

Geologic and Bathymetric Reconnaissance Overview of the San Pedro Shelf Region, Southern California

by Stephen C. Wolf and Christina E. Gutmacher

This Open File Report was prepared in support of the Cabrillo (Southern California Bight Regional Investigations - Life, Land, Ocean) project of the Western Region's Coastal & Marine Geology Program.

A compilation of US Geological Survey surveys conducted over the San Pedro shelf area was made to determine areal coverage and quality of pre-existing 3.5-kHz bathymetric, high-resolution, and deep-penetration seismic-reflection data. Maps presented in this report depict: 1) the bathymetry and morphology of the seafloor, 2) the thickness of unconsolidated(?) sediments overlying the youngest observed erosional surface, and 3) the near-surface regional geologic structure and stratigraphy including an

analysis of the Palos Verdes Fault Zone.

The maps in this report were primarily developed from data collected during two cruises in 1978 and 1979 (field activity ID's S-2-78-SC and S-2A-79-SC). These two cruises provide sufficient data to present a geologic reconnaissance overview of the San Pedro shelf region. The results of this compilation will be used as part of the planning process to acquire new data to identify offshore earthquake hazards and to correlate the offshore geology with groundwater aquifer systems and onshore geology.

Sheet 1 shows the tracklines of the 1978 and 1979 surveys used in this report. Sheet 2 depicts a plan view image of the seafloor and bathymetric contours developed from

multibeam data from Gardner and Dartnell (2002). Sheet 3 shows an isopach map of unconsolidated(?) sediments, a high-resolution seismic-reflection profile section across the mid-shelf which shows a bedrock high and a flat-lying stratigraphic sequence separated by the Palos Verdes Fault Zone, and a seismic-reflection profile across a paleo-valley, cut during a sealevel lowstand, that is associated with the present day San Gabriel Canyon. Sheet 4 exhibits a series of seismic-reflection profiles across the Palos Verdes Fault Zone and illustrates the fault orientation, sea floor expression, and relationship to the structural bedrock ridge to the west. Sheet 5 is a compilation of high-resolution and deep-penetration seismic-reflection profiles illustrating the relatively flat-lying

stratigraphic sequence between bedrock highs both offshore south of Palos Verdes and near the coast. Traceable reflectors observed on some high-resolution profiles can be correlated with the identical reflectors on matching deeper-penetration profiles. Additionally, a generalized geologic cross section representative of the San Pedro Shelf is shown. Sheet 6 is an isopach map showing the apparent thickness of the uppermost unconsolidated sediment layer overlying the inner shelf, based on data collected on a survey completed in 1973 (field ID K-2-73-SC). Sheet 7 depicts the distribution of recent and older drainage basins which provided sediments into the ancestral and present day San Gabriel Submarine Canyon (seismic profile and cross-section

S-2-78-SC

(Metadata URL:
<http://walrus.wr.usgs.gov/infobank/s/s278sc.html/s-2-78-sc.meta.html>)
List of analog data used in sheets 2-5 of this report:

- LINE 2 122/1527 - 122/1800
U RT, U LFT, 3.5 RT, 3.5 LFT
- LINE 2A 125/1552 - 125/1654
U RT, U LFT, 3.5 RT
- LINE 5 122/2145 - 122/2300
U RT, U LFT, 3.5 RT, 3.5 LFT
- LINE 6 123/0324 - 123/0603
U RT, U LFT, 3.5 RT, 3.5 LFT
- LINE 10 123/1216 - 123/1413
U RT, U LFT, 3.5 RT, 3.5 LFT
- LINE 15 123/2215 - 123/2340
U RT
- LINE 59 125/0630 - 125/1030
U RT
- LINE 65 132/0630 - 132/0830
U RT

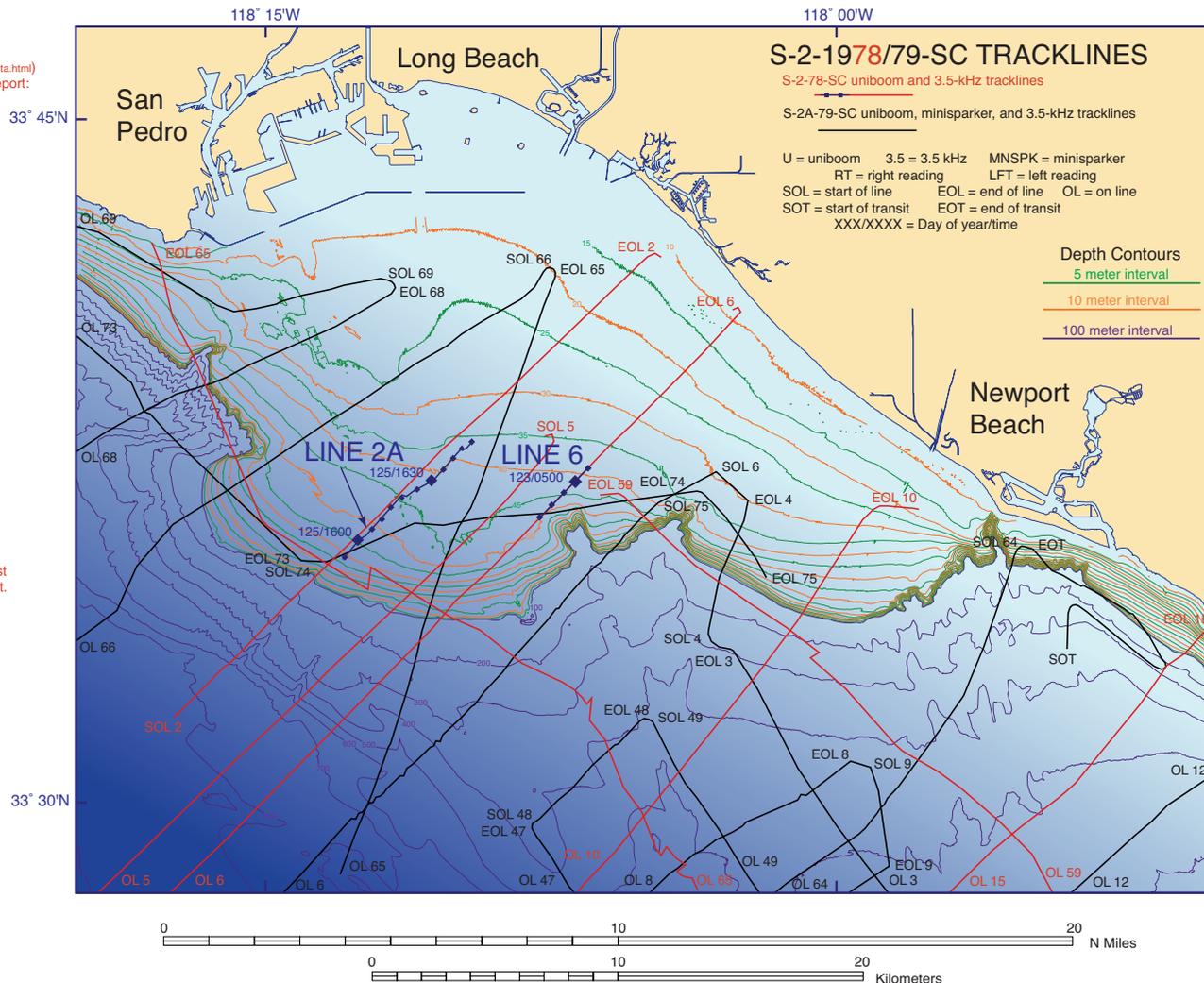
Line 6 is the location of a uniboom seismic line north of the head of San Gabriel submarine canyon showing a paleo-valley cut at a lower stand of sealevel. See sheet 3 of this report.

