Table 21-7. Comparison of seismic wave velocities in the ISFSI study area and at the DCPP power block

Depth Interval (Feet)	ISFSI Site	Power Block Site
5-50	Refraction Velocities Compressive Wave (Vp) [1] (feet/second) 2700-6500	Refraction Velocities Compressive Wave (Vp) [1] (feet/second) 2350-5700
5-50 50-200	Suspension Velocities Compressive Wave (Vp) [2] (feet/second) 4500-9100 7300-12700	Downhole Velocities Compressive Wave (Vp) [3] (feet/second) 2450-9800 5690-15000
10-30 30-150	Suspension Velocities Shear Wave (Vs) [2] (feet/second) 3400-4800 3100-5400	Downhole Velocities Shear Wave (Vs) [4] (feet/second) 2200-4400 2600-5400

[1] Velocities reported for rock below thin soil layer or surface disturbed zone (John A. Blume & Associates, 1968)

[2] Averaged from WLA 1998 borings

[3] Averaged from 1967 and 1977 borings DDH-1 through 4 and DDH-A through D (URS/John A. Blume & Associates, 1977)

[4] LTSP envelope (PG&E, 1988)

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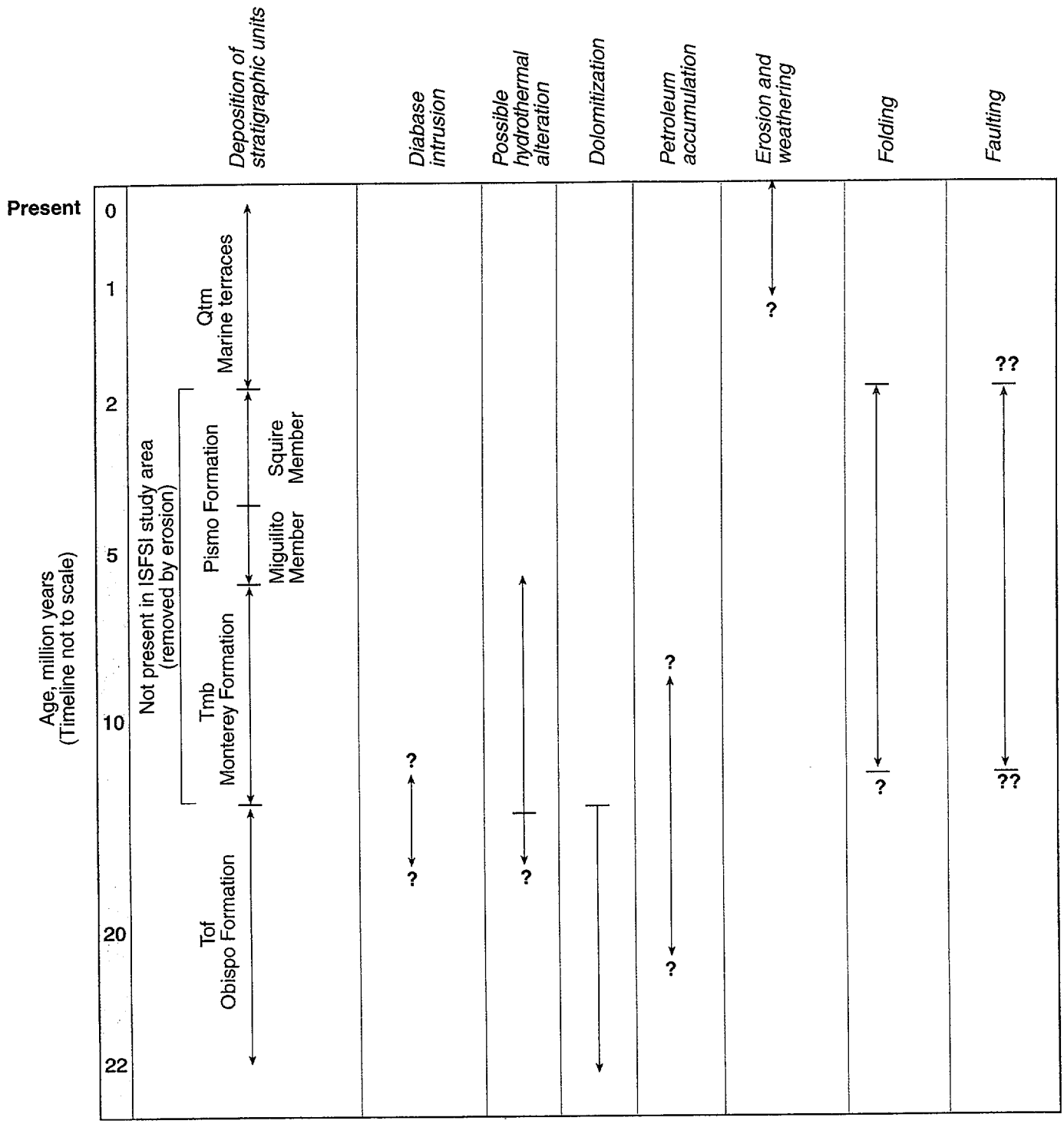
Security-Related Information – Withhold Under 10 CFR 2.390.



DIABLO CANYON ISFSI

FIGURE 21-8
CHRONOLOGY OF STRATIGRAPHY AND GEOLOGIC PROCESSES AT THE ISFSI STUDY AREA

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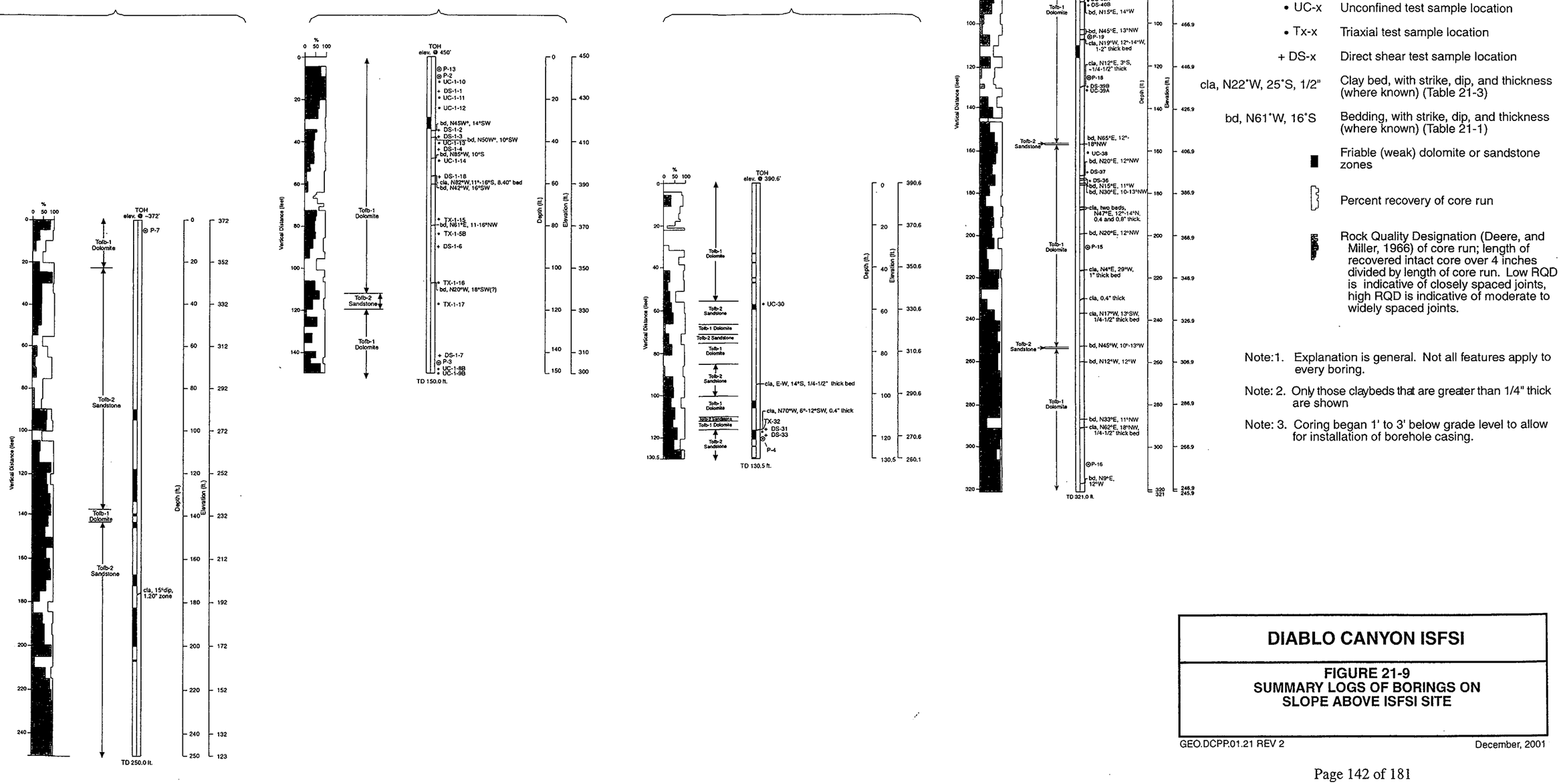

Note:1. Explanation is general. Not all features apply to every boring.

Note: 2. Only those claybeds that are greater than 1/4" thick are shown

Note: 3. Coring began 1' to 3' below grade level to allow for installation of borehole casing.

