Crustal structure from offshore wide-angle seismic data: Application to South Yellow Sea

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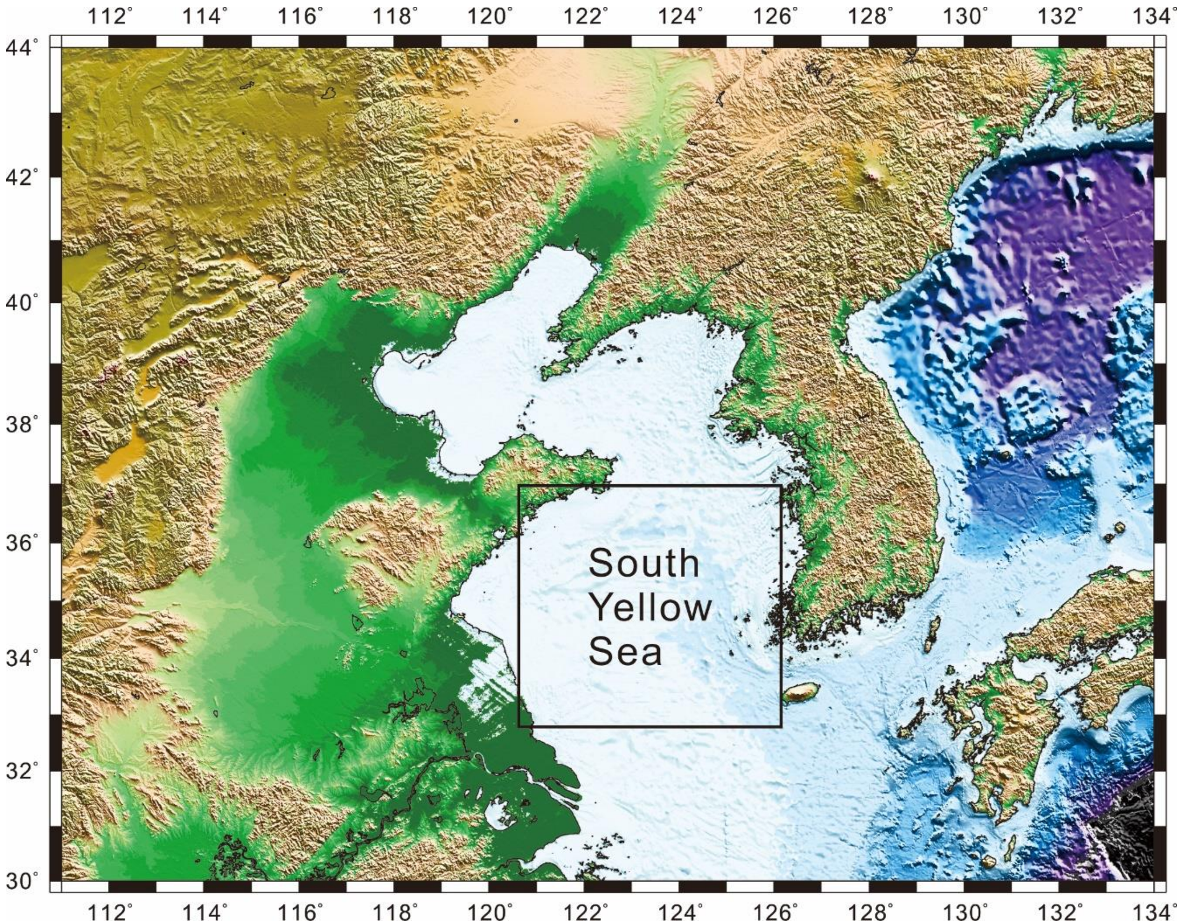
Location of the South Yellow Sea (SYS)

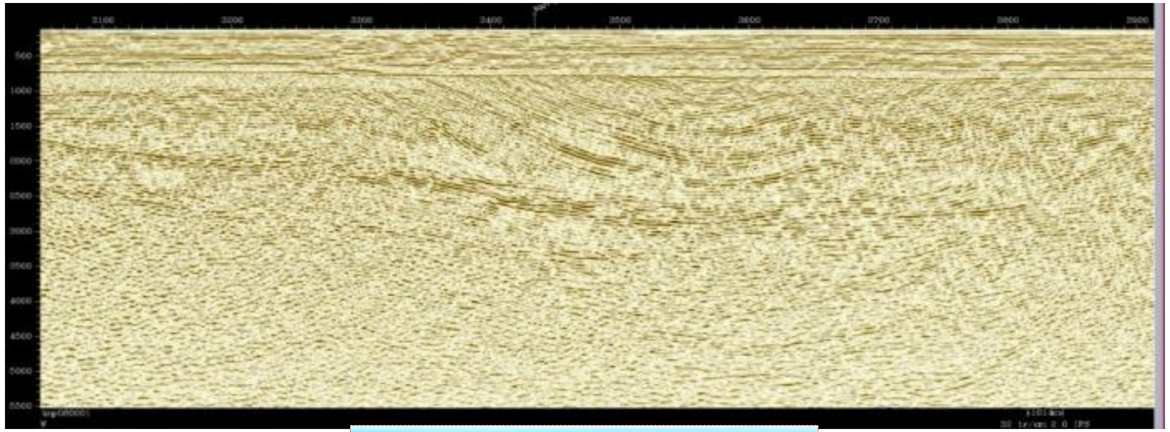


The South Yellow Sea (SYS) basin, situated between Shandong and Korean peninsulas.

