ESTIMATES OF CRUSTAL THICKNESS OF BAJA CALIFORNIA, SONORA AND SINALOA, MEXICO, USING DISPERSE SURFACE WAVES

Leobardo López-Pineda[1], Cecilio J. Rebollar[1] and Luis Quintanar[2]

[1]Centro de Investigación Científica y de Educación Superior de Ensenada, CICESE;

[2]Instituto de Geofísica, UNAM.

CICESE

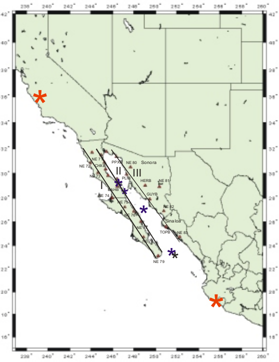

Fig. 1. This map shows the location of the seismic stations (NARS-Baja and RESBAN). Asterisks show the location of the earthquakes of magnitude greater than five that were used in the surface wave analysis. Transects I, II and III are depicted.

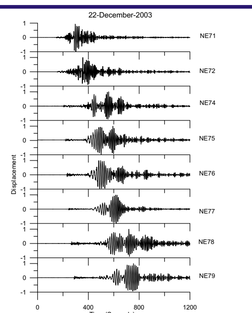

Fig 2. Rayleigh wave trains of the Paso Robles California earthquake of 22 December 2003, M_w=6.6.

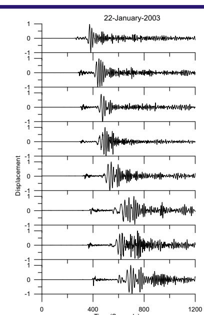

Fig 3. Rayleigh wave trains of the Tecoman Colima earthquake of 22 January 2003, M_w=7.4.

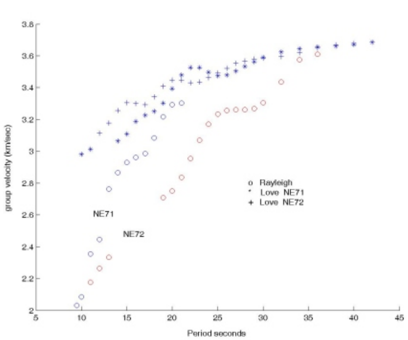

Fig 4. Dispersion of Love and Rayleigh waves of the Loreto earthquake of 12 March 2003, M_w=6.4 observed at the NE71 and NE72 seismic stations.

Abstract

Dispersed surface waves of regional events recorded at NARS-Baja and RESBAN networks located over the Baja California Peninsula, Sonora and Sinaloa, Mexico, were used to estimate shear wave elastic models and crustal thickness. We analyzed fundamental modes of surface waves with period between 10 and 40 seconds. Multiple filter analysis and the inversion described by Herrmann and Ammon (2002) was used. Crustal thickness estimated in the Peninsular Ranges of Northern Baja California agree with those obtained by previous studies. We analyzed dispersion of surface waves with northwest-southeast travel paths along the east and west of the Baja California Peninsula as well as a northwest-southeast travel path west of Sonora-Sinaloa Mexican states. It was found that the crustal structure east of the Baja California Peninsula is similar to the structure of Sonora and Sinaloa. The correlation between those two structures suggested that a distance of the order of 275±25 km separated them, if we consider Baja California Peninsula as a rigid body moving toward the northwest relative to the North America plate. This displacement between the structures agree with the displacement calculated with dating of Miocene deposits located in San Felipe Baja California Peninsula (Pacific Plate), and Isla Tiburon located west of Sonora (North America plate).

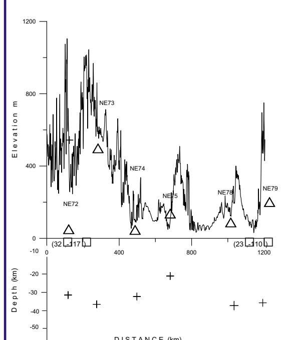

Fig. 5 Transect I located west of the Baja California Peninsula. Crosses indicate the Moho depth estimates and triangles are the seismic stations. Over the top is depicted the topography. Beginning and end of the transect are indicated by the geographic coordinates.

