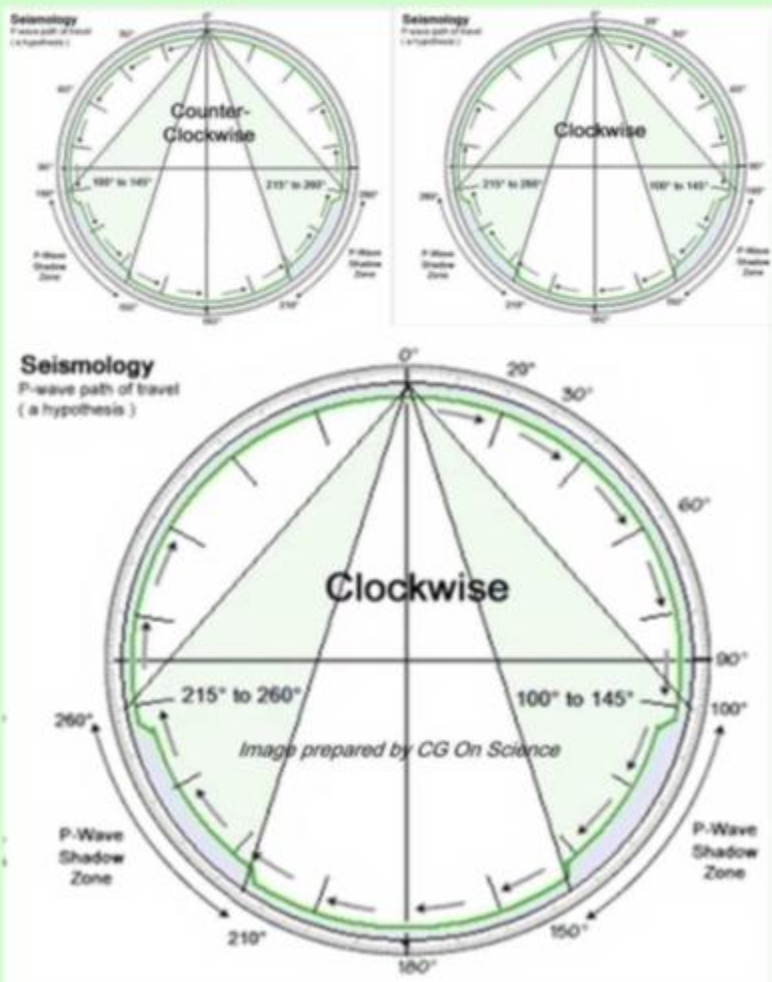
CG ON SCIENCE ON SEISMOLOGY

by Wayne H. Wilhelm

Earthquake P-wave Travel



A CG on Science Production

Contents

Website: https://www.CGonScience.com

Prologue

CGonScience: *CG stands for Curious George. An autodidact. A 1972 graduate of Crestview Local High School. A 1974 graduate of YSU. Joined Mensa in 2008.*

CGS is about promoting ***alternative possibilities***, possibilities which might be more plausible than what scientists currently believe.

‘The progress of science is strewn with the skeletons of discarded theories, theories which once seemed to possess eternal life.’

The essence of that saying is attributed to A. Koestler in his book, *'The Ghost in the Machine'*. As technology improves, things previously thought to be absolute truths can end up being discarded. Such is the essence of science.

A ***CGS Challenge*** is an attempt to expose errant hypotheses / theories, to get science to discard such theories at a much earlier stage. As it is, errant hypotheses / theories may take decades if not centuries to be discarded.

CGS Challenge

For nearly a century (since 1936), research by Inge Lehmann has been used to establish the interior of the Earth has a mantle, a liquid outer core, and a solid inner core. CG on Science challenges those claims.

This chapter on Seismology presents evidence of two things.

1) **Inge Lehmann's presentation of how P-waves are believed to travel through the Interior of the Earth can't possibly be valid.**

2) **CG on Science presents an alternative (see cover page) to Inge Lehmann's presentation.**

Chapter 11: On Seismology

***CG on Science** is about promoting alternative possibilities, possibilities which might be more plausible than what scientists currently believe.*

CG on Science claims seismologists failed to consider and account for when a P-wave descends into the Earth's mantle and the P-wave path of travel changes from descent to ascent, the progressive change in fluidity reverses. When the progressive change in fluidity reverses, the curvature of the P-wave path of travel would switch from being convex to concave relative to the center of the Earth. That's with the assumption as Inge Lehmann claims that, as depth increases into the Earth's interior, fluidity decreases.

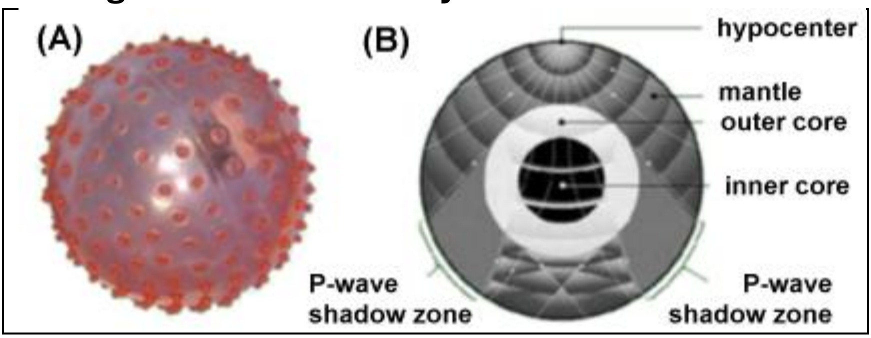
Image 11.1: Inge Lehmann [i]

In 1936, Inge Lehmann was credited with the discovery of the Earth having a liquid outer core and solid inner core. For nearly a century, the scientific community has accepted her research as being valid.

What are P-waves?