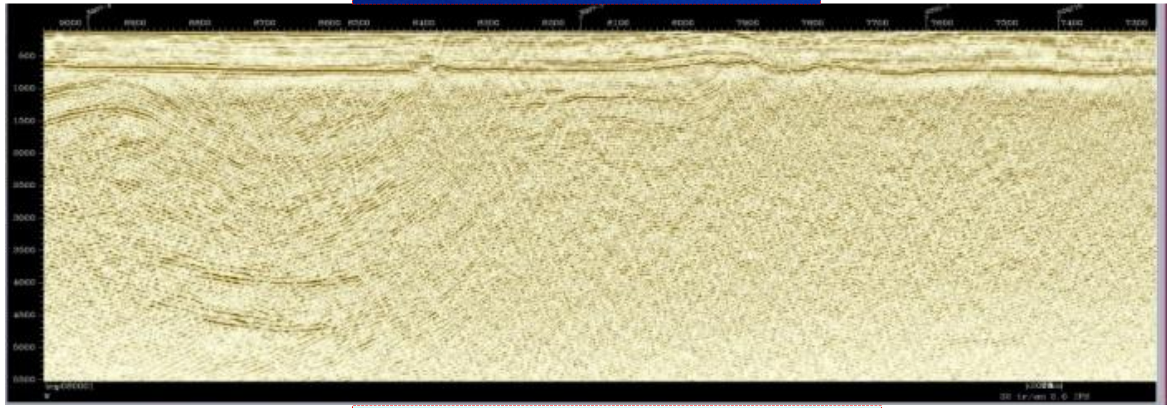
The collision between the North China Block (NCB) and the South China Block (SCB) during the Triassic formed one of the most extensive ultra-high-pressure (UHP) metamorphic belts worldwide, which was located at the north of the SYS.

The sedimentary basin was filled with Cenozoic-Mesozoic continental sediments overlying the Pre-Paleozoic and Mesozoic-Paleozoic marine sediments.

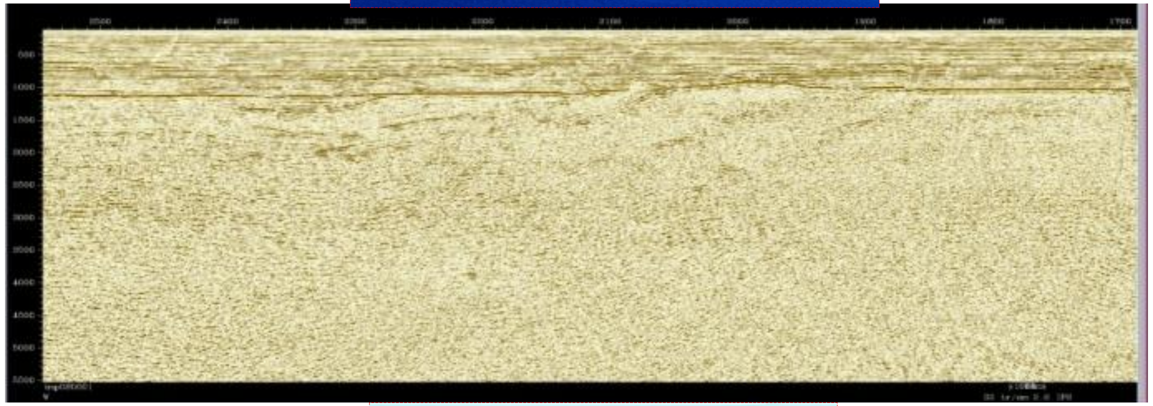
Mutil-channel seismic data



High quality profile



General quality profile



Moho Depth

Hao et al., 2003:
29km(from Gravity inversion)

Wang et al., 2013:
30-33km(from Gravity and Magnetic inversion)

Qi, 2015：
30-35km(from wide-angle seismic data inversion)

The lack of detail in the offshore seismic model in the crustal levels means that the deep boundaries of the Northern Sulu Orogen and internal geotectonic setting of the basin in the SYS remain ambiguous.