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FIGURE 21-9
SUMMARY LOGS OF BORINGS ON SLOPE ABOVE ISFSI SITE

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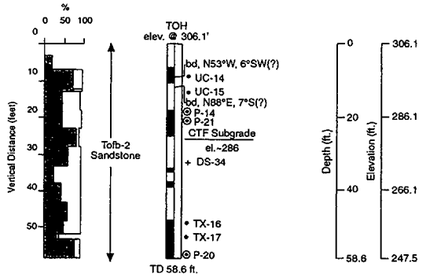
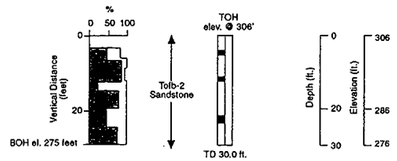
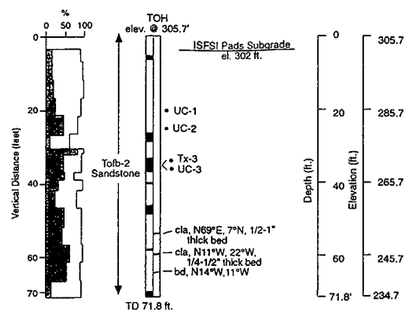
BORING 01CTF-A



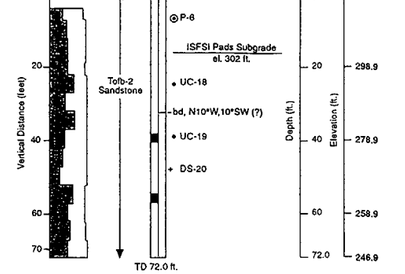
BORING 00BA-3



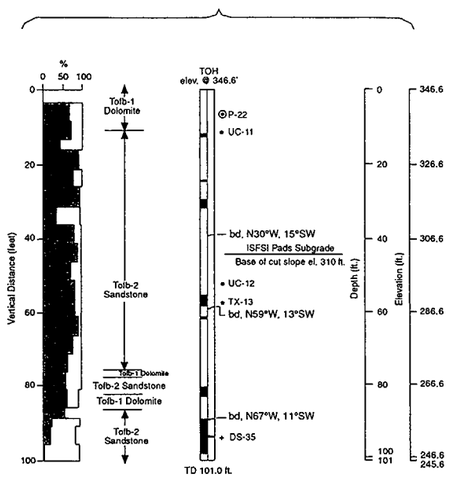
BORING 01-A



BORING 01-B



BORING 01-H



Explanation

⊙ P-x	Petrographic sample location
• UC-x	Unconfined test sample location
• Tx-x	Triaxial test sample location
+ DS-x	Direct shear test sample location
cla, N22°W, 25°S, 1/2"	Clay bed, with strike, dip, and thickness (where known) (Table 21-3)
bd, N61°W, 16°S	Bedding, with strike, dip, and thickness (where known) (Table 21-1)
▮	Friable (weak) dolomite or sandstone zones
	Percent recovery of core run
	Rock Quality Designation (Deere, and Miller, 1966) of core run; length of recovered intact core over 4 inches divided by length of core run. Low RQD is indicative of closely spaced joints, high RQD is indicative of moderate to widely spaced joints.

Note:1. Explanation is general. Not all features apply to every boring.

Note: 2. Only those claybeds that are greater than 1/4" thick are shown

Note: 3. Coring began 1' to 3' below grade level to allow for installation of borehole casing.

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FIGURE 21-10
SUMMARY LOGS OF BORINGS NEAR SOUTHWEST END OF ISFSI SITE

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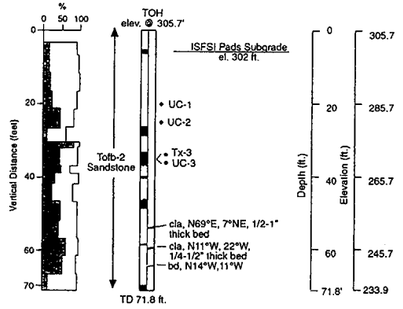
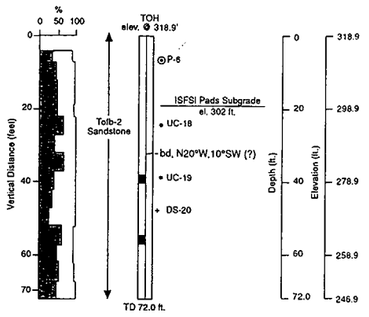
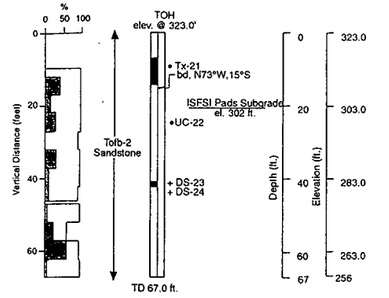
BORING 01-A



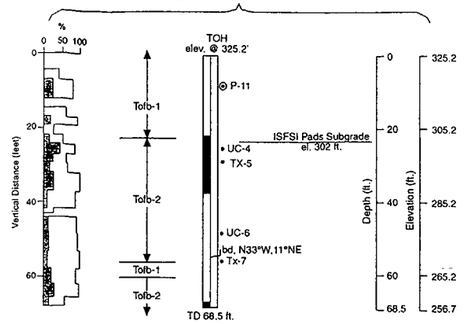
BORING 01-B



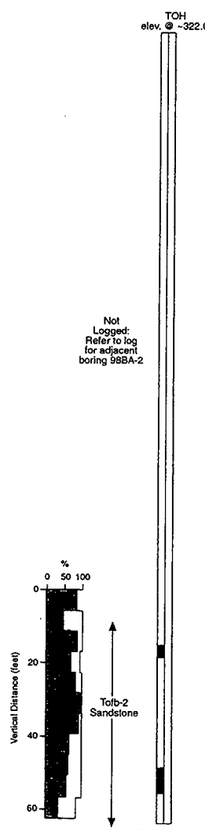
BORING 01-C



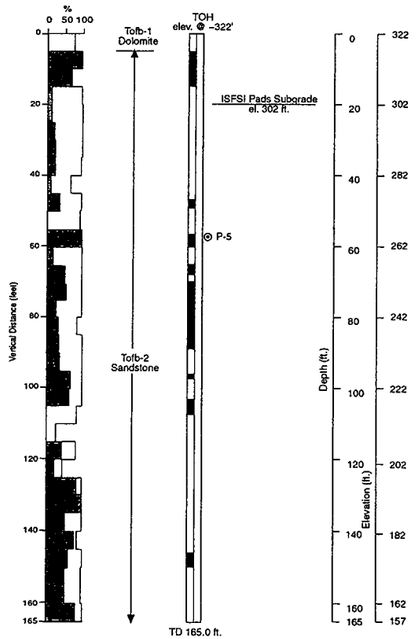
BORING 01-D



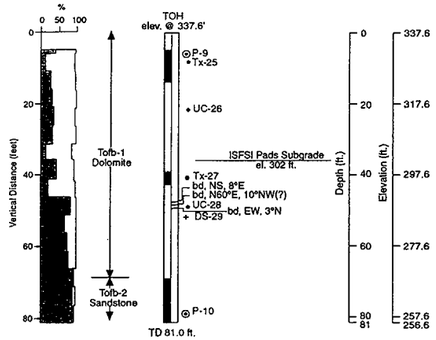
BORING 98BA-3



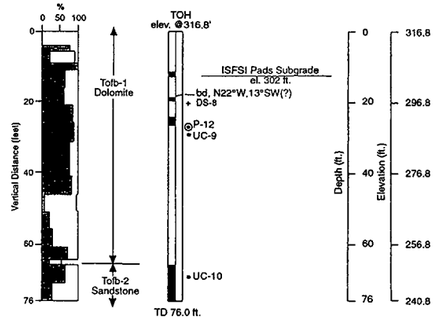
BORING 98BA-2



BORING 01-E



BORING 01-G



Explanation

⊙ P-x	Petrographic sample location
• UC-x	Unconfined test sample location
• Tx-x	Triaxial test sample location
+ DS-x	Direct shear test sample location
cla, N22°W, 25°S, 1/2"	Clay bed, with strike, dip, and thickness (where known) (Table 21-3)
bd, N61°W, 16°S	Bedding, with strike, dip, and thickness (where known) (Table 21-1)
▮	Friable (weak) dolomite or sandstone zones
	Percent recovery of core run
	Rock Quality Designation (Deere, and Miller, 1966) of core run; length of recovered intact core over 4 inches divided by length of core run. Low RQD is indicative of closely spaced joints, high RQD is indicative of moderate to widely spaced joints.

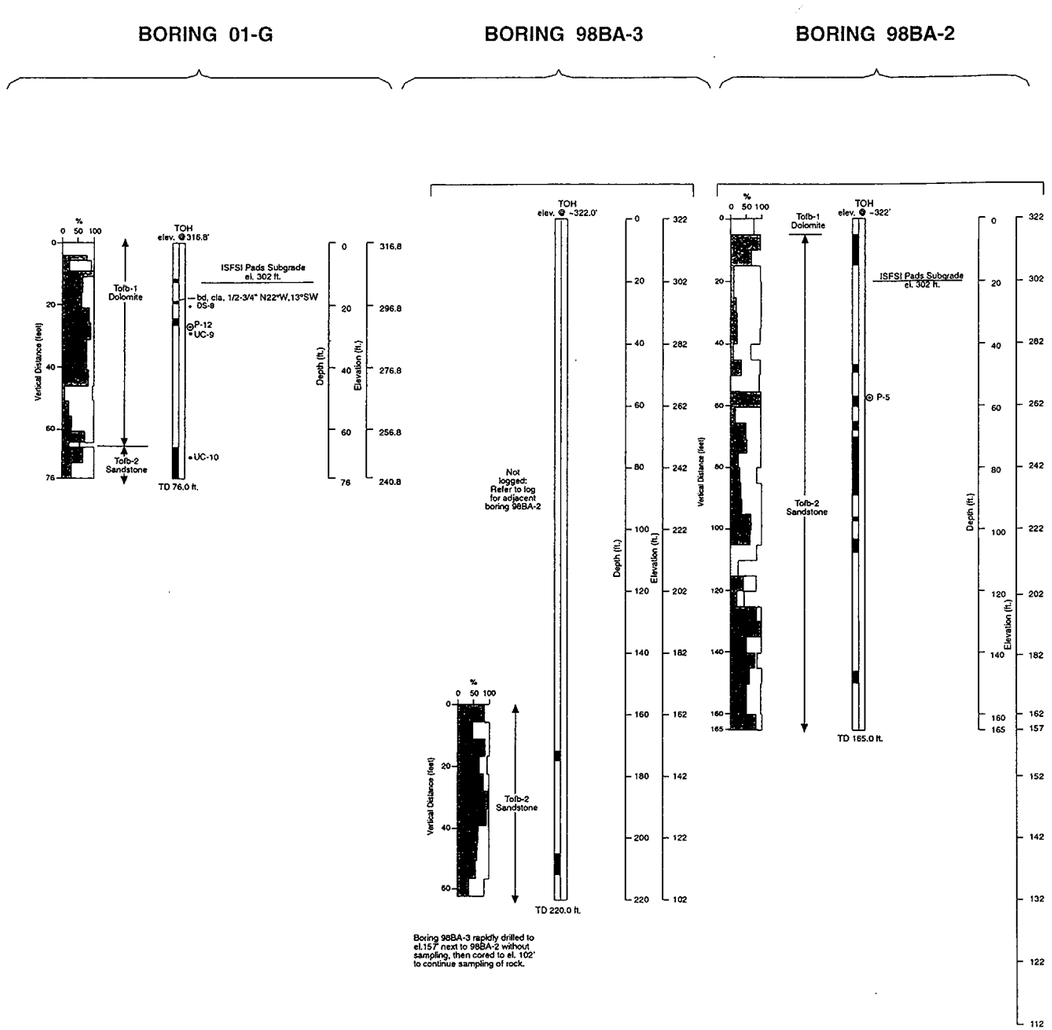
Note:1. Explanation is general. Not all features apply to every boring.

