ANALYTICAL REPORT

SOURCE ROCK
ORGANIC MATTER REFLECTANCE
AND TYPING

HARVEY 2

PREPARED FOR
GSWA

APRIL 2015

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
Vr	HAWK			
E1252		215279	core	322.1 m
E1253		215298	core	793.1 m
E1254		215248	core	1252.05 m
E1255		215247	core	1260.6 m
E1256		215245	core	1312.2 m
E1257		215242	core	1337.1 m

METHODS

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

With core 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 though 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 μm^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 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.

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
HARVEY-2

ERC#	Depth (m)	$\overline{R}_{vmax}$	Range	SD	N	Sample description including liptinite fluorescence, maceral abundances, mineral fluorescence
E1252 215279 Core	322.1 $\overline{R}_I$	0.28 -	0.19-0.40 -	0.053 -	25 -	Fluorescing liptinite absent. (Coal, V, vitrite. Sample consists exclusively of coal of vitrite composition. Vitrinite is made predominantly of compressed woody tissues with Eu-ulminite composition. Rare Corpohuminite fillings with reflectance marginally higher than Eu-ulminite. Pyrite sparse.)
E1253 215298 Core	793.1 $\overline{R}_I$	0.46 1.20	0.39-0.55 0.69-2.07	0.048 0.342	25 10	Abundant sporinite and sparse liptodetrinite orange, rare cutinite dull orange. (Claystone and argillaceous siltstone with shaly coal and traces of coal. Shaly coal, major, I>L>V, inertinite>clarodurite>vitrinertite(i). Shaly coal comprises about 20% of the sample and approximate maceral composition on mineral free basis: inertinite 90%; liptinite 10%; vitrinite 5%. Coal rare, I, inertite. Dom major, I>L>V. Inertinite major, liptinite abundant, vitrinite common. Mineral fluorescence weak orange. Iron oxides rare. Pyrite sparse.)
E1254 215248 Core	1262.05 $\overline{R}_I$	0.34 -	0.27-0.43 -	0.033 -	25 -	Fluorescing liptinite absent. (Coal, V, vitrite. Sample consists exclusively of coal of vitrite composition. Polished surfaces of coal have dark and bright zones. Weak fluorescence from the dark zones in coal under blue light excitation. Mineral fluorescence in cleats in coal is bright orange. Pyrite sparse.)
E1255 215247 Core	1260.6 $\overline{R}_I$	0.34 0.87	0.25-0.43 0.51-1.54	0.045 0.313	25 10	Fluorescing liptinite absent. (Coarse sandstone with weathered/altered coal. Coal dominant, V>>I, vitrite. Coal comprises about 50% of the sample and approximate maceral composition on mineral free basis: vitrinite >99%; inertinite traces. Coal consists mainly of Texto-ulminite. Textinite and Corpohuminite in coal are relatively unaffected by weathering/altering. Dom rare, V>I. Vitrinite and inertinite rare, liptinite absent. Mineral fluorescence weak orange in rare argillaceous material. Pyrite sparse.)
E1256 215245 Core	1312.2 $\overline{R}_I$	0.35 1.12	0.28-0.44 0.52-1.64	0.034 0.335	25 6	Fluorescing liptinite absent. (Coarse sandstone with weathered/altered coal. Coal major, V>>I, vitrite. Coal comprises about 20% of the sample and approximate maceral composition on mineral free basis: vitrinite >99%; inertinite traces. Some coal grains have fully compressed desmocollinite like textures while most grains still retains cellular structures and are Textinite and Eu-ulminite. Dom rare, V>I. Vitrinite and inertinite rare, liptinite absent. Mineral fluorescence weak orange in rare argillaceous material. Pyrite sparse.)
E1257 215242 Core	1337.1	0.34* 0.51#	0.27-0.47 0.45-0.58	0.046 0.043	25 6	Fluorescing liptinite absent. (Weathered coal with minor Siltstone. Coal dominant, V, vitrite. Coal comprises about 80% of the sample and consists exclusively of vitrite. Some coal grains have bright and dull zones, probably due to oxidation. Organic matter in some coals extensively replaced by pyrite. Mineral fluorescence bright orange in cleats in coal. Pyrite major.)

