

MGL1111 Ocean Bottom Seismometer Profiles: Instrument Relocations and Preliminary Data Quality Assessment

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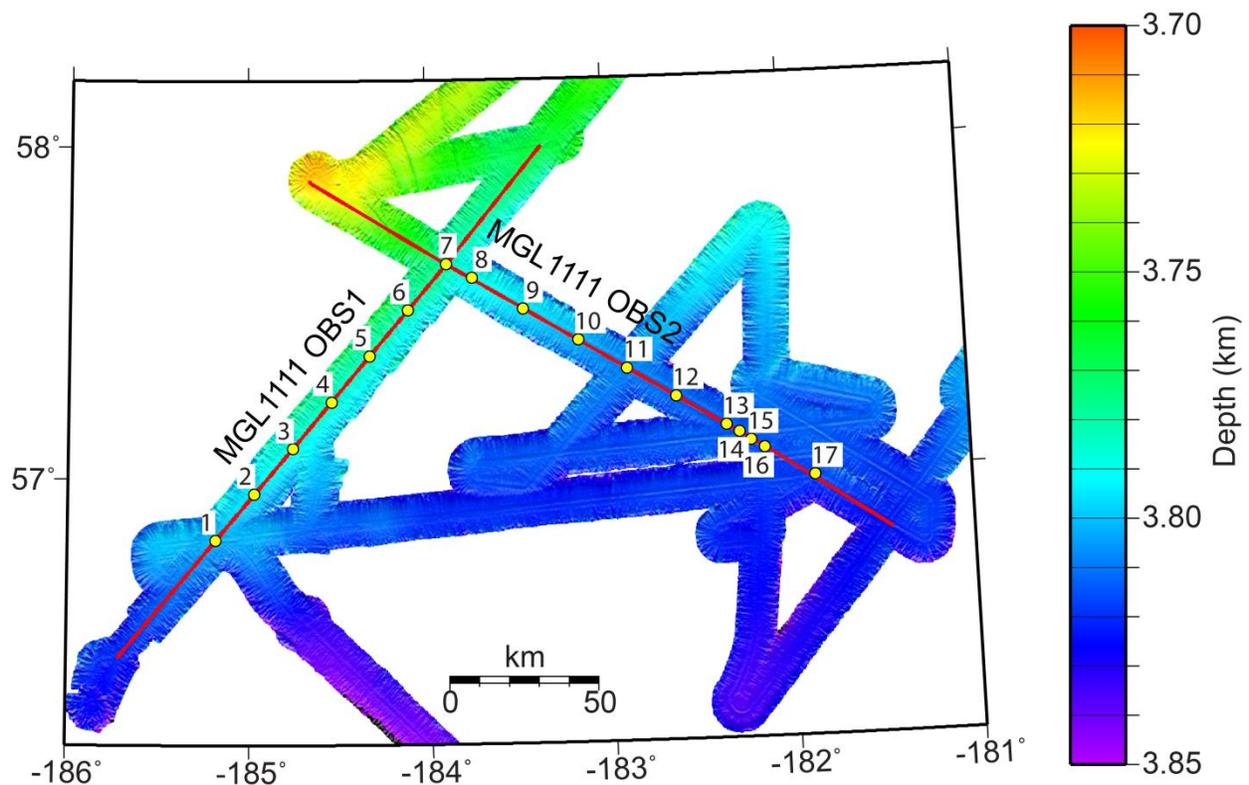


Fig. 1. Multibeam bathymetry along MGL1111 wide-angle profiles OBS1 and OBS2. 17 OBSs recorded shots from both profiles; all instruments were recovered with high-quality data.

Study Area and Field Program

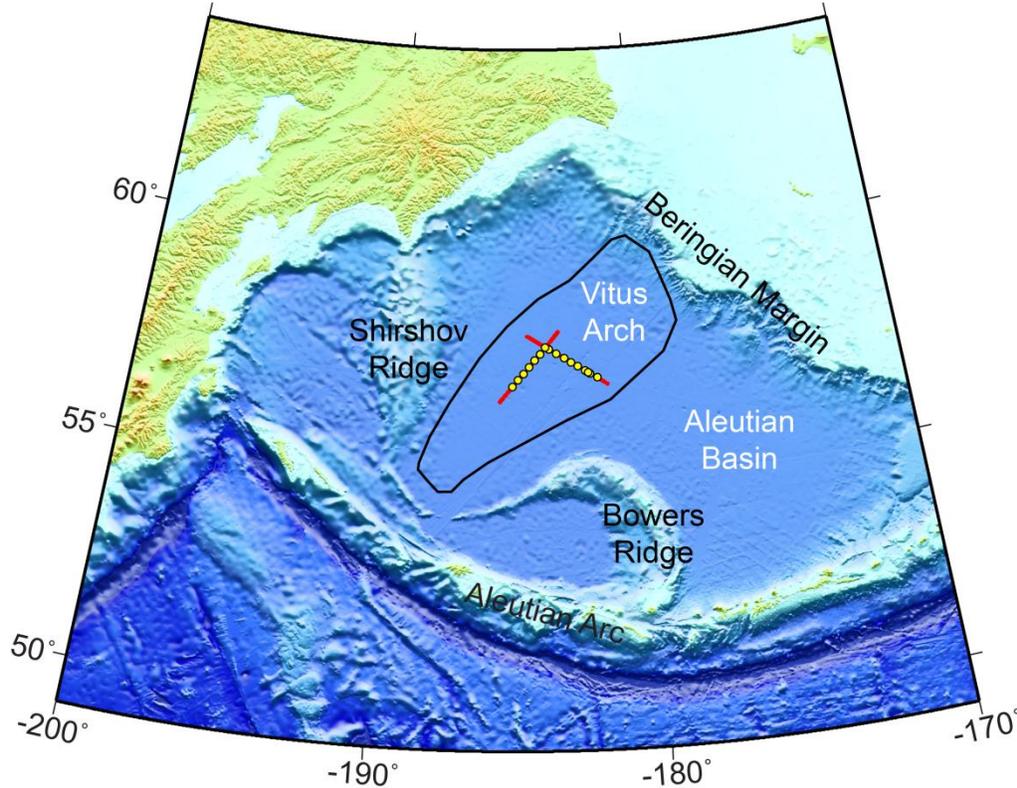


Fig. 2. Topography of the Aleutian Basin study region. Seafloor bathymetry is from Smith and Sandwell [1997], and onshore topography is GTOPO30 from U.S. Geological Survey.

The Aleutian Basin, located in the southwestern Bering Sea, is surrounded by the Beringian margin, Shirshov Ridge, Bowers Ridge, and Aleutian Arc. One model for its tectonic history includes subduction of the Kula plate beneath the Beringian margin from 55-65 Ma, with subduction shifting south of the Aleutian arc at 55 Ma leaving behind a trapped piece of the Kula plate [Cooper *et al.*, 1992]. From 42-55 Ma a major reorganization occurred in the Kula-Farallon-Pacific system which may have initiated volcanism and seafloor spreading along the Vitus arch which continued to ~29 Ma [Cooper *et al.*, 1992]. Today the Vitus arch is a buried 100-200-km-wide extensionally deformed zone with linear basement structures and geophysical anomalies [Cooper *et al.*, 1992].

Profiles MGL1111 OBS1 and OBS2 are located along the Vitus arch; profile OBS1 is parallel to the interpreted ridge axis, and profile OBS2 is parallel to the spreading direction. 17 OBSs were deployed along the two profiles, and recorded shots at 150-m spacing. All operations were conducted by the R/V *Langseth*.

