SEP 6 1984

Docket No.: 50-508

APPLICANT: Washington Public Power Supply System (WPPSS)

FACILITY: Nuclear Project 3

SUBJECT: MEETING SUMMARY

On August 23, 1984, NRC and applicant representatives met in Bethesda, Maryland to discuss the details of their position paper on subduction zone earthquake. A meeting notice and attendance roster are enclosed (Enclosures 1 and 2 respectively).

The applicant presented information on the following items: (i) WNP-3 situation and status, (ii) Anticipated geologic investigations of geosciences program, and (iii) characteristics of the Juan De Fuca/North American Plate Boundary. The highlights of the applicant's presentation are provided in Enclosure 3.

The technical presentation was made by Dr. Greg Davis, geological consultant to WPPSS. The major open issue is whether or not there is potential for a great earthquake (magnitude 8 or greater) in the site region as a result of the subduction of the Juan De Fuca oceanic plate beneath the North American continental plate. Available evidence supports active subduction but is insufficient to determine if it is occurring seismically or aseismically. Dr. Davis stated that the problem was still unresolved but based on the most recent study by WPPSS, the case for aseismic slip is more strongly supported now than it has been in the past. The evidence on which that opinion is based falls into four categories: geodecy, earthquake fault plane solutions, comparison of the geologic characteristics of the Juan De Fuca/North American plate boundary with other plate boundaries around the globe, and comparison of the seismicity of the Juan De Fuca/North American margin with other margins worldwide.

The staff was satisfied with the efforts of the applicant and provided oral comments. Detailed comments will be provided at a later date following review of the applicant's submittal.

ORIGINAL SIGNED BY

B. K. Singh, Project Manager
Licensing Branch No. 3
Division of Licensing

Enclosures: As stated

cc: As stated

| | | |
|---|---|---|
| DL:LB#3 | DL:LB#3 | DL:LB#3 |
| BKSingh/yt | TNovak | GKnighton |
| 9/5/84 | 9/5/84 | 9/5/84 |

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# GEOSCIENCES BRANCH MEETING

I. INTRODUCTION

II. WNP-3 SITUATION & STATUS

III. SUPPLY SYSTEM POSITION PAPER ON SUBDUCTION ZONE EARTHQUAKE

IV. SUPPLY SYSTEM PLANS

V. NRC COMMENTS

VI. NRC PLANS
- W/USGS
- W/OTHERS

VII. USGS PLANS

VIII. SUPPLY SYSTEM COMMENTS

IX. DISCUSSION

Enclosure 2

# Attendance List

## WNP-3 Meeting

8/23/84

| | | |
|---|---|---|
| B. K. Singh | NRC/NRR/DL/LB#3 | Project Manager |
| S. Brocoum | NRC/NRR/DE/GSB | Leader, Geology Section |
| J Kimball | NRC/NRR/DE/GSB | Seismologist |
| N. Bell | Coalition for Safe Power | Intervenor |
| Leon Reiter | NRC/GSB | Leader, Seismology Section |
| Dick McMullen | NRC GSB | Geologist |
| Alan Wang | ACRS | Staff Engineer |
| R. Savio | ACRS | SENIOR STAFF ENG |
| R.C. TREWHAUS | USGS | GEOLOGIST |
| D.D. TILLSON | WPPSS CONSULTANT | |
| W. Kiel | WPPSS | Geologist |
| J.P. BURN | WPPSS | DIR. OF ENGR. |
| D.W. COLEMAN | WPPSS | Licensing Project Manager |
| G.A. Davis | WPPSS Consultant (USC) | Professor of Geology |
| T.E. Bushnell | Portland General Electric | Mgr, Civil Engg. |
| C Trammell | NRC | |
| DAVID WHITNEY | McGRAWHOUSE NEWS SERVICE | REPORTER |
| V. NERSES | NRC/NRR/DL/LB#3 | PM |
| FREDERIC SNIDER | EBASCO GEOSCIENCES | Geologist |
| JOE ROKROWECHIO | Ebasco | Licensing |

Enclosure 3

# WNP-3 SITUATION AND STATUS

- 0 PROJECT IS 76% COMPLETE
- 0 FULL CONSTRUCTION ACTIVITIES STOPPED DUE TO LACK OF FINANCING
- 0 CONSTRUCTION RESTART DATE TO BE DETERMINED BY BONNEVILLE POWER ADMINISTRATION IN NEXT FEW MONTHS
  - PROJECT PLANNING PRESENTLY BASED ON A JULY 1985 RESTART DATE AND A JUNE 1989 FUEL LOAD
  - PUBLIC PROCESS IN WHICH ALL PROJECT COMPLETION ALTERNATIVES WILL BE EVALUATED
- 0 DESIGN IS APPROXIMATELY 95% COMPLETE
- 0 PRESERVATION PROGRAM IMPLEMENTED
- 0 ESSENTIAL DESIGN & LICENSING ACTIVITIES CONTINUING
- 0 PREPARATIONS FOR OPERATIONS CONTINUING
- 0 400 FULL TIME EQUIVALENT PEOPLE WORKING ON THE PROJECT
- 0 RESPONSES TO NRC QUESTIONS CONTINUING
  - 496 QUESTIONS RECEIVED
  - 397 RESPONSES COMPLETE
  - 21 PARTIAL RESPONSES PROVIDED
  - MORE RESPONSES WILL BE PROVIDED THIS YEAR
  - REMAINDER TO BE PROVIDED FOLLOWING CONSTRUCTION RESTART.
- 0 SUPPLY SYSTEM INVOLVEMENT IN CESSAR-F ACTIVITIES MAINTAINED
- 0 DRAFT SAFETY EVALUATION REPORT (SER) EXPECTED FROM NRC LATER THIS YEAR
- 0 EXPECT TO RECEIVE MORE NRC QUESTIONS.

# GEOSCIENCES PROGRAM

## ANTICIPATED GEOLOGIC INVESTIGATIONS

FY-85 (7/84-6/85)

- BROADBAND NETWORK
- PLATE COMPARISON STUDIES
- MARINE TERRACE INVESTIGATIONS
- THERMAL/MECHANICAL MODELING
- LAKE SEDIMENT STUDY
- "CRITICAL" EARTHQUAKE STUDY

FY-86* (7/85-6/86)

- RANDOM EARTHQUAKE
- CRUSTAL/SITE AREA FAULT INVESTIGATIONS
- PUGET SOUND SEISMICITY
- BROADBAND NETWORK

FY-87* (7/86-6/87)

- GROUND MOTION STUDIES
- PROBABILITY STUDY
- BROADBAND NETWORK

QUESTION RESPONSES

- AUGUST, 1986
- NOVEMBER, 1987

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* TENTATIVE, SUBJECT TO ANNUAL REVIEW.

# CHARACTERISTICS OF THE JUAN DE FUCA/NORTH AMERICAN PLATE BOUNDARY

- Presumably ongoing compressive deformation of sediments at the base of the continental slope suggests active plate convergence
- Complete absence anywhere along boundary of large historical earthquakes interpreted as interface events
- Complete absence along boundary of reported low-angle thrust mechanisms indicating relative plate movements
- Virtual absence of shallow seismicity that might indicate presence of shallow plate interface
- Presence of dominant N-S compression in focal mechanism determinations in North American plate
- Complex strain field based on contemporary leveling and geodimeter measurements
- Small size of the Juan de Fuca plate

840831-1A

# CHARACTERISTICS OF THE JUAN DE FUCA/NORTH AMERICAN PLATE BOUNDARY (con't)

- Presence of subplates (Gorda, Explorer) that appear to have ceased subducting and are internally deforming
- Low convergence rate
- Youthfulness of the subducting crust
- Burial of the offshore plate boundary and trench by voluminous late cenozoic sediments
- High heat flow values from the sediment-covered portions of the Cascadia Basin
- High fluid pressures in subducted sediments generated by dewatering at the offshore plate interface
- No compelling evidence to support segmentation of the subducting Juan de Fuca plate
- Existance of an active adjacent volcanic arc

