Locating Epicenters

How do seismologists determine the location of an earthquake?
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• The first seismograph was invented in 132 AD by the Chinese astronomer and mathematician Chang Heng

  • It could register an earthquake and determine direction the earthquake came from
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• Mercalli Scale - developed by Giuseppe Mercalli in 1902, it measured the intensity of an earthquake based on the effects to Earth’s surface, humans, objects in nature and other man-made structures.
 Locating Epicenters

• Mercalli Scale [continued]

  • Higher values of intensities are closer to the epicenter and lower values of intensity are farther away
<table>
<thead>
<tr>
<th>Intensity</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Instrumental</td>
</tr>
<tr>
<td>II</td>
<td>Feeble</td>
</tr>
<tr>
<td>III</td>
<td>Slight</td>
</tr>
<tr>
<td>IV</td>
<td>Moderate</td>
</tr>
<tr>
<td>V</td>
<td>Rather Strong</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
</tr>
<tr>
<td>VII</td>
<td>Very Strong</td>
</tr>
<tr>
<td>VIII</td>
<td>Destructive</td>
</tr>
<tr>
<td>IX</td>
<td>Ruinous</td>
</tr>
<tr>
<td>X</td>
<td>Disastrous</td>
</tr>
<tr>
<td>XI</td>
<td>Very Disastrous</td>
</tr>
<tr>
<td>XII</td>
<td>Catastrophic</td>
</tr>
</tbody>
</table>
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• Richter Scale - developed by Charles Richter, it measured the amount of energy released during an earthquake using a logarithmic scale

• Magnitude - a number to quantify the amount of seismic energy released from an earthquake
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• Richter Scale [continued]

  • The Richter Scale’s magnitude is determined from the following measurement:

    • Seismogram’s amplitude of waves
    • Distances from other seismographs
    • Epicenter distance
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• Modern seismographs are used to accurately determine the location of an epicenter

• To find the epicenter location you need to triangulate a position using three different seismograph stations
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• Steps to Locate an Epicenter:
  1. Find the arrival time difference between the p-wave and s-wave
S-wave 07:31:00
P-wave 07:27:00
Difference 00:04:00

Time [h:min:sec]
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• Steps to Locate an Epicenter [continued]:

2. Use scrap paper to mark the time difference on the “Earthquake P-Wave and S-Wave Travel Time” chart

3. Slide the scrap paper [with the time difference marks] until it fits perfectly between the S and P lines

4. Look straight down for the “Epicenter Distance”
Earthquake P-Wave and S-Wave Travel Time

TRAVEL TIME (min)

EPICENTER DISTANCE ($\times 10^3$ km)

P

S
Scrap Paper

2,600 km
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• Steps to Locate an Epicenter [continued]:

5. Using a safety compass, draw a circle from the seismograph station for the determine “Epicenter Distance”
Steps to Locate an Epicenter [continued]:

6. Repeat steps 1-5 for the two additional seismograms to find the intersecting point for the three circles

7. Mark it with an “X”
Epicenter