

A computer code for calculating velocity structure parameters using Rayleigh wave phase velocity dispersion data

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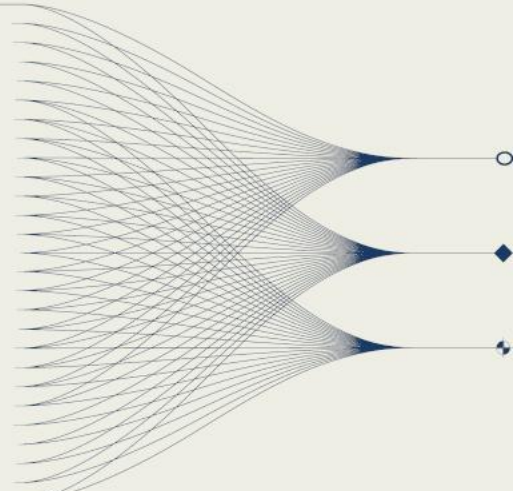
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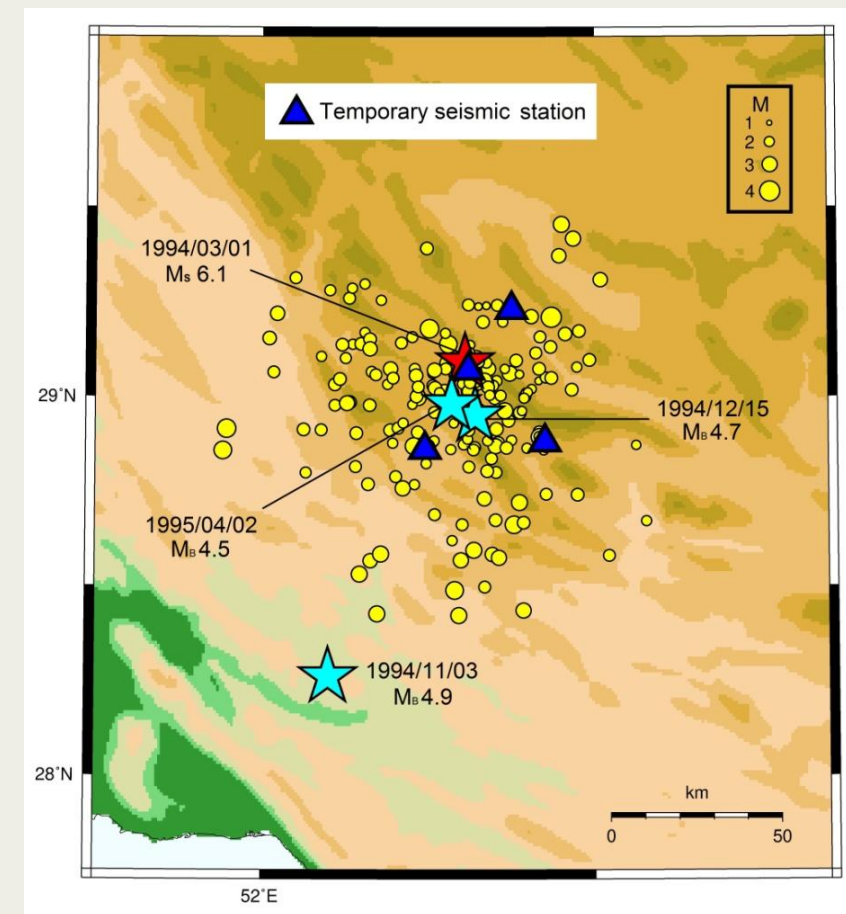
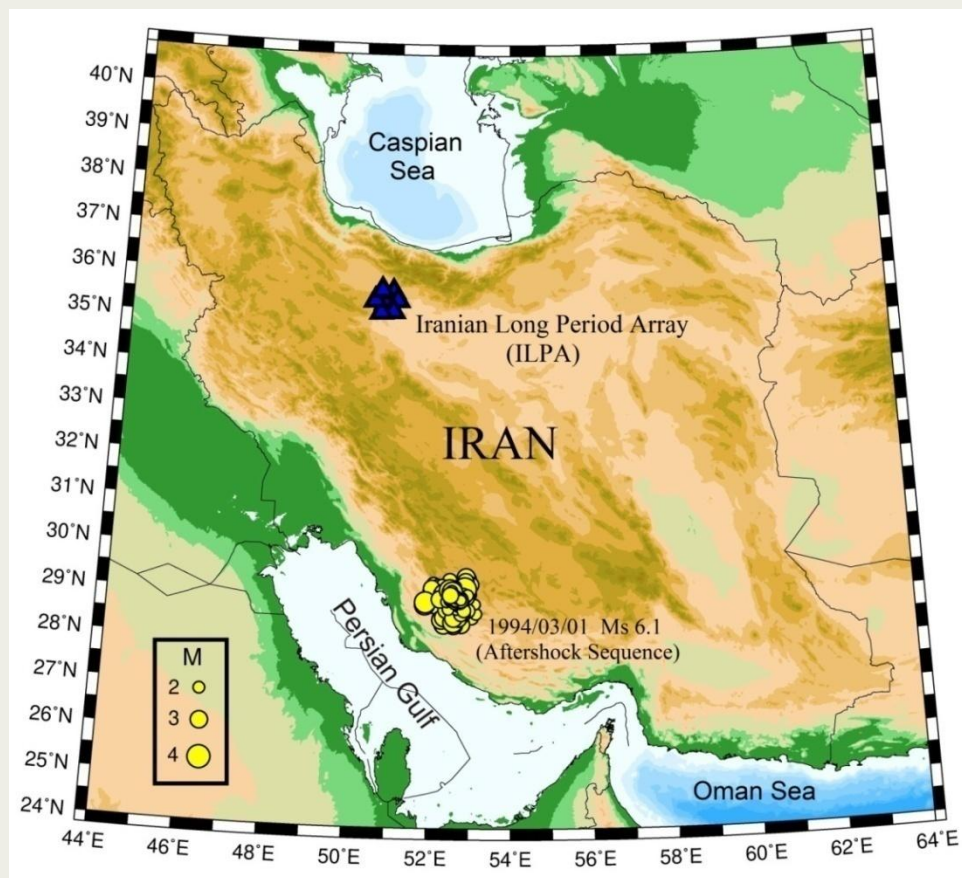
INTRODUCTION AND MAIN RESULTS

