

# **ANALYTICAL REPORT**

## **SOURCE ROCK ORGANIC MATTER REFLECTANCE AND TYPING**

**CODY 1**

**PREPARED FOR  
WA DEPARTMENT OF MINES,  
INDUSTRY REGULATION AND SAFETY**

**NOVEMBER 2021**



Energy Resources Consulting Pty Ltd  
PO Box 54  
Coorparoo, Qld 4151  
Australia

## SOURCE ROCK ORGANIC MATTER REFLECTANCE AND TYPING

### INTRODUCTION

Samples were received (see table below) to be evaluated for the reflectance of organic matter (vitrinite where possible) as well as an assessment of the types of organic matter present. If HAWK pyrolysis was also requested, the equivalent sample number is also indicated. HAWK data are reported separately.

ERC Sample No.		Company Reference	Sample Type	Other information
V <sub>r</sub>	HAWK			
E4511	HWA4511	237765	Cuttings	2902 - 2905 m
E4512	HWA4512	237766	Cuttings	2944 - 2947 m
E4513	HWA4513	237767	Cuttings	3007 - 3013 m
E4514	HWA4514	237768	Cuttings	3025 - 3028 m
E4515	HWA4515	237769	Cuttings	3145 - 3148 m

### METHODS

Sample preparation methods may vary slightly depending upon whether core/ outcrop or cuttings were received.

With core and outcrop samples, a flat face perpendicular to bedding is prepared by grinding. This is placed in a 30 mm diameter mould along with several randomly oriented grains. The whole is mounted in epoxy resin.

With cuttings, the samples are passed through a 2 mm sieve and where necessary are gently cracked in a mortar and pestle. This is then mounted in epoxy resin.

The epoxy resin mounted samples are polished using a variety of wet and dry papers, diamond polishing compounds and colloidal silica. The polished samples are dried in a desiccator for a minimum of 12 hours prior to analysis.

Analysis is made using a Leica MP4500P system with Hilgers DISKUS software. A mechanical stage is used to traverse the sample in a regular pattern. Mean maximum reflectance in oil of the organic matter is determined by rotating the microscope stage. Reflectance is determined of a 2  $\mu\text{m}^2$  area at 546nm using a total magnification of 500X.

A visual estimation of organic matter types and abundances was also made using comparison charts under both reflected and blue light excitation. The categories used are:

Descriptor	%
Absent	0
Rare	<0.1
Sparse	0.1 < x < 0.5
Common	0.5 < x < 2.0
Abundant	2.0 < x < 10.0
Major	10.0 < x < 40.0
Dominant	>40.0

The samples are also examined in blue light fluorescence using a Royal Blue LED as the excitation source.

## RESULTS

Results are tabulated as follows. Low resolution images are provided in an appendix for reference purposes. High quality images are provided in a separate image file.

### Data presentation

Individual sample results are reported in the following format:

ERC No. Client No.	Depth (ft / m)	$R_{Vmax}^{*1}$	Range <sup>*2</sup>	SD <sup>*3</sup>	N <sup>*4</sup>
x1234	3106 $R_I^{*5}$ Alginite <sup>*5</sup> Bitumen <sup>*5</sup>	0.79	0.64 - 0.91	0.145	25

\*1 Mean of all the maximum reflectance readings obtained.

\*2 Lowest Rmax and highest Rmax of the population considered to represent the first generation vitrinite population.

\*3 Standard Deviation

\*4 Number of fields measured (Number of measurements = 2N because 2 maximum values are recorded for each field)

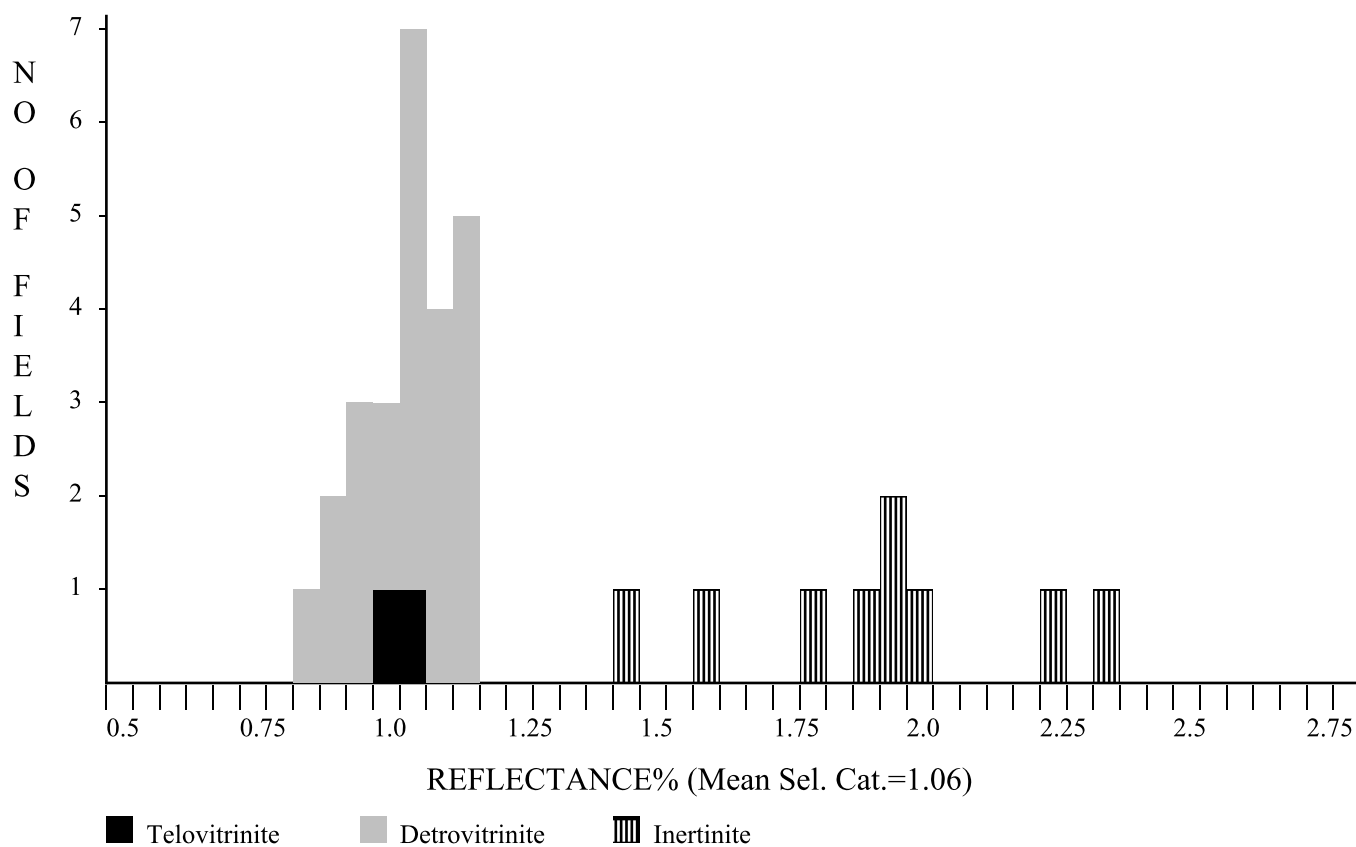
\*5 Reflectance of multiple vitrinite populations or of other organic matter types.  $R_I$  = Inertinite mean maximum reflectance etc; subscripts may be expanded as necessary.

