Addendum: Earth's Interior Structure—
Seismic Travel Times in a Constant Velocity Sphere v1.1

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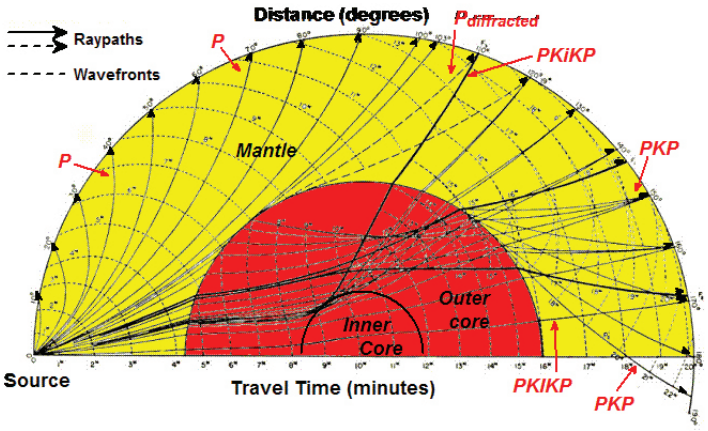
Geophysics research is continuously revealing insights that greatly enhance our understanding of the Earth's interior. It is unfortunate, however, that while our scientific understanding advances, very little progress has been made with regards to the pedagogical content knowledge of this same subject matter. Instruction regarding the Earth's interior structure is commonly limited to didactic methods that make little effort to inspire or engage the minds of students. For example, presenting factoids about each layer, their order, and their name. If a more engaging approach is used, it is likely limited to the creation of some variant of a scale model of these layers. Encouraging students to develop an understanding of the makeup and scale of the Earth's layers is important, but what has frequently been missing from such instruction is a feasible method to present students with seismic evidence in a manner that allows students to discover, or dispel the presence of a layered Earth for themselves.

In the activity, ***Earth's Interior Structure - Seismic Travel Times in a Constant Velocity Sphere*** (Braile, 2000), students explore the evidence that leads scientists to conclude that the Earth has a layered internal structure. To begin, students first apply the principle of Occam's Razor to explore Earth Structure and work from the hypothesis that the Earth is homogeneous throughout. Students then create a scale model of the homogeneous earth and create a travel time curve for seismic waves traveling through their model. Next, students compare this model travel time curve to a standard one most commonly used in Earth science classes to triangulate the epicenter of an earthquake. Such a comparison reveals that the travel time curve for the model does not align with the real Earth travel time curve they have been provided. Therefore, students are able to conclude that the Earth cannot be homogeneous (the model does not match reality), and must have at least one layer. In its present form this activity is useful in addressing content standards regarding Earth structure, as well as emphasizing the importance of both observational data and models in science.



Graphic from Larry Braile's **Earth's Interior Structure—Seismic Travel Times in a Constant Velocity Sphere.**

Since the development of this activity in 2000, technological enhancements allowing seismic data to be quickly served over the web now provide a substantial opportunity to enhance this activity. The Rapid Earthquake Viewer (**http://rev.seis.sc.edu/**), developed by the University of South Carolina and the IRIS Consortium with funding from the National Science Foundation, provides the general public with the ability to access seismic waveform data, for recent earthquakes with only a few mouse clicks. For this activity the availability of this data allows teachers to replace the real Earth travel time curve provided in the activity, with earthquake data from a recent event. Thus instead of simply providing an abstract graph, like a travel time curve, teachers and students can then create their own travel time curve for a recent earthquake. Such a switch is useful to add relevance to the lesson by using data from a recent event that students may have heard about on the news. Further, the process of building their own travel time curve can also enhance students understanding of this graph and what it represents.

Alternative instructions…

To create your own travel time curves you need a record section. A record section is a set of seismic recordings distributed across the Globe and plotted

vertically with time on the Y-axis and distance away from the epicenter in degrees. To get a record section for a recent newsworthy event, visit

http://rev.seis.sc.edu/

1) Click on Earthquake view
2) Then using the map select an earthquake of interest.
3) The next page will have a record section on the right side.
4) Grab the image of the record section and then print this. Each student will need a copy.
5) Students should analyze the record section and identify the time that seismic energy first arrived at each seismic station shown.
6) The distance of each station from the epicenter of the earthquake, and corresponding time of arrival of seismic energy should be plotted on the blank graph provided in Appendix I.
7) Students should then connect these points with curve(s).
8) Continue on with the existing activity as written replacing the travel time curve provided by the activity with the travel time curve the students have created based on observational data, AND have students plot the travel time curves they create for the homogeneous Earth model on this same graph for easy comparison.

