AMOCO

Results of 1982 Field Program
McArthur River
Permits OP191/OP198
Northern Territory, Australia

ONSHORE

Volume 2 of 7
Figures & Tables

OPEN FILE

Amoco Australia Petroleum Company

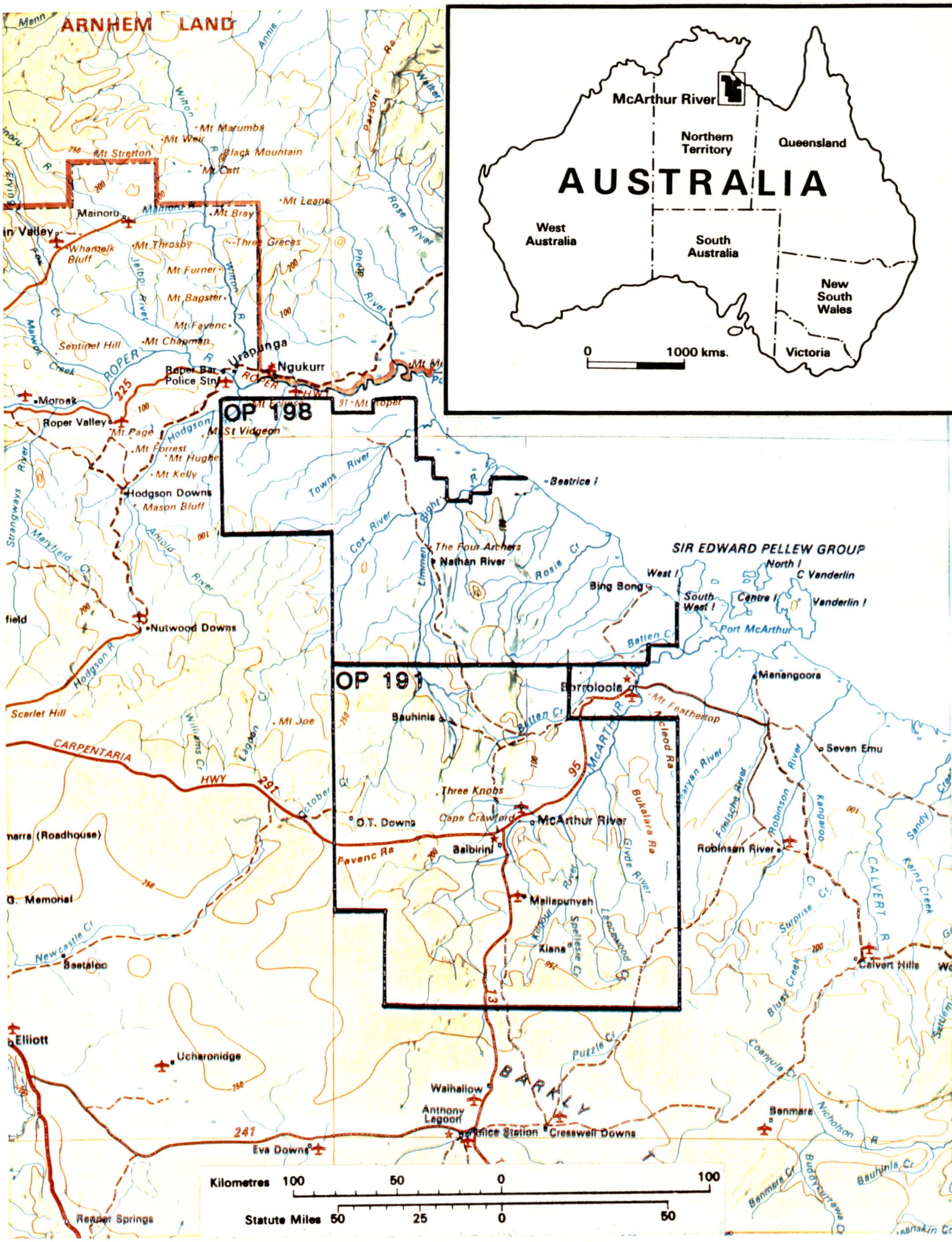


FIGURE 1-1
Location Map, McArthur River Area

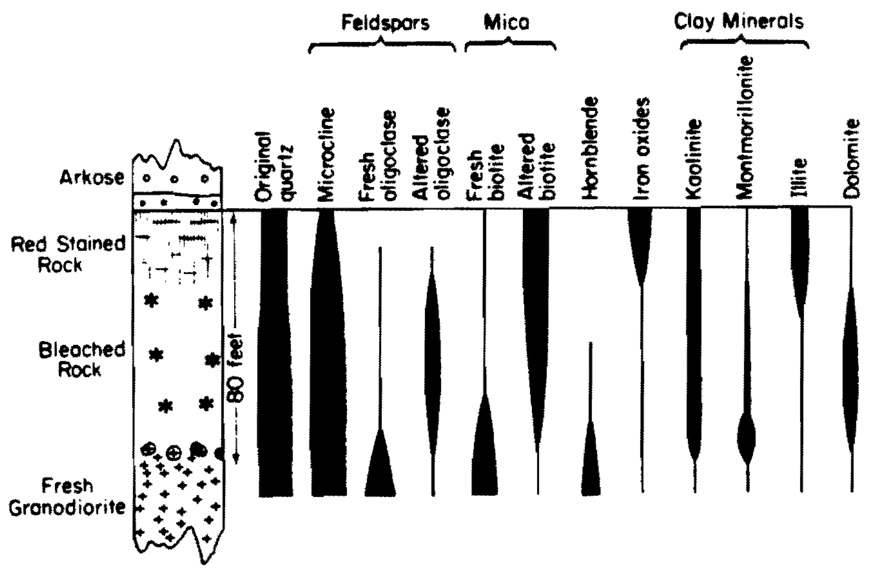


Figure 5-1. Diagram showing persistence with depth of important minerals in Pre-Arkose weathering mantle (after Wahlstrom, 1948).

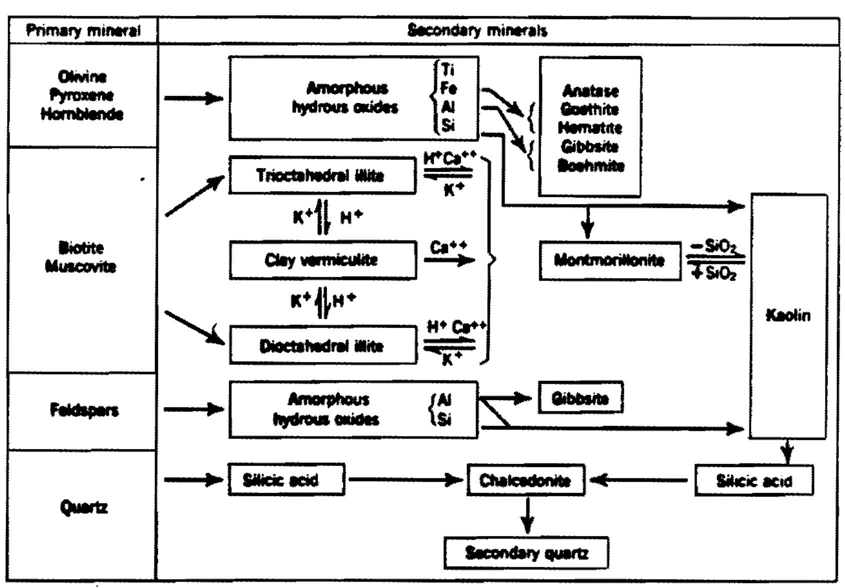


Figure 5-2. Chemical weathering patterns of the primary rock-forming minerals (after Fieldes and Swindale, 1954).

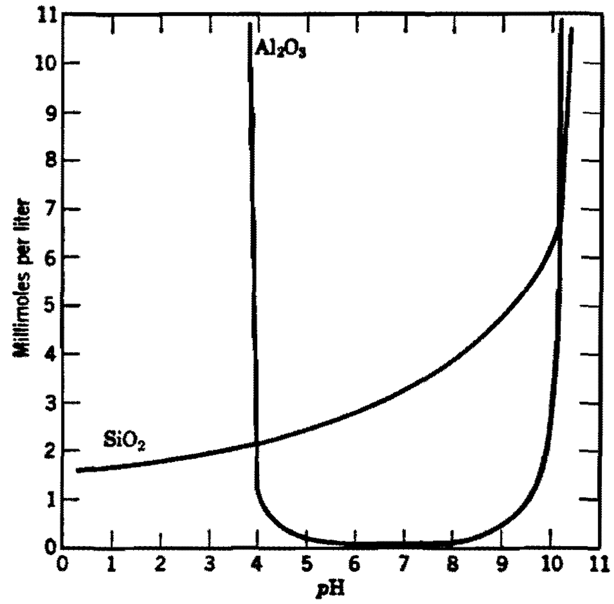


Figure 5-3. The solubility of silica and alumina as a function of pH. Note the insolubility of alumina over the range of 4-10 of pH (after Mason, 1966).

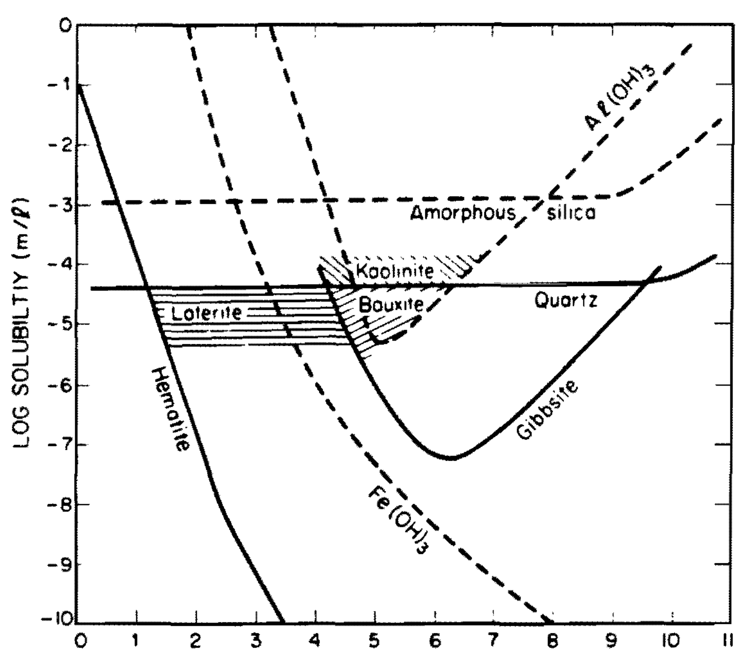


Figure 5-4. The solubilities of hematite, gibbsite, quartz, and their amorphous equivalents as a function of pH. Fields of stability of laterite, bauxite and kaolinite are labeled, but metastable fields also exist (from Blatt et. al., 1980).

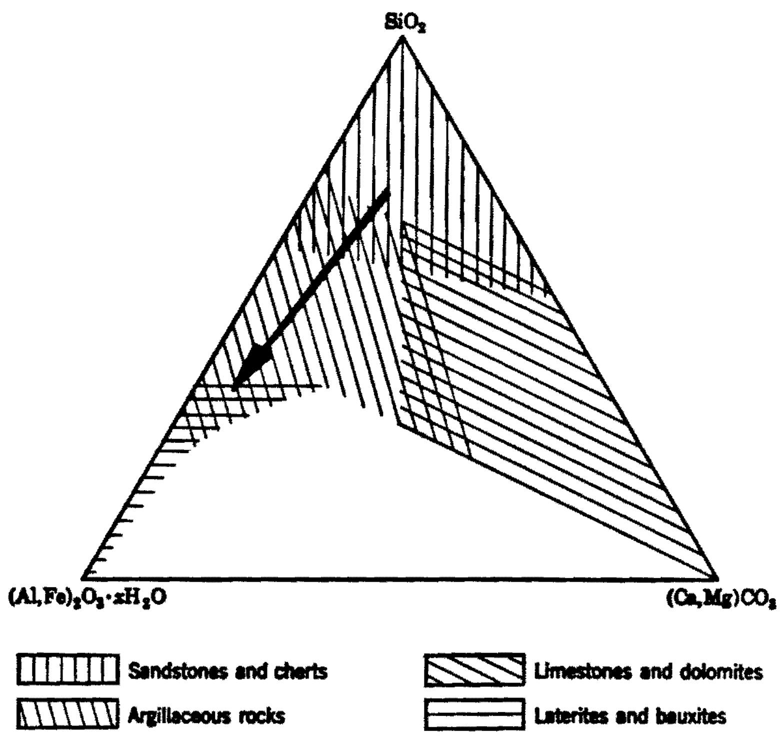


Figure 5-5. The chemical composition of common sediments. Sediments with compositions falling in the blank area are rare or nonexistant. The arrow follows the path of composition of a weathering quartz arenite with some feldspars and detrital clay minerals (after Mason, 1966).