840831-2A

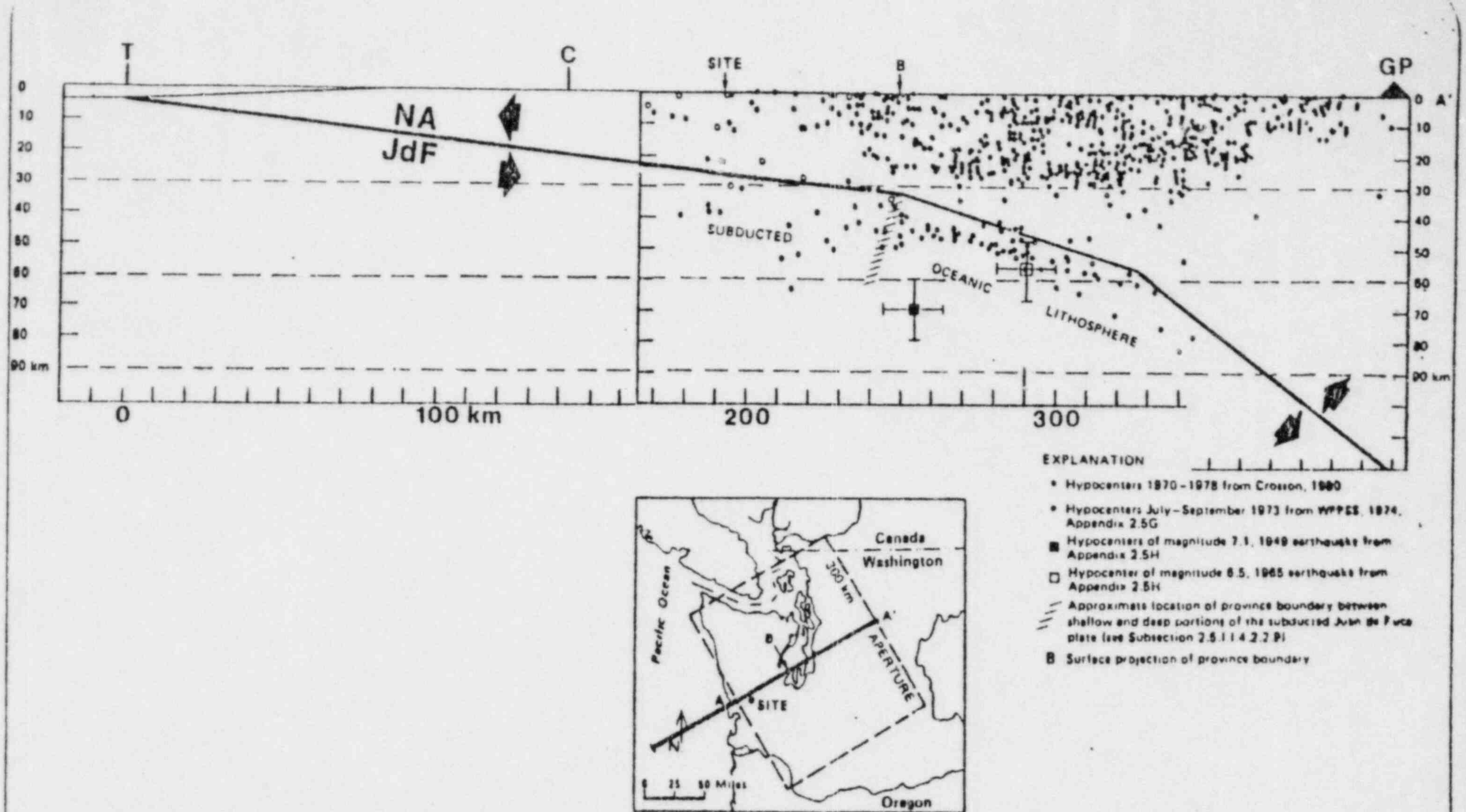



FIGURE 1: Modification of Figure 2.5-31, WNP-3 FSAR, illustrating distribution of earthquake hypocenters, western Washington, largely from Crosson (1983). The inferred position of the top of the subducted Juan de Fuca plate is shown.

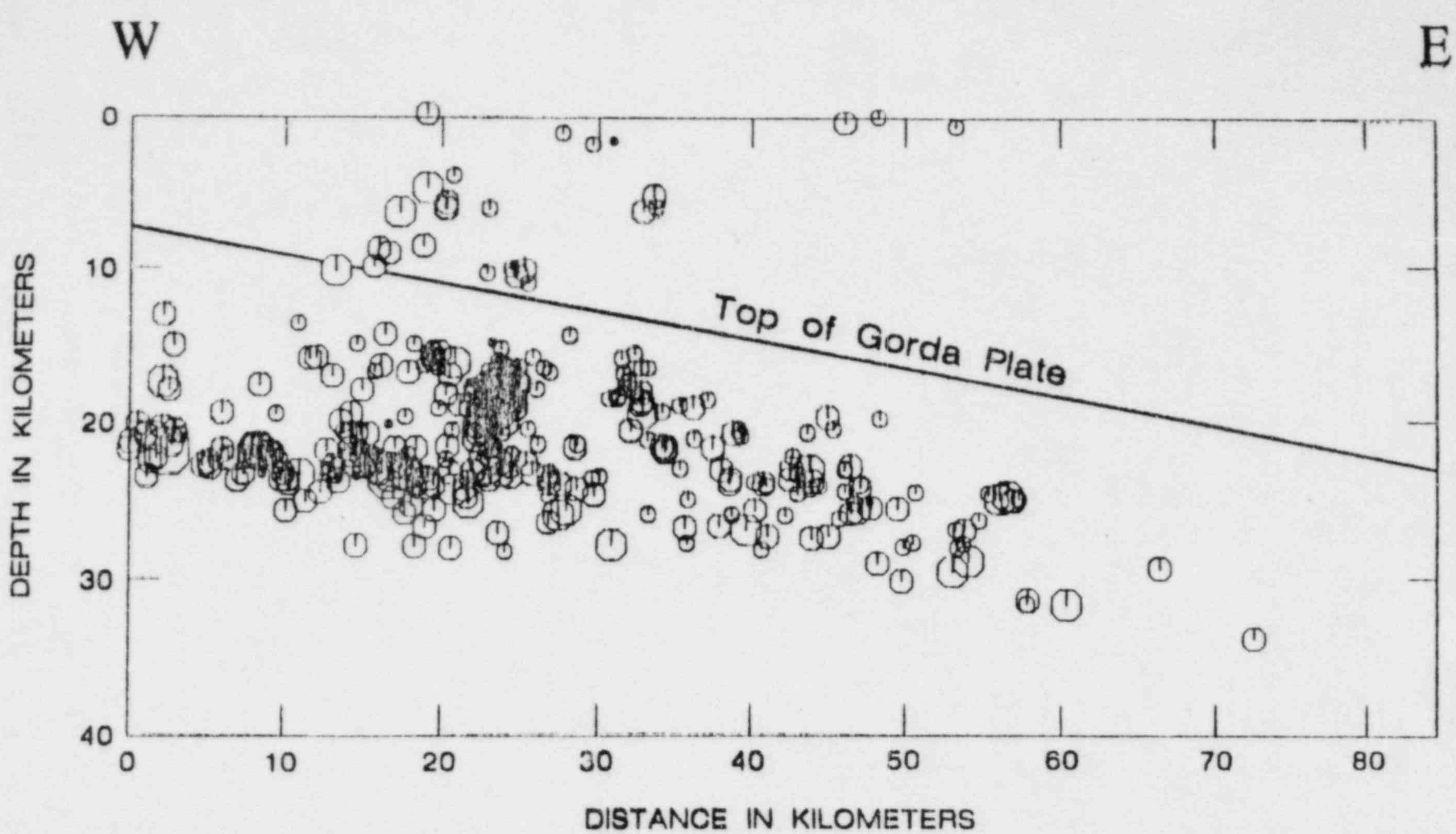



FIGURE 2: Distribution of seismicity and inferred location of top of Gorda plate, northwesternmost California (Figure 10 from Jackens and Griscom, 1983.)

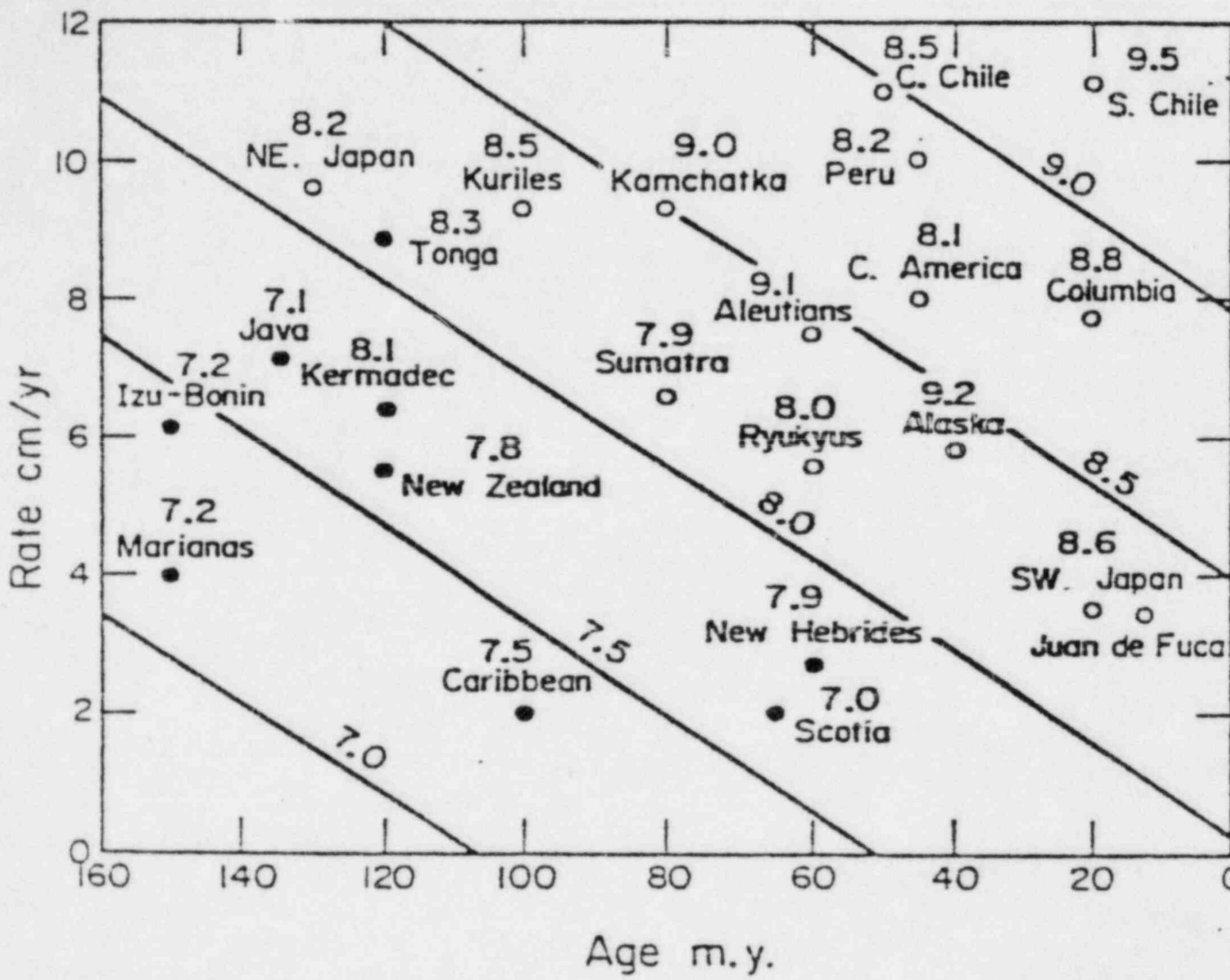



FIGURE 3: Relationship of maximum energy magnitude $M_W$ to convergence rate and age of subducted lithosphere for major subduction zones. The contours of $M_W$ are the predicted maximum earthquake magnitude against the other two variables. Open and closed circles are subduction zones with and without back-arc basins, respectively. (Figure 1 from Heaton and Kanamori, 1984).

