

CHAPTER 5

RESULTS AND INTERPRETATION

From the study of well's cutting by fluorescence microscopy, the macerals are identified, counted and grouped. Based on the dominant maceral in each sample depth that can be divided into the maceral zone, by review follow the location of each well from north to south trending in the east and west graben (Figure 5.1 and 5.2) see detail of macerals contain in Appendix B-1 to B-10.

5.1 MACERAL DISTRIBUTION

5.1.1 Maceral distribution in the east graben

1. WELL NAME : 'A : (Appendix B-1)

1. Liptinite zone from -2826.3 ft to -4995.3 ft

In this zone compose of maceral in vitrinite, liptinite and inertinite groups.

The macerals in vitrinite group :

Humocollinite is mainly gelinite as piece coal of the average of 3.03-27.42% were found in all depth. Some pieces show cracking that may be replaced by exsudatinite;

Humodetrinite mainly attrinite as a small flake found only at the depth between -2826.3 ft to -3281.1 ft composed between 1.16-12.2%.

The macerals in liptinite group :







-  Liptinite zone
-  Exsudatinitite zone
-  Vitrinite zone : gelinite, attrinite and exsudatinitite
-  Vitroliptinitite zone : mainly gelinite, some liptinitite and exsudatinitite
-  Alginite zone
-  Sample loss

Figure 5.1 : Symbol description about macerals contain used in Figure 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 and 6.1.

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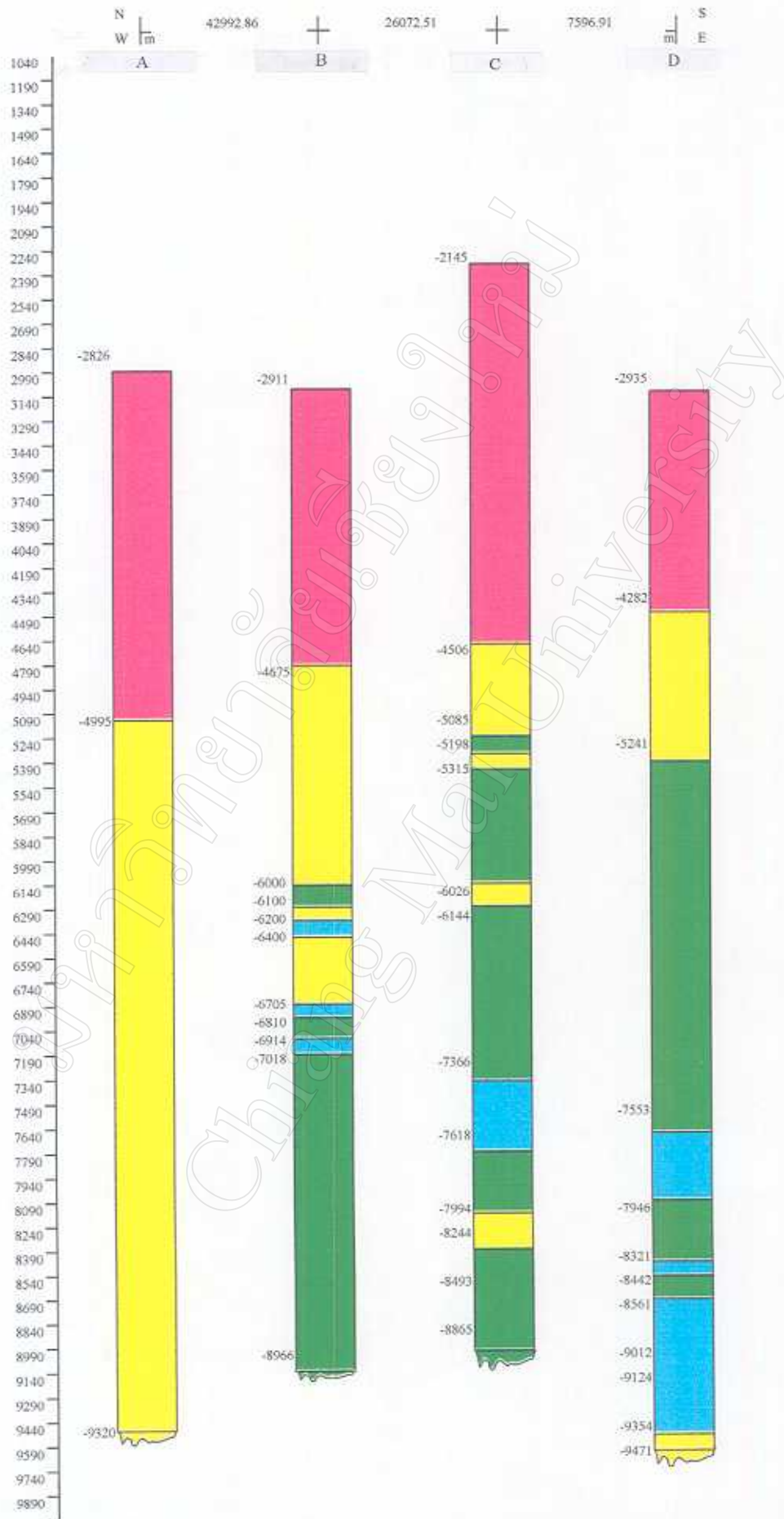


Figure 5.2 Macerals distribution in each well in the east graben of the Pattani Basin.

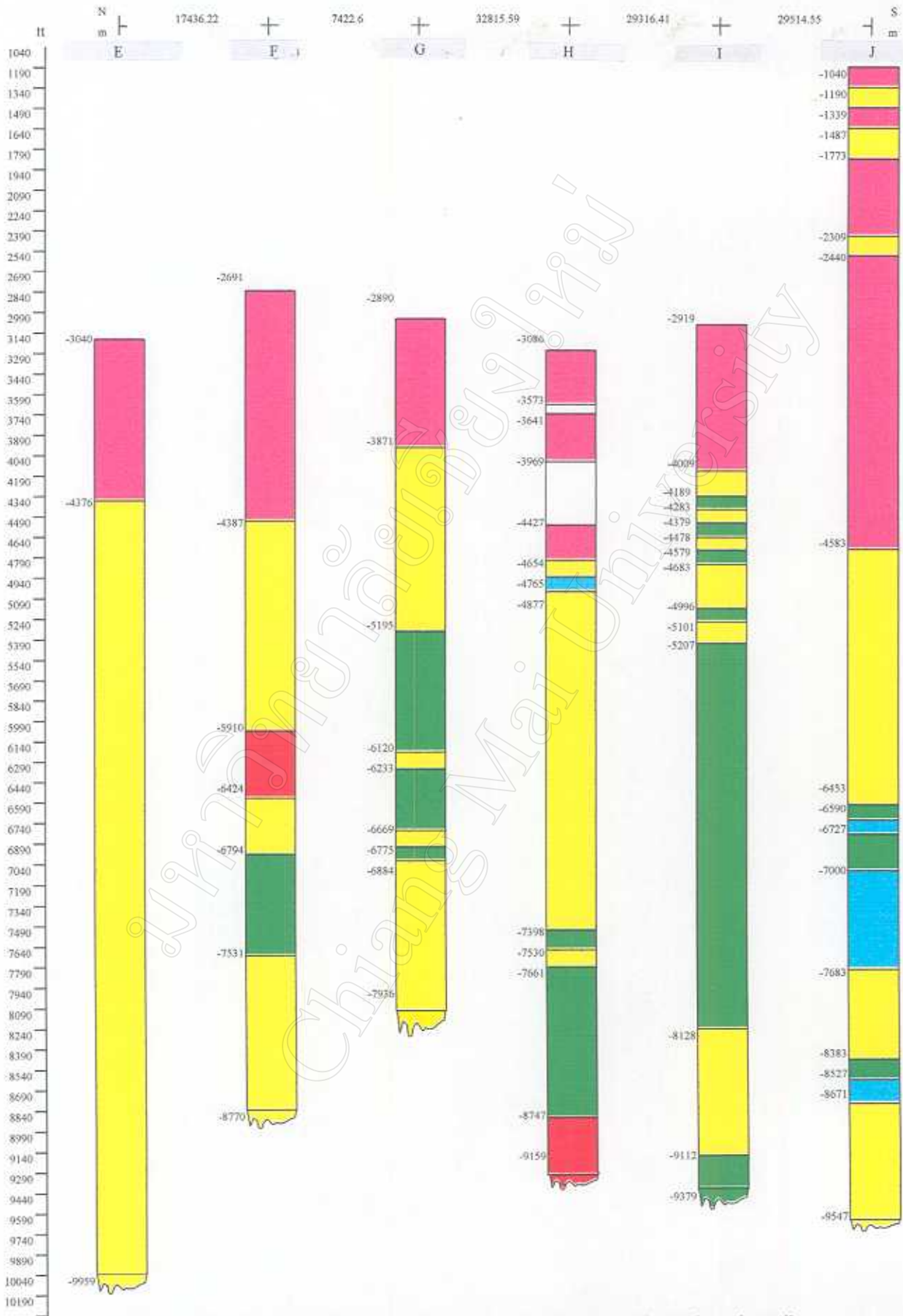


Figure 5.3 Macerals distribution in each well in the west graben of the Pattani Basin, north-south trending.

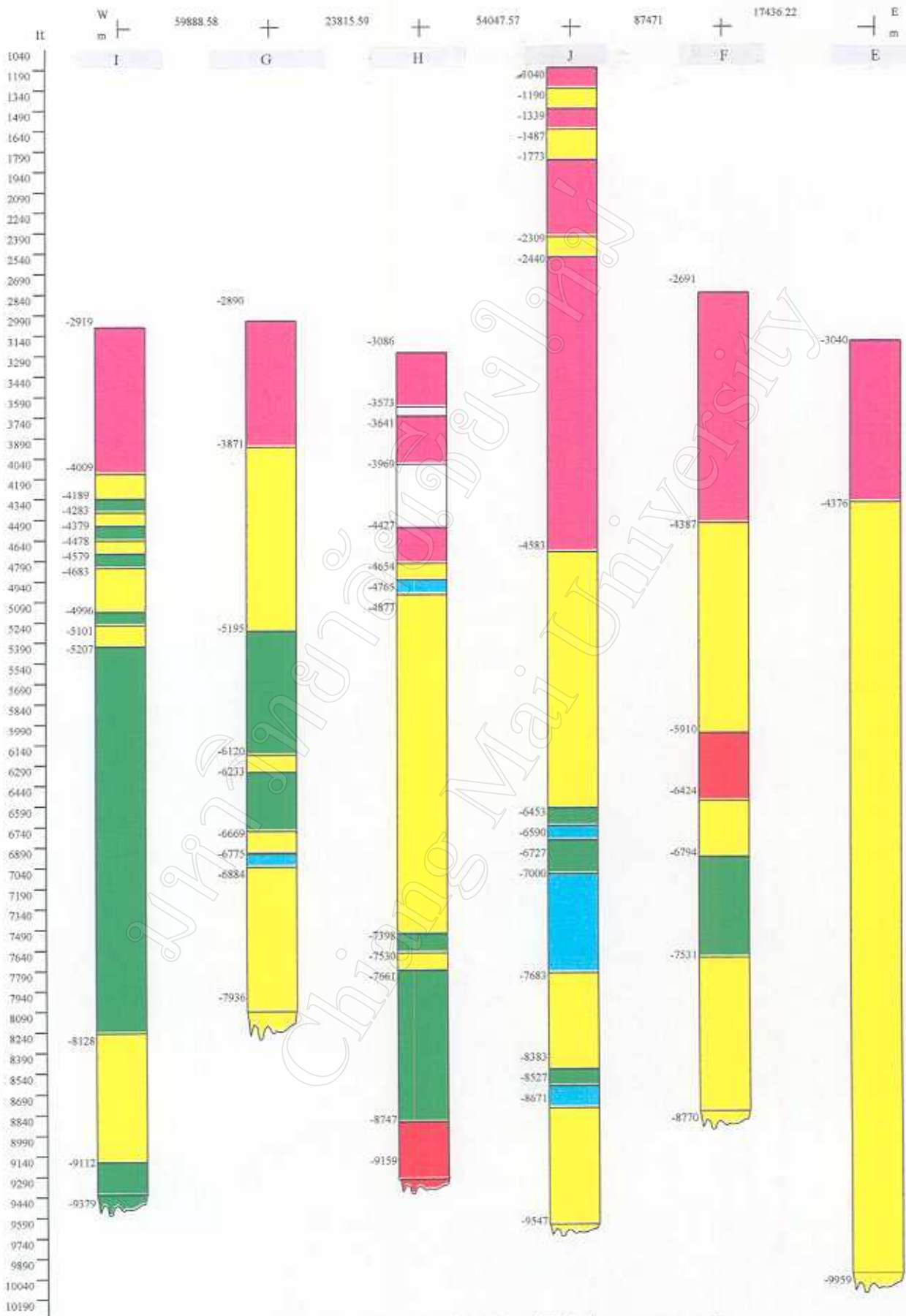


Figure 5.4 Macerals distribution in each well in the west graben of the Pattani Basin in east-west trending.

Sporinite were found 1.13-10.47% through this zone but disappear in some depth, especially in the lower part of this zone, -4254.4 ft to -4995.3 ft.

Cutinities is rare and was found only in some depth.

Resinite is common maceral 4.17-22.06% that present at all depth of samples.

Amber present 2.04-12% through this zone.

Suberinite is also common range from 4.84-24.24% through this zone.

Alginite mainly alginite B was found range from 2.04-17.56%.

Bituminite is present in the same amount as alginite range between 3.03-16.33%.

Exsudatinite was found as light oil impregnated the clay grains displayed pale green in color and show zoning.

Liptodetrinite was found in higher amount than other macerals in this group about 14.52-51.02% through this zone.

The macerals in inertinite group :

Sclerotinite is only one maceral in inertinite group that present in this zone, its contain 1.16-5.13% at the depth between -2940.3 ft to -3723.3 ft and characterized by have one cell (teliospore type) to many cells (sclerotite type) is filled by resin or exsudatinite in cell-cavity.

2. Exsudatinite zone between -4995.3 ft to -9320.3 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Only exsudatinite appear by all clay grains in this zone have impregnated by light oil in the upper part characterized by greenish yellow in color before change to yellowish green to yellow in the deeper part which is the characteristic of heavy oil.

The macerals in inertinite group : not found

2. WELL NAME : B (Appendix B-2)

1. Liptinite zone between -2910.8 ft to -4675.3 ft

The macerals in vitrinite group :

Humocollinite is mainly gelinite that disappear in the upper part, -2910.8 ft to -3073.5 ft, but show below this depth in a wide range of 3.13-29.73% in all depth.

Humodetrinite is mainly attrinite, present less than 5% in the depth between -3073.5 ft and -3319.9 ft.

The macerals in liptinite Group :

Sporinite was found in some depth at the range of 2.32-7.89%.

Cutinite appears in the depth -2910.8 ft to -2992 ft and -4321.7 ft to -4675.3 ft in rate 5.88% and 5.41-10.72%.

Resinite and suberinite are dominated macerals in this zone. Resinite is not found only at the depth of -2992 ft to -

3073.5 ft, but appears through this zone in range of 7.14-35.56%.

Amber present at the range of 2.32-20% and disappear in some depth.

Suberinite appears in all depth in wide range 2.7-42.89%.

Alginite was found in some depth at the range of 2.32-11.11%.

Bituminite was found at the range of 2.08-10.53% and disappear in some depth.

Exsudatinite appears at the end of this zone ranging between 2.7-13.51%.

Liptodetrinite presents at all depth in varies amount, 2.44-62.49%, with the lower content in the upper and increasing with depth.

The macerals in inertinite group :

Sclerotinite appears between the depth of -2910.8 ft to -3233.9 ft and -3486.3 ft to -3820.5 ft at the range of 2.08-4.88%.

2. Exsudatinite zone between -4675.3 ft to -6000.1 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Only exsudatinite appear to be impregnated all clay grains in this zone and could be the light oil in the upper part as characterized by greenish yellow in color before change to

yellowish green to yellow in the deeper part which is the characteristic of heavy oil.

The macerals in inertinite group : not found

3. Vitroliptinite zone between –6000.1 ft to –6100.4 ft

The macerals in vitrinite group :

Humodetrinite is mainly attrinite was found at 3.45%.

The macerals in liptinite group :

Resinite was found about 3.45%, with 13.8% alginite and 10.34% liptodetrinite.

All clay grains are impregnated by exsudatinite and displayed greenish yellow to yellow in color.

The macerals in inertinite group : not found

4. Exsudatinite zone between –6100.4 ft to –6200.3 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Found alginite 3.85%.

Exsudatinite was found impregnated all clay grains in this zone by light oil in the upper part as characterized by greenish yellow in color before change to yellowish green to yellow in the deeper part which is the characteristic of heavy oil.

The macerals in inertinite group : not found

5. Vitrinite zone between -6200.3 ft to -6400.1 ft

The macerals in vitrinite group :

Humodetrinite is mainly attrinite was found ranging from 17.14-18.75%.

The macerals in liptinite group :

Alginite was found in the range of 3.13-11.43%.

Exsudatinite appear to be impregnated all clay grains in this zone by light oil in the upper part as characterized by greenish yellow in color before change to yellowish green to yellow in the deeper part which is the characteristic of heavy oil.

The macerals in inertinite group : not found

6. Exsudatinite zone between -6400.1 ft to -6705.3 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Exsudatinite appear to be impregnated all clay grains in this zone by light oil in the upper part as characterized by greenish yellow in color before change to yellowish green to yellow in the deeper part which is the characteristic of heavy oil.

The macerals in inertinite group : not found

7. Vitrinite zone between -6705.3 ft to -6810.1 ft

The macerals in vitrinite group :

Humodetrinite is mainly attrinite was found about 5.41%.

Humocollinite is mainly gelinite are dominated macerals in this zone, at 13.51%.

The macerals in liptinite group :

Alginite was found about 13.51%.

Exsudatinite are still abundant in this depth, it was found about 67.57%.

The macerals in inertinite group : not found

8. Vitroliptinite zone between -6810.1 ft to -6913.6 ft

The macerals in vitrinite group :

Humodetrinite is mainly attrinite was found about 17.14%.

Humocollinite is mainly gelinite and was found only 5.71%.

The macerals in liptinite group :

It was found 2.86% sporinite, 2.86% cutinite, 8.57% alginite, 2.86% bituminite and 5.71% liptodetrinite.

All clay grains are impregnated by exsudatinite displayed greenish yellow to yellow in color.

The macerals in inertinite group : not found

9. Vitrinite zone between -6913.6 ft to -7018 ft

The macerals in vitrinite group :

Humodetrinite is mainly attrinite was found about 18.18%.

Humocollinite is mainly gelinite was found about 6.06%.

The macerals in liptinite group :

Only exsudatinitite was found in this zone at small amount.

The macerals in inertinite group : not found

10. Vitroliptinite zone between -7018 ft to -8966.2 ft

The macerals in vitrinite group :

Humodetrinite is mainly attrinite was found at the range of 2.94-51.85%.

Humocollinite is mainly gelinite was found at the range of 2.17-38.46%.

The macerals in liptinite group :

Sporinite was found 13.79% at depth -7860.2 ft to -7965.5 ft and 2.56% at depth -8509.7 ft to -8623.7 ft.

Resinite appears at the depth -7337.2 ft to -7441.2 ft and -7965.5 ft to -8395.8 ft, 2.44% and 2.33-4.88% respectively.

Suberinite was found only 2.94% at the depth -7123.8 ft to -7231.4 ft.

Alginite is the most abundant in this zone at the range between 2.44-32.61%, but disappear in some depth.

Bituminite was found in some depth at the range of 2.17-11.11%.

All clay grains are impregnated by exsudatinite and displayed greenish yellow to yellow in color.

Liptodetrinite present in some depth in the upper part of this zone at the range of 2.17- 5.71%, but from -7860.2 ft to -8966.2 ft its increases continuously to 12.5-31.71%.

The macerals in inertinite group : not found

3. WELL NAME : C (Appendix B-3)

1. Liptinite zone between depth 2970 ft to 6570 (-4506.4 SS) ft

Remark : sample lost in 5520 ft to 5670 ft

The macerals in vitrinite group :

Humocollinite is mainly gelinite and appear continuously through the measure depth 2970 ft to 4770 ft at the range of 1.96-18.75%, below this depth it was found in some depth at the range of 2.22-26.19%.

The macerals in liptinite group :

Sporinite was found less than 5% in some depth.

Cutinite was found at the range between 1.96-13.64% and disappear in some depth.

All depth contains resinite at the range of 4.44-30.14%.

Amber was found at the range of 1.92-17.65% and disappears at the depth of 4620 ft to 4920 ft, 5370 ft to 5520 ft and 6120 ft to 6270 ft.

Suberinite appear in a wide range between 1.56-29.55% in almost depth.

Alginite mainly lamaginite appears in higher frequency at the range 2.22-9.52% and bituminite appear between 1.37-9.8% in some depth.

Liptodetrinite is most abundant macerals in all depth was found at the range of 28.57-66.67%.

Exsudatinitite appears before end of this zone.

The macerals in inertinite group :

Sclerotinite was found continuously in sample depth 2970 ft to 4470 ft, below this depth it was found in some depth less than 5%.

2. Exsudatinitite zone between -4506.4 ft to -5085.2 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Only exsudatinitite appears in this zone displayed pale greenish yellow to yellow.

The macerals in inertinite group : not found

3. Vitroliptinitite zone between -5085.2 ft to -5198.5 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears at the range of 3.33%.

Humocollinitite, it was found as gelinitite at 6.67%.

The macerals in liptinite group :

Alginite was found at 3.33%, exsudatinite are rich, contain about 83.33% and liptodetrinite was about 3.33%.

The macerals in inertinite group : not found

4. Exsudatinite zone between -5198.5 ft to -5315.2 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Only exsudatinite appears in this zone displayed pale greenish yellow to yellow.

The macerals in inertinite group : not found

5. Vitroliptinite zone between -5315.2 ft to -6025.8 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears at the range of 14.29-25.76% and disappear at -5671.4 ft to -5798.8 ft.

Humocollinite, it was found only gelinite at the range of 6.45-32.08% through this zone.

The macerals in liptinite group :

Resinite was found continuously in the depth -5433.9 ft to -5907.8 ft at the range of 2.08-5.66%.

Alginite was found at the range of 1.89-18.96% through this zone.

Bituminite appears in some depth at the range of 1.72-3.77%.

Exsudatinite is the highest, its contain 26.42-74.19%.

The macerals in inertinite group : not found

6. Exsudatinite zone between -6025.8 ft to -6144.1 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Only exsudatinite appears in this zone displayed pale greenish yellow to yellow.

The macerals in inertinite group : not found

7. Vitroliptinite zone between -6144.1 ft to -7365.6 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears in all depth at the range of 11.36-36.23%.

Humocollinite, it was found only gelinite ranging from 25-35.38% through this zone.

The macerals in liptinite group :

Resinite was found in some depth at the range of 1.45-3.45%.

Suberinite was found 2.08% at the depth -6381.6 ft to -6500.7 ft.

Alginite appears ranging 1.45-25% and disappear in some depth.

Bituminite appears 4.55-5.88% in the depth -6500.7 ft to -6740.9 ft.

Exsudatinite was found through this zone too, at the range more than 15% in every depth.

The macerals in inertinite group : not found

8. Vitrinite zone between -7365.6 ft to -7618.0 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears in all depth at 32.88%.

Humocollinite, gelinite was found at 32.88-34.25% through this zone.

The macerals in liptinite group :

Exsudatinite was found through this zone too, at the range of 32.88%.

The macerals in inertinite group : not found

9. Vitroliptinite zone between -7618.0 ft to -7993.5 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears in all depth at the range of 23.08-31.51%.

Humocollinite was found as gelinite at the range of 28.57-42.31% through this zone.

The macerals in liptinite group :

Cutinite presents only 3.57% at the depth -7618.0 ft to -7743.3 ft.

Resinite occurs 1.92% at depth -7868.4 ft to -7995.3 ft.

Suberinite and alginite was found 1.79% at the same depth.

Bituminite appears ranging 1.79-2.74% in the depth – 7618.0 ft to –7868.4 ft.

Exsudatinitite was found through this zone too, at the range of 23.08-31.51%.

Liptodetrinite was found at the range of 8.93-9.62%.

The macerals in inertinite group : not found

10. Exsudatinitite zone between –7993.5 ft to –8243.6 ft

The macerals in vitrinite group : not found

The macerals in liptinitite group :

Only exsudatinitite appears in this zone displayed greenish yellow to deepest yellow.

The macerals in inertinite group : not found

11. Vitroliptinitite zone between –8243.6 ft to >-8865.2 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears in all depth ranging from 17.95-44.9%.

Humocollinitite, it was found only gelinitite at the range of 2.04-42.11% through this zone.

The macerals in liptinitite group :

Cutinite and resinite present only 2.78% and 1.39%, respectively at the same depth –8368.7 ft to –8493.2 ft.

Found alginite 1.45-9.23% in some depth.

