CHAPTER 5

Conclusions

5.1. Accuracy

Angle-midpoint coordinate migration methods are theoretically more accurate for steep dips, wide offsets, and vertical velocity variations than for migrating conventional stacks or constant offset sections. They work where reflectors of two different dips coincide. They permit more accurate velocity analysis after migration when dipping reflections have been correctly located and diffraction noise removed.

There are two mathematical reasons for the accuracy of angle-midpoint methods. First, point diffractions are hyperbolas on angle-midpoint sections. It is easy to write migration equations to handle such simple impulse responses. Second, the transformation into angle-midpoint coordinates tends to map data into portions of the same original moveout slope. This allows the straight forward and accurate implementation of the equations for migrating unstacked data.

Figure 5.1 (growth fault) and Figure 5.2 (synthetic) compare the three angle coordinate migrations to conventional stack migration. All give better images with the slant stack and Snell trace migrations working best. They seem to improve lateral resolution too.

Slant stack migration is the most theoretically accurate of the angle coordinate methods. In addition to dip and offset angle accuracy, it handles post critical angle reflections and refractions, and is the most readily extendible to lateral velocity variations. Snell trace migration is accurate for steep dips, wide offsets, and depth velocity variations. The migration equations for radial traces in this thesis are

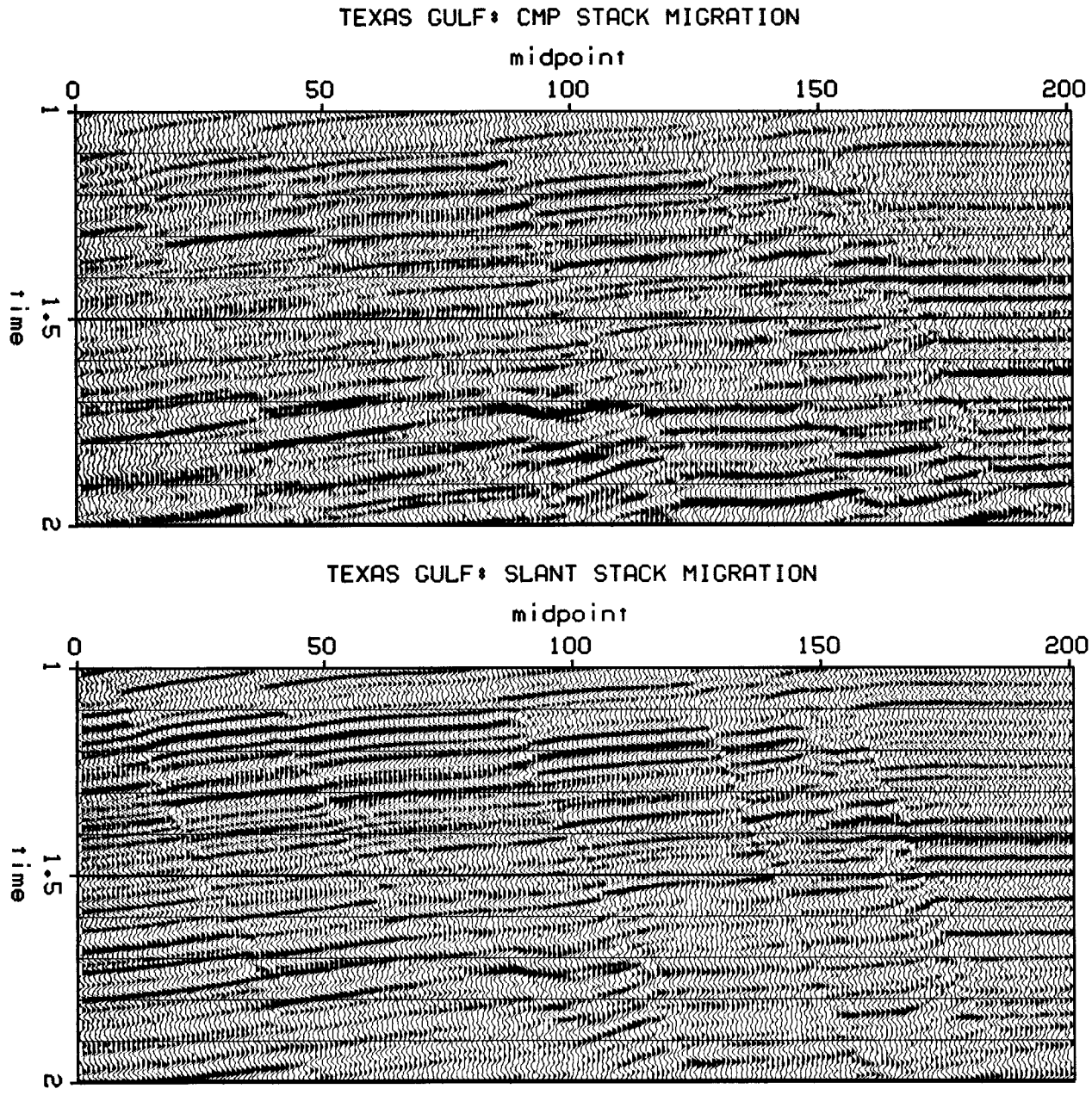
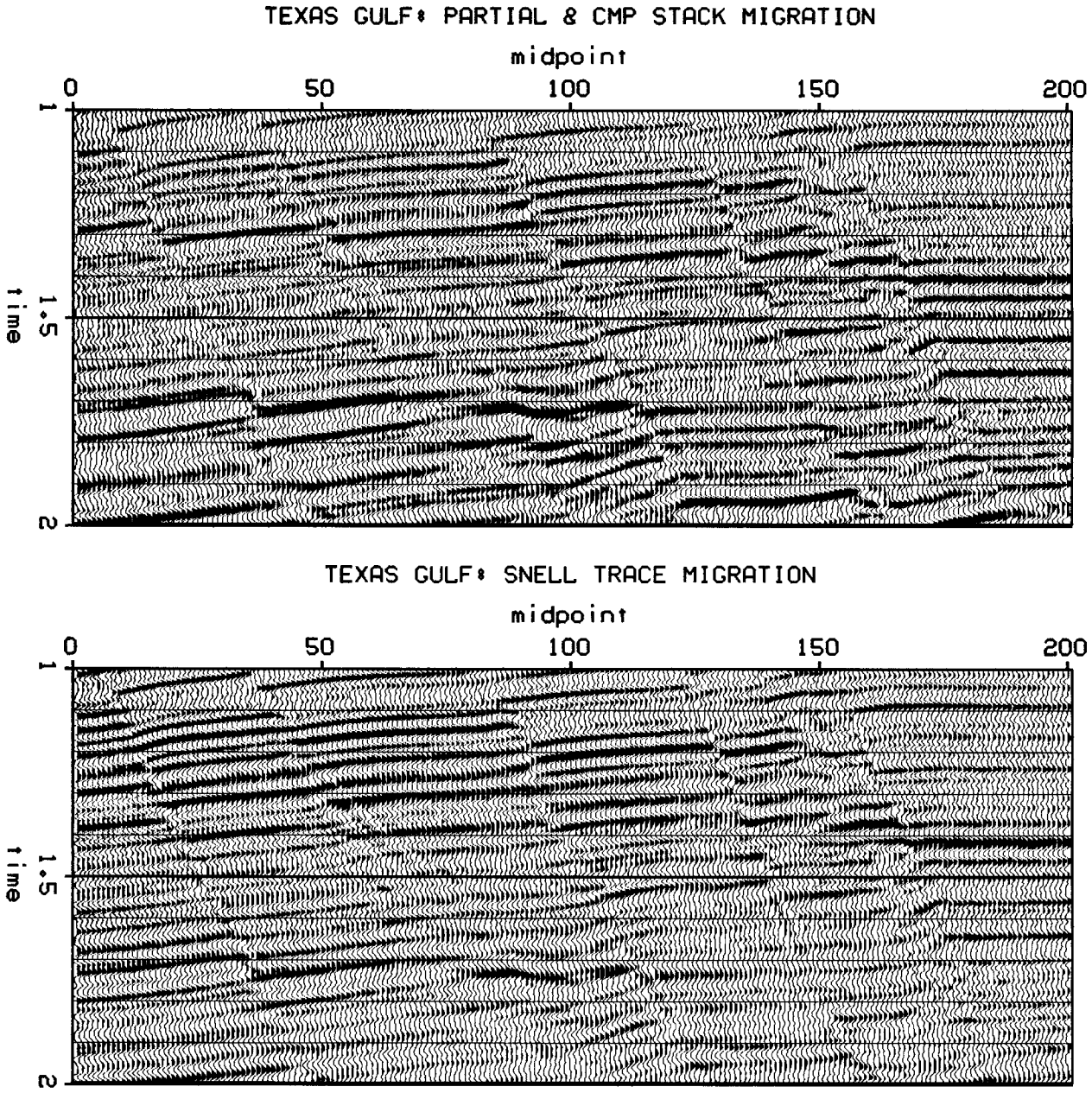