A lot of people have shown an interest in seismology, yet claim they aren't experts, that they don't know the basics. In **Image 11.2 (A)**, think of the dimples located on the perimeter of the globe as being seismographs situated across the perimeter of the Earth. Seismographs detect shockwaves in the ground. Those shockwaves are referred to as P-waves.

Image 11.2 P-wave Analysis [ii]



Earthquakes produce several different types of shock waves. P-waves are the primary shock wave used by seismologists to better understand the interior of the Earth. We don't have the ability to measure P-waves in the interior of the Earth. What we measure is P-waves as they appear on the surface of the Earth. We 'infer' the nature of the interior of the Earth based upon the P-wave surface readings, which includes timestamps.

The hypocenter is the origin of the P-wave. As a P-wave travels outward as the perimeter of a circle (of a sphere), it is believed a portion of the P-wave passing into the interior of the Earth can travel through the interior, reappearing on an opposing side of the planet where a seismograph can detect and measure it. Due to a progressive change in fluidity at various depths, a P-wave doesn't travel in a straight line. In reference to a P-wave not traveling in a straight line, this refers to if you draw a straight line from the hypocenter to a point on the perimeter of a circle expanding outward from the hypocenter, the tangent of that perimeter (slope) will progressively change causing the direction of the line extending outward from the hypocenter changing direction. With a progressive change in fluidity, the P-wave will follow a convex or concave curve.

You might ask, 'How can a P-wave which expands outward as the perimeter of a sphere, change direction?

Picture a line tangent to the perimeter of a circle, with a line passing from the center of the circle to the point of tangency. The tangent line represents the slope of the path of travel of a P-wave. Also, the P-wave is little more than a sound wave. In some materials, a sound wave travels faster than in other materials.

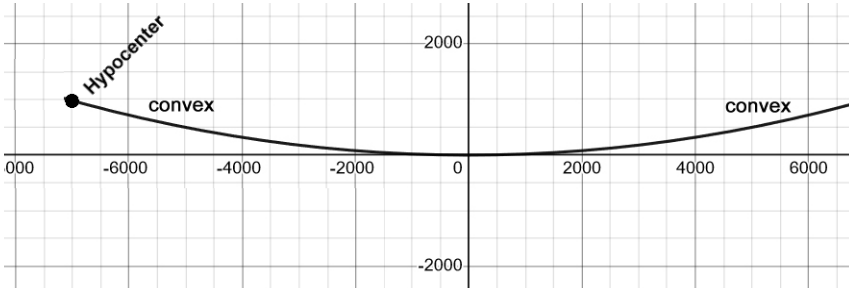
Changes in P-wave velocity can be used to help discern the fluidity of the medium a P-wave is passing through.

Due to the extreme amount of pressure involved, when a P-wave travels into the interior of the Earth, the deeper the P-wave travels, the less the fluidity of the material. With a decrease in fluidity, a P-wave travels faster with a corresponding increase in depth. Consider the line of tangency as having two end points, M and N. The slope is M/N. If M is sound traveling slower (less depth), and N traveling faster (greater depth), the slope tilts backwards '\'.

If the P-wave path of travel increments with a backward slope as it travels through the interior of the Earth, the path of travel follows a convex curve relative to the center of the Earth. (0,0) on the chart **(Pg. 8) Image 11.3**, is the POI (point of inflection). (0,0) is the deepest depth of a P-Wave's descent before the P-wave begins to ascend towards the surface of the planet. Precisely how deep a P-wave will travel depends upon which seismometer will be detecting the P-wave.

The shortest distance between two points is a straight line. Think of that when thinking of the distance between the hypocenter of an earthquake and each of the seismometers on the Earth's surface. Because fluidity of the medium a P-wave is passing through progressively changes with changes in depth, the path of travel of that P-wave is curved.

Image 11.3 P-wave convex curve

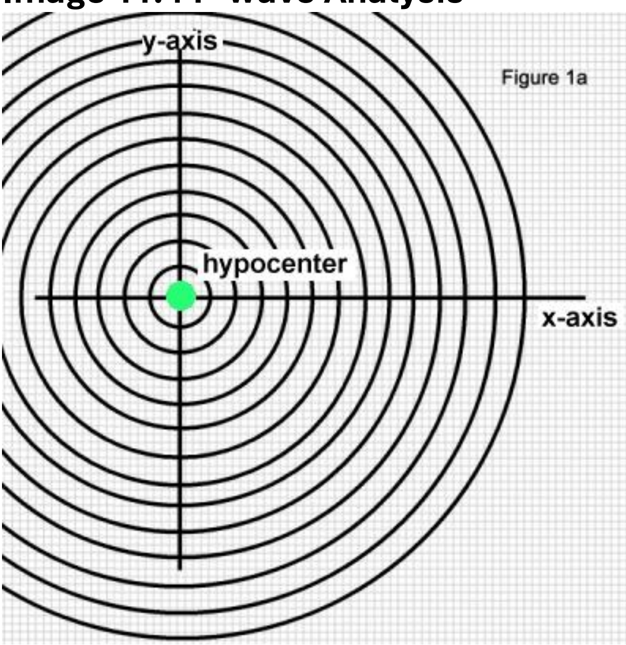


In the depicted convex curve **(Image 11.3)**, (0,0**)** is the closest point to the center of the Earth the P-wave would descend, with the upward ends closer to the outer perimeter of the Earth. Think of this as an upside-down umbrella, with the handle of the umbrella sticking out the top of a mountain somewhere. A concave curve would be different. A concave curve would be like the curvature of the Earth's surface with the umbrella's handle reaching downward towards the center of the Earth.

For that reason, a P-wave path of travel isn't a straight line outward from the hypocenter. Think of a P-wave as the perimeter of a sphere expanding outward concentrically. The hypocenter tends to be 10 to 700 km beneath the surface of the Earth. Any P-wave traveling upward from a hypocenter and reaching the atmosphere would dissipate rather quickly.