Line 2A is the location of a uniboom seismic section across a northeast-southwest bedrock high bounded by the Palos Verdes Fault Zone on the northeast side. See sheets 3, 4, and 5 of this report.

Other USGS seismic databases available in this region:

- 3.5-kHz data
- S-1-78-SC
- F-1-84-SC,
- F-2-84-SC
- Y-1-96-SC

- Uniboom and sparker data
- O-1-69-SC
- K-2-73-SC (see sheets 6, 7 this report)
- S-1-78-SC



S-2A-79-SC

(Metadata URL:
<http://walrus.wr.usgs.gov/infobank/s/s2a79sc.html/s-2a-79-sc.meta.html>)

List of analog data used in sheets 2-5 of this report:

- LINE 3 099/1330 - 099/1442
U RT, 3.5 RT
- LINE 4 099/1453 - 099/1530
U RT, 3.5 RT
- LINE 6 099/1545 - 099/1800
U RT, 3.5 RT
- LINE 8 099/1939 - 099/2219
MNSPK RT, 3.5 RT
- LINE 9 099/2223 - 099/2230
MNSPK RT
- LINE 12 100/0730 - 100/0830
MNSPK RT 3.5 RT
- LINES 47, 48, 49
104/0730 - 104/0930
U RT, 3.5 RT
- TR, LINE 64 105/2130 - 106/0130
U RT, 3.5 RT
- LINE 65 106/0630 - 106/0854
U RT, 3.5 RT
- LINE 66 106/0859 - 106/1130
U RT, 3.5 RT
- LINE 68 106/1700 - 106/1835
U RT, 3.5 RT
- LINE 69 106/1838 - 106/2000
U RT, 3.5 RT
- LINE 73 107/1130 - 107/1238
U RT, 3.5 RT
- LINE 74 107/1242 - 107/1403
U RT, 3.5 RT
- LINE 75 107/1406 - 107/1426
3.5 RT

References Sheet 1
(see Sheet 7 for complete reference list)

For bathymetric contours shown here:

Gardner, James V., and Peter Dartnell, 2002, Multibeam Mapping of the Los Angeles, California, Margin: U.S. Geological Survey Open-File Report OF02-162. <http://geopubs.wr.usgs.gov/open-file/of02-162/>

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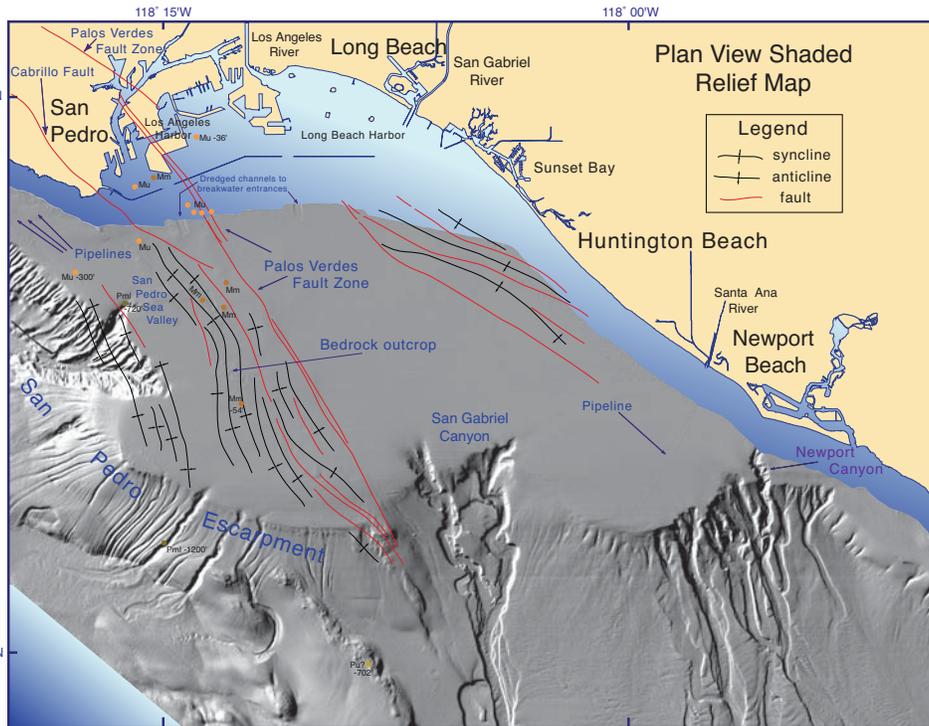
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Digital files available on World Wide Web at <http://pubs.usgs.gov/of/2004/1049/>

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Multibeam shaded relief and bathymetric maps of the San Pedro Shelf region



Cabrillo Fault, onshore location of Palos Verdes Fault Zone, bedrock ages, and sample locations are from Jennings (1962):

- Mu ● Upper Miocene marine
- Mm ● Middle Miocene marine
- Pu ● Upper Pliocene marine
- Pml ● Middle and/or Lower Pliocene marine