Bituminite appears 1.54% in the depth before the end of this zone.

Exsudatinite occurs through this zone too, ranging 19.35-61.54%.

Liptodetrinite was found in some depth at the range of 1.54-8.06%.

The macerals in inertinite group : not found

4. WELL NAME : D (Appendix B-4)

1. Liptinite Zone between -2934.8 ft to -4432.6 ft

In this zone can found the macerals in three group in vary amount,

The macerals in vitrinite group :

Humocollinite, mainly gelinite presents at the range of 1.82-9.8%.

Humodetrinite, mainly attrinite appears ranging from 17.65-32.69%.

The macerals in liptinite group :

Sporinite was found in some depth at the range of 1.82-10%.

Cutinite was found in some depth at the range of 2.04-9.09%.

Resinite is dominate maceral that appears in all depth ranging from 5-14.54% and found associated with alginite, mainly alginite B, presents at the range of 3.85-23.34%.

Amber was found in some depth at the range of 1.82-2.17%.

Suberinite was found in some depth at the range of 1.92-8.16%.

Bituminite presents in some depth at the range of 3.33-12.25%.

Exsudatinie in pale green color zoning presents through this zone.

Liptodetrinite is the most abundant in this zone was found at the range of 7.84-27.46%.

The macerals in inertinite group : sclerotinite appears in some depth in rare amount, less than 5%

2. Exsudatinite Zone between the depth -4432.6 ft to -5241.3 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Only exsudatinite was found impregnated in all clay grain in vary color by in the upper part it displayed pale green to light greenish yellow and slowly change with increasing depth to yellowish green or yellow in the deeper part.

The macerals in inertinite group : not found

3. Vitroliptinite Zone between the depth –5241.3 ft to –7552.9 ft

The macerals in vitrinite group :

Humodetrinite composed of attrinite appears through this zone at the range of 2.5-32.26%.

Humocollinite mainly gelinite is dominant maceral through this ranging from 6.12-58.14%.

The macerals in liptinite group :

Cutinite appears less than 5% at the depth –6047.3 ft to –6280.1 ft.

Resinite was found ranging from 1.79-5.72% in some depth.

Alginite was found through this zone which contains about 1.54-44.9%.

Bituminite appears in some depth at the range of 1.37-9.3%.

Exsudatinite presents at all depths in high amount.

Liptodetrinite presents between the depth –5241.3 ft to –6521.3 ft and –7024.2 ft to –7552.9 ft which contain between 1.85-22.64% and 4.08-7.14%, respectively.

The macerals in inertinite group : not found

4. Vitrinite zone between –7552.9 ft to –7945.7 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears in all depths at 32.88-50.0%.

Humocollinite, it was found only gelinite at 34.25% through this zone.

The macerals in liptinite group :

Exsudatinite occur through this zone too, about 32.88%.

The macerals in inertinite group : not found

5. Vitroliptinite zone between -7945.7 ft to -8321.3 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears in all depth at 11.11-31.94%.

Humocollinite, it was found only gelinite at 34.72-55.56% through this zone.

The macerals in liptinite group :

Alginite appears 1.72% at depth -7945.7 ft to -8072.7 ft.

Exsudatinite was found through this zone too, ranging between 11.11-31.94 %.

Liptodetrinite presents between 1.4-22.22% at -8072.7 ft to -8321.3 ft.

The macerals in inertinite group : not found

6. Vitrinite zone between -8321.3 ft to -8442.5 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears 32.88%.

Humocollinite, gelinite was found at 34.24% through this zone.

The macerals in liptinite group :

Exsudatinite occurs through this zone too, about 32.88%.

The macerals in inertinite group : not found

7. Vitroliptinite zone between -8442.5 ft to -8561.2 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears in all depth 25%.

Humocollinite, gelinite was found about 46.16% through this zone.

The macerals in liptinite group :

Alginite appears at 1.92%.

Exsudatinite occurs through this zone too, about 25 %.

Liptodetrinite presents about 1.92%.

The macerals in inertinite group : not found

8. Vitrinite zone between -8561.2 ft to -9354.1 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears ranging from 27.28-37.7%.

Humocollinite, gelinite appears ranging from 4-40.98% through this zone.

The macerals in liptinite group :

Exsudatinite occur through this zone too, more than 30%.

The macerals in inertinite group : not found

9. Exsudatinite zone between -9354.1 ft to -9470.7 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Only exsudatinite appears in this zone displayed greenish yellow to deepest yellow.

The macerals in inertinite group : not found

5.1.2 Maceral distribution in the west graben

1. WELL NAME : E (Appendix B-5)

1. Liptinite zone between -3040.0 ft to -4376.8 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite appears through this zone ranging from 2.08-10.53% and was not found in some depth.

The macerals in liptinite group :

Sporinite and cutinite appear in some depth less than 5% and between 2-6.25% respectively.

Resinite was found at all depth between 14.29-27.08%.

Amber appears in some depth less than 10%.

Suberinite occurs at all depth between 3.23-35.43%.

Alginite appears in the upper and lower part of this zone, 2.08-10.42%.

Bituminite occurs at all depth between 2.08-11.11%.

Exsudatinite presents at all depth 2.08-58.06% and increase with increasing depth.

Liptodetrinite are rich at all depth between 5.26-31.43%.

The macerals in inertinite group : sclerotinite was found in the depth -3040.0 ft to -3190.0 ft and -3490.0 ft to -3640.0 ft at less than 5%.

2. Exsudatinite zone between -4376.8 ft to >-9958.9 (11,740 MS) ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or yellowish green to yellow or deepest yellow.

The macerals in inertinite group : not found

2. WELL NAME : F (Appendix B-6)

1. Liptinite zone between -2691.0 ft to -4387.7 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite was found at all depth in varies amount 2.5-37.1%.

The macerals in liptinite group :

Sporinite appears 1.47-3.24% in the some depth.

Cutinite was not found only -2937.5 ft to -3183.7 ft but found about 1.92-6.78% in the other depth.

Resinite is common maceral in this zone appears between 1.16-16.98% at every depth.

Amber occurs between 1.61-7.69% and is not present in some depth.

Suberinite is a common maceral too, in all depth it contain 9.45-27.26%.

Alginite, mainly alginite B and bituminite was found ranging at 1.92-11.76% and 1.61-15.56% respectively, and loss in some depth.

Exsudatinitite was found at rare amount in some depth and increasing before the end of this zone.

Liptodetrinite is the most abundant at all depth, mainly above 30%.

The macerals in inertinite group : sclerotinite presents less than 5% in the depth between -2691.0 ft to -3427.3 ft and -3670.0 ft to -3911.1 ft.

2. Exsudatinitite zone between -4387.7 ft to -5910.4 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinitite appears in this zone displayed greenish yellow to yellow.

The macerals in inertinite group : not found

3. Alginite zone between -5910.4 ft to -6424.1 ft

The macerals in vitrinite group : not found

The macerals in liptinite group :

Mainly alginite appears in this zone displayed brown or yellowish green color circular zoning.

Exsudatinites appear associated with alginite displayed greenish yellow to deepest yellow in color.

The macerals in inertinite group : not found

4. Exsudatinites zone between -6424.1 ft to -6793.7 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinites appears in this zone displayed greenish yellow to yellow.

The macerals in inertinite group : not found

5. Vitroliptinites zone between -6793.7 ft to -7531.2 ft

The macerals in vitrinite group :

Humodetrinite, mainly attrinite appears in some depth ranging from 14.29-39.29%.

Humocollinite, only gelinite was found ranging between 14.81-32.89% through this zone.

The macerals in liptinite group :

Alginite, bituminite and liptodetrinite were found in some depth less than 5%.

Every depth contains exsudatinites higher than 30%.

The macerals in inertinite group : not found

6. Exsudatinites zone between -7531.2 ft to -8772.9 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or yellowish green to yellow or deepest yellow.

The macerals in inertinite group : not found

3. WELL NAME : G (Appendix B-7)

1. Liptinite Zone from -2889.8 ft to -3871.4 ft

The macerals in vitrinite group : humocollinite, only gelinite was found in some depth ranging from 2.32-5.88%.

The macerals in liptinite group :

Cutinite was found in some depth less than 5%.

Resinite and suberinite are dominated macerals in this zone contain about 7.69-18.52% and 7.15-25.48% respectively.

Amber occurs at all depth ranging from 2.44-7.9%.

Alginite presents about 1.85-9.52% in almost every depth.

Bituminite occurs in some depth at the range of 3.92-12.19%.

Exsudatinite presents before the end of this zone at 2.38%.

Liptodetrinite is the most abundant at all depth that contains more than 31.48-64.72%.

The macerals in inertinite group : found only sclerotinite less than 5% in some depth.

2. Exsudatinite Zone between -3871.4 ft to -5195.9 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or yellowish green in color.

The macerals in inertinite group : not found

3. Vitroliptinite Zone between -5195.9 ft to -6120.4 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears between 2.27-31.25% in almost depth.

Humocollinite, mainly gelinite was found between 6.45-43.23%.

The macerals in liptinite group :

Cutinite, suberinite and bituminite were found only at one depth at less than 5%.

Resinite was found at the depth -5306.6 ft to -5655.8 ft between 2.08 - 7.27%.

Exsudatinite presents between 2.27-80.65% at all depth.

Liptodetrinite appears between 5.71-36.36% at the depth -5195.9 ft to -6120.4 ft.

The macerals in inertinite group : not found

4. Exsudatinite Zone between -6120.4 ft to -6232.8 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or yellowish green to yellow in color.

The macerals in inertinite group : not found

5. Vitroliptinite Zone between -6232.8 ft to -6668.9 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears between 7.41-21.05%.

Humocollinite, mainly gelinite was found 2.63-3.85%.

The macerals in liptinite group :

Resinite was found about 2.63%, 3.85-7.89% alginite and 2.63% bituminite, only exsudatinite presents between 63.17-96.15% and liptodetrinite was about 3.85%.

The macerals in inertinite group : not found

6. Exsudatinite Zone between -6668.9.4 ft to -6775.9 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or yellowish green to yellow in color.

The macerals in inertinite group : not found

7. Vitrinite Zone between -6775.9 ft to -6884.0 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite appears at 12.12%.

Humocollinite, mainly gelinite was found about 12.12%.

The macerals in liptinite group : exsudatinite presents about 75.76% at all depth.

The macerals in inertinite group : not found

8. Exsudatinite Zone between -6884.0 ft to >-7936.3ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or yellowish green to yellow or deepest yellow in color.

The macerals in inertinite group : not found

4. WELL NAME : H (Appendix B-8)

1. Liptinite zone between -3086.3 ft to -4653.6 ft

Remark: sample loss in -3536.8 ft to -3747.7 ft and -3968.9 ft to -4427.4 ft.

The macerals in vitrinite group :

Humodetrinite found only attrinite in some depth in varies amount 1.3-27.27%.

Humocollinite, mainly gelinite appears at all depth ranging from 3.7-27.27%.

The macerals in liptinite group :

Sporinite was found between 1.2-9.09% in some depth.

Cutinite presents between 1.32-8.54% in some depth.

Resinite was found at all depth about 4.55-23.26% and found amber ranging from 2.36-12.05% in the upper part.

Suberinite was found less than 5% at the depth -3086.3 ft to -3536.8 ft.

Alginite was found 3.61-11.62% and bituminite occur 5.55-10.53% in some depth.

Exsudatinite appears about 2.6-88.9% at all depth.

Liptodetrinite is richness in this zone at every depth have 21.94-27.91%.

The macerals in inertinite group : sclerotinite was found in the uppermost depth of this zone at less than 5%.

2. Exsudatinite Zone between -4653.6ft to -4764.8 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed pale greenish yellow or greenish yellow in color.

The macerals in inertinite group : not found

3. Vitrinite Zone between -4764.8 ft to -4876.8 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite appears about 3.7%.

Humodetrinite, mainly attrinite appears about 3.7%.

The macerals in liptinite group : only exsudatinite appears in this zone displayed pale greenish yellow or yellowish green in color.

The macerals in inertinite group : not found

4. Exsudatinite Zone between -4876.8 ft to -7398.2 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or greenish yellow to yellow in color.

The macerals in inertinite group : not found

5. Vitroliptinite Zone between -7398.2 ft to -7529.5 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite appears about 27.27%.

Humodetrinite, mainly attrinite appears about 31.82%.

The macerals in liptinite group :

It was found 2.27% bituminite, 26.14% exsudatinite and 12.5% liptodetrinite.

The macerals in inertinite group : not found

6. Exsudatinite Zone between -7529.5 ft to -7660.9 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or greenish yellow to yellow in color.

The macerals in inertinite group : not found

7. Vitroliptinite zone between -7660.9 ft to -8746.7 ft

The macerals in vitrinite group :

Humodetrinite, mainly attrinite appears between 9.43-35.3% at all depth.

Humocollinite, mainly gelinite appears at almost every depth in the range of 17.91-28.38%.

The macerals in liptinite group :

Resinite was found in only one depth -7660.9 ft to -7794.9 ft at less than 1.47%.

Alginite was found between 1.35-4.05% through this zone.

Bituminite was found between 1.35-9.84% in almost depth.

Exsudatinite was found more than 16.98 up to 33.82% through this zone.

Liptodetrinite appears ranging between 7.35-17.57% in all depth.

The macerals in inertinite group : not found

8. Alginite zone between -8746.7 ft to -9159.0 ft

The macerals in vitrinite group : Humodetrinite, mainly attrinite appears between 9.43-23.64% at all depth.

Humocollinite, mainly gelinite appears at almost every depth in the range of 5.96-39.63%.

The macerals in liptinite group :

Resinite was found in only one depth -7660.9 ft to -7794.9 ft at less than 1.47%.

Mainly alginite appears in this zone displayed brown or yellowish green color circular zoning 17.98-28.87%.

Bituminite was found between 2.99-7.55% in almost depth.

Exsudatinite appear associated with alginite displayed greenish yellow to deepest yellow in color.

Liptodetrinite appears ranging between 9.09-10.45% in all depth.

The macerals in inertinite group : not found

5. WELL NAME : ERAWAN M-6 (Appendix B-9)

1. Liptinite zone between -2918.6 ft to -4009.4 ft

In this zone comprises of the maceral in all three groups;

The macerals in vitrinite group :

Humodetrinite, only attrinite was found between 2.7-18.59% in all depth.

Humocollinite, mainly gelinite contains between 7.41-30.23%.

The macerals in liptinite group :

Sporinite appears in some depth between 1.82-6.25%.

Cutinite appears only in the upper part at less than 5%.

Resinite and suberinite are dominated macerals, appear between 2.94-20% and 2.08-17.5% respectively.

Amber was found in some depth between 2.08-5.41%.

Alginite presents at all depth between 2.08-35.13% and bituminite appears in some depth ranging between 1.82-14.58%.

Exsudatinite show pale green color zoning in the upper part at less than 10% and increases with increasing depth up to more than 60% before end of this zone.

○ Liptodetrinite rich in this zone have 5.88-37.5%.

The macerals in inertinite group : only sclerotinite was found rarely in some depth.

2. Exsudatinite Zone between -4009.4 ft to -4189.1 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed pale greenish yellow or greenish yellow in color.

The macerals in inertinite group : not found

3. Vitroliptinite Zone between -4189.1 ft to -4283.2 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite contains about 7.69%.

The macerals in liptinite group :

Exsudatinite appears in this zone displayed greenish yellow or greenish yellow to yellow in color.

Liptodetrinite appears about 3.85%.

The macerals in inertinite group : not found

4. Exsudatinite Zone between -4283.2 ft to -4378.9 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or greenish yellow in color.

The macerals in inertinite group : not found

5. Vitroliptinite Zone between -4378.9 ft to -4478.0 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite consists about 3.85%.

The macerals in liptinite group :

Exsudatinite appears in this zone displayed greenish yellow or greenish yellow in color.

Liptodetrinite have 3.85%

The macerals in inertinite group : not found

6. Exsudatinite Zone between -4478.0 ft to -4579.1 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed greenish yellow or greenish yellow in color.

The macerals in inertinite group : not found

7. Vitroliptinite Zone between -4579.1 ft to -4682.7 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite was found about 20.52%.

Humocollinite, mainly gelinite contains about 7.7%.

The macerals in liptinite group :

Resinite, suberinite, alginite and liptodetrinite consist about 2.56% each.

Exsudatinitite appears in this zone displayed greenish yellow or greenish yellow in color.

The macerals in inertinite group : not found

8. Exsudatinitite Zone between -4682.7 ft to -4996.4 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinitite appears in this zone displayed greenish yellow or greenish yellow in color.

The macerals in inertinite group : not found

9. Vitroliptinite Zone between -4996.4 ft to -5101.4 ft

The macerals in vitrinite group :

Humodetrinite, only attrinite was found about 3.12%.

Humocollinite, mainly gelinite contains about 15.63%.

The macerals in liptinite group :

It was found 6.25% suberinite, 3.12% alginite and 9.38% liptodetrinite. Exsudatinitite appears in this zone displayed greenish yellow or greenish yellow in color.

The macerals in inertinite group : not found

10. Exsudatinitite Zone between -5101.4 ft to -5207.1 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinitite appears in this zone displayed greenish yellow or greenish yellow in color.

The macerals in inertinite group : not found

11. Vitroliptinitite Zone between -5207.1 ft to -8127.5 ft

The macerals in vitrinite group :

Humodetrinite, attrinite was found between 3.12-34.69% through this zone.

Humocollinite, gelinite is a dominated maceral in this zone between 2.56-40%.

The macerals in liptinite group :

cutinite, amber, suberinite and bituminite appear in some depth at less than 5%.

Resinite was found in some depth between 1.72-19.23%.

Alginite was found between 1.59-25.64%.

Exsudatinitite appears in all depth in varies amount.

Liptodetrinite are rich in this zone that appear in all depth between 2.27-21.82%.

The macerals in inertinite group : not found

12. Exsudatinite Zone between -8127.5ft to -9112.2 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed yellowish green or yellow to deepest yellow in color.

The macerals in inertinite group : not found

13. Vitroliptinite Zone between -9112.2 ft to >-9378.8 (12,280 MS) ft

The macerals in vitrinite group :

Humodetrinite, only attrinite was found at 3.33% in some depth.

Humocollinite, mainly gelinite is dominate macerals contains about 3.85-46.3%.

The macerals in liptinite group :

Cutinite, suberinite and alginite were found less than 5% in all depth.

Resinite was found between 3.33-16.67% and liptodetrinite was found between 3.33-24.06%.

Exsudatinite was still found abundant at all depth.

The macerals in inertinite group : not found

6. WELL NAME : J (Appendix B-10)

1. Liptinite Zone between -1039.9 ft to -1189.8 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite is dominate macerals at about 44.73%.

The macerals in liptinite group :

It was found 31.58% resinite, 10.53% bituminite and 13.16% liptodetrinite.

The macerals in inertinite group : not found

2. Exsudatinite Zone between -1189.8ft to -1339.2 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed pale yellowish green or pale greenish yellow in color.

The macerals in inertinite group : not found

3. Liptinite Zone between -1339.2 ft to -1487.1 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite is dominate macerals, consists about 3.7%.

The macerals in liptinite group :

It was found 3.7% resinite, 3.7% bituminite and 88.9% exsudatinite.

The macerals in inertinite group : not found

4. Exsudatinite Zone between -1487.1 ft to -1773.2 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed pale yellowish green or pale greenish yellow in color.

The macerals in inertinite group : not found

5. Liptinite Zone between -1773.2 ft to -2307.2 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite is dominate macerals and consists about 32.62-79.31%.

The macerals in liptinite group :

Sporinite and cutinite were found between 1.96-4.35% and 3.92% respectively.

Resinite was found through this zone between 4.35-13.79%.

Amber, suberinite and alginite were found at the depth -2042.3 ft to -2307.2 ft less than 5%.

Exsudatinite was found between 6.9-48.78% in some depth.

Liptodetrinite was found between 2.44-28.26%.

The macerals in inertinite group : sclerotinite appears less than 5% in some depth.

6. Exsudatinite Zone between -2307.2 ft to -2440.0 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed pale yellowish green or pale greenish yellow in color.

The macerals in inertinite group : not found

7. Liptinite Zone between -2440.0 ft to -4583.1 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite is dominate macerals, consists about 2.86-38.71%.

The macerals in liptinite group :

Sporinite appears in some depth between 2.13-14.04%.

Cutinite, amber and bituminite present in some depth at less than 10%.

Resinite and suberinite are dominate in this zone comprise between 3.03-25.52% and 2.13-25.64% respectively.

Alginite, mainly lamaginite appears at all depth between 2.13-15.79%.

Exsudatinite presents in some depth.

Liptodetrinite is still abundant between 6.45-66.67% at all depth.

The macerals in inertinite group : sclerotinite appears less than 5% in some depth.

8. Exsudatinite Zone between -4583.1 ft to -6453.3 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed yellowish green or greenish yellow to yellow in color.

The macerals in inertinite group : not found

9. Vitroliptinite Zone between -6453.3 ft to -6590.1 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite appears at all depth about 8.11%.

The macerals in liptinite group :

Suberinite was found between 8.11%.

Exsudatinite appears in this zone displayed yellowish green or greenish yellow to yellow or deepest yellow in color.

Liptodetrinite appears about 8.11%.

The macerals in inertinite group : not found

10. Vitrinite Zone between -6590.1 ft to -6726.6 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite appears at all depth about 16.67%.

The macerals in liptinite group :

Exsudatinite appears in this zone displayed yellowish green or greenish yellow to yellow or deepest yellow in color.

The macerals in inertinite group : not found

11. Vitroliptinite Zone between -6726.6 ft to -6999.6 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite appears at all depth in the range of 7.69-37.14%.

The macerals in liptinite group :

Exsudatinite appears in this zone displayed yellowish green or greenish yellow to yellow or deepest yellow in color.

Liptodetrinite appears in some depth between 3.85-8.57%.

The macerals in inertinite group : not found

12. Vitrinite Zone between -6999.6 ft to -7683.1 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite appears at all depth in the range of 7.41-55.56%.

The macerals in liptinite group :

Exsudatinite appears in this zone displayed yellowish green or greenish yellow to yellow or deepest yellow in color.

The macerals in inertinite group : not found

13. Exsudatinite Zone between -7683.1 ft to -8382.9 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinite appears in this zone displayed yellowish green or greenish yellow to yellow in color.

The macerals in inertinite group : not found

14. Vitroliptinite Zone between -8382.9 ft to -8527.2 ft

The macerals in vitrinite group :

Humocollinite, mainly gelinite appears at all depth about 3.7%.

The macerals in liptinite group :

Resinite and suberinite were found about 3.7%.

Exsudatinitite appears in this zone displayed yellowish green or greenish yellow to yellow or deepest yellow in color.

The macerals in inertinite group : not found

15. Vitrinite Zone between -8527.2 ft to -8671.4 ft

The macerals in vitrinite group :

Humodetrinite, attrinite was found about 28.57%.

Humocollinite, mainly gelinite appears about 5.71%.

The macerals in liptinite group :

Exsudatinitite appears in this zone displayed yellowish green or greenish yellow to yellow or deepest yellow in color.

The macerals in inertinite group : not found

16. Exsudatinitite Zone between -8671.4 ft to -9547.4 ft

The macerals in vitrinite group : not found

The macerals in liptinite group : only exsudatinitite appears in this zone displayed yellowish green or greenish yellow to yellow or deepest yellow in color.

The macerals in inertinite group : not found

5.2 INTERPRETATION

5.2.1 GEOGRAPHIC DISTRIBUTION

5.2.1.1 VERTICAL DISTRIBUTION

In the east graben (Figure 5.2), liptodetrinite and vitrinite zone distributed in the lower part of each well before change to exsudatinitite zone and then liptinite zone in the uppermost part. In the west graben (Figures 5.3 and 5.4), the macerals distribution in the vertical section displayed as similar as in the east graben.

5.2.1.2 LATERAL DISTRIBUTION

In the east graben both north - south and east - west direction (Figure 5.2) liptinite zone has an equal thickness through both section. The thickness of exsudatinitite zone is gradually increase northward and westward but vitroliptinite and vitrinite zone are thicker southward and eastward. In the west graben of both north - south direction (Figure 5.3) and east - west direction (Figure 5.4), the liptinite zone has a uniform thickness. While exsudatinitite zone become more dense to the north and east. Vitroliptinite zone and vitrinite zone, the contact is possibly abrupt change, its thickness become more dense to the south and west.