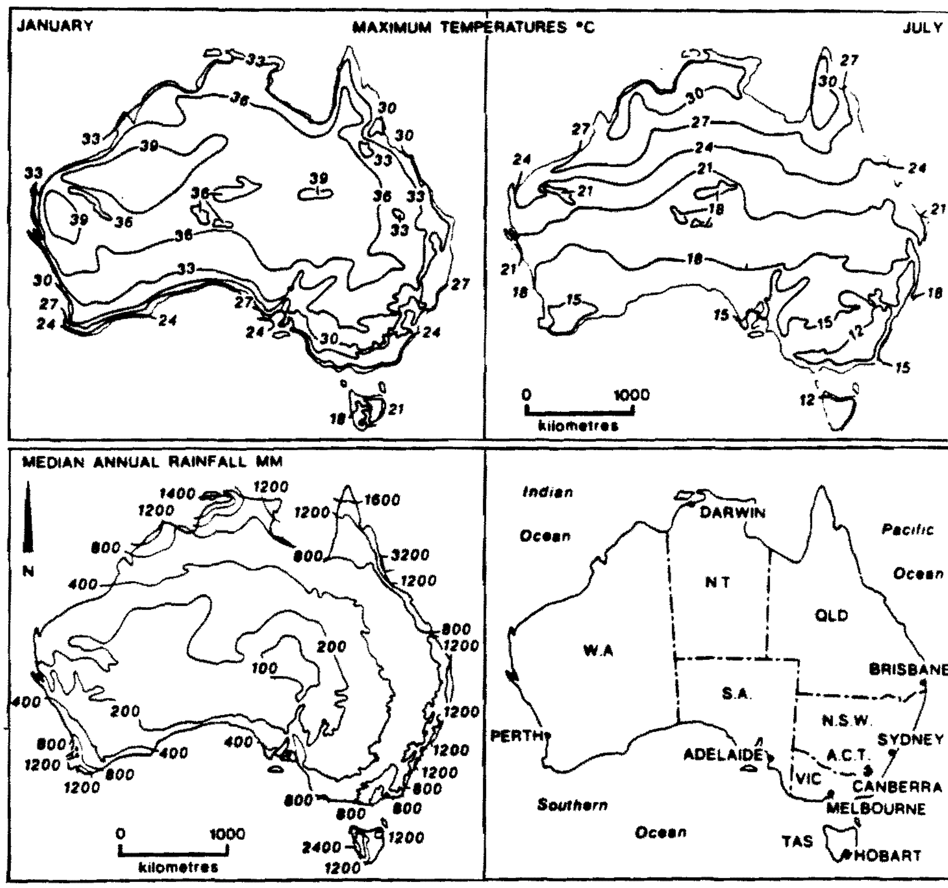


Figure 5-6. The median annual rainfall and mean maximum temperatures in summer (January) and winter (July) of Australia (Mabbutt, 1980).

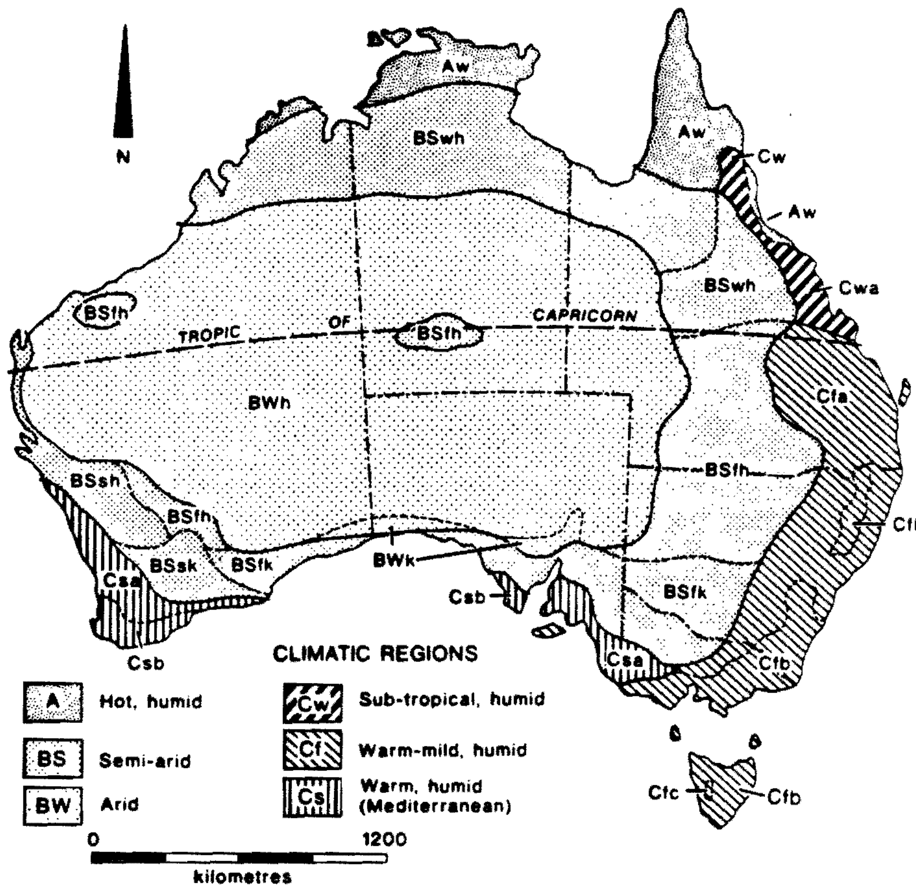


Figure 5-7. Climatic regions of Australia, using the Koppen 1936 system modified after Gentilli, 1972. Detailed legend on Table 5-4. Note that the McArthur River area lies in the BSwh zone; hot, subhumid, dry winter (Mabbutt, 1980).

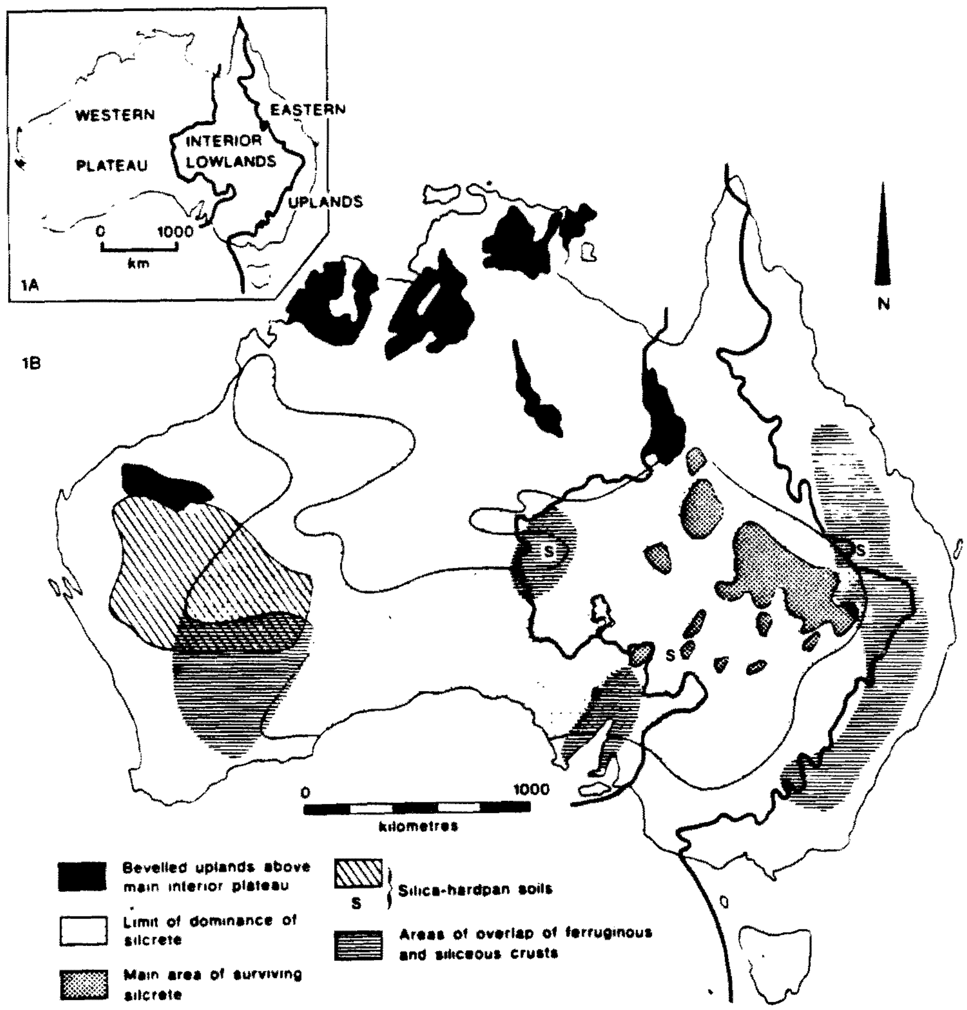


Figure 5-8. A. The main geomorphical sub-divisions of Australia. B. The distribution of silcretes and siliceous hardpans (from Mabbutt, 1980).

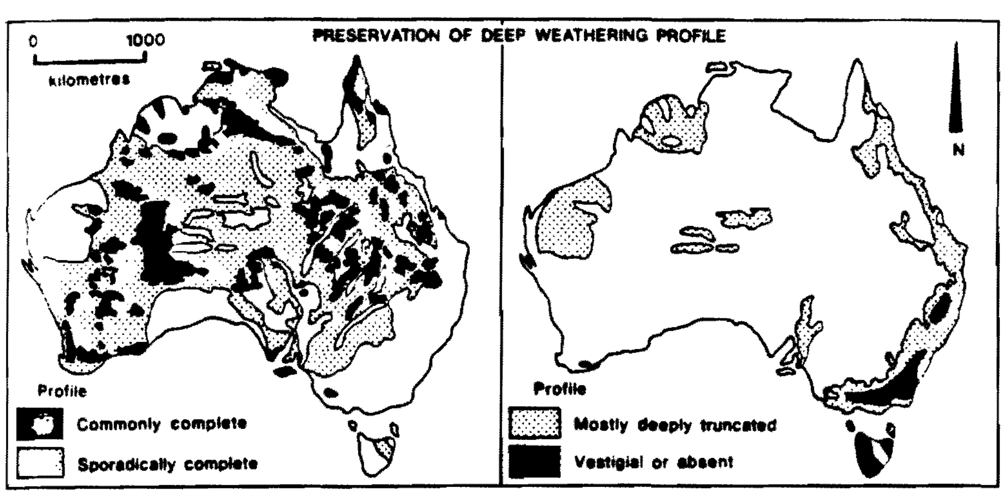


Figure 5-9. The degree of preservation of deep weathering profiles in Australia (from Mabbutt, 1980).