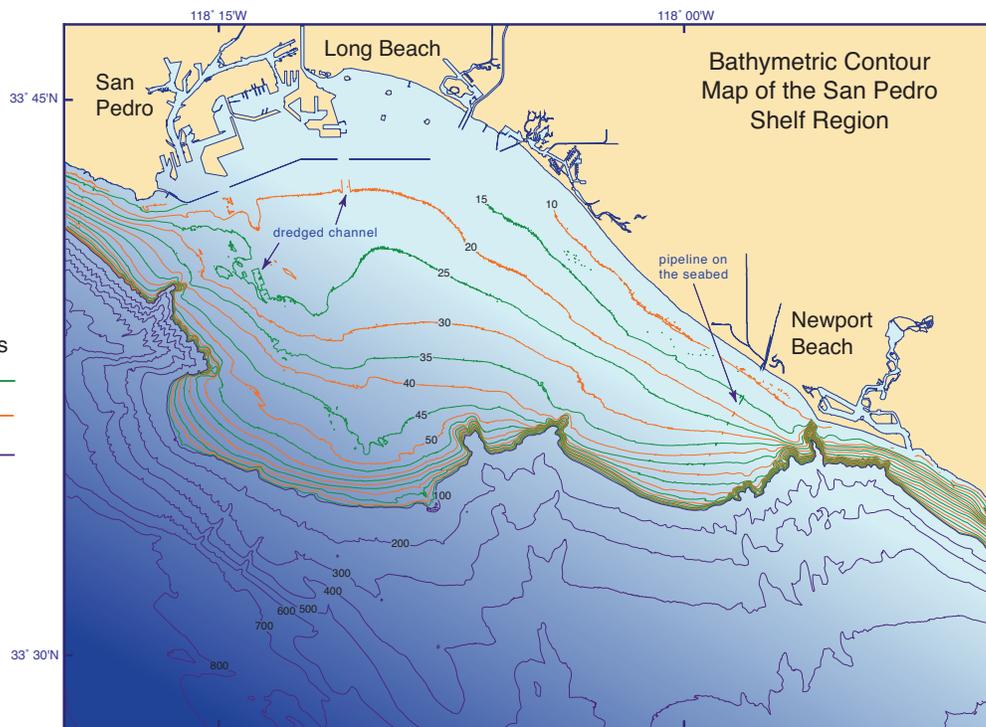
Sample depths where shown are referenced from below seabed.

Location of Palos Verdes Fault Zone in Los Angeles Harbor area interpreted by Stephen Wolf from seismic data taken on USGS cruise A-1-00-SC. Metadata URL: <http://walrus.wr.usgs.gov/infobank/a/a100sc/html/a-1-00-sc.meta.html>

Plan view shaded relief and bathymetric contour maps developed from data published by Gardner and Dartnell (2002). The imagery above shows a rough seabed over a structural bedrock high west of the Palos

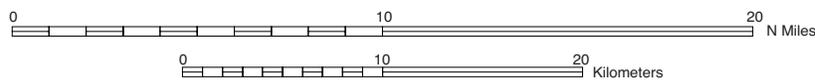
Verdes Fault Zone in contrast to the relatively smooth seabed to the east which overlies a relatively flat-lying stratigraphic sequence. Positions of offshore faults and axes of anticlines and synclines interpreted from

seismic data are approximate and are primarily shown to illustrate the structural grain of the bedrock high. See sheets 4 and 5 which show seismic-reflection profile sections across the shelf.



Depth Contours

- 5 meter interval
- 10 meter interval
- 100 meter interval



References Sheet 2 (see Sheet 7 for complete reference list)

Gardner, James V., and Peter Dartnell, 2002, Multibeam Mapping of the Los Angeles, California, Margin, U.S. Geological Survey Open-File Report OF02-162, <http://geopubs.wr.usgs.gov/open-file/of02-162/>

Jennings, C.W., compiler, 1962, Geologic Atlas of California: Long Beach, California Division of Mines and Geology GAM-007, scale 1:250,000.