Location of survey line for the velocity model in this study

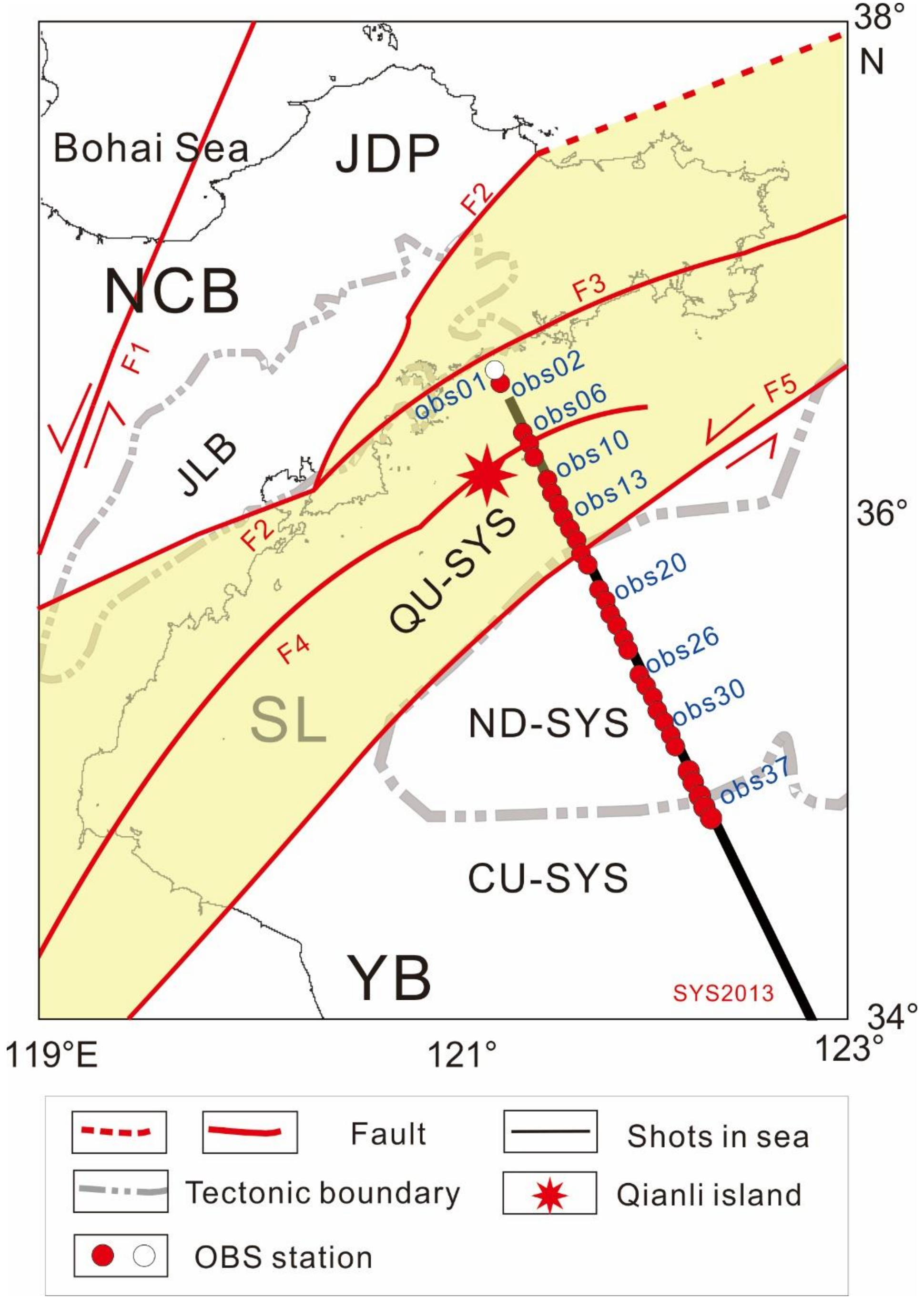


Table 1 Sensor parameters of the survey line

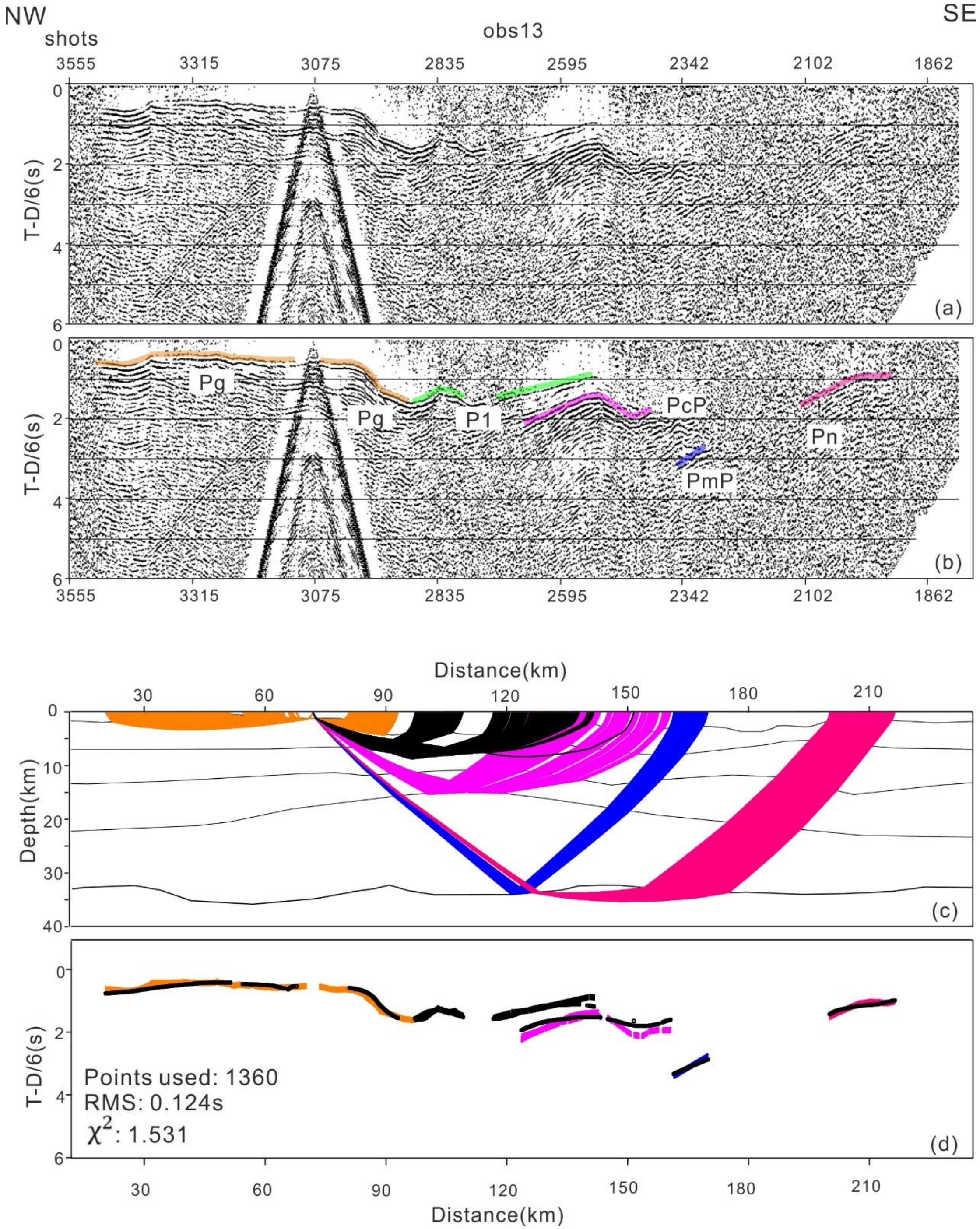
Region	Offshore	
Sensor	MicroOBS	GeoproOBS
Working frequency	4.5Hz~200Hz	2Hz~100Hz
samples per second	250	250