*vitrinite in dull zones #vitrinite in bright (?oxidized) zones

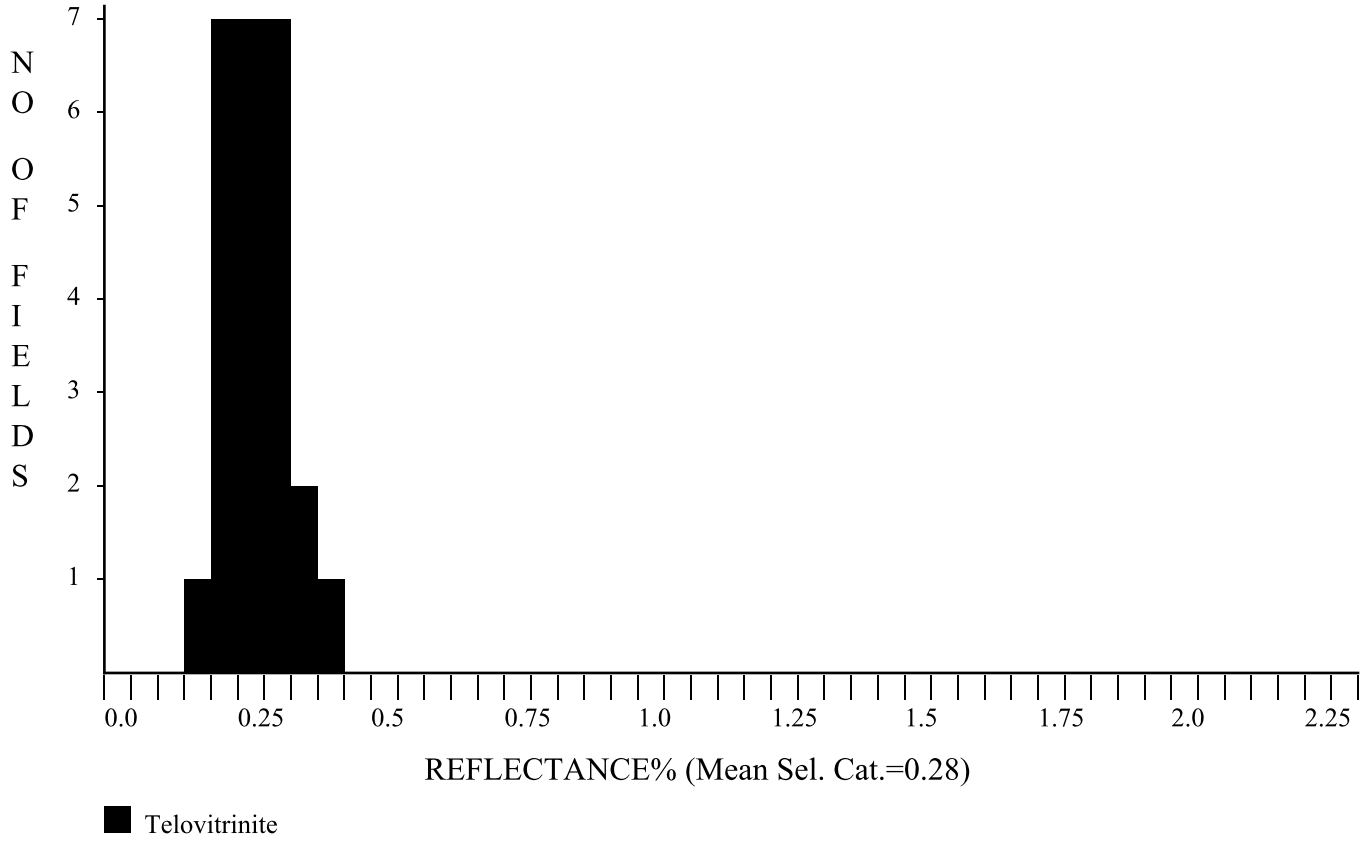
Plates

E1252A Coal, vitrite (Eu-ulminite), Rv max = 0.36%, reflected white light, X50
E1252B Same as E1252A, in fluorescence mode
E1252C Corpohuminite associated with Eu-ulminite, Rv max = 0.40%, reflected white light, X50
E1252D Same as E1252C, in fluorescence mode
E1253A Detrovitrinite in argillaceous siltstone, Rv max = 0.50%, reflected white light, X50
E1253B Same as E1253A, in fluorescence mode
E1253C Sporinite in argillaceous siltstone, reflected white light, X50
E1253D Same as E1253C, in fluorescence mode
E1253E Inertite coal, reflected white light, X50
E1254A Vitrite coal, Rv max = 0.36%, reflected white light, X50
E1254B Same as E1254A, in fluorescence mode
E1254C Fluorescing mineral matter in cleats in coal, reflected white light, X50
E1254D Same as E1254C, in fluorescence mode
E1255A Weathered/altered vitrite (Texto-ulminite) coal, Rv max = 0.39%, reflected white light, X50
E1255B Same as E1255A, in fluorescence mode
E1255C Unweathered inertodetrinite in weathered vitrinite matrix in coal, reflected white light, X50
E1255D Same as E1255C, in fluorescence mode
E1255E Corpohuminite relatively unaffected bu weathering, Rv max = 0.36%, reflected white light, X50
E1256A Relatively unweathered/altered vitrite coal, Rv max = 0.36%, reflected white light, X50
E1256B Same as E1256A, in fluorescence mode
E1256C Coal textinite, Rv max = 0.37%, reflected white light, X50
E1255D Coal Eu-ulminite, Rv max = 0.44%, reflected white light, X50
E1257A Dull (?unoxidized) zone in vitrite coal, Rv max = 0.30%, reflected white light, X50
E1257B Same grain, bright zone, Rv max = 0.58%, reflected white light, X50
E1257C Pyrite replacing organic matter in coal, reflected white light, X50