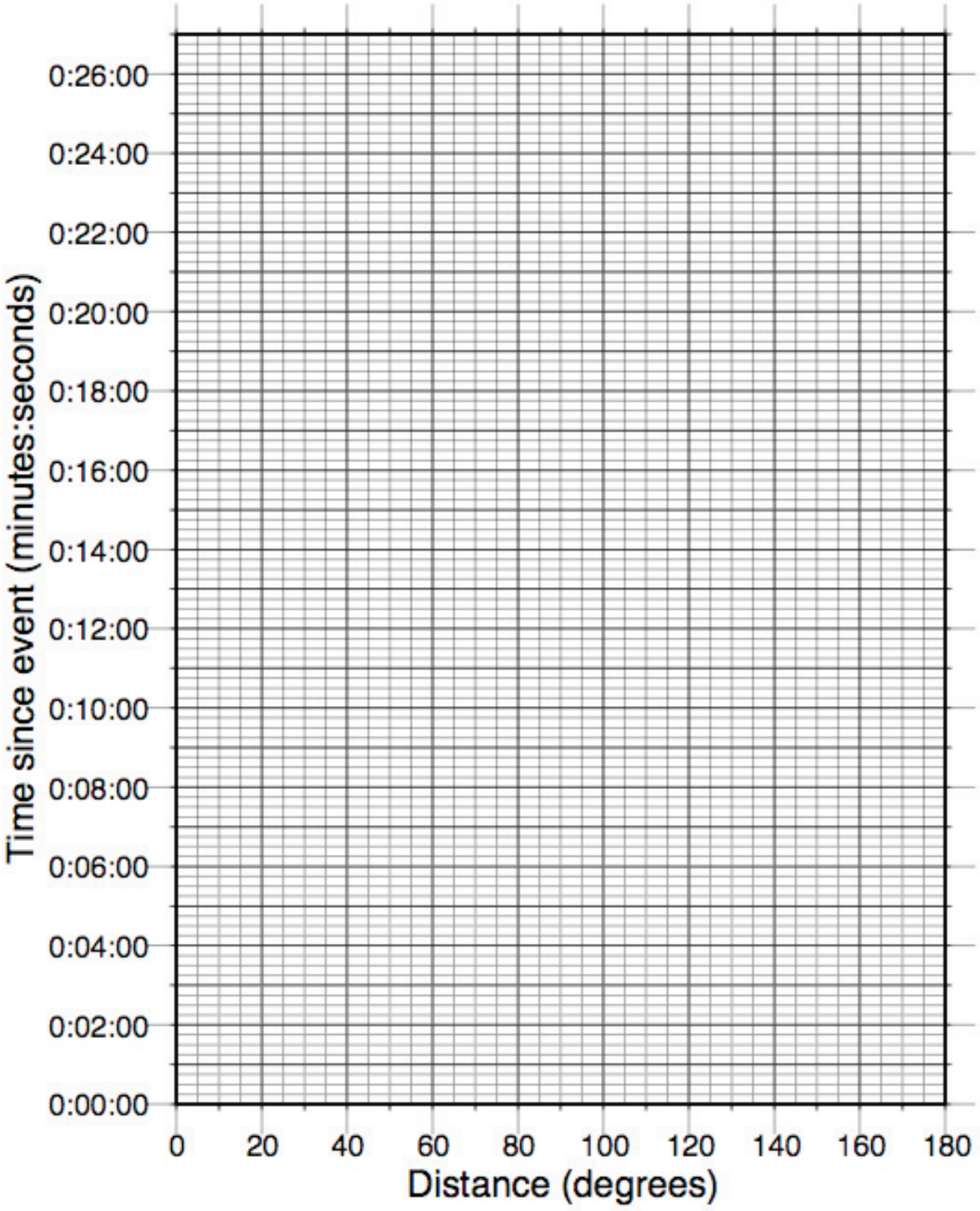
References

Braile, L. (2000) Earth's Interior Structure - Seismic Travel Times in a Constant Velocity Sphere. Accessed online 12/10/06 at http://web.ics.purdue.edu/~braile/edumod/constvel/constvel.htm

Appendix I

Blank Graph for Travel Time Curves

Blank Graph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0:04:00
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Time since event (minutes:seconds)
0
20
40
60
80
100
120
140
160
180
Distance (degrees)