Note: 2. Only those claybeds that are greater than 1/4" thick are shown

Note: 3. Coring began 1' to 3' below grade level to allow for installation of borehole casing.

DIABLO CANYON ISFSI

FIGURE 21-11
SUMMARY LOGS OF BORINGS AT ISFSI SITE



Explanation

⊙ P-x	Petrographic sample location
• UC-x	Unconfined test sample location
• Tx-x	Triaxial test sample location
+ DS-x	Direct shear test sample location
cla, N22°W, 25°S, 1/2"	Clay bed, with strike, dip, and thickness (where known) (Table 21-3)
bd, N61°W, 16°S	Bedding, with strike, dip, and thickness (where known) (Table 21-1)
▮	Friable (weak) dolomite or sandstone zones
	Percent recovery of core run
RQD	Rock Quality Designation (Deere, and Miller, 1966) of core run; length of recovered intact core over 4 inches divided by length of core run. Low RQD is indicative of closely spaced joints, high RQD is indicative of moderate to widely spaced joints.

Note:1. Explanation is general. Not all features apply to every boring.

Note: 2. Only those claybeds that are greater than 1/4" thick are shown

Note: 3. Coring began 1' to 3' below grade level to allow for installation of borehole casing.

DIABLO CANYON ISFSI

FIGURE 21-12
SUMMARY LOGS OF BORINGS
NEAR EAST END OF ISFSI SITE

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Explanation

Geology

Quaternary

- **af** — Artificial fill (engineered)
- **Qal, Qdf, Qc, Qls, Qhf** — Quaternary deposits - alluvium (Qal), debris flow (Qdf), colluvium (Qc), landslide (Qls), Holocene colluvial fan (Qhf)
- **Qpf** — Pleistocene colluvial fan
- **Qpt$_m$** — Pleistocene marine terrace deposit (inferred)

Tertiary

- **Tvr** — Volcanic rock (middle Miocene), diabase intrusive sills and dikes

Obispo Formation (lower and middle Miocene)

- **Tof$_b$** — Member Tof, unit b - dolomite, dolomitic siltstone, dolomitic sandstone, and sandstone: medium to thick bedding
  - *DOLOMITE SUBUNIT*
    - **Tof$_b$-1** — Dolomite, clayey dolomite, dolomitic siltstone to fine-grained dolomitic sandstone, and limestone. The unit contains occasional discontinuous to continuous (tens to hundreds of feet) clay beds that are generally 1/32- to 1/2-inch thick, but locally are thicker. Rocks in this unit are moderately to well cemented, moderately hard to hard, moderately to slightly weathered, brittle and typically medium strong.
    - **Tof$_b$-1a** — Friable dolomite and dolomitic siltstone of unit Tof$_b$-1. These rocks typically have low hardness, are very weak to weak, and occur as discontinuous zones where weathering and/or alteration has been concentrated. Inferred lateral extent of friable zones is schematic.
  - *SANDSTONE SUBUNIT*
    - **Tof$_b$-2** — Fine to coarse-grained dolomitic sandstone and sandstone (arkosic to arenitic) with lesser dolomite beds. Detrital clasts are composed primarily of dolomitized feldspars, marine fossil fragments, and volcanic rock fragments. Discontinuous clay beds that are generally less than 1/2-inch thick occur locally within the unit. The rocks are of low to medium hardness, moderately to well cemented and typically medium strong.
    - **Tof$_b$-2a** — Friable sandstone of unit Tof$_b$-2. These rocks typically are of low hardness, are very weak to weak, and occur as discontinuous zones where weathering and/or alteration has been concentrated. Inferred lateral extent of friable zones is schematic.
- **Tof$_c$** — Member Tof, unit c - shale, claystone and siltstone, thin to medium bedding, extensively sheared
- **Tor** — Member Tor - volcanic rock, zeolitized and silicified tuff

Symbols

- Apparent dip of bedding
- Apparent dip of bedding measured in boring
- Bedding shown schematically and inferred from projection of nearby surface outcrops or borehole surveys
- ? Lithologic contact, inferred except where encountered in boreholes and surface mapping, queried where uncertain
- Fault - location based on projection of trench or surface exposure. Vertical projection is inferred. Dip of fault assumed to be vertical unless well constrained by multiple surface attitudes. Queried where uncertain. Sense of vertical separation is indicated by arrows and inferred horizontal right-slip displacement by ⊕ (moving away from viewer) and ⊙ (moving toward viewer).
- Clay, silty and sandy, tan to brown, some angular fragments within clay matrix, locally contains foraminifera, generally thin (1/16 to 1/2 inch). Clay beds more common and more laterally continuous in dolomite unit than in the sandstone unit.
- <1/8", 1/8"-1/4", >1/4" — Clay bed - weight of solid line indicates bed thickness where encountered in borings or trenches, dashed line where inferred (no thickness indicated); queried where uncertain, clay beds projected beyond borings or trenches based on thickness (>1/4-inch thick beds projected 100 feet as solid line and 100 feet as dashed line, 1/8-inch to 1/4-inch thick beds projected 50 feet solid and 50 feet dashed, <1/8-inch thick beds projected 25 feet solid and 25 feet dashed) unless constrained to be shorter on adjoining boreholes and trenches.
- 01-H, TD 30.5 ft. — Exploration boring, number (01-H, initial number indicates year drilled) and depth (TD 30.5 feet) indicated
- T-18 — Exploration trench, number indicated; trenches are shown open if they cross section line, filled if projected into section line
- Groundwater elevation and date of measurement indicated

Pleistocene Marine Terraces Designation*

- **Q$_1$** Oxygen Isotope Stage 5a marine terrace (80,000 years old)
- **Q$_2$** Oxygen Isotope Stage 5e marine terrace (120,000 years old)
- **Q$_3$** Oxygen Isotope Stage 7 marine terrace (210,000 years old)
- **Q$_4$** Oxygen Isotope Stage 9 marine terrace (330,000 years old)
- **Q$_5$** Oxygen Isotope Stage 11 marine terrace (430,000 years old)

* *Ages and correlation of marine terraces based on K.L., Hansen, J.R. Wesling, W.R. Lettis, K.I. Kelson and L. Mezger, 1994. Correlation, ages, and uplift rates of Quaternary marine terraces, in Alterman, I.B., McMullen, R.B., Cluff, L.S., and Slemmons, D.B., eds., Seismotectonics of the Central California Coast Ranges: Boulder, Colorado, Geological Society of America Special Paper 292.*

C09

DIABLO CANYON ISFSI

FIGURE 21-13
EXPLANATION FOR CROSS SECTIONS

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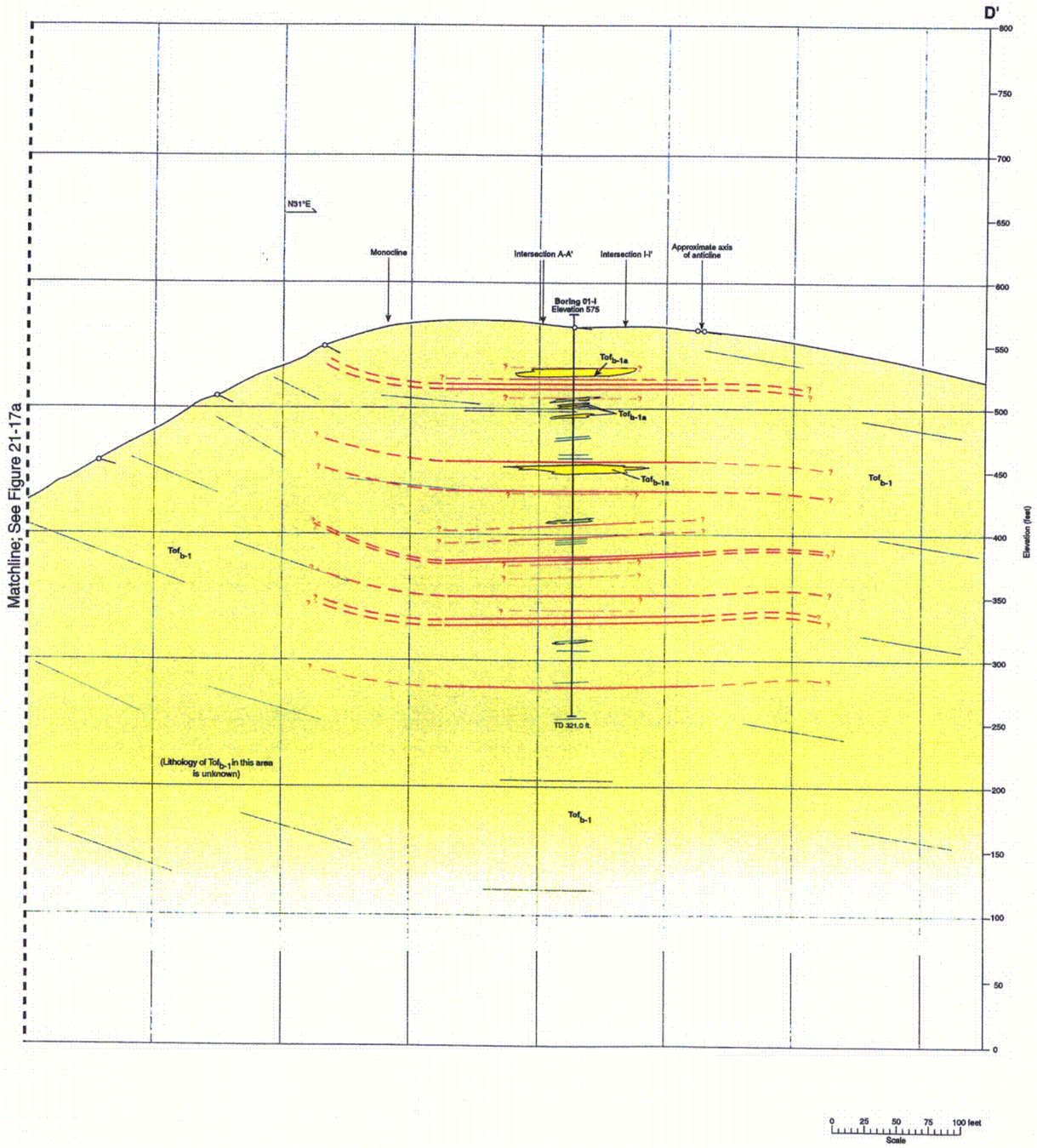
Security-Related Information – Withhold Under 10 CFR 2.390.

