

5. If d is the distance from the location of the earthquake to the seismograph and v_s is the speed of the S waves then the time for these waves to reach the seismograph is $t_s = d/v_s$. Similarly, the time for P waves to reach the seismograph is $t_p = d/v_p$. The time delay is $\Delta t = (d/v_s) - (d/v_p) = d(v_p - v_s)/v_s v_p$, so

$$d = \frac{v_s v_p \Delta t}{(v_p - v_s)} = \frac{(4.5 \text{ km/s})(8.0 \text{ km/s})(3.0 \text{ min})(60 \text{ s/min})}{8.0 \text{ km/s} - 4.5 \text{ km/s}} = 1900 \text{ km} .$$

We note that values for the speeds were substituted as given, in km/s, but that the value for the time delay was converted from minutes to seconds.