Module 2

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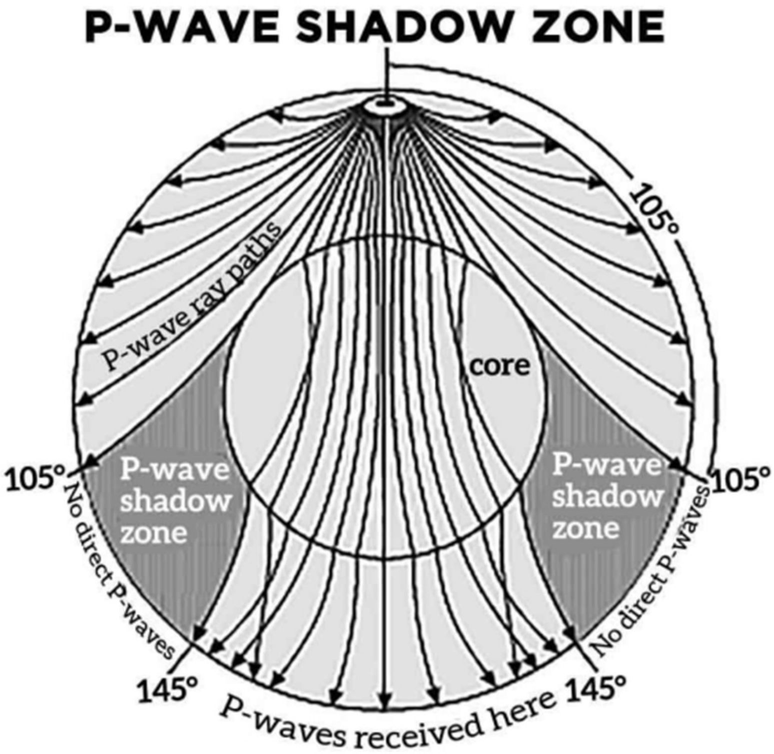
In the images below we see the Shadow Zones (places where P or S waves do NOT reach, respectively). We assume a planet's layers to be homogeneous—i.e. the density and stress moduli of material at a fixed radius from the center are the same for sections at all angles. Of course, there is difference between layers at different radii.

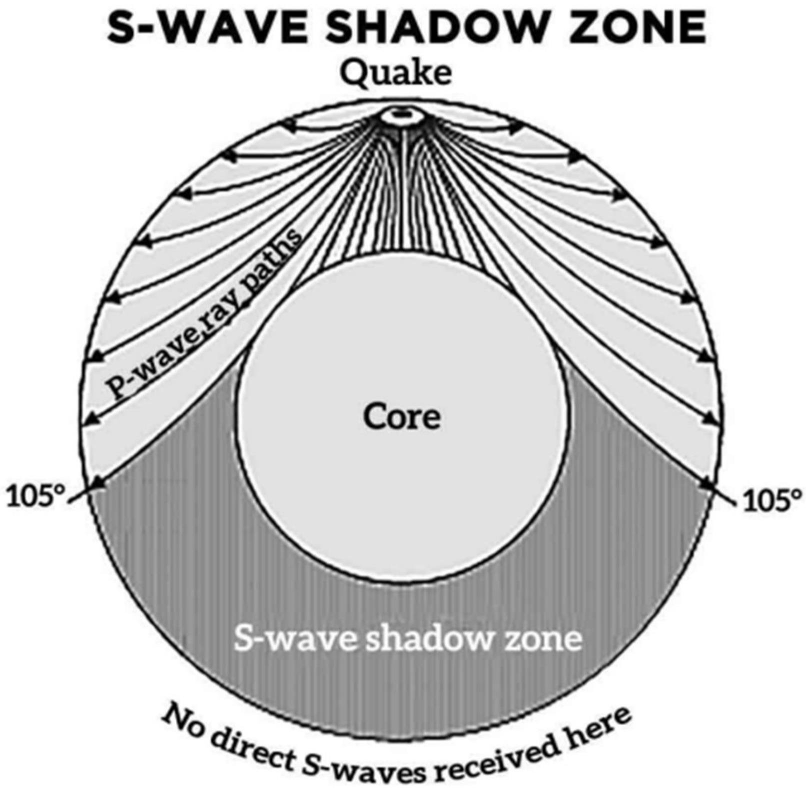
Applying Snell's law thus predicts that from the hypocentre of earthquake close to center, waves should travel from that point through a 1. continuous zone the edge circle of which subtends a certain angle at the centre with the hypocentre-line 2. another set of waves that meets the core and continues through that straight to the other side, roughly a cone bracketing the core extended to the surface of the planet.

And this is indeed what we see; for P-waves.



The shadow zone of P-waves is thus between the subtensions at the center of two angles of the hypotenuse to the zone.

However, in many (most) planets, the S-wave Shadow zone also encompasses the part opposite the core which is the surface projection of the base of the conical bracket of the core.



In the previous slide, we have already answered why. In young planets (younger than 6 billion my) the core is liquid. A liquid has NO shear strength because it is a fluid, conforming to its container. A strain causes no stress, but free displacement. And S-waves, which are shear waves cannot pass through fluids.

Thus the presence of the S-wave shadow zone with the extra part on the opposite side indicates the planet has a liquid core. This is exactly how we historically found out the Earth has a liquid core.

Conclusion: The absence of S-waves (shear waves) on the opposite side of a planet indicates a liquid core.