WAVE SPEED

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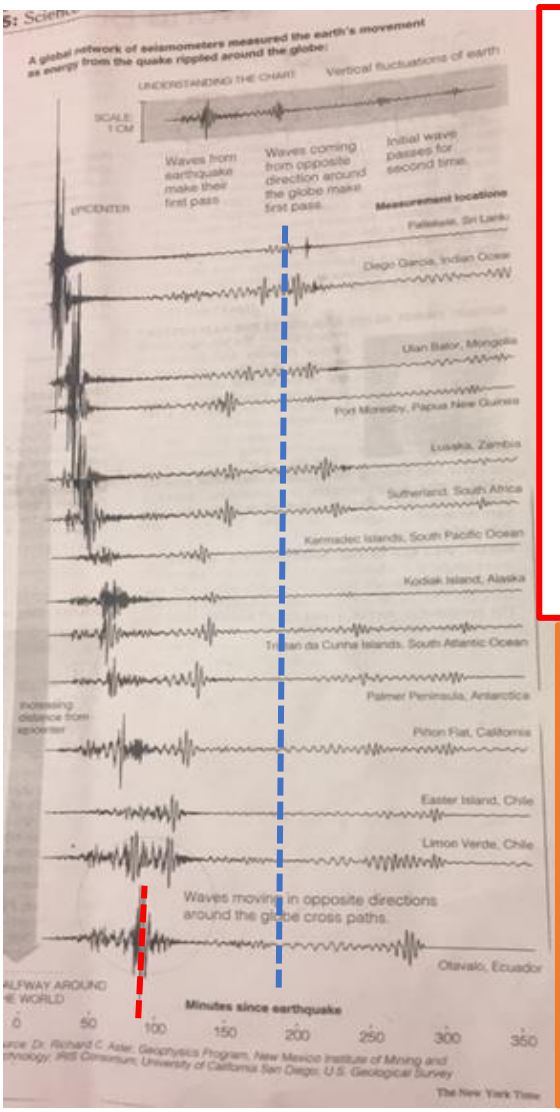
ASIA'S DEADLY WAVES: SCIENCE; Quake's Echo Raised Surface Around Globe New studies of the giant earthquake that produced devastating tsunamis in the Indian Ocean show that its **shock waves ricocheted around the globe for hours and lifted the earth's surface nearly an inch even half a world away.** ''They're **like ripples in a pond,'' Dr. Richard C. Aster, a geophysicist at the New Mexico Institute of Mining and Technology, said yesterday. ''But the pond is a sphere, so they keep going around and around.''** Dr. Aster, who compiled seismograms to measure the shock waves at increasing distances from the quake's epicenter, **said the waves were 1,000 times the size of those that seismologists customarily measure. The colossal jolt struck Dec. 26 off the west coast of northern Sumatra, and the shock waves radiated out through the earth's rocky interior, traveling faster than waves do in air or water.** Dr. Aster used data gathered by a global network of seismometers run by the Incorporated Research Institutions for Seismology, or IRIS, a consortium based in Washington that is financed mainly by the National Science Foundation. **Dr. Aster said that even in Ecuador, the shock wave displaced the earth's surface more than two centimeters, or nearly an inch, but the movement was too slow to be perceptible to humans.** The jolt was much sharper in Pallekele, Sri Lanka, and shook the ground over a range of nearly four inches, he said. Waves from the quake weakened as they bounced around the globe but were still discernible after making a complete loop. The seismogram from Tristan da Cunha, a group of British islands in the South Atlantic, shows the main wave arriving after a little more than an hour, then two smaller ones that circled the earth in two directions arriving after about 120 minutes and 230 minutes.



INTRODUCTION: Objective of this application is to find speed of this earthquake wave. Sri Lanka is very close to Sumatra where quake happened. Circumference of earth at equator is 40,075 km. We will consider finding wave speed at Sir Lanka and Ecuador, both close to equator using time of arrival from left chart.

QUESTIONS: (a) As stated in lower left of chart, Ecuador is halfway around the earth. As indicated by red line the wave first arrived there in 90 min. Find speed of wave in km./s.?, (b) Sri Lanka is very close to Sumatra where quake happened. As indicated by the blue line the waves coming from opposite direction around entire globe make first pass in 180 min. Find wave speed (in km./s.) using Sri Lanka data?,(c) How well does your calculations compare with wikipedia speed of S waves in box below?

HINTS: 60 seconds/ min. , x = v t

ANSWERS: (a) 3.71 km./s., (b) 3.71 km./s., (c) 3 to 4 km./s. is typical speed of S longitudinal quake waves.

Earthquake waves are of two types: P & S waves. Earthquakes do not occur below 700km inside Earth, and most of them occur in the top 200km inside Earth. Here, P-waves are the fastest, and travel at around 7-8 km/s. S-waves travel at around 3-4 km/s.

S waves:
Surface **waves** in **earthquakes**can be divided into two types. The first is called a Love **wave**. Its motion is essentially that of S **waves** that have no **vertical**displacement; it **moves the ground from side to side in a horizontal plane but at right angles to the direction of propagation.**