Instrument Relocation

I inverted direct water wave arrivals to estimate instrument position on the seafloor for all instruments. Initial positions were set to deployment positions, and instrument depths were obtained from processed multibeam bathymetry acquired by the R/V *Langseth* (Fig. 1). Shot positions and times were generated by LDEO, and shot depths were set to 9 m. The inversions place the seafloor positions 13-244 m from deployment positions, with a mean difference of 130 m. Table 1 summarizes instrument positions, and Fig. 3 displays the inversion for position of OBS 07.

Table 1. OBS Positions

OBS	Water Depth (m)	Deployment	Seafloor
01	3800	(56.81770, 174.81730)	(56.81762, 174.81841)
02	3795	(56.95630, 175.03090)	(56.95619, 175.03020)
03	3789	(57.09450, 175.24610)	(57.09390, 175.24671)
04	3783	(57.23370, 175.46060)	(57.23249, 175.46399)
05	3783	(57.37180, 175.67700)	(57.37246, 175.67802)
06	3781	(57.50960, 175.89400)	(57.51085, 175.89354)
07	3780	(57.64730, 176.11140)	(57.64820, 176.11279)
08	3790	(57.60500, 176.25570)	(57.60580, 176.25660)
09	3794	(57.50930, 176.53850)	(57.50920, 176.53838)
10	3803	(57.41290, 176.84340)	(57.41273, 176.84331)
11	3807	(57.32310, 177.11300)	(57.32345, 177.11336)
12	3811	(57.23350, 177.38220)	(57.23447, 177.38337)
13	3812	(57.14370, 177.65480)	(57.14208, 177.65329)
14	3813	(57.11960, 177.72620)	(57.11880, 177.72677)
15	3813	(57.09390, 177.78920)	(57.09507, 177.79256)
16	3814	(57.07080, 177.86300)	(57.06994, 177.86442)
17	3817	(56.98130, 178.13260)	(56.98067, 178.13426)

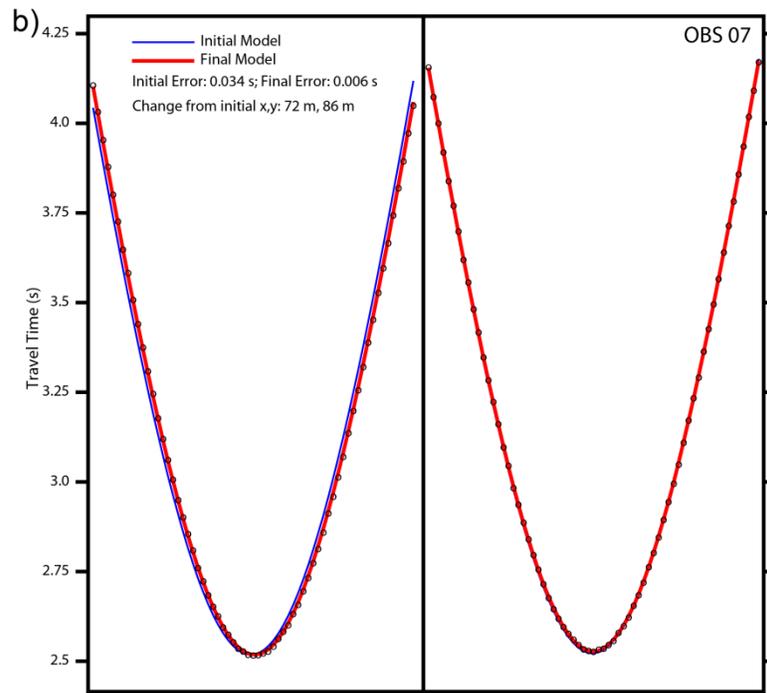
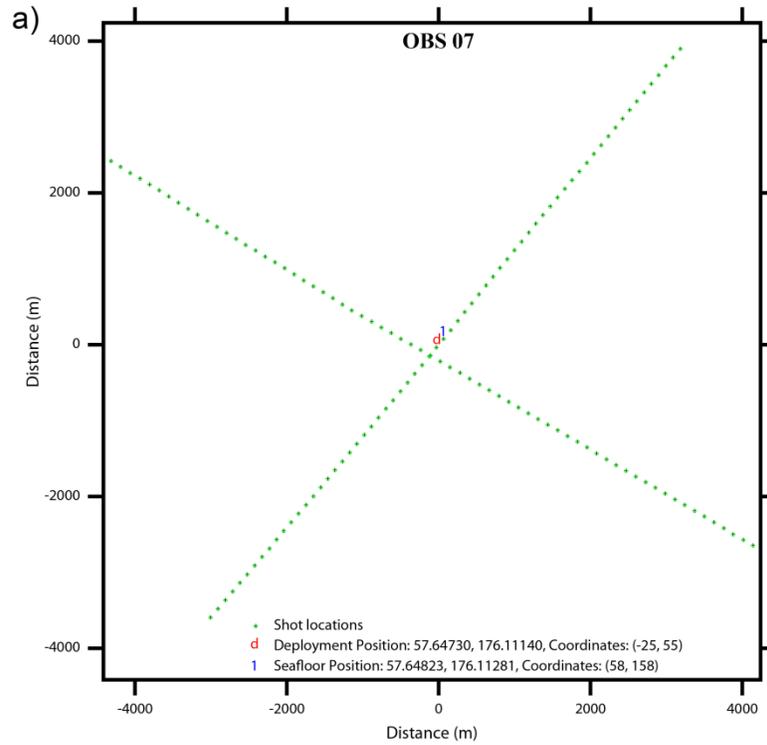


Fig. 3. a) Deployment and estimated seafloor position of OBS 07. Green circles and crosses display shot positions; direct water wave travel times from these shots were inverted for position of instrument on seafloor. b) Calculated water wave travel times from shots to instrument for deployment position (blue) and estimated seafloor position (red).

Record Sections

All recovered OBSs recorded excellent hydrophone and vertical channel data, with the exceptions of OBS 09 and OBS 12 where the vertical data were poor. Fig. 4. displays example record sections. At near offsets, first arrivals include the direct water wave, energy refracting through the sediments, and energy refracting through the basement (*Pg* phase). On most instruments a clear basement reflection is observed as a secondary arrival (Fig. 4a), but on some instruments it is not (Fig. 4b). At longer offsets the *Pg* phase continues as a first arrival to 30-50 km (Fig. 4c and Fig. 4d), and the *PmP* phase is a prominent secondary arrival starting at offsets of 20 km (Fig. 4c and Fig. 4d), and continuing to offsets as great as 100 km (Fig. 4d). A strong *Pn* phase is observed to offsets of 80-90 km on some instruments (Fig. 4c), while it is faint or absent on others (Fig. 4d). Record sections for all instruments are displayed in Fig. 5 for line 1 and Fig. 6 for line 2.

All instruments recorded all shots. The offline data (line 2 shots recorded by instruments on line 1, or line 1 shots recorded by instruments on line 2) may be helpful for obtaining information about anisotropy, although the experimental geometry is not ideal. Example record sections for offline data are displayed in Fig. 7.

References

- Cooper, A. K., M. S. Marlow, D. W. Scholl, and A. J. Stevenson (1992), Evidence for Cenozoic crustal extension in the Bering Sea region, *Tectonics*, 11, 719-731.
- Smith, W. H. F., and D. T. Sandwell (1997), Global sea floor topography from satellite altimetry and ship depth soundings, *Science*, 277, 1956-1962, doi: 10.1126/science.277.5334.1956.