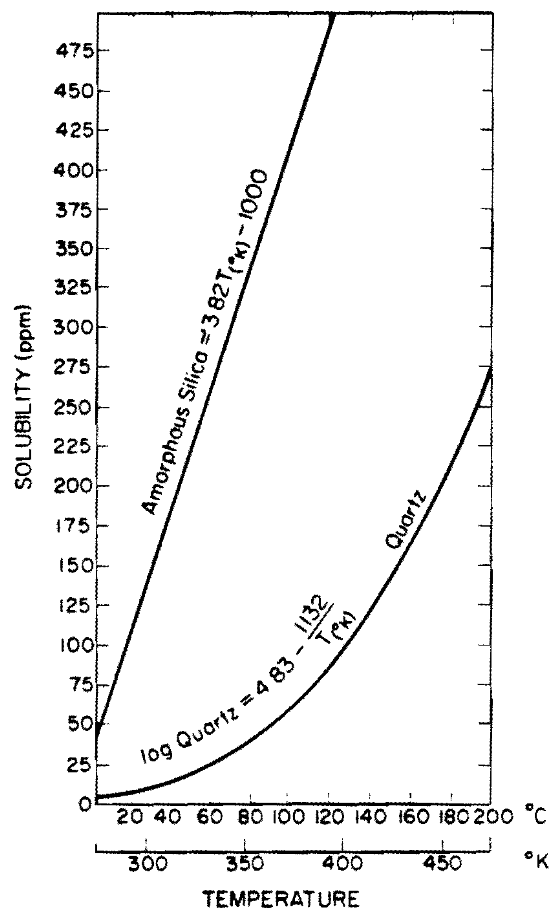


Figure 5-10. The solubilities of amorphous silica and quartz as a function of temperature. Note that with increasing temperature a solution of SiO2 becomes increasingly more oversaturated with respect to quartz than to amorphous silica. This favors the precipitation of quartz at higher temperatures (from Blatt et. al, 1980).

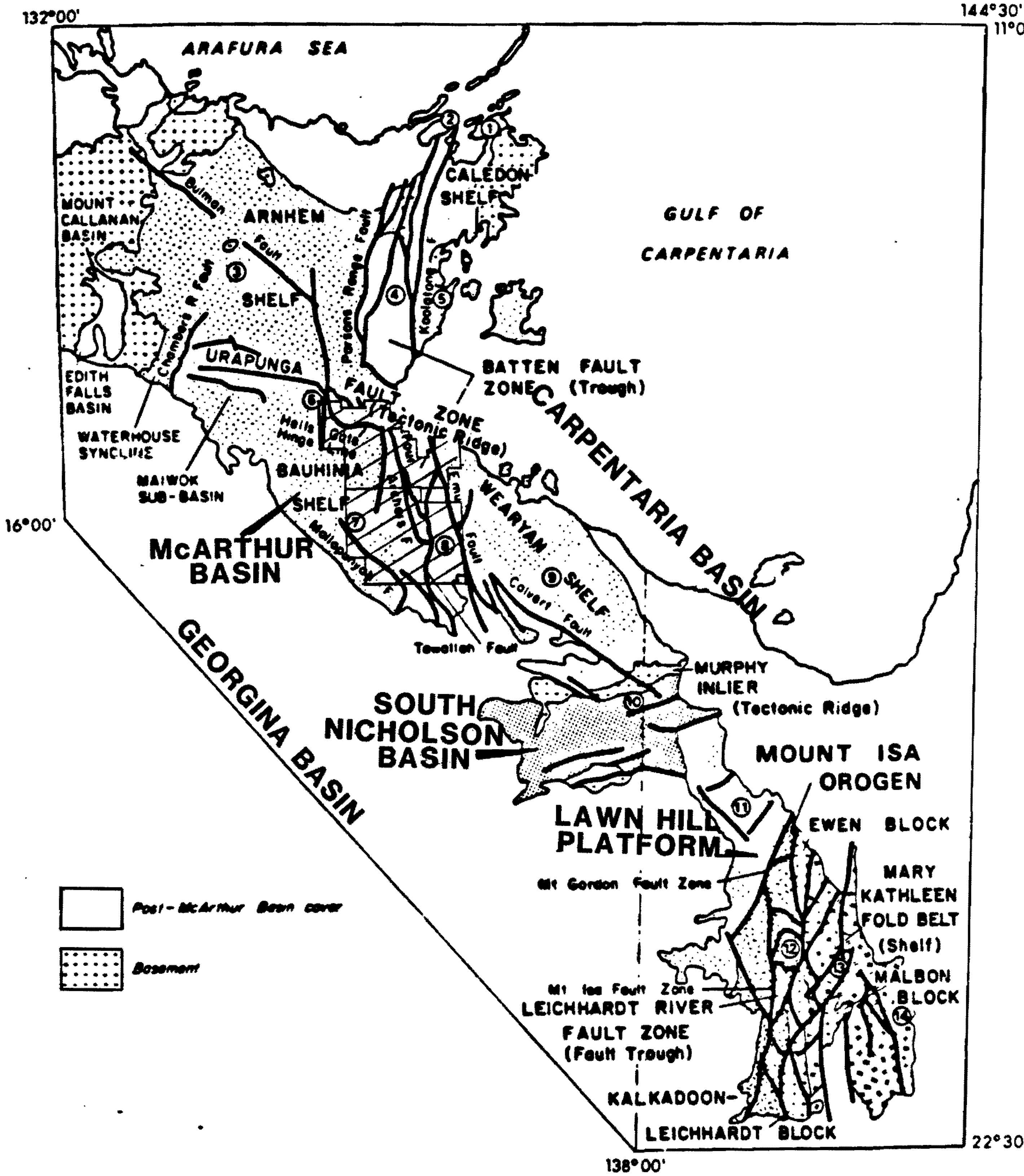


Figure 7-1. Regional tectonics and distribution of Proterozoic sediments along northwest-trending right-lateral wrench system. A number of pull-apart basins have developed throughout the trend (from Plumb, et al, 1980).

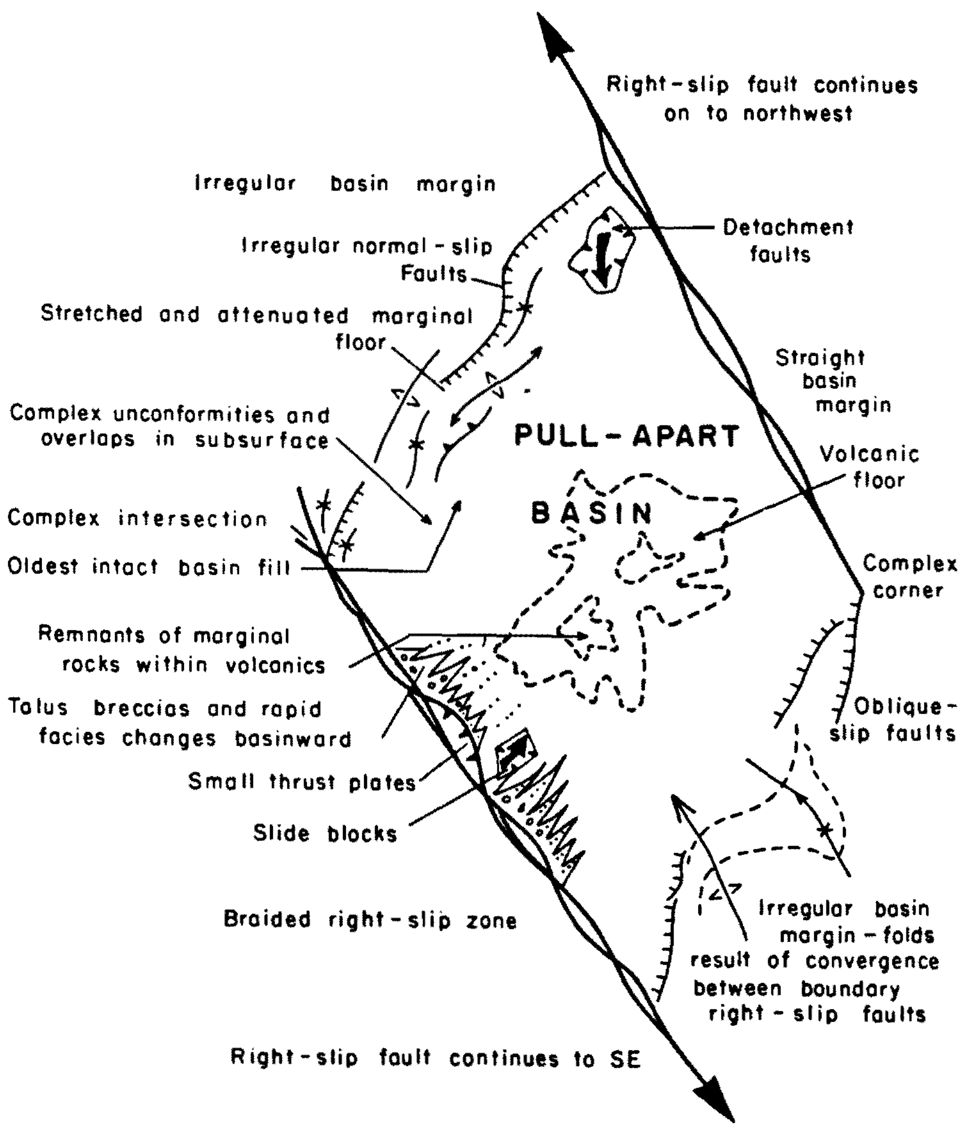


Figure 7-2. Sketch of an idealized pull-apart basin in a right-lateral wrench fault system (from Crowell, 1974).

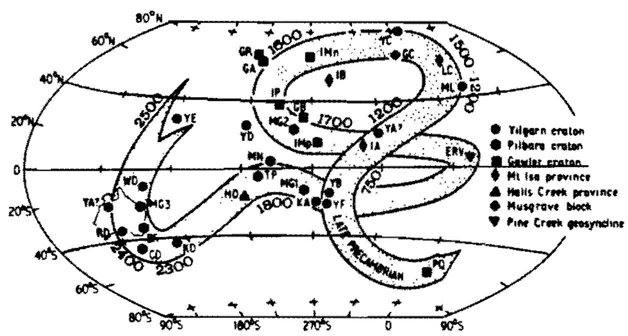


Figure 7-3. Polar wander curve for Australia during the Proterozoic as established from paleomagnetic data from dyke groups listed on right side of figure. Approximate ages shown are in millions of years (from Embleton, 1980).