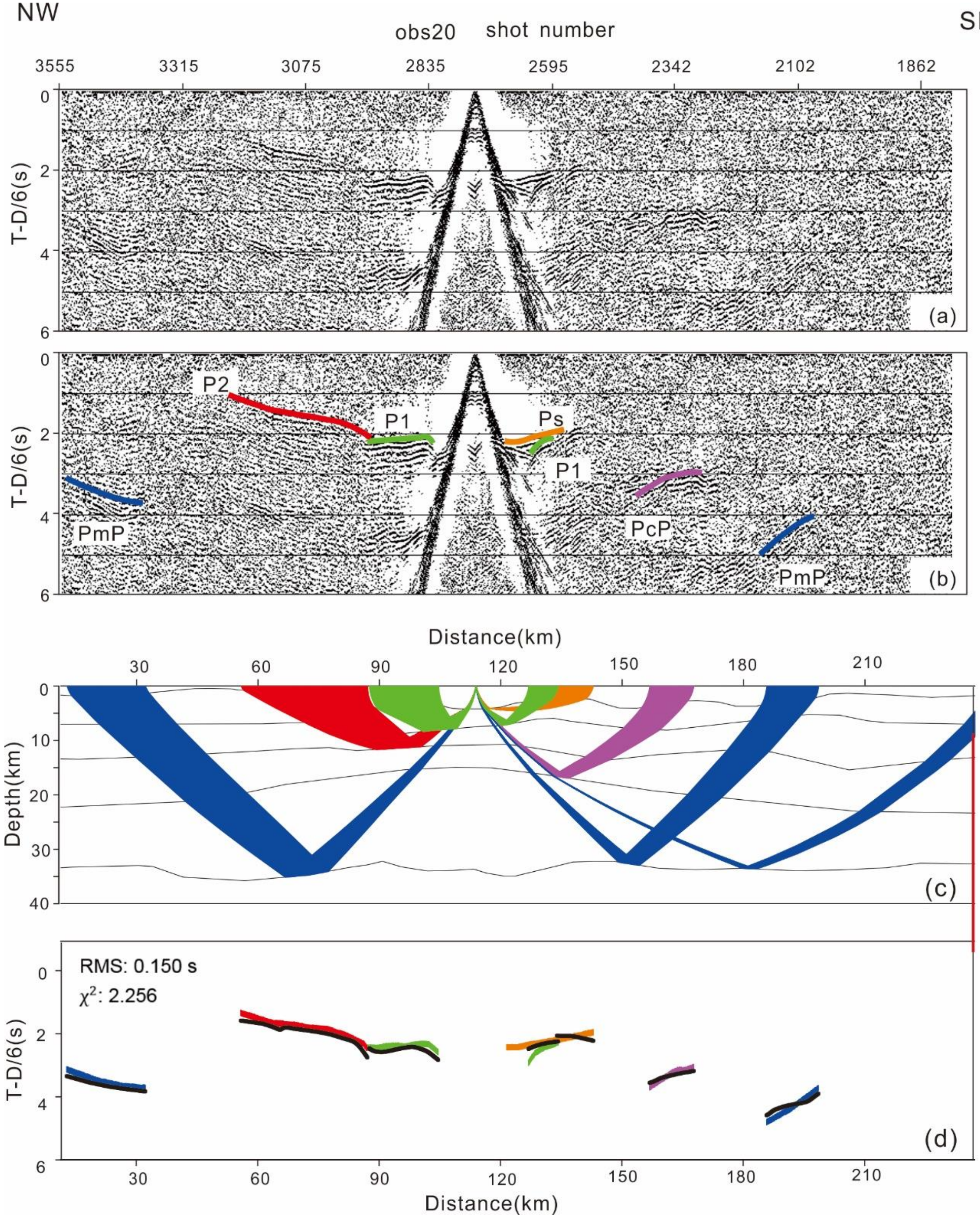
Table 2 Observation parameters of the survey line

