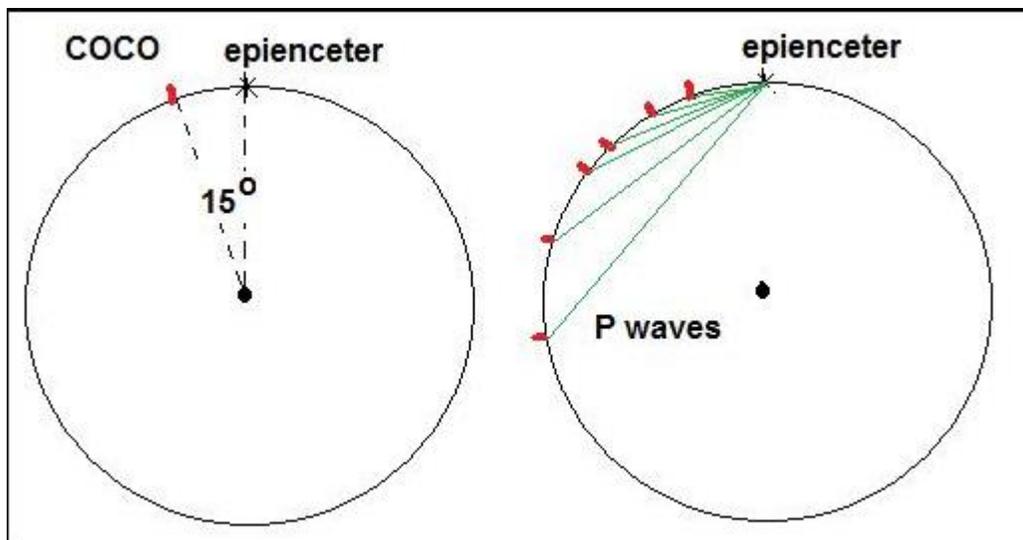


## Introduction:

The seismic waves produced from the December 26, 2004 earthquake that shook the Indian Ocean were recorded all over the world. You are provided with data from 20 stations which recorded waves, distributed at distances between 0 and 180 degrees from the epicentre.

### Part 1: Determining the Shadow Zone

1. Use a compass to draw a circle (1/2 page) to represent a cross section of the Earth, and mark a star at the top as 0 degrees, the epicentre of the earthquake.
2. On the left hand side of the cross section, use a protractor to mark the location on the circle of all the stations that recorded P waves (see the data below). (For example COCO is 15° from the epicentre. To locate COCO measure 15° to the left of the epicentre.)



Method for measuring the angle from the epicentre, and the seismic wave motion for the stations receiving the waves.

3. On the right hand side mark all of the stations that recorded S waves.
4. As a general approximation we can assume that the seismic waves travel through the Earth in a straight line. Draw a straight line from the epicentre location to the station that recorded the waves.
5. With many different samples of data from different earthquakes around the world, scientists have deduced the core to be approximately spherical. We know that S waves do not travel through liquids, which is the boundary of the outer core. Use a compass to draw the largest circle possible (from the centre of the Earth) without crossing an S wave. This is the outer core.

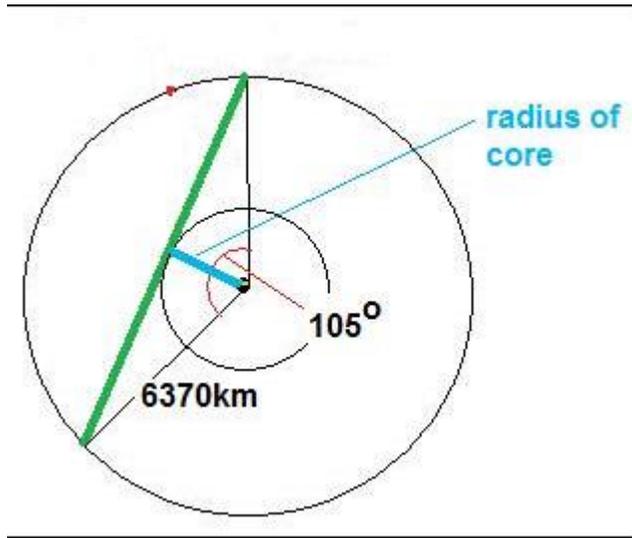
### Data for wave arrivals at the different stations:

COCO (Cocos Islands), 15° from epicentre	P= yes	S= yes
DGAR (Chagos Islands), 26° from epicentre	P= yes	S= yes
ENH (Hubel Province, China), 30° from epicentre	P= yes	S= yes
BJT (Beijing, China), 41° from epicentre	P= yes	S= yes
GUMO (Marianas Islands), 50° from epicentre	P= yes	S= yes
CTSO (Australia), 55° from epicentre	P= yes	S= yes
MBAR (Mbarara, Uganda) 65° from epicentre	P= yes	S= yes
LSZ (Lusaka, Zambia) 69° from epicentre	P= yes	S= yes
SUR (Sutherland, S. Africa), 79° from epicentre	P= yes	S= yes
SBA (Scott Base, Antarctica), 89° from epicentre	P= yes	S= yes
COLA (Alaska), 98o from epicentre	P= yes	S= yes
KIP (Kipapa, Hawaii), 104° from epicentre	P= no	S= no
PMSA (Palmer, Antarctica), 117° from epicentre	P= yes	S= no
COR (Corvallis, Oregon), 121° from epicentre	P= yes	S= no
RCBR (Riachuelo, Brazil), 132° from epicentre	P= yes	S= no
CCM (Missouri, USA), 138° from epicentre	P= yes	S= no
HKT (Hockley, Texas), 145° from epicentre	P= yes	S= no
TEIG (Yucatan, Mexico), 156° from epicentre	P= yes	S= no
JTS (Costa Rico), 166° from epicentre	P= yes	S= no
PAYG (Galapagos Islands), 173° from epicentre	P= yes	S= no

### Part 2: Discussion

1. What happens to the S waves around 100 degrees from the epicentre? What conclusions could you make regarding the material beyond 100 degrees?
2. The shadow zone is the area where no P and S waves are recorded. Label and shade in this region on your cross section. Research and explain why it exists.
3. Research and describe what the Moho boundary is.

## Extension



We know that the Earth has a radius of 6 370 km. How could you calculate the size of the Earth's core if the shadow zone starts at 105 degrees? Use the diagram to the left (hint: it could be calculated using a right triangle).