HAWK data, where requested, are reported separately in spread sheet format.

Note that if samples are retained by ERC, they will be held for at least 12 months after reporting but may be discarded after that date.

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA						
Sample# Client ref.	Depth (m)	$\overline{R}_{vmax}$	Range	SD	N	Sample description including liptinite fluorescence, maceral abundances, mineral fluorescence CODY 1 GSWA# 237765
E4511 237765 Ctgs	2902-2905 $\overline{R}_I$	1.06 2.05	0.89-1.19 1.46-3.05	0.083 0.423	25 10	Sparse sporinite and rare liptodetrinite dull orange to weak brown, rare cutinite dull orange to weak brown. (Claystone>argillaceous siltstone>coarse siltstone>coal. Coal rare, V, vitrite. Dom abundant, I>L>V. Inertinite abundant, liptinite sparse common, vitrinite sparse. Mineral fluorescence patchy weak orange. Iron oxides common. Pyrite sparse.) GSWA# 237766
E4512 237766 Ctgs	2944-2947 $\overline{R}_I$	1.09 1.99	0.98-1.21 1.52-2.70	0.071 0.352	13 10	Sparse sporinite and rare liptodetrinite dull orange to weak brown, rare cutinite dull orange to weak brown. (Fine claystone>argillaceous siltstone. Dom abundant, I>L>V. Inertinite abundant, liptinite sparse, vitrinite rare. Fluorescing mineral matter may have masked weak fluorescing liptinite and actual liptinite content of the sample could be higher than the assessed value. Mineral fluorescence patchy weak orange. Iron oxides rare. Pyrite sparse.) GSWA# 237767
E4513 237767 Ctgs	3007-3013 $\overline{R}_I$	1.07 2.11	0.91-1.24 1.35-3.41	0.084 0.467	17 20	Sparse to common acritarchs and sparse liptodetrinite orange to dull orange, rare lamalginite dull orange to weak brown. (Calcareous claystone>carbonate>argillaceous siltstone. Dom common, I>L>V. Inertinite and liptinite common, vitrinite rare to sparse. Acritarch <i>Michrystidium</i> species present. Mineral fluorescence patchy weak to moderate orange. Iron oxides rare. Pyrite common.) GSWA# 237768
E4514 237768 Ctgs	3025-3028 $\overline{R}_I$	1.09 1.95	0.97-1.25 1.43-2.49	0.069 0.286	25 10	Sparse acritarchs and rare liptodetrinite orange to dull orange, rare to sparse lamalginite dull orange to weak brown. (Calcareous claystone>carbonate>argillaceous siltstone. Dom common, I>L>V. Inertinite common, liptinite sparse, vitrinite rare to sparse. Mineral fluorescence patchy weak to moderate orange. Iron oxides common. Pyrite abundant.) GSWA# 237769
E4515 237769 Ctgs	3145-3148 $\overline{R}_I$	1.09 1.97	0.98-1.24 1.44-2.74	0.070 0.375	16 20	Fluorescing liptinite absent. (Sandstone>siltstone>fine claystone>carbonate. Dom common, I>V. Inertinite common, vitrinite rare to sparse, liptinite absent. Mineral fluorescence patchy weak to moderate orange in fine grained sediments. Iron oxides rare. Pyrite sparse.)

GSWA, 237765, Cody 1, 2902-2905m, ctgs(E4511)

