Today's material comes from p. 200 - 218 in the textbook.
Please read and understand all of this material!

Seismic Resolution
Resolution defines your spacing (horizontal resolution) and dominant source frequency (vertical resolution).

What do we mean by resolution?
Suppose we are looking out a window and see an object in the distance. We have detected the object, but we can’t tell what it is.
When we get our binoculars and look at the object, we see that it is actually not one thing, but it is two cars. We can now say that we resolved the two objects.

Vertical Resolution
How thin a layer can we resolve?
Dependent on seismic wavelength
Reflectors are barely resolved when their separation $= \lambda/4$
$\lambda = v/f$ (velocity = frequency x wavelength)
If $v = 2000$ m/s and $f = 30$ Hz
Separation = $(66.67$ m$)/4 = 16.67$ m
If $v = 8000$ m/s and $f = 20$ Hz
Separation = $(400$ m$)/4 = 100$ m
If $v = 2000$ m/s and $f = 3500$ Hz
Separation = $(0.5714$ m$)/4 = 0.1428$ m

Seismic Resolution
*Horizontal resolution:*
The reflection of interest comes from a region of the reflector determined by the frequency and the depth to the reflector, the Fresnel (pronounced “Fernel”) zone. This is the zone on the reflector where the reflected signal comes back to the surface in phase and adds to the energy return at the receiver. We can also call this the acquisition footprint.
Fresnel Zone Examples

\[ r = \sqrt{\frac{\lambda h}{2}} \]

<table>
<thead>
<tr>
<th>Reflector Depth</th>
<th>V</th>
<th>f</th>
<th>( \lambda )</th>
<th>Zone Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 m</td>
<td>2000 m/s</td>
<td>25 Hz</td>
<td>80 m</td>
<td>200 m</td>
</tr>
<tr>
<td>1000 m</td>
<td>1500 m/s</td>
<td>100 Hz</td>
<td>15 m</td>
<td>87 m</td>
</tr>
<tr>
<td>1000 m</td>
<td>1500 m/s</td>
<td>10 kHz</td>
<td>0.15 m</td>
<td>~8.5 m</td>
</tr>
<tr>
<td>2000 m</td>
<td>3000 m/s</td>
<td>15 Hz</td>
<td>200 m</td>
<td>~450 m</td>
</tr>
</tbody>
</table>

Resolution
Resolution decreases rapidly with depth as more and more area on the reflection interface is "averaged" to form the reflection signal.

Resolution increases as frequency increases, since a smaller area will be in phase.

Here is an example of a "fully interpreted" seismic profile. What is the event history here?
Here is a detail of an interpretation. We usually draw lines on the reflecting horizons first, then try to pick faults where reflection terminate.

Another example of fault interpretation.

Folds and faults in the Gulf of Mexico.