Table 1. Characteristics of the Stress State That Minimized the Weighted One-Norm Misfit of the *Qian and Pedersen* [1991] Borehole Breakout Data

	S_1	S_2	S_3
Azimuth	N106.8°E	N16.7°E	N251.7°E
Plunge	3.5°	2.5°	85.7°
Value	2	1.40	1

Optimized $\phi, 0.40^{1.00}_{0.00}$; minimum weighted one-norm misfit, 1.71°; 95% confidence level for weighted one-norm misfit, 2.03°.

misfit was observed.

In Figure 6 we plot *Qian and Pedersen*'s [1991] data with the theoretical breakout pattern expected for the stress state resulting from their inversion. A Poisson's ratio of 0.25 was used in this calculation. The data show almost constant breakout azimuths regardless of the borehole orientation. Because of the relatively restricted range of borehole azimuths present in their data a large number of nondegenerate normal and strike-slip faulting stress regimes could fit their observations with nearly constant breakout orientations up to the maximum deviation of 45° (Figure 2). In this case the data are not well distributed in order to constrain the complete stress tensor. *Qian and Pedersen*'s [1991] high uncertainty in the S_h/S_v ratio reflects exactly this problem with the data distribution. This will be a common problem in strike-slip stress regimes if highly deviated holes are not available. The only way to remedy this is to either find or drill boreholes that are nearly horizontal.

To compare the inversion technique of *Qian and Pedersen* [1991] with the genetic algorithm and Powell optimizer technique described above, we "inverted" their data set, using our technique. The data set was not gridded, since it shows a large amount of consistency. The breakout data are best described by a thrust faulting stress state in which S_1 is oriented N106.8°E plunging 3.5°. S_2 is also almost horizontal, oriented N16.7°E, plunging 2.5°. Finally, S_3 is almost vertical, plunging 85.7° at an azimuth of N251.7°E (Table 1). The ϕ value for our solution is 0.40.

Error bounds on our stress state determination are shown in Figures 8 and 9. Figure 8 shows contour plots of the 95% confidence misfits for the three principal directions on a lower hemisphere stereographic projection keeping ϕ constant. The direction of S_1 is very tightly constrained, but the orientations of S_2 and S_3 are al-

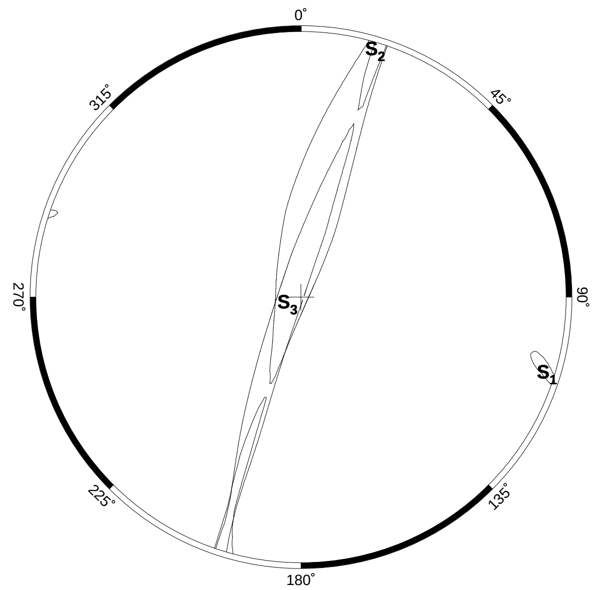

Figure 8. Results from the reanalysis of the *Qian and Pedersen* [1991] borehole breakout data using our GA and Powell optimization technique. Lower hemisphere stereographic projection shows contours of the 95% weighted one-norm misfit confidence limits for the three principal stress directions. The stress state ratio ϕ is held constant at 0.40. Note that the direction of S_1 is very well constrained, but S_2 and S_3 can lie virtually anywhere within a vertical plane striking N16.7°E.