A recent shallow earthquake in the Corinth Gulf, Greece (M_w 5.3) generated unusual long-period waves (periods > 5 seconds) between the P- and S-wave arrival. The 5-second period, being significantly longer than the source duration, indicates a structural effect. Observed seismograms were examined by methods of the frequency-time analysis. Dispersion curves of the fast long-period (FLP) waves indicated group velocities ranging from 3 to 5.5 km/s for periods between 4 and 10 s, respectively, with large variations among the stations. The generalized dispersion curve splits into two major strips, probably related to lateral variations of the crustal structure. Forward simulations for several existing crustal models were made. A few partially successful models served for a sensitivity study, which showed that the FLP wave seemed to be mainly due to the low-velocity layers in the uppermost 4 kilometers of the crust. Finally the shallow crustal structure was retrieved by inverting observed seismograms by Neighborhood algorithm. The inversion confirmed that the FLP wave in seismograms at more than a single station cannot be explained with a 1-D crustal model. The path-dependent models provided a partial explanation for the strips revealed in the experimental dispersion curves. An alternative explanation is by contribution of several leaking modes.