	Length (km)	Receivers	Receiver spacing (km)	Shots	Shot energy	Shot spacing (km)
Sea area	326	39	6	2501	6060 inch^3	0.125

NCB, North China Block; YB, Yangtze Block;SL, Sulu Orogen; JDP, Jiaodong Peninsula; JLB, Jiaolai basin; SYS, South Yellow Sea; QU-SYS, Qianliyan Uplift of SYS; NB-SYS, Northern Depression of SYS; CU-SYS, Central Uplift of SYS; SB-SYS, Southern Depression of SYS; F1, Tanlu Fault; F2, Wulian-Qingdao-Yantai Fault; F3, Qingdao-Rongcheng Fault; F4, Fault in QU; F5, Jiashan-Xiangshui-Qianliyan Fault; obs01-obs37, OBS stations.

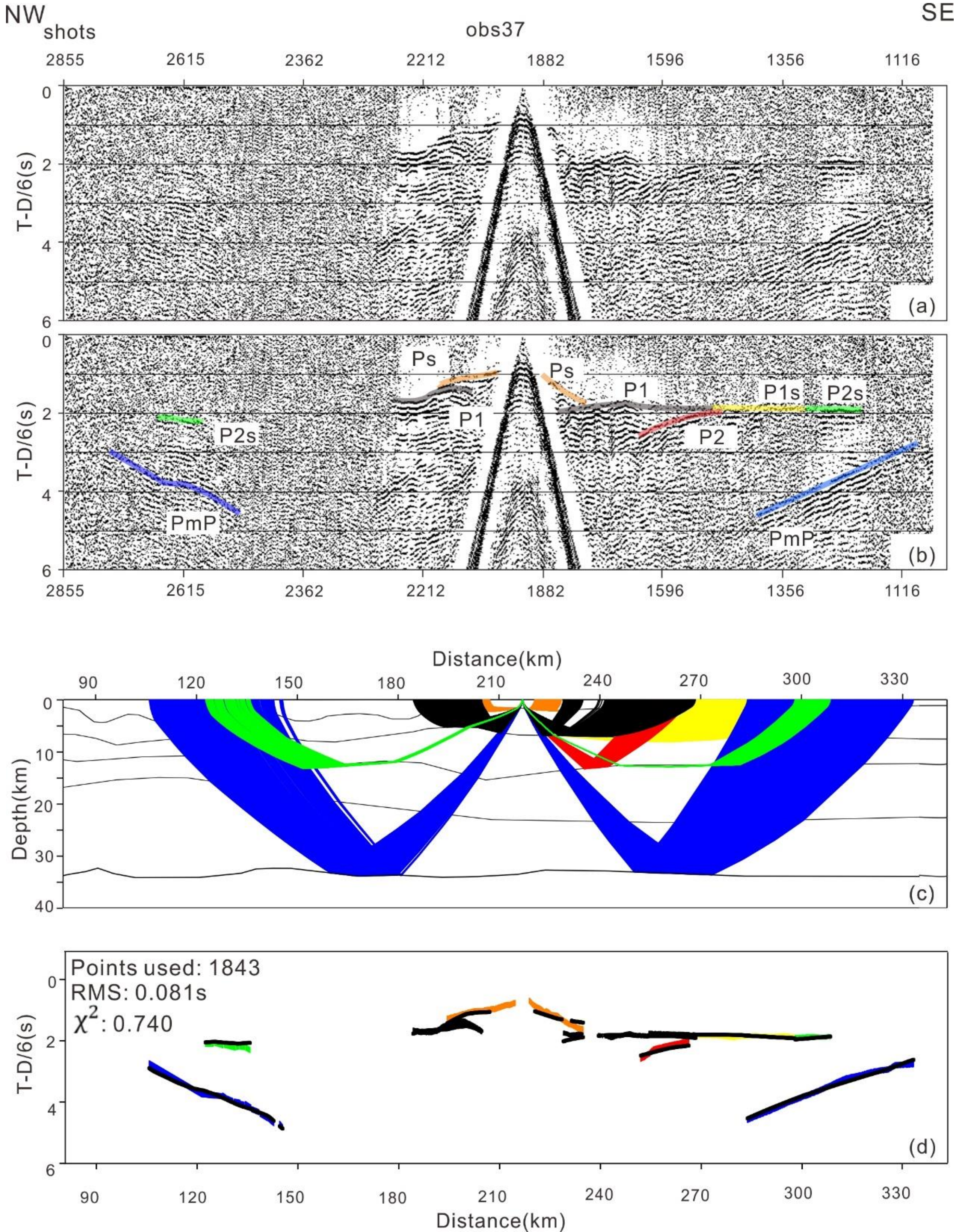
Sample on the Qianliyan Uplift of SYS





Sample on the , Northern Depression of SYS

Sample on the Central Uplift of SYS

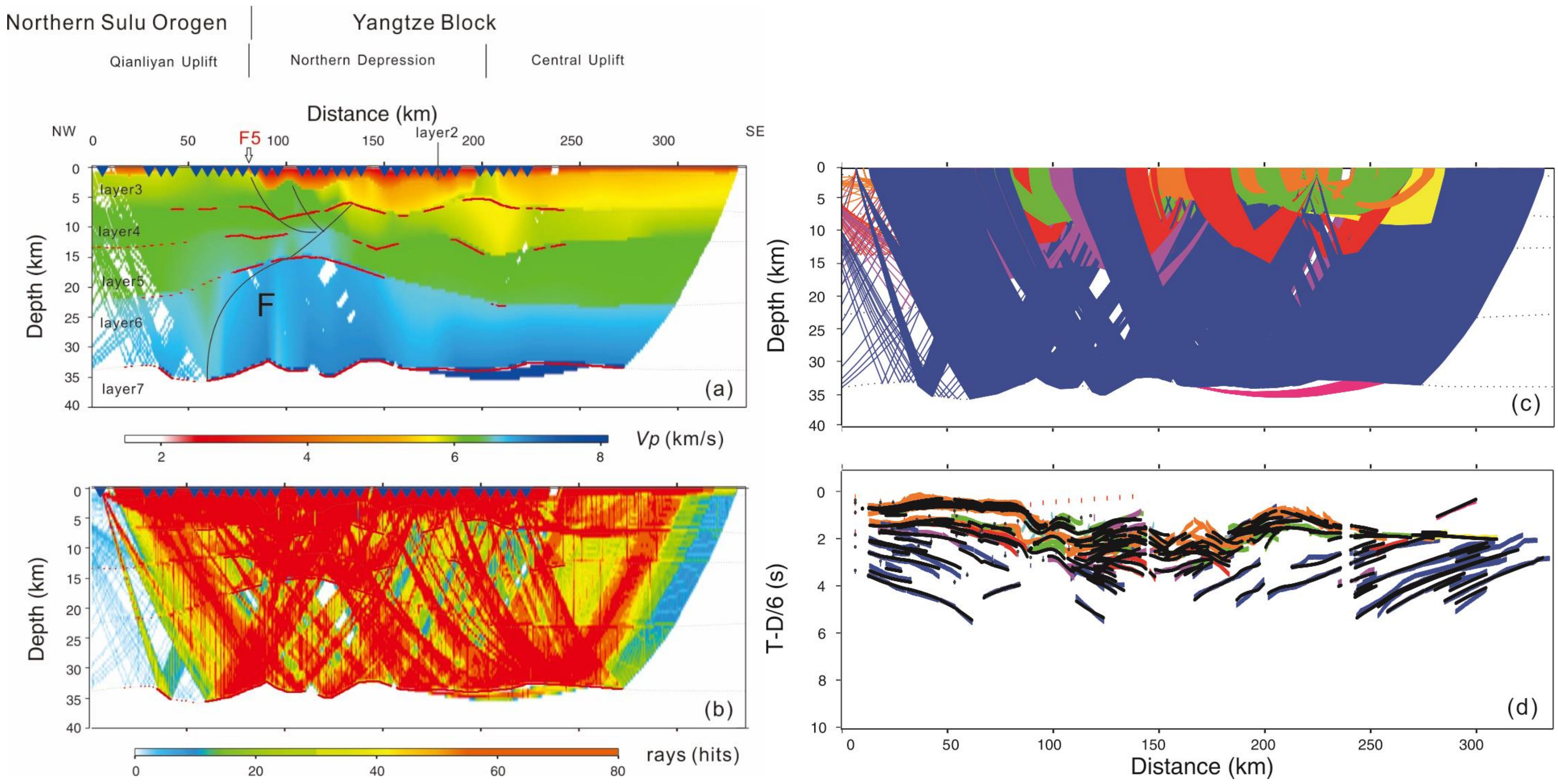


(a) Seismic record section at a reduction velocity of 6 km/s.

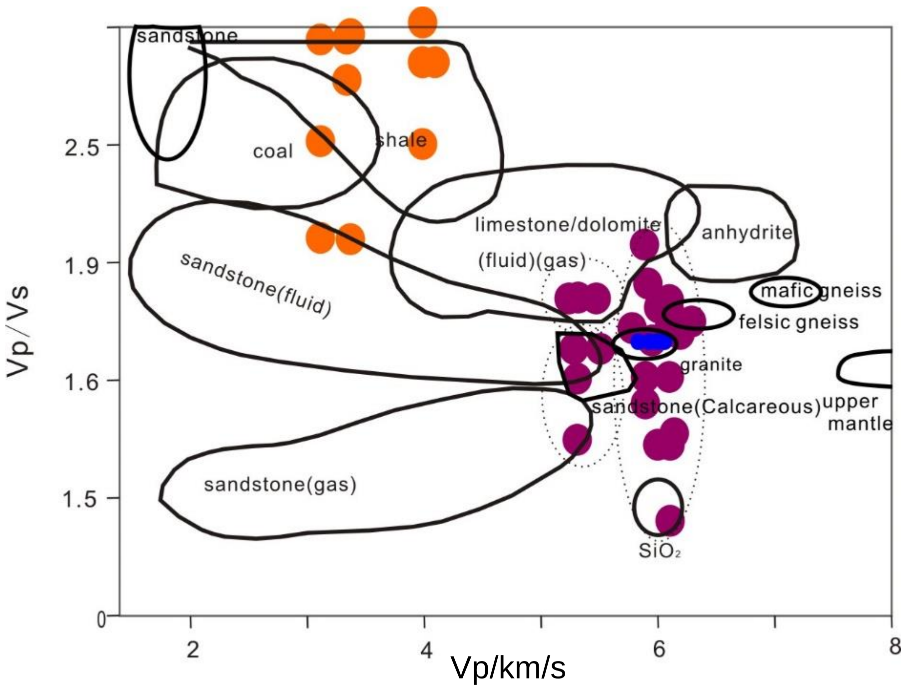
(b) Ray coverage in the final model. Different colors indicate different ray types.