YALCO DOLOMITE 82-6, 82-7

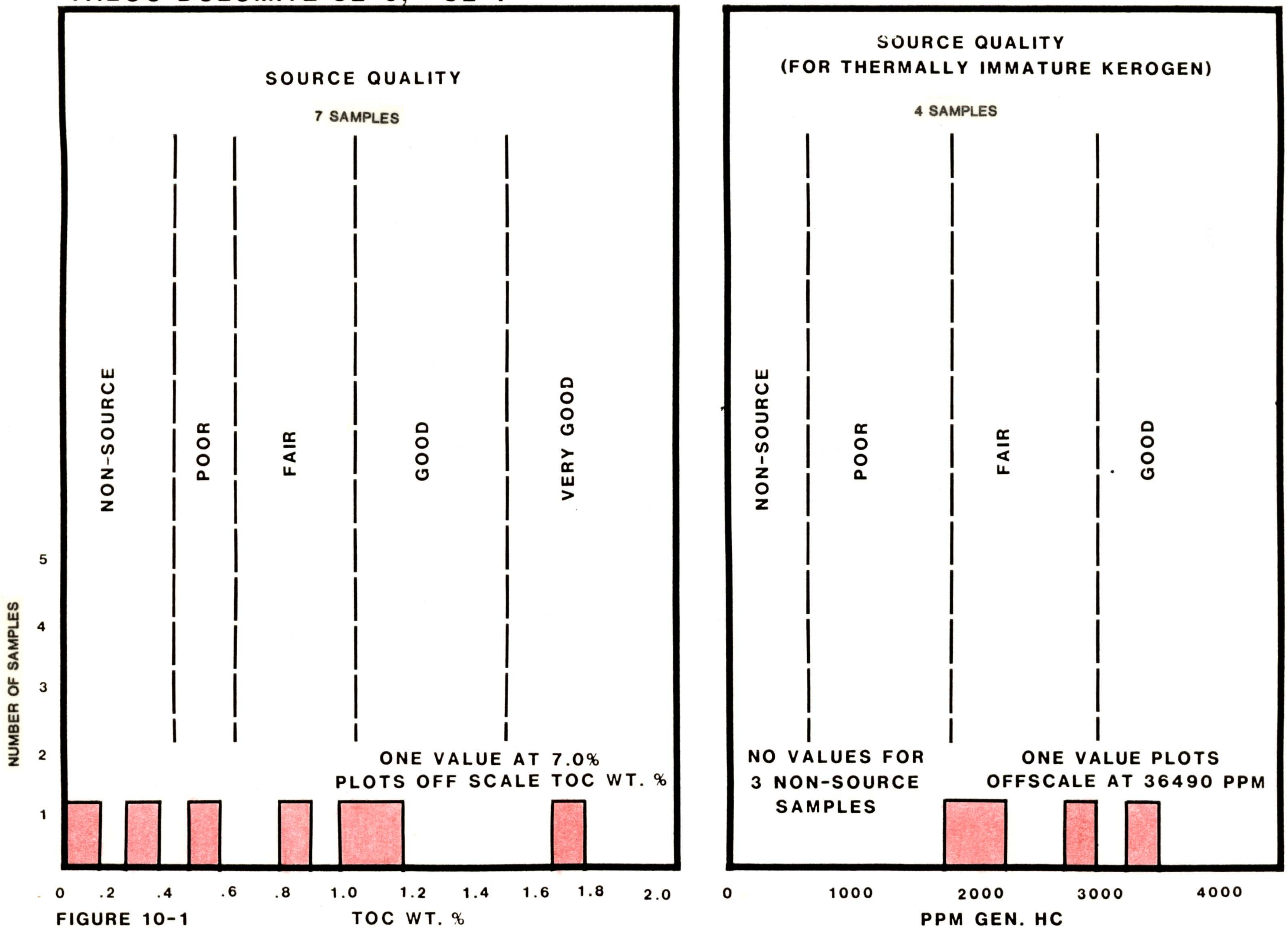


FIGURE 10-1

YALCO DOLOMITE 82-6, 82-7 THERMAL MATURITY

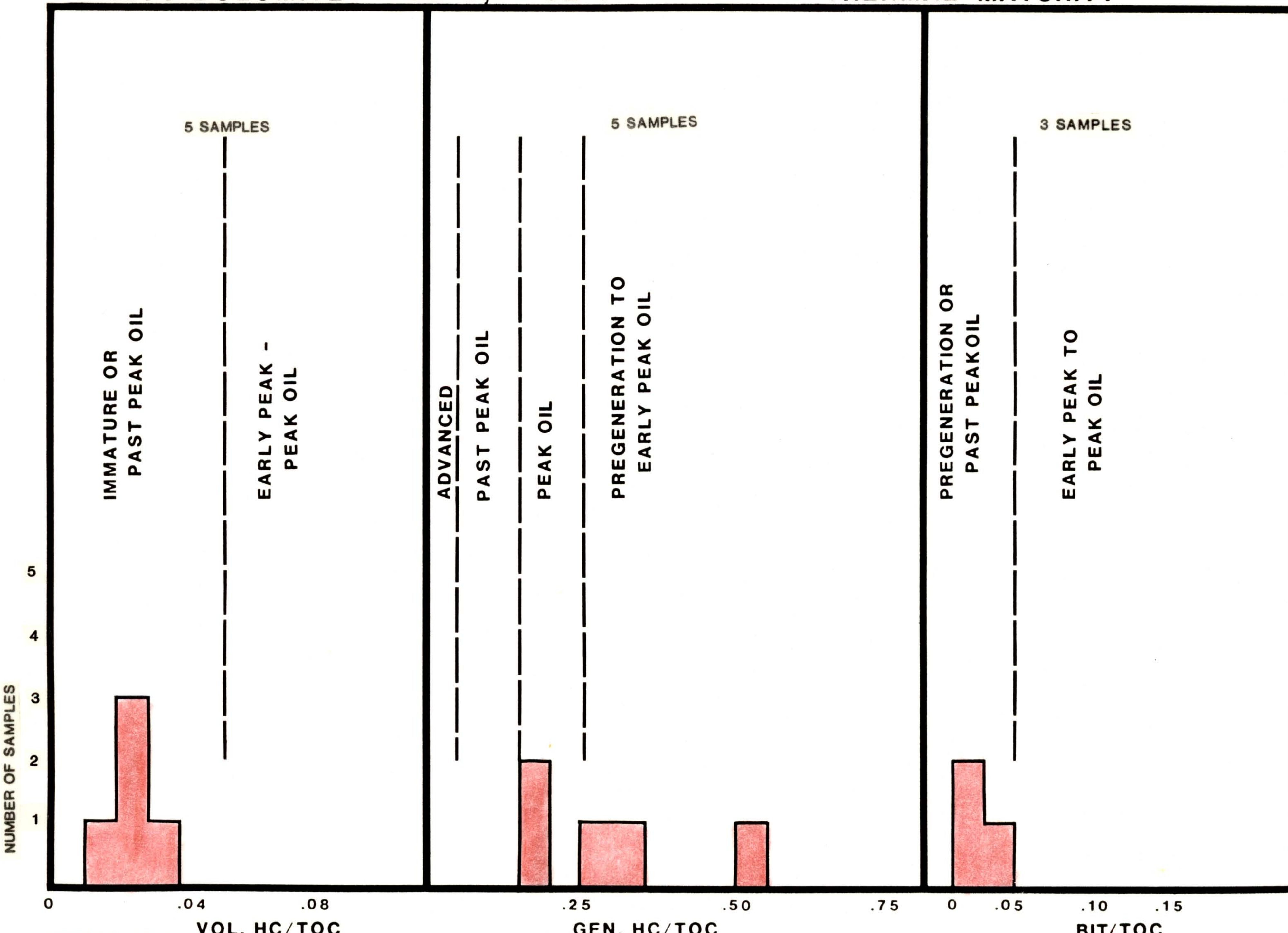


FIGURE 10-2

YALCO DOLOMITE 82-6

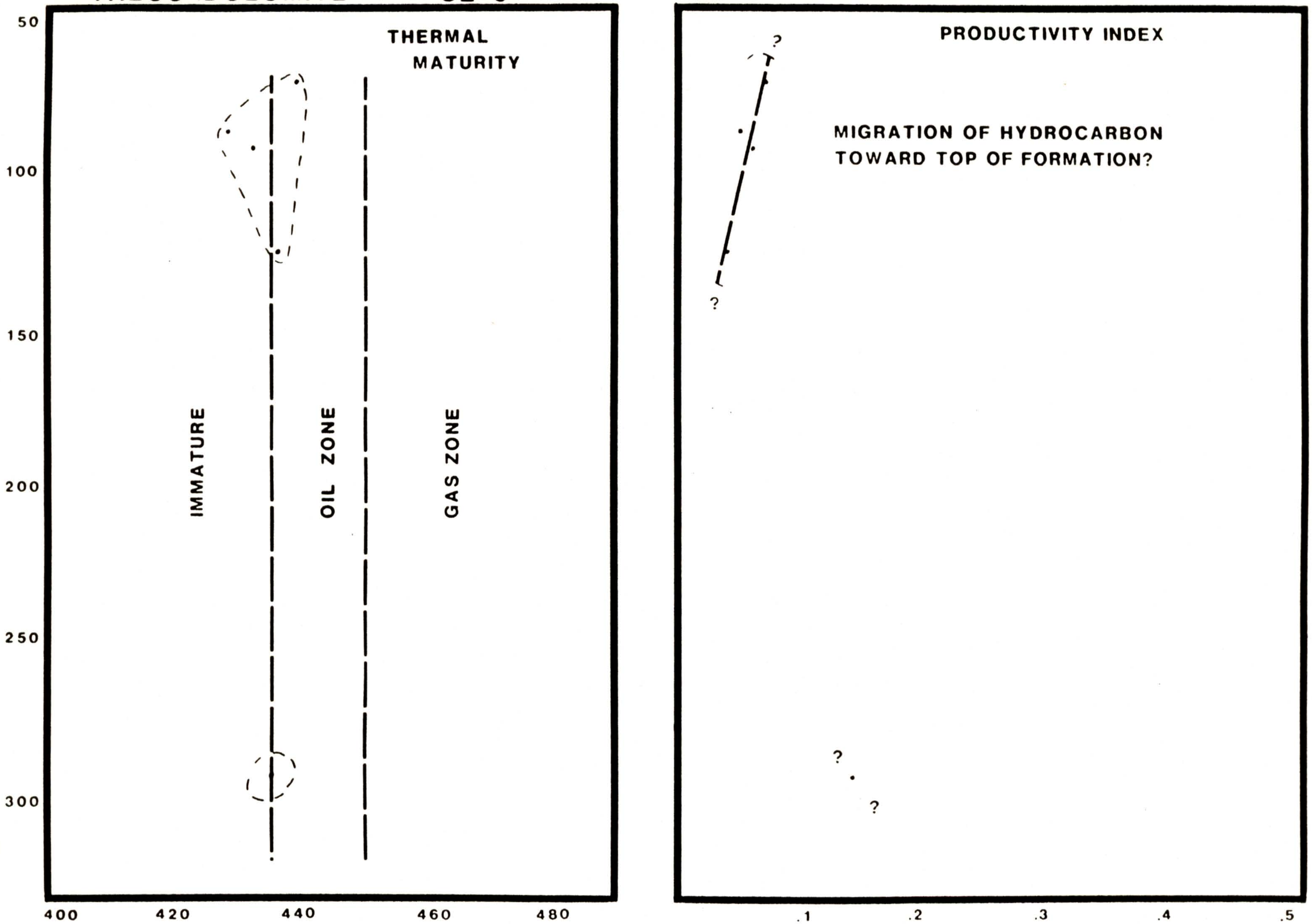


FIGURE 10-3

LANSEN CREEK SHALE 82-1, 82-8

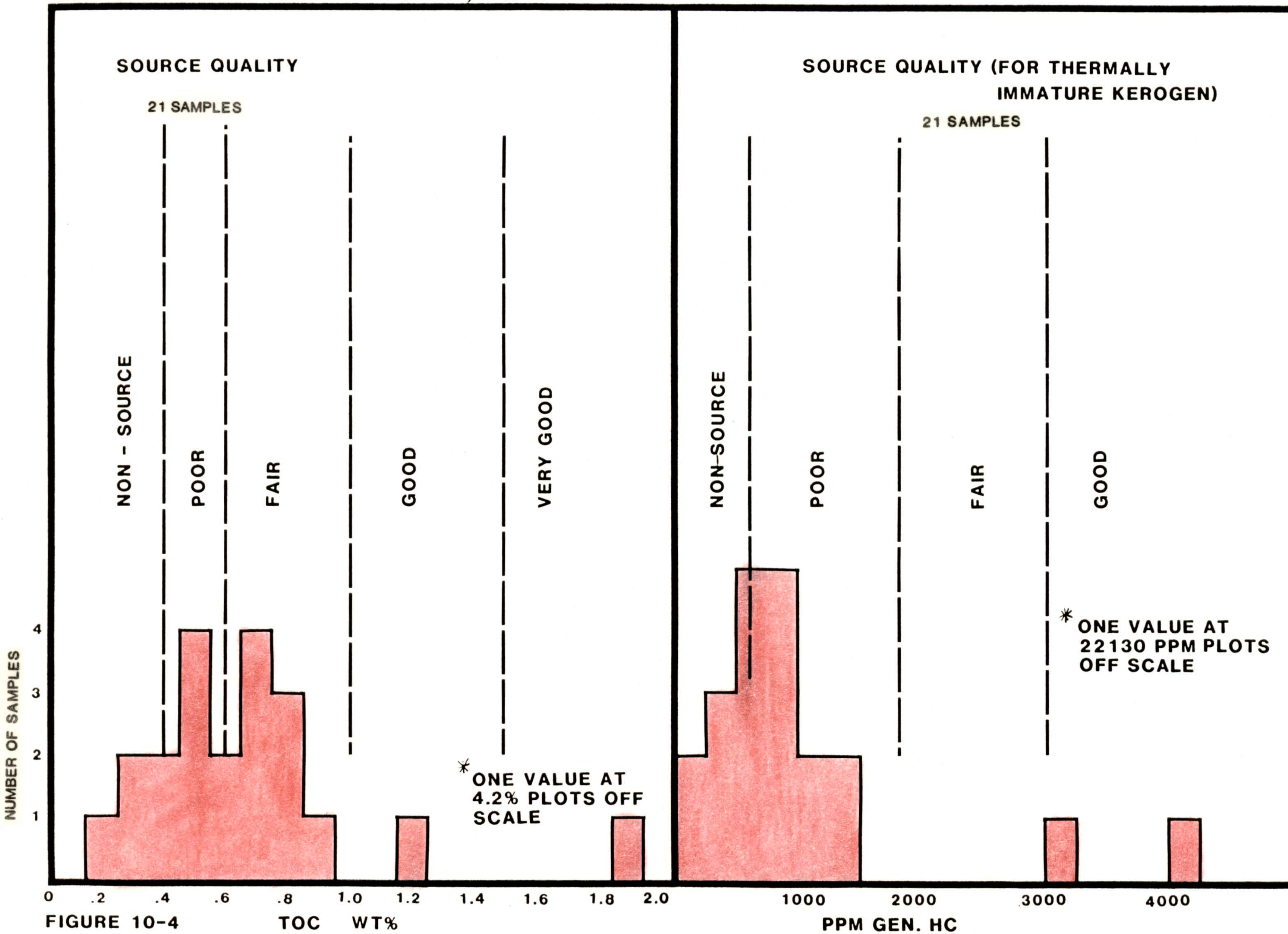
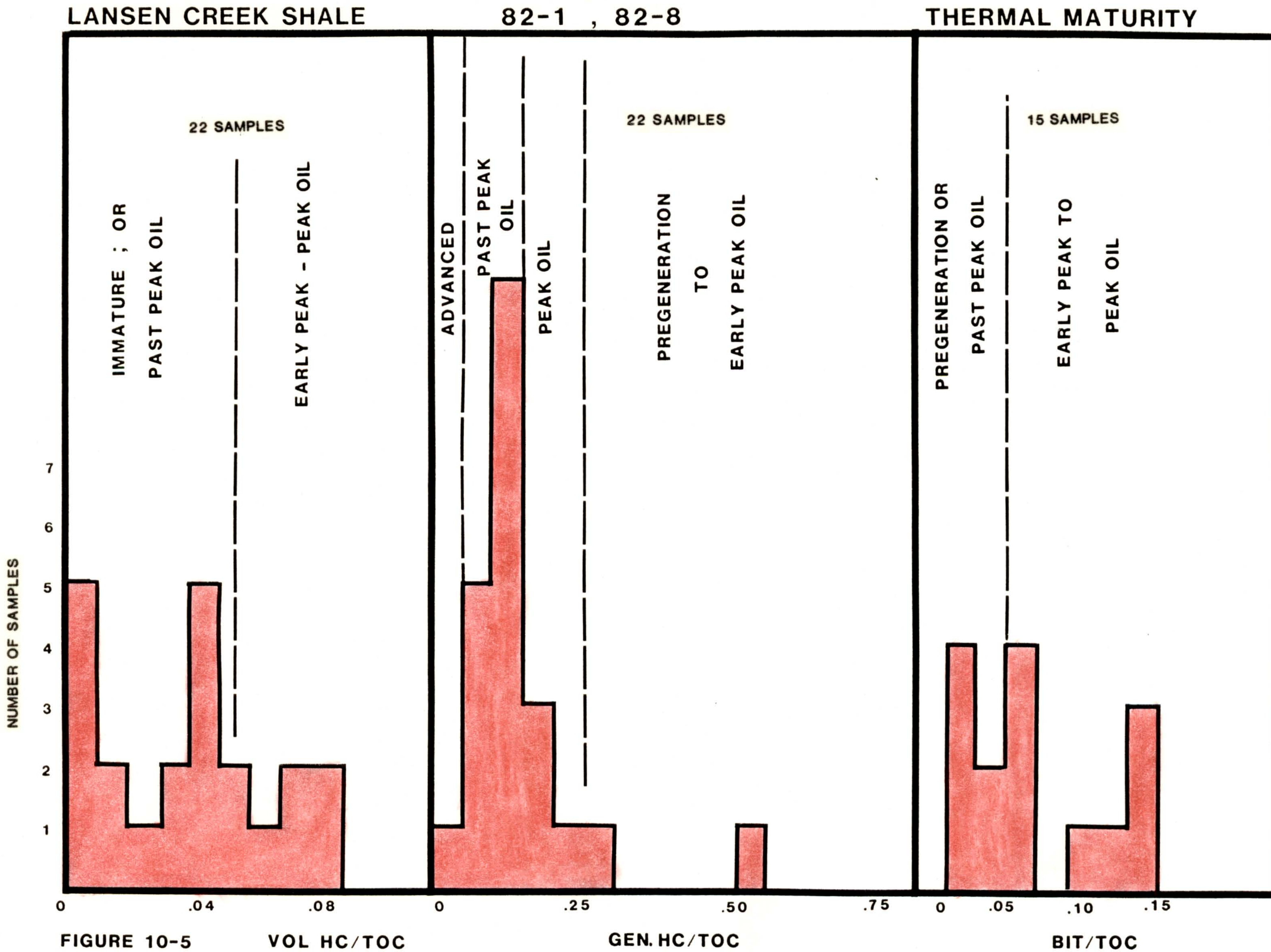


FIGURE 10-4


LANSEN CREEK SHALE
82-1 , 82-8