5.2.2 LITHOLOGY AND MACERAL DISTRIBUTION

Considering the lithology in Chapter 3 and macerals distribution in the Topic 5.1, the relationship between lithology and macerals distribution can describe as follows:

In the east graben (Figure 5.5) (Tables 5.1 to 5.4), liptinite zone appears in gray clay and coal lithology and both covers sequence 5 and upper sequence 4. Jardine (1997) described lithology of sequence 5 in gray claystone, extensive coals and shales, point bars and channel sands deposited in deltaic plain or transgressive marginal marine environment. Exsudatinitic zone displayed a major role in sequence 4, in various color of claystone. Jardine (1997) identified lithology of sequence 4 as red beds, point bars and channel sands, few coals deposited in fluvial environment. Only three wells to the east and south contain vitroliptinite in lower sequence 4, sequence 3 and upper sequence 2 that are in coaly shale, sand and reddish brown clay. Jardine (1997) interpreted the lithology of sequence 2 as interbedded gray shales, red bed point bar, and channel sands, accretionary coals that locally overpressured lithology deposited in fluvial floodplain or deltaic plain environment before graduated change to deposited in gray shales and coals lithology in marginal marine (lagoonal depositional) environment in sequence 3.

In the west graben (Figures 5.6 and 5.7) (Tables 5.5 to 5.10) the maceral distribution in each sequence has the same lithology as in the east graben. Only vitroliptinite and vitrinite zones are distributed in sequence 3, by more thickness to the west and south and some in lower part of sequence 4 and in the upper part of sequence 2.

Structure and shape of macerals in liptinitic zone in sequence 5 and 4 of every well are resinite and suberinite, derived from land plants. Their bright yellow color under fluorescence indicates short burial and less affected by any processes.

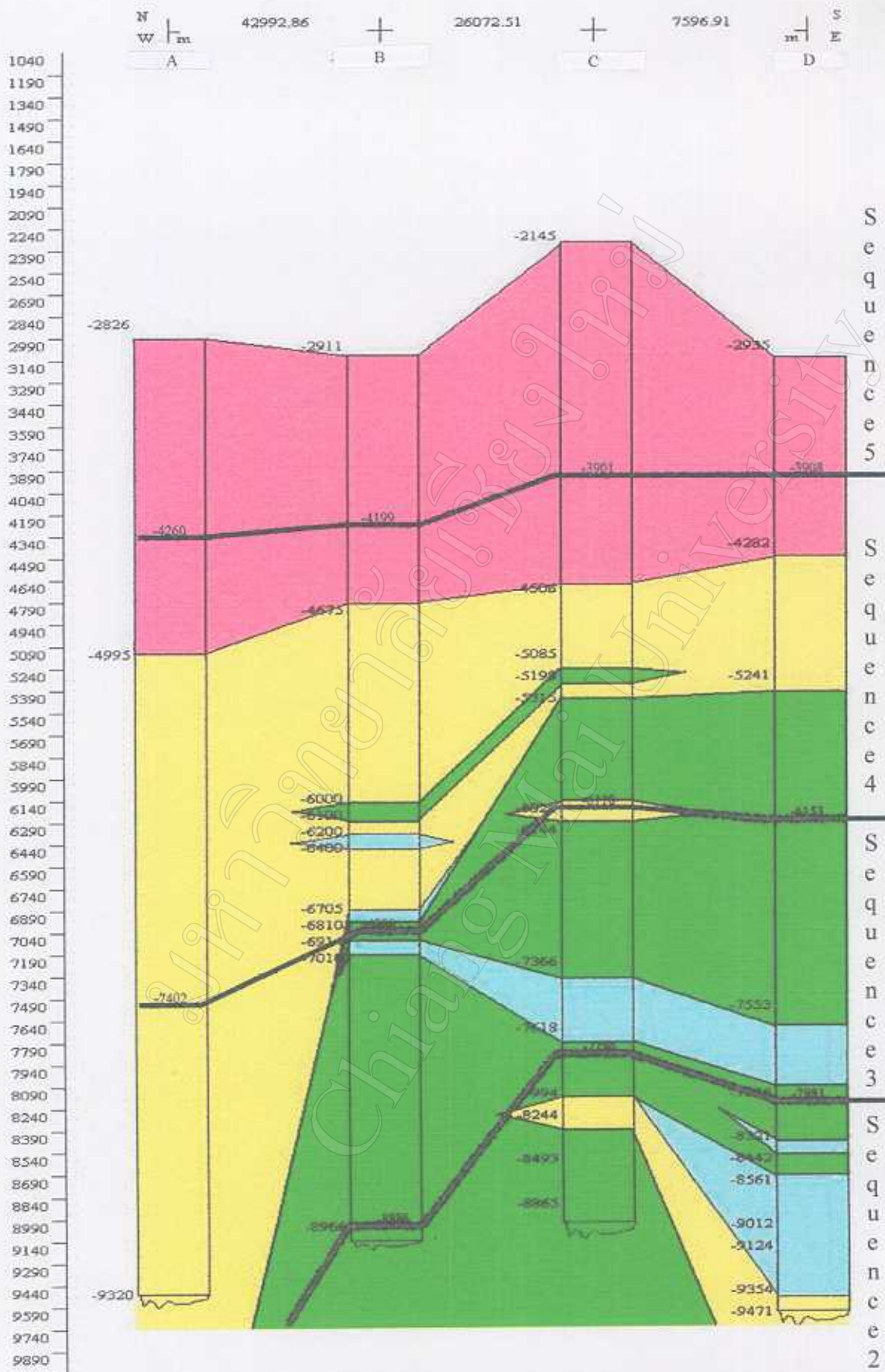


Figure 5.5 Relationship between macerals distribution and lithology in each sequence in east graben of the Pattani Basin.

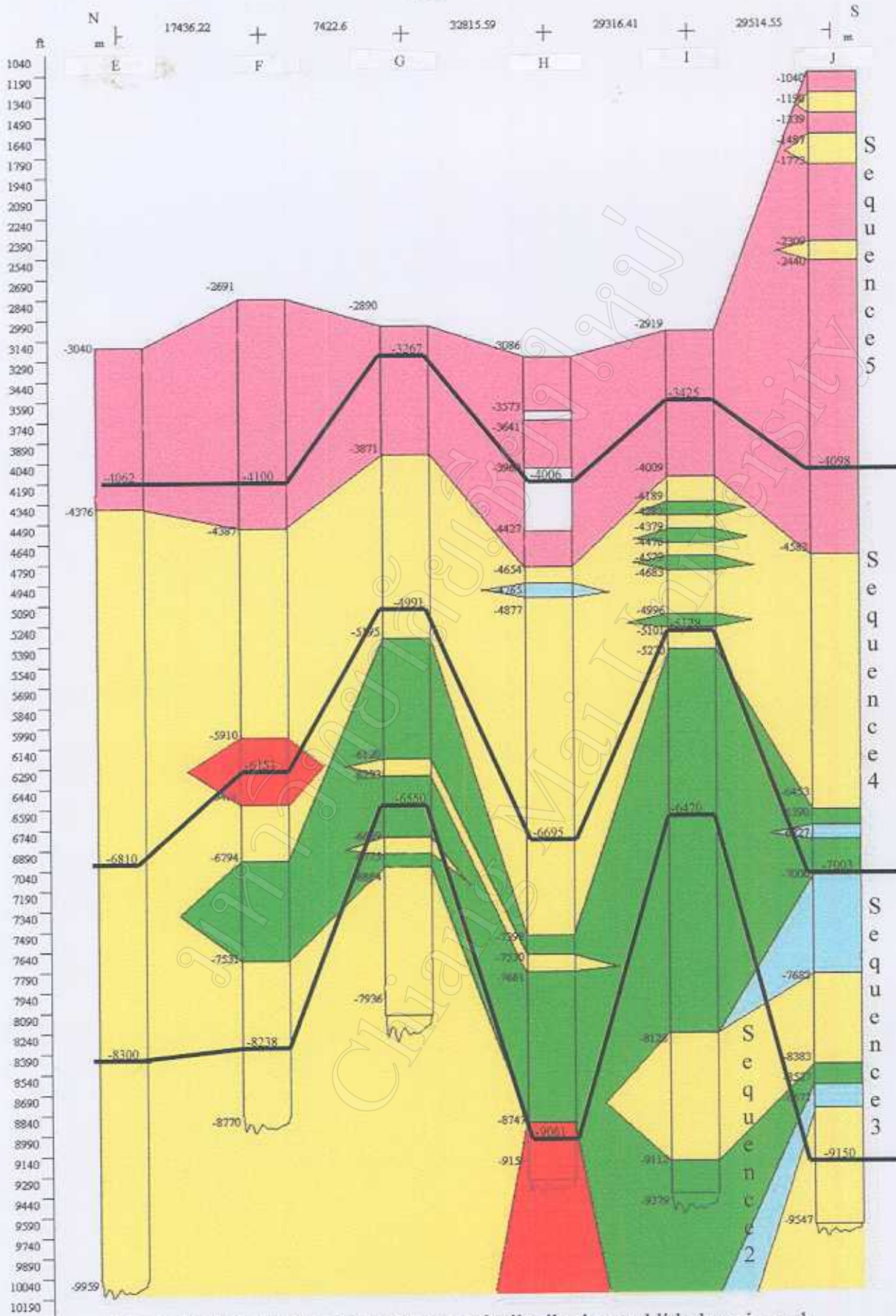


Figure 5.6 Relationship between macerals distribution and lithology in each sequence in the west graben of the Pattani Basin, in north -south direction.

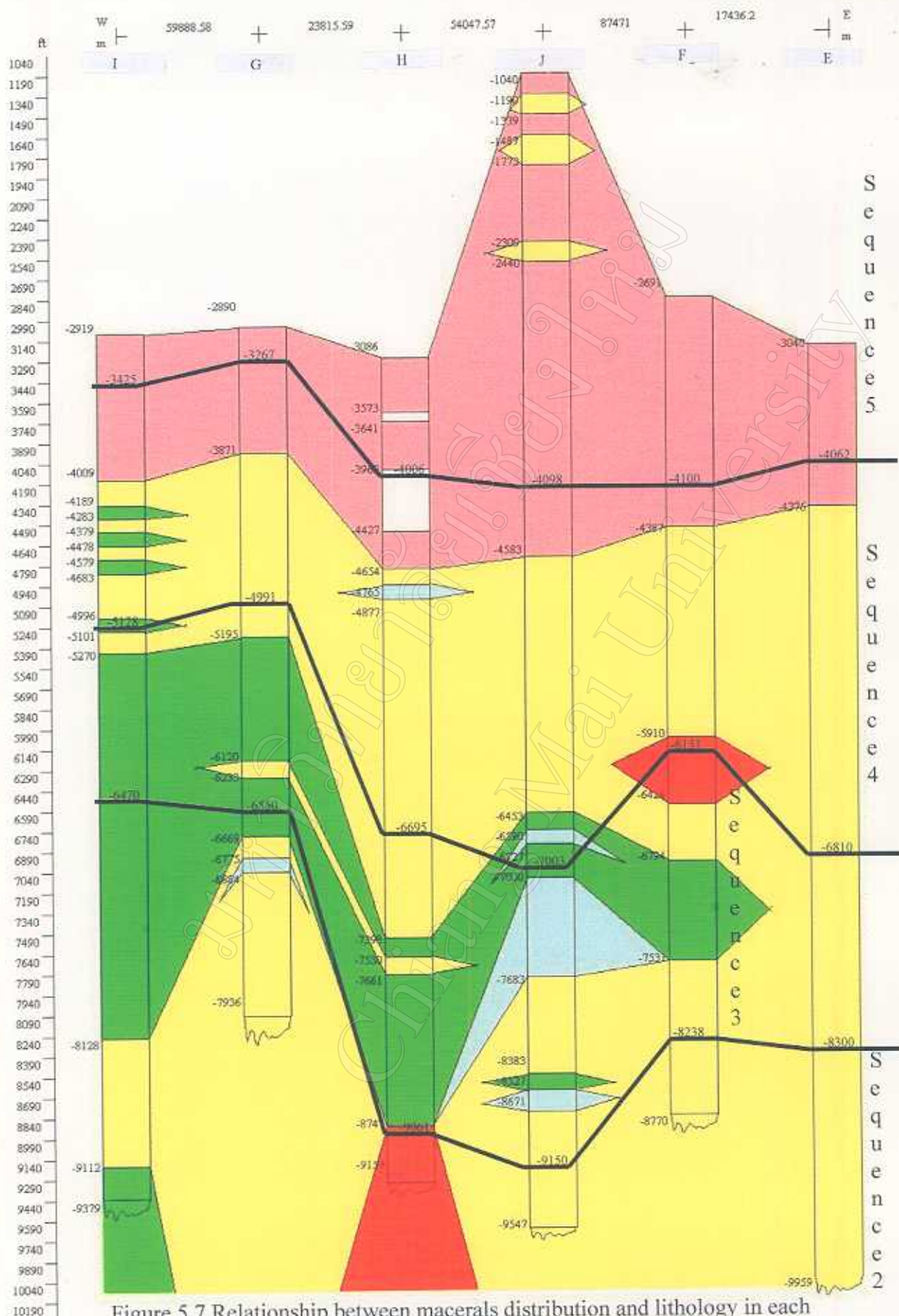


Figure 5.7 Relationship between macerals distribution and lithology in each sequence in the west graben of the Pattani Basin, in east-west direction.

EAST GRABEN

Table 5.1 Relationship between lithology and maceral distribution in A well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
5	-2826 to -4260	gray clay 85-95%, coal or coaly shale 5-15%.	-2826 to -4260	Liptinite zone
4	-4260 to -4889	gray clay 90-95%, coal or coaly shale 5-10%.	-4260 to -4995	Liptinite zone
	-4889 to -7402	gray/brown or reddish brown clay 100%.	-4995 to -7402	Exsudatinite zone
3	-7402 to >-9320	brown or reddish brown clay	-7402 to >-9320	Exsudatinite zone

Table 5.2 Relationship between lithology and maceral distribution in B well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
5	-2911 to -4199	gray clay 70-95%, coal or coaly shale 5-30%.	-2911 to -4199	Liptinite zone
4	-4199 to -4675	gray clay 85-90%, coal or coaly shale 10-15%.	-4199 to -4675	Liptinite zone
	-4675 to -5509	gray/brown or reddish brown clay 100%	-4675 to -6000	Exsudatinite zone
	-5509 to -6100	brown or reddish brown clay 20-90%, sand 10-80%	-6000 to -6100	Vitroliptinite zone
	-6100 to -6410	brown or reddish brown clay 90-95%, coaly shale 5-10%.	-6100 to -6200	Exsudatinite zone
	-6410 to -6705	brown or reddish brown clay	-6200 to -6400	Vitrinite zone
	-6705 to -6880	brown or reddish brown clay 90-95%, coaly shale 5-10%.	-6400 to -6705	Exsudatinite zone
	-6705 to -6880	brown or reddish brown clay 90-95%, coaly shale 5-10%.	-6705 to -6810	Vitrinite zone
3	-6880 to -7755	brown or reddish brown clay 90-95%, coaly shale 5-10%.	-6810 to -6880	Vitroliptinite zone
	-7755 to -7860	brown or reddish brown clay 75%, coaly shale 5%, sand 20%.	-6880 to -6914	Vitroliptinite zone
	-7860 to -8886	brown or reddish brown clay 95%, coaly shale 5%.	-6914 to -7018	Vitrinite zone
2	-8886 to >-8966	brown or reddish brown clay 95%, coaly shale 5%.	-7018 to -8886	Vitroliptinite zone
	-8886 to >-8966	brown or reddish brown clay 95%, coaly shale 5%.	-8886 to >-8966	Vitroliptinite zone

Table 5.3 Relationship between lithology and maceral distribution in C well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
5	-2145 to -3901	gray clay 80%, coal or coaly shale 20%.	-2145 to -3901	Liptinite zone
4	-3901 to -4678	gray clay 80-90%, coal or coaly shale 10-20%.	-3901 to -4506	Liptinite zone
	-4678 to -5085	gray/brown or reddish brown clay 100%.	-4506 to -5085	Exsudatinite zone
	-5085 to -6110	brown or reddish brown clay 95%, coaly shale 5%.	-5085 to -5198	Vitroliptinite zone
			-5198 to -5315	Exsudatinite zone
3	-6110 to -6988	brown or reddish brown clay 95%, coaly shale 5%.	-6110 to -6144	Exsudatinite zone
	-6144 to -7366		Vitroliptinite zone	
	-6988 to -7618	brown or reddish brown clay	-7366 to -7618	Vitrinite zone
	-7618 to -7756	brown or reddish brown clay 95%, coaly shale 5%.	-7618 to -7756	Vitroliptinite zone
2	-7756 to -7994	brown or reddish brown clay 95%, coaly shale 5%.	-7756 to -7994	Vitroliptinite zone
	-7994 to -8244		Exsudatinite zone	
	-8244 to -8493	brown or reddish brown clay 95%, coaly shale 5%.	-8244 to -8856	Vitroliptinite zone
	-8493 to -8865	brown or reddish brown clay		
>-8865	brown or reddish brown clay 95%, coaly shale 5%.			

Table 5.4 Relationship between lithology and maceral distribution in D well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	maceral zone	
5	-2935 to -3908	gray clay 90%, coal or coaly shale 10%.	-2935 to -3908	Liptinite zone
4	-3908 to -4134	gray clay 90%, coal or coaly shale 20%.	-3908 to -4433	Liptinite zone
	-4134 to -4284	gray/brown or reddish brown clay 90%, coaly shale 10%.		
	-4284 to -4433	gray/brown or reddish brown clay 80%, sand 20%.		
	-4433 to -5117	gray/brown or reddish brown clay 100%.	-4433 to -5241	Exsudatinite zone
	-5117 to -6153	brown or reddish brown clay	-5241 to -6153	Vitroliptinite zone

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	maceral zone	
		90%, coaly shale 10%.		
3	-6153 to -7981	brown or reddish brown clay 90-95%, coaly shale 5-10%.	-6153 to -7553 -7553 to -7946 -7946 to -7981	Vitroliptinite zone Vitrinite zone Vitroliptinite zone
2	-7981 to -9012	brown or reddish brown clay 95%, coaly shale 5%.	-7981 to -8321 -8321 to -8442	Vitroliptinite zone Vitrinite zone
	-9012 to -9124	brown or reddish brown clay	-8442 to -8561	Vitroliptinite zone
	-9124 to -9354	brown or reddish brown clay 95%, coaly shale 5%.	-8561 to -9354	Vitrinite zone
	-9354 to -9471	brown or reddish brown clay	-9354 to >-9471	Exsudatinite zone

WEST GRABEN

Table 5.5 Relationship between lithology and maceral distribution in E well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
5	-3040 to -4062	gray clay 85-90%, coal or coaly shale 10-15%.	-3040 to -4062	Liptinite zone
4	-4062 to -4377	gray clay 90-95%, coal or coaly shale 5-10%.	-4062 to -4376	Liptinite zone
	-4377 to -4786	gray/brown or reddish brown clay 100%.	-4376 to -6810	Exsudatinite zone
	-4786 to -6810	brown or reddish brown clay		
3	-6810 to -6853	brown or reddish brown clay 80%, sand 20%.	-6810 to -8300	Exsudatinite zone
	-6853 to -8200	brown or reddish brown clay		
2	-8300 to -9086	brown or reddish brown clay	-8300 to >-9959	Exsudatinite zone
	-9086 to -9285	brown or reddish brown clay		
	-9285 to >-9959	40-80%, sand 20-60%. brown or reddish brown clay		

Table 5.6 Relationship between lithology and maceral distribution in F well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
5	-2691 to -4100	gray clay 80-90%, coal or coaly shale 10-20%.	-2691 to -4100	Liptinite zone
4	-4100 to -4269	gray clay 80-90%, coal or coaly shale 10-20%.	-4100 to -4388	Liptinite zone
	-4269 to -4763	gray/brown or reddish brown clay 100%.	-4388 to -5910	Exsudatinite zone
	-4763 to -6156	brown or reddish brown clay	-5910 to -6151	Liptinite (alginite) zone
3	-6151 to -6298	brown or reddish brown clay 40-80%, sand 20-60%.	-6151 to -6424	Liptinite (alginite) zone
	-6298 to -6794	brown or reddish brown clay	-6424 to -6794	Exsudatinite zone
	-6794 to -7531	brown or reddish brown clay 95%, coaly shale 5%.	-6794 to -7531	Vitroliptinite zone
	-7531 to -8238	brown or reddish brown clay	-7531 to -8238	Exsudatinite zone
2	-8238 to >-8770	brown or reddish brown clay	-8238 to >-8770	Exsudatinite zone

Table 5.7 Relationship between lithology and maceral distribution in G well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
5	-2890 to -3267	gray clay 85%, coal or coaly shale 15%.	-2890 to -3267	Liptinite zone
4	-3267 to -3753	gray clay 85-90%, coal or coaly shale 10-15%.	-3267 to -3871	Liptinite zone
	-3753 to -4101	gray/brown or reddish brown clay 100%.	-3871 to -4991	Exsudatinite zone
	-4101 to -4991	brown or reddish brown clay		
3	-4991 to -5086	brown or reddish brown clay	-4991 to -5196	Exsudatinite zone
	-5086 to -6007	brown or reddish brown clay 95%, coaly shale 5%.	-5196 to -6120	Vitroliptinite zone
	-6007 to -6120	brown or reddish brown clay	-6120 to -6233	Exsudatinite zone
	-6120 to -6453	brown or reddish brown clay 95%, coaly shale 5%.	-6233 to -6550	Vitroliptinite zone
	-6453 to -6550	brown or reddish brown clay		
2	-6550 to >-7936	brown or reddish brown clay	-6550 to -6669	Vitroliptinite zone
			-6669 to -6776	Exsudatinite zone
			-6776 to -6884	Vitronite zone
			-6884 to >-7936	Exsudatinite zone

Table 5.8 Relationship between lithology and maceral distribution in H well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
5	-3086 to -3169	gray clay 65%, coal or coaly shale 15%, sand 20%.	-3086 to -4006	Liptinite zone
	-3169 to -3344	gray clay 85%, coal or coaly shale 15%.		
	-3344 to -3856	gray clay 65%, coal or coaly shale 15%, sand 20%.		
	-3856 to -4006	gray clay 90%, coal or coaly shale 10%.		
4	-4006 to -4514	gray clay 90-95%, coal or coaly shale 5-10%.	-4006 to -4654	Liptinite zone
	-4541 to -5351	gray/brown or reddish brown clay 100%.	-4654 to -4765	Exsudatinite zone
	-5351 to -6118	brown or reddish brown clay	-4765 to -4877	Vitrinite zone
	-6118 to -6372	brown or reddish brown clay 80%, sand 20%.	-4877 to -6695	Exsudatinite zone
	-6372 to -6500	brown or reddish brown clay		
	-6500 to -6627	brown or reddish brown clay 60%, sand 40%.		
	-6627 to -6695	brown or reddish brown clay		
3	-6695 to -7398	brown or reddish brown clay	-6695 to -7398	Exsudatinite zone
	-7398 to -9159	brown or reddish brown clay 95%, coal or coaly shale 5%.	-7398 to -7530	Vitroliptinite zone
			-7530 to -7661	Exsudatinite zone
			-7661 to -8747	Vitroliptinite zone
			-8747 to -9061	Liptinite (alginite) zone
2	-9061 to >-9159	brown or reddish brown clay 95%, coal or coaly shale 5%.	-9061 to >-9159	Liptinite (alginite) zone

Table 5.9 Relationship between lithology and maceral distribution in I well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
5	-2919 to -3425	gray clay 85%, coal or coaly shale 15%.	-2919 to -3425	Liptinite zone
4	-3425 to -3542	gray clay 85-90%, coaly shale 10-15%.	-3425 to -4009	Liptinite zone
	-3542 to -3738	gray clay 50-70%, coaly shale 10%, sand 20-40%.		
	-3738 to -3830	gray/brown or reddish brown		

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
	-3830 to -3921	clay 100%. gray/brown or reddish brown clay 95%, coaly shale 5%.	-4009 to -4189	Exsudatinitic zone
	-3921 to -4189	gray/brown or reddish brown clay 100%.	-4189 to -4283	Vitroliptinitic zone
	4189 to -4579	brown or reddish brown clay	-4283 to -4379	Exsudatinitic zone
	-4579 to -4683	brown or reddish brown clay 75%, coal or coaly shale 5%, sand 20%.	-4379 to -4478	Vitroliptinitic zone
	-4683 to -5128	brown or reddish brown clay 40-60%, sand 20-60%.	-4478 to -4579	Exsudatinitic zone
			-4579 to -4683	Vitroliptinitic zone
			-4683 to -4996	Exsudatinitic zone
			-4996 to -5101	Vitroliptinitic zone
			-5107 to -5128	Exsudatinitic zone
3	-5128 to -5207	brown or reddish brown clay 40%, sand 60%.	-5128 to -5207	Exsudatinitic zone
	-5207 to -6470	brown or reddish brown clay 95%, coal or coaly shale 5%.	-5207 to -6470	Vitroliptinitic zone
2	-6470 to -6618	brown or reddish brown clay 95%, coal or coaly shale 5%.	-6470 to -8128	Vitroliptinitic zone
	-6618 to -6728	brown or reddish brown clay 75%, coal or coaly shale 5%, sand 20%.		
	-6728 to -7057	brown or reddish brown clay 95%, coal or coaly shale 5%.		
	-7057 to -7166	brown or reddish brown clay 75%, coal or coaly shale 5%, sand 20%.		
	-7166 to -7591	brown or reddish brown clay 95%, coal or coaly shale 5%.		
	-7591 to -7695	brown or reddish brown clay 75%, coal or coaly shale 5%, sand 20%.		
	-7695 to -7800	brown or reddish brown clay 95%, coal or coaly shale 5%.		
	-7800 to -8128	brown or reddish brown clay 55-80%, coal or coaly shale 5%, sand 20-40%.		
	-8128 to -8237	brown or reddish brown clay	-8128 to -9112	Exsudatinitic zone
	-8237 to -8351	brown or reddish brown clay 40%, sand 60%.		