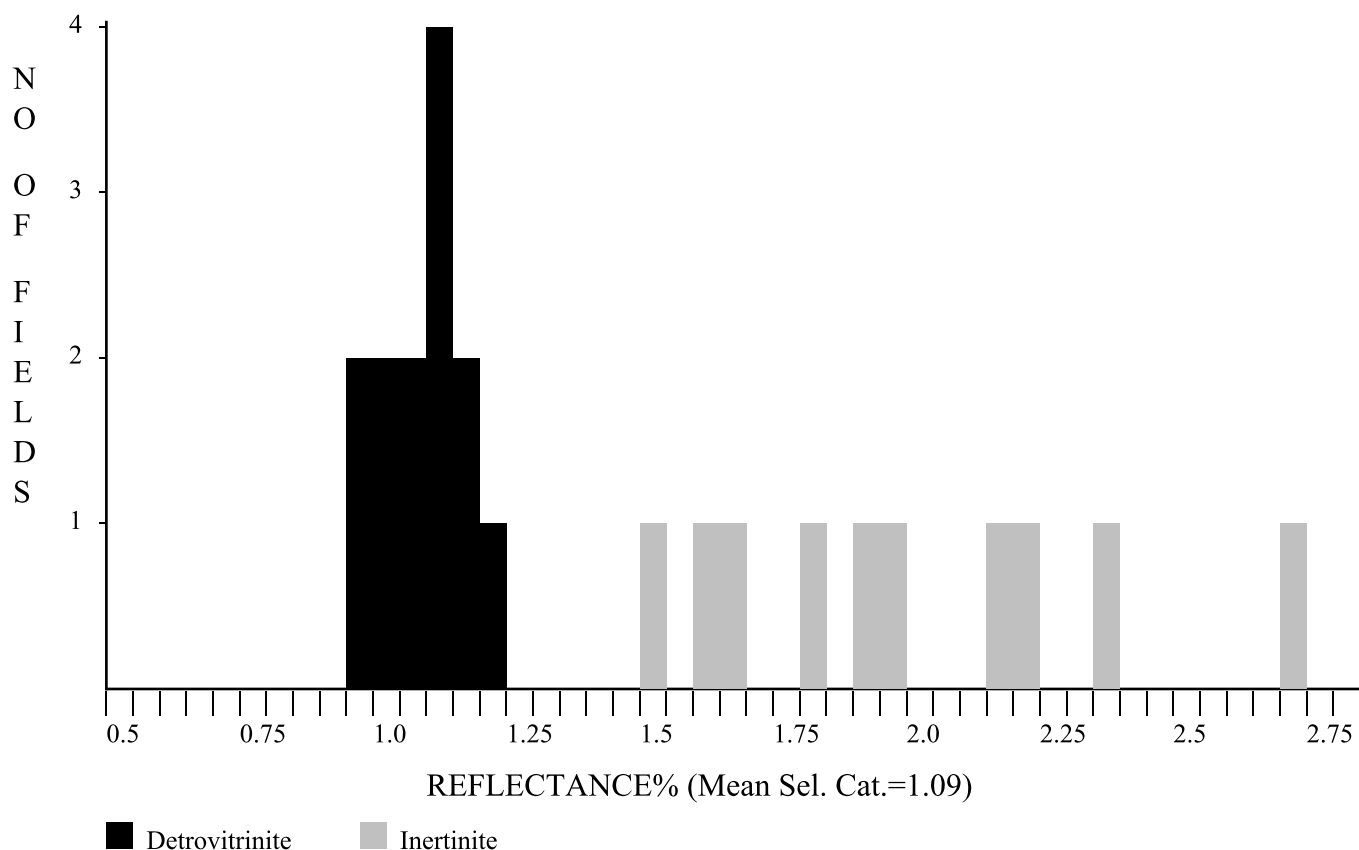


Maceral Category	N	Mean	Standard Deviation
Telovitrinite	2	1.06	0.025
Detrovitrinite	23	1.06	0.086
Inertinite	10	2.05	0.423
<b>Total</b>	<b>35</b>	<b>1.34</b>	<b>0.505</b>

Selected categories: Telovitrinite, Detrovitrinite:

No. of Readings: 25  
Mean of Selected Categories: 1.06  
Standard Deviation of Selected categories: 0.083

GSWA, 237766, Cody 1, 2944-2947m, ctgs(E4512)

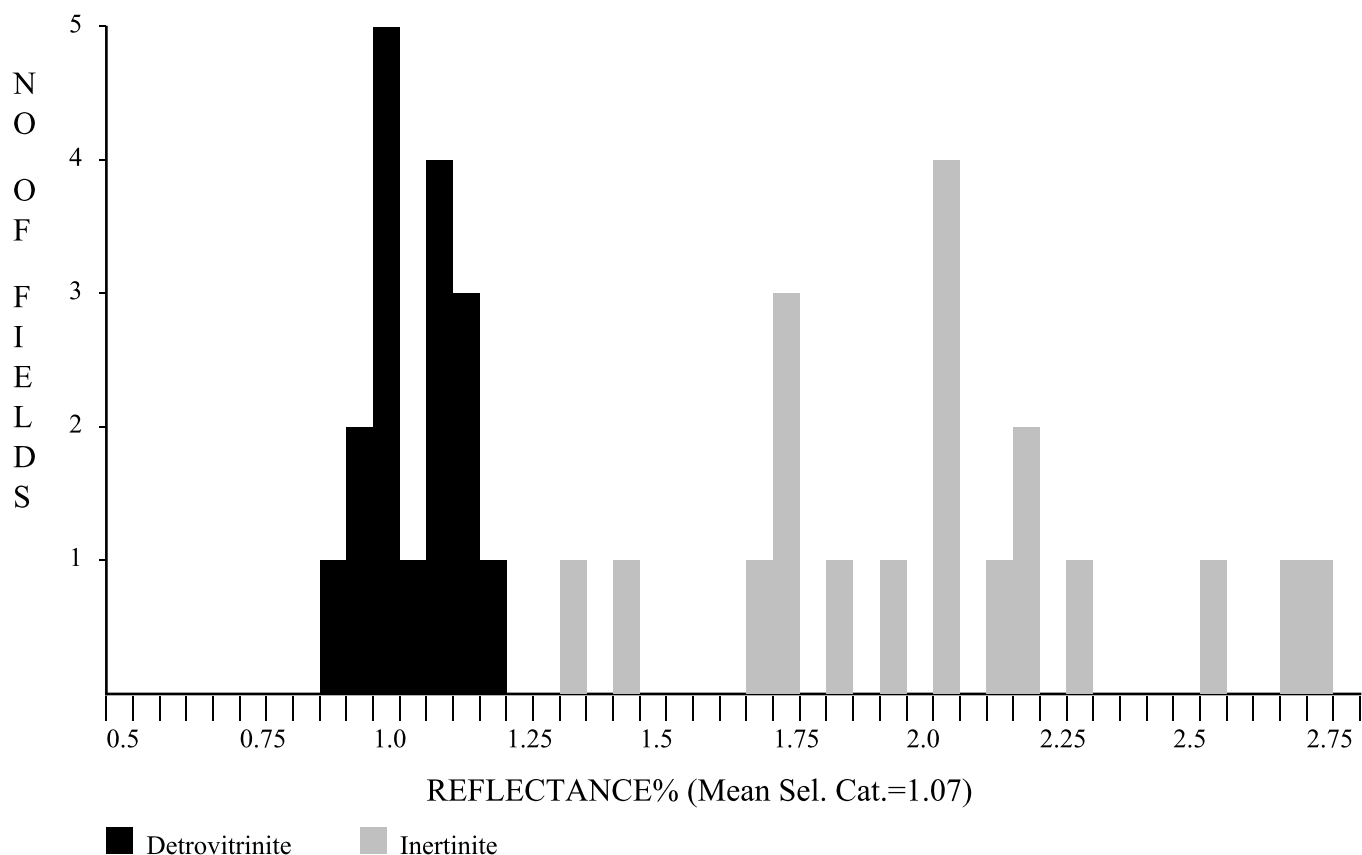


Maceral Category	N	Mean	Standard Deviation
Detrovitrinite	13	1.09	0.071
Inertinite	10	1.99	0.352
<b>Total</b>	<b>23</b>	<b>1.48</b>	<b>0.507</b>

Selected categories: Detrovitrinite:

No. of Readings: 13  
Mean of Selected Categories: 1.09  
Standard Deviation of Selected categories: 0.071

GSWA, 237767, Cody 1, 3007-3013m, ctgs(E4513)