We developed a computer code to derive a crust and upper mantle velocity structure for southwest Iran (Firuzabad region) in the central Zagros by an application of the two-event, single-station method of Rayleigh wave phase velocity dispersion analysis. Three sets of digital recordings of large earthquakes in the Firuzabad region in 1994 and 1995 made at the Iranian Long Period Array (ILPA) were used to perform the spectral analysis. The observed Rayleigh wave phase velocity dispersion data then systematically inverted to obtain a best fitting model. The preferred model has a crustal thickness of 44 ± 2 km. The upper crust consists of a ~ 8 km thick sedimentary layer ($V_p \sim 5.15$ km/s) above a ~ 22 km thick upper crystalline crust ($V_p \sim 6.19$ km/s). The lower crystalline crust is unusually slow ($V_p \sim 6.75$ km/s) with a thickness of ~ 14 km. The total thickness of the crystalline crust in this region of the central Zagros (~ 36 km) is similar to the thickness of the stretched margin of the Arabian Platform, suggesting that the Zagros is now in an early stage of continental collision.



Firuzabad Region (Location and seismicity)

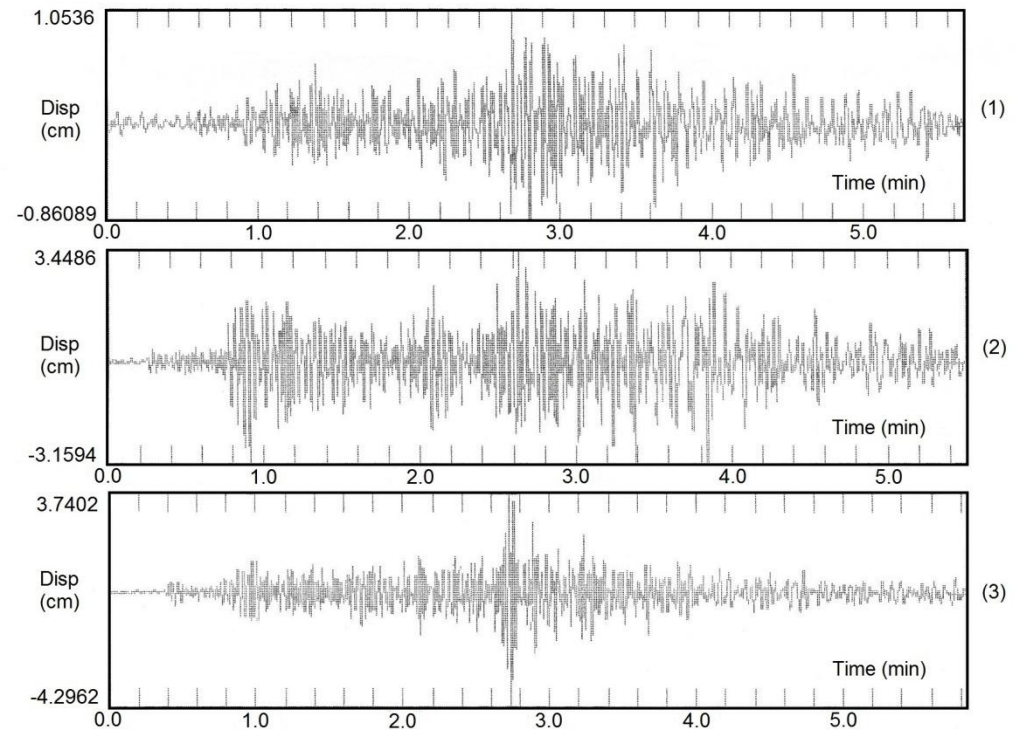
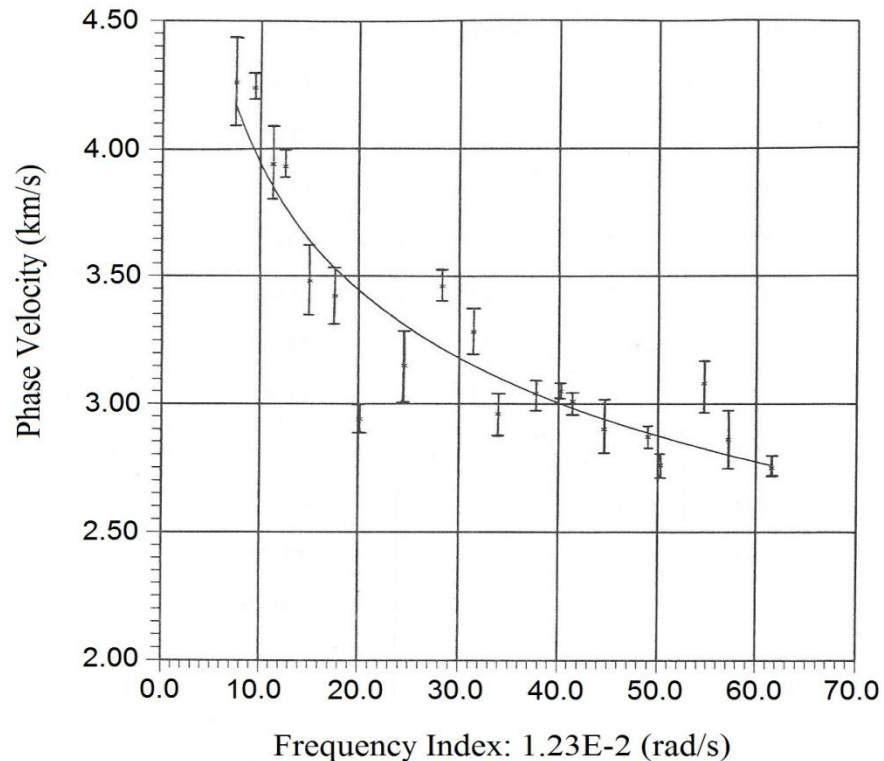
Firuzabad region (Fars province) is located southwest of Iran within the seismically active Zagros fold and thrust belt. On March 1st 1994, a large earthquake (M_s 6.1) occurred in this region and about a week of the aftershock sequence was recorded by a local temporary network of the Institute of Geophysics, Tehran University. Also three events including two aftershocks were recorded by the ILPA.



The two-event , single-station method