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
	-8351 to -8597	brown or reddish brown clay	-9112 to >-9379	Vitroliptinite zone
	-8597 to -8981	brown or reddish brown clay 80%, sand 20%.		
	-8981 to -9112	brown or reddish brown clay		
	-9112 to 9379	brown or reddish brown clay 40-80%, sand 20-60%.		
	>-9379	brown or reddish brown clay		

Table 5.10 Relationship between lithology and maceral distribution in J well.

Lithology from cutting sample			Macerals distribution	
sequence	depth (ft)	lithology	depth (ft)	maceral zone
5	-1040 to -1190	gray clay 95%, coal or coaly shale 5%.	-1040 to -1190	Liptinite zone
	-1190 to -1773	gray clay 100%	-1190 to -1339	Exsudatinitic zone
	-1773 to -2307	gray clay 95%, coal or coaly shale 5%.	-1339 to -1487	Liptinite zone
	-2307 to -2440	gray clay 100%	-1487 to -1773	Exsudatinitic zone
	-2440 to -4098	gray clay 90%, coal or coaly shale 10%.	-1773 to -2307	Liptinite zone
4	-4098 to -4316	gray clay 90%, coal or coaly shale 10%.	-2307 to -2440	Exsudatinitic zone
	-4316 to -4583	gray/brown or reddish brown clay 95%, coaly shale 5%.	-2440 to -4098	Liptinite zone
	-4583 to -6453	brown or reddish brown clay	-4098 to -4583	Liptinite zone
	-6453 to -7003	brown or reddish brown clay 95%, coaly shale 5%.	-4583 to -6453	Exsudatinitic zone
			-6453 to -6590	Vitroliptinitic zone
3			-6590 to -6727	Vitrinite zone
			-6727 to -7000	Vitroliptinitic zone
			-7000 to -7003	Vitrinite zone
	-7003 to -7683	brown or reddish brown clay 95%, coaly shale 5%.	-7003 to -7683	Vitrinite zone
	-7683 to -8383	brown or reddish brown clay	-7683 to -8383	Exsudatinitic zone
2	-8383 to -8671	brown or reddish brown clay 95%, coaly shale 5%.	-8383 to -8527	Vitroliptinitic zone
	-8671 to -9150	brown or reddish brown clay	-8527 to -8671	Vitrinite zone
			-8671 to -9150	Exsudatinitic zone
	-9150 to >-9547	brown or reddish brown clay	-9150 to >-9547	Exsudatinitic zone

Exsudatinite is the only one macerals found at all the depth. In the upper sequence it displayed pale green or greenish yellow in color and changing with depth to be yellow or deepest yellow in the lower sequence. The pale green or greenish yellow exsudatinite is a result of short carbon chain was migrate away from source rocks. On the other hand, yellow or deepest yellow exsudatinite has longer carbon chain.

Vitroliptinite and vitrinite zone are mainly in sequence 3. In sequence 4 and 2, there are as a lens. Liptinite macerals in this sequence are degrading. The color of liptinite under fluorescence shows yellowish brown or brown darker than those found in sequence 5. This is an indicator of the migrated out of light oil and changing to bituminite. This zone represents the oil/gas source where oil/gas has already migrated out.

5.2.3 ORGANIC MATURITY

Due to the fact that gas is the major hydrocarbon of the Pattani Basin, it is related to evolution paths of maceral groups in coal after Van Krevelen diagram are that type III kerogen. Its precursor is derived essentially from continental plants and contain much identifiable vegetal debris and provide convenient gas source rocks, if buried at sufficient depth (Tissot and Welte, 1984).

Appearance of macerals in the east and west graben in sequence 5 and upper sequence 4 indicated that it is too young to be a source rock. Exsudatinite zone present in sequence 4, 3, and 2 is mainly hydrocarbon product. Vitrinite and vitroliptinite zone mainly preserved in sequence 3 and some in sequence 2 and 4. The zone has more thick to the west and south in

the west graben and has more thick to the east and south in the east graben. It acted as a source of the Pattani Basin and generate exsudatinite. It migrated to the upper sequence to the center of the basin.

5.3 PALEOENVIRONMENT

The depositional environment in the Pattani Basin started with lacustrine deposited in sequence 1 that oil shale are dominate sedimentary rocks. Most oil shales were deposite under anoxic or oxygen deficient bottom waters, because the lack of a large oxygen reservoir is favourable for the preservation of labile, hydrogen rich biomass (maceral precursor). Anoxic or oxygen deficient of bottom water is function of the intensity of circulation (water exchange) in the respective lake or sea. Figure 5.8 is a block diagram of lacustrine setting, illustrate the restricted water body and accumulation of algal organic matter which may lead to the deposition of sequence 1 and sequence 2 oil shale. There are many algal species inhabiting in the gulf of Thailand. Many algal species can be recognized including lamaginite formed the remains of filamentous algal, colonial algal including botryococcus brownii (a colonial algae) and pila as well as unicellular algae (Unocal, 1998).

Peat deposition in fluvial/alluvial and lacustrine environment, Figures 5.9 and 5.10 successively illustrate coal and oil shale forming environments alluvial/fluvial fans. These coal seams may be interbedded with conglomerates, alluvial sandstones as well as lacustrine mudstones. In this setting, groundwater discharge from precipitation in the mountains is instrumental in promoting peat accumulaton and preservation. Groundwater

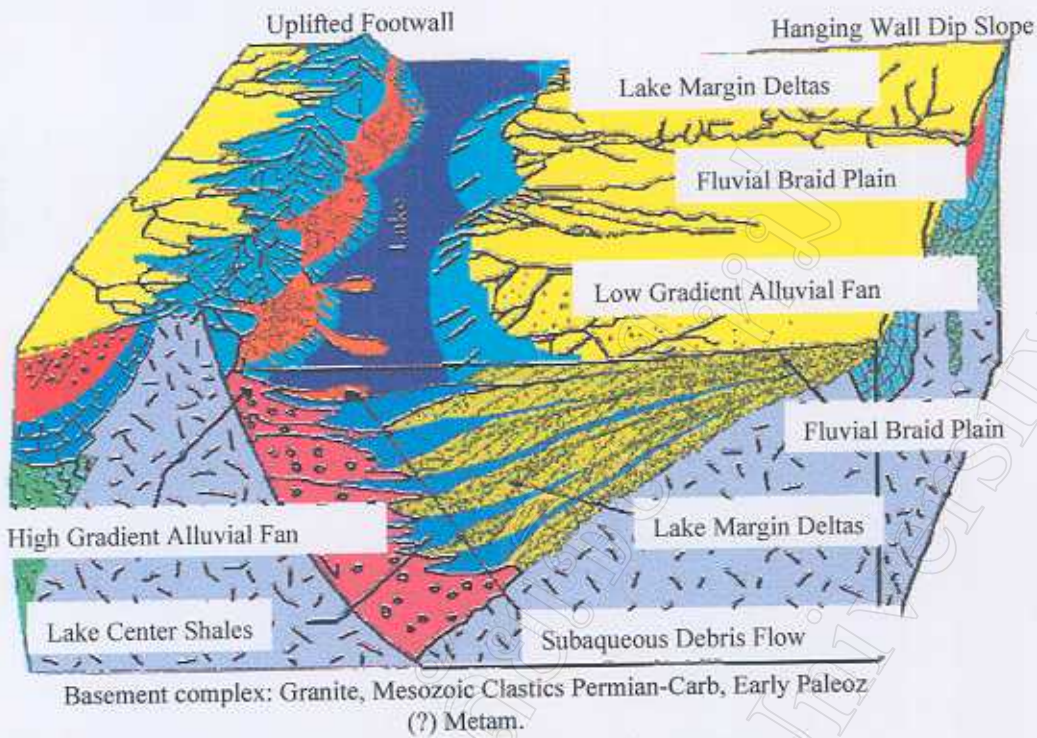


Figure 5.8 Depositional environment of sequence 1 (after Unocal, 1998)

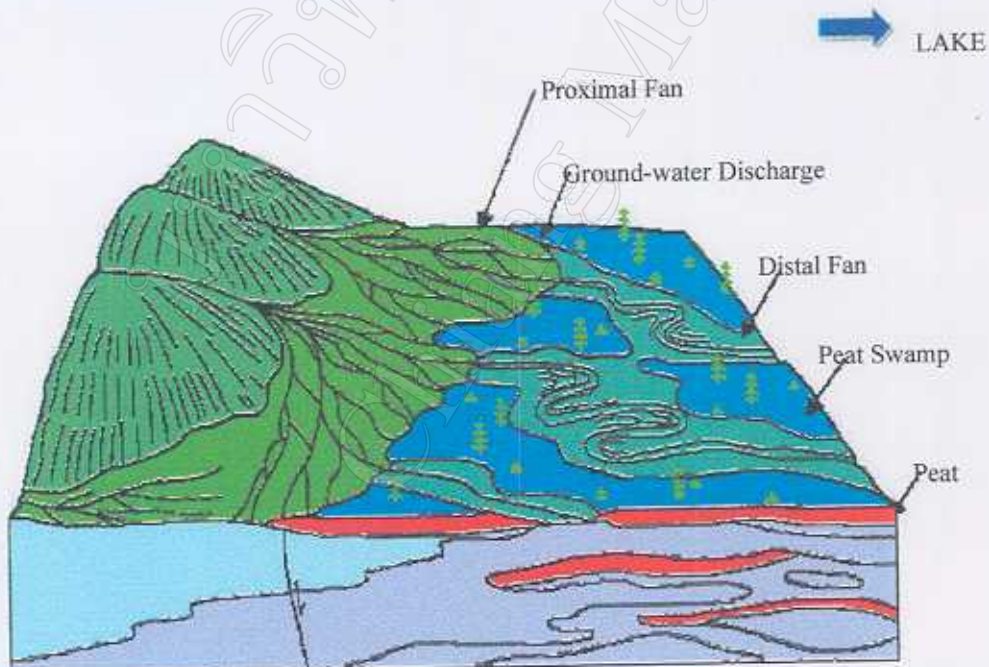


Figure 5.9 Idealized reconstruction of alluvial fan peats within an intermontane basin (after Unocal, 1998).

recharge by heavy rainfall in the adjacent highlands maintain a relatively high water level both for supporting vegetation growth and peat preservation from excessive oxidation. Continued subsidence accommodates increasing peat accumulations, resulting in the formation of thick coal seams. The coal deposits in the intermontane fluvial/alluvial environments typically contain low organic and inorganic (pyritic) sulfur. Due to the great burial depths of the syn-rift sequences, penetration of these coals by drilling is rare. Though penetrations are rare it is believed that these syn-rift fluvial/alluvial coal and lacustrine shale facies are widely present in the Pattani Basin, though of great maturities and depth.

Swamp environments persist from the alluvial/fluvial systems to the lagoonal facies, which then gradually change into lacustrine deposits. The interbedding of coals and oil shales results from the different phases of lagoonal expansion and contraction, which is controlled by tectonic and climatic changes. In the syn-rift deposits in the Pattani Basin, the Khmer Trough and in the northern Malay basins where coal and lacustrine algal shale facies were deposited. Organic sedimentation occurred in the early stage of the failed rifting, prior to peneplainization by the developing fluvial system.

Another important coal-forming environment is the fluvial floodplain. This facies is well developed in the Pattani Basin, especially in sequence 3, upper sequence 2, lower sequence 4 and sequence 5. An analog of the intermontane fluvial system with vegetation growth in the floodplains is illustrated in Figure 5.11. The figure provides a close-up of a floodplain coal (peat) deposit. In this environment, organic preservation is poor, the

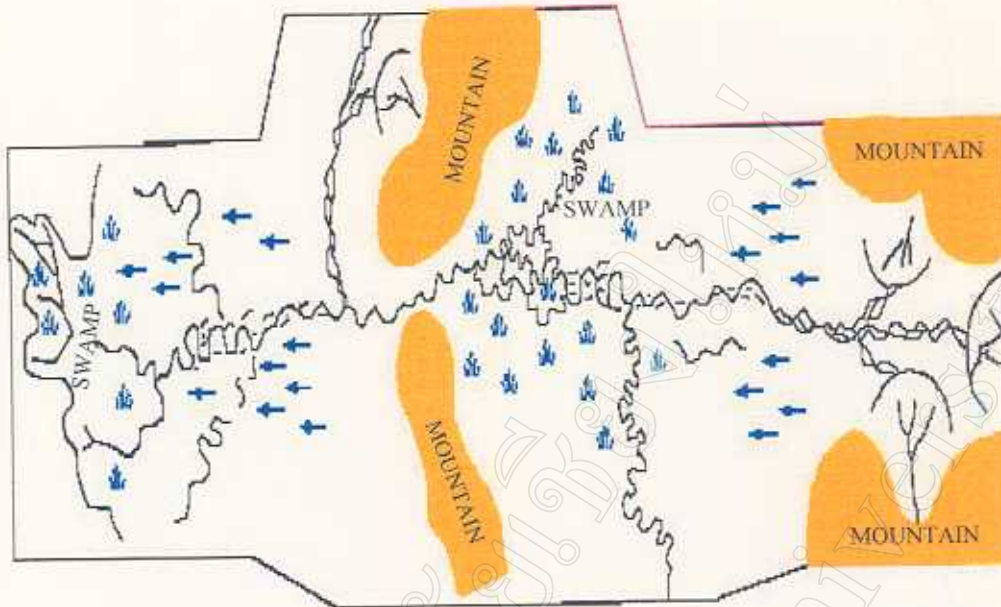


Figure 5.10 Hypothetical intermontane fluvial-deltaic system analogous to the Pattani Basin during Miocene deposition (after Unocal, 1998).

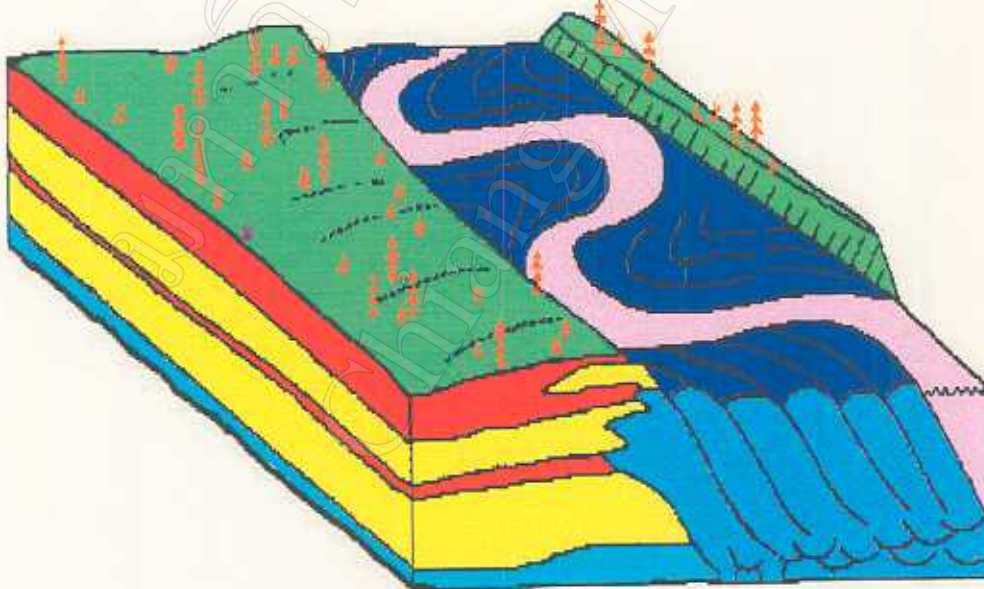


Figure 5.11 Pattern of peat accumulation in backswamps adjacent to meandering fluvial channels (after Unocal, 1998)

environment has too high oxic to preserve the land plant remains. Nevertheless, at sequence 3 time in the Pattani Basin, the underground water levels were sufficiently high to preserve the organic matter. Proximity to the ancient sea ways and occasional marine incursions also facilitated organic preservation, and the preservation of hydrocarbon generation potentials. However, the generally oxic environment of swamps associated with fluvial systems are reflected by the relative low hydrogen indices of Pattani coaly kerogen.

The main hydrocarbon-bearing reservoirs in the Pattani Basin are fluvial and fluvial-deltaic sandstone within sequence 4, 3 and upper sequence 2. Source rocks mapping in the basin are gas-prone coals and coaly shales in sequence 2, sequence 3 and lower sequence 4, and oil-prone lacustrine shales in sequence 1 and lower sequence 2.

A well

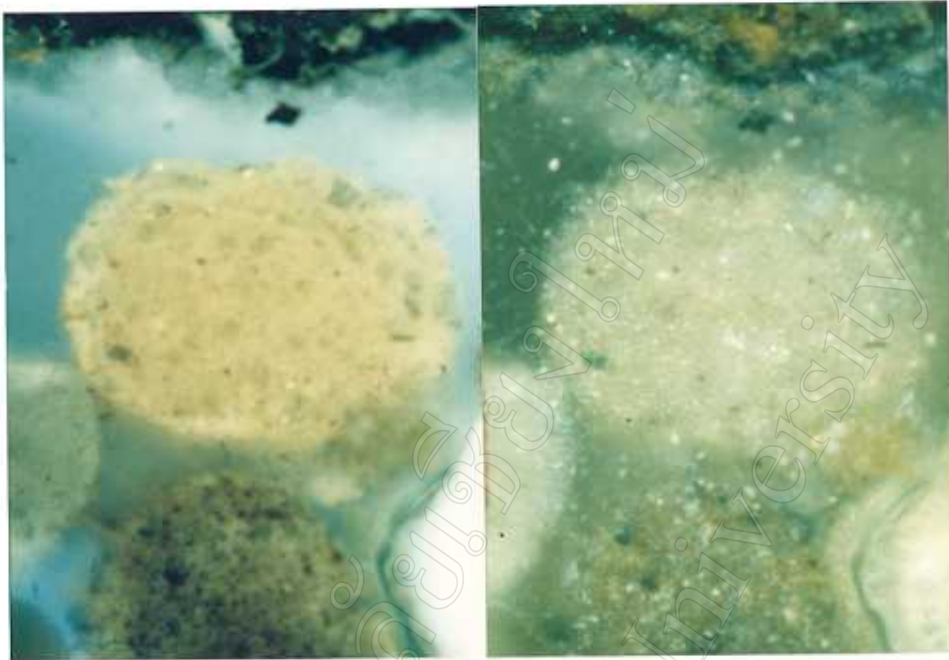


Figure 5.12 : Exsudatinite impregnated in clay grain displayed pale green color and zoning at -3281.1 ft to -3393.5 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

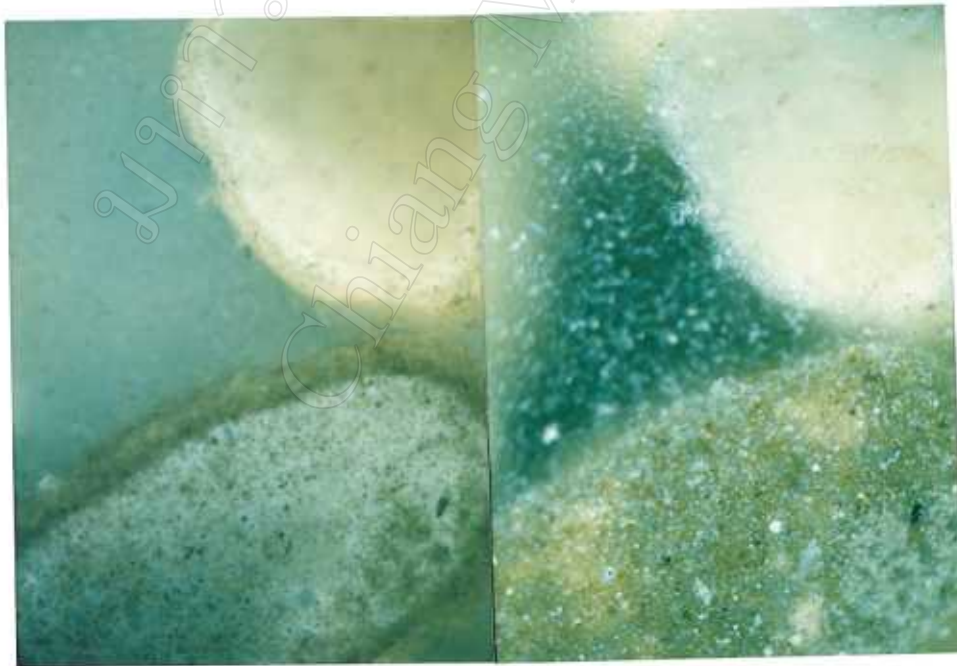


Figure 5.13 : Exsudatinite impregnated in clay grain displayed pale green color and zoning at -3393.5 ft to -3504.2 ft under (left) under oil-fluorescence light (right) under oil-white light (10x20).

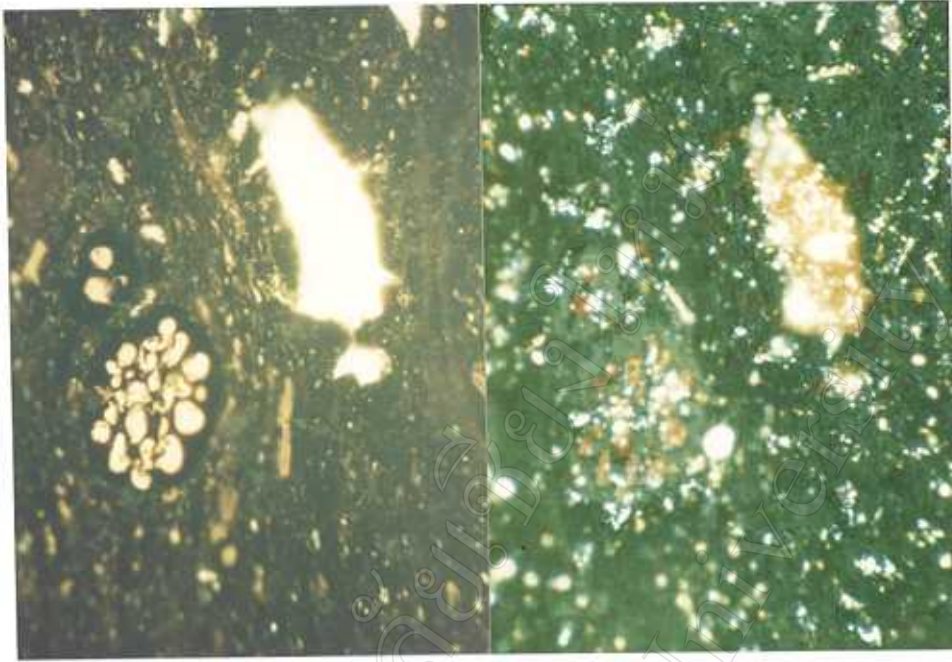


Figure 5.14 : Liptodetrinite as groundmass, resinite body (bright yellow), sclerotinite has many cells infill by resinite (exsudatinitite) at -3723.2 ft to -3831.6 ft (left) under oil-fluorescence light (right) under oil-white light (10x50).

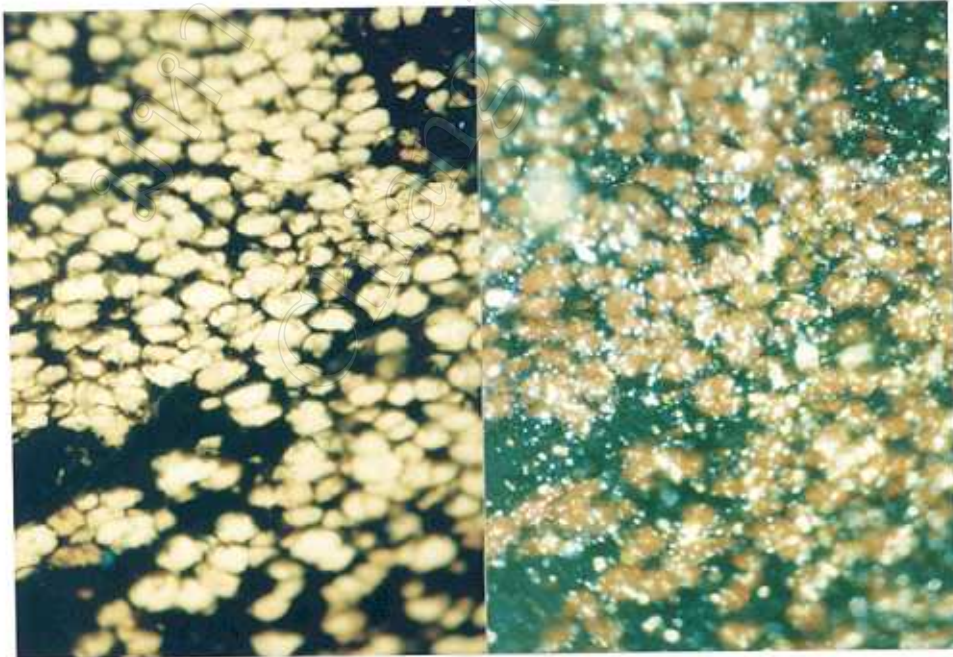


Figure 5.15 : Resinite mass at -4783.2 ft to -4889.2 ft (left) under oil-fluorescence light (right) under oil-white light (10x50).