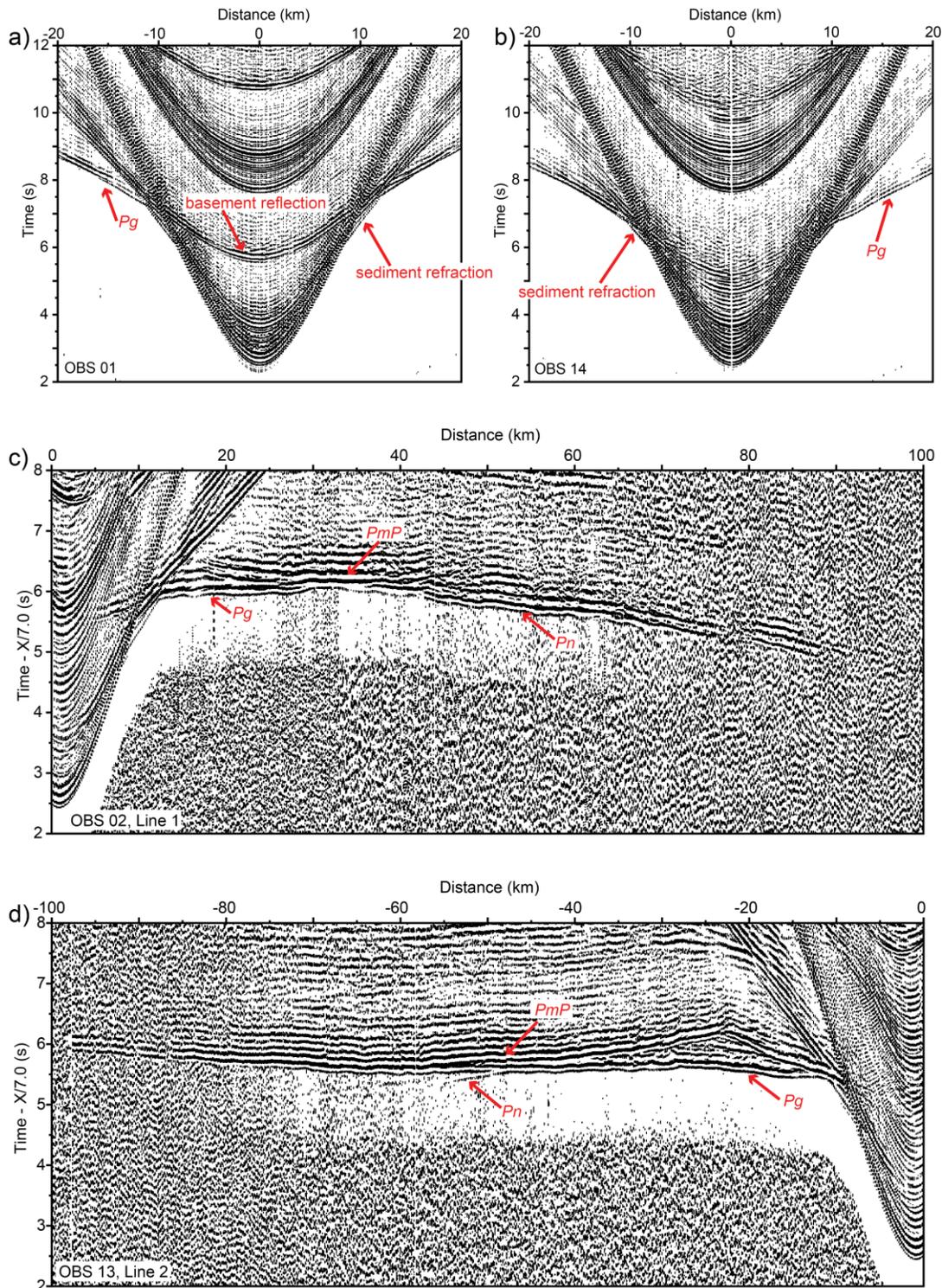


Fig. 4. Near offset arrivals on hydrophone channel of a) OBS 01 and b) OBS 14. Record sections are plotted with range scaling by a factor of $R^{1.0}$, where R is the distance of the shot from the receiver. Record sections for vertical channel of c) OBS 09, Line 1 and d) OBS 13, Line 2. Data are plotted with a reduction velocity of 7 km/s, and have an 0.5-second agc applied. Data for all record sections are bandpass filtered with a low cut of 3 Hz and a high cut of 15 Hz. Prominent arrivals are identified.

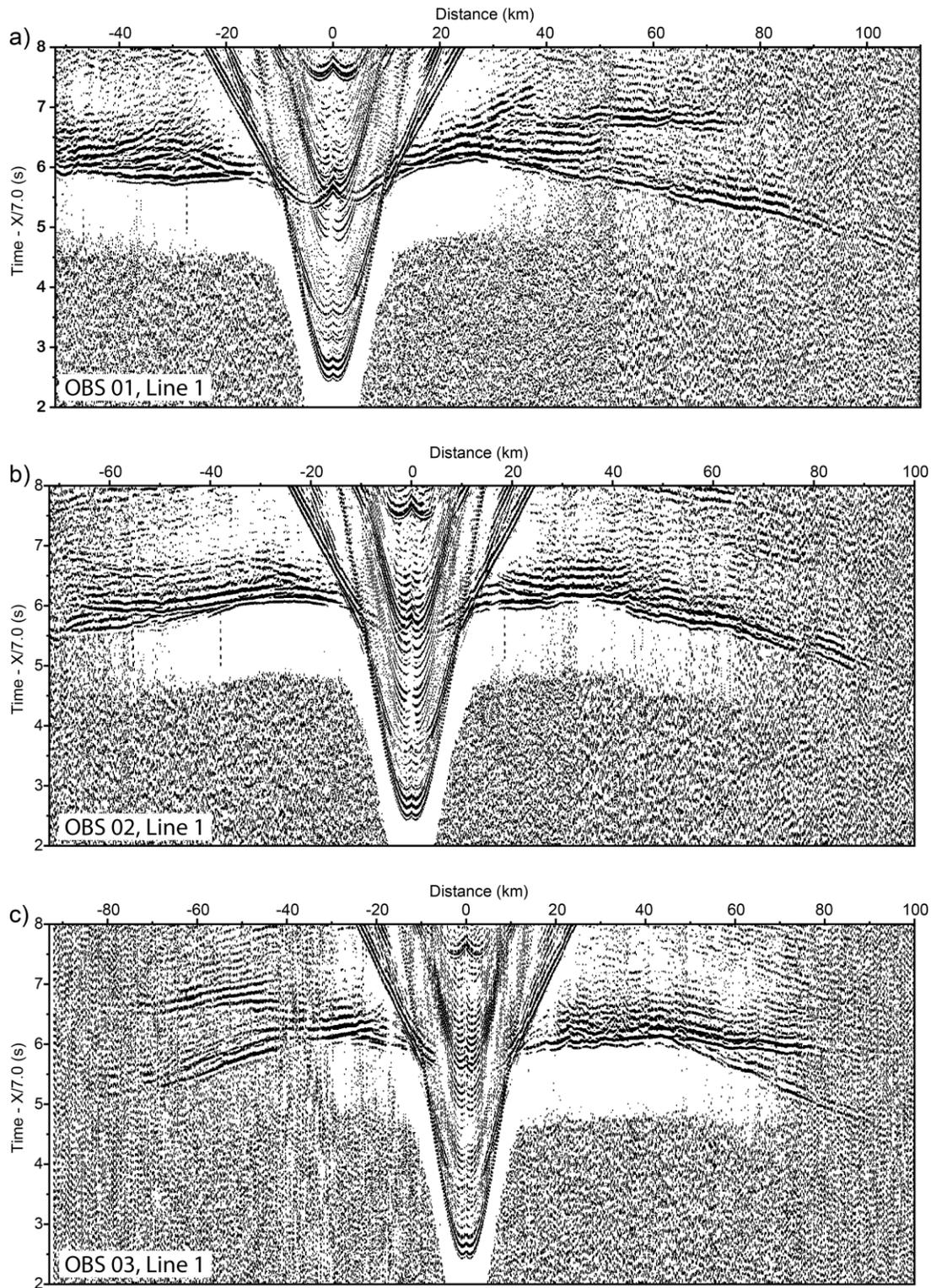


Fig. 5. Record sections for all in-line instruments on Line 1. Vertical channel is displayed for all OBSs. Data are plotted with a reduction velocity of 7 km/s, and have an 0.5-second agc applied. Data are bandpass filtered with a low cut of 3 Hz and a high cut of 15 Hz.