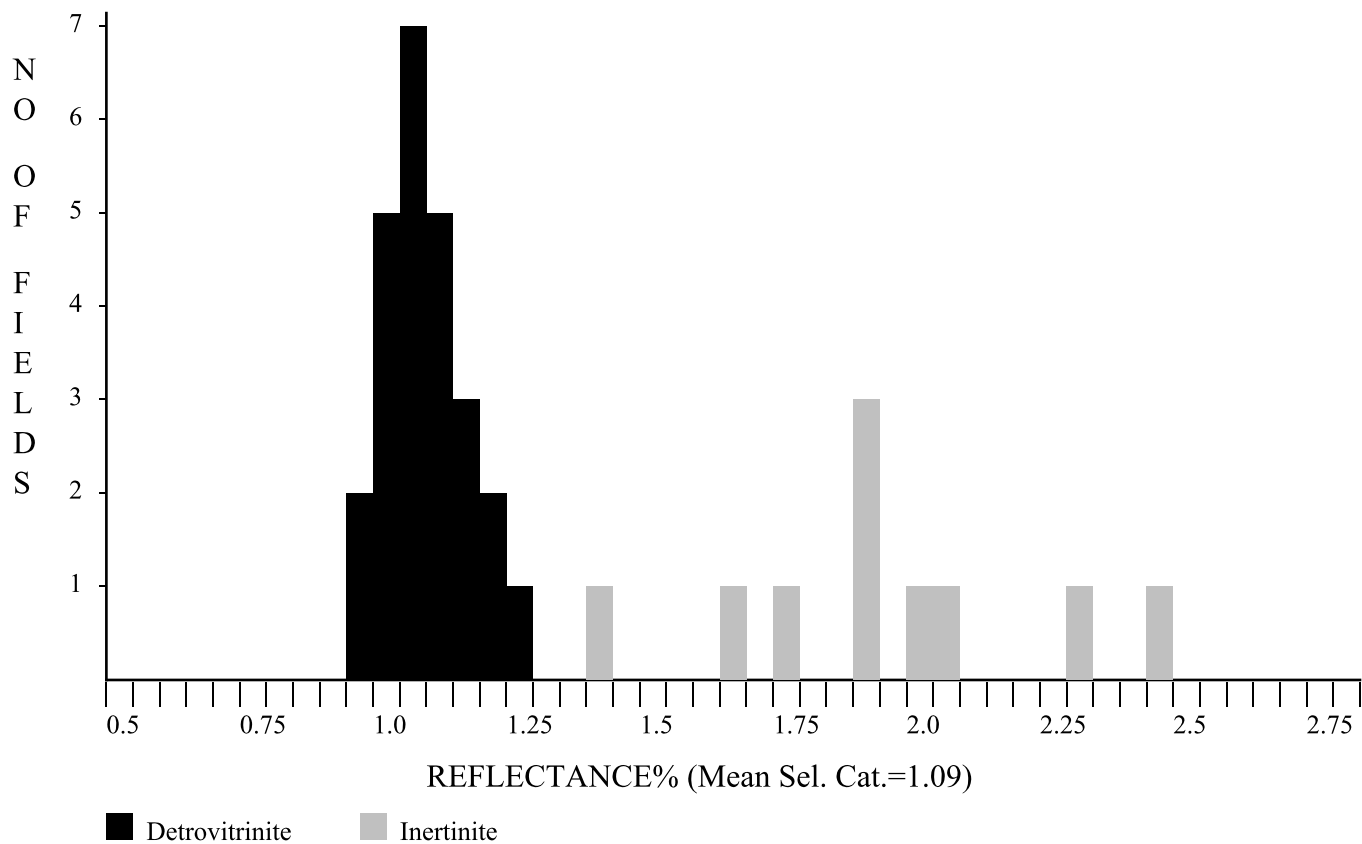


Maceral Category	N	Mean	Standard Deviation
Detrovitrinite	17	1.07	0.084
Inertinite	20	2.11	0.467
<hr/>			
Total	37	1.64	0.624

Selected categories: Detrovitrinite:

No. of Readings:	17
Mean of Selected Categories:	1.07
Standard Deviation of Selected categories:	0.084

GSWA, 237768, Cody 1, 3025-3028m, ctgs(E4514)



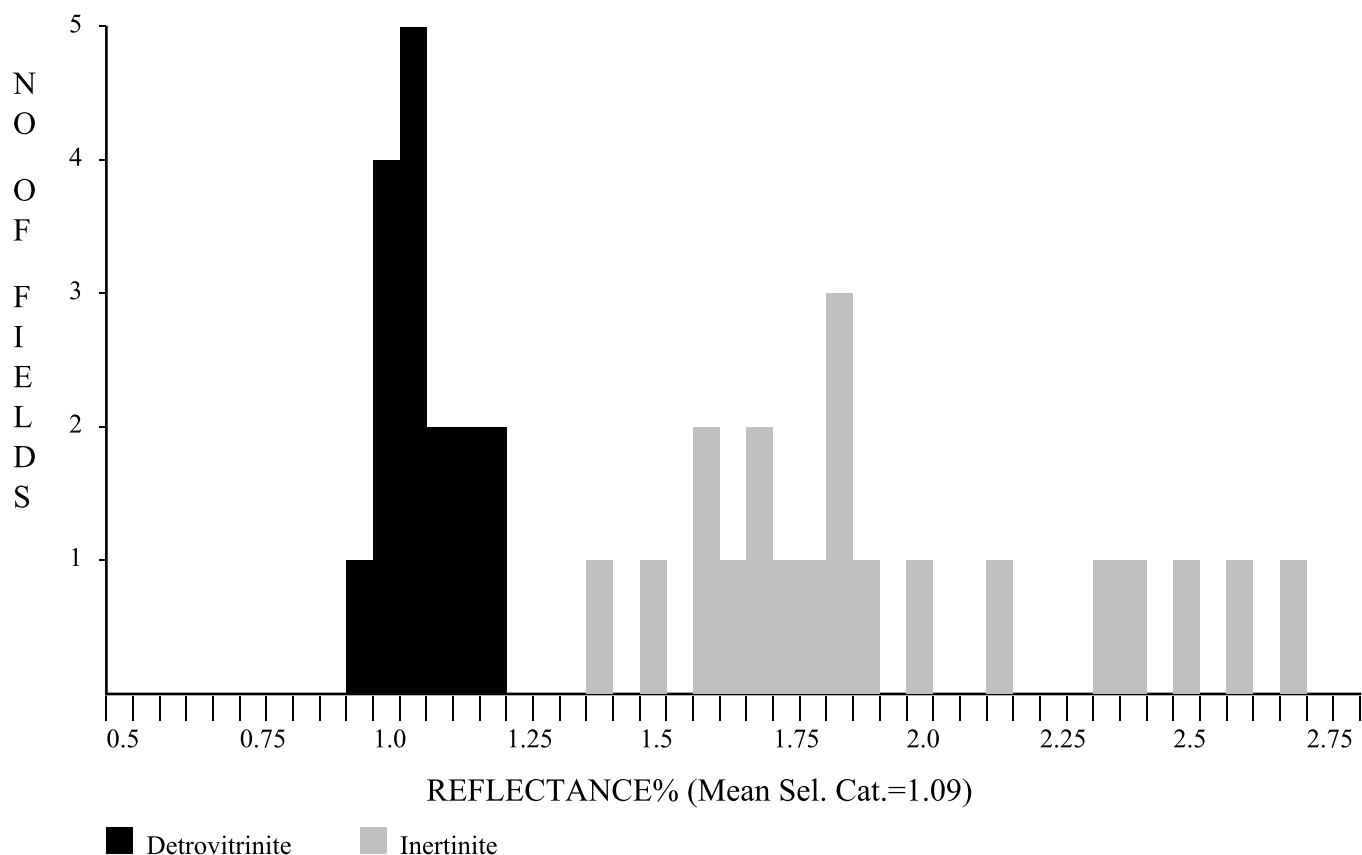
Maceral Category	N	Mean	Standard Deviation
Detrovitrinite	25	1.09	0.069
Inertinite	10	1.95	0.286
<b>Total</b>	<b>35</b>	<b>1.34</b>	<b>0.421</b>