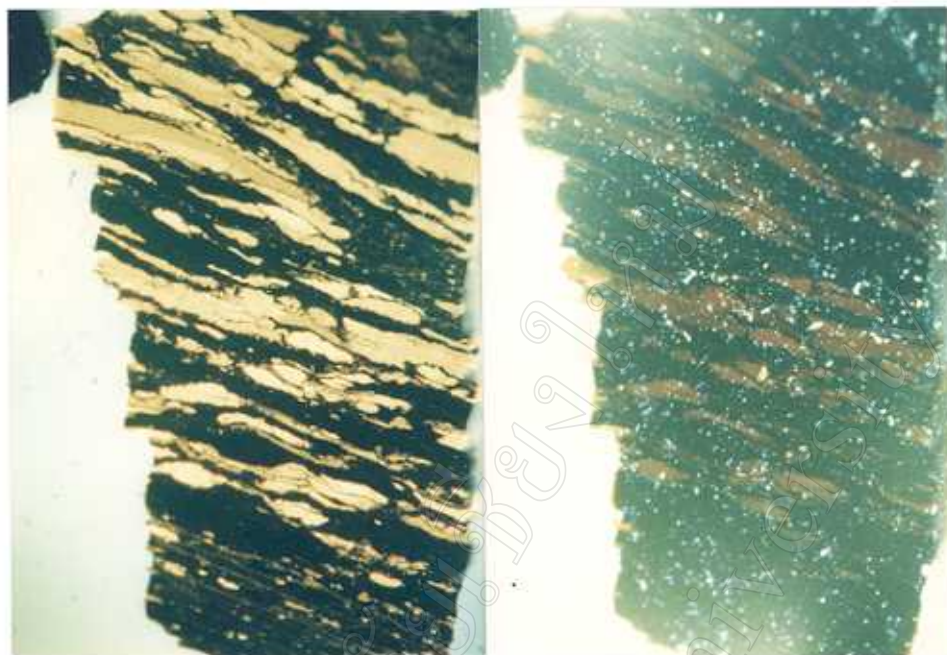


Figure 5.16 : Alginite A, sporinite, cutinite and resinite at -3938.1 ft to 4044.3 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

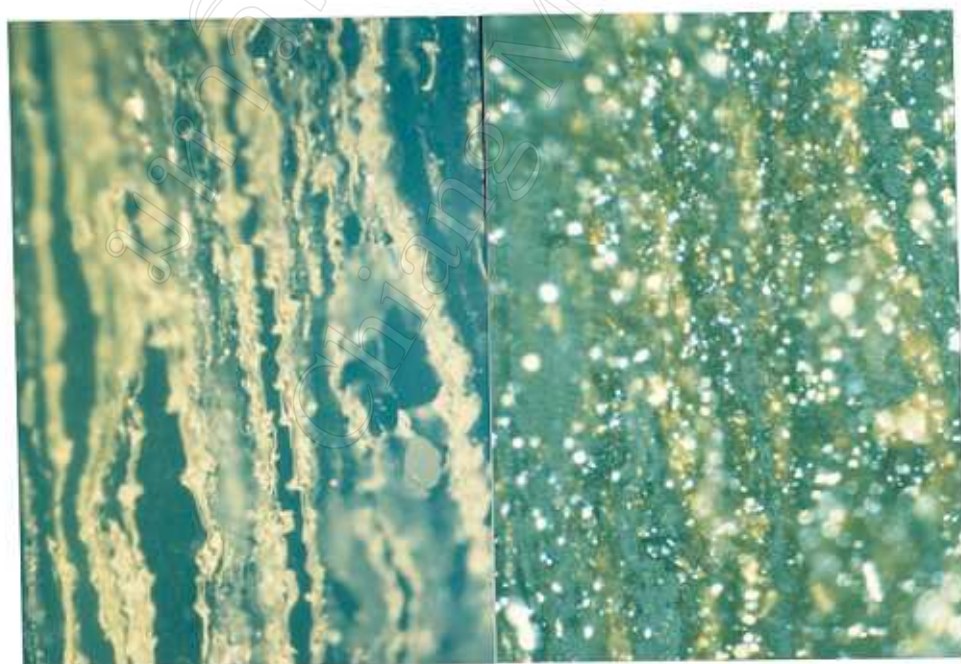


Figure 5.17 : Sapropelic coal has suberinite, liptodetrinite and sporinite at -4254.4 ft to -4359.9 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

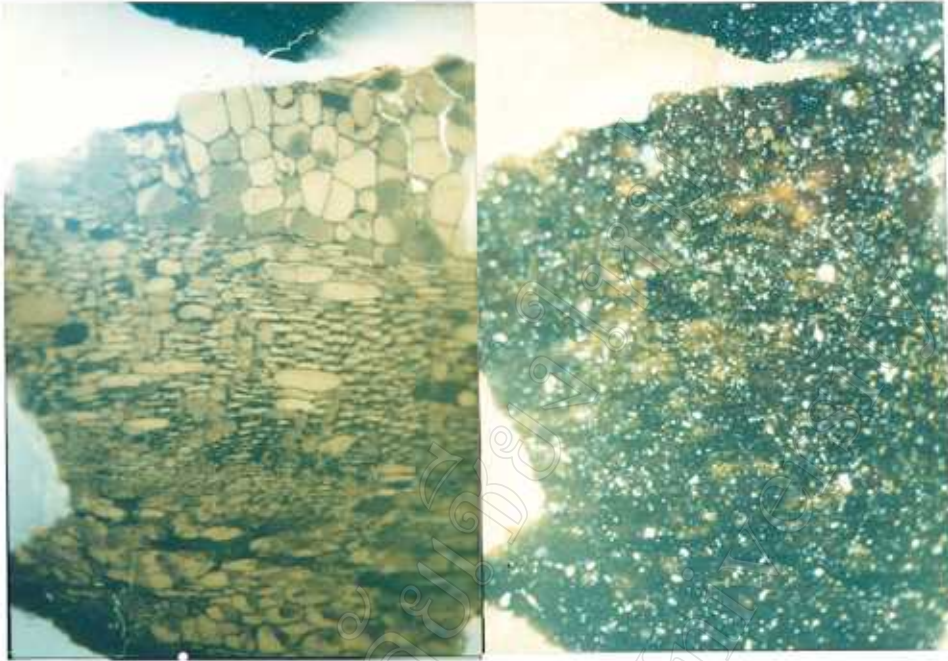


Figure 5.18 : Exsudatinite filled in ulminite at -4571.2 ft to -4677.2 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

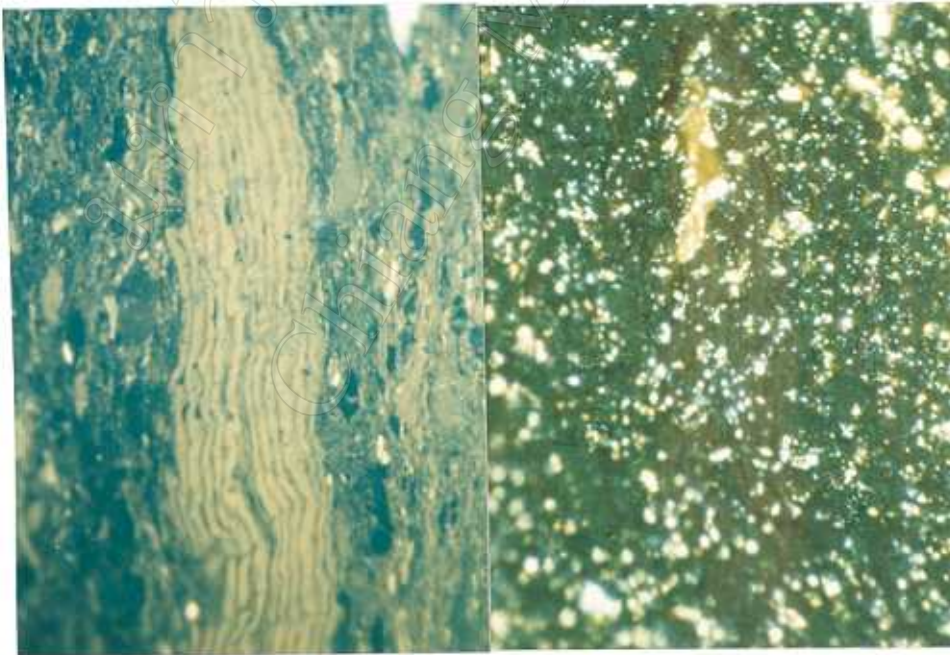


Figure 5.19 : Suberinite band, liptodetrinite as groundmass and sporinite at -4995.3 ft to -5101.6 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

B well

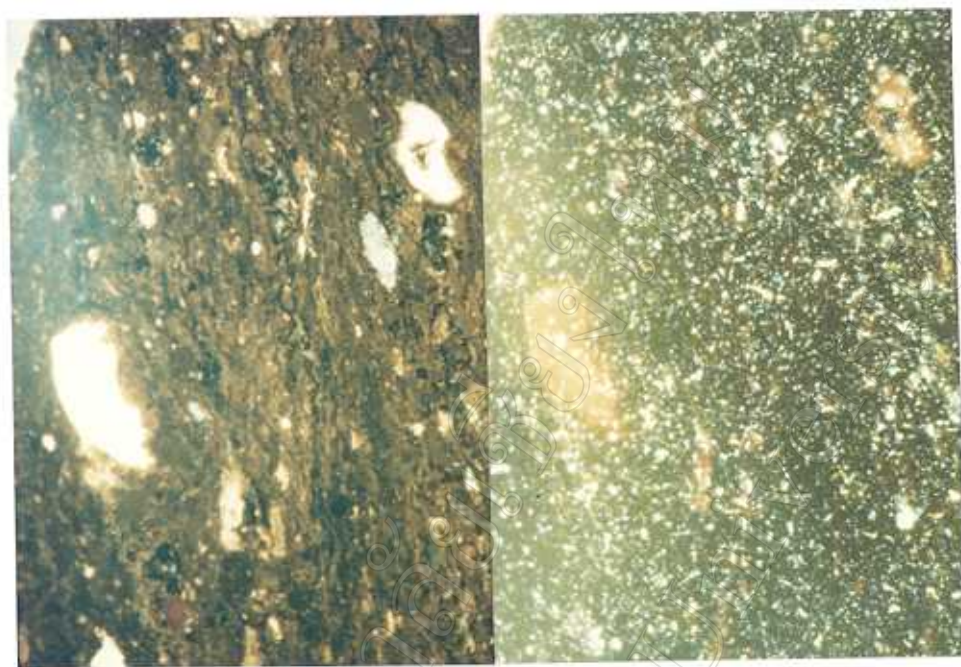


Figure 5.20 : liptodetrinite as groundmass, sporinite and cutinite at -2910.8 ft to -2992 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

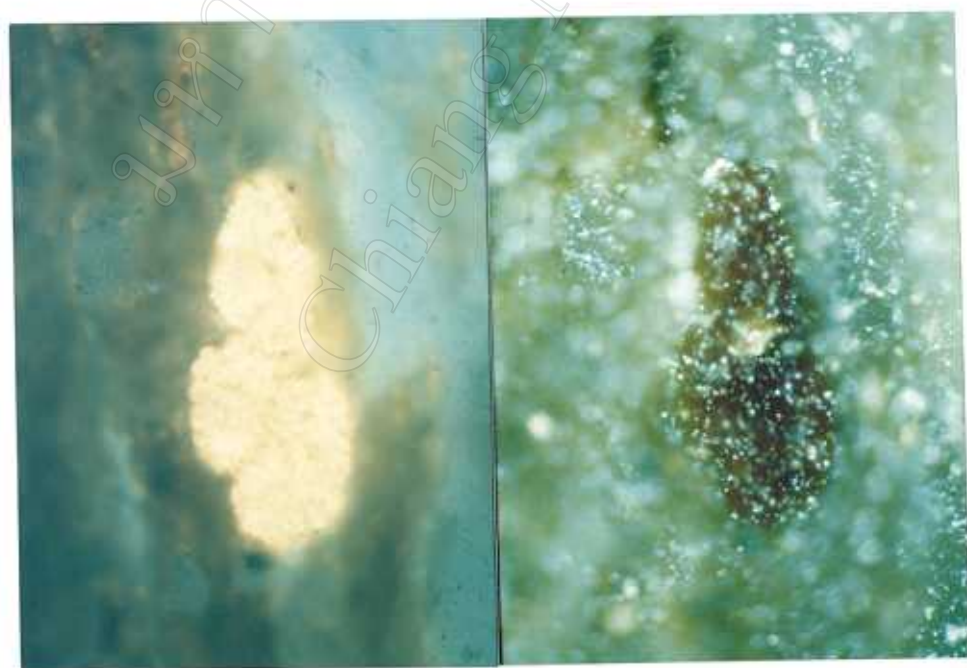


Figure 5.21 : Alginite A at -3572 ft to -3656.3 ft (left) under oil-fluorescence light (right) under oil-white light (10x50).

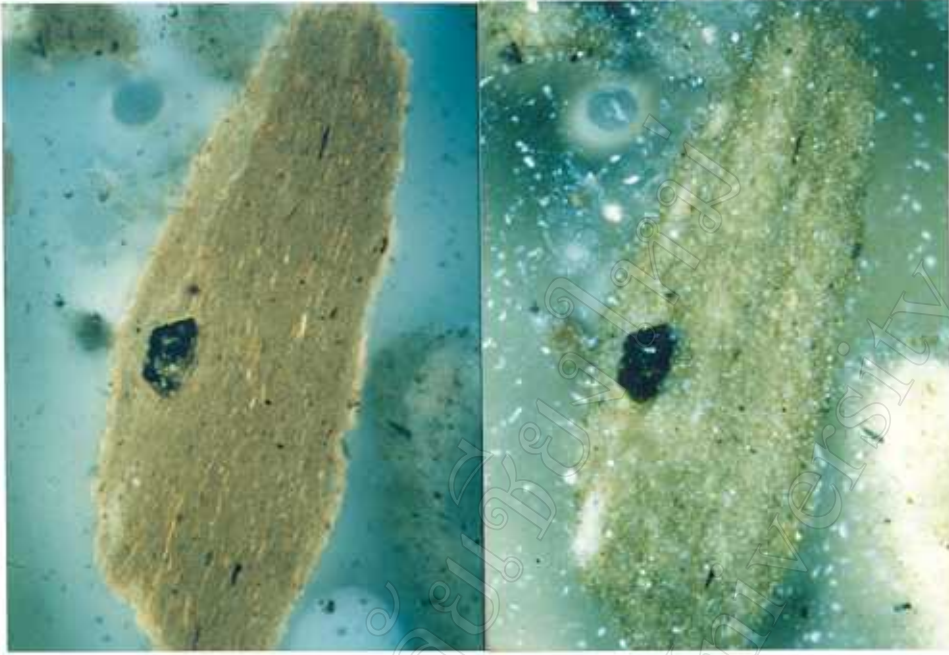


Figure 5.22 : oil shale has lamagenite rich, exsudatinite impregnated in clay grain at -3820.5 ft to -3902.5 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

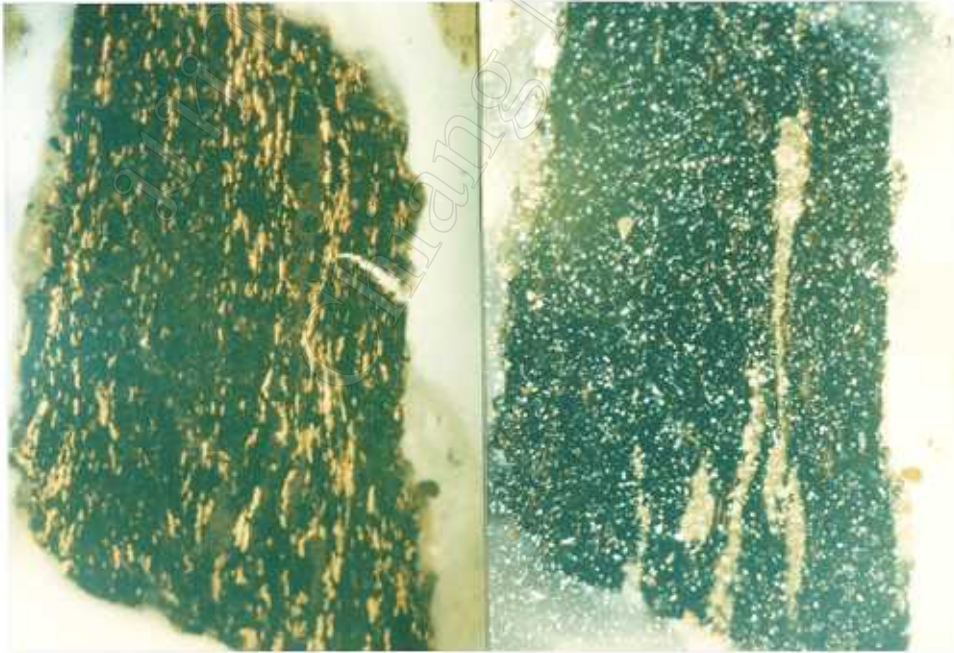


Figure 5.23 : Lamagenite or alginite B at -3902.5 ft to -3985.5 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

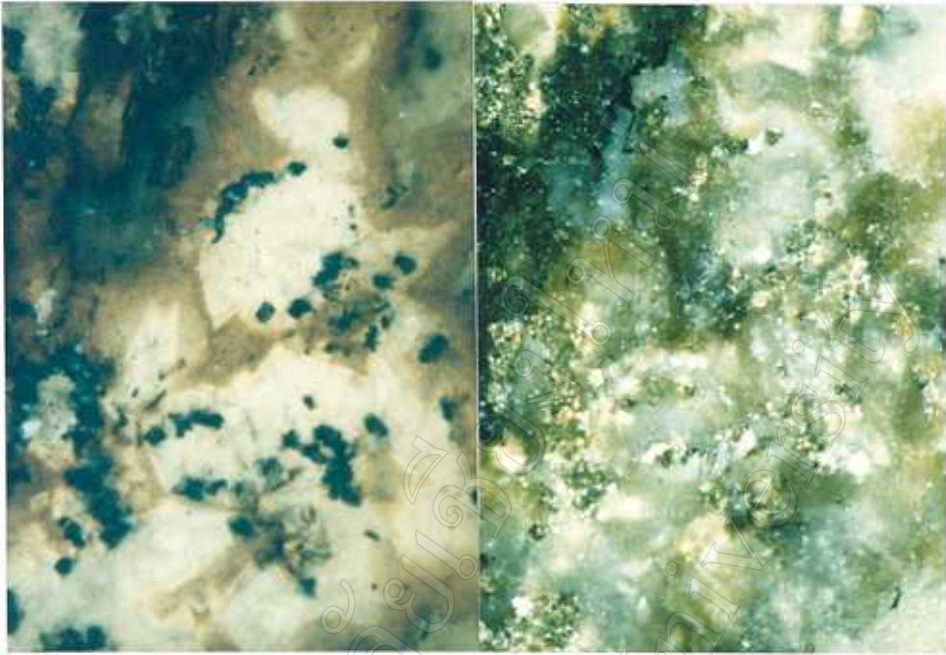


Figure 5.24 : Exsudatinite impregnated in clay grain displayed pale green color and zoning at -6809.7 ft to -6913.6 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

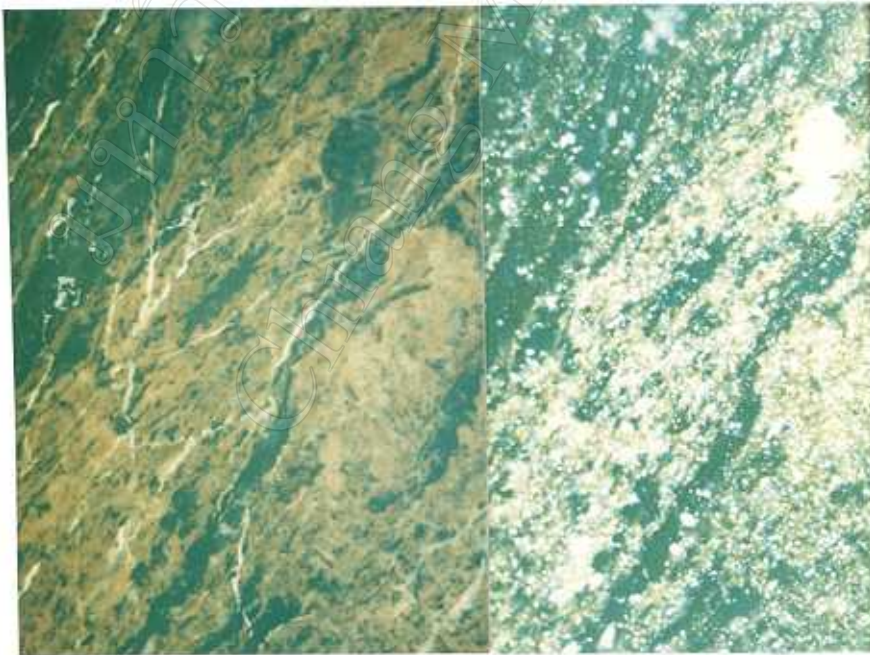


Figure 5.25 : Sapropelic coal has high liptinite content; suberinite type show degrading state, attrinite and gelinite at -7965.5 ft to -8053.9 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

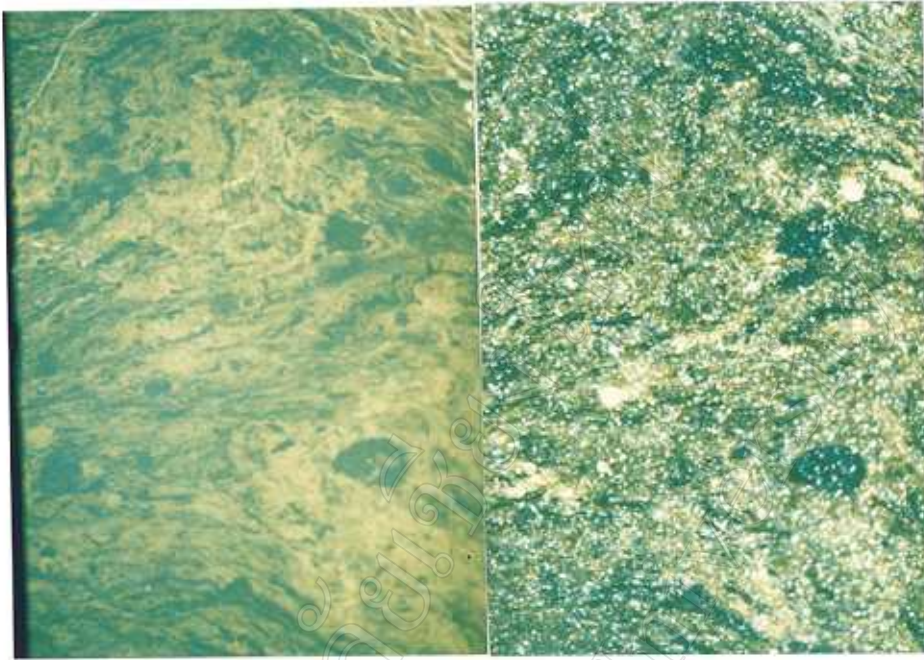


Figure 5.26 : Sapropelic coal has high liptinite content; suberinite type show degrading state, attrinite and gelinite at -8053.9 ft to -8167.9 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