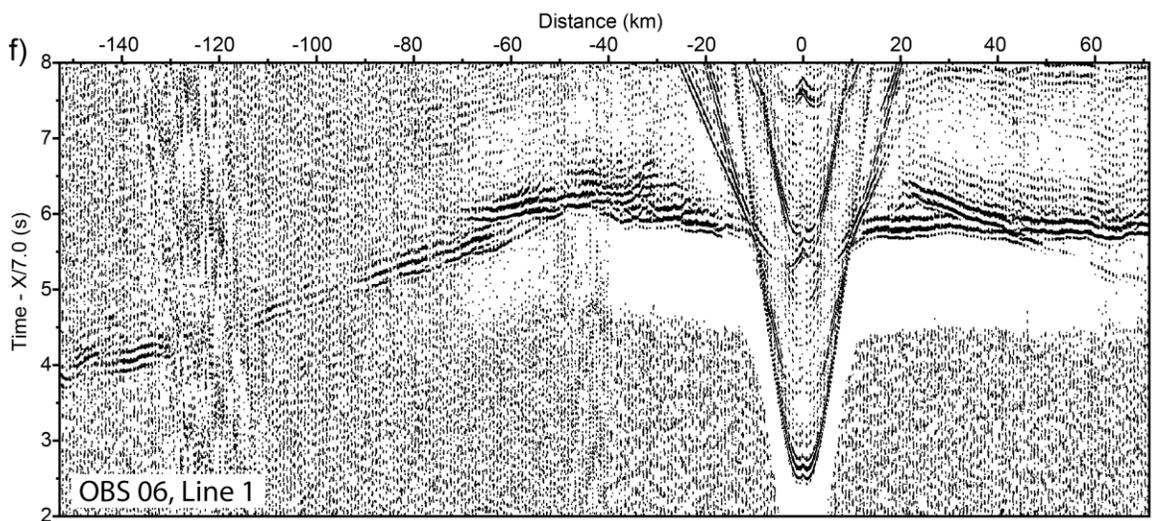
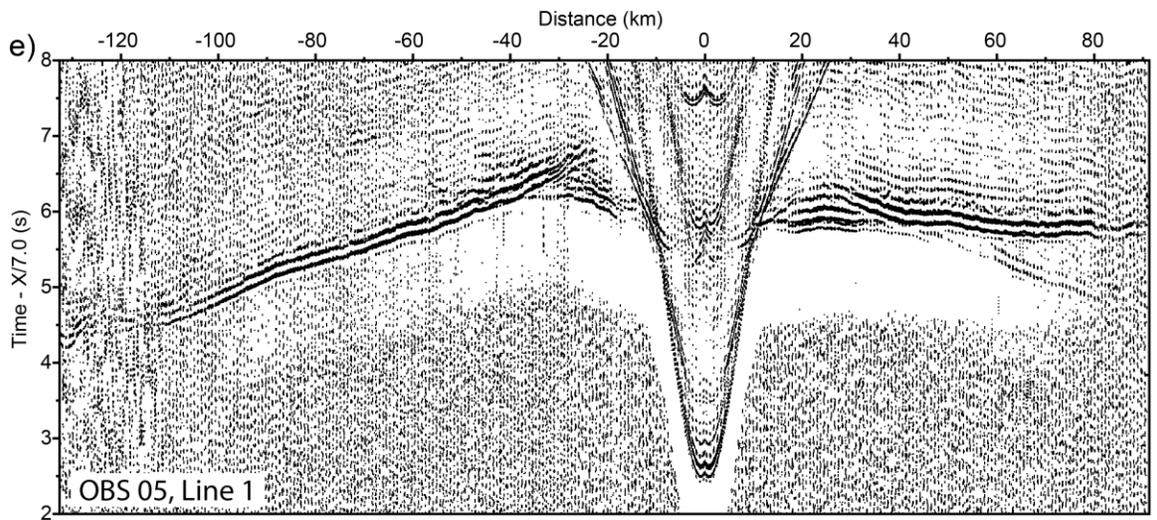
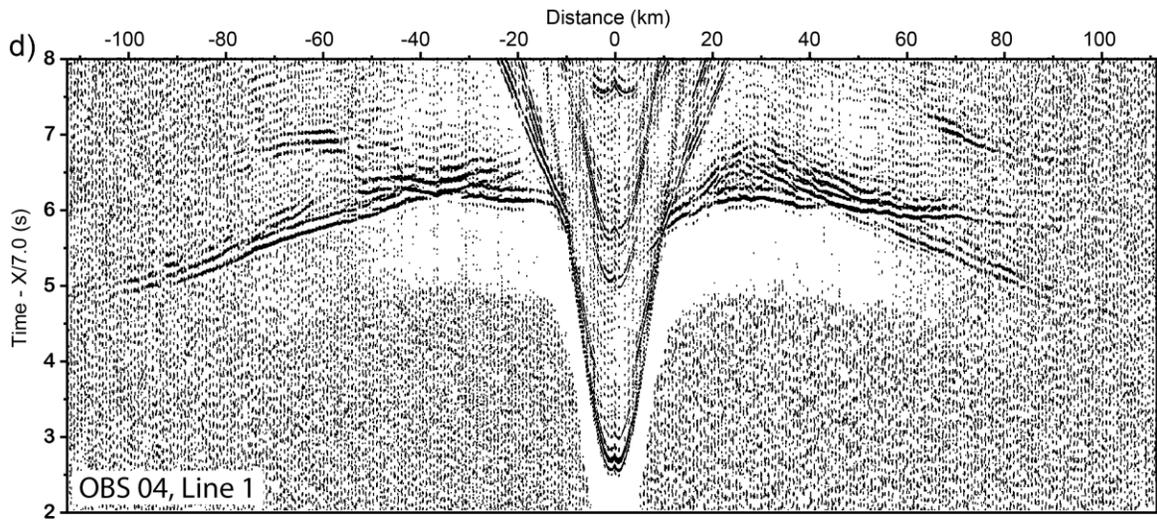


Fig. 5., cont.