The methodology involves using two earthquakes recorded at a single seismic station to determine the phase velocity of Rayleigh waves. In this study by comparing the arrival times of Rayleigh waves from three events (1994/11/03, M 4.9; 1994/12/15, M 4.7 and 1995/04/02, M 4.5) in a combination of 3 sets of two earthquakes recorded at station No.1 of ILPA, the phase velocity dispersion was calculated (Farahbod & Gheitanchi, 1996).

Rayleigh Wave Phase Velocity Dispersion



Velocity model

The V_p/V_s ratio (the ratio of compressional to shear wave velocity) based on the aftershock sequence of March 1st 1994 estimated by least-squares regression as 1.773 ± 0.006 (Farahbod, 2025). Based on the methodology of Harkrider and Anderson (1962), we developed a computer code to invert the observed Rayleigh wave phase velocity dispersion data to obtain a best fitting model. The preferred model has a crustal thickness of 44 ± 2 km. The upper crust consists of a ~ 8 km thick sedimentary layer ($V_p \sim 5.15$ km/s) above a ~ 22 km thick upper crystalline crust ($V_p \sim 6.19$ km/s). The lower crystalline crust is unusually slow ($V_p \sim 6.75$ km/s) with a thickness of ~ 14 km. The total thickness of the crystalline crust in this region of the central Zagros is ~ 36 km.

Conclusions

The total thickness of the crystalline crust in this region of the central Zagros (~ 36 km) is similar to the thickness of the stretched margin of the Arabian Platform, suggesting that the Zagros is now in an early stage of continental collision.

References

- Harkrider, D.G. & Anderson, D.L., (1962). Computation of surface wave dispersion for multilayered anisotropic media, Bulletin of the Seismological Society of America, 52 (2): 321–332.
- Farahbod, A.M. & Gheitanchi, M., (1996). An investigation of earthquake activity in Firuzabad Fars area, Institute of Geophysics, Tehran University, 138 p.
- Farahbod, A.M., (2025). Crustal velocity structure of subduction zone vs. continental collision zone, case studies of western Canada and southwestern Iran (in prep).