If P-waves traveled downward into the interior of the planet; if the P-wave path of travel curved, the point at which the P-wave appears on the surface of the planet can be other than a straight line outward from the hypocenter. Since fluidity in the interior of the planet varies along with the velocity of the P-wave, analysis of P-wave path of travel should be able to lead us to a better understanding of the interior of the Earth.

Image 11.4 P-wave Analysis



We can tell if the P-wave wasn't traveling in a straight line if the time it takes for the P-wave to travel a straight-line distance between the hypocenter and a seismometer is too short. We can then adjust for fluidity by adjusting the length of the estimated P-wave path of travel. Less fluidity of the medium the P-wave is passing through would mean the P-wave is traveling faster. If the P-wave is traveling faster, the length of the perceived path of travel would have to be longer. If the distance traveled is longer, that means the path of travel must be curved.

For this chapter, the only wave being referenced is the P-wave. A P' (P' Prime) wave is a P-wave which travels into and through the core of a planet. For the purpose of this discussion, P-wave travel through the core can't be discussed until we first establish how a P-wave travels through the Earth's mantle. This writing is almost entirely about P-wave travel through the Earth's mantle (and crust).

In **(Pg. 5) Image 11.2 (B)**, there is a section of the perimeter of the planet where seismographs aren't detecting P-waves. That section is labeled as a P-wave Shadow Zone. Think of it as a P-wave dead zone. That dead zone has caused a lot of confusion in the world of seismology, though its technical name is P-wave shadow zone. Why aren't P-waves being detected there? P-waves are being detected there, but those are secondary and tertiary P-waves (echoes).

If the shadow zone didn't exist, normal thinking would lead us to believe (presume) earthquake P-waves would travel around the Earth in the crust, that P-waves traveling deeper into the interior of the Earth would dissipate and disappear in the fluid interior of the Earth. According to research conducted by Inge Lehmann (1888-1993) and published in 1936, because of the P-wave shadow zone, if the P-waves aren't traveling along the Earth's crust / outer perimeter, the P-waves must be traveling through the Earth's fluid interior.

(Pg. 5) Image 11.2 (B) depicts the expansion of P-waves as they are believed to be traveling through the interior of the Earth. Notice the length of the projected P-wave paths of travel through the interior of the Earth due to the P-waves being curved. If Lehmann projected the P-wave paths of travel as a straight line from the hypocenter to the seismograph node recording the P-wave, the amount of time would be wrong. The amount of time was too long. Even with adding curvature to the P-wave path of travel, the time factor was still an issue.

That led to Lehmann having to adjust the velocity of the P-waves as they traveled through the interior of the Earth. Lehmann finally postulated that fluidity must be decreasing with a corresponding increase in depth. She then postulated the Earth has a liquid outer core and a solid inner core. Over the years, as better readings and calculations were being made, adjustments kept having to be made to correct various discrepancies.

If fluidity of the interior of the Earth progressively increased with a corresponding increase in depth, P-waves would dissipate and never reappear on the surface of the planet. To compensate for the shadow zone, Inge Lehmann claimed fluidity must therefore be decreasing in the interior of the Earth with any increase in depth. Such a claim was justified by postulating pressure with any increase in depth could offset the boiling point of any mass, resulting in the fluidity of that mass decreasing with a corresponding increase in depth.

With that claim, it was asserted P-waves (like sound waves) travel faster in the interior of the Earth than waves passing through the Earth’s outer crust, even though the outer crust is primarily solid while the interior of the Earth is primarily liquid. It’s all about pressure. As to fluidity, Inge Lehmann asserted the Earth must therefore have a liquid outer core and a solid inner core.

Bogus construct.

When you look at certain aspects of something and known laws of physics don't support what you're seeing, you alter the known laws of physics so that they support what you're seeing. That led to the conclusion of Inge Lehmann’s research being false, a bogus construct.

There are several issues indicating Inge Lehmann was wrong about the interior of the Earth and fluidity. Due to our inability to create a model capable of producing the kind of pressures we would see in the mantle and core, Inge Lehmann's claims managed to survive a hundred years. i.e.: What is the speed of sound in the Earth's crust? What is the speed of sound (vibrations) at the deepest depth in the mantle? Did anyone travel to the center of the Earth and measure how long it took for a P-wave to arrive? No. We can't do that (yet). What is the speed of sound at the center of the Earth's core? According to Lehmann, the speed of sound at the deepest depth in the interior of the Earth is faster than in the Earth's crust. Are her claims based upon fact or fiction?

Look at **(Pg. 5) Image 11.2 (B)** again. Visualize in your mind what we would have if we took all the projected P-wave paths of travel and flipped them, aligning those paths of travel as if they were traveling from the hypocenter, through the Earth's exterior crust. An initial projection should come close to matching what would be expected if the P-waves were traveling though the Earth's crust instead of through the interior of the Earth. There isn't much of a difference. That leaves the possibility P-waves detected by various seismographs traveled through the Earth's crust, not the interior (mantle or core). The only issue, what happened to P-waves when they disappeared at the edge of the Shadow Zone then re-appeared at the far edge of the Shadow Zone? **CG on Science** offers a proposal for how that could be possible.

Understanding the Earth's Core

If you go scuba diving, the deeper you dive beneath the surface of the water, the greater the pressure. The moment you start to ascend back towards the surface, pressure will begin to decrease.

In the case of seismology, the progressive change involves fluidity. When a P-wave descends into the mantle, seismologists claim fluidity of the medium the P-wave will be passing through will progressively decrease. If there’s a progressive decrease in fluidity with an increase in depth, the P-wave path of travel would follow a convex curve relative to the center of the planet. Being convex, the P-wave's path of travel will eventually reach a POI (point of inflection) heading back towards the surface of the planet where waiting seismographs can detect them.

