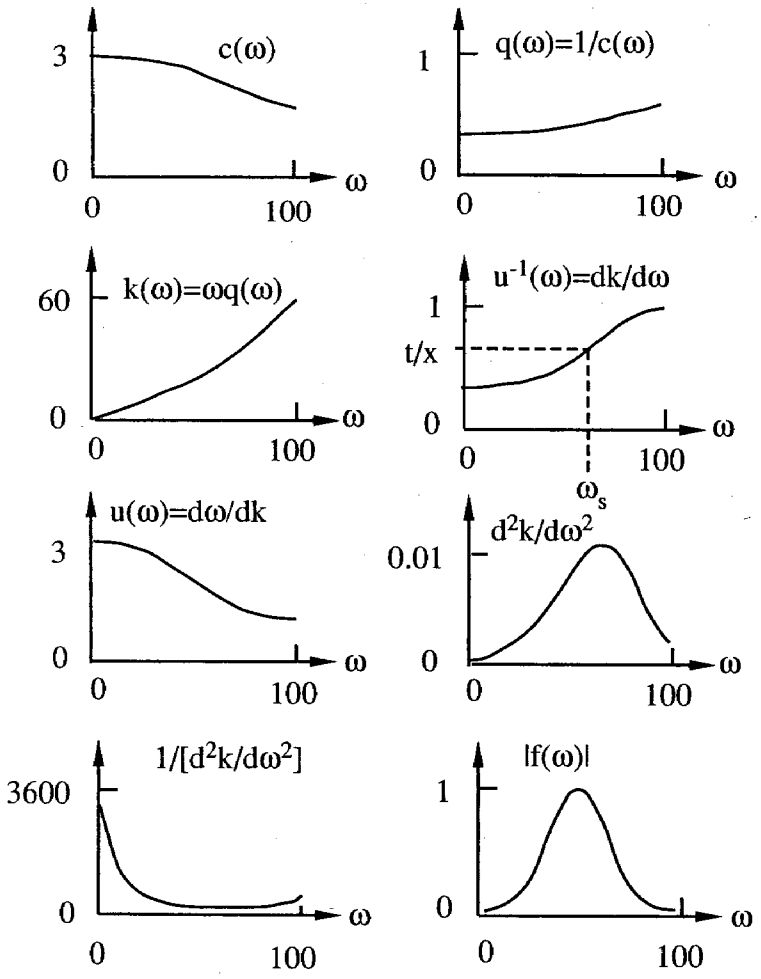


FIGURE 8.12 Parameters used in an application of the stationary phase approximation. We consider a surface wave that consists of a single mode with phase velocity, $c(\omega)$ (top, left graph). This curve can be used to calculate the horizontal slowness, $q(\omega)$, horizontal wavenumber, $k(\omega)$, inverse group velocity, $u^{-1}(\omega)$, group velocity, $u(\omega)$, $d^2k/d\omega^2$ and $1/[d^2k/d\omega^2]$ (lower, left graph). The stationary frequency, ω_s, is read off the graph of $u^{-1}(\omega)$, given time, t, and distance, x. The amplitude of the surface wave is proportional to $|d^2k/d\omega^2|^{-1/2}$. A hypothetical source spectrum, $f(\omega)$, is also needed in the calculation (lower, right graph).

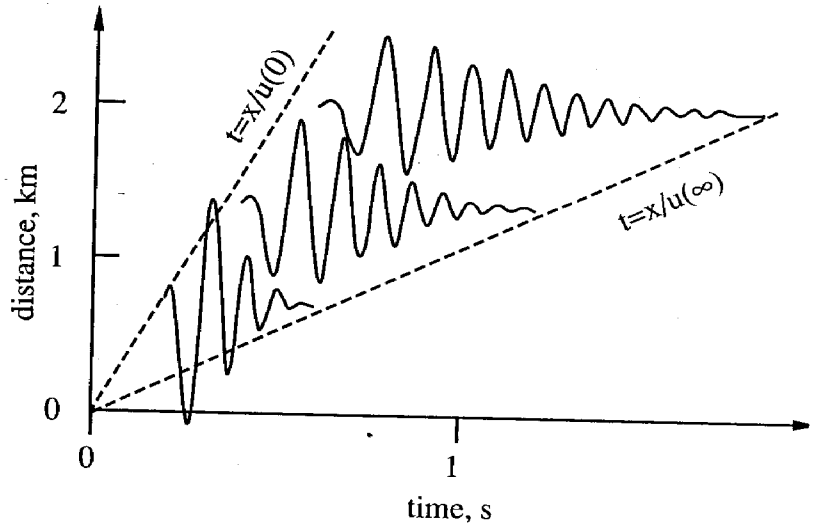
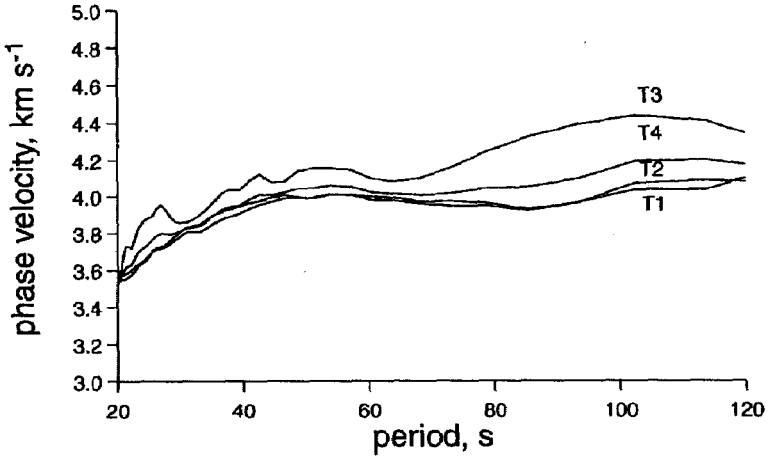


FIGURE 8.13 Application of the stationary phase approximation. The pressure p(x,t), due to the surface wave with parameters given in figure 8.12, for three values of distance, x. Note that the signal is limited to a time and distance interval controlled by the limiting group velocities, $u(\omega = 0)$ and $u(\omega = \infty)$.