C well

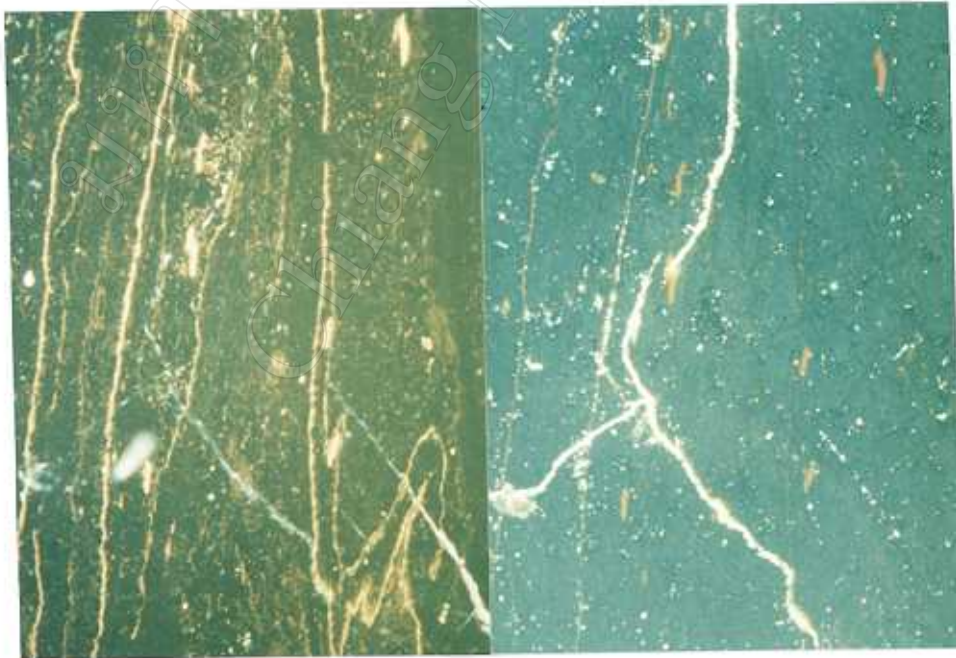


Figure 5.27 : Cutinite, resinite and liptodetrinite as a groundmass at measure depth 3150 ft to 3720 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

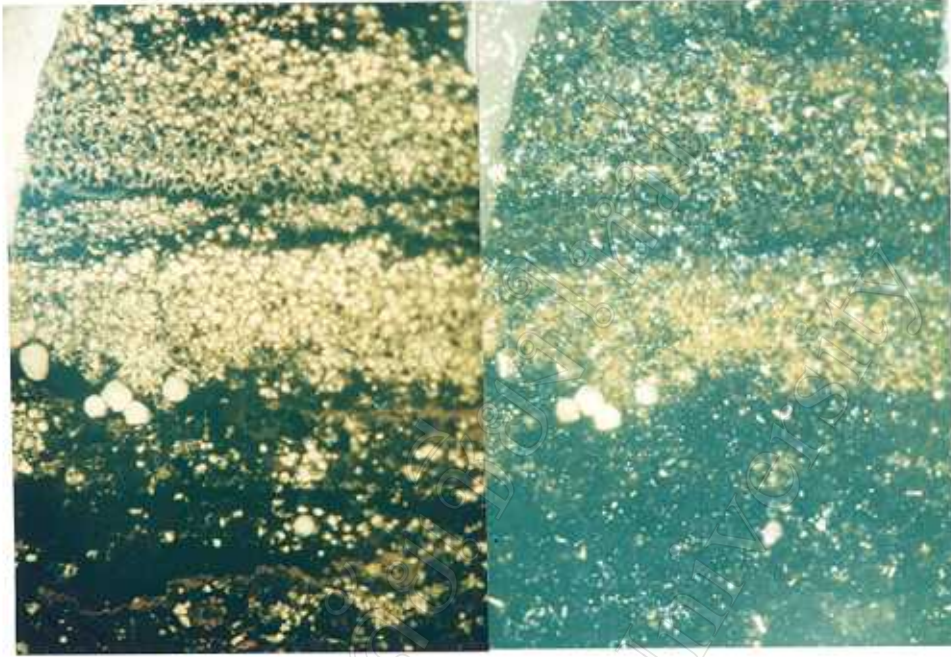


Figure 5.28 : Resinite mass fill in cell cavity of sclerotinite and suberinite at measure depth 3300 ft to 3420 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

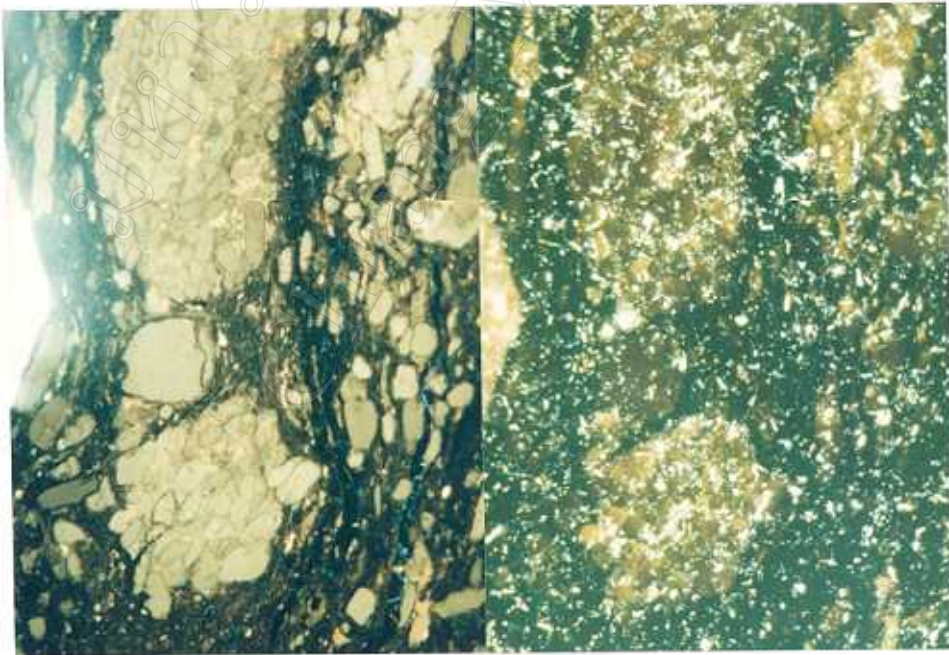


Figure 5.29 : Exsudatinite filled in ulminite at measure depth 3600 ft to, 3720 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

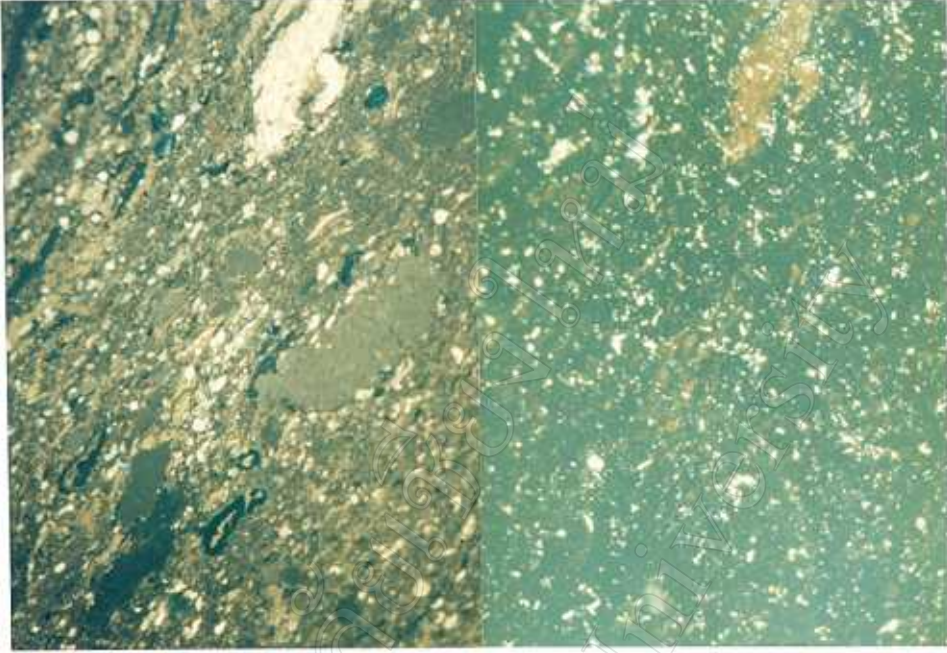


Figure 5.30 : Liptodetrinite, bituminite (brown) at measure depth 3750 ft to 3870 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

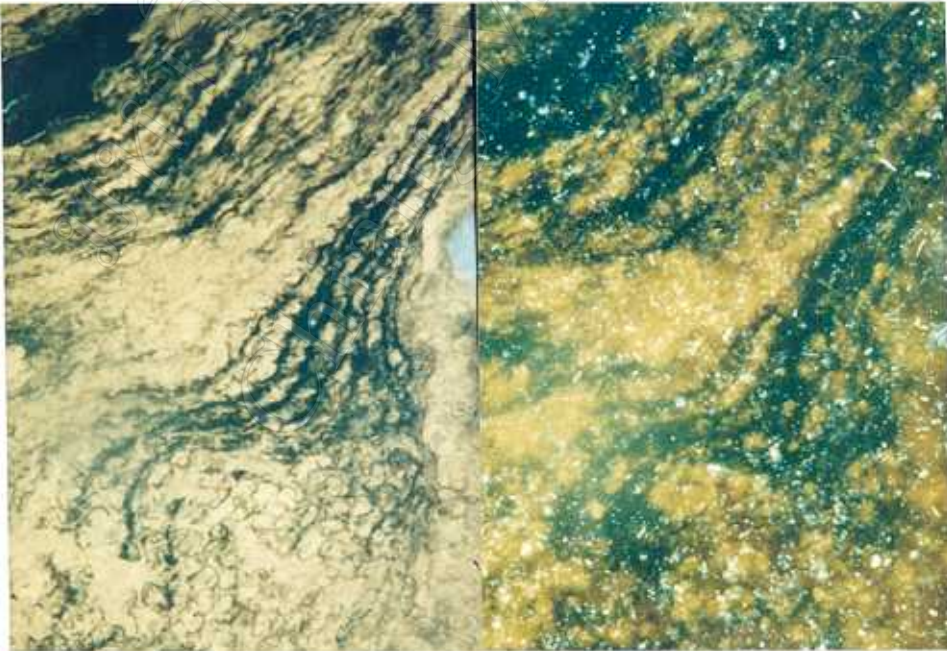


Figure 5.31 : Thick layer of suberinite, diffuse in texture, significant degrading at measure depth 4200 ft to 4320 ft (left) under oil-fluorescence light (right) under oil-white light (10x50).

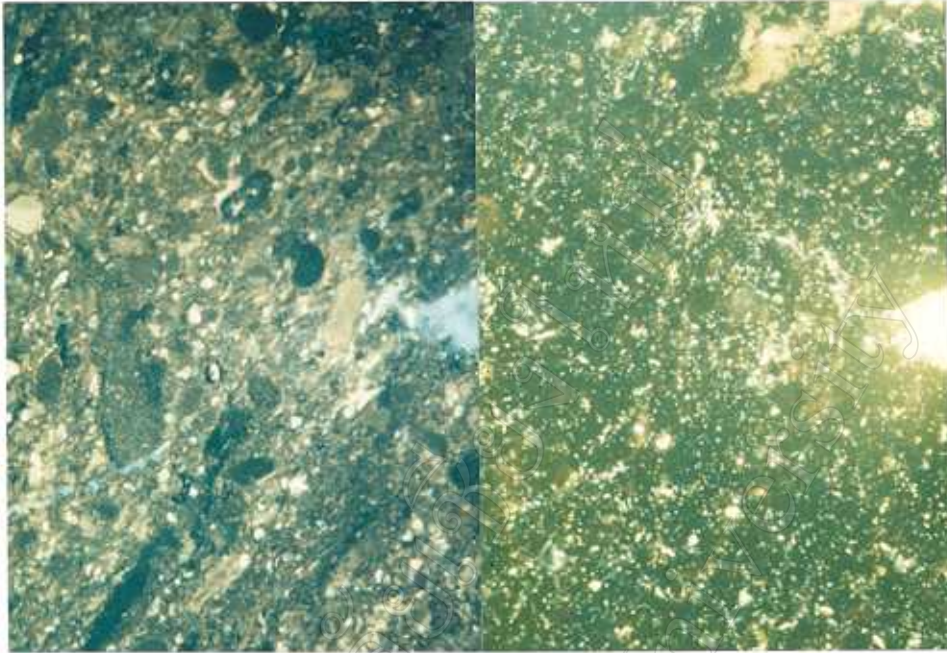


Figure 5.32 : Liptodetrinite as a groundmass, bituminite (brown) indicated degrading at -4218.9 ft to -4292.8 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

D: well

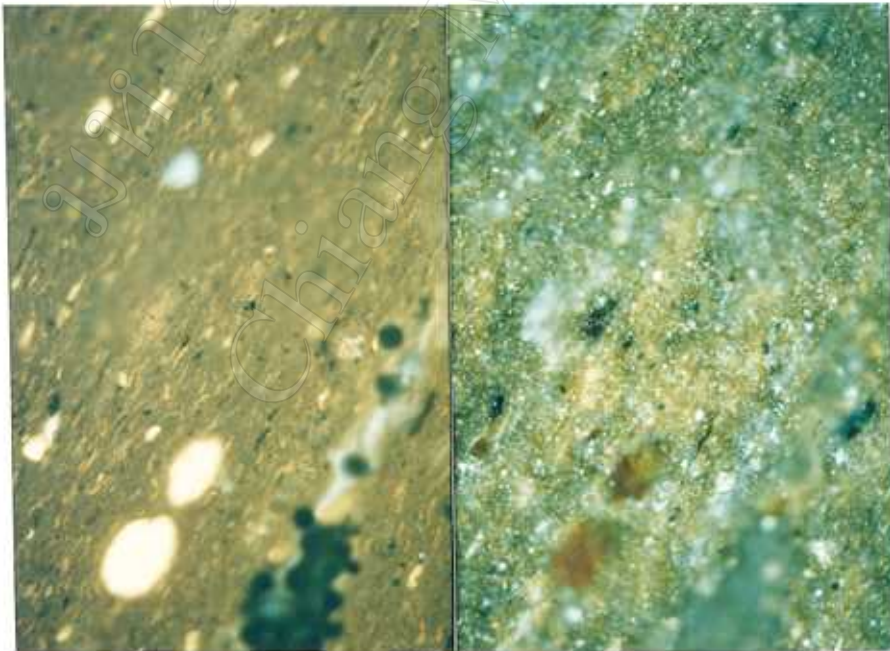


Figure 5.33 : Oil shale has lamaginite or alginite B rich, Alginite A (bright yellow) at -3234.7 ft to -3384.7 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

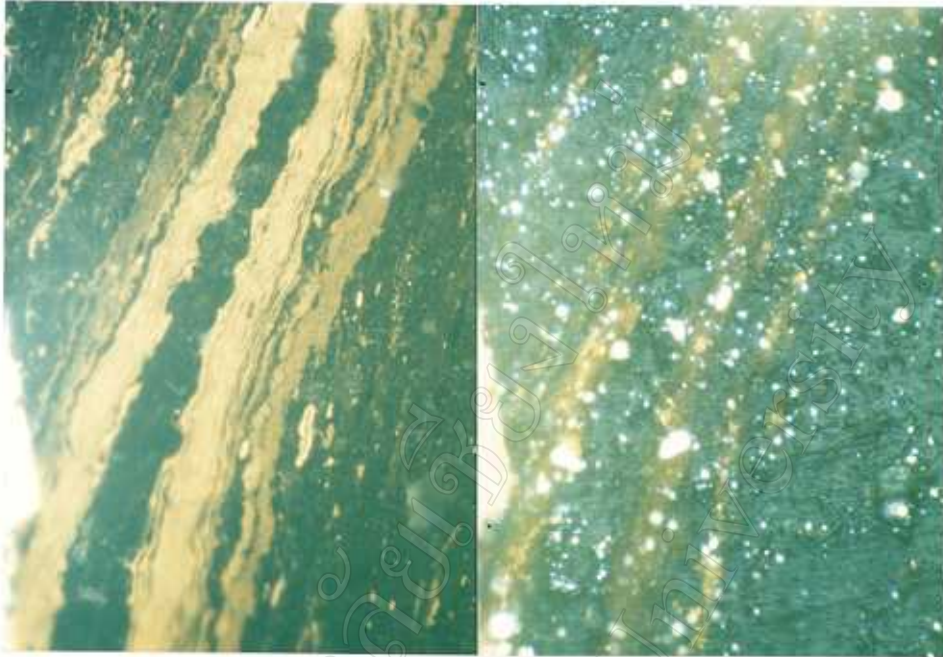


Figure 5.34 : suberinite band, sporinite, and liptodetrinite at -3984.5 ft to -4134.3 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

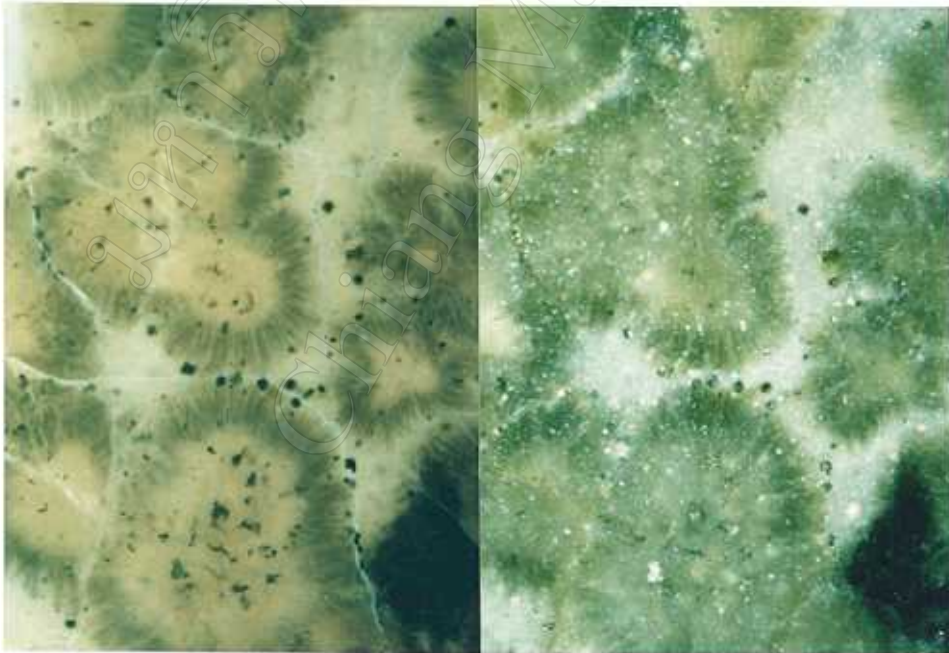


Figure 5.35 : Alginite A (?) as an unidentified type or clay flocculate impregnated by exsudatinite show radial ring layer and oxidation rim (brown) at -5933.3 ft to -6047.3 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

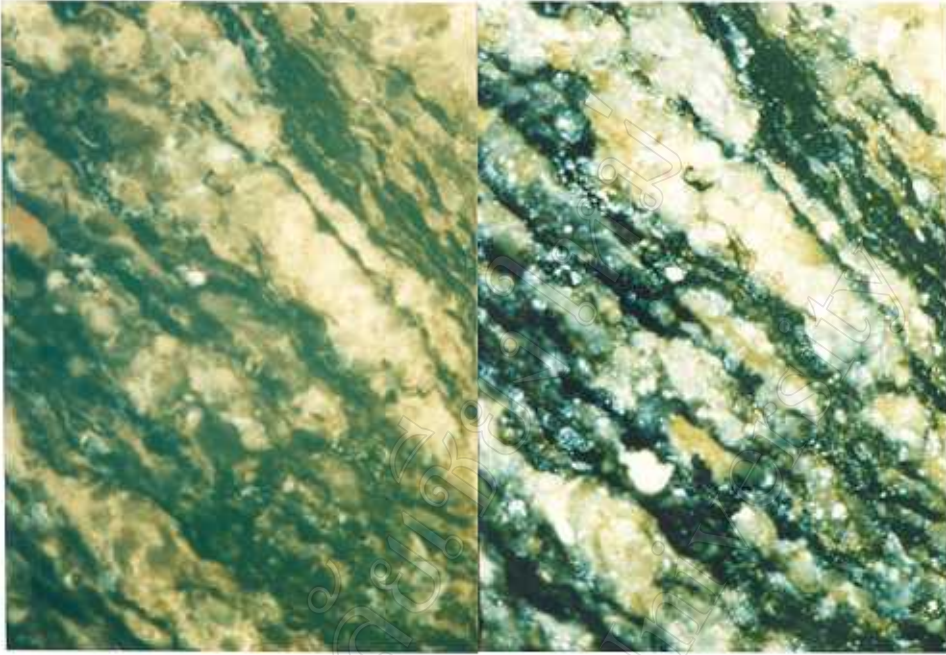


Figure 5.36 : Sapropelic coal has high liptinite content show degrading state, gelinite has exsudatinite fill in crack, and quartz grains at -6047.3 ft to -6163.7 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

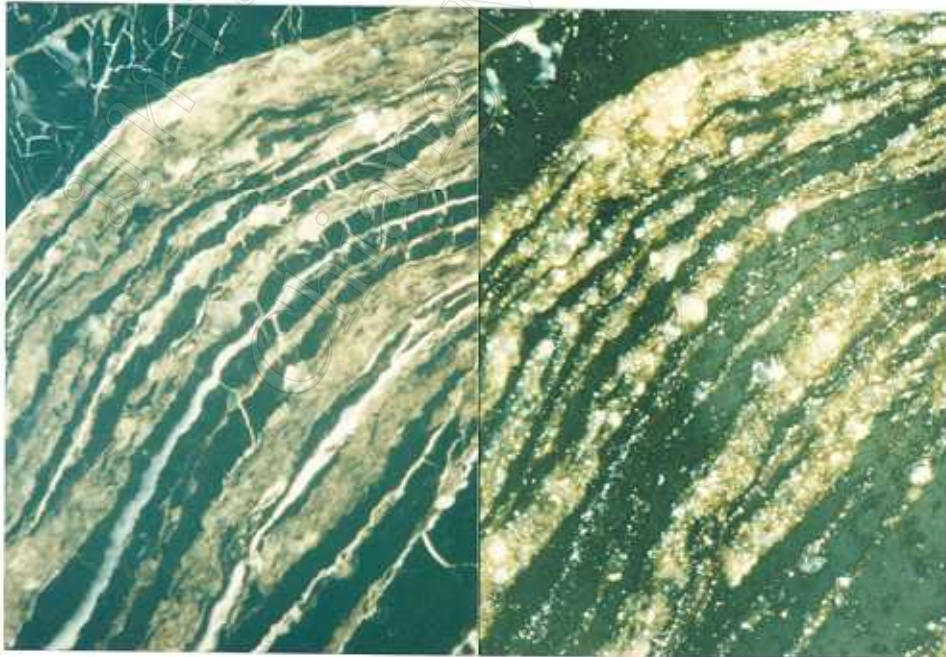


Figure 5.37 : Sapropelic coal has huminite and exsudatinite impregnated in clay grain displayed yellow color at -6771.1 ft to -6897.6 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

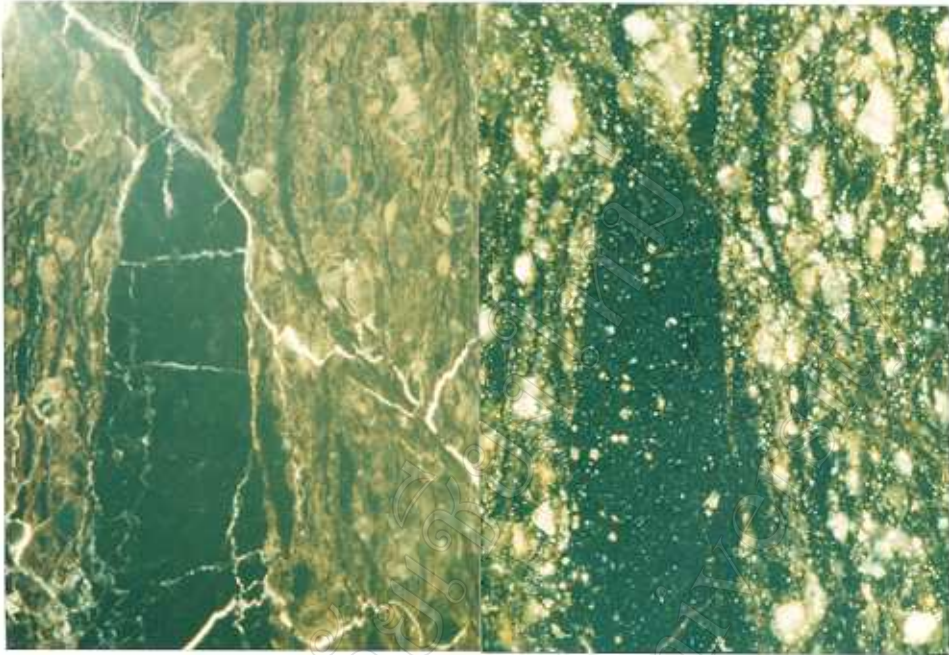


Figure 5.38 : Sapropelic coal of high liptinite content shows degrading, in gelinite coal, exsudatinite impregnate, quartz grains at -7024.2 ft to -7154.6 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