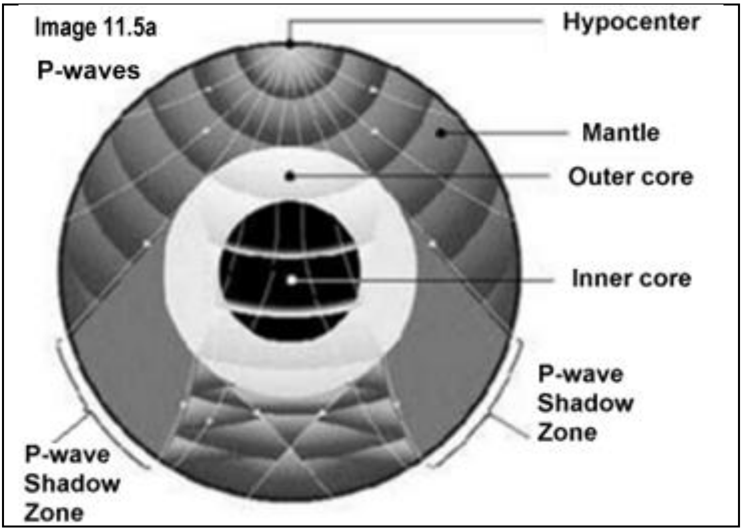
Pay particular attention to the Earth's mantle. We must figure out how the P-wave is traveling through the mantle before we can figure out how P-waves are traveling through the core. In the mantle, the moment the P-wave begins to ascend, fluidity of the medium the P-wave is passing through will change from progressively decreasing to progressively increasing, the same type of reversal we would experience when scuba diving.

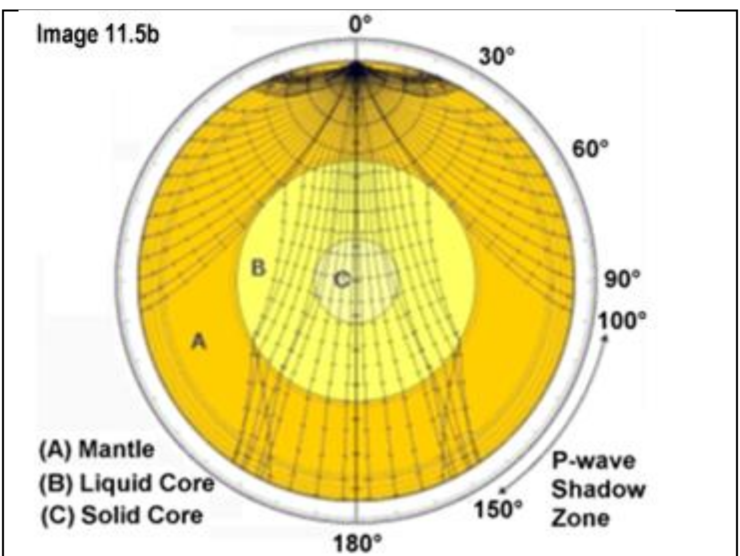
In the case of P-waves, if fluidity decreases with a corresponding increase in depth, then the opposite must occur when ascending. With a progressive increase in fluidity, the P-wave path of travel would follow a concave curve. the opposite of convex.

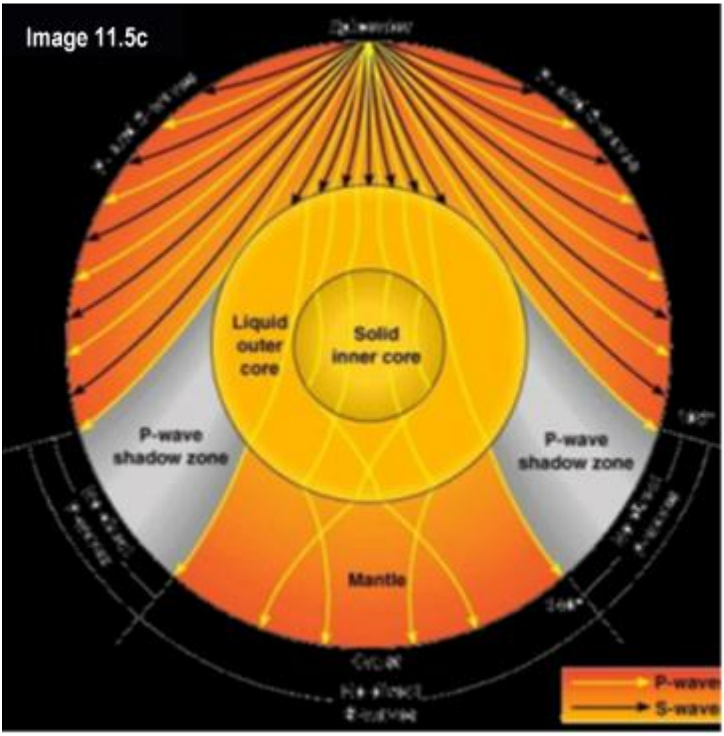
All depictions scientists use to portray the P-wave path of travel through the interior of the Earth fail to portray that reversal. Because of that failure, all images used to portray the P-wave path of travel must be invalid. For the moment, we can completely ignore any projections of P-wave travel into the core. Until P-wave path of travel in the mantle is properly projected, we can't claim to know anything about how P-waves travel through the Earth's core.

See the following three images. They are all invalid projections of P-wave path of travel through the interior of the Earth.

Images 11.5 (a,b,c), P-wave Path of Travel through the Interior of the Earth **(three images)** [iii]







Disproving Inge Lehmann's research as to how P-waves travel through the interior of the Earth's interior shouldn't affect most current day applications of Seismology. Current-day applications mainly apply to the Earth's crust and should remain unaffected by such a finding. Credit should still go to Inge Lehmann for the extensive amount of research she did involving Seismology. That may also be why no one has countered those claims over the past hundred years or so. We don't have the ability to build a model or descend more than a few miles into the depths of the Earth's interior.

