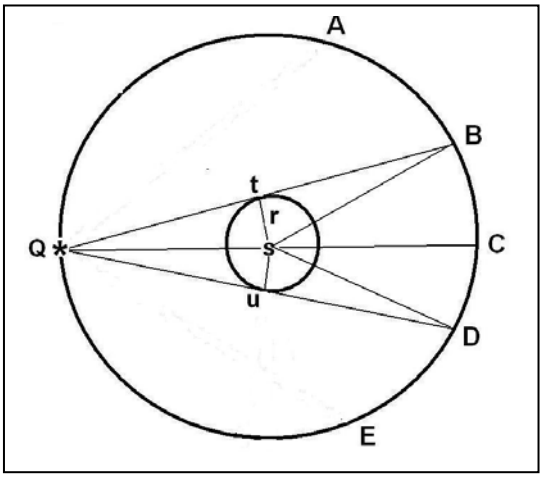
Sometimes old data can uncover new secrets! Four seismometers were deployed by Apollo astronauts between 1969 and 1972. They were able to record continuous lunar seismic activity until late-1977.

A detailed mathematical analysis of this data reveals that the seismic data are consistent with a model in which the moon has a solid, iron-rich inner core and a fluid, primarily liquid-iron outer core. The core contains a small amount of elements such as sulfur, which is a composition similar to the core of our own Earth.

The analysis they used can be shown with a simple geometry problem:



Suppose a 'moonquake' occurs at Point Q in the figure. Its shock waves travel along the chords from Q to the various seismometers located at points A, B, C, D and E. In addition:

1 - The radius of the moon, R has a length of 1,738 km.

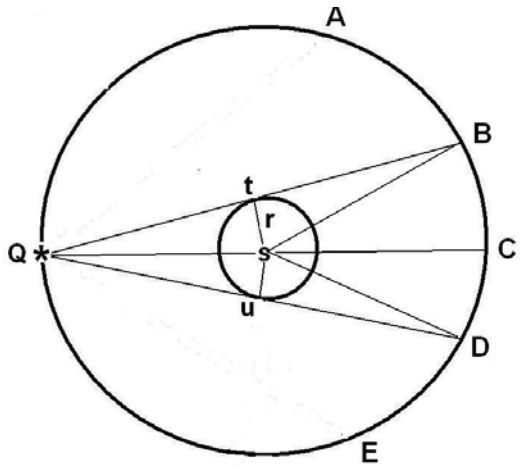
2 - The radius of the core, r, is defined by the segment **ts**.

3 - Angles **Qts** and **Qus** are right-angles.

Basic Seismology: An earthquake generates two kinds of shock wave signals called P-waves and S-waves. When rock is compressed like a sound wave, it produces a pressure wave called the P-wave along its direction of travel. When it moves from side-to-side perpendicular to its direction of travel, it is called a shear wave or S-wave. Although P-waves can travel through a liquid, S-waves are strongly reduced in strength, or sometimes absent all-together.

Suppose on the moon, Stations A and E record normal seismic S and P-wave signals, however, Stations B and D record signals in which the S-wave is slightly reduced in strength compared to Station's A and E. Station C records P-waves but no S-waves. Assume that Station C is in the shadow zone of the liquid lunar core, and that Stations B and D define seismic signals grazing the outer edge of a hypothetical lunar liquid core. Stations B and D are separated by 900 km along the lunar surface.

Problem 1 - From the figure above, and your knowledge of the properties of inscribed arcs what is the radius in kilometers of the core, r, based on this seismic date?



The arc, BCD = 900 km.
Qs = R = 1,738 km

Angle BsD = 360 x (900 km/ 2πR)
= 360 x (900 km / 10918 km)
= 30 degrees

Angle BsC = 15 degrees

Angle BQC = 1/2 Angle BsC = 7.5 degrees

Angle BQC = Angle tQs

Segment st = r

Then:

Sin (Angle tQs) = r/R

r = R sin(7.5 degrees)

r = 1,738 (0.13)

r = 226 km.