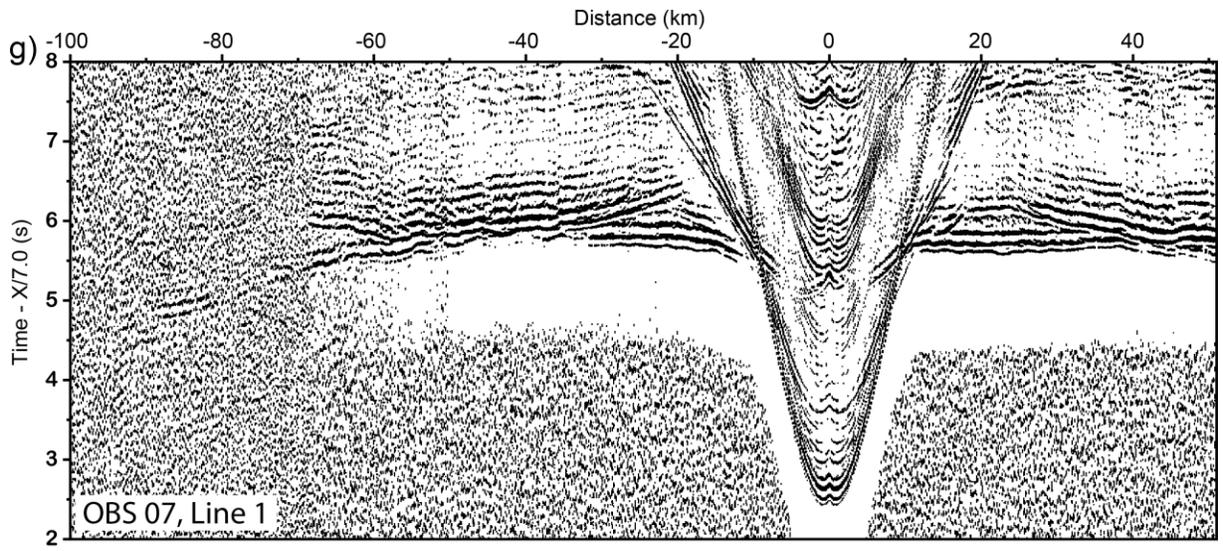


Fig. 5, cont.

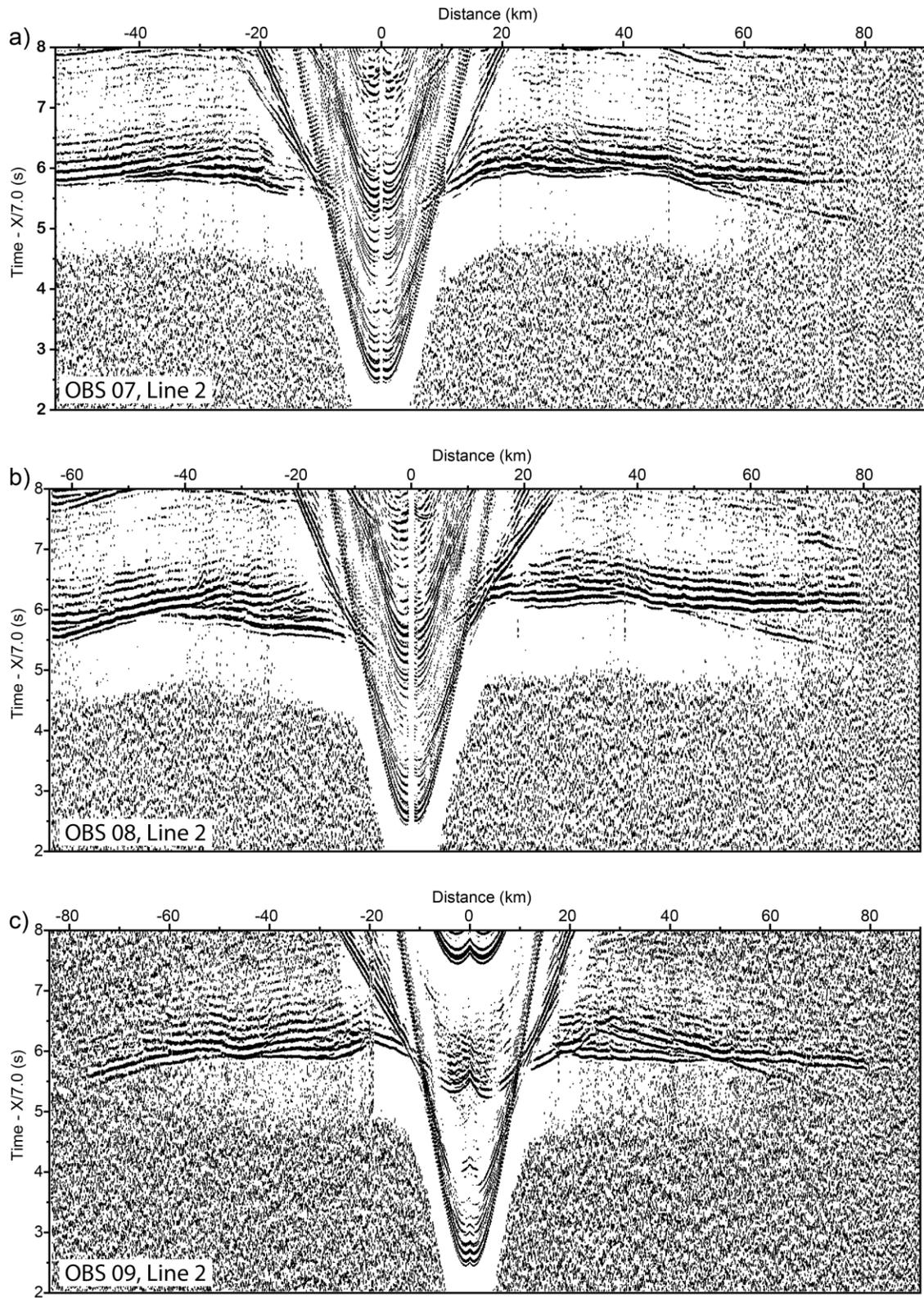


Fig. 6. Same as Fig. 5, except for inline instruments on Line 2. Hydrophone channel is displayed for OBS 09 and OBS 12 because of poor vertical channel on these instruments.