THERMAL MATURITY
22 SAMPLES
IMMATURE ; OR
PAST PEAK OIL
EARLY PEAK - PEAK OIL
22 SAMPLES
ADVANCED
PAST PEAK
OIL
PEAK OIL
PREGENERATION
TO
EARLY PEAK OIL
15 SAMPLES
PREGENERATION OR
PAST PEAK OIL
EARLY PEAK TO
PEAK OIL
NUMBER OF SAMPLES
7
6
5
4
3
2
1
0
.04
.08
0
.25
.50
.75
0
.05
.10
.15
VOL HC/TOC
GEN. HC/TOC
BIT/TOC
FIGURE 10-5

LANSEN CREEK SHALE 82-1 VS. 82-8

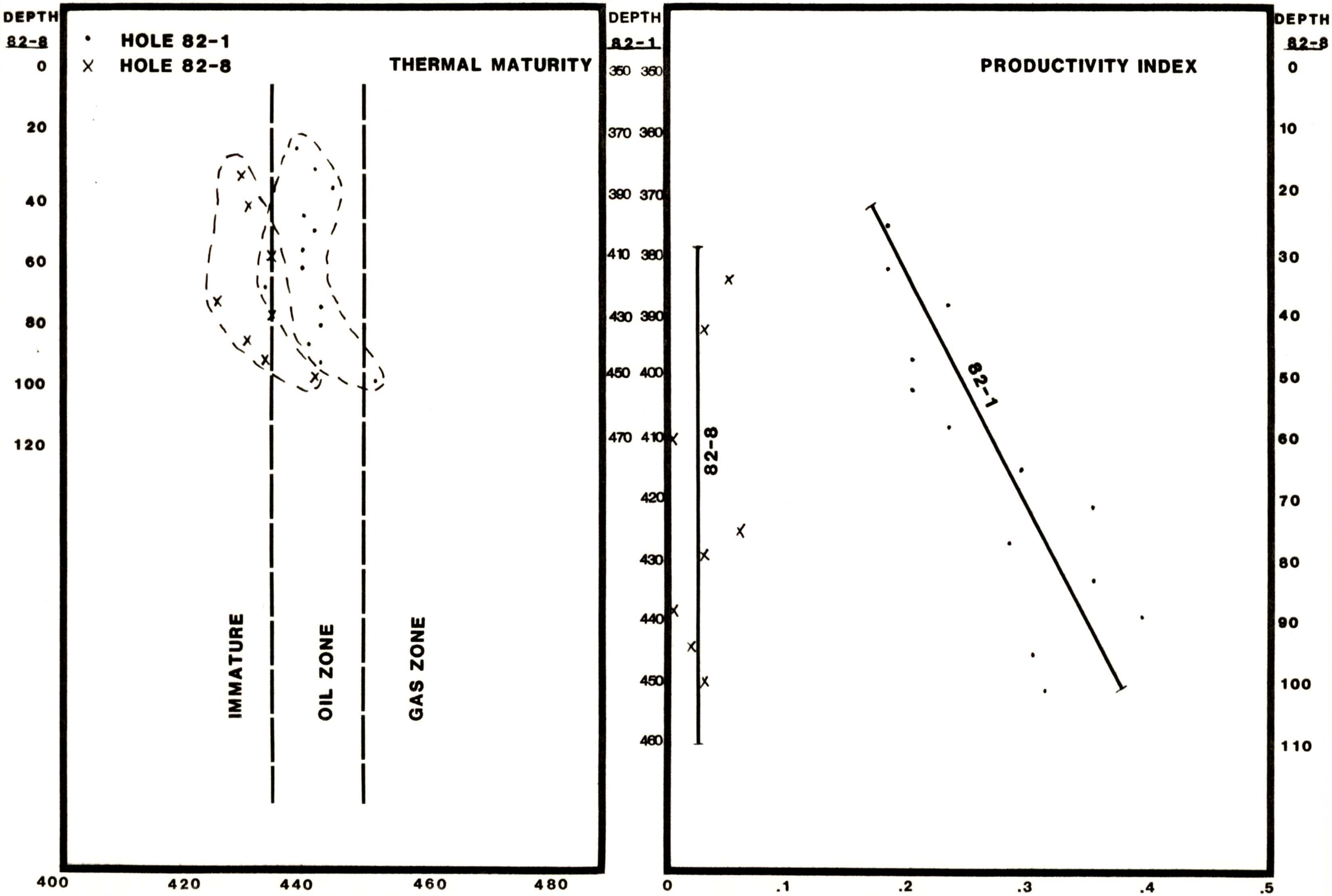


FIGURE 10-6 TEA MAX. TEMP.