E well

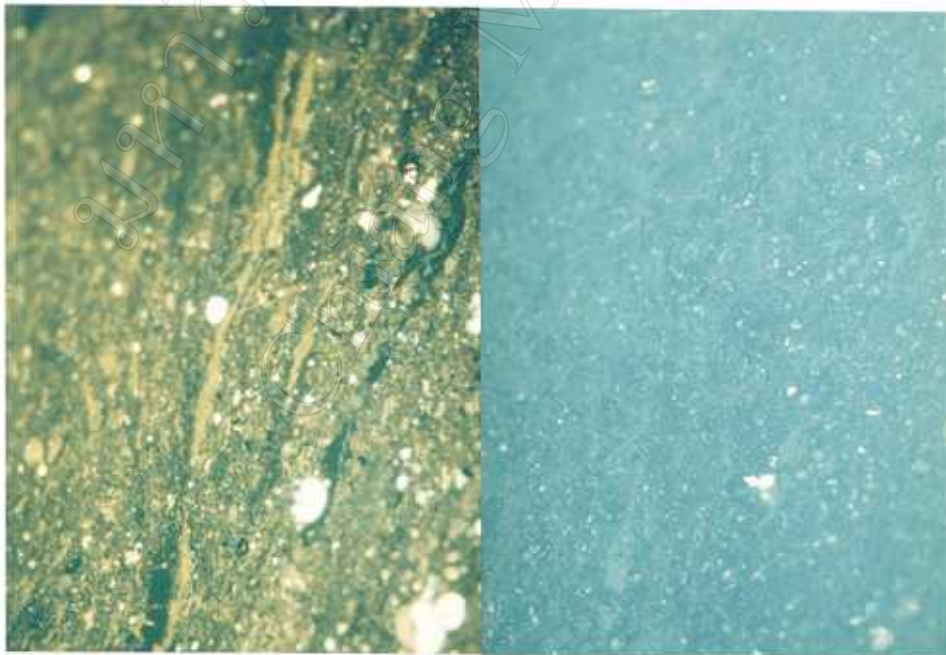


Figure 5.39 : Sapropelic coal of high liptinite content show degrading liptodetrinite and resinite body at -3190.0 ft to -3340.0 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

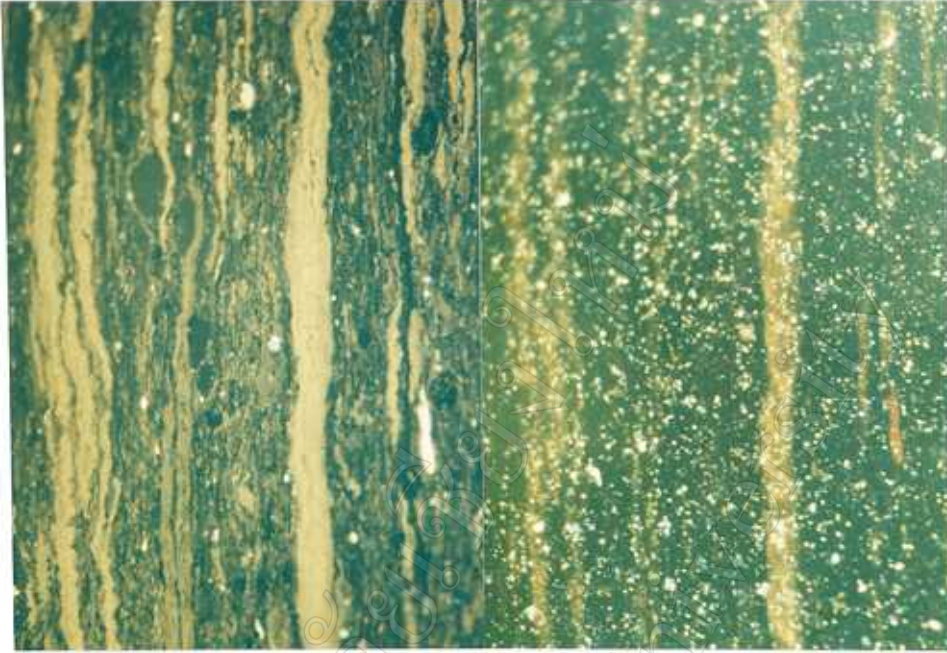


Figure 5.40 : Thick band of lamagenite and liptodetrinite as groundmass, resinite (bright yellow), bituminite (brown) at -3340.0 ft to -3490.0 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

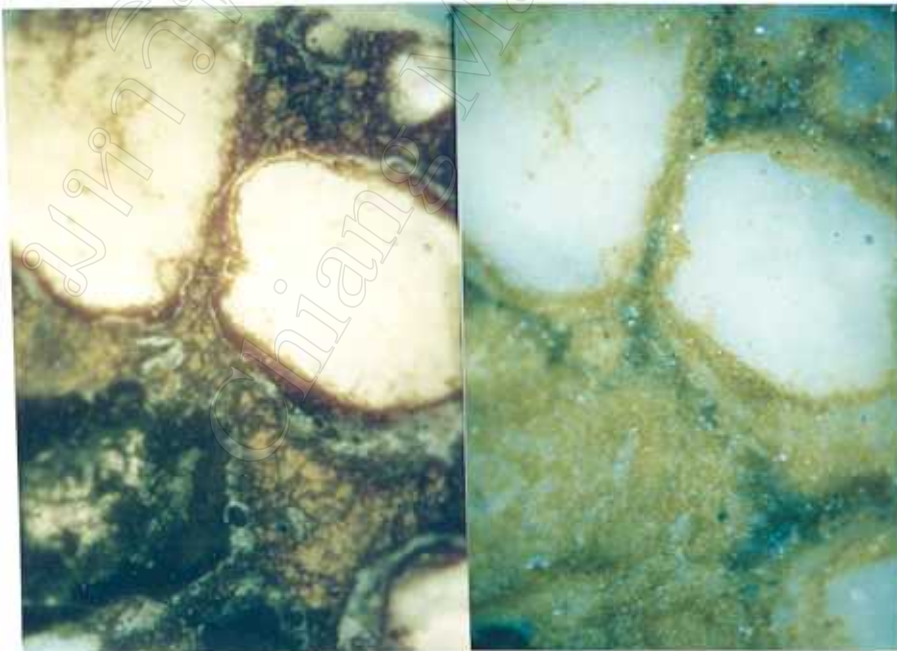


Figure 5.41 : Exsudatinite impregnated in clay grains displayed pale green color and show zoning, surround by liptodetrinite at -3939.7 ft to -4088.2 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

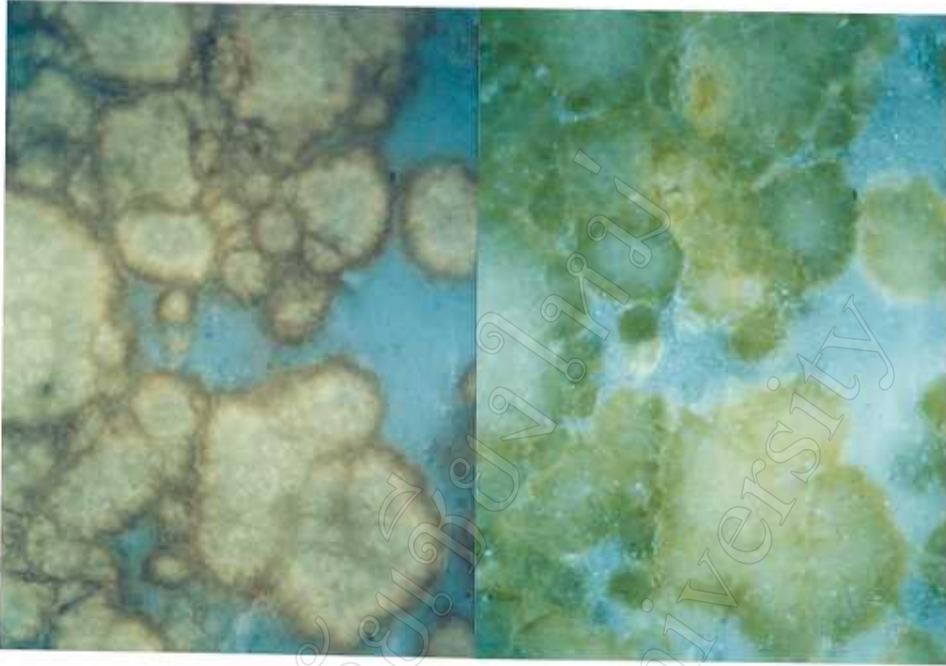


Figure 5.42 : Alginite A (?) as an unidentified type at -4376.8 ft to -4515.1 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

F well

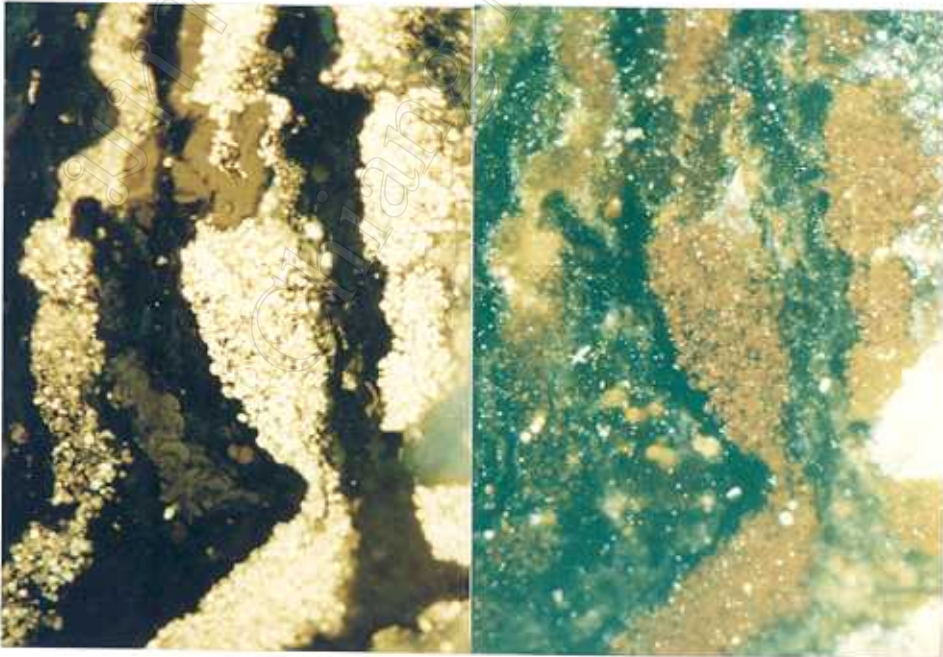


Figure 5.43 : Resinite trap at -3670.0 ft to -3790.9 ft (left) under oil-fluorescence light (right) under oil-white light (10x50).

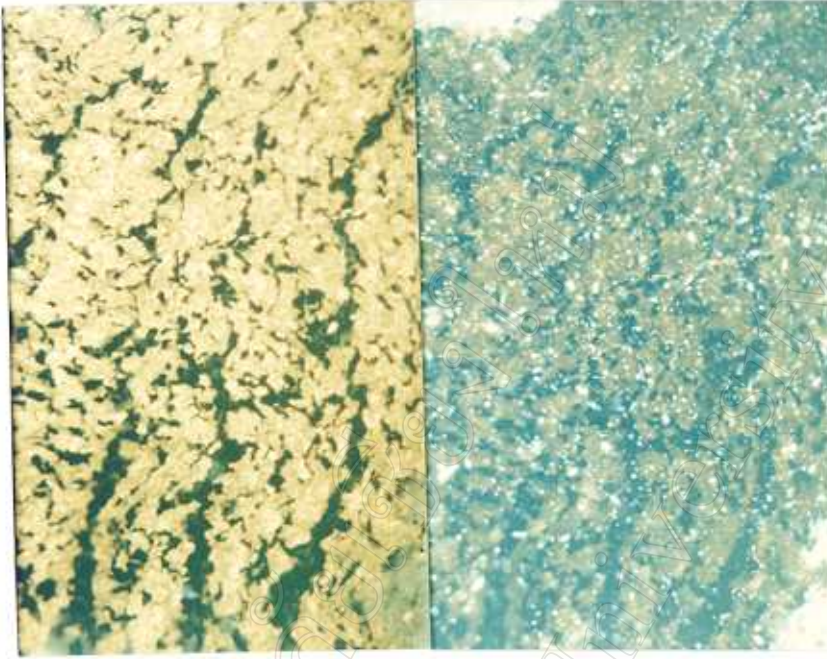


Figure 5.44 : Suberinite band at -4031.2 ft to -4150.1 ft (left) under oil-fluorescence light (right) under oil-white light (10x50).

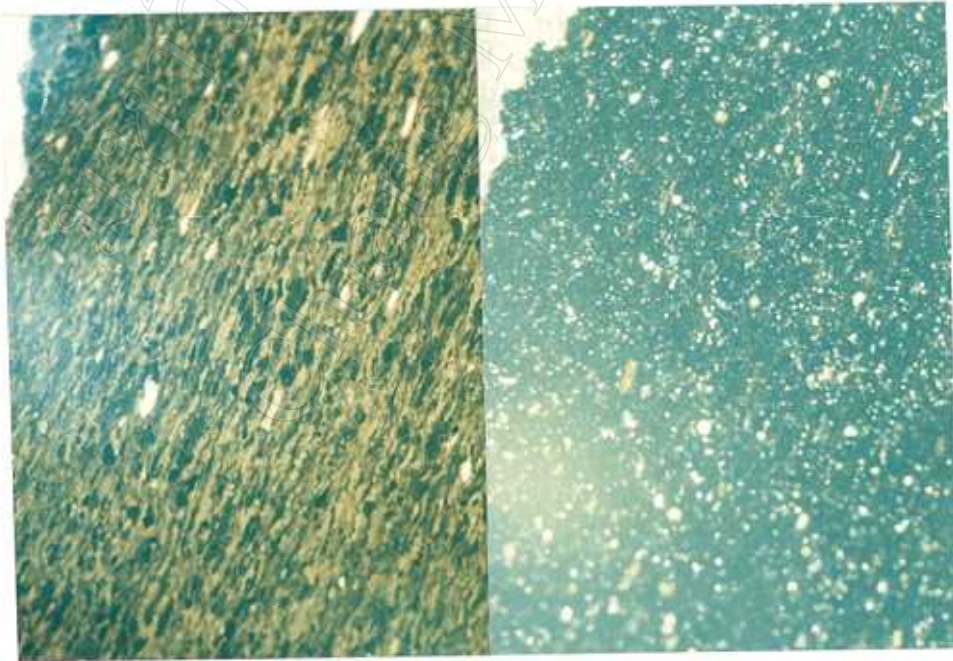


Figure 5.45 : Alginite B degrading as groundmass, sporinite at -3670 ft to -3790.9 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

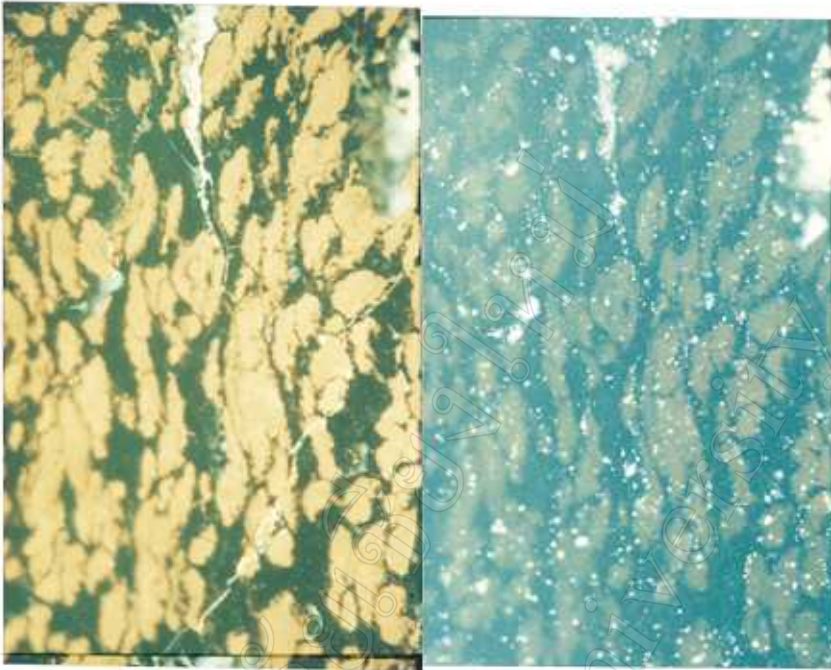


Figure 5.46 : Alginite A mass at -4268.9 ft to -4389.7 ft (left) under oil-fluorescence light (right) under oil-white light (10x50).

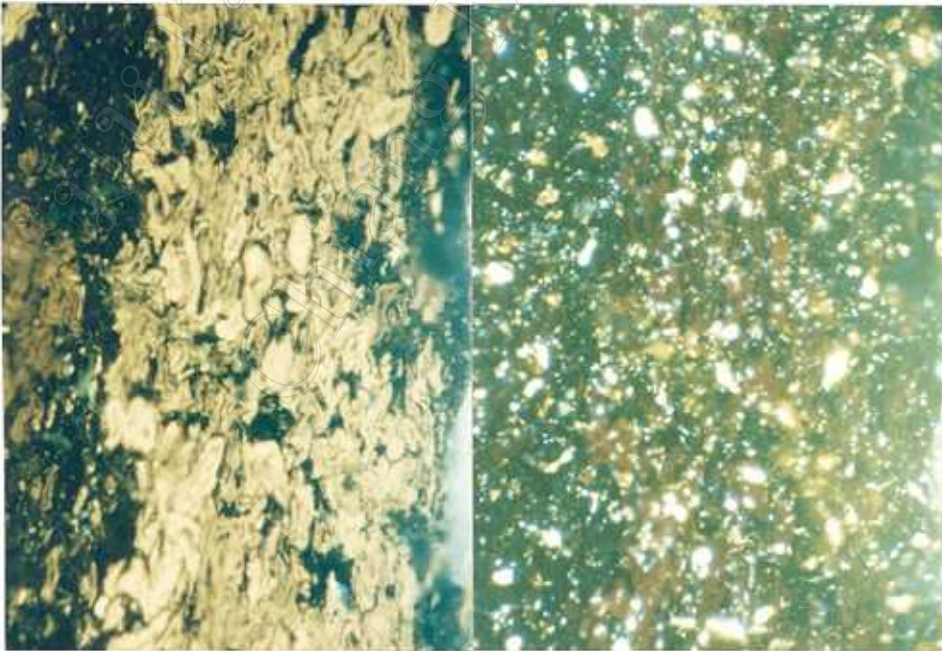


Figure 5.47 : Mass of sporinite in cannel coal at -3183.7 ft to -3305.6 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

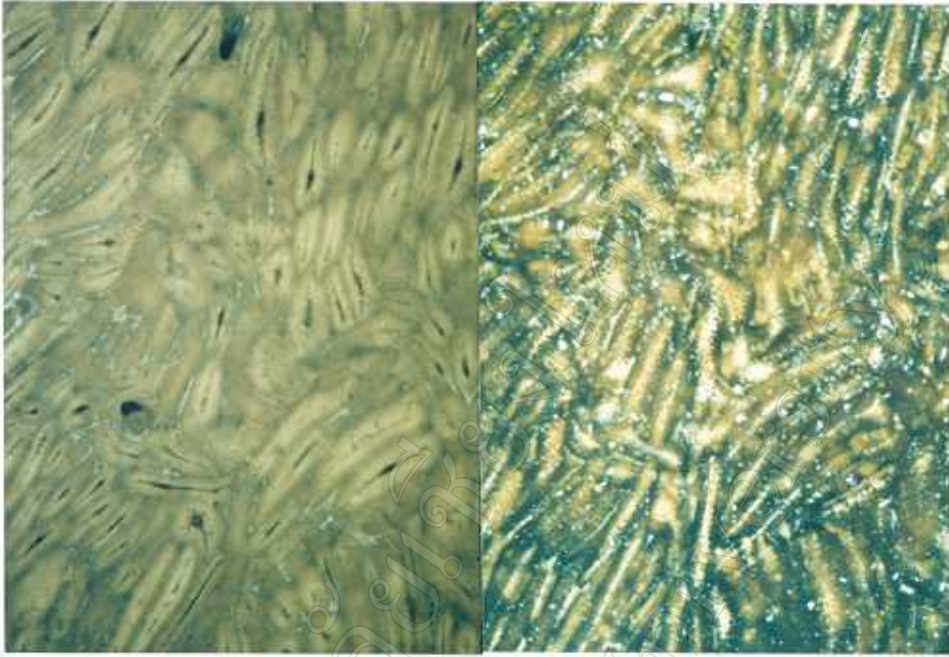


Figure 5.48 : Alginite A (?) at -6040.1 ft to -6169.5 ft (left) under oil-fluorescence light (right) under oil-white light (10x50).

G well

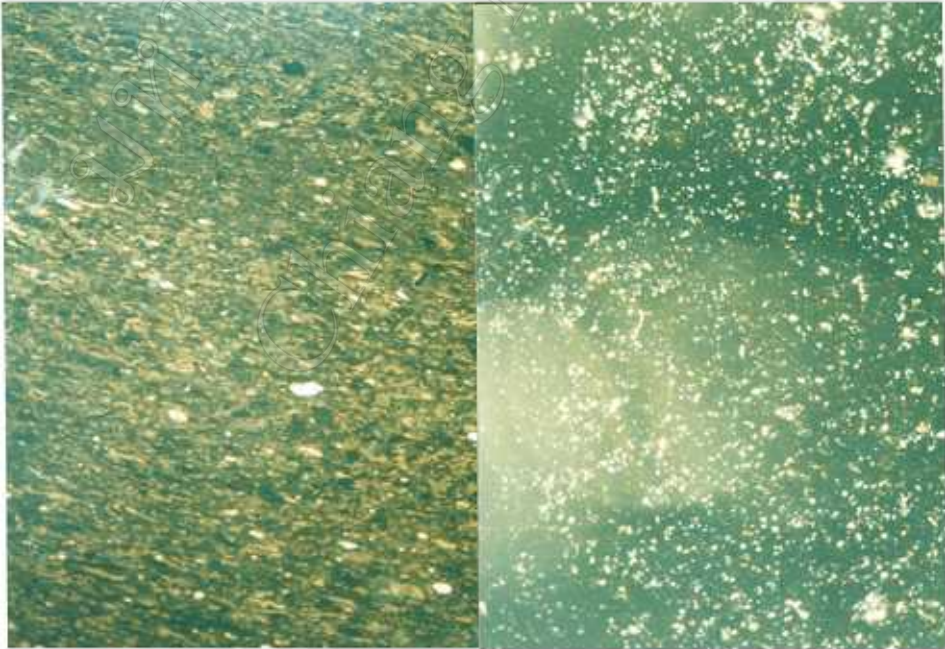


Figure 5.49 : Lamaginite or alginite B, resinite body (bright yellow) at -2984.5 ft to -3080.1 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

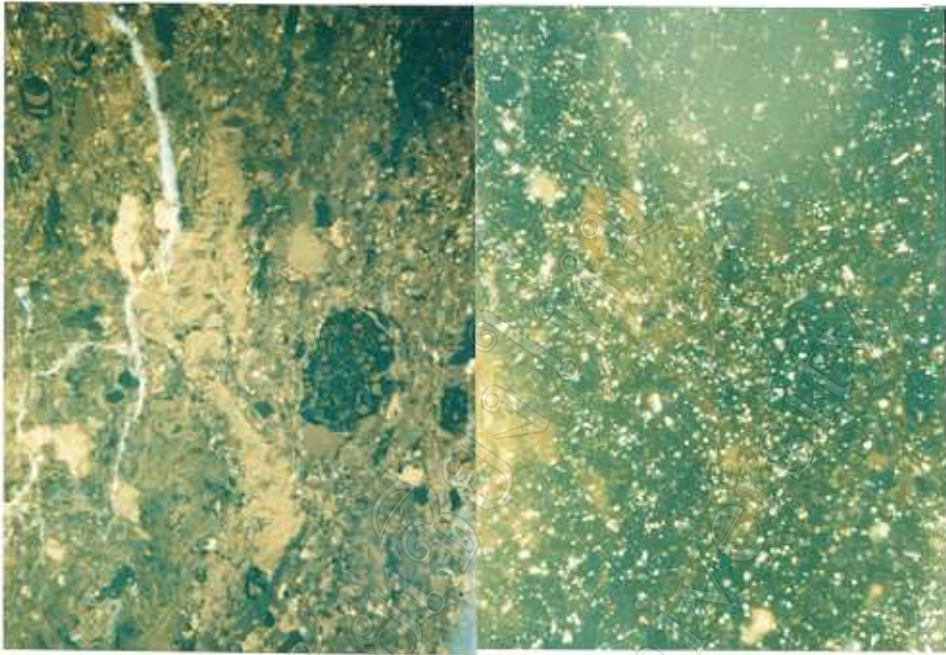


Figure 5.50 : Sapropelic coal of high liptinite content shows degrading, exsudatinites filling in cell cavity of sclerotinite at -3516.7 ft to -3634.6 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