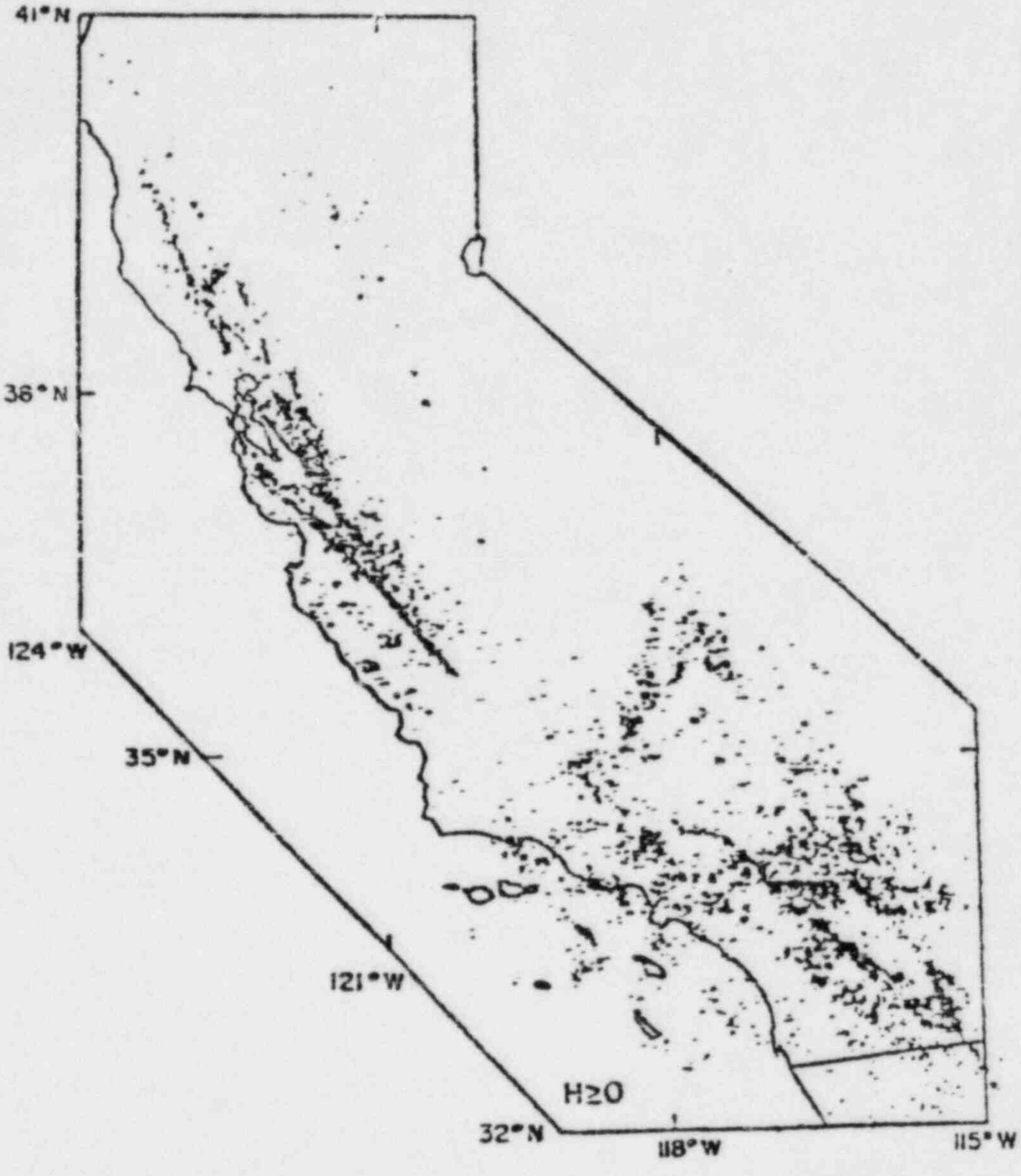



FIGURE 4: Epicenters reported from both the USGS in central-northern California during the period 1971 to 1981. (See text for discussion.)

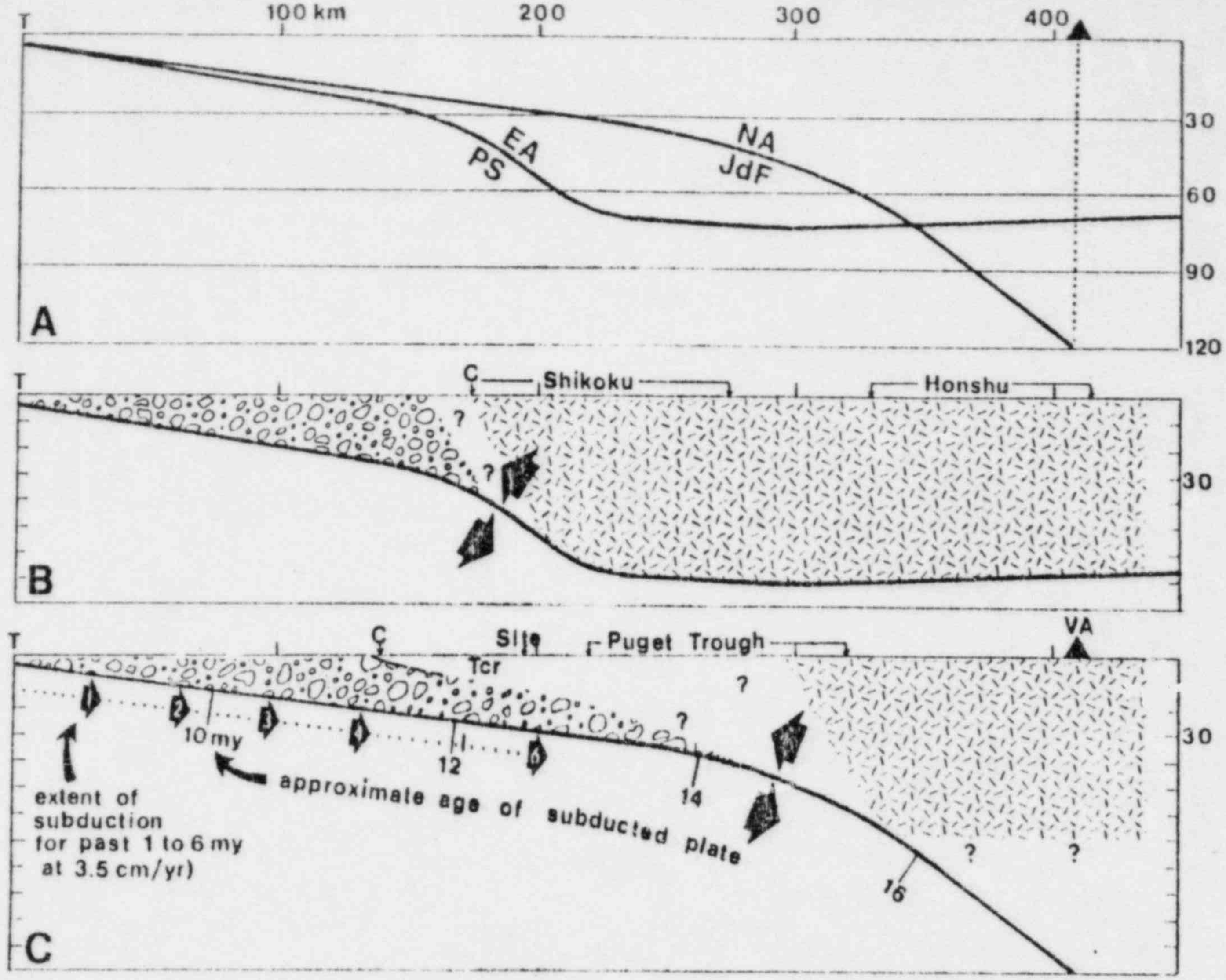



**FIGURE 5:** Comparative geometry and geology of the Juan de Fuca/North American and Philippine Sea/Eurasian plate interactions.

A. Comparative profiles of the plate interfaces. The geometry of the Juan de Fuca/North American interface is taken from Figure 1; that of the Philippine Sea/Eurasian interface is largely from Hirahara, 1981.

B. Crustal geology of the Eurasion upper plate along a NW-SE section from the Nankai Trough (trench), T, to Honshu Island. Pre-Cenozoic continental lithosphere extends to at least the southern coastline (C) of Shikoku Island (Kimura, 1974). Cenozoic accreted deposits are shown by the pattern between T and C. No contemporary volcanic arc is present in Honshu.

C. Crustal geology of the North American plate along the line of section illustrated in Figure 1. The boundary between pre-Cenozoic accreted terrane and Cenozoic rocks accreted to North America underlines the Puget Trough. The major low-angle fault near the coastline (C) separates hanging wall Eocene basalts of the Crescent Formation from Eocene to Pleistocene sediment of the underlying accreted wedge. Location of this thrust fault is from Snavely and Wagner (1983). Figures in the lower Juan de Fuca plate indicate that the age of oceanic lithosphere beneath the WNP-3 site is approximately 12 m.y. and that the oceanic lithosphere beneath the site was beneath the offshore trench (now filled) only 6 million years ago. VA = volcanic arc.


FIGURE 6: Bathymetry of the Nankai Trough south of Shikoku and Honshu Islands, Japan. Lines are 1° apart; depths in fathoms. From map 2306N, Bathymetric Atlas of the Northwestern Pacific Ocean, U.S. Naval Oceanographic office H.O. Pub. No. 1301, 1969.