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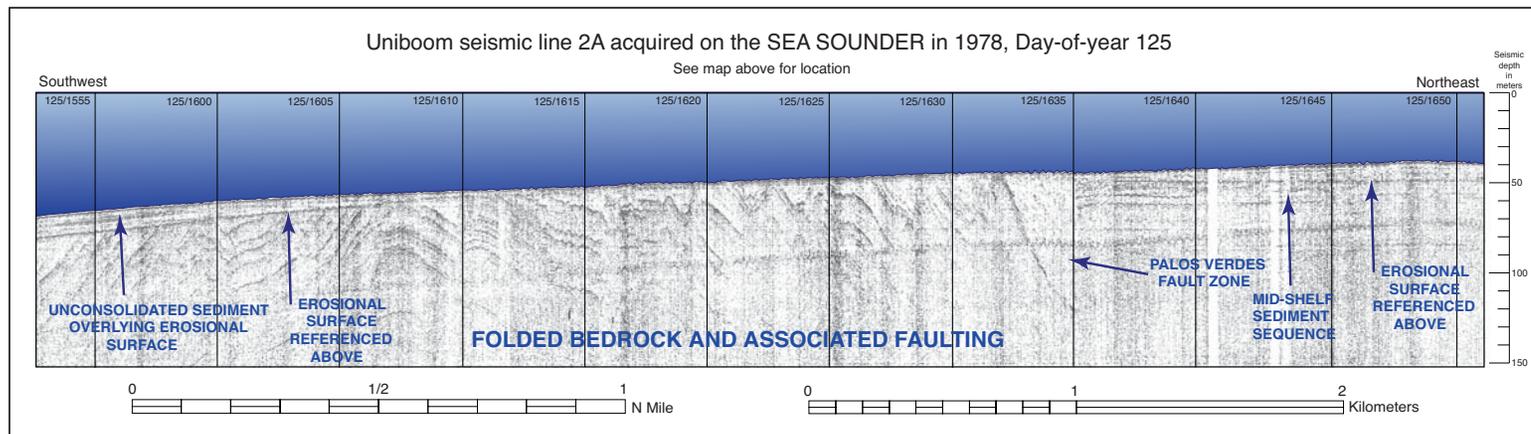
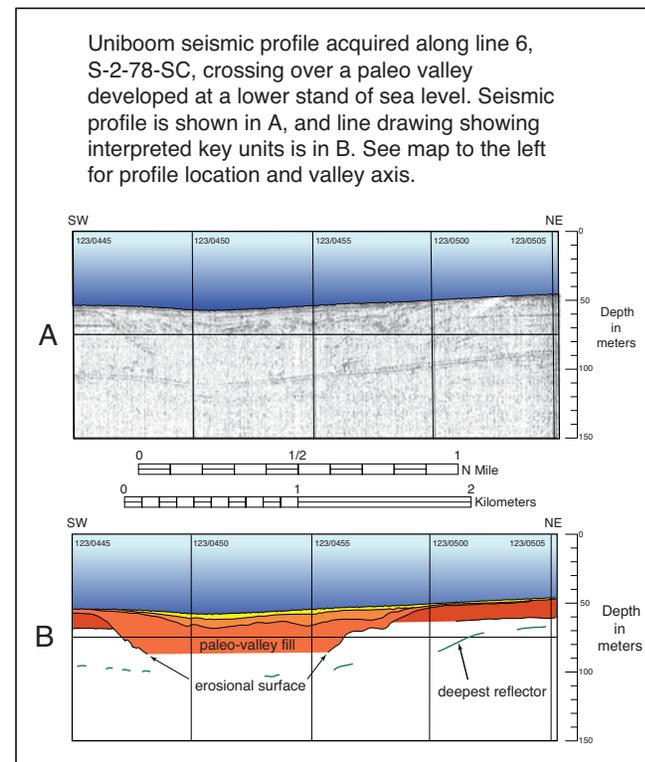
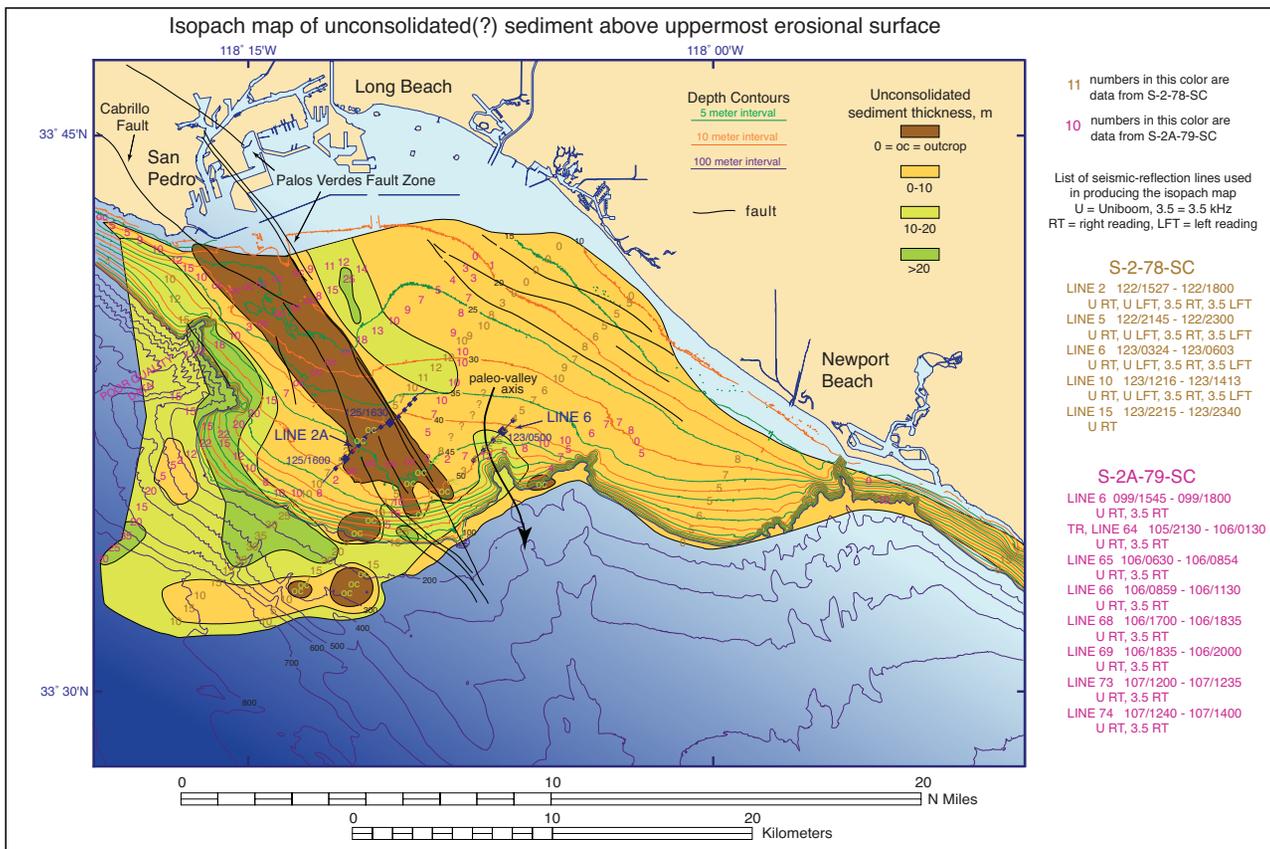
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The S-2A-79-SC data generally show penetration depths equal to or greater than those shown for S-2-78-SC. Data collected during the 1978 cruise were recorded using a 1/4-second scan in contrast to data collected in 1979 which were recorded at a 1/2-second scan. Differences between cruises such as tuning of the instrumentation, resolution, sea states, power output of the acoustic system, and speed of the vessel over the sea floor all effect the quality of data recorded.

References Sheet 3

(see Sheet 7 for complete reference list)

for bathymetric contours:

Gardner, James V., and Peter Dartnell, 2002, Multibeam Mapping of the Los Angeles, California, Margin, U.S. Geological Survey Open-File Report OF02-162. <http://geopubs.wr.usgs.gov/open-file/of02-162/>

for onshore faults:

Jennings, C.W., compiler, 1962, Geologic Atlas of California: Long Beach, California Division of Mines and Geology GAM-007, scale 1:250,000 (reprinted 1992).