Security-Related Information – Withhold Under 10 CFR 2.390.



Notes

1. Location of cross section shown on Figures 21-3 and 21-4. Nearby borings are projected to cross section.
2. See Figure 21-13 for explanation of geologic units.
3. Horizontal scale = vertical scale.

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FIGURE 21-17b
CROSS SECTION D-D'

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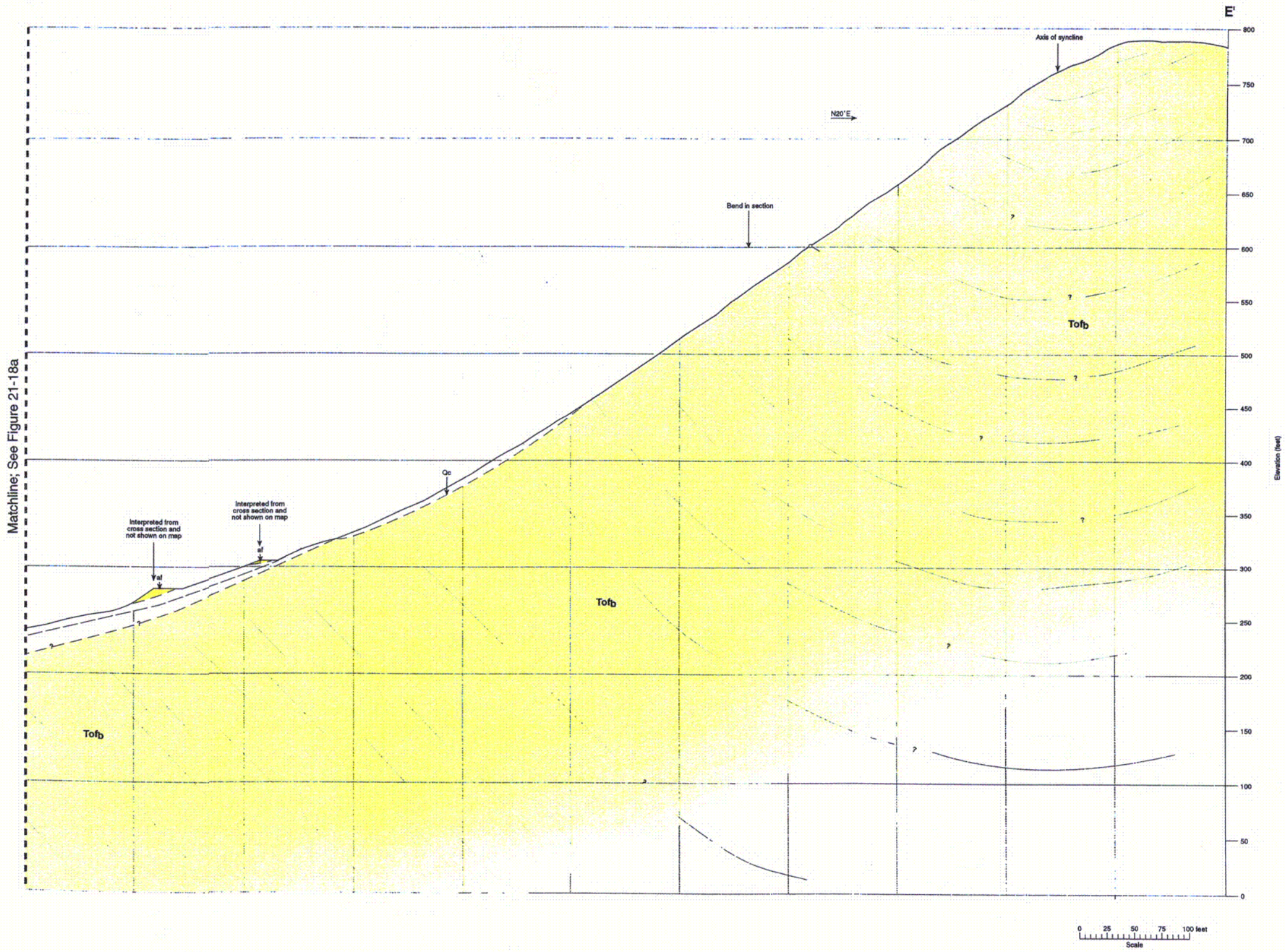

Notes

1. Location of cross section shown on Figures 21-3 and 21-4. Nearby borings are projected to cross section.
2. See Figure 21-13 for explanation of geologic units.
3. Horizontal scale = vertical scale

C16

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FIGURE 21-18b
CROSS SECTION E-E'

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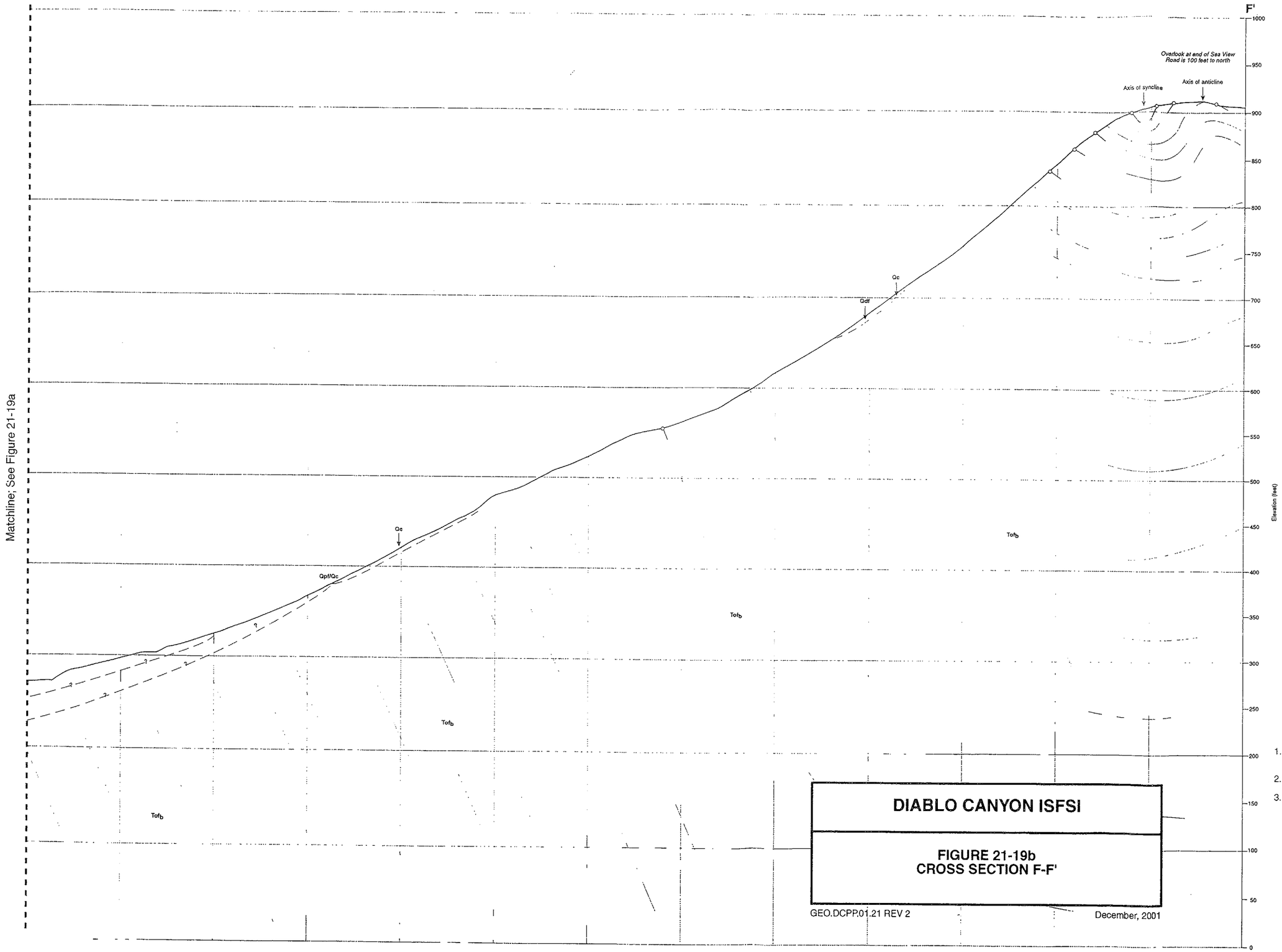

Notes

1. Location of cross section shown on Figures 21-3 and 21-4. Nearby borings are projected to cross section.
2. See Figure 21-13 for explanation of geologic units.
3. Horizontal scale = vertical scale.

0 25 50 75 100 Feet
Scale

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FIGURE 21-19b
CROSS SECTION F-F'

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Exploratory boring core from ISFSI study area laid out in stratigraphic succession for studying geologic correlation of bedrock units. Photo roll JGH R5.

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FIGURE 21-28
CORE BOXES FROM ISFSI STUDY AREA LAID OUT IN STRATIGRAPHIC ORDER

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Clay bed within dolomite (Tof_{b-1}) with sample tube in trench T-14B. Photo roll JLB-8.