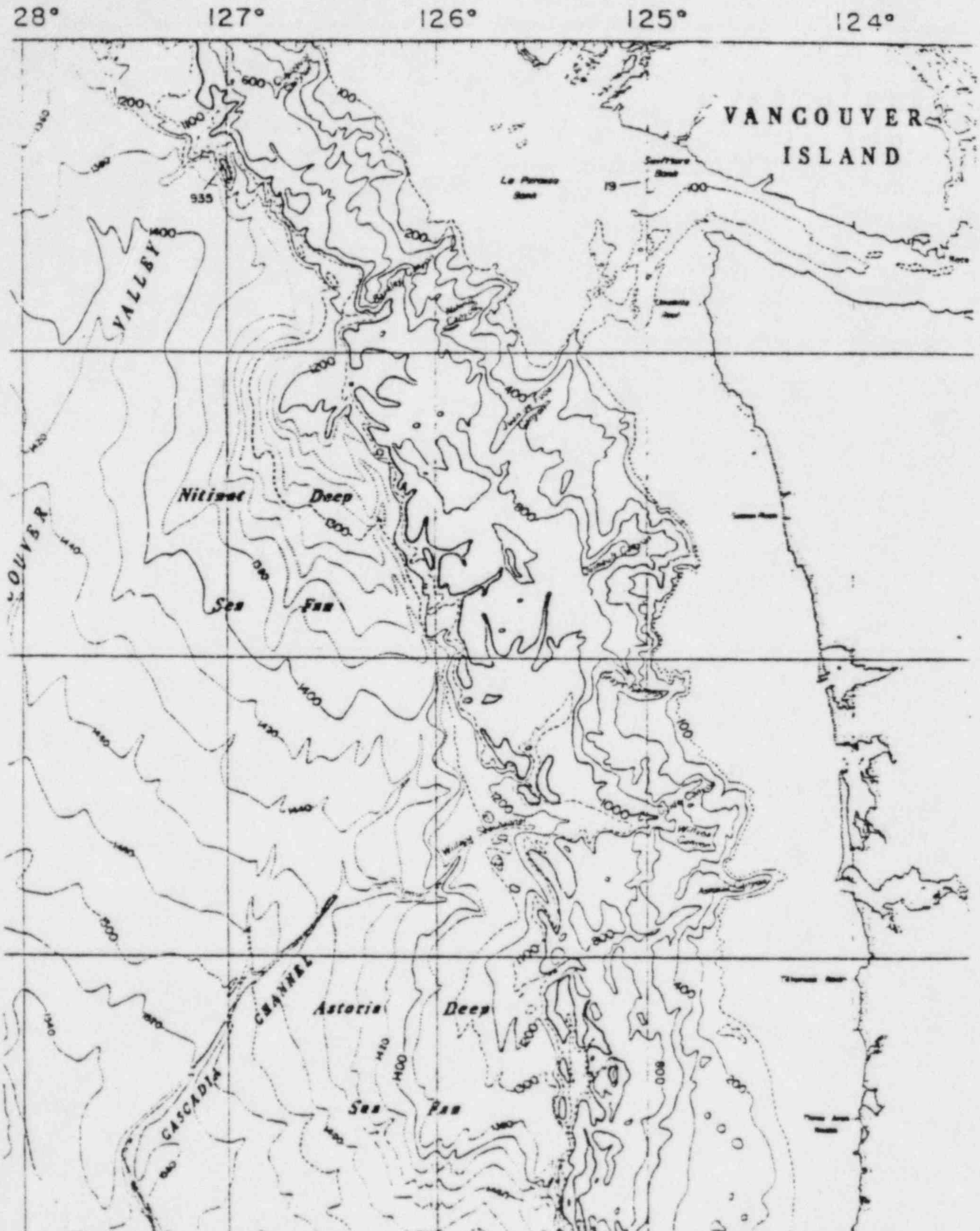



FIGURE 7: Bathymetry of the Cascadia Basin and continental margin, southwestern British Columbia, Washington, and northwestern Oregon. Lines are 1° apart; depths in fathoms. From map 1390N, Bathymetric Atlas of the Northeastern Pacific Ocean, U.S. Naval Oceanographic office H.O. Pub. No. 1301, 1971.

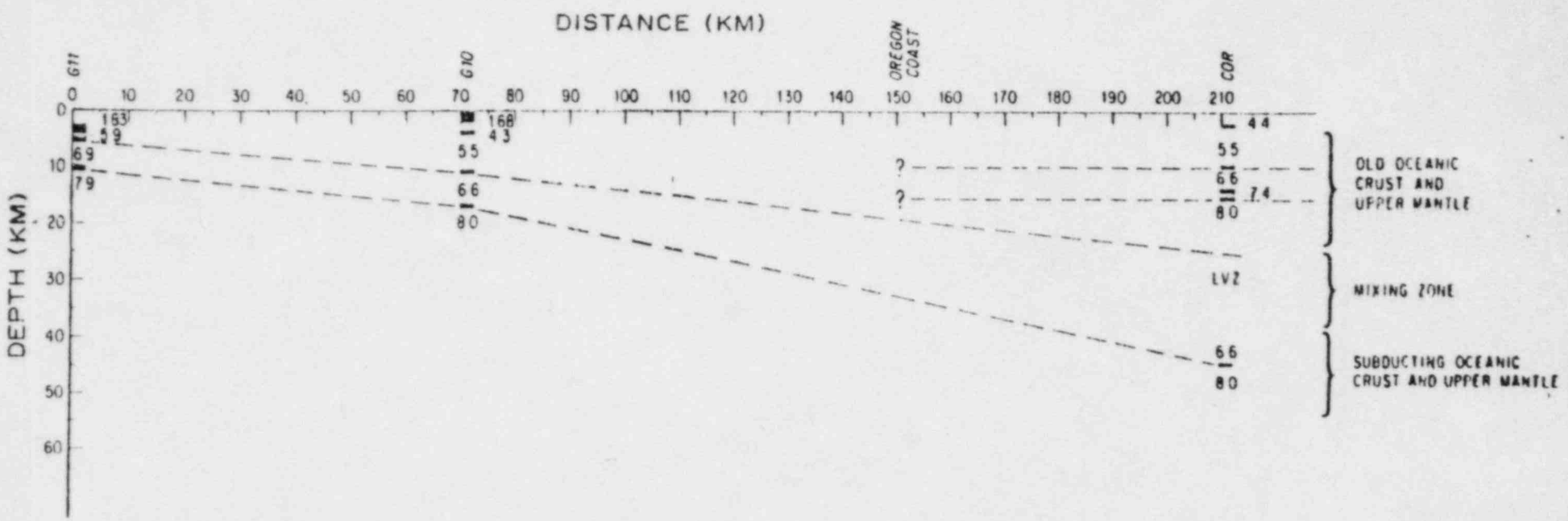
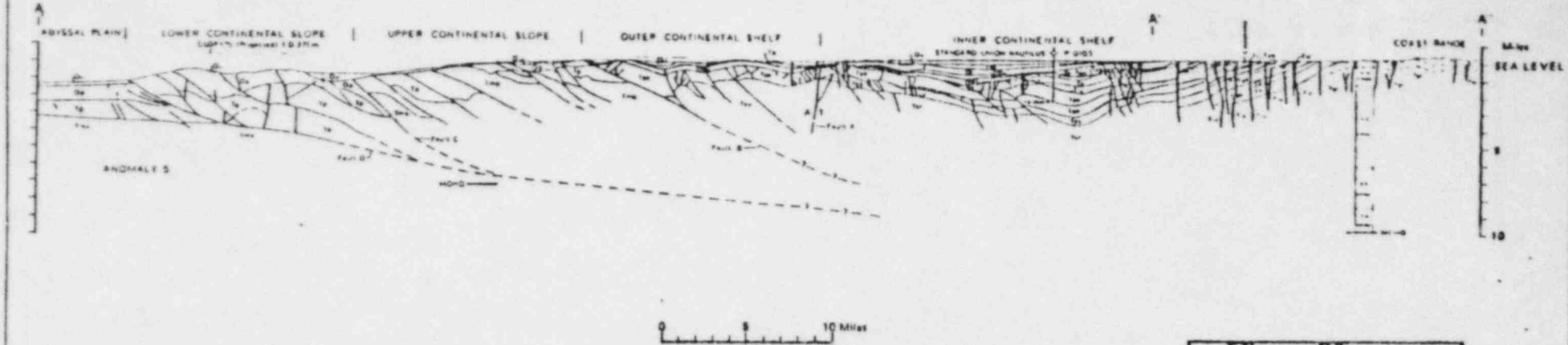



**FIGURE 8:** Schematic cross-section of inferred upper plate/lower plate relations, central Oregon Coast Ranges and western margin of Willamette Valley (COR = Corvallis). Figure is Figure 8 of Langston (1981). (See text for discussion.)