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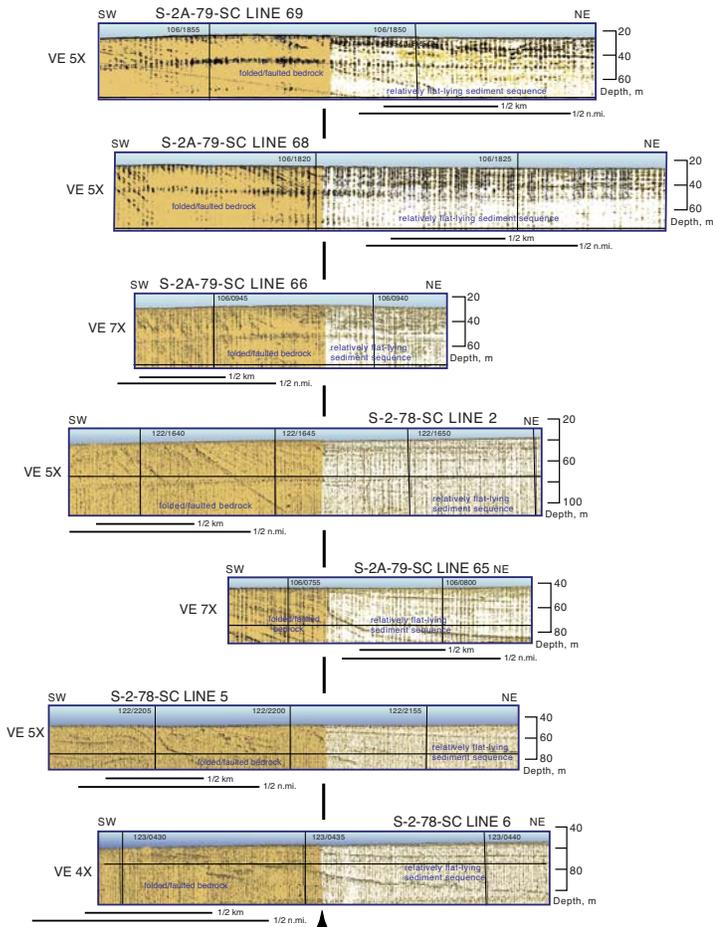
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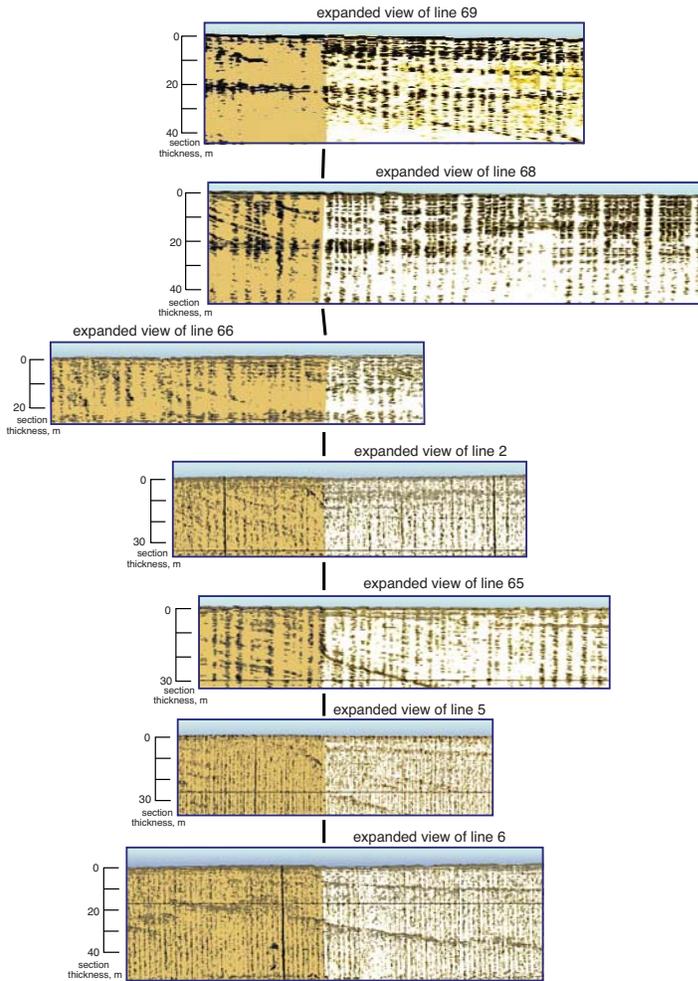
Seismic-reflection profiles across the Palos Verdes Fault Zone along the outer edge of the San Pedro Shelf

Selected uniboom seismic-reflection profiles
(VE = vertical exaggeration as shown)



Palos Verdes Fault Zone

Uniboom seismic-reflection-profile segments shown below cross the Palos Verdes Fault Zone. To show fault characteristics, each segment is expanded 2X from the original profile to the left.



Palos Verdes Fault Zone

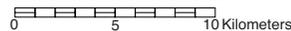
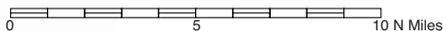
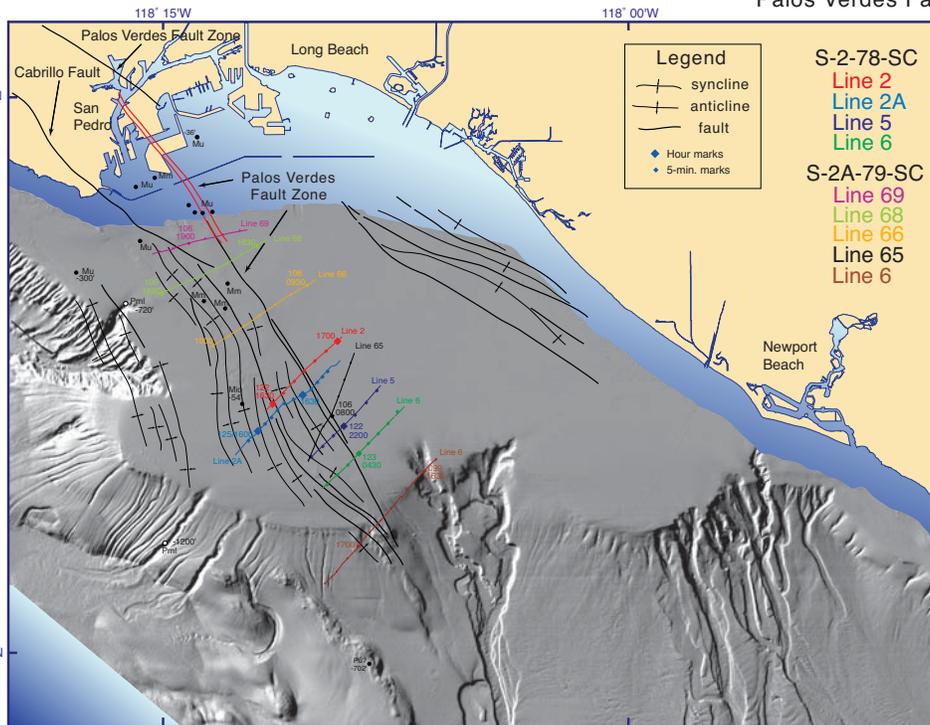
Positions of offshore faults and axes of anticlines and synclines, interpreted from seismic data, are approximate and are primarily shown to illustrate the structural grain of the bedrock high west/southwest of the Palos Verdes Fault Zone.

Cabrillo Fault, onshore location of Palos Verdes Fault Zone, bedrock ages, and sample locations are from Jennings (1962):

- Mu ● Upper Miocene marine
- Mm ● Middle Miocene marine
- Pu ● Upper Pliocene marine
- Pml ● Middle and/or Lower Pliocene marine

Sample depths where shown are referenced from below seabed.

Location of Palos Verdes Fault Zone in Los Angeles Harbor area interpreted by Stephen Wolf from seismic data taken on USGS cruise A-1-00-SC.