Selected categories: Detrovitrinite:

No. of Readings:	25
Mean of Selected Categories:	1.09
Standard Deviation of Selected categories:	0.069



GSWA, 237769, Cody 1, 3145-3148m, ctgs(E4515)



Maceral Category	N	Mean	Standard Deviation
Detrovitrinite	16	1.09	0.070
Inertinite	20	1.97	0.375
<b>Total</b>	<b>36</b>	<b>1.58</b>	<b>0.520</b>

Selected categories: Detrovitrinite:

No. of Readings:	16
Mean of Selected Categories:	1.09
Standard Deviation of Selected categories:	0.070

Dr Peter Crosdale (MAIG)  
Director, ERC  
7<sup>th</sup> November, 2021

## **APPENDIX - PLATES**

High quality images are provided in a separate image file. Images provided in this report are for reference purposes only.

E4511A Detrovitrinite in argillaceous siltstone,  $R_{v\max} = 1.16\%$ , reflected white light, X50

E4511B Same as E4511A, in fluorescence mode

E4511C Vitrite coal,  $R_{v\max} = 1.03\%$ , reflected white light, X50

E4511D Same as E4511C, in fluorescence mode

E4511E Semifusinite in argillaceous siltstone,  $R_l = 1.46\%$ , reflected white light, X50

E4511F Same as E4511C, in fluorescence mode

E4511G Weak fluorescing sporinite in argillaceous siltstone, reflected white light, X50

E4511H Same as E4511G, in fluorescence mode

E4512A Detrovitrinite in fine claystone,  $R_{v\max} = 1.08\%$ , reflected white light, X50

E4512B Same as E4512A, in fluorescence mode

E4512C Weak fluorescing sporinite in fine claystone, reflected white light, X50

E4512D Same as E4512C, in fluorescence mode

E4513A Detrovitrinite in calcareous claystone,  $R_{v\max} = 1.12\%$ , reflected white light, X50

E4513B Same as E4513A, in fluorescence mode

E4513C Semifusinite in calcareous claystone,  $R_l = 1.46\%$ , reflected white light, X50

E4513D Same as E4513C, in fluorescence mode

E4513E Acritarch Michrystidium in calcareous claystone, reflected white light, X50

E4513F Same as E4513C, in fluorescence mode

E4514A Detrovitrinite in calcareous claystone,  $R_{v\max} = 1.06\%$ , reflected white light, X50

E4514B Same as E4514A, in fluorescence mode

E4514C Weak fluorescing lamalginite in calcareous claystone, reflected white light, X50

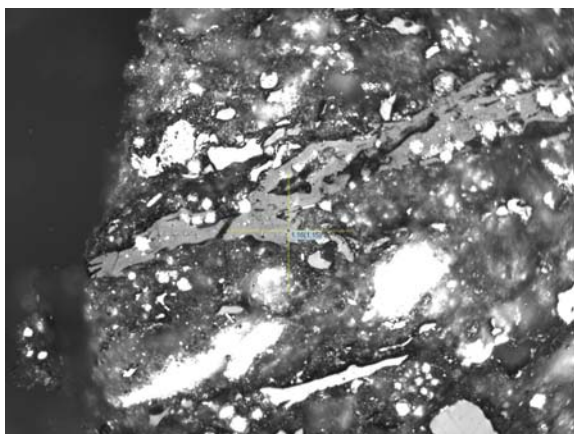
E4514D Same as E4514C, in fluorescence mode

E4515A Detrovitrinite in siltstone,  $R_{v\max} = 1.13\%$ , reflected white light, X50

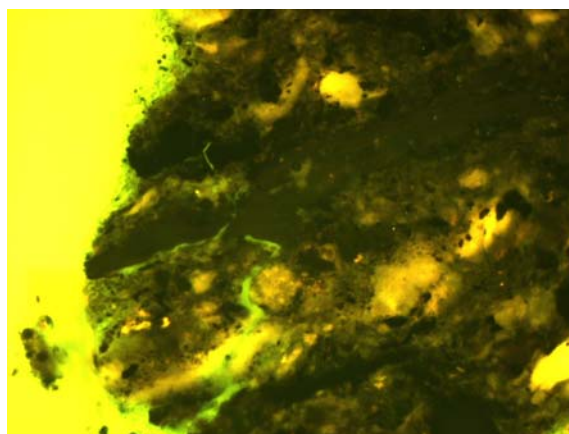
E4515B Same as E4515A, in fluorescence mode

E4515C Semifusinite in siltstone,  $R_l = 2.19\%$ , reflected white light, X50

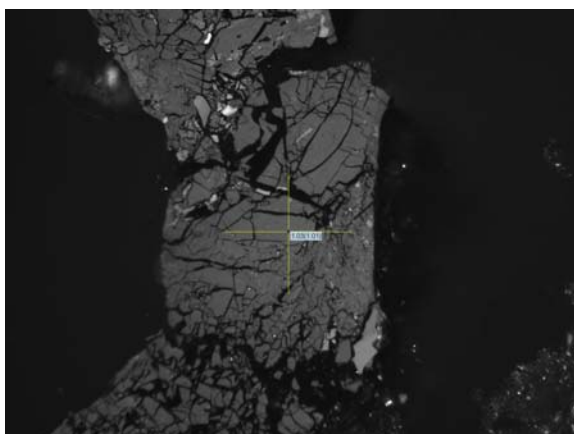
E4515D Same as E4515C, in fluorescence mode