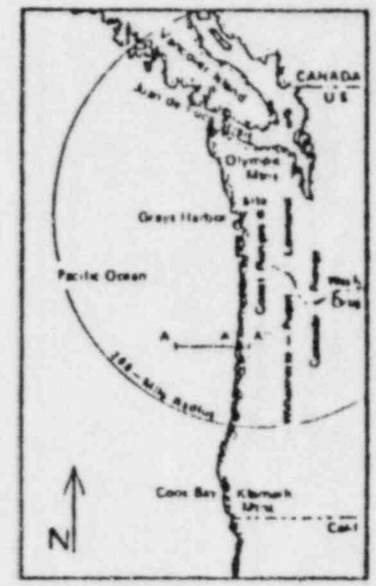



## EXPLANATION

- - ?- ? Geologic Contact

——— Fault

- **Qu** Holocene and Pleistocene semi-consolidated shell-bearing marine micaceous fine-grained lithic sand and silt
- **Qp** Pleistocene semi-consolidated, slightly calcareous marine siltstone and very fine-grained sandstone
- **Tp** Pliocene sedimentary rocks
- **Tmu** Upper Miocene (?) sedimentary rocks
- **Tmv** Upper Miocene tholeiitic basalt (oceanic crust)
- **Tcf** Cape Foulweather Basalt (middle Miocene)
- **Twc** Sandstone of Whale Cove (middle Miocene)
- **Tdb** Depoe Bay Basalt (middle Miocene)
- **Tfu** Intrusive basalt (middle Miocene)
- **Ta** Astoria Formation (middle Miocene)
- **Tyq** Yaquina Formation (lower Miocene and upper Oligocene)
- **Tmo** Inferred middle Miocene to upper Oligocene melange
- **Tn** Nye Mudstone (lower Miocene)
- **Tlq** Camptonite intrusive and extrusive rocks (lower Oligocene and upper Eocene)
- **Toe** Oligocene and upper Eocene sedimentary rocks
- **Ty** Yamhill Formation (upper and middle Eocene)
- **Tt** Tyee Formation (middle Eocene)
- **Tes** Middle Eocene marin siltstone and sandstone
- **Tsr** Siletz River Volcanics (lower and middle Eocene)
- **Teu** Inferred lower Eocene arkosic and lithic marine sandstone




INDEX MAP

SOURCE: modified from Snavely et al. (1980)

**FIGURE 9:** Geologic cross-section of the Continental Slope and Shelf through central Oregon (modified from Snavely and others, 1980).

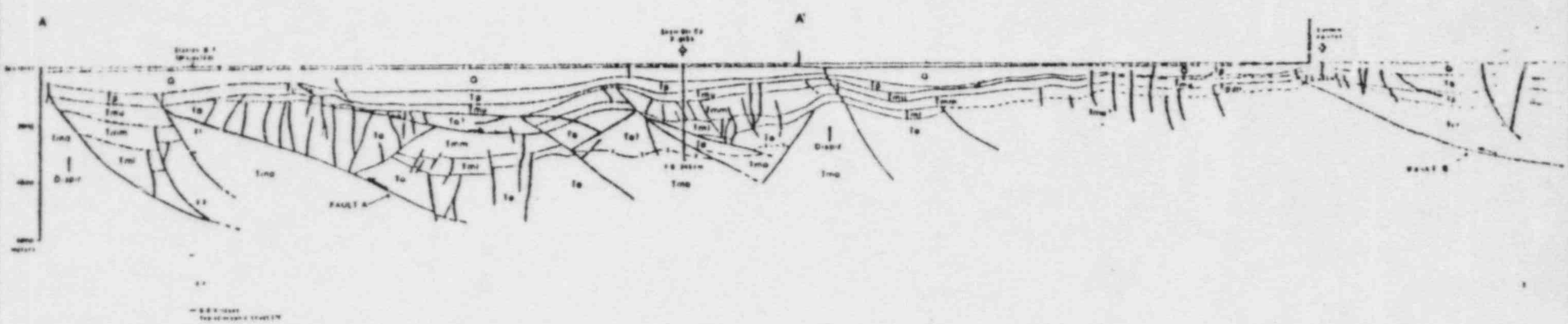


FIGURE 10: Preliminary geologic cross-section A-A across the continental margin of southwestern Washington (Figure 3, Snavely and Wagner, 1983).