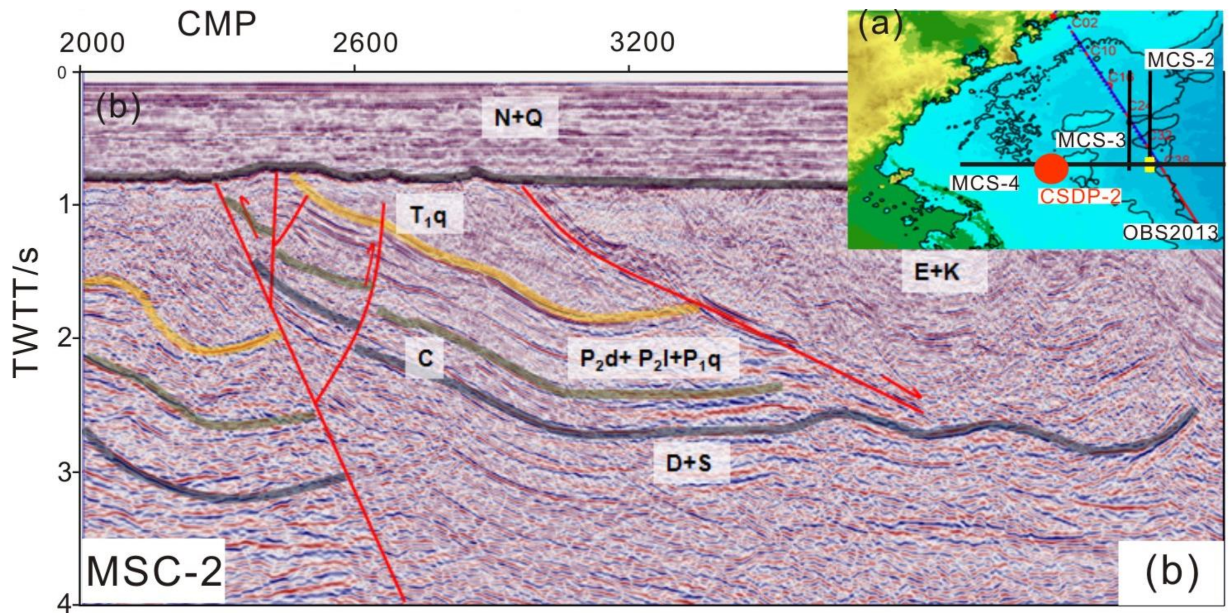
(c) Observed travel-times (colors) and modelled travel-times (black dots).

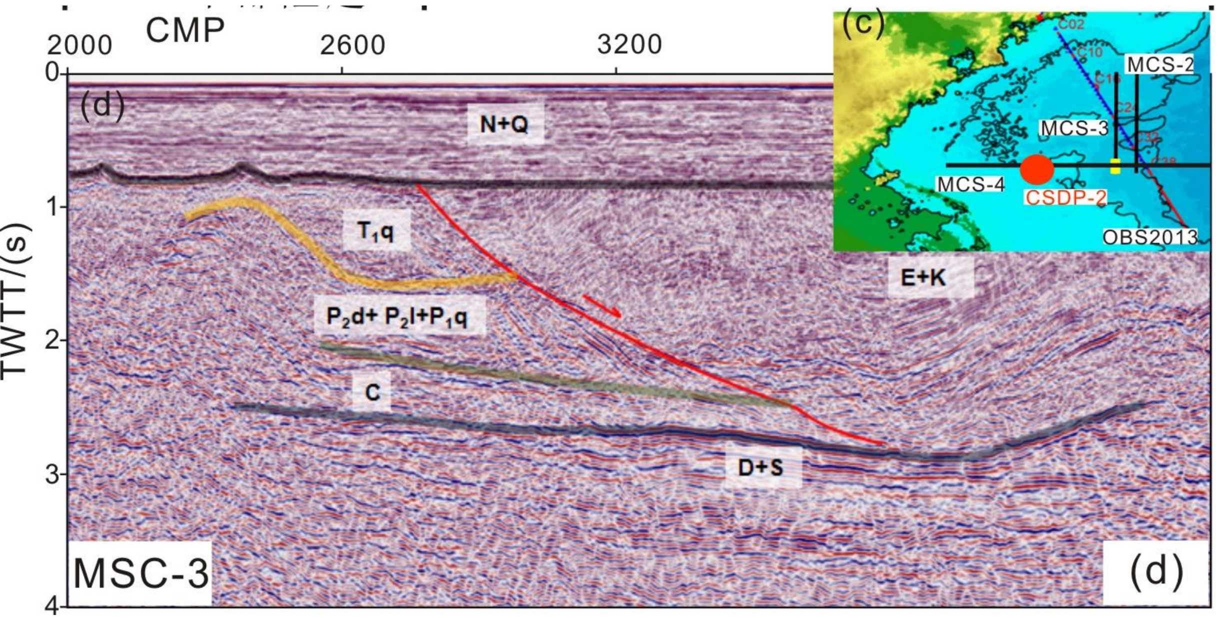
Pg is a base refraction wave with strong energy and good continuity, which is tracked continuously onshore and in the Qianliyan Uplift. Ps denotes shorter basement refraction waves in continental basins of the South Yellow Sea, as recognized in the near offset channels of the OBS stations. P1 and P2 indicate reflected waves from the internal interfaces of the upper crust, which are missing in some gathers. P1s and P2s, which is the refractive wave in the upper and middle crust, respectively, mainly appears in the southern part of the survey line. PcP represents a reflected wave from the upper interface of the lower crust. PmP is a Moho reflection wave with strong energy and good continuity. Pn denotes rays refracted in the upper mantle.