References Sheet 4 (see Sheet 7 for complete reference list)

For shaded relief:
Gardner, James V., and Peter Dartnell, 2002, Multibeam Mapping of the Los Angeles, California, Margin, U.S. Geological Survey Open-File Report OF02-162
<http://geopubs.wr.usgs.gov/open-file/of02-162/>

Jennings, C.W., compiler, 1962, Geologic Atlas of California: Long Beach, California Division of Mines and Geology GAM-007, scale 1:250,000 (reprinted 1992)

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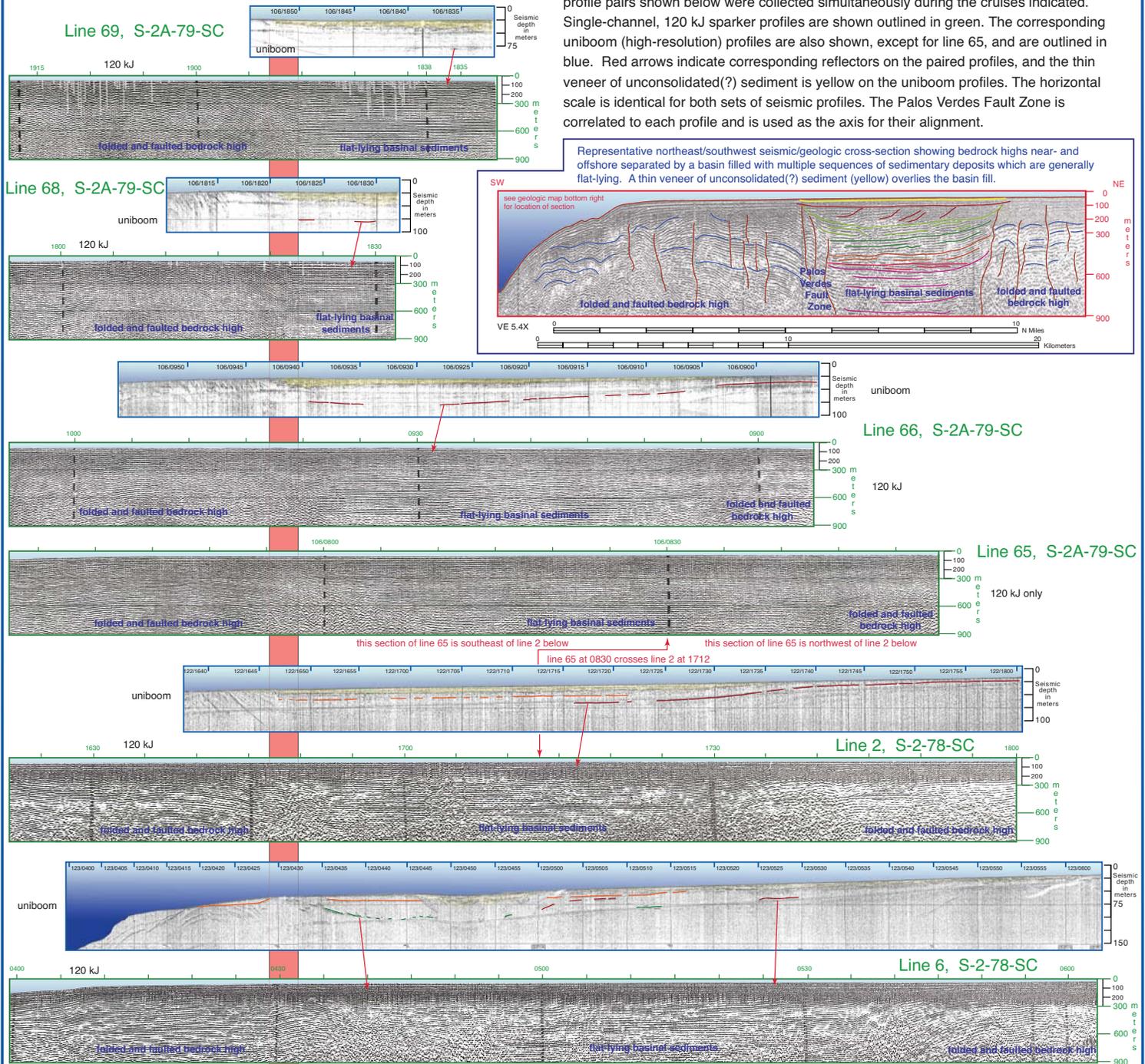
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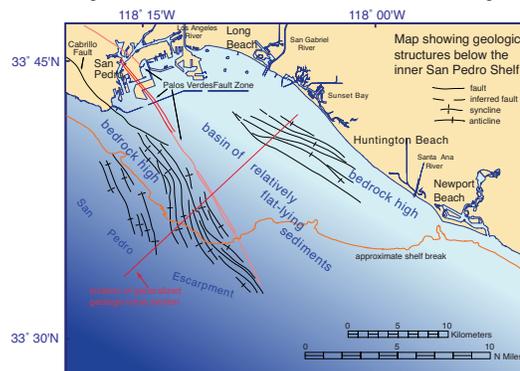
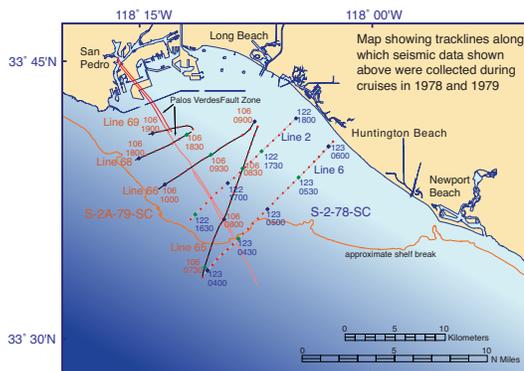
The geologic map and generalized cross-section shown here are derived from 120 kilo-Joule single-channel sparker and high-resolution uniboom seismic-reflection data. Seismic

profile pairs shown below were collected simultaneously during the cruises indicated. Single-channel, 120 kJ sparker profiles are shown outlined in green. The corresponding uniboom (high-resolution) profiles are also shown, except for line 65, and are outlined in blue. Red arrows indicate corresponding reflectors on the paired profiles, and the thin veneer of unconsolidated(?) sediment is yellow on the uniboom scale. The horizontal scale is identical for both sets of seismic profiles. The Palos Verdes Fault Zone is correlated to each profile and is used as the axis for their alignment.



Palos Verdes Fault Zone

Positions of harbor area Palos Verdes Fault Zone, and offshore faults and axes of anticlines and synclines, are interpreted from seismic data; they are approximate and are primarily shown to illustrate the structural grain of the bedrock highs west/ southwest of the Palos Verdes Fault Zone and along the inner San Pedro Shelf.