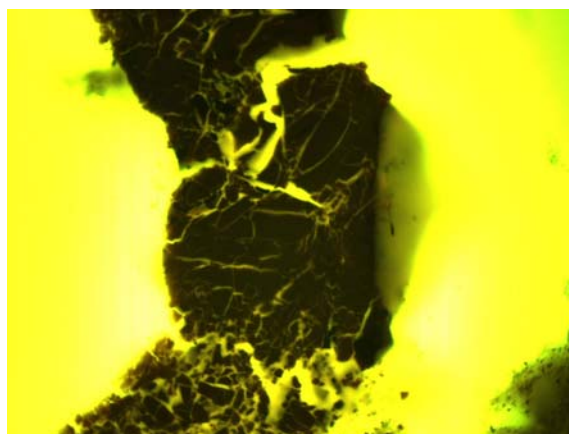
E4511A Detrovitrinite in argillaceous siltstone,  $R_{v\max} = 1.16\%$ , reflected white light, X50



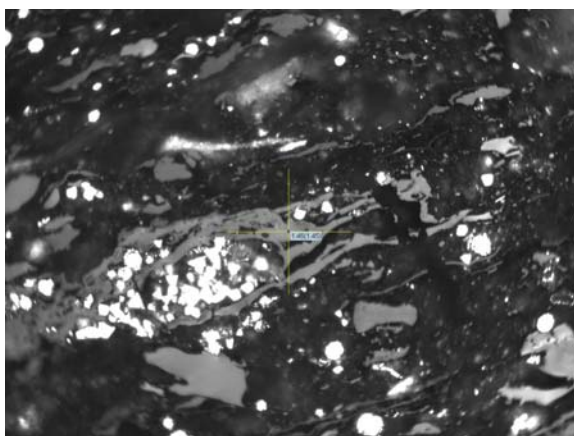
E4511B Same as E4511A, in fluorescence mode



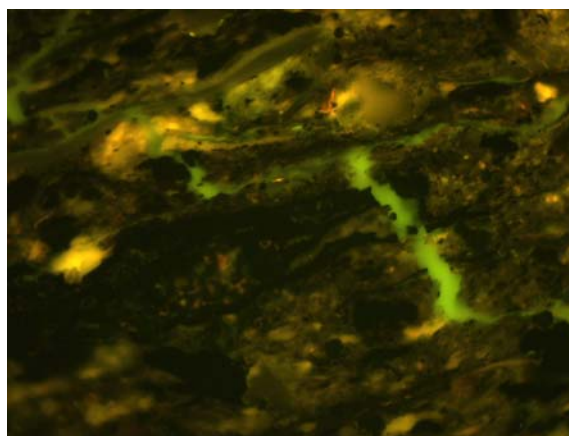
E4511C Vitrite coal,  $R_{v\max} = 1.03\%$ , reflected white light, X50



E4511D Same as E4511C, in fluorescence mode



E4511E Semifusinite in argillaceous siltstone,  $R_f = 1.46\%$ , reflected white light, X50



E4511F Same as E4511E, in fluorescence mode

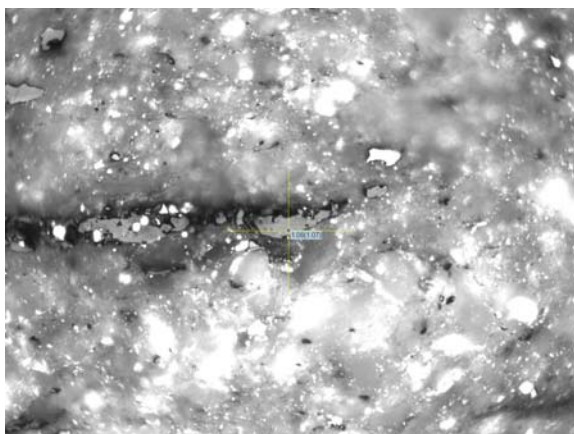


E4511G Weak fluorescing sporinite in argillaceous siltstone, reflected white light, X50

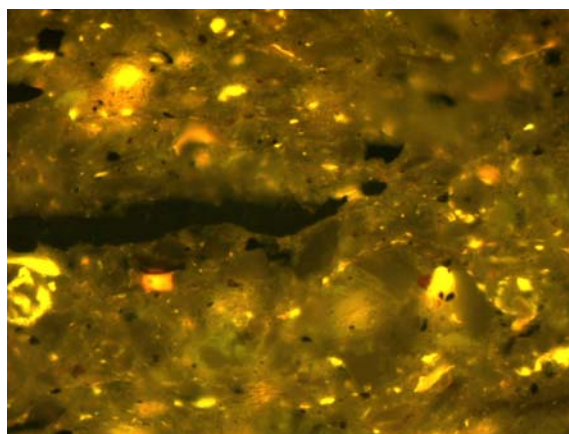


E4511H Same as E4511G, in fluorescence mode

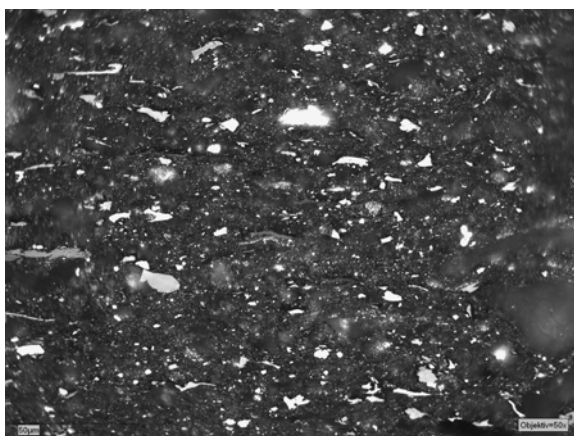




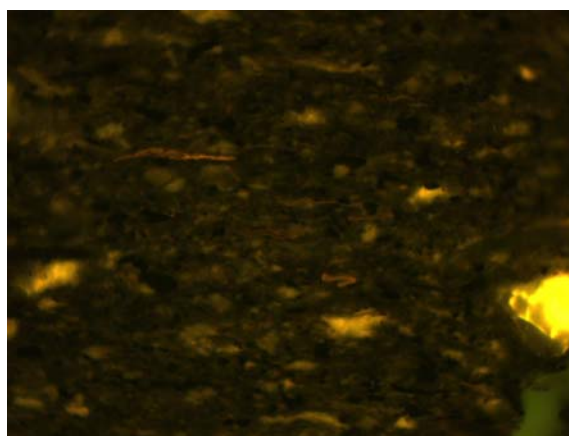
E4512A Detrovitrinite in fine claystone,  $R_v$   
 $R_{\text{max}} = 1.08\%$ , reflected white light, X50