Image 11.6 [iv] P-wave Analysis

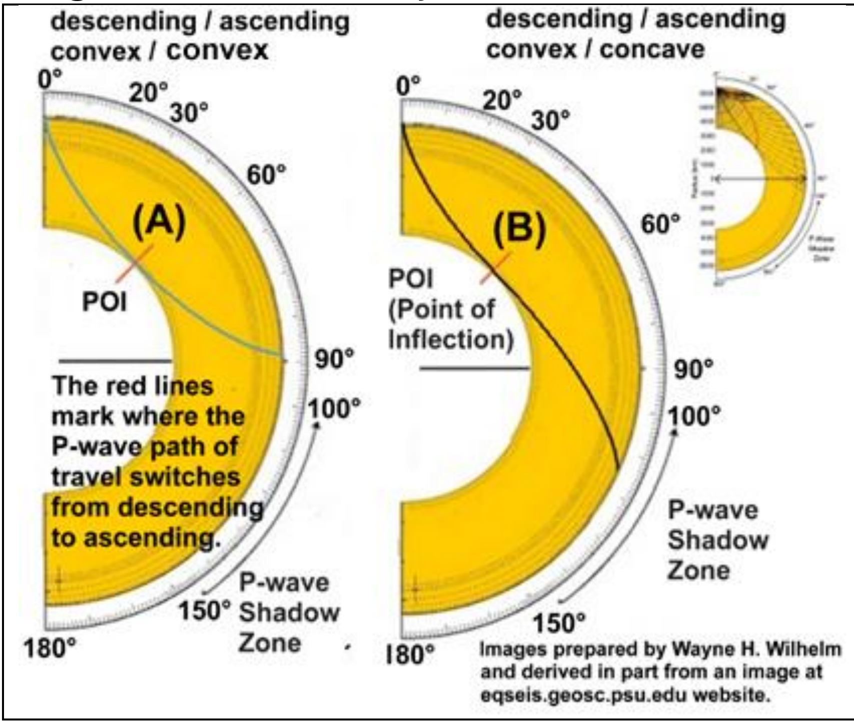


Image 11.6 (A) is Inge Lehmann's portrayal.
Image 11.6 (B) is **CG on Science's** portrayal.

In **Image 11.6**, a red line marks the POI (point of inflection). The POI is meant to portray the point at which the P-wave path of travel switches from descending to ascending inside the mantle. The moment that reversal occurs, the progressive change in fluidity of the medium through which the P-wave is traveling will reverse. Instead of the progressive change in fluidity continuing to decrease, the progressive change in fluidity would begin to increase. With the progressive change in fluidity increasing, the P-wave path of travel through the mantle would switch from being convex to concave **(Pg. 19) Image 11.6 (B).**

The portrayal is that of the interior of the Earth where 0° is the hypocenter of an earthquake. A P-wave descends from the earthquake's hypocenter into the interior of the mantle. As the P-wave descends, there's a progressive change in fluidity of the medium the P-wave is passing through which is depicted as causing the P-wave path of travel to be convex relative to the center of the Earth. The portrayal as convex is due to the belief (claim by Inge Lehmann), that fluidity of the material through which a P-wave is passing decreases with a corresponding increase in depth. At the POI, the progressive change in fluidity should reverse with the P-wave path of travel becoming concave.

(Pg. 19) Image 11.6 (A) shows a progressive change in fluidity of the medium through which the P-wave is passing as producing a convex curve relative to the center of the Earth, both while descending and ascending. **In (Pg. 19) Image 11.6 (B), t**he Image shows the progressive change in fluidity as producing a convex curve while descending, then when the P-wave path of travel begins to ascend, the P-wave path of travel is depicted as being concave.

Ask yourself, "***Should the 2nd half of a P-wave path of travel switch from convex to concave after reaching the POI (point of inflection)?***"

If the second half of the P-wave path of travel was switched from convex to concave, the P-wave path of travel would end up in the Shadow Zone. We know that isn't possible because seismographs in the Shadow Zone aren't detecting any P-waves. With that in mind we must ask: What's truly going on with the P-wave's path of travel inside the mantle?

Alternative Hypothesis

Reconsider the possibility that despite there being a P-wave Shadow Zone, P-waves emitted by a hypocenter and detected by seismographs scattered across the globe, were traveling through the crust of the Earth, not the Mantle or Core. Presume that any P-waves descending into the interior of the Earth dissipate without re-appearing at the surface of the planet. As to the Shadow Zone, this hypothesis proposes P-waves momentarily go deeper at the edge of the Shadow Zone, becoming undetectable, then reappear at the far side of the Shadow Zone.

CG on Science is not talking about magic.

A P-wave expands outward, concentrically, from a hypocenter. That P-wave travels along the Earth's crust. As the P-wave's perimeter expands further, the slope of the tangent to the P-wave's direction of travel progressively tilts forward with the slope causing the P-wave’s path of travel to follow a concave curvature. If you wonder how the perimeter of an expanding P-wave can change course, what changes course is a line drawn perpendicular to point of tangency of a line drawn tangent to that curve. A progressive change in slope of that tangent line can be enough for a P-wave's path of travel to slowly become deeper into the Earth's crust. The slope is what determines how deep a P-wave travels, and where (if ever) that P-wave will reappear on the surface of a planet.

