processing sequence. The first dataset is the Kim Tech Lost Hills reflection data acquired in Lost Hills, California (Squires et al. 1989). We calculate and display the instantaneous polarizations and orientation logs of selected shot records. In the colour sections of instantaneous polarization of inline and crossline sources, there is a coherent polarization of N42°W ± 3° which is source-independent and appears on almost all traces and reflection events. In the colour sections of orientation logs, two coherent polarizations of N42°W ± 3° and N42°E ± 3° appear on all reflection events. The later one can be interpreted as the polarization of the slower split shear-wave. This polarization is then input to PAC to carry out pre-stack rotation. The final stack section obtained by this sequence is optimized compared with the section obtained by post-stack rotation analysis.

The second dataset is Line 17 of Dimmit County reflection data acquired at Dimmit County, Texas (courtesy of Amoco). In the colour sections of shot records of the inline source, there is a coherent polarization of 0° ± 3° from the inline direction appearing on all reflection events, while in the sections of the crossline source, there is a coherent polarization of 90° ± 3° from inline direction. This shows that the coherent anisotropic
polarization is changing and coincides with the source direction and no shear-wave splitting is apparent. There are two interpretations: either the line is along the crack strike; or the anisotropy in the zone concerned is too weak to observe. In the stack section only small time delay between the fast and slower shear-wave can be interpreted. This processing and interpretation results agree with the results of rotation analysis.

In conclusion, pre-stack rotation can improve stacking results and it can be efficiently implemented using complex component analysis, and the processing procedure for multi-component shear-wave reflection data in the presence of anisotropy can thus be simplified.

REFERENCES


SRIRAM, R. et al., 1990. Recording and processing vector wave field data: a review of the 1989 SEG summer research workshop. The Leading Edge, 9, no. 11, 1 l-16.