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FIGURE 21-29
CLAY BED IN TRENCH T-14B

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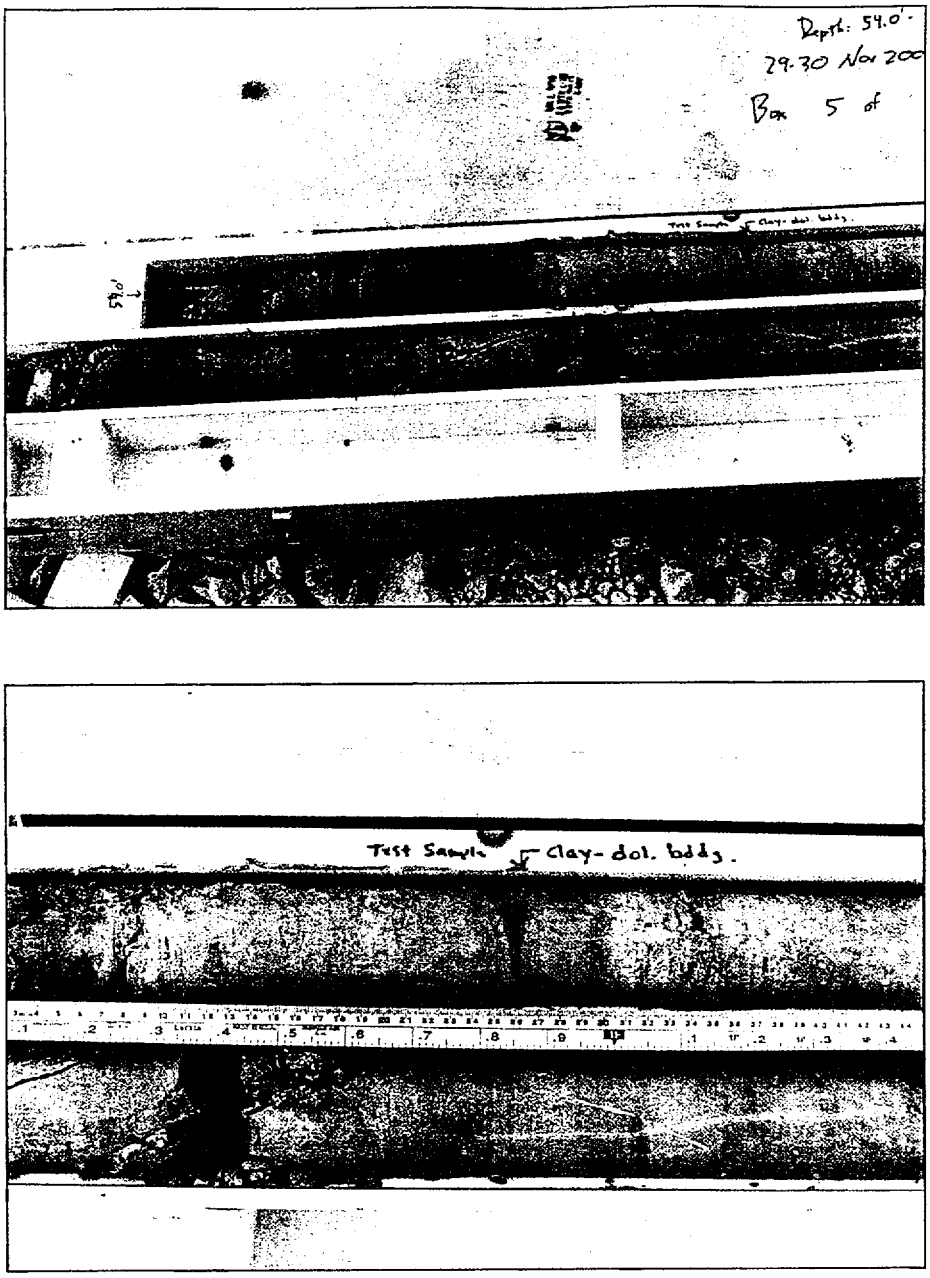

Clay bed in boring 00BA-1 at 55 feet. Note tight contacts with bounding rock, and low dip angle. Photo roll JLB-8

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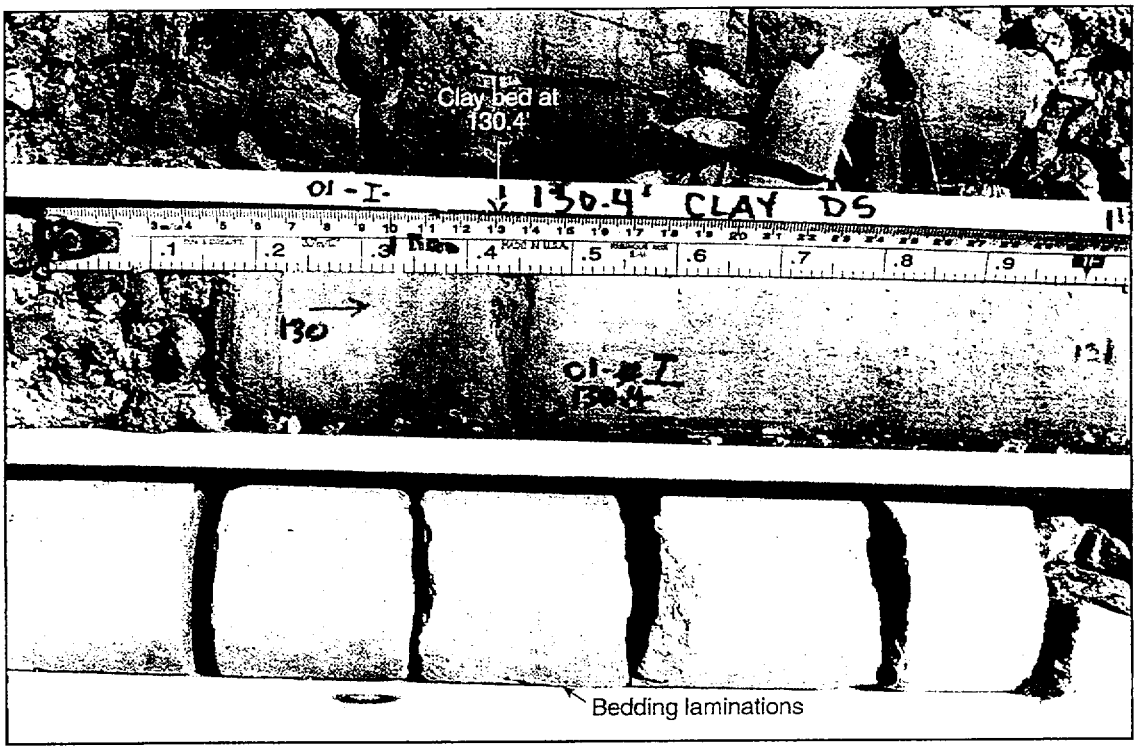
FIGURE 21-30 CLAY BED AT 55 FEET IN BORING 00BA-1



Typical appearance of clay bed and bedding laminations in a section of core at 130 feet from boring 01-I, south of the ISFSI. Clay bed occurs within Tof_{b-1}.
Photo roll 01JLB-ba.

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FIGURE 21-31 CLAY BED AT 130 FEET IN BORING 01-I

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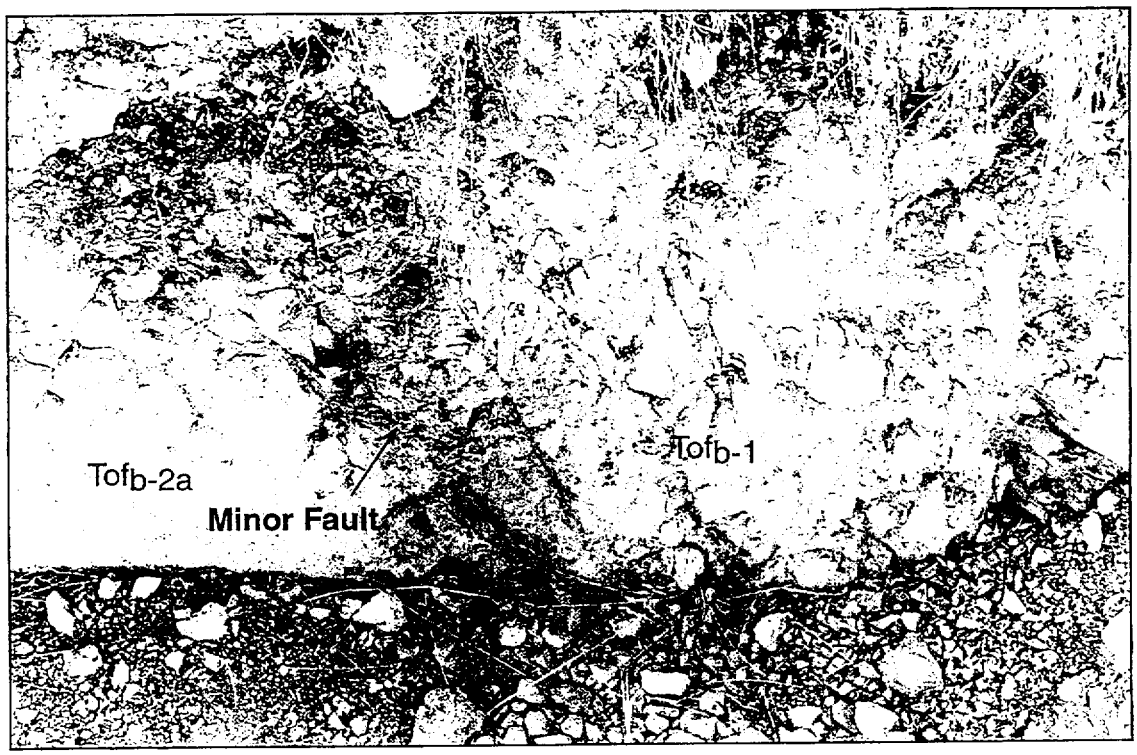
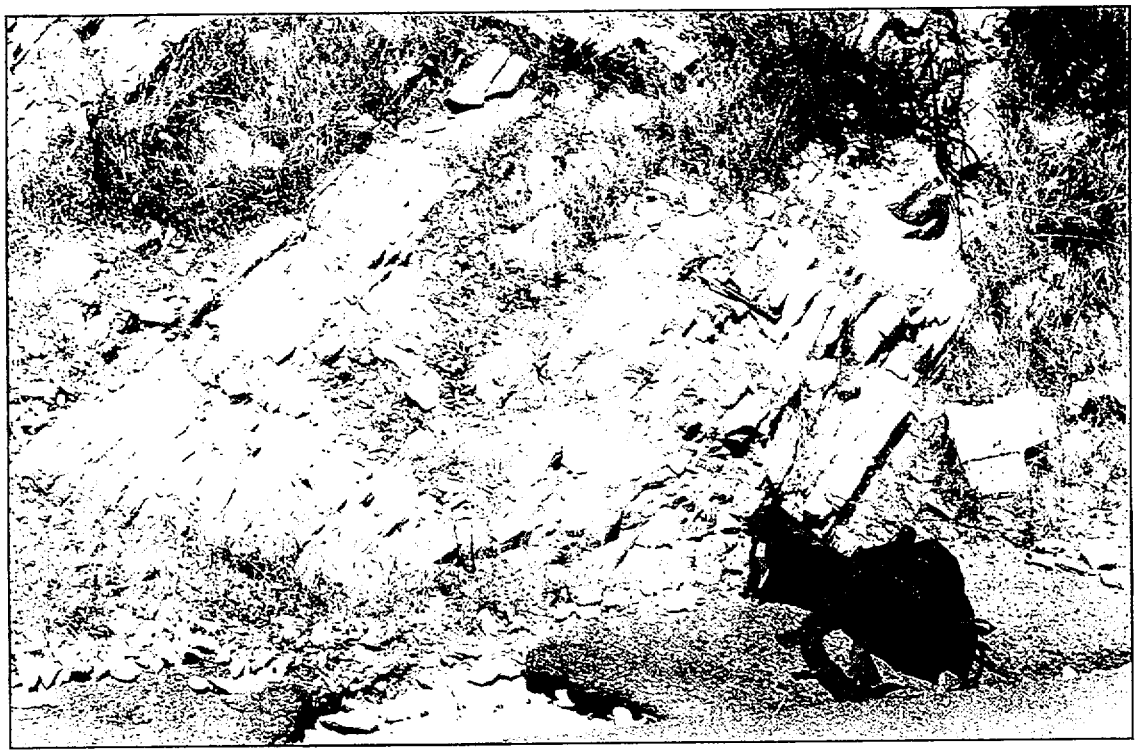


Minor fault in trench T-1 juxtaposing friable sandstone (Tof_{b-2a}) on left against dolomite (Tof_{b-1}) on the right. Photo roll JLB-2.