Image 11.7 Hypothesis

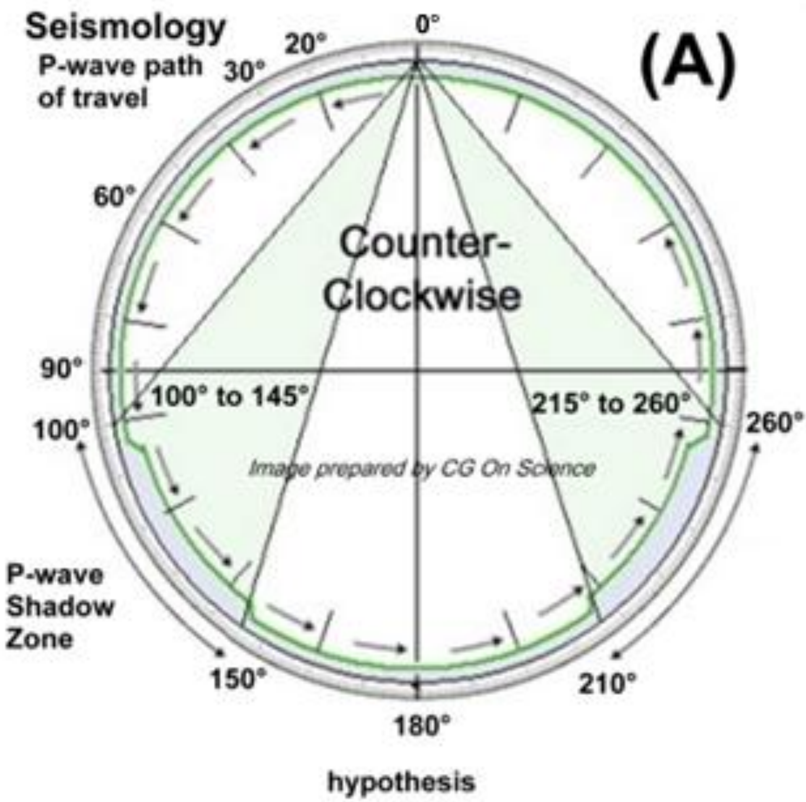
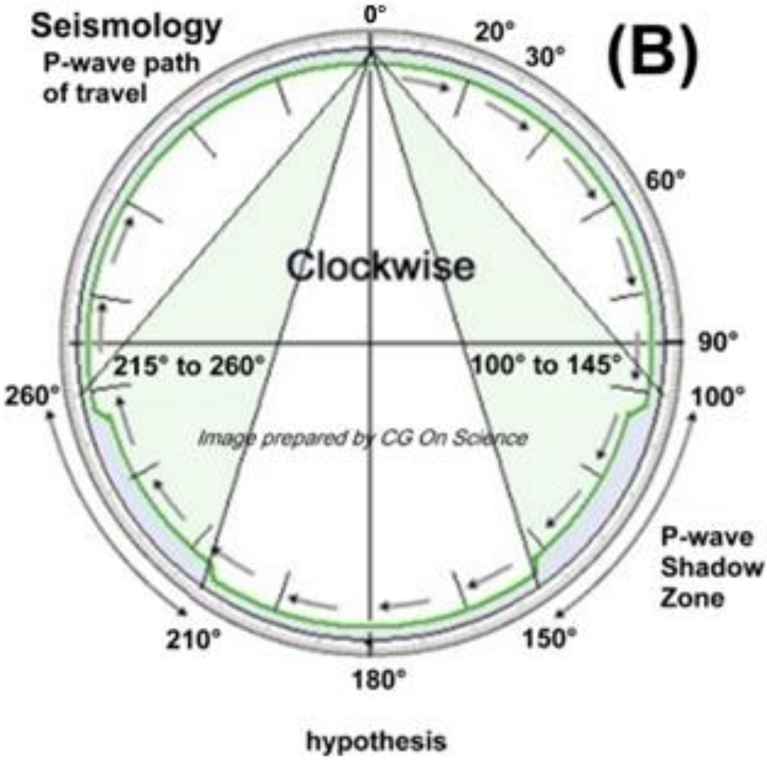


Image 11.8 Hypothesis



In this scenario, traveling around the Earth's perimeter (crust) would be concave [relative to the center of the Earth]. By the time the P-wave reaches the Shadow Zone, the slope of the path of travel can have caused the P-wave to have progressively descended to being just below the P-wave Shadow Zone; too deep to be detected by seismographs but not deep enough to cease to exist.

With that descent, by the time the P-wave reaches the Shadow Zone, the slope '*rate of change*' would escalate. That escalation would cause the P-wave path of travel to flip becoming convex, but still too deep to be detected by seismographs. Shortly after becoming convex, the P-wave path of travel would reach a new POI and switch back to concave. This time, although concave, the slope would be shallow enough to enable the P-wave to come within range of seismometers at the far side of the P-wave Shadow Zone.

Note the arrows **(Pg. 23) Image 11.7 (A)** and **(Pg. 24) Image 11.8 (B)**. There are two images. Both are what you have if you cut the planet in half. Technically, any P-wave from a hypocenter simultaneously travels in all directions. There are two images because the P-wave's path of travel can overlap. P-waves spreading to the left travel counterclockwise away from the hypocenter. In the other image, P-waves spread clockwise away from the hypocenter. Note the 180° mark on the side of the Earth opposite the hypocenter. The 180° mark doesn't end the P-wave's path of travel. We don't know how much further the P-wave can travel. Theoretically, if the P-wave is traveling through the Earth's crust along the perimeter, the P-wave might travel the globe multiple times. That might seem unlikely. It’s still a possibility we must consider. Careful analysis of seismograph data from seismometers around the planet should enable us to figure out how far.