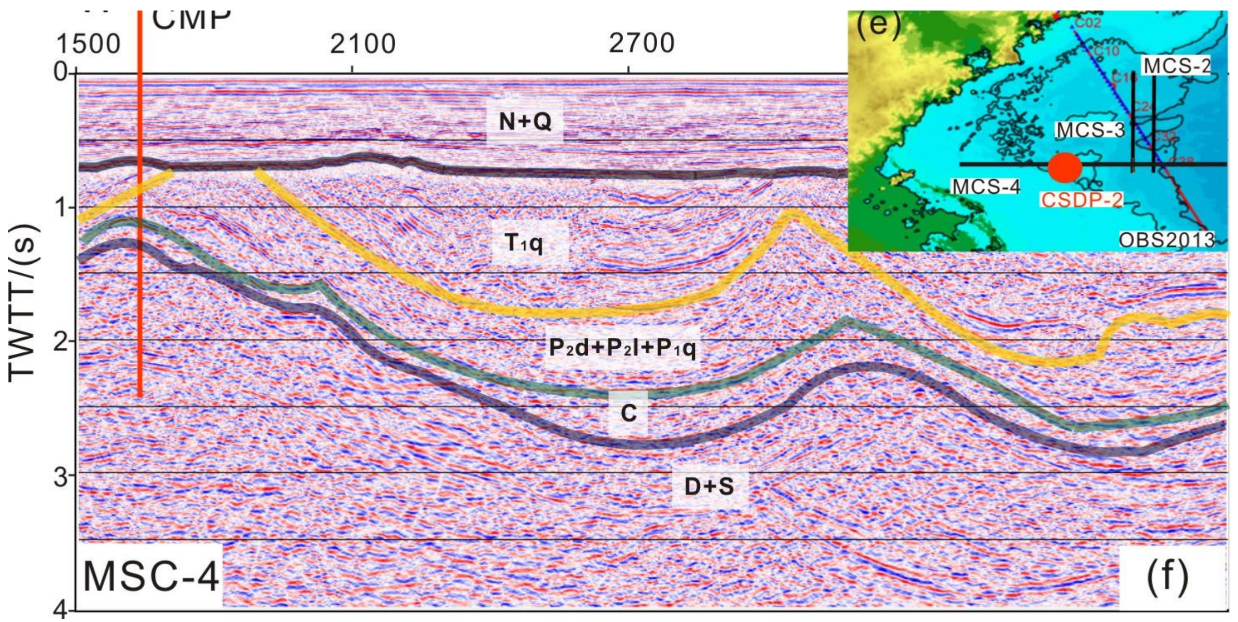


Northern Sulu Orogen
Yangtze Block
Qianliyan Uplift
Northern Depression
Central Uplift
Distance (km)
NW
SE
F5
layer2
layer3
layer4
layer5
layer6
layer7
F
Depth (km)
(a)
Vp (km/s)
(b)
rays (hits)
(c)
(d)
T-D/6 (s)


Vp/Vs
Vp/km/s
2.5
1.9
1.6
1.5
0
2
4
6
8
sandstone
coal
shale
limestone/dolomite
anhydrite
(fluid)(gas)
sandstone(fluid)
mafic gneiss
felsic gneiss
granite
sandstone(Calcareous)
upper mantle
sandstone(gas)
SiO₂


CMP
2000
2600
3200
0
1
2
3
4
TWTT/s
(b)
N+Q
T₁q
E+K
C
P₂d+ P₂l+P₁q
D+S
MSC-2
(a)
MCS-2
MCS-3
MCS-4
CSDP-2
OBS2013


CMP
2000
2600
3200
0
1
2
3
4
TWTT/(s)
(d)
N+Q
T₁q
E+K
P₂d+ P₂l+P₁q
C
D+S
MSC-3
(c)
MCS-2
MCS-3
MCS-4
CSDP-2
OBS2013


CMP
1500
2100
2700
0
1
2
3
4
TWTT/(s)
N+Q
T₁q
P₂d+P₂l+P₁q
C
D+S
MSC-4
(f)
(e)
MCS-2
MCS-3
MCS-4
CSDP-2
OBS2013

Conclusions

- The moho depth achieved in this paper (32-36 km) is consistent with those from previous studies, without a root.
- The uplift and denudation in the orogeny generally appear stronger in the north than in the south.
- The deep NW-dipping fault (F)is the deep footprint of fault system in the South Yellow Sea and appears a normal fault from the velocity feature. Shallow faults in the northern South Yellow Sea could converge towards the deeper crust.