DIABLO CANYON ISFSI
FIGURE 21-32 MINOR FAULT IN TRENCH T-1



Thin-to medium-bedded dolomite (Tof_{b-1}) exposed in the roadcut of Reservoir Road directly southwest of the ISFSI. Note the laminations and bedding parting surfaces in the dolomite. Gray zones in the rock are believed to be petroliferous stains.
Photo roll JLB4-3.

DIABLO CANYON ISFSI

FIGURE 21-33
BEDDED DOLOMITE ON RESERVOIR ROAD

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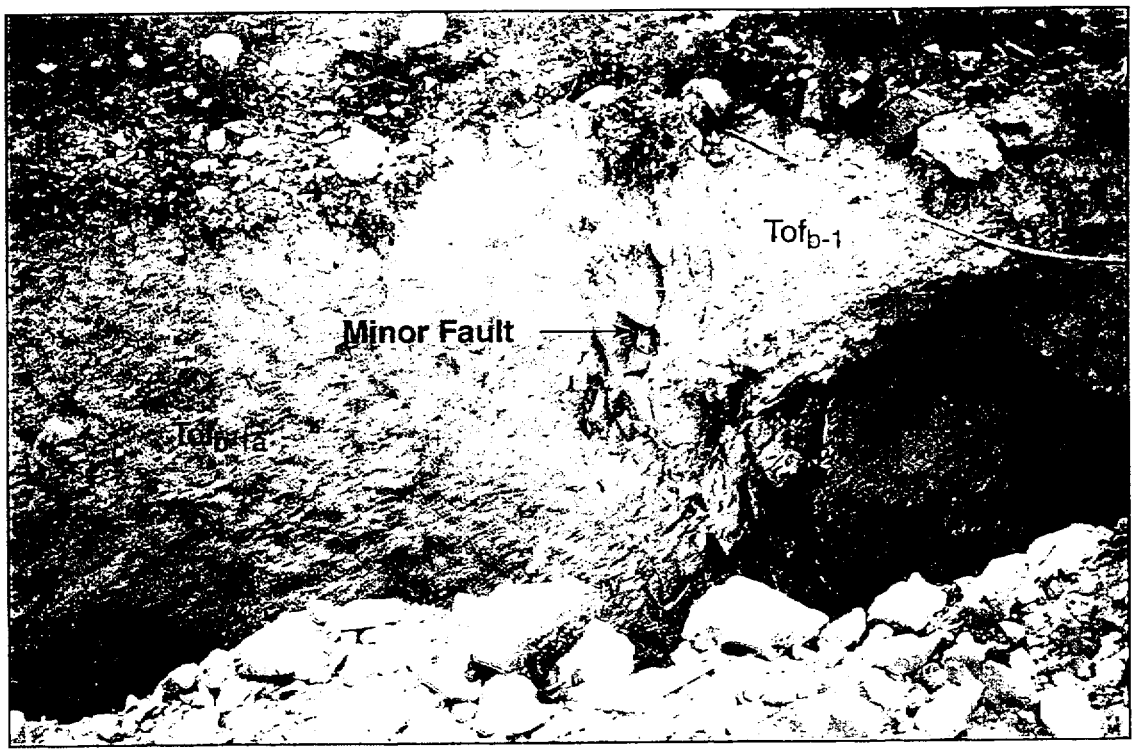

Friable dolomite (Tof_{b-1a}; left part of photo) in contact with closely-fractured dolomite (Tof_{b-1}; right part of photo) in trench T-20A. Shear fabric in dolomite at the contact indicates the presence of a minor fault. Photo roll JGH 2-1.

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FIGURE 21-34
MINOR FAULT IN TRENCH T-20A

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Outcrop of thick to massive bedded, weathered sandstone (Tof_{b-2}), directly west of the ISFSI. Photo roll JLB OLD-2.

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FIGURE 21-35
SANDSTONE OUTCROP IN THE ISFSI STUDY AREA

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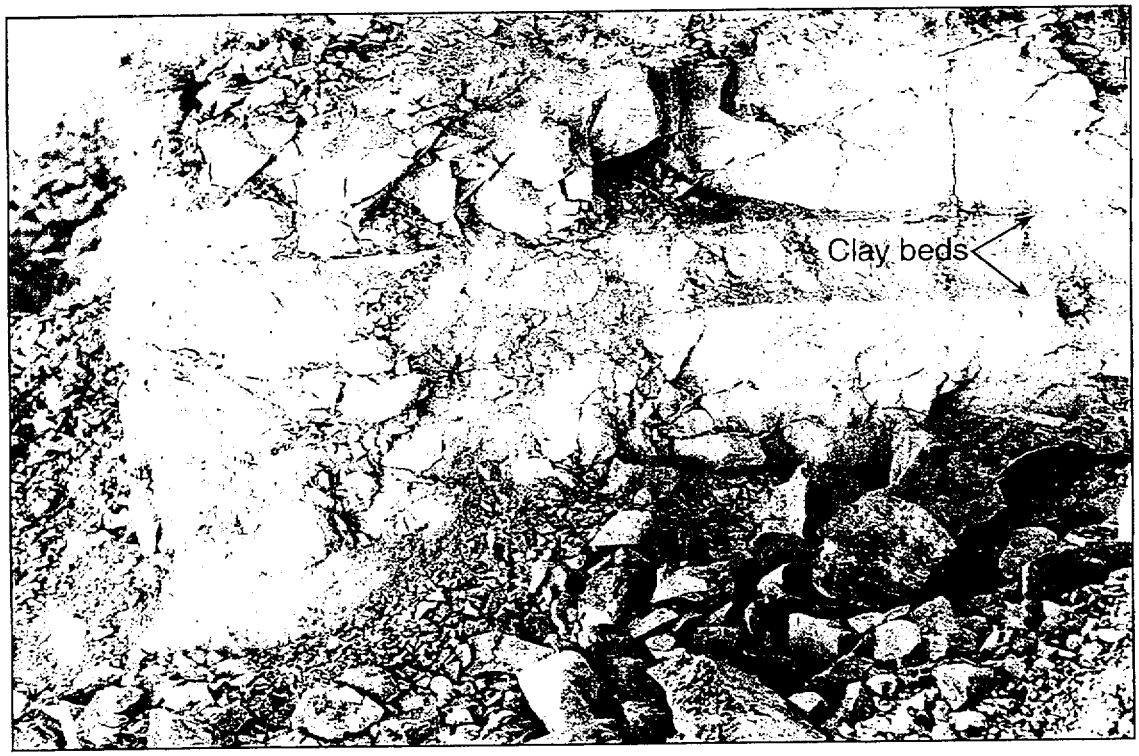

Typical dolomite (Tof_{b-1}) and thin clay beds exposed in trench T-11C. Clay beds are subhorizontal and define bedding. Photo roll 01JLB-1.

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FIGURE 21-36
CLAY BEDS AND DOLOMITE IN TRENCH T-11C

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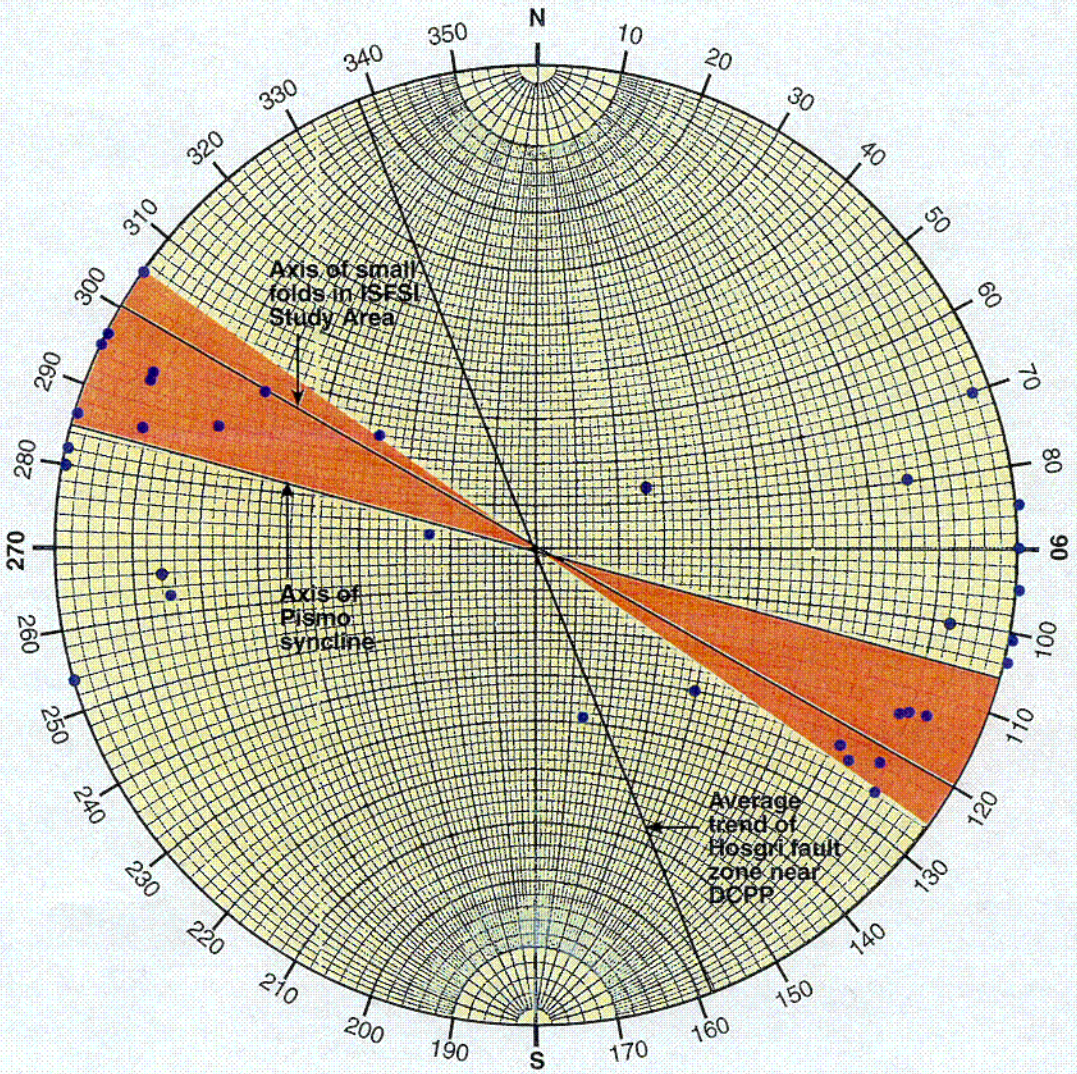

Explanation

- General range in strike of zone of minor faults
- Rake of slickenside on fault plane of minor faults

Equal-angle lower hemisphere plot.