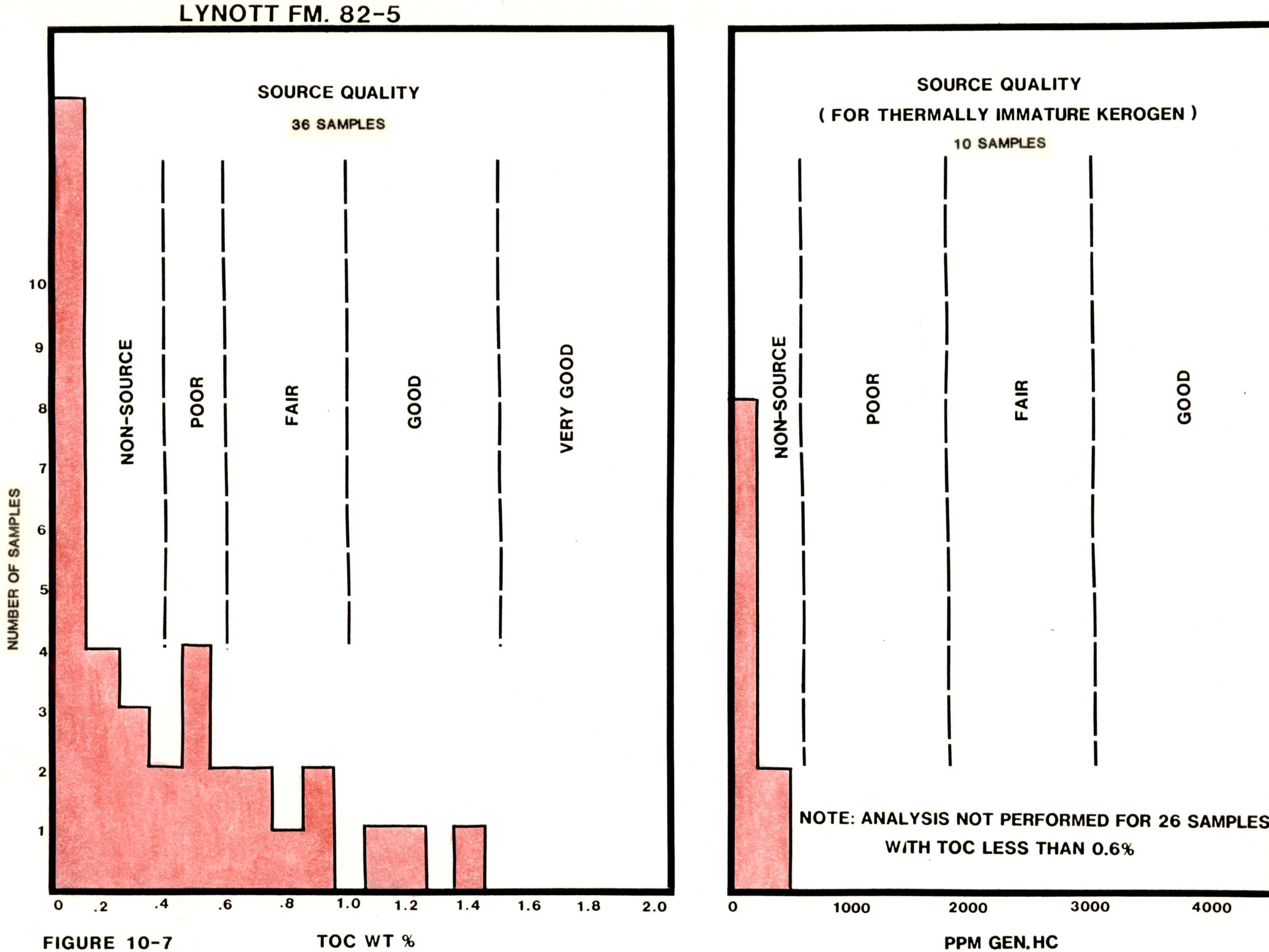
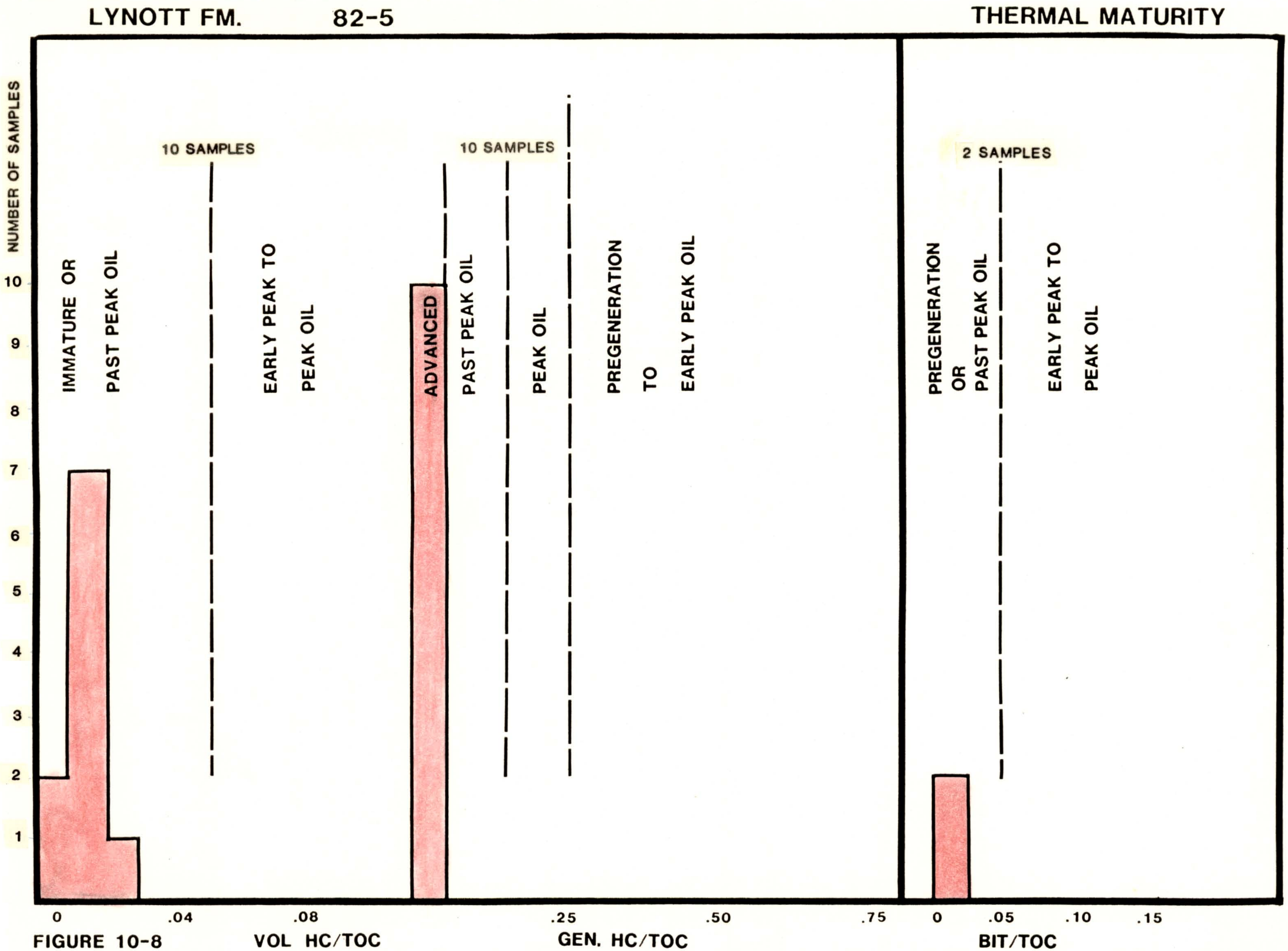

LYNOTT FM. 82-5
SOURCE QUALITY
36 SAMPLES
NON-SOURCE
POOR
FAIR
GOOD
VERY GOOD
NUMBER OF SAMPLES
1
2
3
4
5
6
7
8
9
10
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
TOC WT %
SOURCE QUALITY
(FOR THERMALLY IMMATURE KEROGEN)
10 SAMPLES
NON-SOURCE
POOR
FAIR
GOOD
NOTE: ANALYSIS NOT PERFORMED FOR 26 SAMPLES
WITH TOC LESS THAN 0.6%
0
1000
2000
3000
4000
PPM GEN. HC

FIGURE 10-7



LYNOTT FM.
82-5
THERMAL MATURITY
NUMBER OF SAMPLES
10 SAMPLES
10 SAMPLES
2 SAMPLES
IMMATURE OR
PAST PEAK OIL
EARLY PEAK TO
PEAK OIL
ADVANCED
PAST PEAK OIL
PEAK OIL
PREGENERATION
TO
EARLY PEAK OIL
PREGENERATION
OR
PAST PEAK OIL
EARLY PEAK TO
PEAK OIL
10
9
8
7
6
5
4
3
2
1
0
.04
.08
.25
.50
.75
0
.05
.10
.15
VOL HC/TOC
GEN. HC/TOC
BIT/TOC

FIGURE 10-8

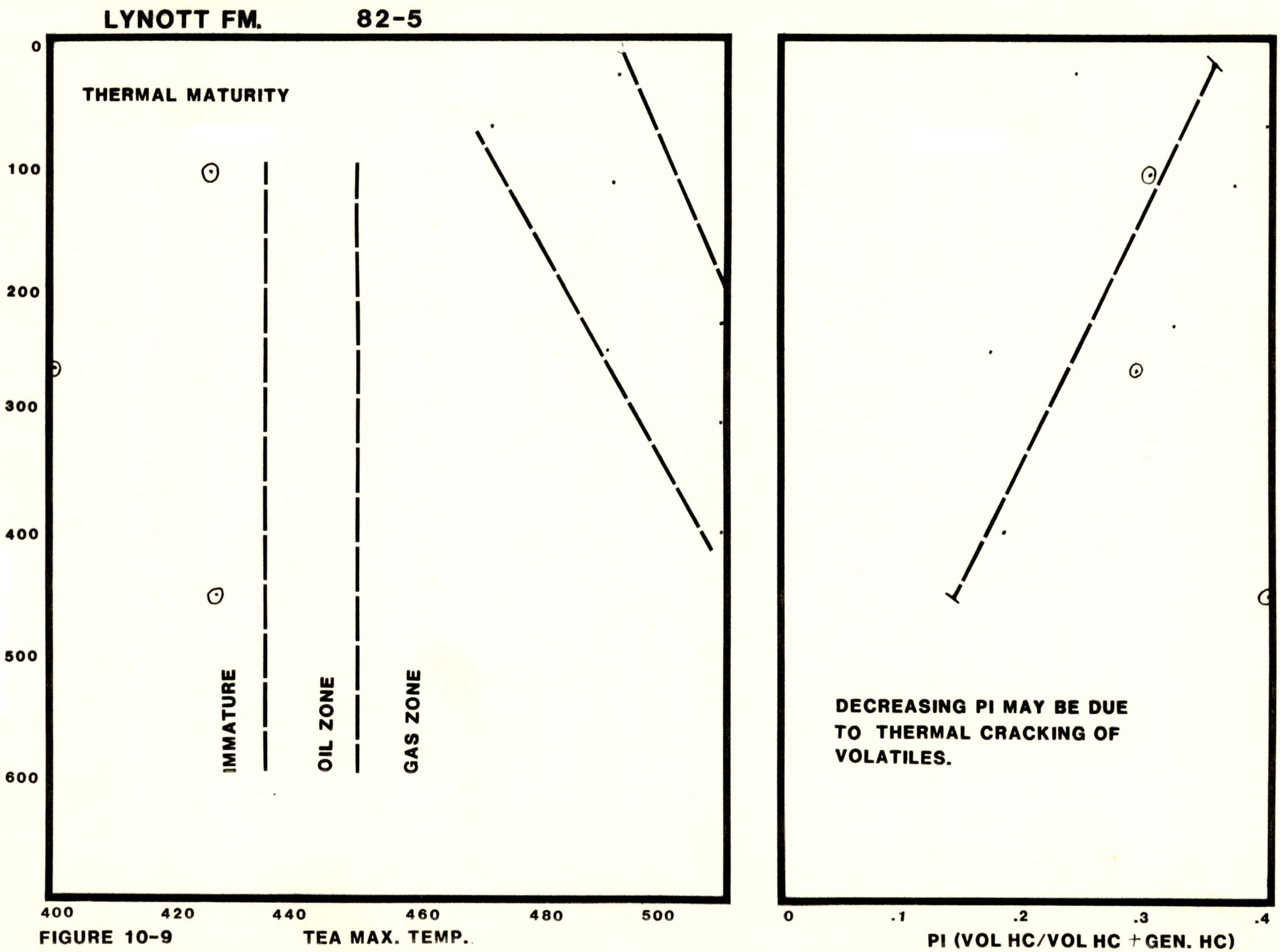

LYNOTT FM.
82-5
THERMAL MATURITY
0
100
200
300
400
500
600
IMMATURE
OIL ZONE
GAS ZONE
400
420
440
460
480
500
TEA MAX. TEMP.
DECREASING PI MAY BE DUE TO THERMAL CRACKING OF VOLATILES.
0
.1
.2
.3
.4
PI (VOL HC/VOL HC + GEN. HC)

