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Mode-2 internal solitary waves offshore Central America discovered by seismic oceanography method

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In the past, most of the internal solitary waves (ISWs) found by seismic oceanography (SO) method were mode-1 ISWs. We discover many mode-2 ISWs in the Pacific coast of Central America by using SO method for the first time. These mode-2 ISWs are convex mode-2 ISWs with the maximum amplitudes of about 10 m, and most of them are ISWs with smaller amplitudes. The pycnocline for the mode-2 ISWs on the shelf (ISW3) is displaced 6.4% of the total seawater depth from the mid-depth of the total seawater. The deviation is large, and it shows a strong asymmetry feature of the peaks and troughs on the seismic profile. This is consistent with the results of previous numerical simulation. Observing the changes in the fine structure of mode-2 ISWs packet through pre-stack migration, it was found that the overall waveform of the three mode-2 ISWs (ISW1, ISW2, and ISW3) on the shelf during the acquisition time period of about 40 seconds is stable. The apparent phase velocity of these mode-2 ISWs calculated by the pre-stack migration section using the Common Offset Gathers is about 0.5 m/s, and their apparent propagation directions are from SW to NE along the seismic line (44 ° N, 0° pointing north). The vertical amplitude distribution and estimated apparent velocities of these mode-2 ISWs are basically consistent with the theoretical values calculated from the KdV equation. By analyzing the apparent velocities of the three mode-2 ISWs (ISW1, ISW3, and ISW5) with relatively small apparent velocity errors, it is found that the apparent velocity of mode-2 ISWs generally increases with the increasing depth of seawater. In addition, the apparent phase velocity of the mode-2 ISWs with a larger maximum amplitude is generally larger. Based on the analysis of hydrological data in the study area, it was found that a strong anticyclone developed on the northwest side of the seismic survey line and a weaker anticyclone developed on the southeast side. These anticyclones will increase the depth of the thermocline in the surrounding seawater. According to previous studies, the deepening of the thermocline (pycnocline) maybe conducive to the generation of mode-2 ISWs.

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