Rayleigh wave phase and group velocity

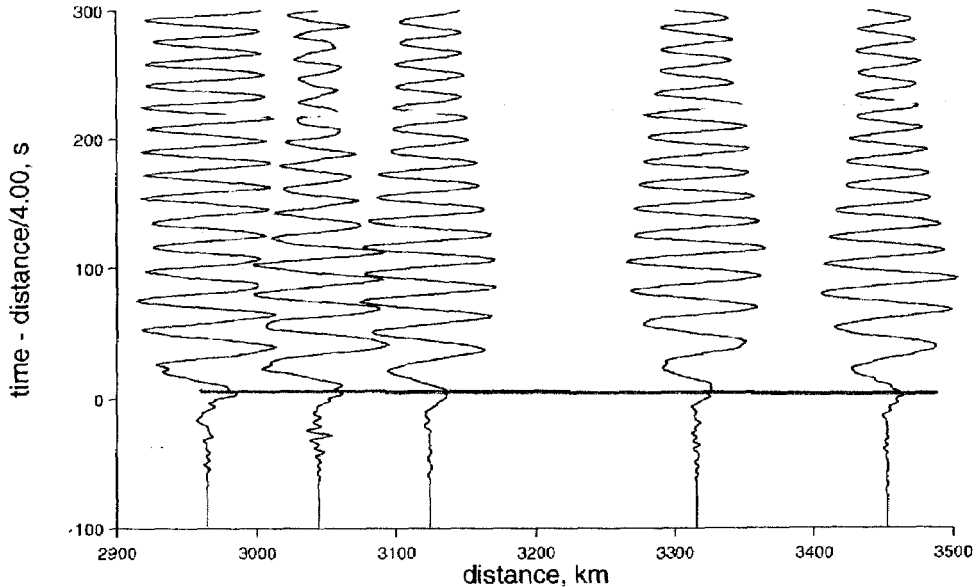
1. The velocity of a single-frequency wave, called the the phase velocity, $v(\omega)$, varies with frequency, ω (called *dispersion*)
2. A wavecrest (red and green lines, below) is an interference phenomenon. It does *not* move at the phase velocity, but rather at the group velocity,

$$u(\omega)=v(\omega)[1-(dv/d\omega)\omega/v(\omega)]^{-1}$$

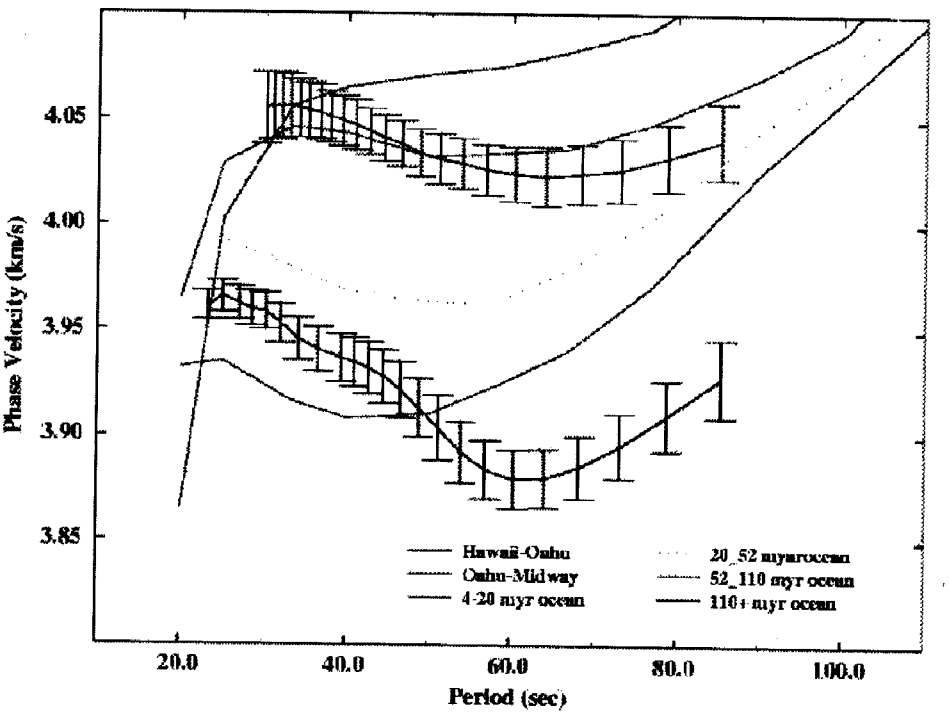


Phase velocities computed from groups of three seismograms at the left

Rayleigh waves from mid-Atlantic Ridge earthquake observed along east coast of North America



3. In a uniform half-space, the Rayleigh wave is non-dispersive with a constant phase velocity of 92% of the shear velocity.
4. In the earth, in the 20-100 second period range, phase velocities typically increase from about 3.5 to 4.5 km/s, reflecting the increase in shear velocities from the crust to mantle.


Phase Velocity (km/s)
4.05
4.00
3.95
3.90
3.85
20.0
40.0
60.0
80.0
100.0
Period (sec)
Hawaii-Oahu
Oahu-Midway
4-20 myr ocean
20_52 myrocean
52_110 myr ocean
110+ myr ocean