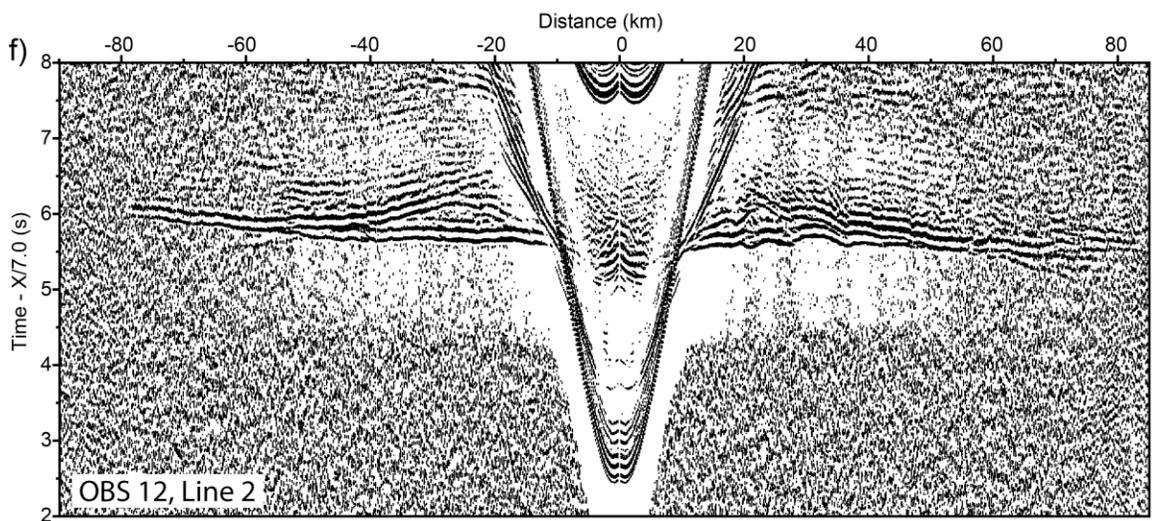
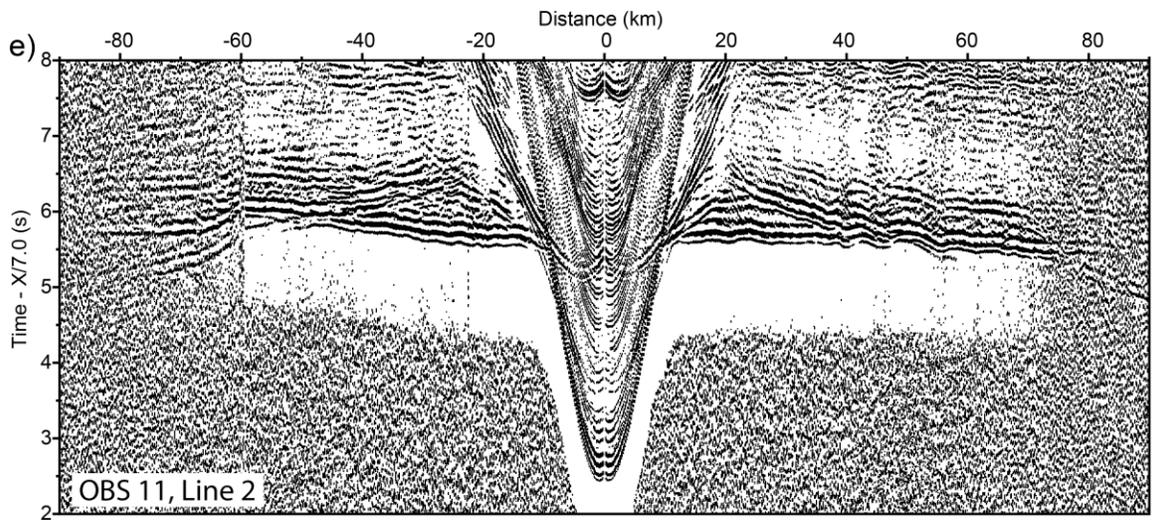
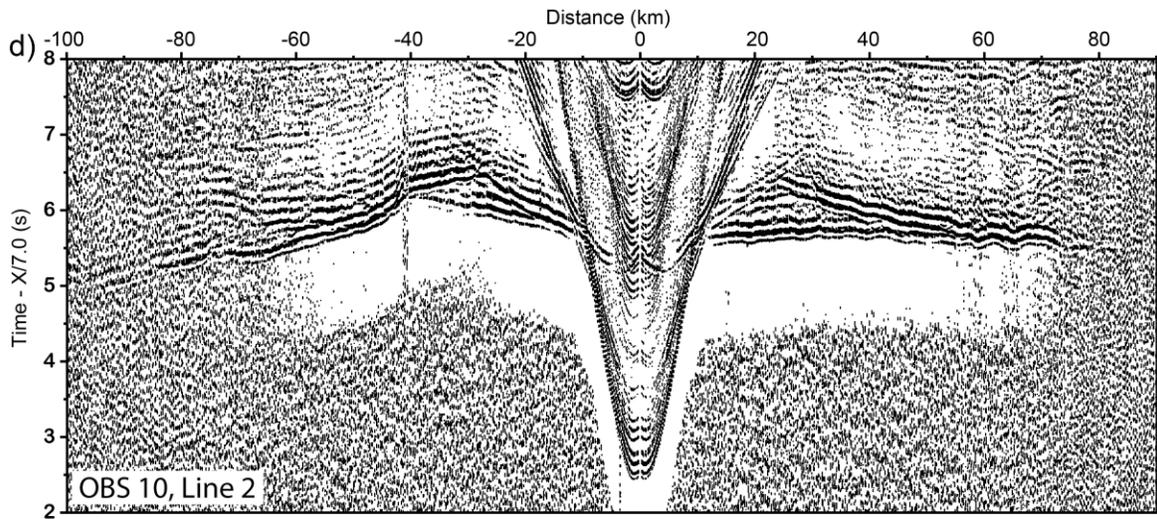


Fig. 6, cont.

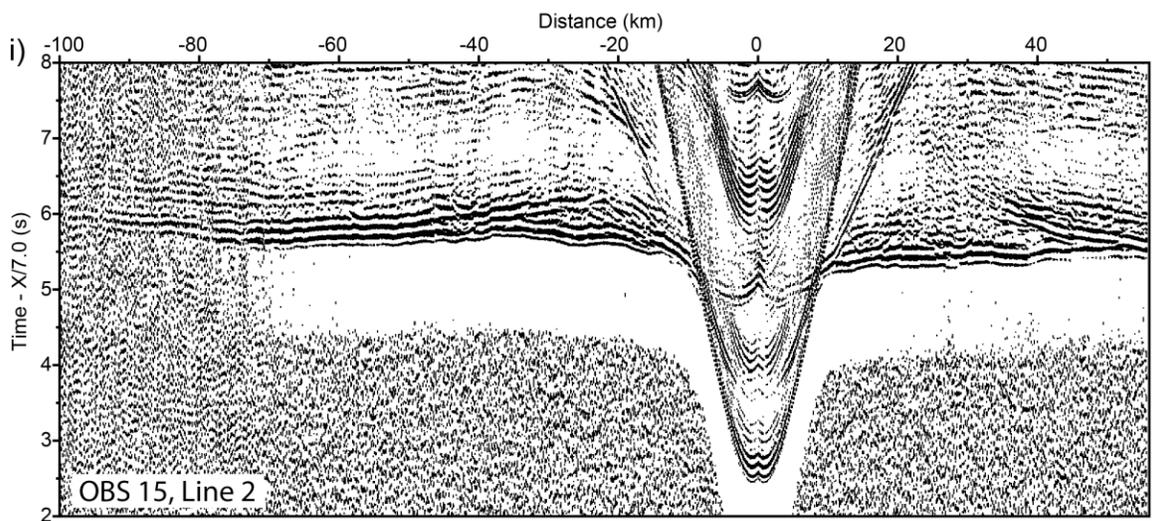
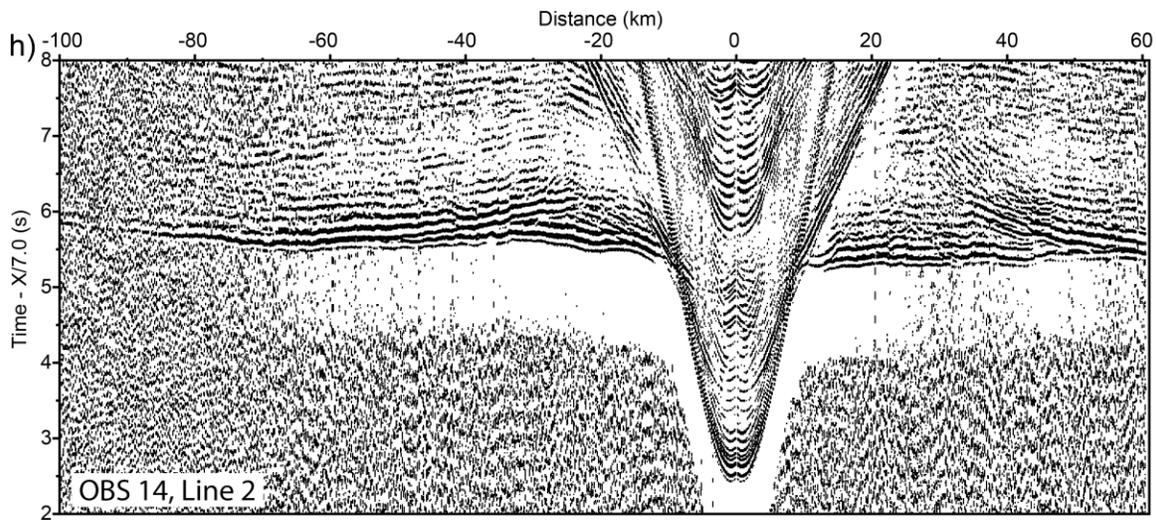
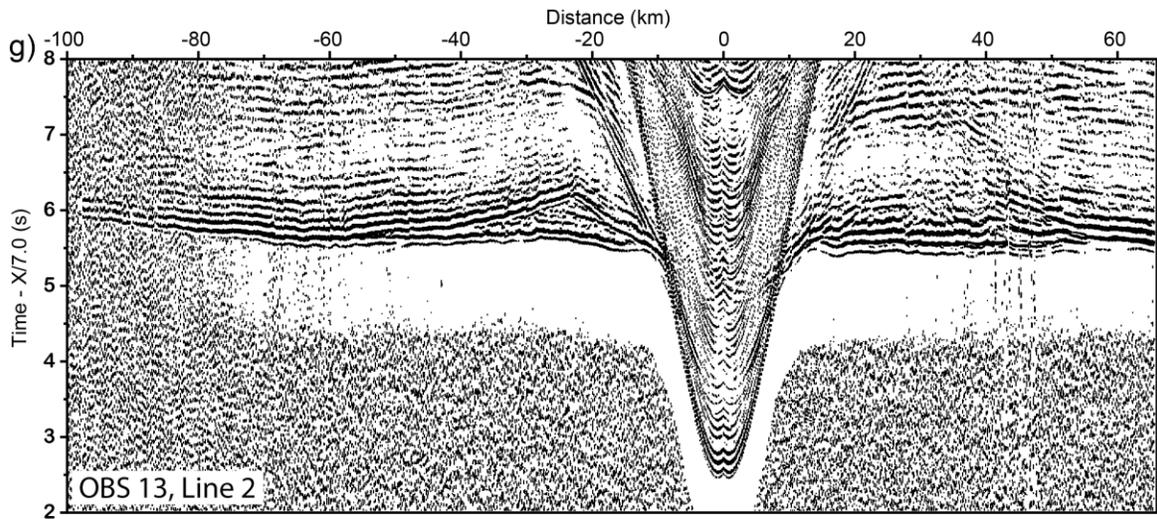