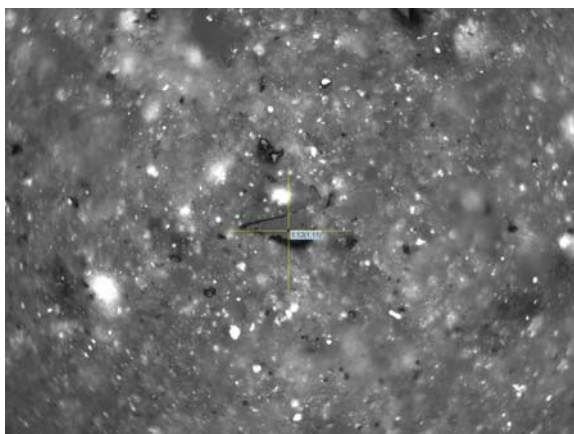
E4512B Same as E4512A, in fluorescence  
mode



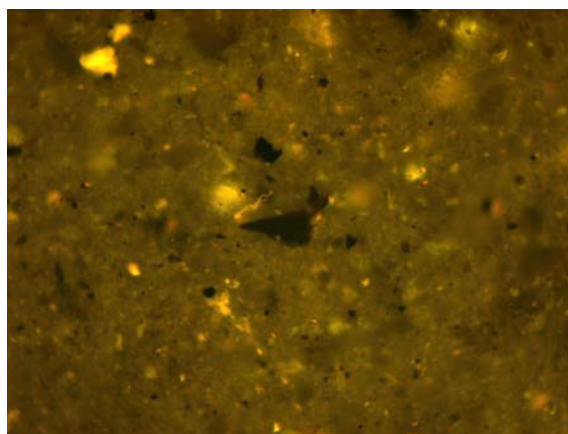
E4512C Weak fluorescing sporinite in fine  
claystone, reflected white light, X50



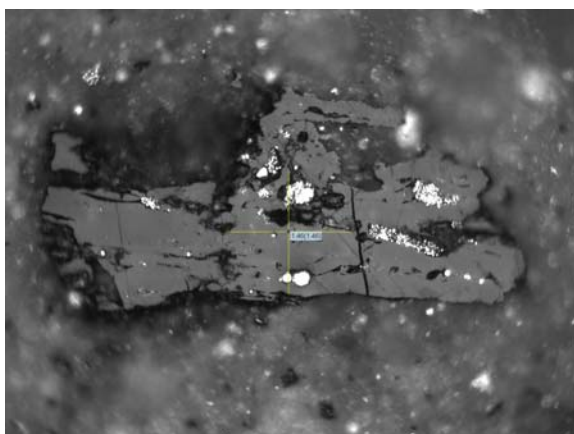
E4512D Same as E4512C, in fluorescence  
mode



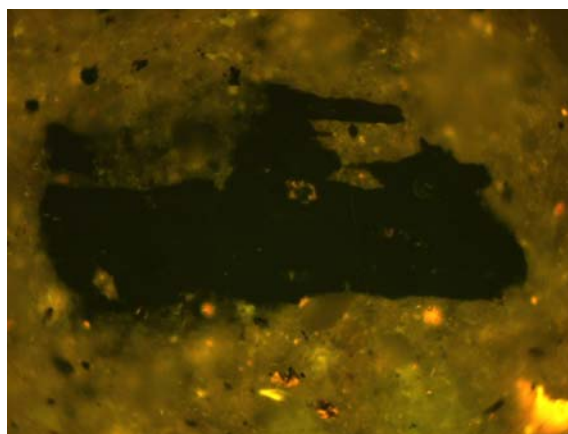
E4513A Detrovitrinite in calcareous claystone,  $R_{v \max} = 1.12\%$ , reflected white light, X50



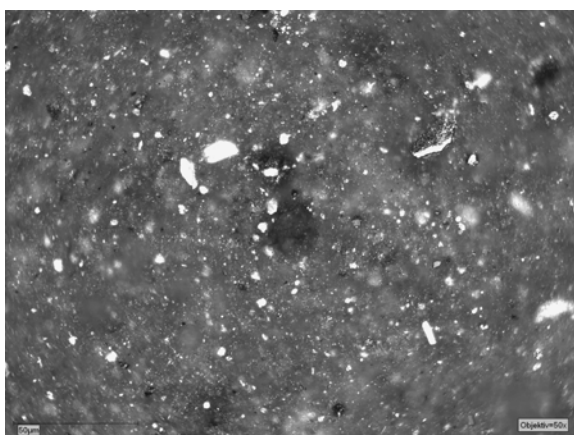
E4513B Same as E4513A, in fluorescence mode



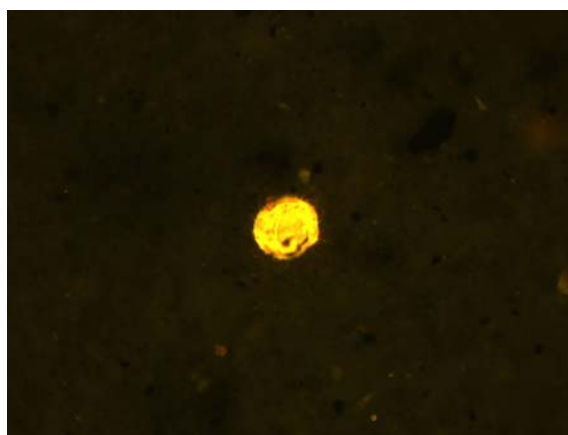
E4513C Semifusinite in calcareous claystone,  $R_t = 1.46\%$ , reflected white light, X50



E4513D Same as E4513C, in fluorescence mode

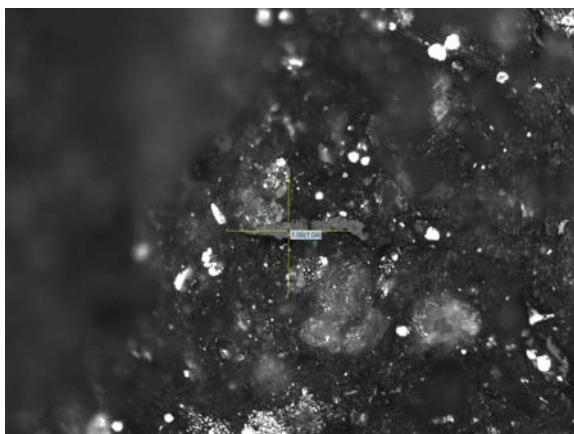


E4513E Acritarch Michrystidium in calcareous claystone, reflected white light, X50