FIGURE 10-9

MAINORU FM. 82-2, 82-3

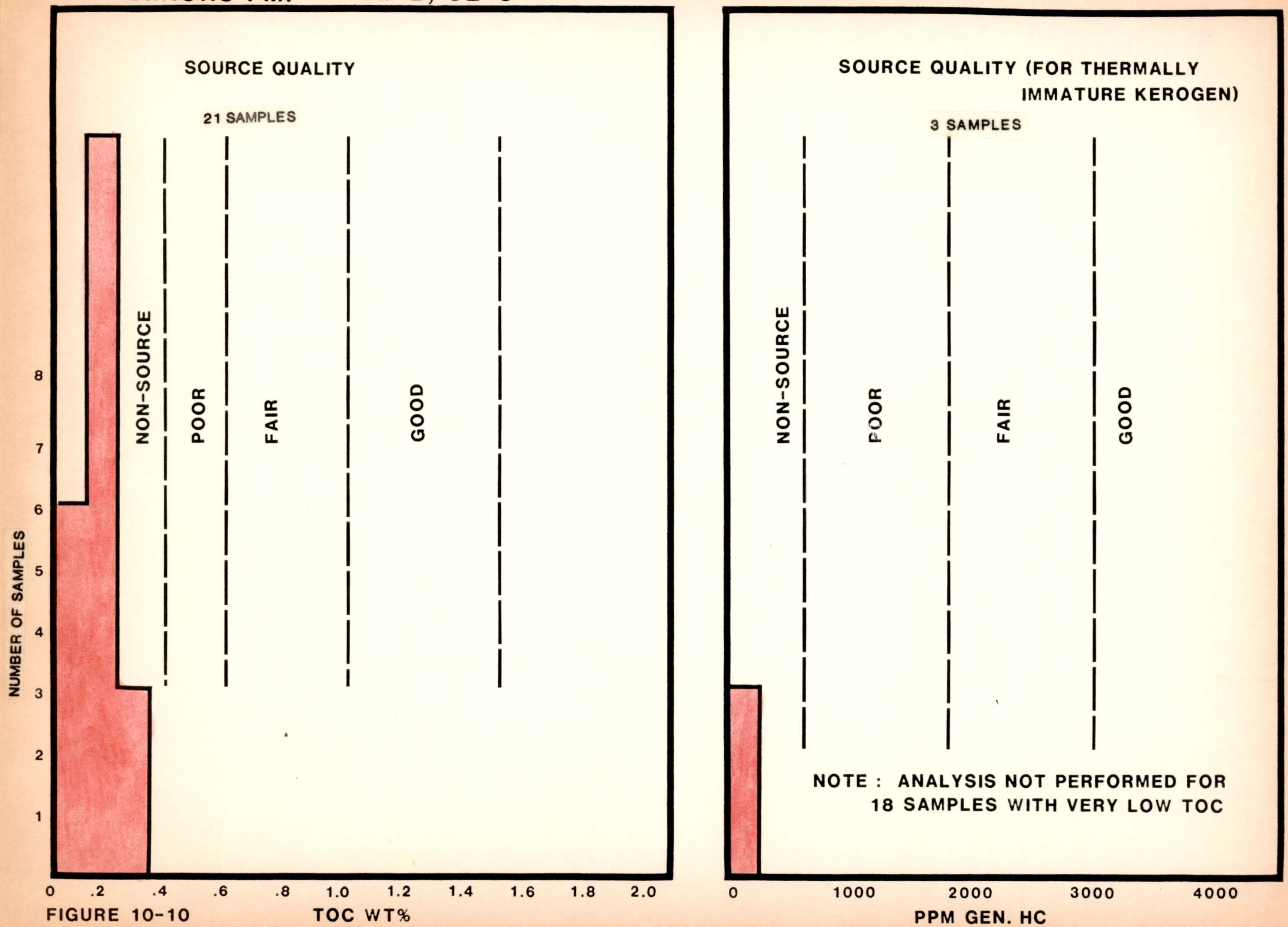


FIGURE 10-10

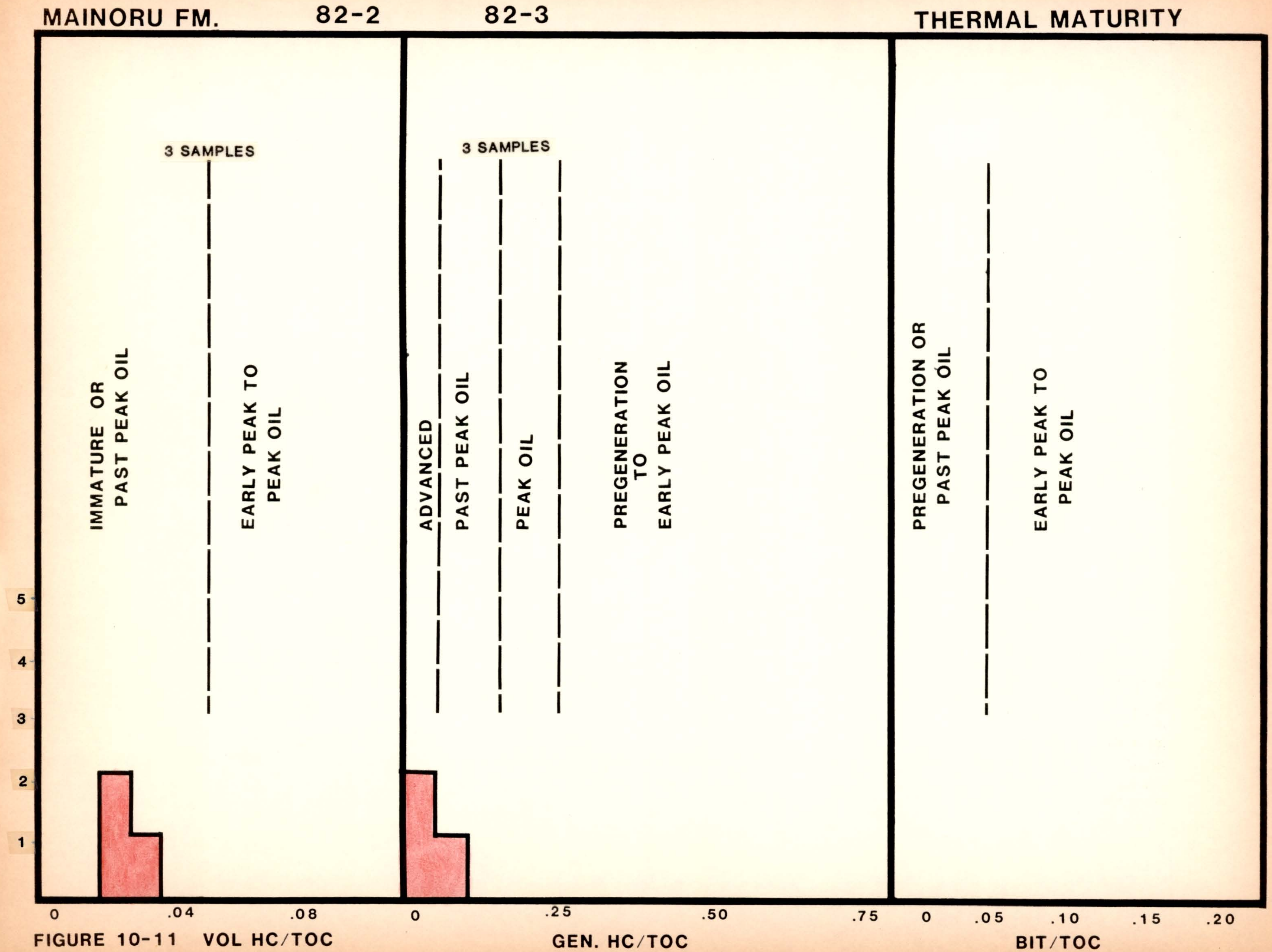

MAINORU FM.
82-2
82-3
THERMAL MATURITY
3 SAMPLES
3 SAMPLES
IMMATURE OR PAST PEAK OIL
EARLY PEAK TO PEAK OIL
ADVANCED
PAST PEAK OIL
PEAK OIL
PREGENERATION TO EARLY PEAK OIL
PREGENERATION OR PAST PEAK OIL
EARLY PEAK TO PEAK OIL
5
4
3
2
1
0
.04
.08
0
.25
.50
.75
0
.05
.10
.15
.20
VOL HC/TOC
GEN. HC/TOC
BIT/TOC

FIGURE 10-11

Plate 1-1. Eight Mile Waterhole Base Camp, on the McArthur River. The camp provided accomodation for 12 to 15 people.

Plate 1-2. Bell 206-B Jet Ranger III helicopter slinging 200 litre (44 Imperial gallons) fuel drums of diesel fuel to drill rig. This helicopter was also utilized for geological fieldwork.

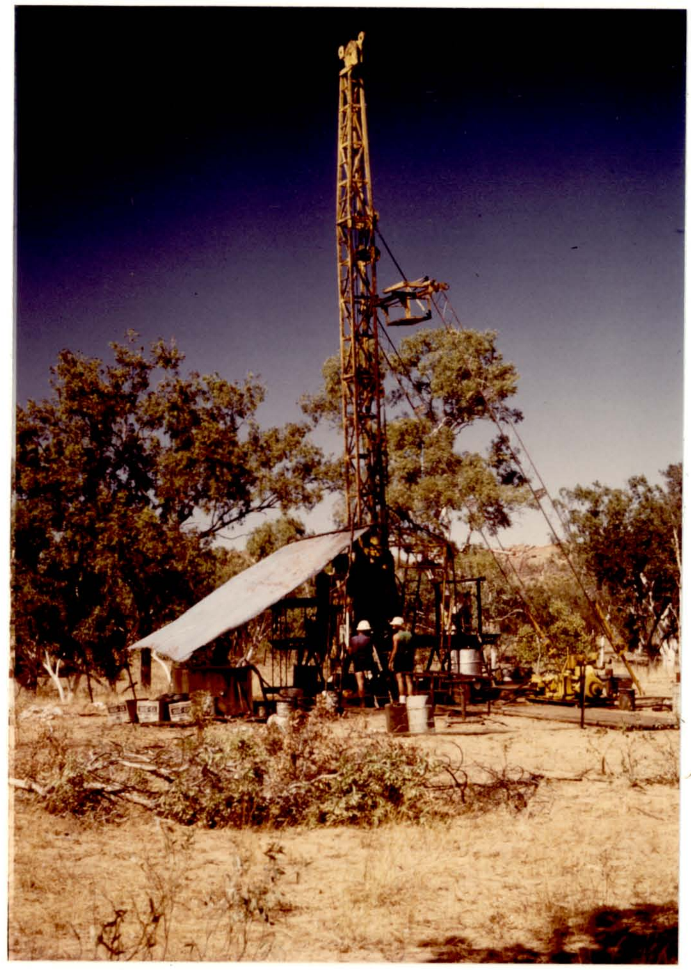


Plate 1-3. Long year 44 Diamond Coring Rig on site at Corehole 82-7: Jumping Wallaby No. 1. This rig disassembled into sixteen segments and was shuttled between coresites by a Bell 206-B Jet Ranger III helicopter. The heaviest component of the rig is the gear box, weighing on the order of 1300 pounds.

Plate 7-1. View looking to the north-northeast (grid location 5967-135980) along faulted *en echelon* domes. Exposed unit in structure's core is Arnold Sandstone. Approximate areal extent of dome is 28 km^2 (11 mi^2.).

Plate 7-2. Numerous vertical to sub-vertical fractures within Bessie Creek Sandstone in right-lateral strike-slip fault zone in northwestern corner of O.P. 198. Commonly, silicification of strata occurs within fault zones in the region. More typically, the Bessie Creek Sandstone is friable at surface.