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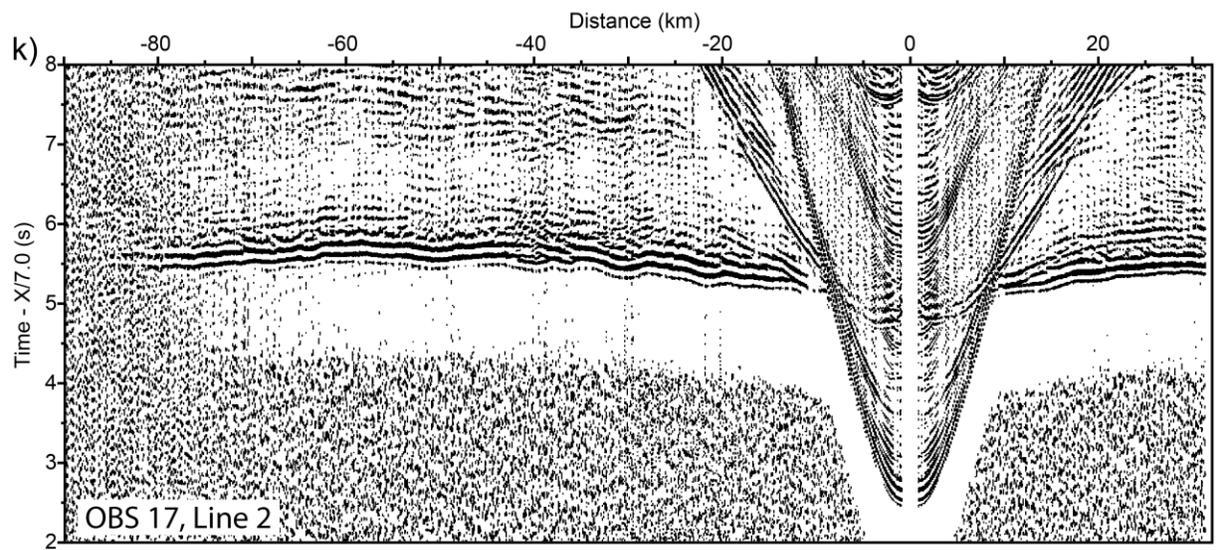
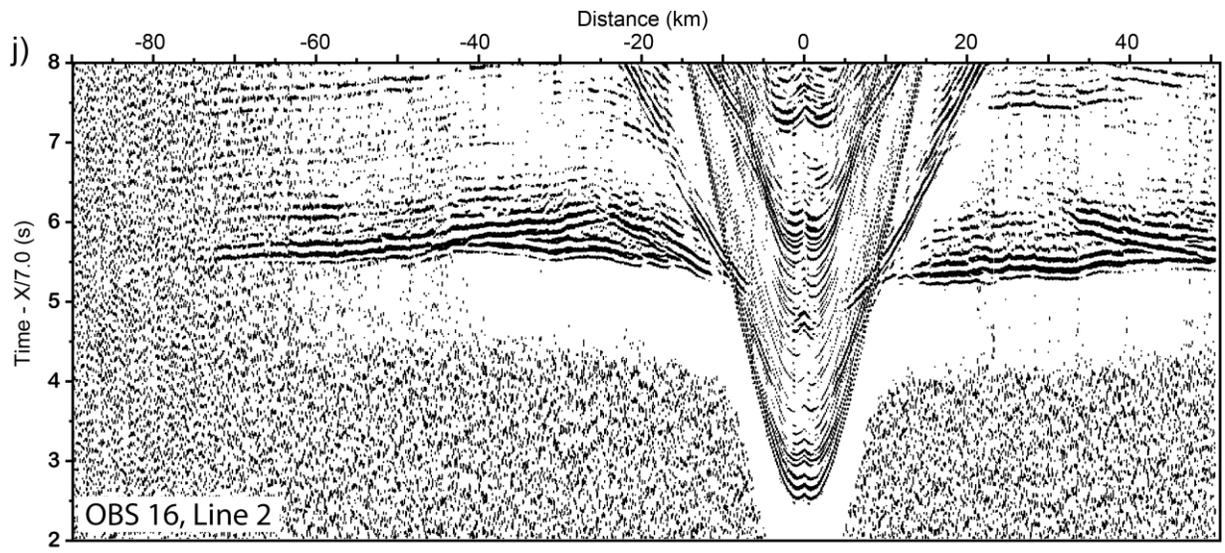


Fig. 6, cont.