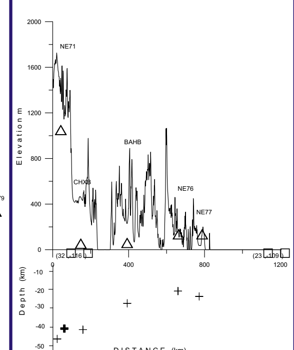

Fig. 6 Transect II located east of the Baja California Peninsula. Crosses indicate the Moho depth estimates and triangles are the seismic stations. The bold cross show the Moho depth calculated by Lewis et al. (2001). Over the top is depicted the topography. The beginning and end of the transect are indicated by the geographic coordinates.

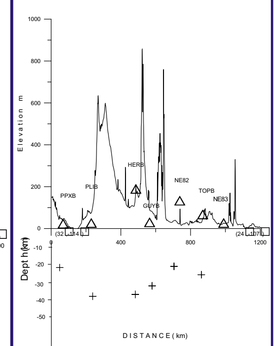

Fig. 7 Transect III located west of Sonora and Sinaloa. Crosses indicate the Moho depth estimates and triangles are the seismic stations. Over the top it is indicate the topography. The beginning and end of the transect are indicated by the geographic coordinates.

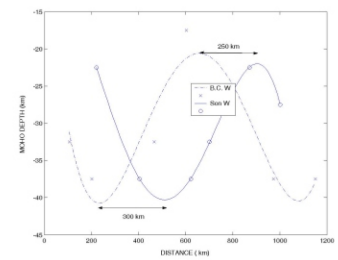

Fig. 8 Plot of transects I and III of Moho depth vs. distance. The fitting of the transect I is delineated with discontinues line and the fitting of transect III is delineated with continuous line. The misfit between both transects are depicted with arrows.

Date(Y/M/D)	Lat N	Lon W	Mw	Depth
03/10/02	23.32°	108.53°	6.5	10
22/01/03	18.77°	104.10°	7.6	24
12/03/03	26.61°	111.09°	6.2	5
12/11/03	29.16°	113.67°	5.4	5
22/12/03	35.71°	121.10°	6.6	7
18/02/04	23.64°	108.82°	5.9	10
24/09/04	28.57°	112.72°	5.9	10

Table 1. Earthquake located in Colima, Gulf of California and California used in the surface waves analysis.

Profile of shear wave velocities along transect I

Depth km	NE72	NE73	NE74	NE75	NE78	NE79
5	3.60	3.66	3.04	2.64	3.62	3.47
10	3.40	3.53	3.17	3.33	3.65	3.55
15	3.28	3.38	3.39	3.85	3.67	3.66
20	3.38	3.35	3.65	4.12	3.71	3.77
25	3.64	3.49	3.89	4.26	3.76	3.88
30	3.94	3.74	4.08	4.36	3.84	3.98
35	4.20	4.03	4.24	4.43	3.96	4.08
40	4.39	4.31	4.37	4.49	4.11	4.18
45	4.53	4.56	4.49	4.54	4.28	4.30
50	4.62	4.75	4.59	4.56	4.47	4.45

Profile of shear wave velocities along transect II

Depth km	NE71	CHXB	BAHB	NE76	NE77
5	3.44	3.40	3.15	3.15	3.13
10	3.51	3.45	3.30	3.32	3.38
15	3.57	3.51	3.51	3.59	3.66
20	3.61	3.57	3.74	3.89	3.89
25	3.62	3.63	3.95	4.14	4.09
30	3.62	3.72	4.12	4.32	4.25
35	3.66	3.84	4.26	4.44	4.39
40	3.75	4.01	4.37	4.52	4.51
45	3.93	4.22	4.47	4.57	4.59
50	4.21	4.47	4.56	4.60	4.65

Profile of shear wave velocities along transect III

Depth km	PPXB	PLIB	HERB	GUYB	NE82	TOPB
5	3.06	3.55	2.78	2.97	2.92	2.58
10	3.20	3.44	3.18	3.14	3.35	3.07
15	3.59	3.33	3.56	3.40	3.76	3.58
20	3.97	3.30	3.77	3.64	4.04	3.87
25	4.21	3.39	3.86	3.83	4.20	4.02
30	4.33	3.60	3.92	4.01	4.31	4.13
35	4.39	3.92	4.01	4.20	4.39	4.24
40	4.44	4.30	4.14	4.39	4.46	4.35
45	4.50	4.73	4.31	4.56	4.52	4.45
50	4.57	5.15	4.50	4.68	4.57	4.53

Table 2. Shear wave elastic models with minimum rms obtained from the inversion of surface wave dispersion along I, II and III travel paths. Bold shear wave velocities indicate Moho depth.