FIGURE 5.1: Comparison of angle migration methods (field data). The CMP stack migration and three angle coordinate migrations of a Texas Gulf growth fault are displayed on this and the following page. All three angle migrations improve the steep dipping fault plane reflections and lateral resolution over the CMP stack migration. The slant stack and Snell trace methods work best.


TEXAS GULF# PARTIAL & CMP STACK MIGRATION
midpoint
0
50
100
150
200
time
1
1.5
2
TEXAS GULF# SNELL TRACE MIGRATION
midpoint
0
50
100
150
200
time
1
1.5
2

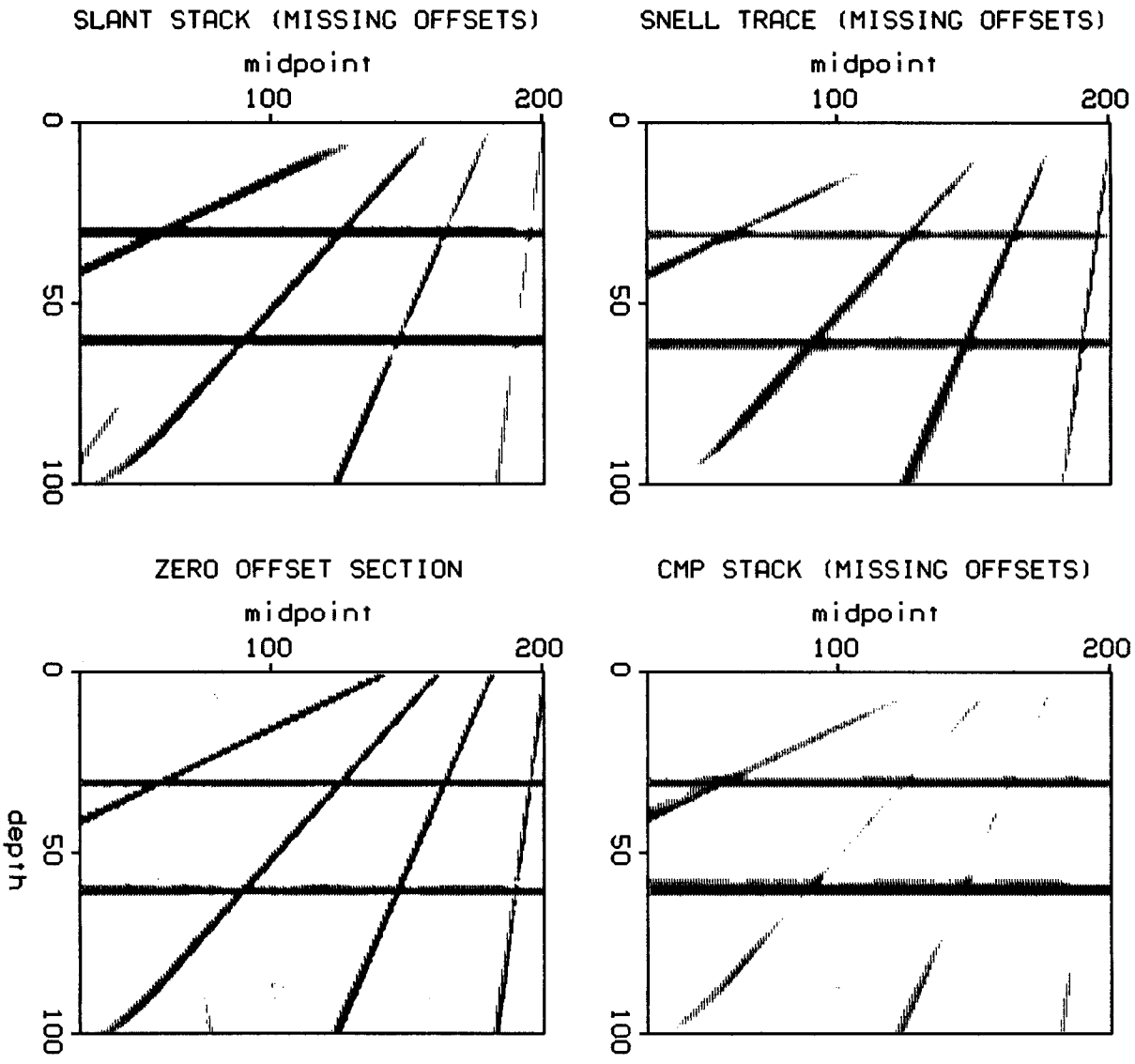


FIGURE 5.2: Comparison of angle migration methods (synthetic). The angle midpoint methods (on top) image the dipping reflectors better than conventional processing (lower right). The zero offset migration is the best possible migration and is meant as a reference result. In practice, it is not possible to collect high quality zero offset data.

accurate only for constant velocity. However, this is sufficient for partial migration, and radial traces have increased angle accuracy over existing partial migration schemes.

5.2. Workability

Angle-midpoint coordinate methods retain the practical advantages of offset-midpoint coordinates. These include resistance to truncation and aliasing, and dip insensitivity. Furthermore, angle-midpoint coordinate methods are more accurate than offset-midpoint coordinate methods.