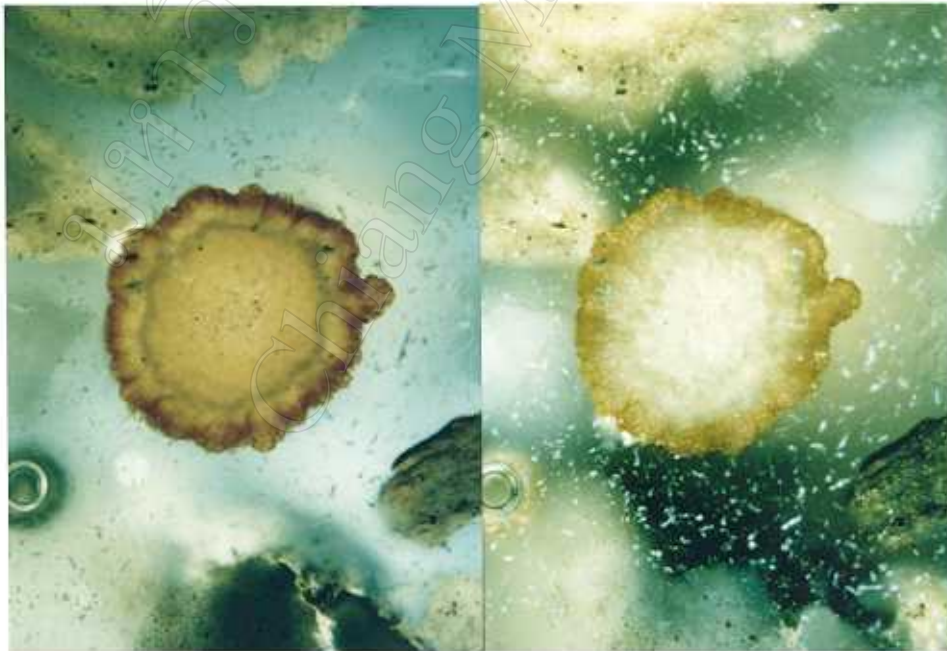


Figure 5.51 : Alginite A(?) and clay flocculate impregnated by exsudatinites show ring layer at -3753.2 ft to -3871.4 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

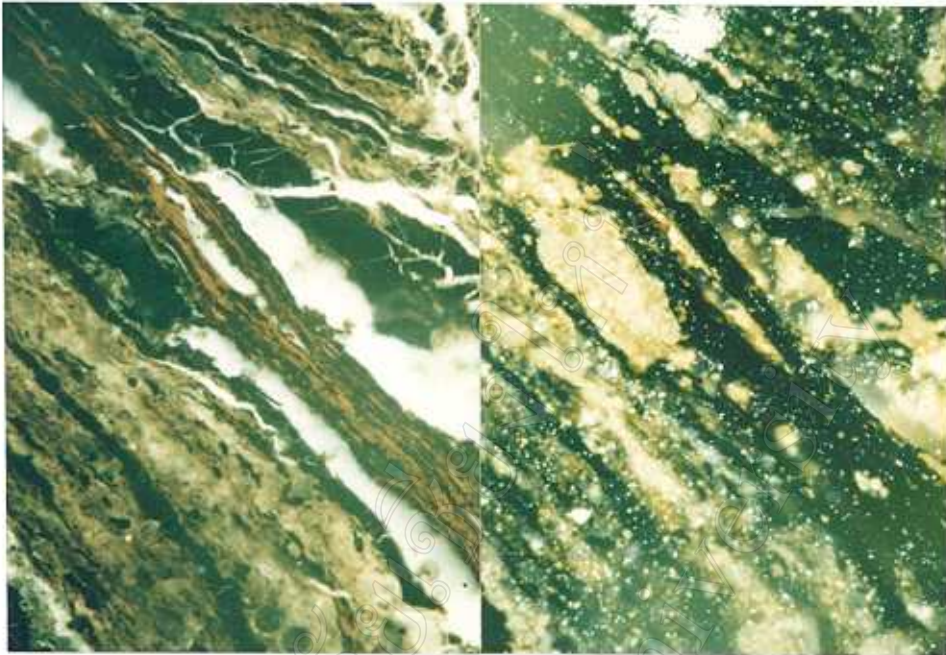


Figure 5.52 : Sapropelic coal of high liptinite content shows degrading, exsudatinite impregnated and interbedded, huminite maceral; gelinite type, and quartz grain, at -5195.9 ft to -5306.6 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

H — well

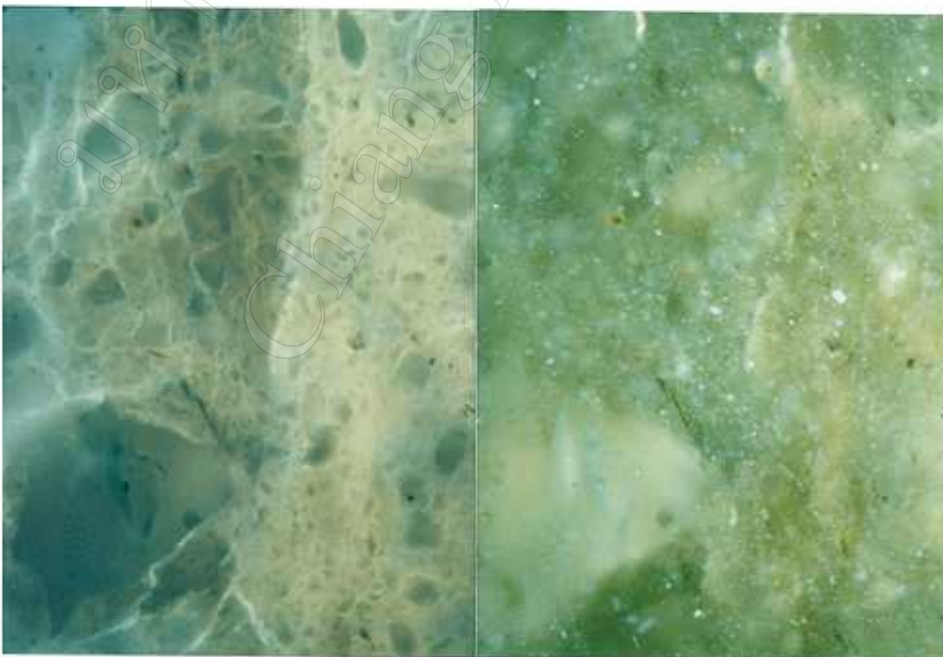


Figure 5.53 : Exsudatinite impregnated in quartz grains displayed yellow to deepest yellow at -8064.3 ft to -8199.1 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

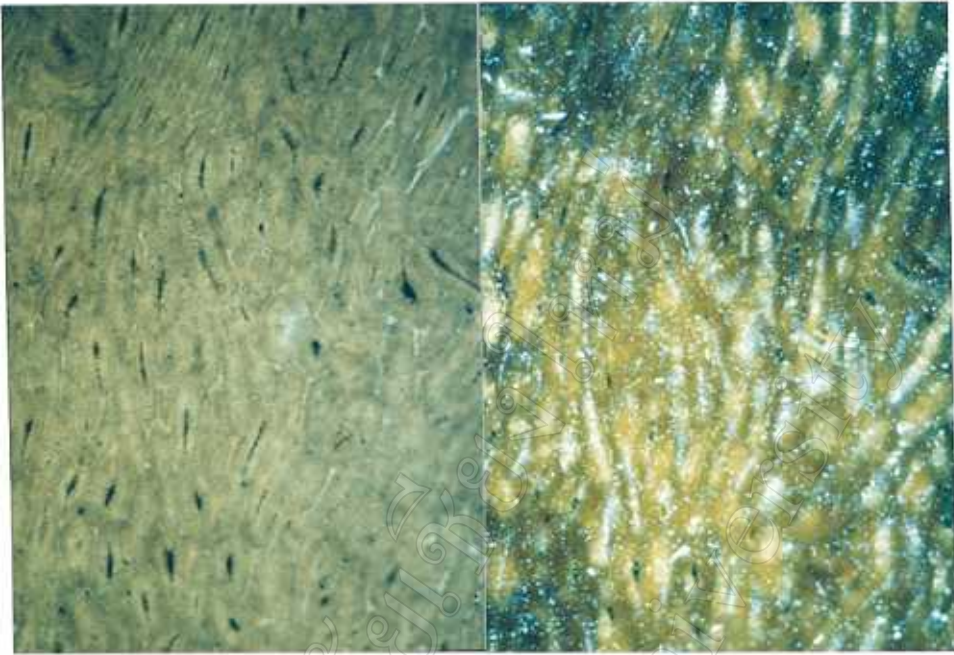


Figure 5.54 : Alginite A (?) at -9020.7 ft to -9159.0 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

I well

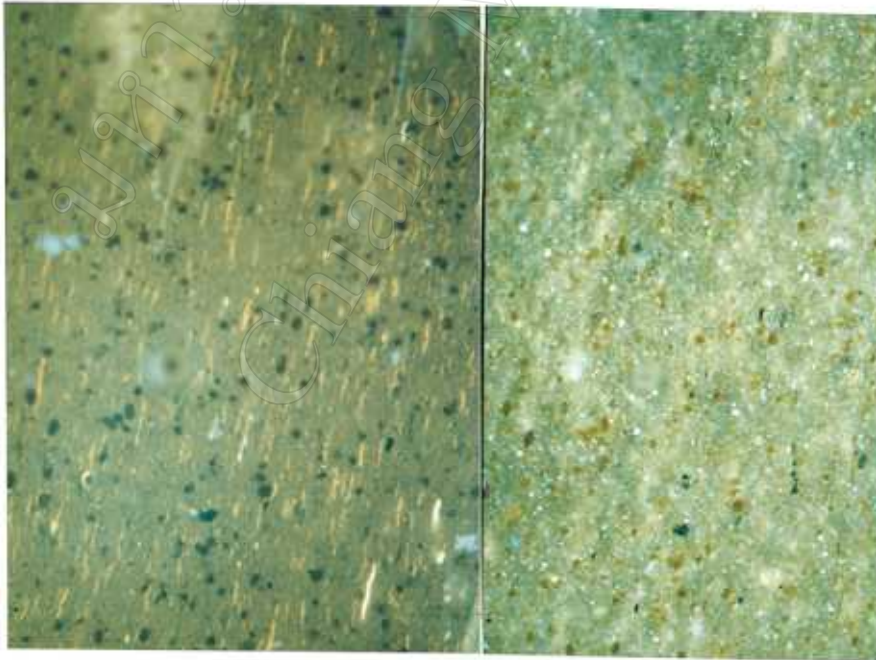


Figure 5.55 : Oil shale has laminites rich at -3437.4 ft to -3542.1 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

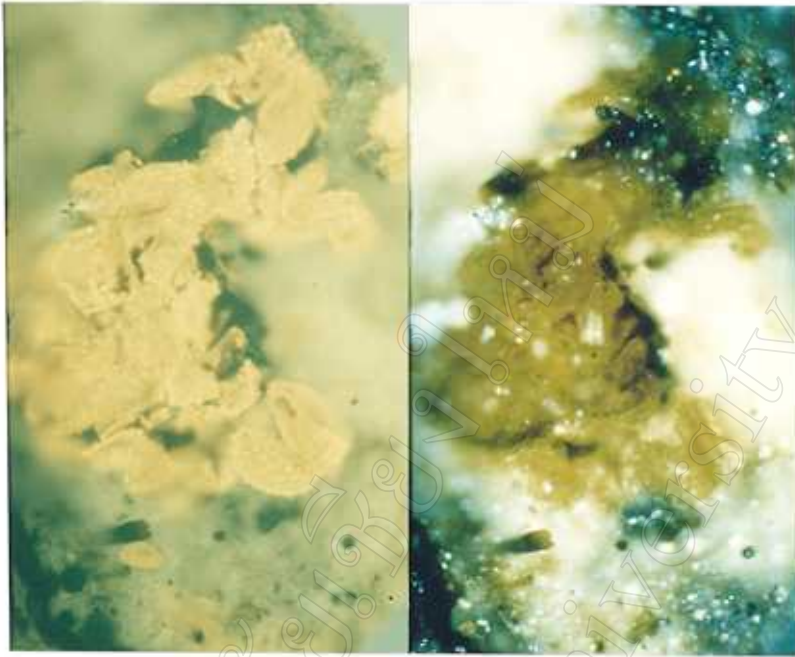


Figure 5.56 : Mass of sporinite at -3642.8 ft to -3738.0 ft (left) under oil-fluorescence light (right) under oil-white light (10x50).

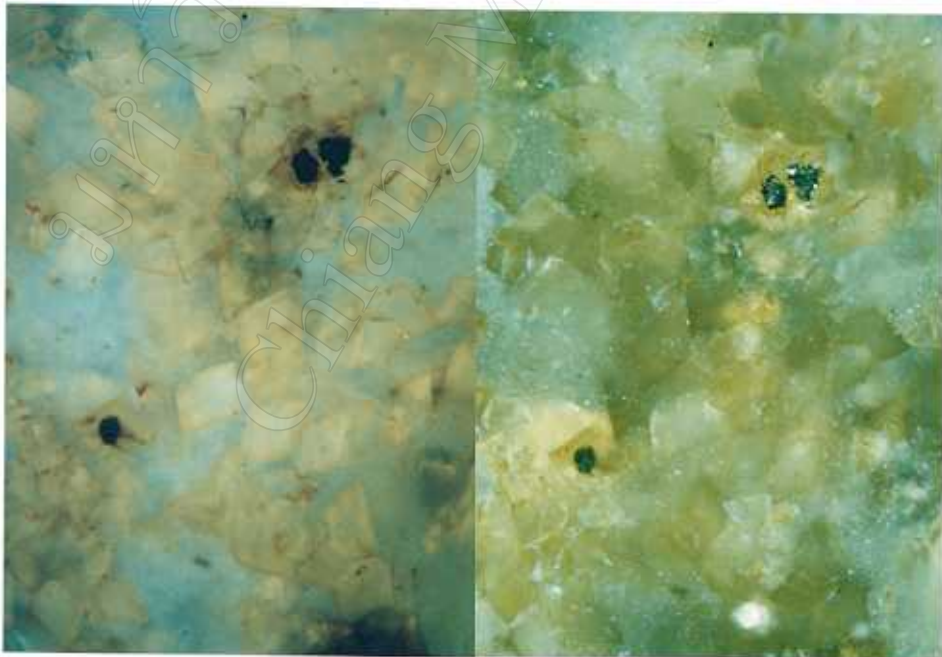


Figure 5.57 : Exsudatinite impregnated in carbonate crystals displayed yellow color at -5312.9 ft to -5418.7 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

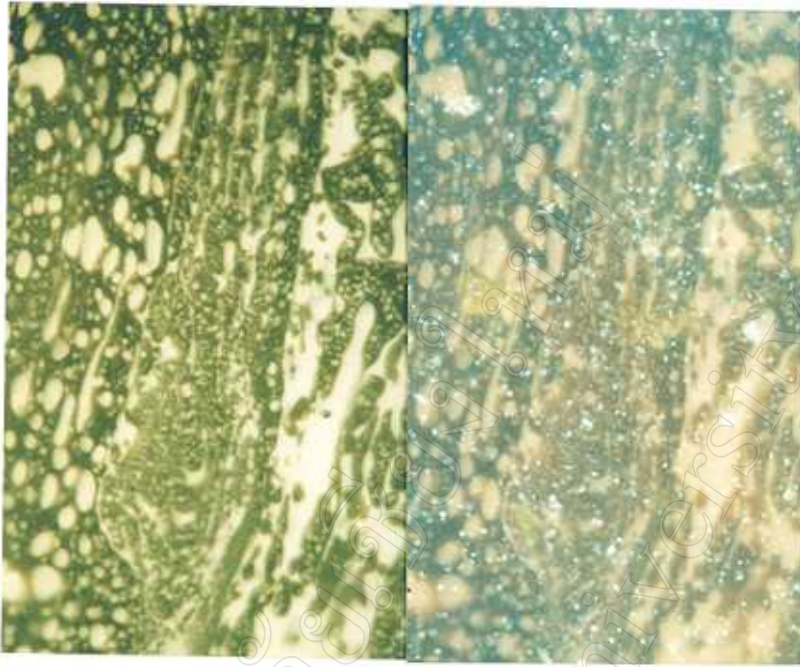


Figure 5.58 : Liptinite maceral; exsudatinite and liptodetrinite type at -3642.8 ft to -3738.0 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

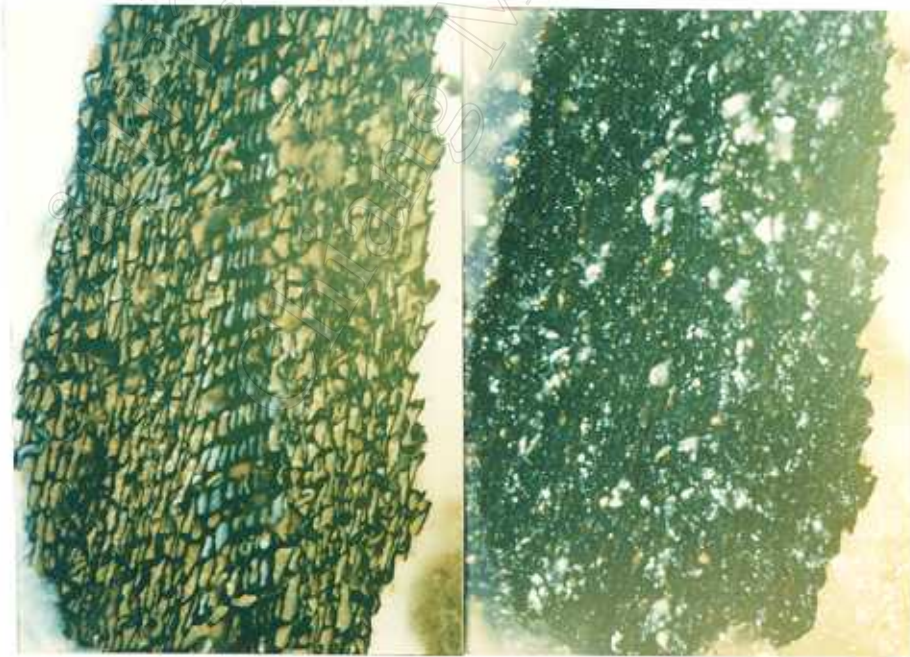


Figure 5.59 : Textinite with exsudatinite filling in cell cavity at -9243.9 ft to -9378.7 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

J well

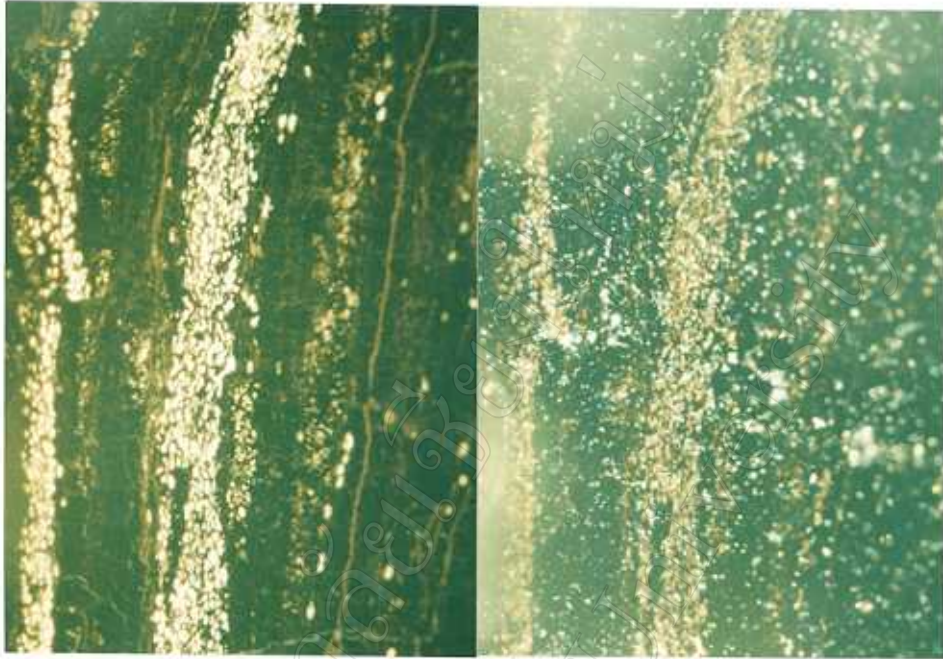


Figure 5.60 : Resinite trapped between cutinite, exsudatinite filled in cracks of gelinite at -2572.8 ft to -2706.0 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

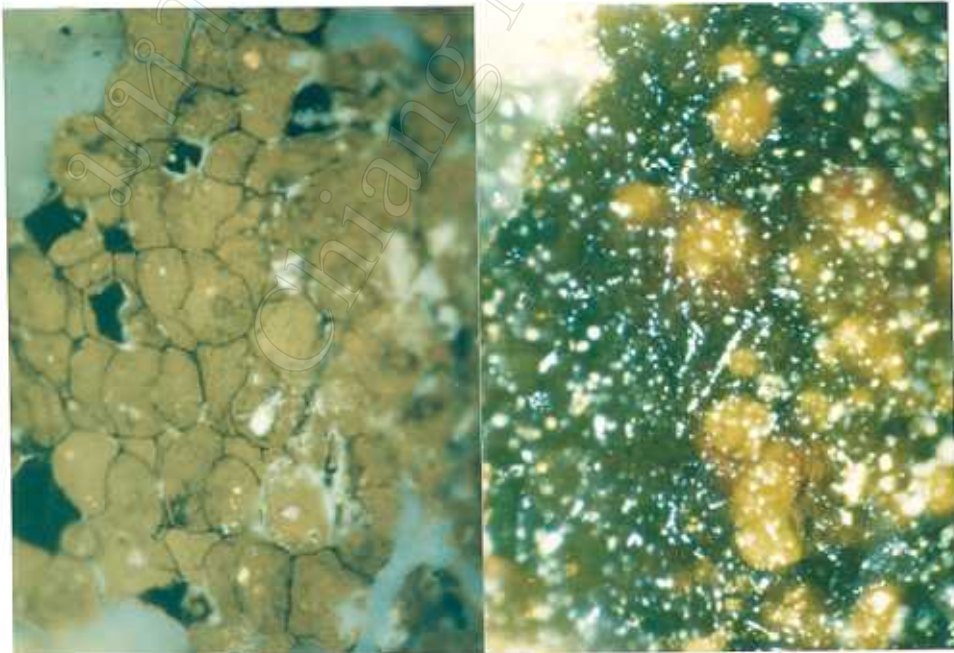


Figure 5.61 : Exsudatinite filled in ulminite at -3512.7 ft to -3647.4 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).

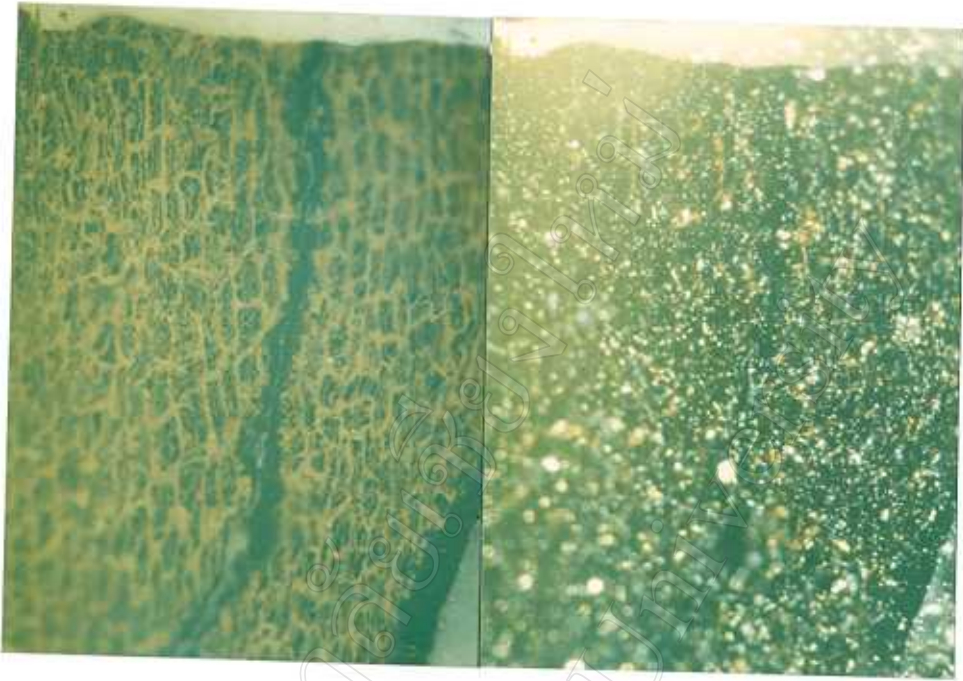


Figure 5.62 : Suberinite show clear structure at -3512.7 ft to -3647.4 ft (left) under oil-fluorescence light (right) under oil-white light (10x20).