References Sheet 5

(see Sheet 7 for complete reference list)

For Cabrillo Fault and onshore location of Palos Verdes Fault Zone:
 Jennings, C.W., compiler, 1962, Geologic Atlas of California: Long Beach, California Division of Mines and Geology GAM-007, scale 1:250,000 (reprinted 1992)

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OPEN-FILE REPORT 2004-1049
Sheet 6 of 7, Version 1.0
Holocene(?) isopach map

Isopach Map Showing the Approximate Thickness of Uppermost (Holocene?) Sediment Layer

Seismic Data Bases
Line # start day/time – end day/time

K-2-73-SC (in purple)

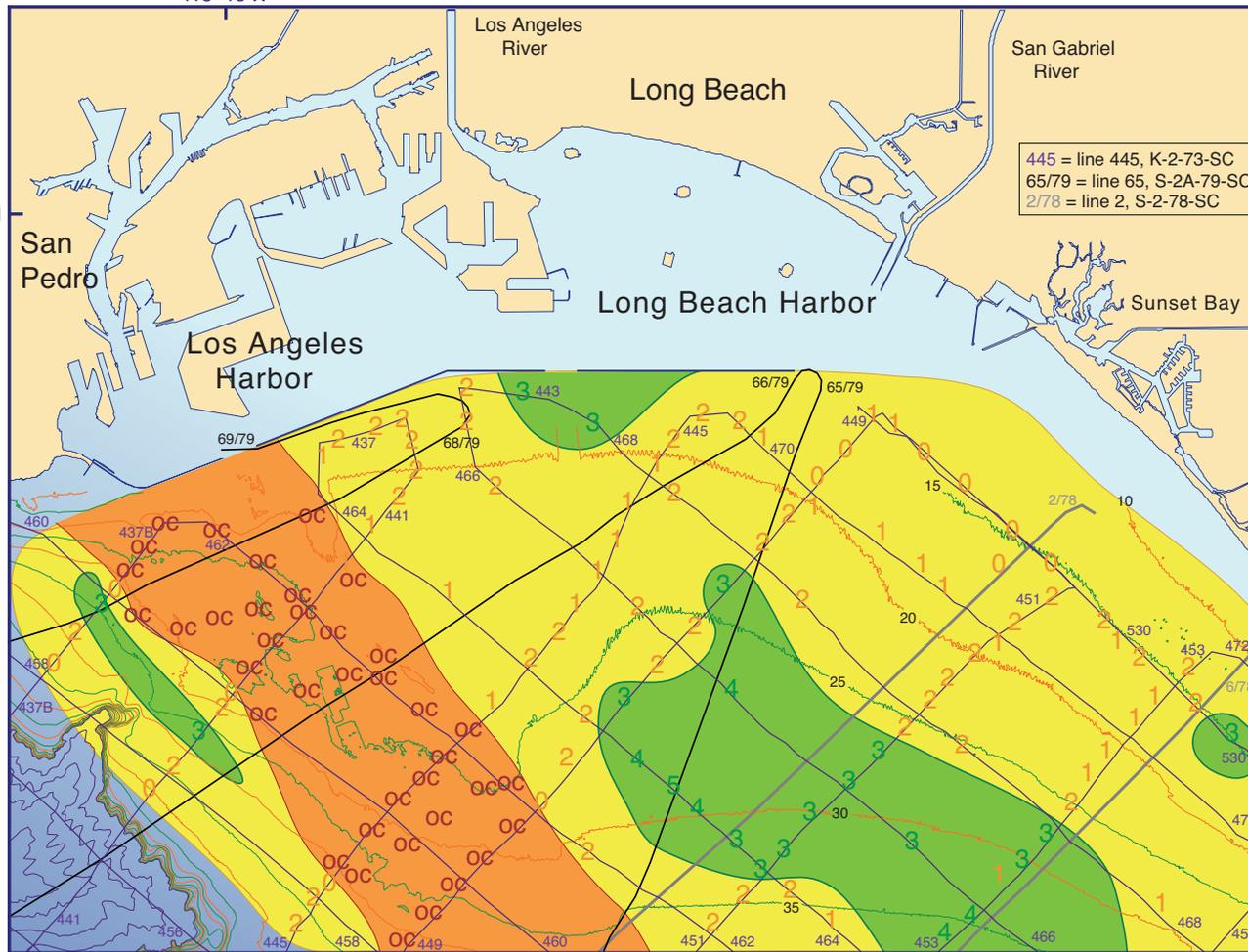
- 431 134/0200 – 134/0235
- 433 134/1649 – 134/1707
- 437B 134/0917 – 134/0953
- 437 135/0623 – 135/0635
- 441 135/0425 – 135/0613
- 443 135/1155 – 135/1203
- 445 135/1646 – 135/2115
- 449 135/2131 – 136/0201
- 450 136/0607 – 136/0631
- 451 136/0225 – 136/0605
- 452 134/2043 – 134/2208
- 452 135/0158 – 135/0349
- 453 136/0635 – 136/1006
- 454 134/1341 – 134/1642
- 455 136/1026 – 136/1505
- 456 134/0956 – 134/1214
- 457 136/1530 – 136/2015
- 458 134/1712 – 134/1957
- 459 134/1230 – 134/1301
- 459 134/2000 – 134/2039
- 460 134/0253 – 134/0600
- 462 134/0630 – 134/0912
- 464 135/0640 – 135/0902
- 465 135/0906 – 135/0917
- 466 135/0921 – 135/1147
- 467 135/1417 – 135/1430
- 468 135/1205 – 135/1400
- 470 135/1434 – 135/1642
- 472 136/1010 – 136/1023
- 528 136/2018 – 136/2024
- 530 136/2029 – 136/2303

S-2A-79-SC (in black)

- Line 65 106/0630 – 106/0854
- Line 66 106/0859 – 106/1130
- Line 68 106/1700 – 106/1835
- Line 69 106/1838 – 106/2000

S-2-78-SC (in grey)

- Line 2 122/1527 – 122/1800
- Line 6 123/0324 – 123/0603



Possible Holocene sediment thickness in meters

- OC
bedrock outcrop
- 2
0-2m
- 3
2-4m

References Sheet 6
(see Sheet 7 for complete reference list)

For bathymetric contours:
Gardner, James V., and Peter Dartnell, 2002, Multibeam Mapping of the Los Angeles, California, Margin, U.S. Geological Survey Open-File Report OF02-162 <http://geopubs.wr.usgs.gov/open-file/of02-162/>

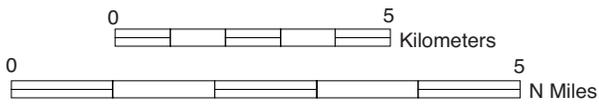
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- Depth Contours**
- 5 meter interval
 - 10 meter interval
 - 100 meter interval