C25

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FIGURE 21-38
COMPARISON OF ORIENTATIONS OF MINOR FAULTS AND FOLDS IN THE ISFSI STUDY AREA WITH OTHER STRUCTURES

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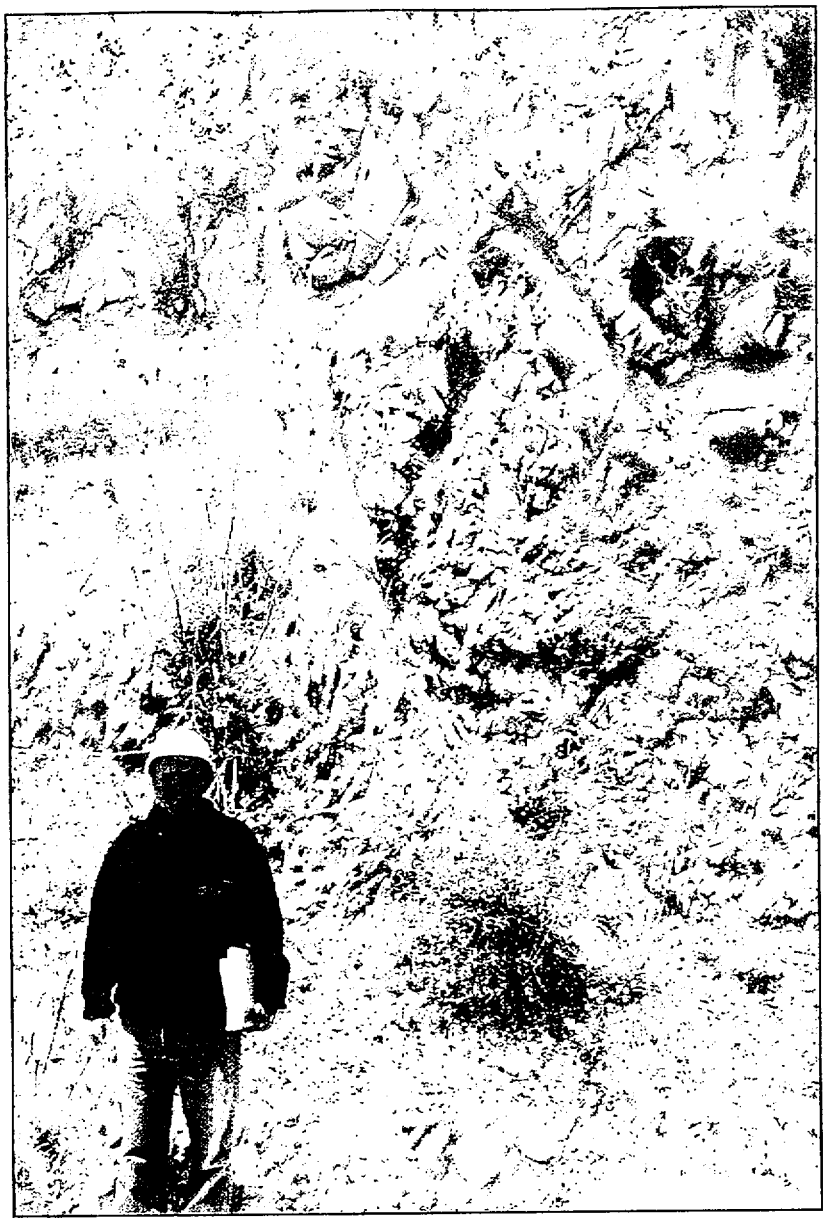

Northward view of Diablo Creek Road cut showing steeply dipping minor faults in dolomite of unit Tof_{b-1}. Slickensides and mullions on the fault plane indicate primarily strike-slip displacement, but bedding also suggests a component of down-to-the- east vertical separation of approximately 3 to 6 feet. These faults are located along projection of faults exposed in trenches at the ISFSI, approximately 800 feet to the southeast, that have similar strike and slickenside/mullion rakes. Photo roll JLB5/16-1.

DIABLO CANYON ISFSI

FIGURE 21-39
MINOR FAULTS ALONG DIABLO CREEK ROAD

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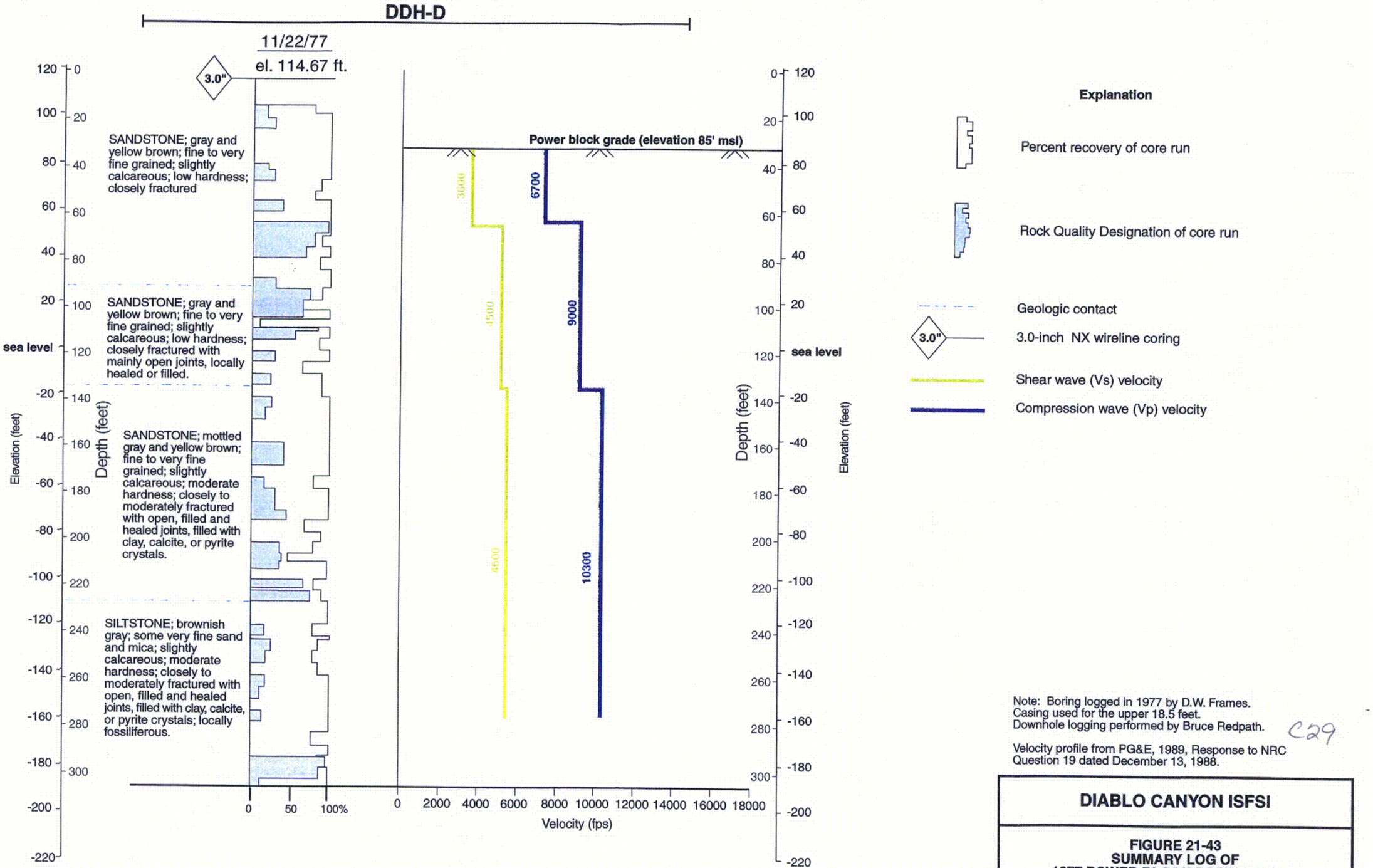

Note: Boring logged in 1977 by D.W. Frames.
Casing used for the upper 18.5 feet.
Downhole logging performed by Bruce Redpath. C29

Velocity profile from PG&E, 1989, Response to NRC Question 19 dated December 13, 1988.