Of the three angle-midpoint coordinate methods, radial traces are the most practical. They do not suffer from the numerical problems of slant stack, are efficient, and are velocity insensitive. Snell traces are almost as efficient and clean as radial traces but require an input velocity model.

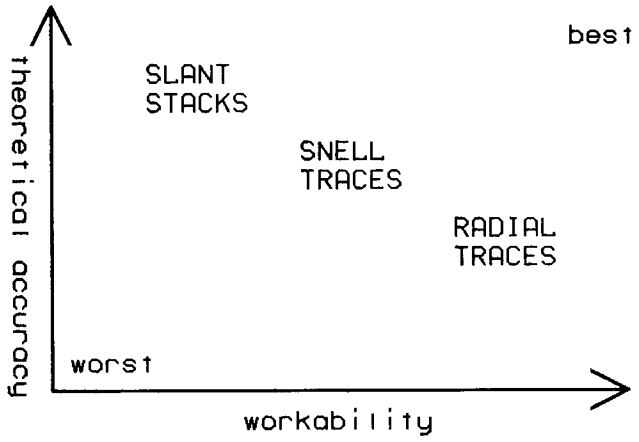


FIGURE 5.3: Qualitative comparison of angle migration methods. Slant stacks are the most accurate method. Radial traces are the most practical method. Snell traces are a good hybrid. Accuracy criteria include lateral and vertical velocity variations, steep dips, and wide offsets. Workability criteria include resistance to truncation and aliasing, dip and velocity insensitivity, and efficient computation.

Figure 5.3 qualitatively ranks the three angle coordinate methods on the basis of accuracy and workability. No one method is optimal or particularly deficient.

5.3. Conditions

One need not incur the extra computational costs of angle coordinate migration methods over conventional stacking unless dipping events are present or good lateral resolution is desired. The presence of steep dips can be verified by CMP stacking at extra high velocities. There should not be significant lateral velocity variations over a span less than a Fresnel zone.