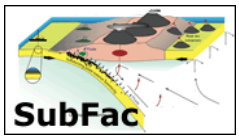
Seismic evidence for fluids in fault zones on top of the subducting Cocos plate beneath Costa Rica



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We present new seismic evidence from the 2005 TICOCAVA active-source seismic study in central Costa Rica that suggests that aqueous fluids released from the subducting Cocos slab are trapped under high pressure within a band of thin faults at the slab-mantle interface. Shear waves (S) and compressional waves (P) that reflect off the subducting slab between depths of 35 and 55 km display a much higher reflection amplitude at a frequency of 20 Hz than at 10 Hz. After comparing a spectral analysis of the slab reflections with seismic velocity models of the slab-mantle interface beneath the forearc of Costa Rica, we found that the discrepancy in the frequency spectra can be explained by up to ten 5-meter-thick fault zones that are spaced ~50 m apart. Inside the fault zones, the shear velocity is as low as 1.0 km/s. Our results suggests that some of the water that is released from subducting oceanic crust beneath the forearc resides in fault zones at the top of the slab, where it may facilitate stable sliding of the subducting plate.

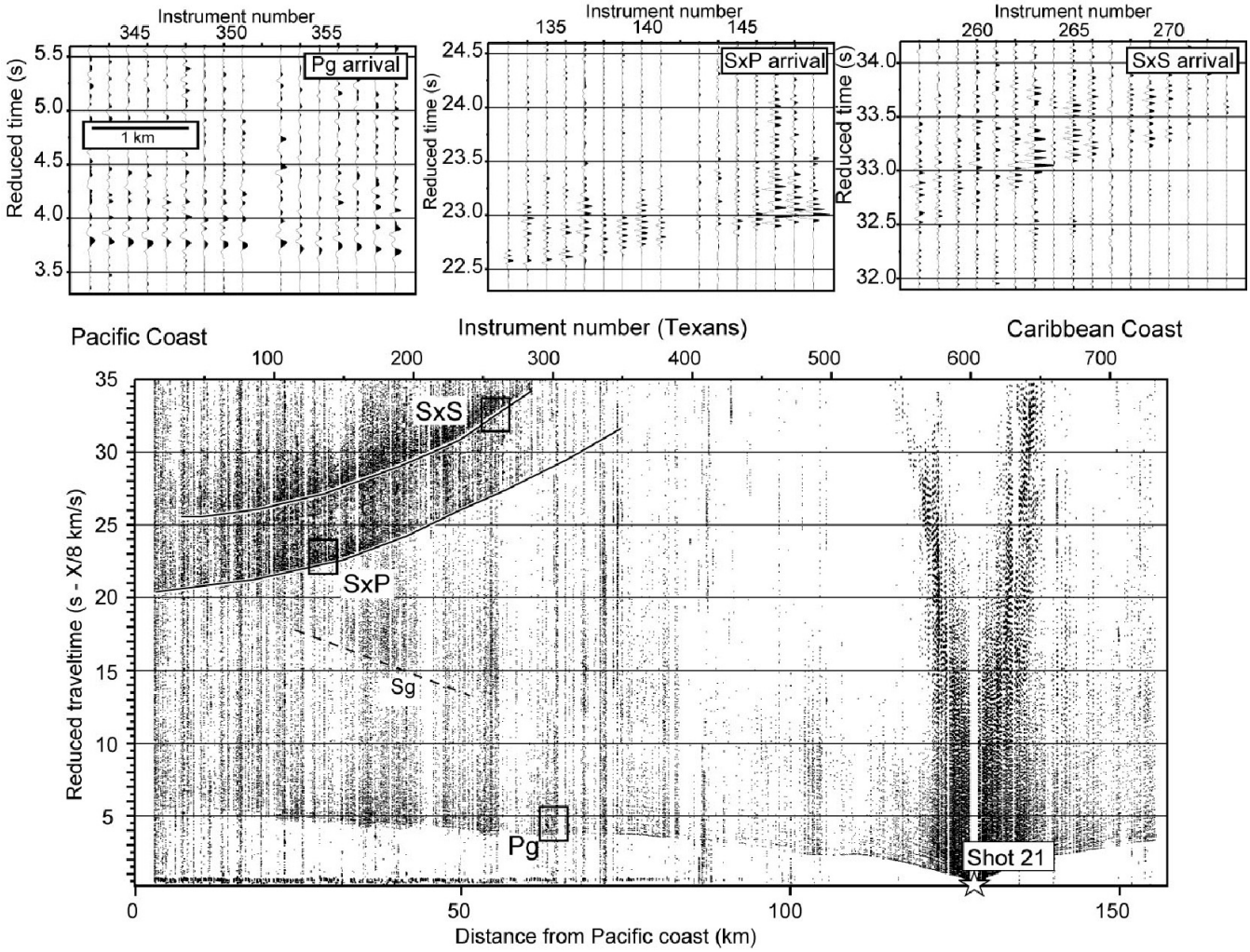

Figure: Shot gather from Shot 21 of the TICOCAVA experiment. The main diagram shows all seismic phases (Pg, Sg, SxP and SxS) with a reduction velocity of 8 km/s. Pg and Sg are the compressional and shear turning waves, respectively. The SxP and SxS phases are a shear wave reflected off the Cocos slab, converted into a compressional and shear wave. The three black squares mark the location of the enlargements (Pg, SxP and SxS) of three panels above.