Marine Geophysics

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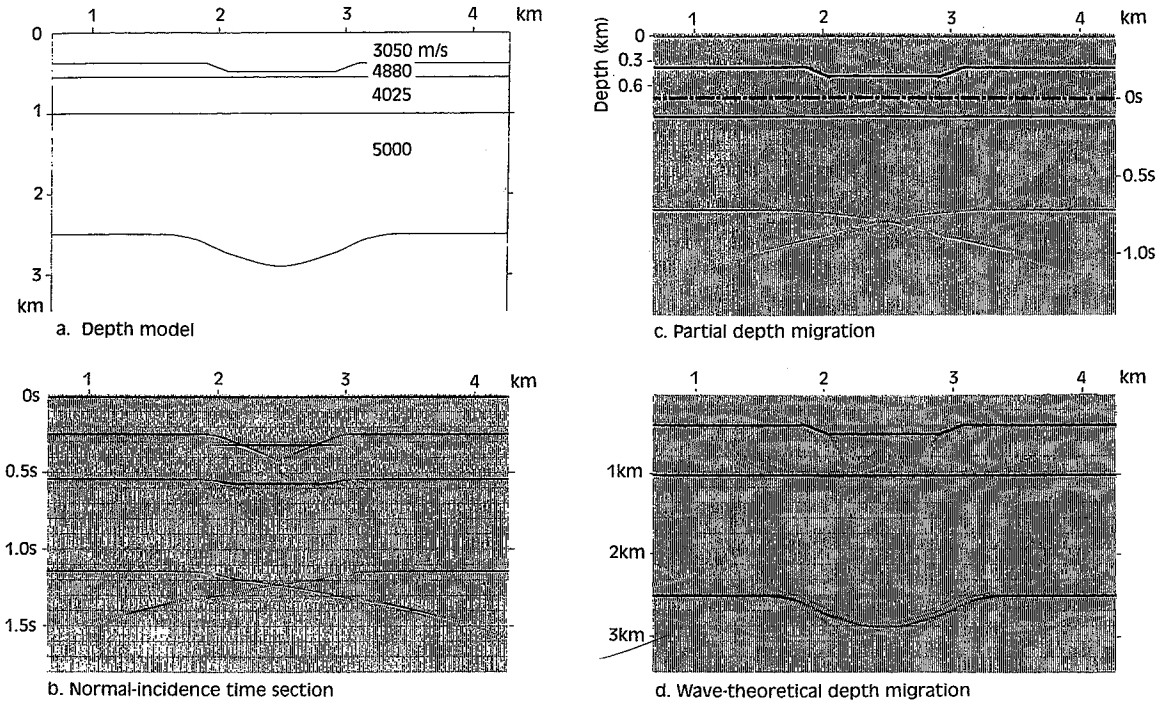

Figure 4.24 Wave-theoretical depth migration. (a) Model structure, with P-wave velocities given in m s^{-1}. The reflection coefficient between the 4880 m s^{-1} and 4025 m s^{-1} layers is zero. Reflection coefficients of all other interfaces are non-zero and identical. (b) Normal incidence time section calculated from the model structure. (c) Partial depth migration. Wave-theoretical migration has been carried out down to a source–receiver level of $\sim$ 750 m, shown by the dashed line. The shallow section is fully migrated in depth. The section below the dashed line is the time section that would be recorded with the source and receiver at a depth of 750 m. (d) Section obtained from wave-theoretical migration of record (b) (courtesy of Western Geophysical).

image seabed structure in more detail and with less ambiguity, many reflection surveys are carried out with a close grid of shot and receiver points spaced a few tens of metres apart so that seismic arrivals from a single point in the subsurface are recorded from different directions as well as at different source–receiver offsets (Figure 4.25). Such dense acquisition in offshore regions has been made possible by the development of accurate navigation systems and the use of multiple sources in conjunction with several receiver arrays (Section 5.9.4). Seismic returns are grouped into small cells or *bins*, data being included in a particular bin if a mid-point falls within that area of the subsurface. Data from each bin can then be stacked and migrated to produce a three-dimensional image of the subsurface.

Typically, the edges of a subsurface bin are 12.5 m in the inline direction of the survey and 25 m in the crossline. Digitization of the seismic trace at 2 ms provides a vertical sampling of 3 m for an average subsurface velocity of 3 km s^{-1}. The bin size is chosen so a high resolution of the subsurface can be achieved and aliasing during processing avoided, but it should not be so small that many bins are empty. Data points in the volume should be separated by less than one-half of a seismic wavelength. If f_{max} is the highest seismic frequency and α_{max} is the maximum dip, then the maximum separation Δx_s is (Sheriff and Geldart, 1995)

$$\Delta x_s \leq \frac{V}{4 f_{max} \sin\alpha_{max}} \tag{4.67}$$

Data within each bin should contain the same number of traces and the same uniform distribution of offsets but, in practice, the trace density is variable because the pattern of survey tracks is not ideal and also because of the presence of structural complexity in the subsurface. Traces for empty bins are normally generated by averaging data from an adjacent part of the subsurface. In some processing procedures empty bins are allowed to expand, usually in the crossline direction, until they