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Sheet 7 of 7, Version 1.0
Paleo-valley/drainage basins

San Gabriel Canyon Paleo-Valley and Associated Drainage Basins

SOURCES OF DATA For San Pedro Shelf: K-2-73-SC

Metadata URL: <http://walrus.wr.usgs.gov/infobank/k/k273sc/html/k-2-73-sc.meta.html>

Uniboom plus 120-kiloJoule sparker lines:

431, 433, 437, 437B, 441, 445, 449, 450, 451, 453, 455, 457, 459, 462, 464, 465, 466, 468, 470, 528, 530

Uniboom lines: 443, 472

120-kJ sparker lines: 452, 454, 456, 458, 460, 467

Uniboom vellum copy rolls:

13, 14, 15

120-kJ sparker vellum copy rolls:

13, 14, 15

Uniboom original rolls:

21, 22, 26, 27, 28, 29, 33

120-kJ sparker original rolls:

11, 12

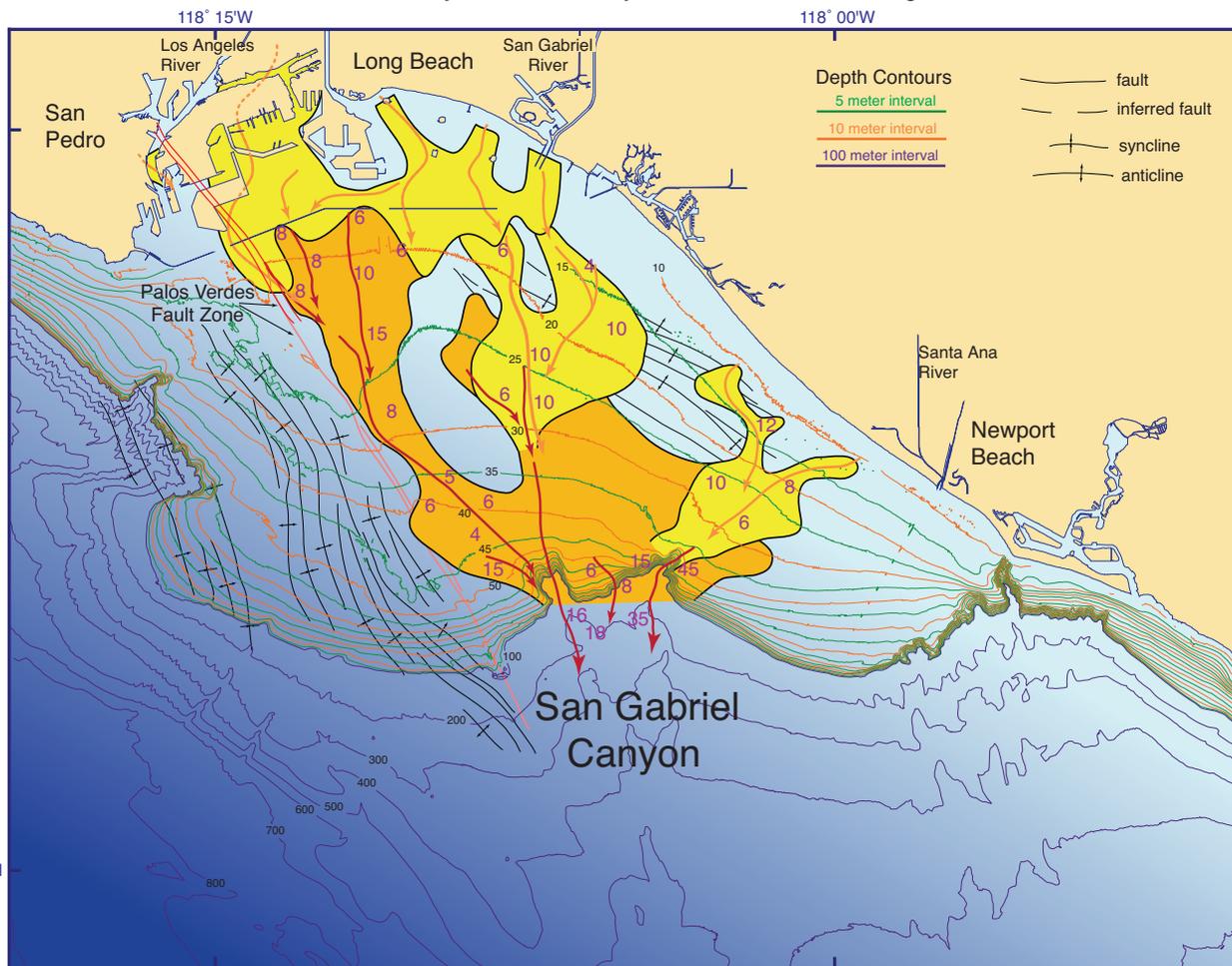
For Palos Verdes Fault Zone and drainage patterns in and near harbor area: A-1-00-SC

Metadata URL: <http://walrus.wr.usgs.gov/infobank/a/a100sc/html/a-1-00-sc.meta.html>

Geopulse lines: 403, 800, 802, 806, 816, 817, 818, 821, 835, H800A, H801A, H802A, H803A, H809, H810, H815, H817A, H819, H819A, H820, H820A, H821A, H822, H823, H823A, H824, H825, H826, H836, H837, H838, H899A, transit H821A-822

Minisparker lines: 401M,

802AM, 802M, 813AX, 815AM, 840, 841, H800B, H802B, H805M, H806M, H807, H808, H808M, H809M, H809MD, H811A, H812A, H812M, H812M, H813, H814, H817B, H829A, H839, H899B



Depth Contours

5 meter interval

10 meter interval

100 meter interval

fault

inferred fault

syncline

anticline



recent drainage pattern and axis of feeder channels



older drainage pattern and axis of feeder channels

10

numbers represent approximate thickness of sediment fill in meters

OFR References

For shaded relief and bathymetry where shown:
Gardner, James V., and Peter Dartnell, 2002, Multibeam Mapping of the Los Angeles, California, Margin, U.S. Geological Survey Open-File Report OF02-162 <http://geopubs.wr.usgs.gov/open-file/of02-162/>

For Cabrillo Fault, Palos Verdes Fault Zone onshore, and bedrock sample locations and ages offshore where shown:
Jennings, C.W., compiler, 1962, Geologic Atlas of California: Long Beach, California Division of Mines and Geology GAM-007, scale 1:250,000 (reprinted 1992)

The authors gratefully acknowledge the work of Michael Hamer to prepare shaded relief, coastline and bathymetric map bases, and of Florence Wong to upgrade the bathymetric contours and prepare the metadata.

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10 0 10 Kilometers

10 0 10 N Miles