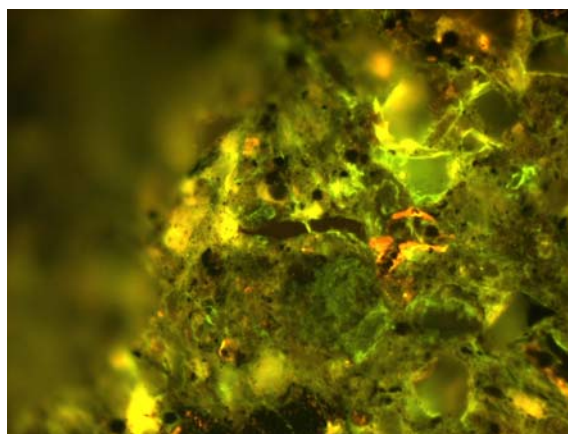


E4513F Same as E4513C, in fluorescence mode

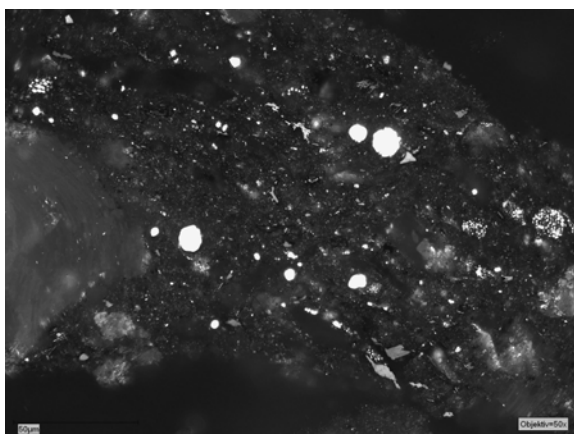




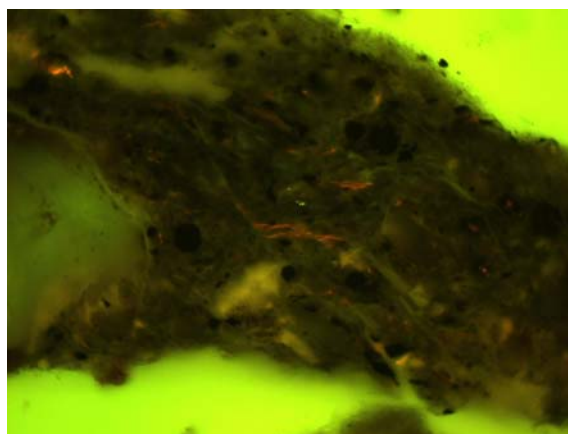
E4514A Detrovitrinite in calcareous claystone,  $R_{v \max} = 1.06\%$ , reflected white light, X50



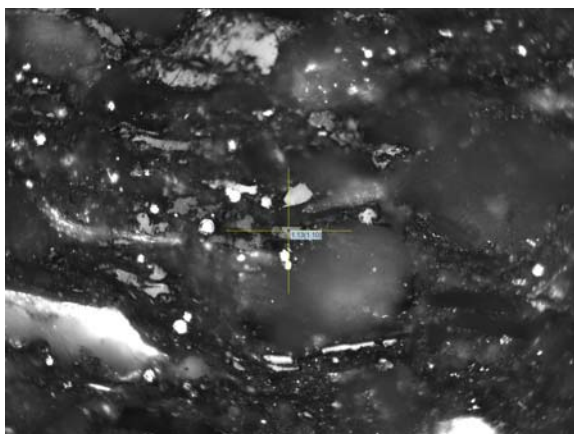
E4514B Same as E4514A, in fluorescence mode



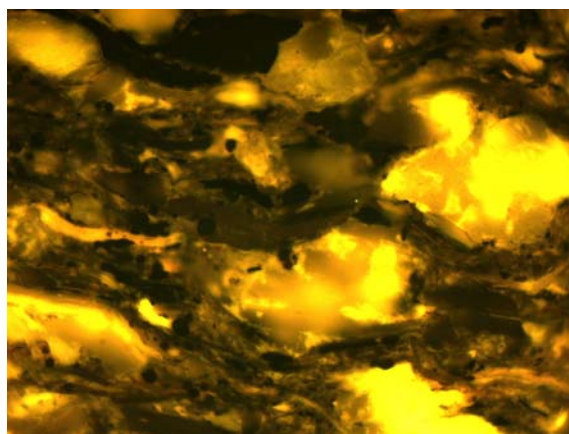
E4514C Weak fluorescing lamalginites in calcareous claystone, reflected white light, X50



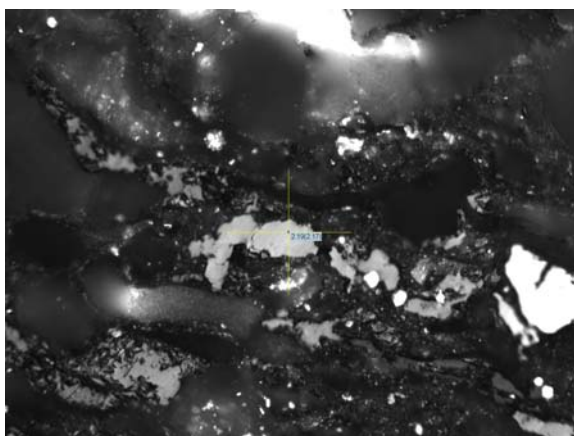
E4514D Same as E4514C, in fluorescence mode



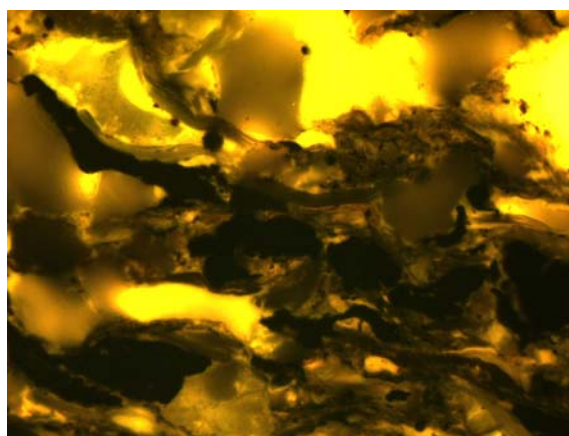
E4515A Detrovitrinite in siltstone,  $R_{v \max} = 1.13\%$ , reflected white light, X50



E4515B Same as E4515A, in fluorescence mode



E4515C Semifusinite in siltstone,  $R_l = 2.19\%$ , reflected white light, X50



E4515D Same as E4515C, in fluorescence mode