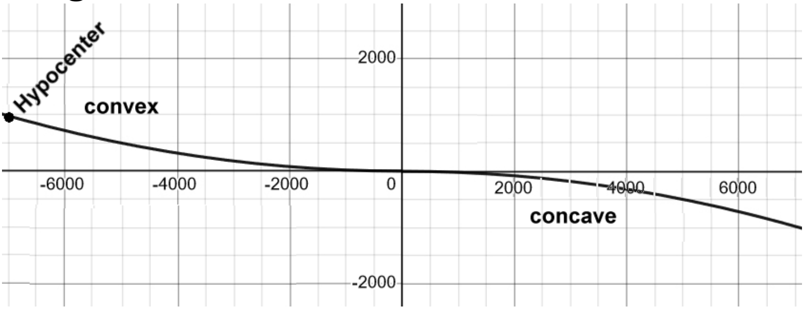
As to P-waves in the interior of the planet, there's no evidence P-waves can travel through the molten interior of a planet, from one side of the planet to the other. Interpretations of seismograph data used by scientists to establish the P-wave path of travel through the interior of the planet are all invalid. The seismograph data is valid. The interpretation of what that data means is what is invalid.

The Math

Image 11.9 P-wave convex / convex curve

In **Image 11.9,** the (x,y) point of (0,0) would mark the POI (Point of Inflection). That's the point at which the P-wave path of travel should switch from descent to ascent. The moment the P-wave path of travel begins to ascend, the progressive change in fluidity reverses. That reversal would cause the P-wave path of travel to switch from convex to concave (a reversal shown in Image 11.9).

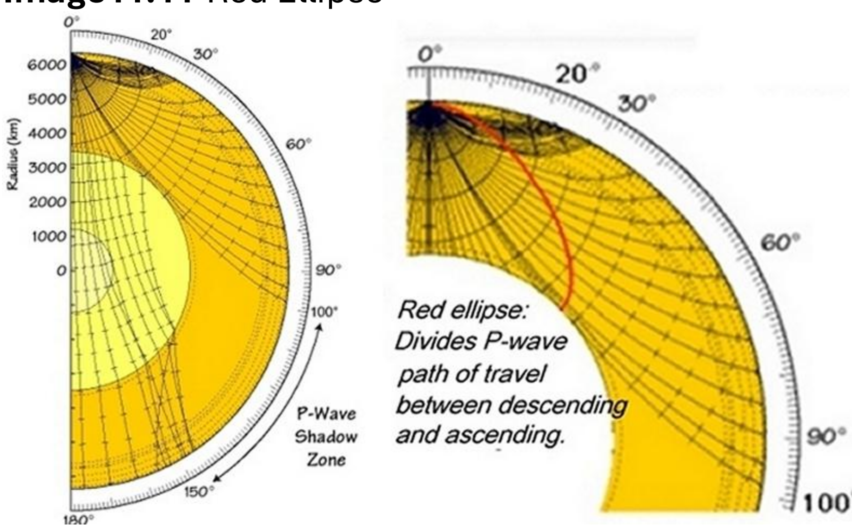
Image 11.10 P-wave convex / concave curve



In **(Pg. 27) Image 11.10**, after the P-wave path of travel reaches the POI, the P-wave path of travel is shown as switching from convex to concave, which is what should be happening, if seismic P-waves did indeed travel through the interior of the Earth.

Image 11.10 describes the P-wave's path of travel in the interior of the Earth's mantle. P-prime (P') is when a P-wave travels into the Earth's central core. For this chapter, P-wave travel is only being discussed as to what occurs in the mantle.

Image11.11 Red Ellipse [III]



Until we correctly portray how a P-wave travels through the mantel, we can’t claim to know how the P-wave is traveling through the core. For that reason, the core has been removed from most of these images.

Image 11.12 P-wave Analysis, Interior of the Earth

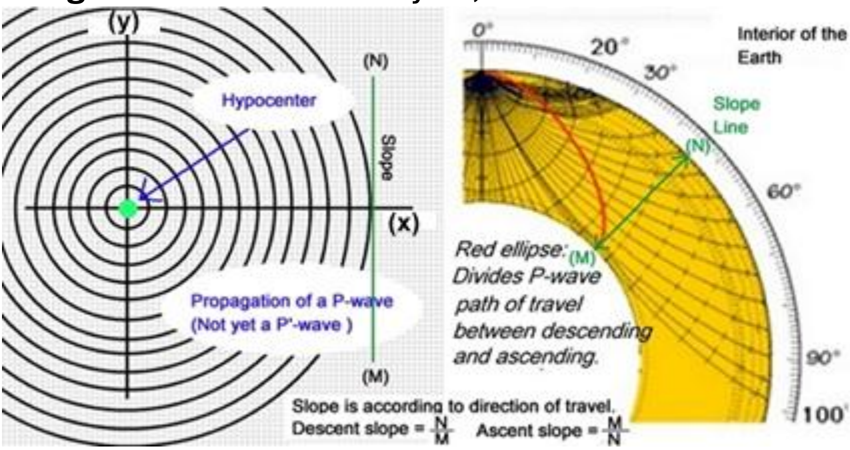
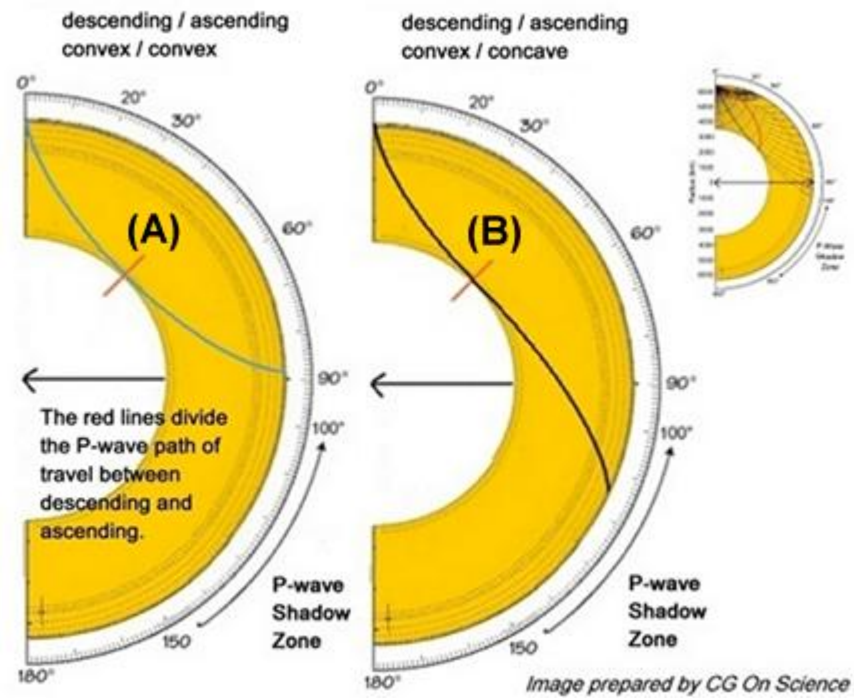