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FIGURE 21-43
SUMMARY LOG OF
1977 POWER BLOCK BORING DDH-D

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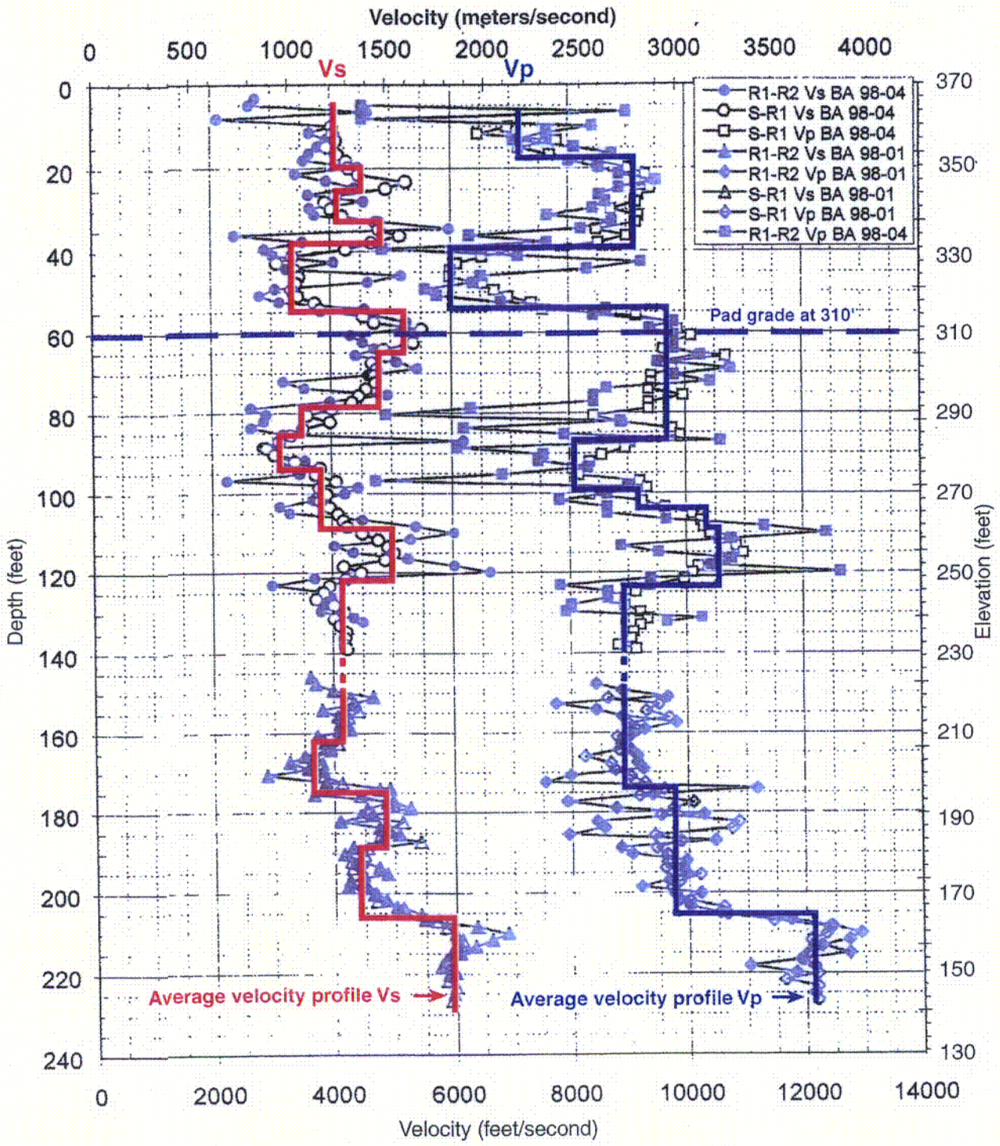
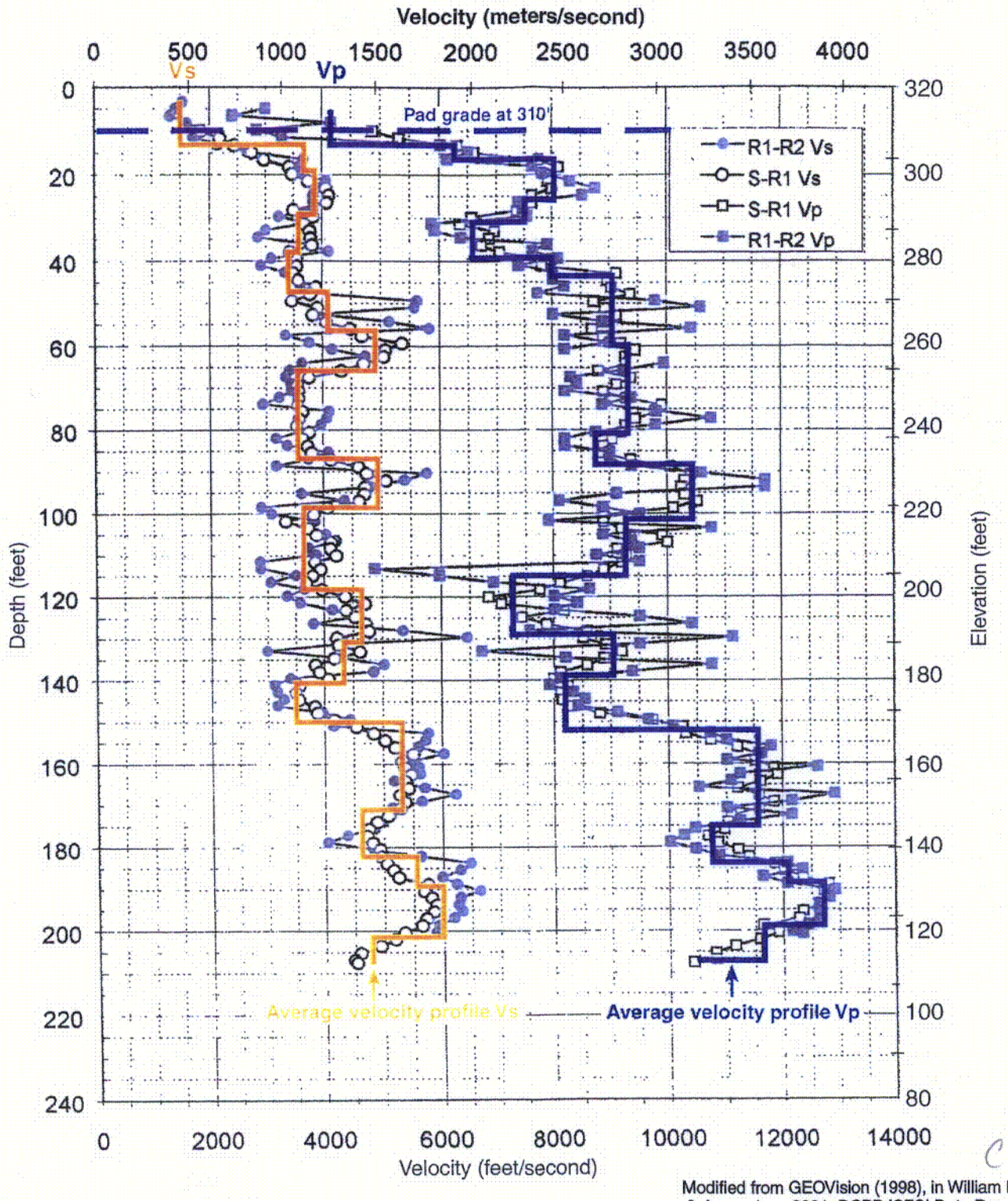
Borings 98BA-1 and 98BA-4



Note: Average velocity profiles interpreted from data

R1 - R2 = Receiver-to-receiver velocity (3.3-foot spacing)
S-R1 = Source-to-receiver velocity (10.3-foot spacing)

Boring 98BA-3



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Modified from GEOVision (1998), in William Lettis & Assoc. Inc., 2001, DCPP ISFSI Data Report C.

DIABLO CANYON ISFSI

FIGURE 21-44
ISFSI SITE SUSPENSION LOGS AND INTERPRETED AVERAGE SEISMIC VELOCITIES

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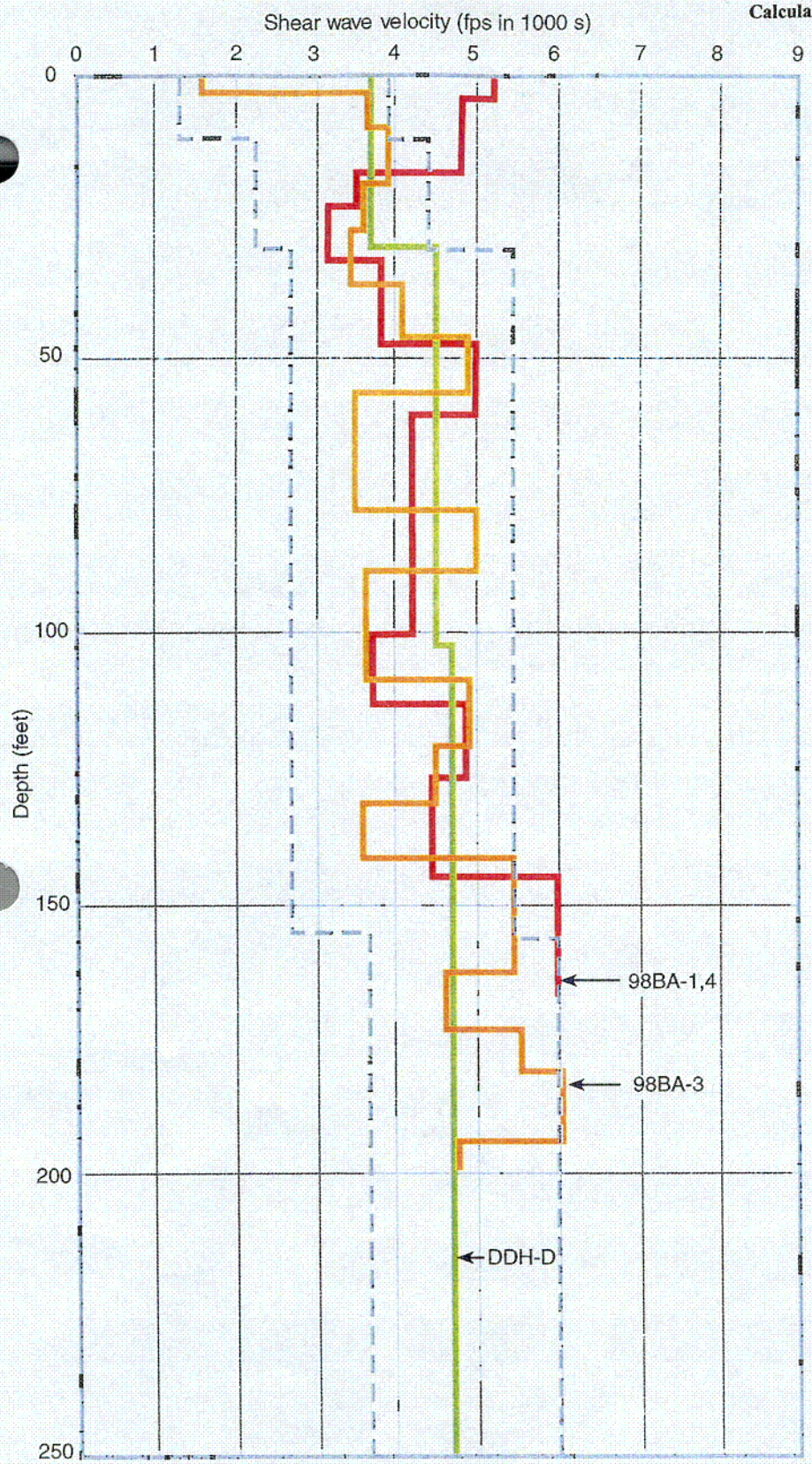

Explanation

Upper- and lower-bound LTSP shear wave profile envelope

Power block boring

DDH-D (1977)

(Figure 2.6-34)

ISFSI borings

98BA-3 (1998)

98BA-1,4 (1998)

(Figure 2.6-33)

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DIABLO CANYON ISFSI

FIGURE 21-45
COMPARISON OF SEISMIC SHEAR-WAVE VELOCITIES AT THE POWER BLOCK AND ISFSI SITES

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