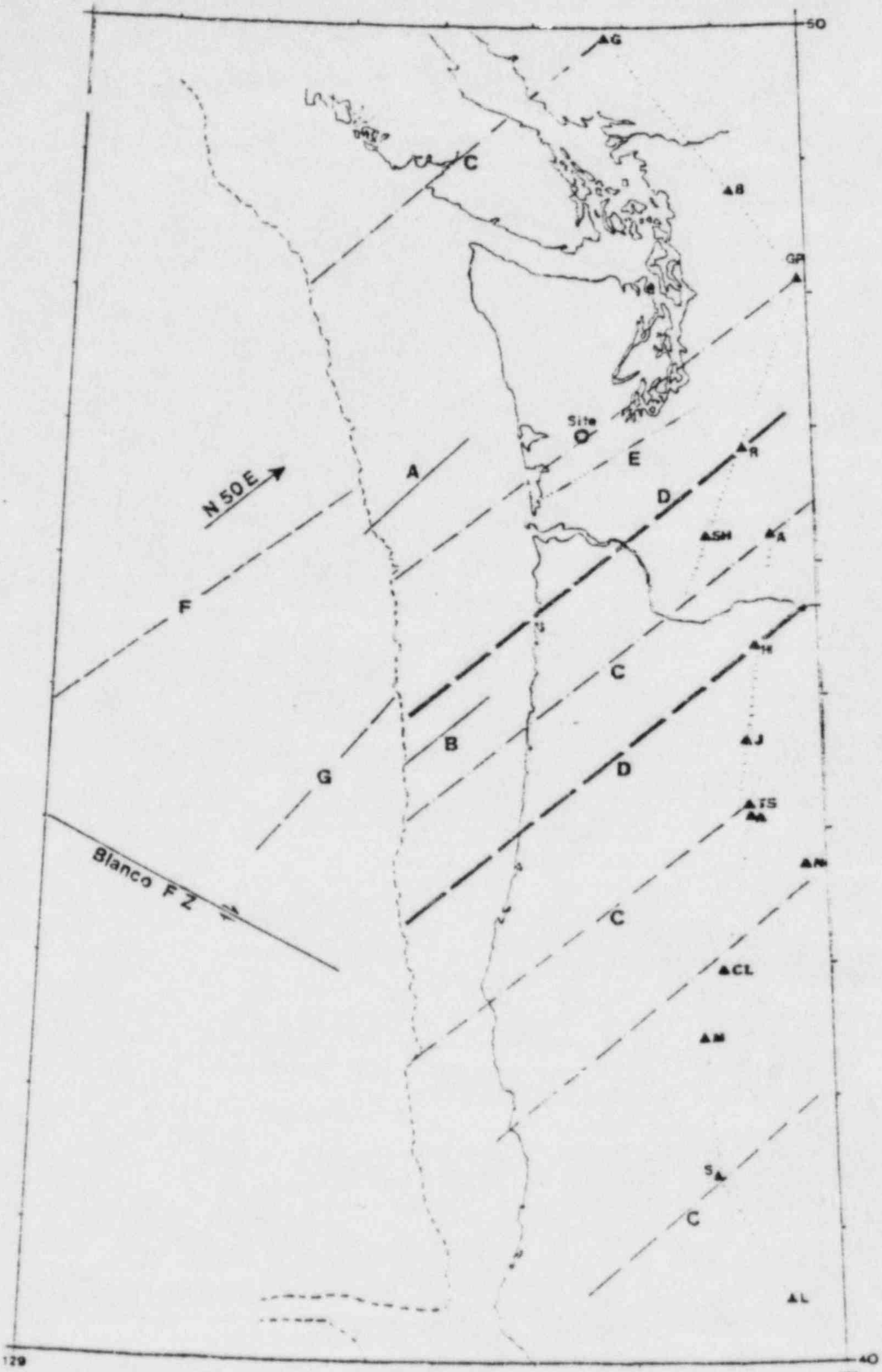
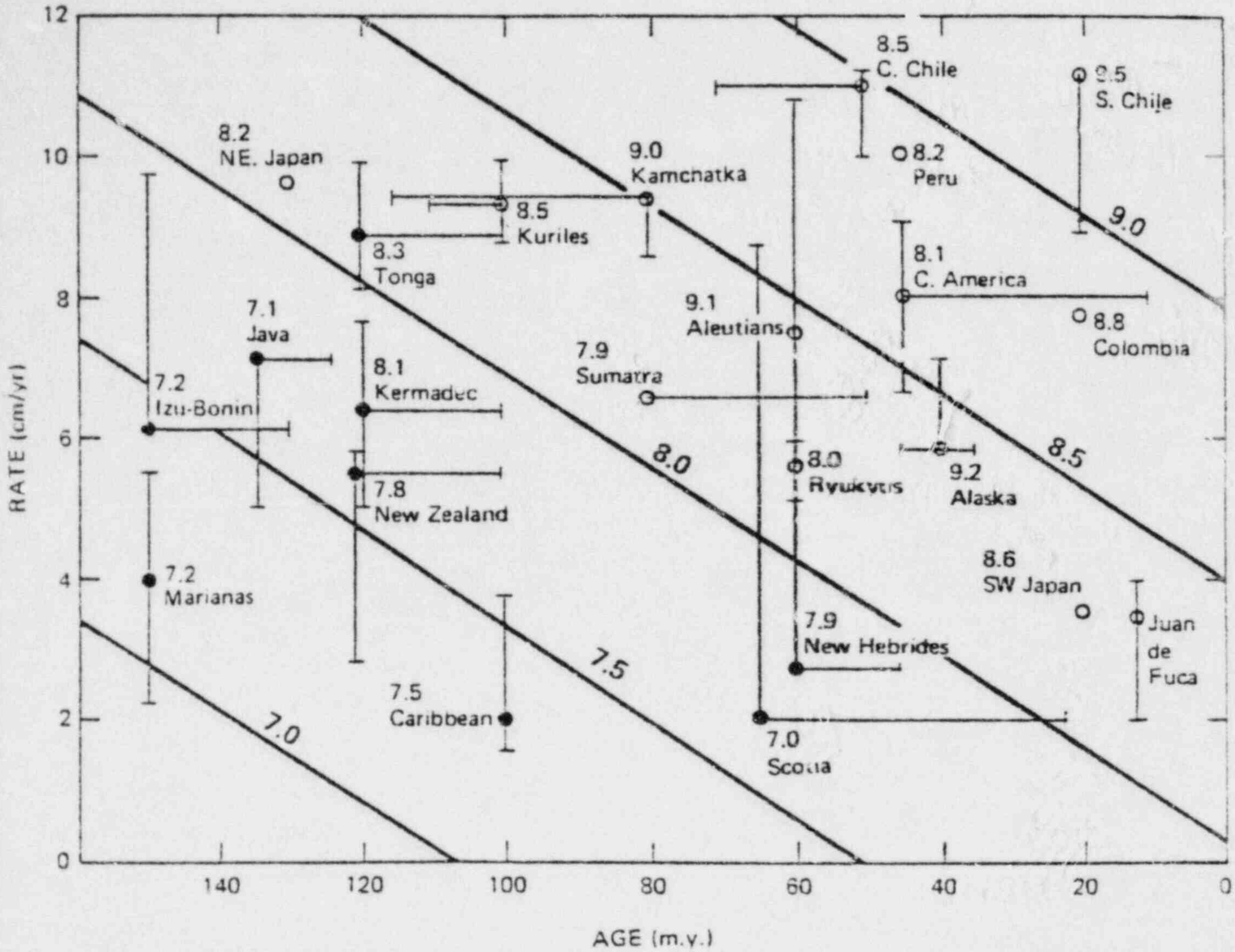
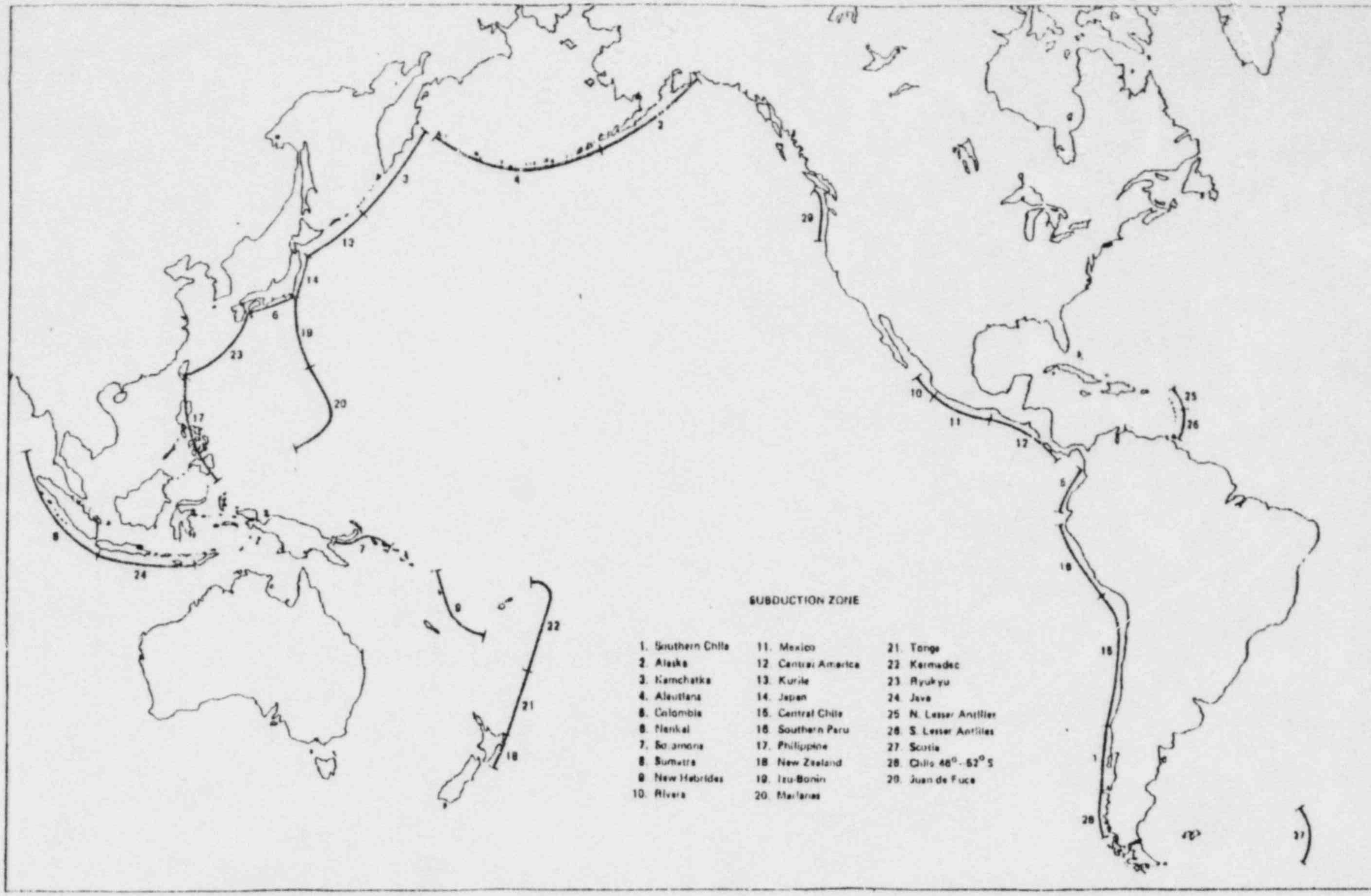
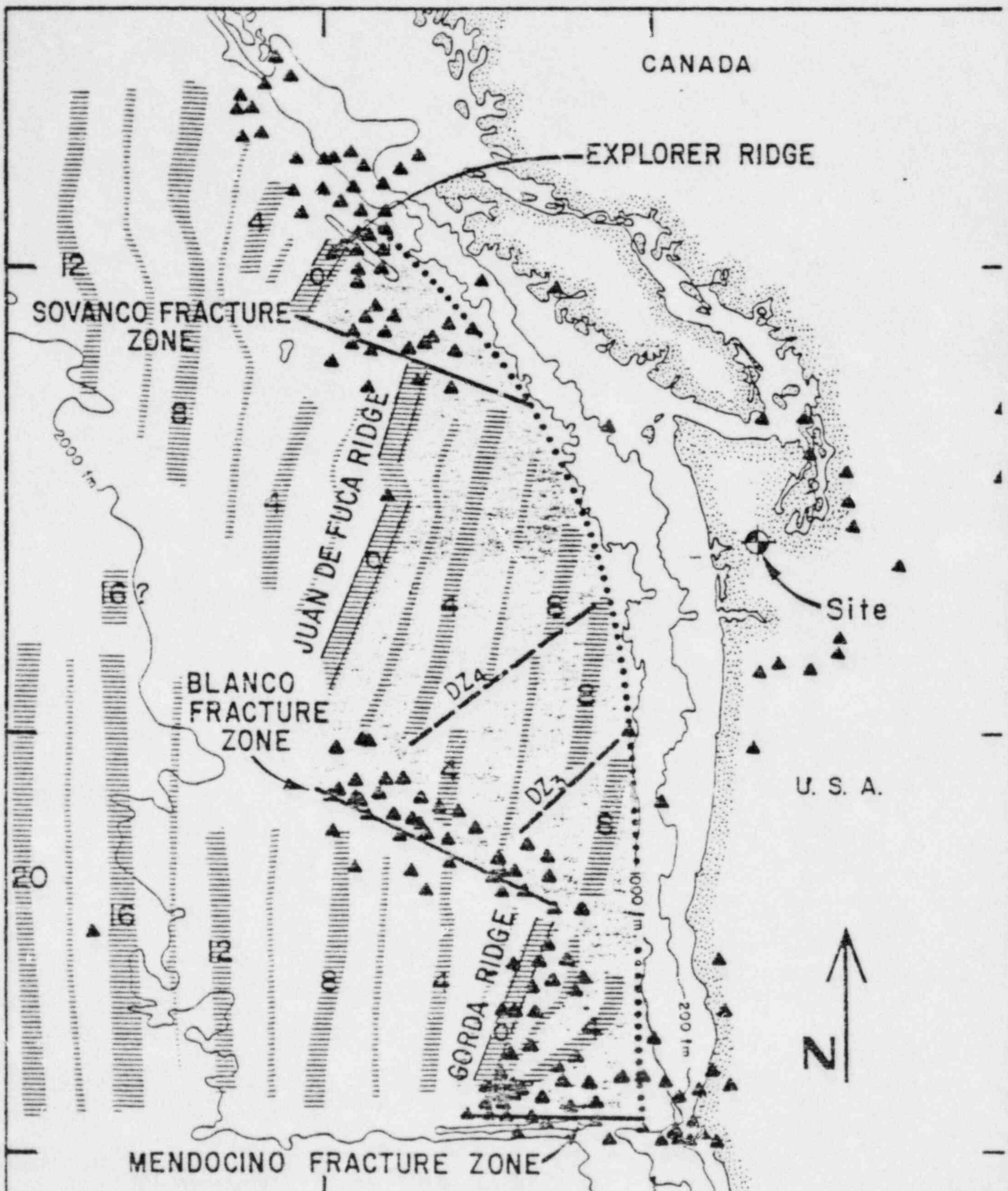