Image 11.12 shows two images. The first image shows P-waves traveling from an earthquake's hypocenter, with the green dot at the center being the hypocenter. If you were to overlay that image over the second image with the green dot at 0°, that would give you a better idea of how P-waves spread outward. In the 2nd image, a green line marked (N) <> (M) has been added to help explain the effects of a variable slope.

The red line is the POI for each of the lines portraying the P-Wave's path of travel through the mantel. The green line would be tangent to the P-wave's path of travel. The green line represents the direction of when a progressive change in fluidity is occurring, as to whether the P-wave is descending into the interior of the mantel or ascending back to the Earth's surface, where waiting seismographs will record the P-wave.

Image 11.13 P-wave Analysis



When descending deeper into the mantle, the slope of the P-wave path of travel varies. When traveling deeper into the Earth's mantle (descent), (N) is the numerator with (M) being the denominator. With ascent, (M) is the numerator with (N) being the denominator.

Descent slope = N/M   Ascent slope = M/N

Reference **(Pg. 29) Image 11.12**. If fluidity of the medium through which a P-wave is passing decreases with descent, the velocity of the P-wave for (N) is slower (above - shallower), with the velocity of the P-wave for (M) being faster (below - deeper). This forces a backward slant ‘\’ on the slope of the direction of travel of the P-wave. A backward slant on the slope (tangent) of the P-wave path of travel causes the path of travel to follow a convex curve relative to the center of the Earth.

When the P-wave path of travel reaches the POI, a change from descent (into the depths of the mantel) reverses, resulting in the P-wave path of travel ascending. However, the moment the ascension begins, fluidity reverses from decreasing to increasing. With an increase in fluidity, the slope of the tangent changes from N/M to M/N. A slope of M/N, with (M) being faster and (N) being slower, the slope acquires a progressively increasing forward slant ‘/’. A progressively increasing forward slant on a P-wave’s path of travel produces a concave curve relative to the center of the Earth as portrayed in **(Pg. 30) Image 11.13 (B)**.

All of this is dependent on the claim fluidity decreases with an increase in depth. If fluidity increases with depth, the P-wave path of travel in the mantel would be concave from the onset. If the P-wave path of travel is concave from the onset (traveling concentrically from the hypocenter), the P-wave path of travel would have a limited ability to descend into the Earth’s mantle. Any P-wave descending into the fluid interior of the planet would dissipate and disappear. Being concave, the P-wave would instead travel around the perimeter of the Earth’s crust never venturing into the deeper depths of the planet.

This completes this discussion on Seismology

About the author...

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CGonScience

CG stands for Curious George. An autodidact. A 1972 graduate of Crestview Local High School. A 1974 graduate of YSU. Joined Mensa in 2008.

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Portions of his research are published on AGM2M.org as well as Quora, and now Amazon Kindle.

CG on Science Publications

CG on Science on:

Astrophysics in the 21st Century	Book
Birth of a Hurricane	ePamphlet
Dark Matter in a Fluid Universe	ePamphlet
On Seismology	ePamphlet
On Significant Numbers	ePamphlet

(listing current as of 19 February 2025)

Simple principles having simple explanations.

For a complete listing of CG on Science publications, including direct links to where to obtain them, visit:

Website: https://www.CGonScience.com

Appendix

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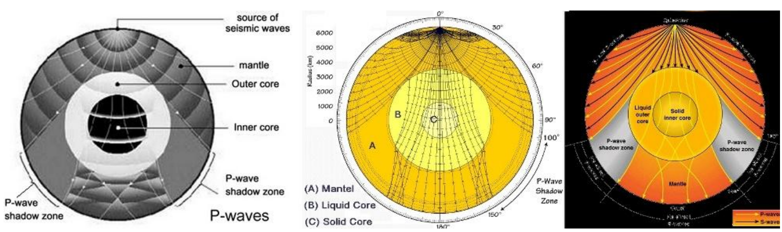
[i] https://www.amnh.org/learn-teach/curriculum-collections/earth-inside-and-out/inge-lehmann-discoverer-of-the-earth-s-inner-core

[ii] Image 11.4 (B) is also from https://www.amnh.org/learn-teach/curriculum-collections/earth-inside-and-out/inge-lehmann-discoverer-of-the-earth-s-inner-core

[iii] **Image 11.4 (a,b,c), P-wave Path of Travel through the Interior of the Earth**



#1 **Image 11.4** (leftmost chart image) **The text on the image was enhanced to make it more readable.** https://www.amnh.org/learn-teach/curriculum-collections/earth-inside-and-out/inge-lehmann-discoverer-of-the-earth-s-inner-core

#2 **Image 11.4** (center chart image) **The original image was only the right half of a circle (180°). Other enhancements were added as well.** http://eqseis.geosc.psu.edu/cammon/HTML/Classes/IntroQuakes/Notes/waves_and_interior.html

#3 **Image 11.4** (rightmost chart image)
https://www.cyberphysics.co.uk/topics/earth/geophysics/SeismicWavesEarthStructure.html

iv

http://eqseis.geosc.psu.edu/cammon/HTML/Classes/IntroQuakes/Notes/waves_and_interior.html