Plate 8-1. Cauliflower chert (nodular anhydrite pseudomorphs) in Mallapunyah Formation. Similar forms exist within the Donnegan Member of the Lynott Formation

Plate 8-2. Conglomerate-breccia in Lynott Formation in vicinity of Tawallah Fault.

Plate 8-3. Turbiditic sequences within Middle to Lower Lynott Formation. Note fining-upward nature of sandstone interbeds.

Plate 8-4. Stretton Sandstone conglomeratic facies at Catfish Hole (Catfish Conglomerate-informal name). Clasts are silicified algal dolomite from Yalco Formation. Note sandy interbed. Corehole 82-6 was collared approximately 200 to 300 meters northeast of this outcrop.

Plate 8-5. View to north at Vizard Formation ridge (near coordinates 5868-742493). Note conspicuous whitish-pink tuff bed near ridge top. The remainder of the unit consists of interbedded silts, shales, and very fine-grained sandstones.

Plate 8-6. Massive conglomerate within Mt. Birch Sandstone in the northwest portion of O.P. 198. Trees are on the order of 7 to 8 meters in height (grid location 5868-721500).

Plate 8-7. Mt. Birch Sandstone at same location as Plate 8-6. Note oligomictic quartz sandstone-clast supported nature of unit. Matrix consists of subangular coarse-grained litharenite.

Plate 8-8. Mt. Birch Sandstone west of Corehole 82-5. Contact between conglomeratic lens and sandstone.

Plate 8-9. Wedge-shaped cross-stratification within Mt. Birch Sandstone west of Corehole 82-5.

Plate 8-10. Solution Breccia within oolitic carbonate member of Kookaburra Creek Formation. Infill of this paleokarst surface by quartz sandstone has occurred. Possible preservation of porosity may exist at depth at this stratigraphic level.

Plate 8-11. Resistant ridge of silicified Limmen Sandstone. Contrast this with porous Hodgson Sandstone outcrop pattern in Plate 8-13. Breaches in the ridge appear to correlate with local porosity development.

Plate 8-12. Large wavelength - low amplitude ripples or possible hummocky cross-stratification in Arnold Sandstone.

Plate 8-13. Castle or pillar topography characteristic of the Hodgson Sandstone. Reservoir properties derived from cored Limmen and Hodgson Sandstone units appear to indicate that surface topography and surface sample "reservoir" characteristics allow qualitative evaluation of sandstone units at depth.

Plate 8-14. Pancake-like mudstone concretions in Corcoran Formation.

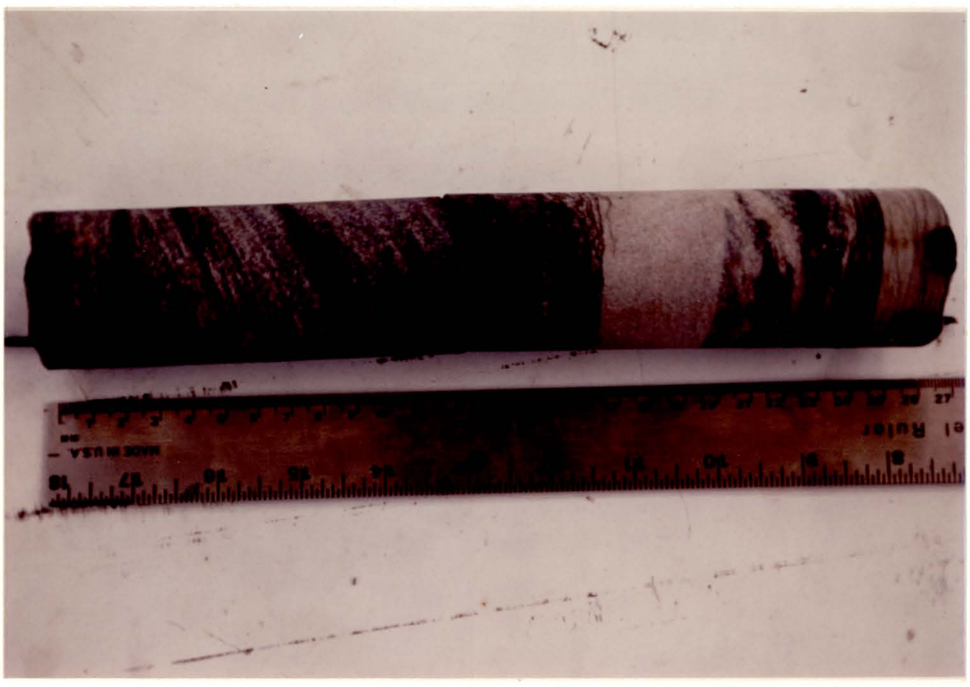


Plate 8-15. Bitumen in Broadmere Sandstone Member (informal) of Cobanbirini Formation encountered in Corehole 82-1. Bitumen occurs infilling porosity and as large clots, such as at the right hand end of the core. Depth of this sample is from 238.58 to 238.85 meters. Scale is in centimetres and inches.

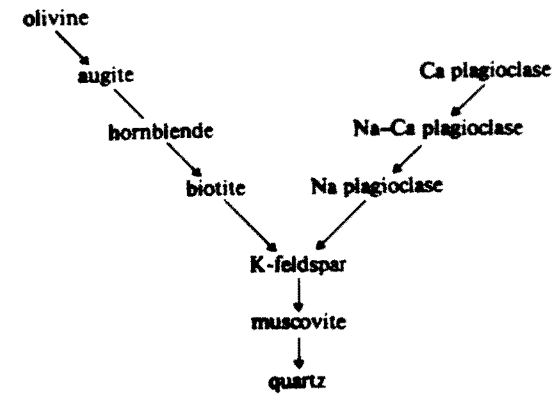


Table 5-1. The "Weatherability" series for the common igneous silicate minerals. This series is the reverse of Bowen's reaction series for mineral crystallization from igneous melts (after Goldich, 1938).

Mineral	*WPI mean*	*WPI range*
olivine	54	44–65
augite	39	21–46
hornblende	36	21–63
biotite	22	7–32
labradorite	20	18–20
andesine	14	
oligoclase	15	
albite	13	
muscovite	10	
quartz	1	

Table 5-2. The Reiche weathering potentials index (WPI) for some common silicate minerals (after Carroll, 1970).

Meters above base	*Granodiorite*	*1*	*10*	*18*	*22*	*24*	*25*	*26*
SiO_2	67.92	68.15	65.46	61.49	58.54	58.66	57.69	55.46
TiO_2	0.55	0.55	0.44	0.78	1.12	1.21	1.34	1.53
Al_2O_3	14.70	14.26	13.22	14.35	19.08	18.02	18.44	21.37
Fe_2O_3	0.91	2.24	2.79	4.65	6.46	6.55	6.85	8.65
FeO	2.61	1.03	0.74	0.78	0.44	0.82	1.04	0.37
CaO	2.94	1.17	2.04	1.75	0.83	0.58	0.76	0.38
MgO	0.98	1.19	1.31	2.18	2.01	1.69	2.71	0.56
Na_2O	3.31	1.95	0.53	0.42	0.61	0.57	0.54	0 49
K_2O	4.38	4.76	5.59	6.90	6.71	7.10	5.94	6.48
H_2O^+	0.80	3.54	5.64	5.81	3.25	3.32	4.03	3.58
H_2O^-	0.36	0.48	0.48	0.43	1.14	1.33	0.93	0.97
P_2O_5	0.18	0.12	0.13	0.24	0.38	0.29	0.32	0.20
CO_2	None	0.10	2.26	0.90	None	None	None	None
MnO	0.03	0.04	0.05	0.05	0.02	0.03	0.03	0 03
Total	99.67	99.58	100.68	100.73	100.59	100.17	100.62	100.07
Uncombined SiO_2	24	31	28	25	21	20	22	20

Table 5-3. Chemical analyses of a parent granodiorite and the soil profile developed on it during the Late Paleozoic (from Wahlstrom, 1948).

A	**HOT HUMID (no month below 18°C)**
Aw	**Monsoonal, with warm dry winter and hot, wet summer**
BS	**WARM TO HOT, SEMI-ARID**
BSwh	**Hot, sub-humid, dry winter**
BSfh	**Hot, uniform light rainfall**
BSfk	**Warm, uniform light rainfall**
BSsh	**Hot, moist winter, dry summer**
BSsk	**Warm, moist winter, dry summer**
BW	**WARM TO VERY HOT, ARID**
BWn	**Hot, erratic rainfall; sub-cyclonic to west, minsoonal to north**
BWk	**Warm, erratic rainfall, mostly in winter**
C	**WARM TO TEMPERATE, HUMID (at least one month below 18°C)**
Cwa	**Sub-tropical; dry winter, long hot moist summer**
Cfa	**Sub-tropical; uniform rainfall, mild winter, long hot summer**
Csa	**Long hot dry summer, mild wet winter (Mediterranean)**
Cfb	**Cool winter, long warm summer, uniform rainfall**
Cfc	**Cold winter, short mild summer, uniform rainfall**
Csb	**Cool wet winter, long warm dry summer (Mediterranean)**

Köppen letter symbols:

a	**hot summer; hottest month over 22°C**
b	**long mild summer; 4 months over 10°C**
c	**short, mild summer; under 4 months over 10°C**
f	**uniform rainfall**
h	**warm, mean annual temperature over 18°C**
k	**cool, mean annual temperature below 18°C**
s	**dry summer**
w	**dry winter**

Table 5-4. Characteristics of main climatic regions in Australia and Koppen letter symbols. Refer to Figure 5-7 (from Mabbutt, 1980).

PETROLEUM GENERATING CAPABILITY

Rating	Total Organic Carbon Wt. %	Generated Hydrocarbons PPM by TEA*
Nonsource	<0.4	< 600
Poor	0.4-0.6	600-1800
Fair	0.6-1.0	1800-3000
Good	1.0-1.5	3000-6000
Very Good	>1.5	>6000

*Thermal evolution analysis on thermally immature samples

KEROGEN TYPE

Petroleum Type	Visual Kerogen Type	Generated Hydrocarbons*/ Total Organic Carbon	Elemental H/C**	Bitumen/Total Organic Carbon***
Gas	Structured	<.15	<0.8	<.05
Gas and condensate	Mixed	.15-.25	<1.0	<.05
Oil	Amorphous (sometimes mixed)	>.25	>1.0	>.05 <.30****

*From thermal evolution analysis for thermally immature kerogens
**For thermally immature samples
***For uncontaminated samples, and where bitumens are not thermally cracked to gas
****Values >.30 indicate non-indigenous oil or contamination; saturate hydrocarbon/bitumen ratio >.70 also indicates non-indigenous oil or contamination.

KEROGEN THERMAL MATURITY

Diagenesis Stage	Pregeneration	Early peak oil-early gas	Peak oil-early peak gas (Oil expulsion)	Past peak oil-peak gas	Advanced
Visual Scale	1-3	4	5	6-7	7
Vitrinite Reflectance %	<.5	.5-.8	.8-1.2	1.2-2.0	> 2.0
Elemental % C	<78	78-81	81-85	85-90	> 90
Elemental H/C	>1.0 (oil source)	>1.0 (oil source)	>.80 (oil source)	.40-.80	< .40
TEA Gen HC/TOC*	>.25 (oil source)	> .25 (oil source)	>.15	< .15	< .05
TEA Vol HC/TOC*	<.05	> .05 (oil source)	>.05 (oil source)	< .05	< .01
TEA Gen HC Max °C	460-490	480-510	490-530	510->540	> 540
Bitumen/TOC*	<.05	> .05 (oil source)	>.05 (oil source)	< .05	< .01
Bitumen Chromatogram	Immature (odd-carbon predominance, sterane hump)	Immature (odd-carbon predominance, sterane hump)	Mature, oil-like molecular distribution	Mature	Insufficient extract for analysis

*Total organic carbon wt. %

Table 10-1