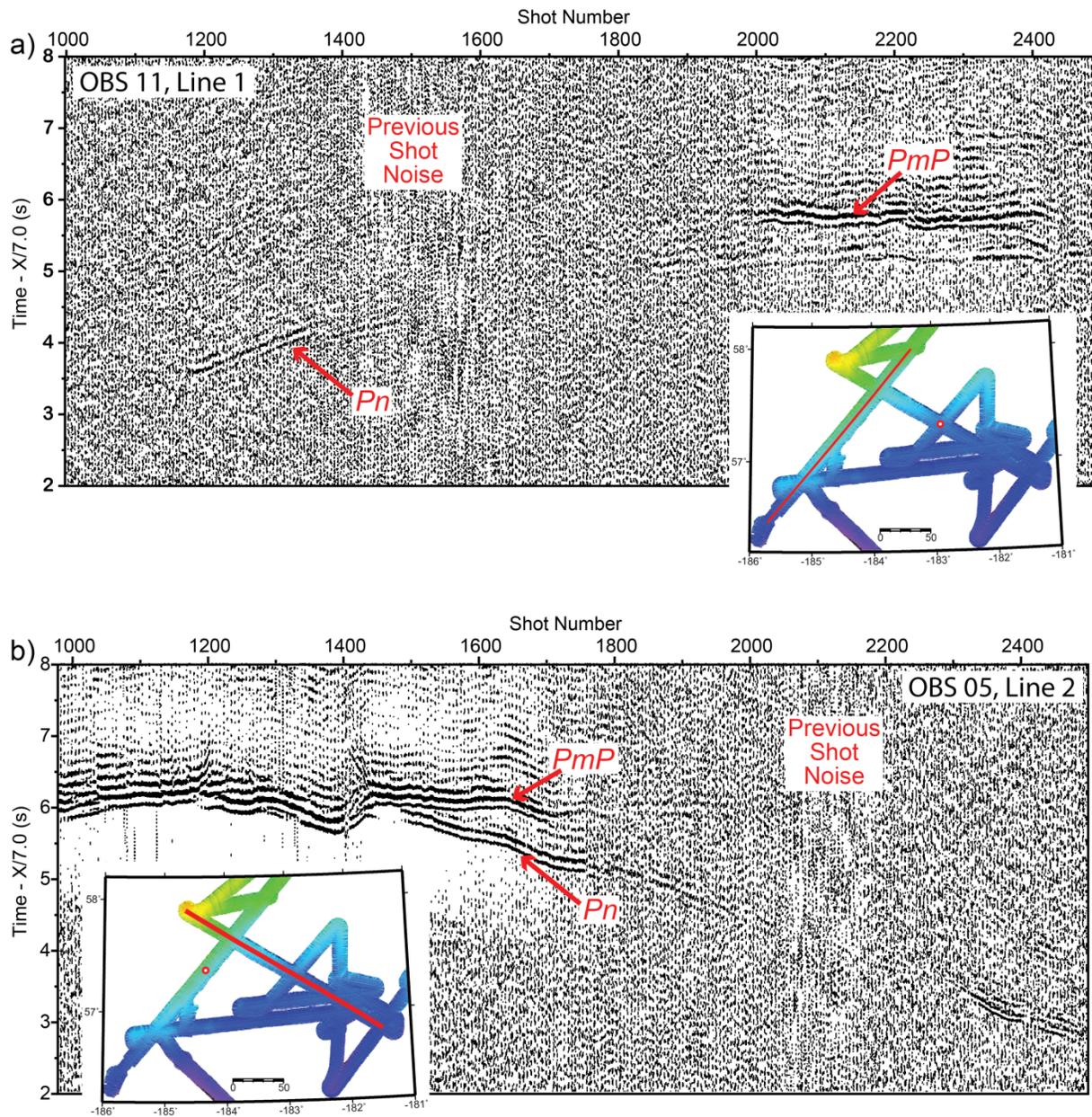


Fig. 7. a) Record section for Line 1 shots recorded by OBS 11 located on Line 2. Closest approach is at shot 2149. b) Record section for Line 2 shots recorded by OBS 05 located on Line 1. Closest approach is at shot 1337. Note good Pn arrivals recorded by both instruments despite presence of previous shot noise at longer offsets.

Coincident MCS Profiles

Coincident MCS profiles were acquired along the two OBS profiles. Fig. 8 displays screen captures of the shipboard-processed migrated sections, with approximate positions of the OBS instruments labeled.

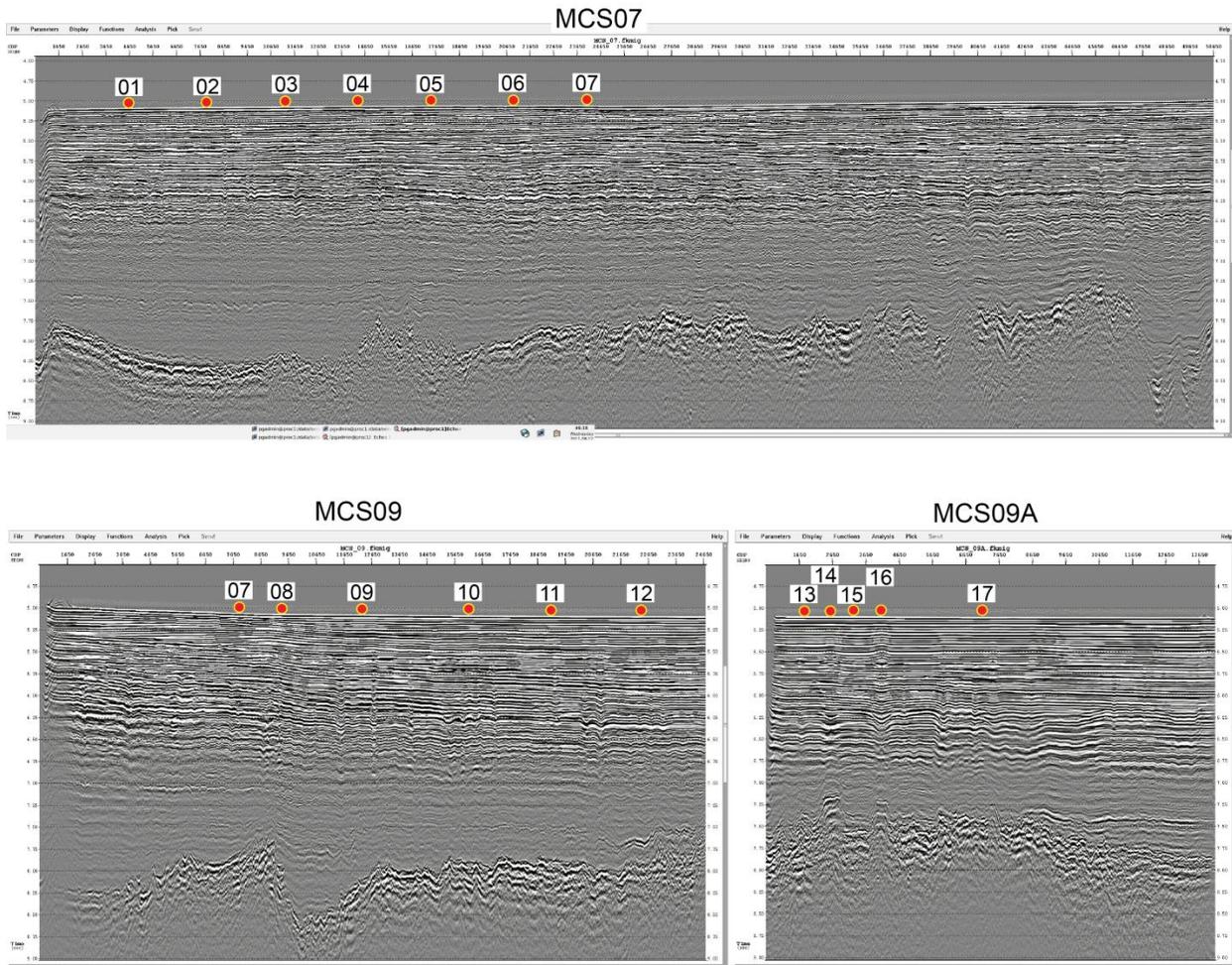


Fig. 8. Coincident MCS profiles. Displayed are screen captures of the shipboard-processed migrated sections. Approximate positions of the OBS instruments are labeled.