Chapter 5. Conclusions

The slant plane wave stack is an active attempt to preserve the wave field characteristics of the data display. A seismic section of data in slant frames, called a p-section, offers a display format in which all subsurface reflectors are illuminated by incident energy of a fixed ray parameter.

Field data displayed in slant plane wave sections are similar in appearance to CMP stacked sections. The signal to noise ratio in slant stacked sections lies between that of single offset sections and CMP stacked sections. Equivalently, the slant stack is a partial coherency stack.

The slant stacked section is an effective display for observation of angle-dependent reflection coefficients. The partial coherency stacking selectively enhances energy around a single ray parameter, and can result in a strongly angle-dependent reflector being clearly evident on a particular slant section and not on the others. As in the case of the field example of Chapter 2, a severely angle dependent reflector evident on a slant section may not be apparent on either the individual CMP gathers or the CMP stacked section. This is due to the averaging effect of the CMP stack over all propagation angles.

The slant stack is sensitive to spatial undersampling of field data. When reflectors are nearly horizontal and subsurface velocity can be crudely estimated, a window placed on the slant summation can effectively reduce this aliasing. However, even when reflectors are nearly horizontal, unless some anti-aliasing window is applied, data with typical field sampling densities will exhibit aliasing in the slant sum. In regions of complicated structure and large reflector dip, ad hoc anti-aliasing methods become more difficult to devise. The problem is reduced as the sampling density of particularly the spatial coordinate is increased.

Root mean square and interval velocities can be estimated in slant frames in a similar manner to methods used in standard coordinates. The partial coherency stacking allows these estimates to be made on corresponding fewer data traces in slant frames. As in the field data example presented in Chapter 3, one may occasionally expect to be able to make an interval velocity estimate between angle-dependent reflectors in slant frames when impossible in standard coordinates because of low signal strength.

The role of the interpretation coordinate transformation is a parallel to that of common midpoint coordinates in standard frames. It collects all data with a common reflection point when the earth is horizontally layered, and offers a first order dip correction to velocity estimation when reflector dip is not greater than ten to fifteen degrees. Migration prior to velocity analysis can be done in slant frames as a complete dip correction.

Seismic sections displayed in slant frames can be correctly regarded as a sampling of a passing upcoming wave field. As such, in regions of strong lateral velocity inhomogeneity, it becomes theoretically possible to downward continue both the upcoming and downgoing waves if the lateral velocity variation is known, thus allowing a rigorous pre-velocity analysis migration to be done in such a region. In addition, a generalization of this process of complete and rigorous downward continuation can be expected to enable one to estimate lateral velocity variations within a cable spread.