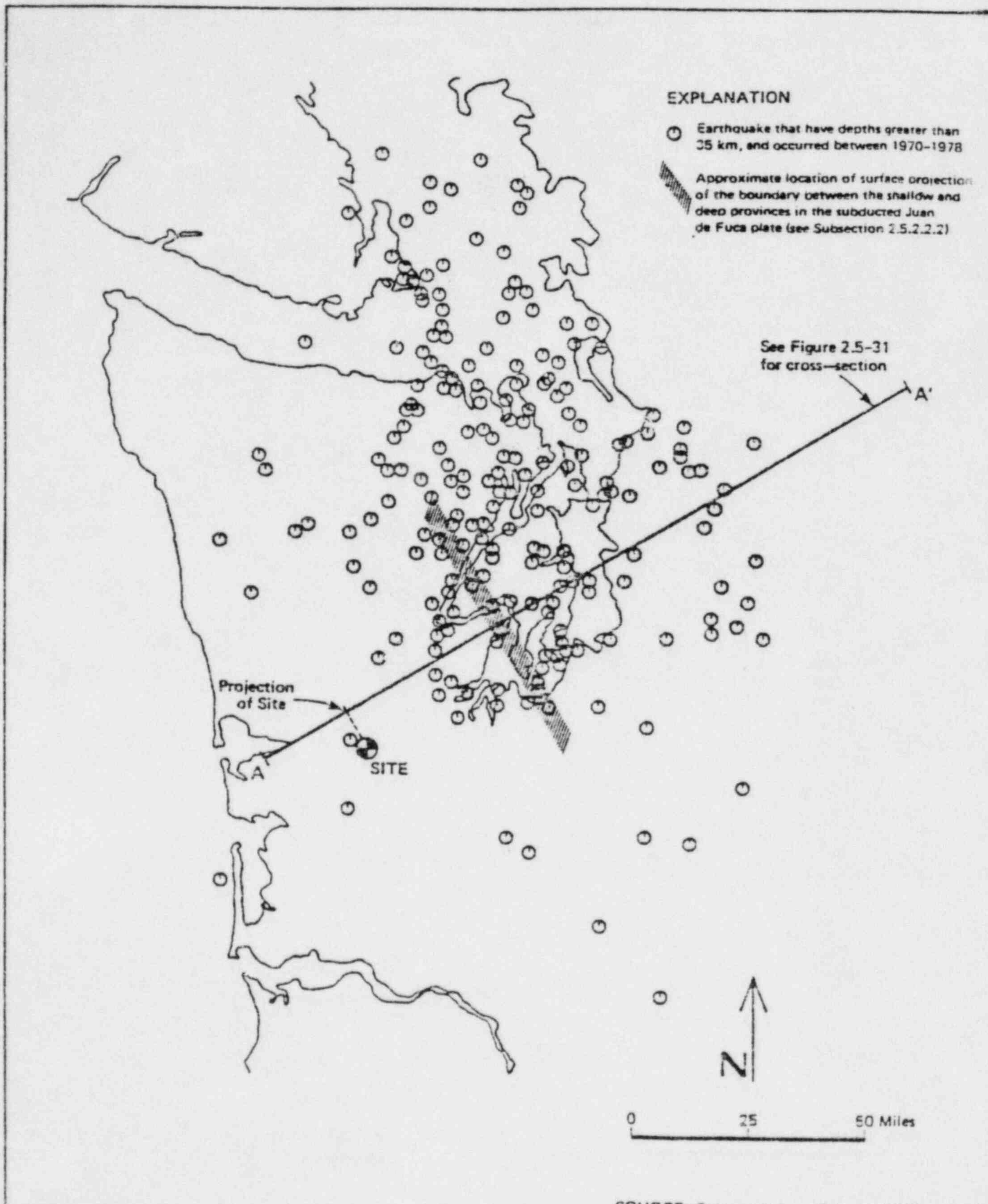

FIGURE 11: Map of the Pacific Northwest showing lineaments postulated by various workers. Dashed line west of coast is base of continental slope. See text for discussion of lineaments as follows: A (Barnard, 1978); B (Kulm, 1983); C (Hughes and others, 1980); D (Weaver and Smith, 1983); E (Weaver and Michaelson, 1983); F and G, zones of "offset" in offshore magnetic anomalies (Pavoni, 1966; Atwater, 1970). N50E arrow indicates relative orientation of inferred North American-Juan de Fuca plate convergence. Cascade volcanoes are from north to south: G = Garibaldi; B = Baker, GP = Glacier Peak; R = Rainier; SH = St. Helens; A = Adams; H = Hood; J = Jefferson; TS = Three Sisters; N = Newberry; CL = Crater Lake (Mazama); M = McLoughlin; S = Shasta; L = Lassen.

