PRACTICAL 4: IDENTIFICATION OF SEISMIC BODY AND SURFACE WAVES

The figure on page 3 shows recordings of an earthquake near the South Sandwich Islands on 30 January 1987 at the Bangui seismograph station (BCAO) in the Central African Republic. The traces display, from top to bottom, the long-period vertical, radial and tranverse ground motion. The radial and transverse components are derived from the north-south and east-west seismograms. A positive radial motion (upwards on the second panel) is away from the source and a positive transverse motion (upwards on the third panel) is anticlockwise relative to the source. The time scale is in minutes after the origin time of the earthquake ($22^h \, 39^m \, 39.8^s$ UTC, UTC = Coordinated Universal Time). The seismograph station is $73.50°$ (geocentric degrees) from the earthquake source. The figure on page 4 is an expanded plot of the first arrival on the three components.

The table below lists the travel times for P-waves and S-waves for a surface source extracted from the 1991 IASPEI Seismological Tables.

Review the example of long period seismograms in lecture 4 before tackling the questions on the next page.

P AND S WAVE TRAVEL TIMES FROM A SURFACE SOURCE
from the IASPEI 1991 Seismological Tables

$\Delta°$	$t(P)$		t(S)	
	m	s	m	s
71.0	11	19.55	20	37.42
72.0	11	25.59	20	48.97
73.0	11	31.55	21	0.40
74.0	11	37.45	21	11.71
75.0	11	43.26	21	22.90

REFERENCE: B.L.N.Kennett (ed.), IASPEI 1991 Seismological Tables, Research School of Earth Sciences, Australian National University, Canberra.

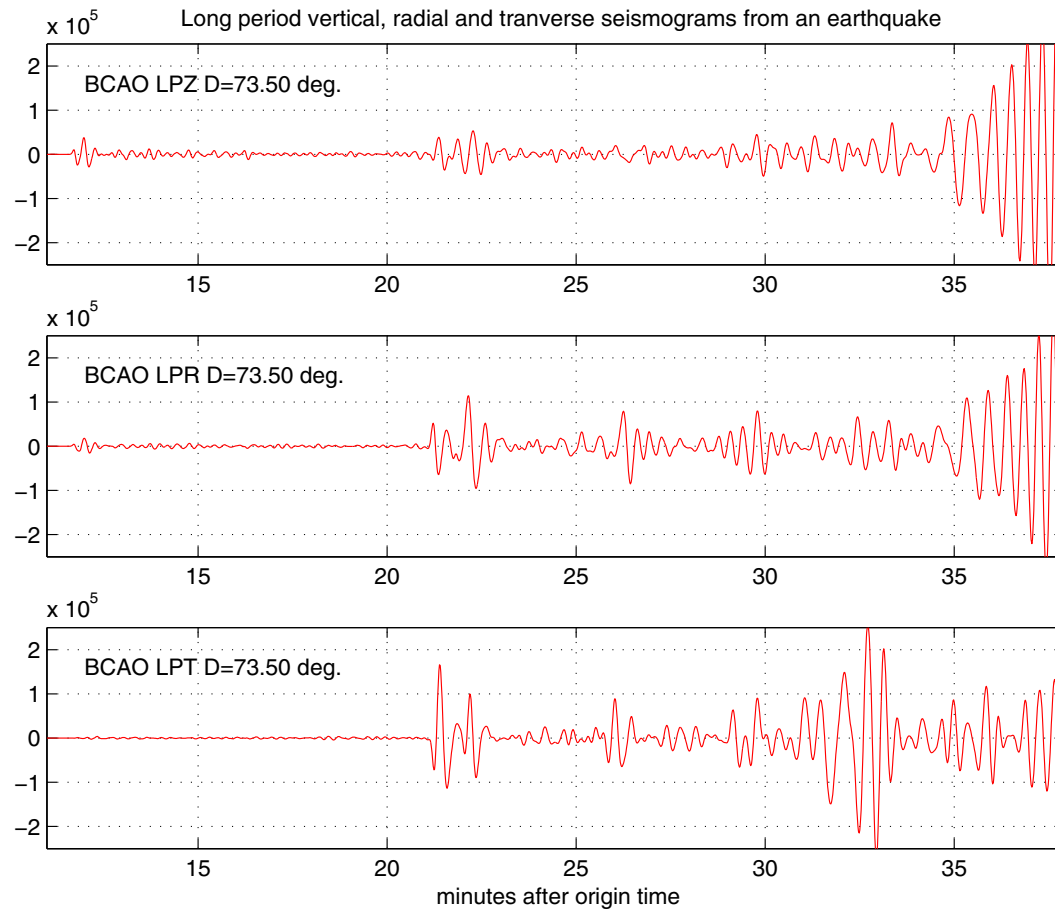## PRACTICAL 4: IDENTIFICATION OF SEISMIC BODY AND SURFACE WAVES

QUESTIONS:

(a) How do you expect P–waves, S–waves, Love (L) waves and Rayleigh (R) waves to record on the vertical, radial and transverse components of ground motion?

(b) The travel times of Love and Rayleigh waves of a given period are proportional to the distance travelled, i.e. plots of travel time against geocentric distance are straight lines. For the earliest Love and Rayleigh waves, these lines have slopes of 0.428 min/deg and 0.474 min/deg. Write down the travel time equations of the two surface waves in the form

$$(\text{travel time in minutes}) = (\text{slope}) \times (\text{distance in degrees})$$

Given that one geocentric degree corresponds to 111.2 km on the Earth's surface, what are the speeds of these two surface waves in km/s?

(c) Using the distance of the earthquake from the epicentre, calculate the expected travel times to BCAO of P–waves and S–waves from the travel time table to the nearest tenth of a minute, and calculate the travel times for Love (L) waves and Rayleigh (R) waves. Hence identify the P–wave, S–wave, Love (L) wave and Rayleigh (R) wave arrivals on the seismograms.

(d) Compare the observed ground motions with those predicted in part (a).

LONG PERIOD VERTICAL, RADIAL AND TRANSVERSE SEISMOGRAMS (1)

Long period vertical, radial and tranverse seismograms from an earthquake

LONG PERIOD VERTICAL, RADIAL AND TRANSVERSE SEISMOGRAMS (2)

Long period vertical, radial and tranverse seismograms from an earthquake

BCAO LPZ D=73.50 deg.

BCAO LPR D=73.50 deg.

BCAO LPT D=73.50 deg.

minutes after origin time