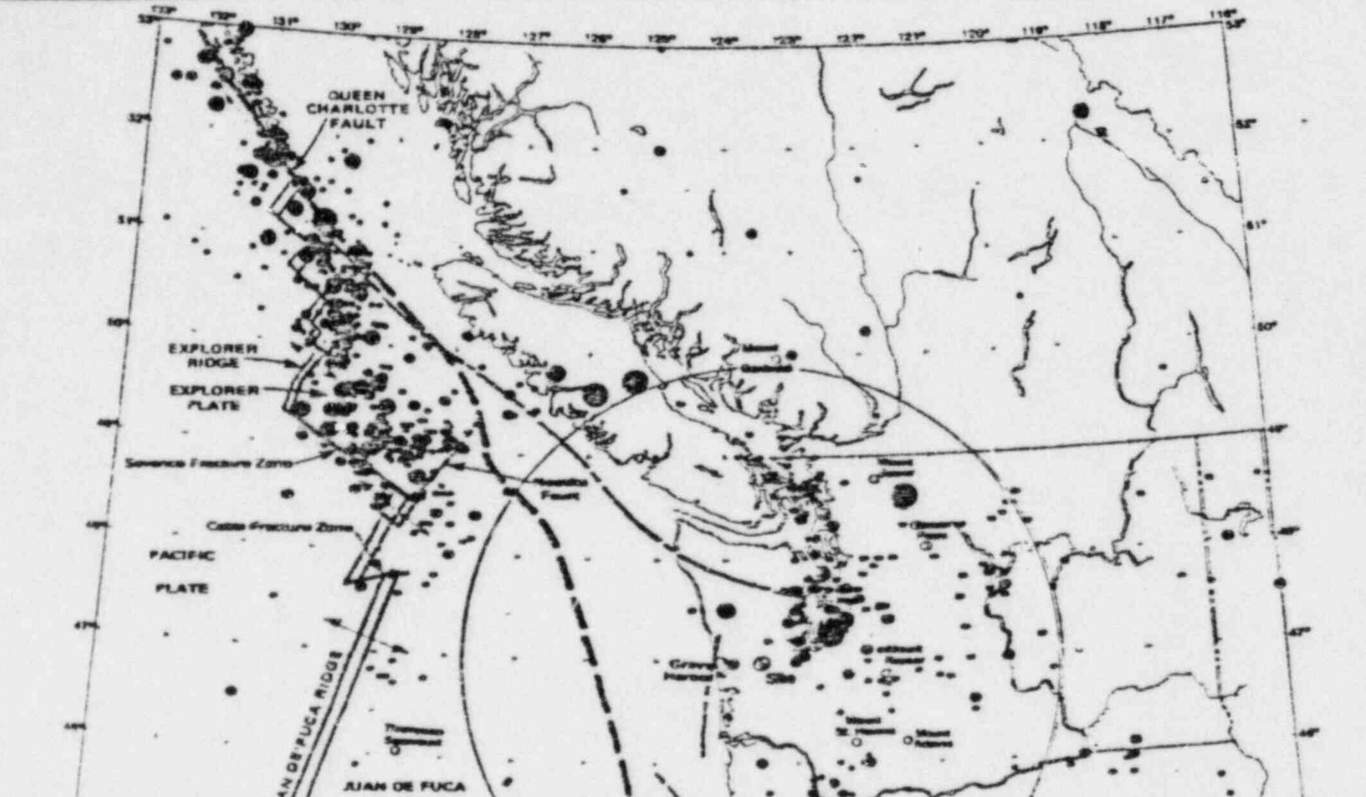


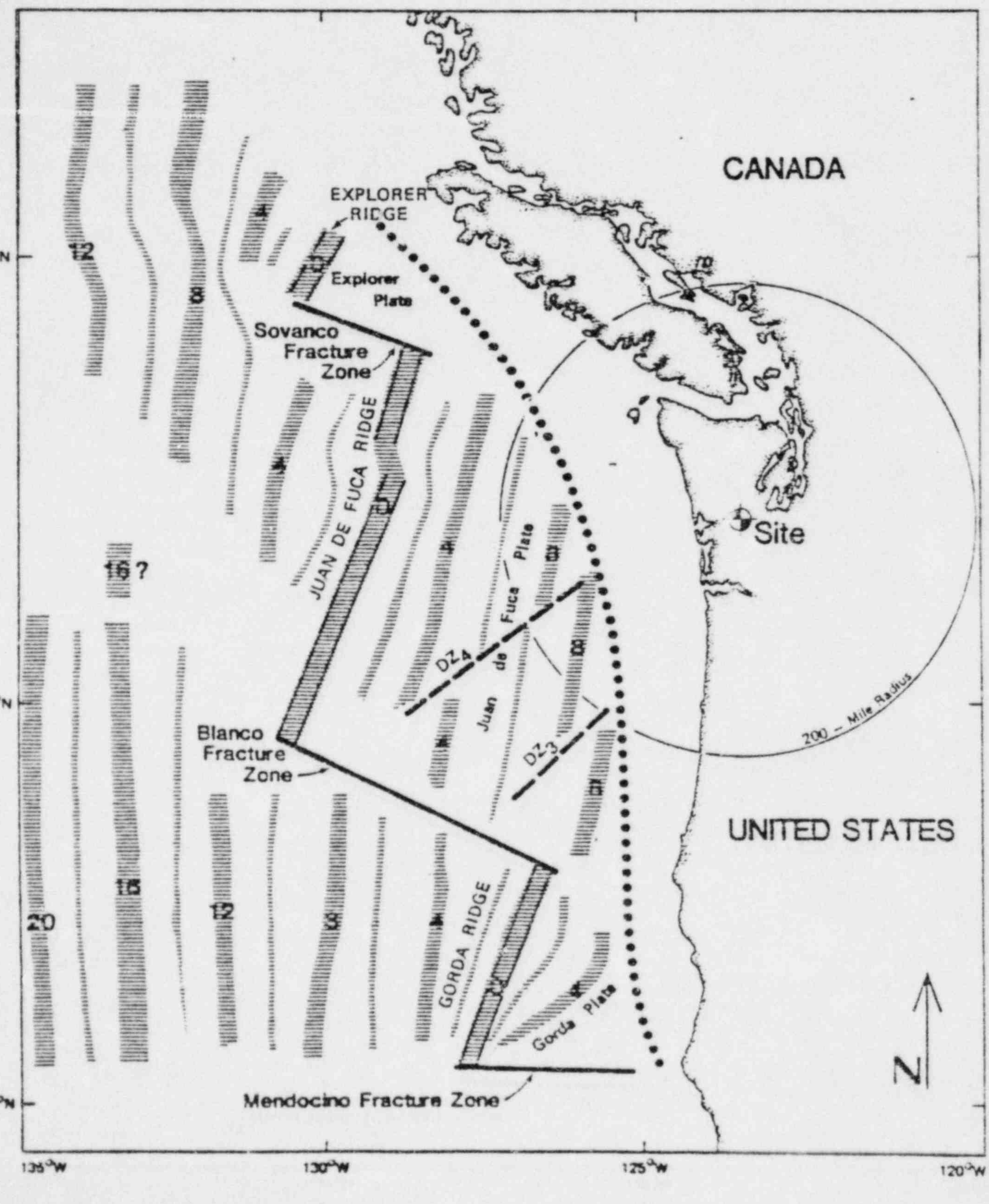

RELATION OF MAXIMUM ENERGY MAGNITUDE, Mw, TO CONVERGENCE RATE AND AGE OF SUBDUCTED LITHOSPHERE: CONTOURS OF Mw ARE PREDICTED MAXIMUM EARTHQUAKES MAGNITUDES BASED ON LINEAR REGRESSION OF OBSERVED MAXIMUM EARTHQUAKE MAGNITUDE ON CONVERGENCE RATE AND AGE; DOTS AND CIRCLES ARE SUBDUCTION ZONES WITH AND WITHOUT BACK ARC SPREADING, RESPECTIVELY (from Heaton and Kanamori, in press). ERROR BARS SHOW THE POSSIBLE RANGE OF VALUES FOR CONVERGENCE RATE AND AGE FOR EACH SUBDUCTION ZONE (see Table 1B)


SUBDUCTION ZONE
1. Southern Chile
2. Alaska
3. Kamchatka
4. Aleutians
5. Colombia
6. Nankai
7. So amons
8. Sumatra
9. New Hebrides
10. Rivera
11. Mexico
12. Central America
13. Kurile
14. Japan
15. Central Chile
16. Southern Peru
17. Philippine
18. New Zealand
19. Izu-Bonin
20. Marianas
21. Tonga
22. Kermadec
23. Ryukyu
24. Java
25. N. Lesser Antilles
26. S. Lesser Antilles
27. Scotia
28. Chile 46° - 52° S
29. Juan de Fuca


CANADA
EXPLORER RIDGE
SOVANCO FRACTURE ZONE
JUAN DE FUCA RIDGE
BLANCO FRACTURE ZONE
GORDA RIDGE
MENDOCINO FRACTURE ZONE
DZ4
DZ3
2000 fm
1000 fm
200 fm
Site
U. S. A.
N
50°N
45°N
40°N
135°W
130°W
125°W
120°


EXPLANATION
Earthquake that have depths greater than 35 km, and occurred between 1970-1978
Approximate location of surface projection of the boundary between the shallow and deep provinces in the subducted Juan de Fuca plate (see Subsection 2.5.2.2.2)
See Figure 2.5-31 for cross-section
A'
Projection of Site
A
SITE
N
0
25
50 Miles
SOURCE: Epicenters from Crossen, 1980


QUEEN CHARLOTTE FAULT
EXPLORER RIDGE
EXPLORER PLATE
PACIFIC PLATE
JUAN DE FUCA RIDGE
JUAN DE FUCA PLATE
200 – Mile Radius
Blanco Fracture Zone
GORDA RIDGE
GORDA PLATE
SAN ANDREAS FAULT
N



CANADA
UNITED STATES
EXPLORER RIDGE
Explorer Plate
Sovanco Fracture Zone
JUAN DE FUCA RIDGE
Juan de Fuca Plate
DZ4
DZ3
Blanco Fracture Zone
GORDA RIDGE
Gorda Plate
Mendocino Fracture Zone
Site
200 - Mile Radius
N
50°N
45°N
40°N
135°W
130°W
125°W
120°W
12
8
4
5
16 ?
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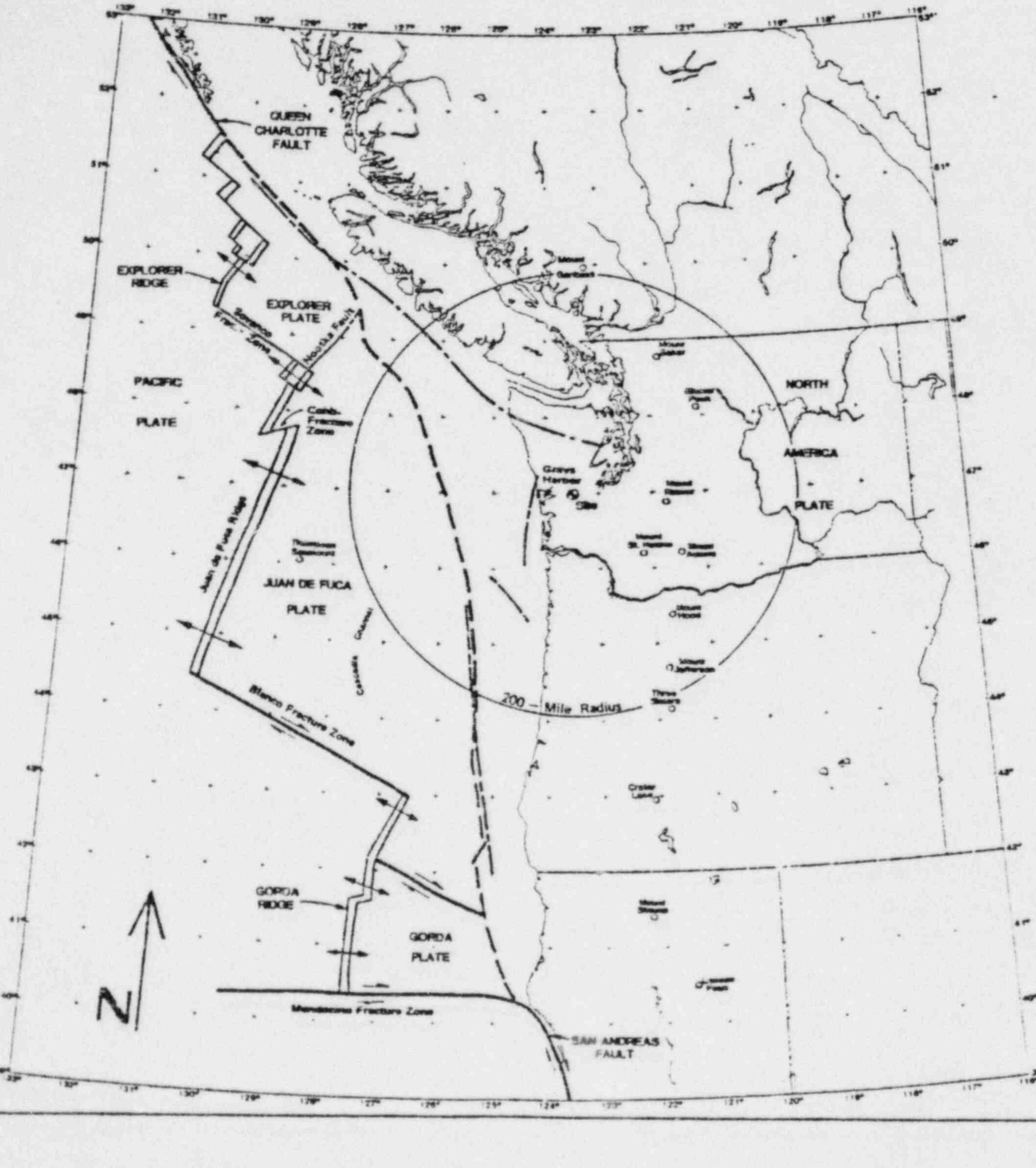
QUEEN CHARLOTTE FAULT
EXPLORER RIDGE
EXPLORER PLATE
Nootka Fault
PACIFIC PLATE
Cobb Fracture Zone
Juan de Fuca Ridge
JUAN DE FUCA PLATE
Cascadia Channel
Blanco Fracture Zone
GORDA RIDGE
GORDA PLATE
Mendocino Fracture Zone
SAN ANDREAS FAULT
NORTH AMERICA PLATE
Grays Harbor
Site
200 – Mile Radius
Crater Lake
N

SEP 6 1984

# MEETING SUMMARY DISTRIBUTION

Docket No(s): 50-508
NRC PDR
Local PDR
NSIC
PRC System
LB3 Reading
Attorney, OELD
GWKnighton
Project Manager B. K. Singh
JLee

NRC PARTICIPANTS

BKSingh
SBrocoum
JKimball
LReiter
DMcMullen
AWang
RSavio
CTrammell
VNerses

bcc: Applicant & Service List

Enclosure 1

JUN 1 5 [illegible]

Docket No.: 50-508

MEMORANDUM FOR: George W. Knighton, Chief, Licensing Branch No. 3, DL

FROM: Victor Nerses Project Manager, Licensing Branch No. 3, DL

SUBJECT: WNP-3 MEETING

DATE & TIME: Thursday, August 23, 1984
9:00 am - 12:00 pm

LOCATION: P-~~110~~ 118
Phillips Building
Bethesda, Maryland

PURPOSE: The applicant will present to the staff the details of their position paper on subduction zone earthquake.

AGENDA: See enclosed.

PARTICIPANTS: WPPSS

D. Coleman, et al

NRC

V. Nerses, B. K. Singh, S. Brocoum, R. Savio

Victor Nerses, Project Manager
Licensing Branch No. 3, DL

Enclosure: Agenda

cc: See next page

Meetings between NRC technical staff and applicants for licenses are open for interested members of the public, petitioners, intervenors, or other parties to attend as observers pursuant to "Open Meeting Statement of NRC Staff Policy", 43 Federal Register 28058, 6/28/78. Those interested in attending this meeting should make their intentions known to the Project Manager, Victor Nerses, at (301) 492-7238, by no later than August 21, 1984.

8406260480

| OFFICE | DL:LB#3 | DL:LB#3 | DL:LB#3 | | | | |
|---|---|---|---|---|---|---|---|