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GSWA, 215279, Harvey-2, 322.1m, Core(E1252)



Maceral Category	N	Mean	Standard Deviation
Telovitrinite	25	0.28	0.053
Total	25	0.28	0.053

Selected categories: Telovitrinite:

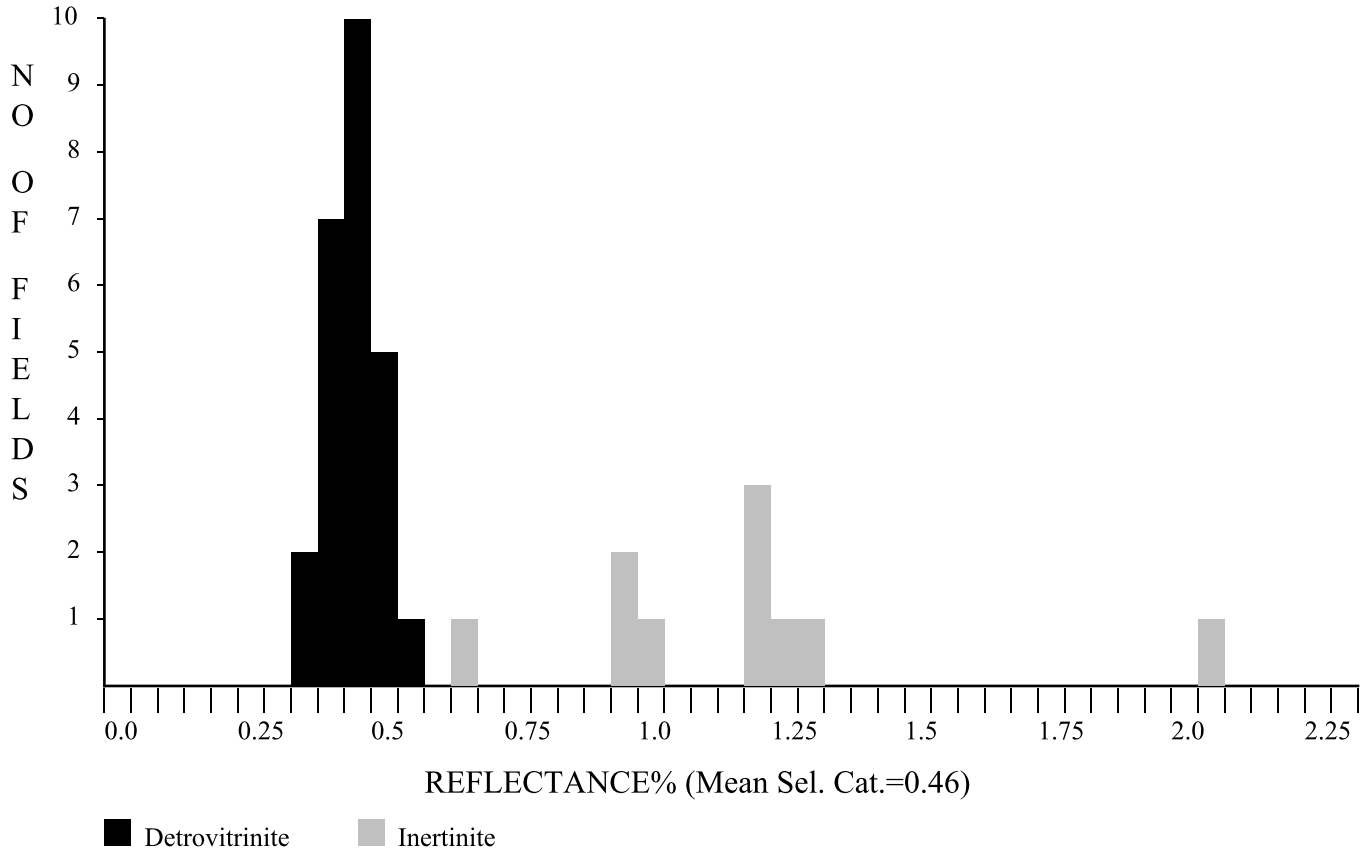
No. of Readings:	25
Mean of Selected Categories:	0.28
Standard Deviation of Selected categories:	0.053

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GSWA, 215298, Harvey-2, 793.1m, Core(E1253)



Maceral Category	N	Mean	Standard Deviation
Detrovitrinite	25	0.46	0.048
Inertinite	10	1.20	0.342
Total	35	0.67	0.381

Selected categories: Detrovitrinite:

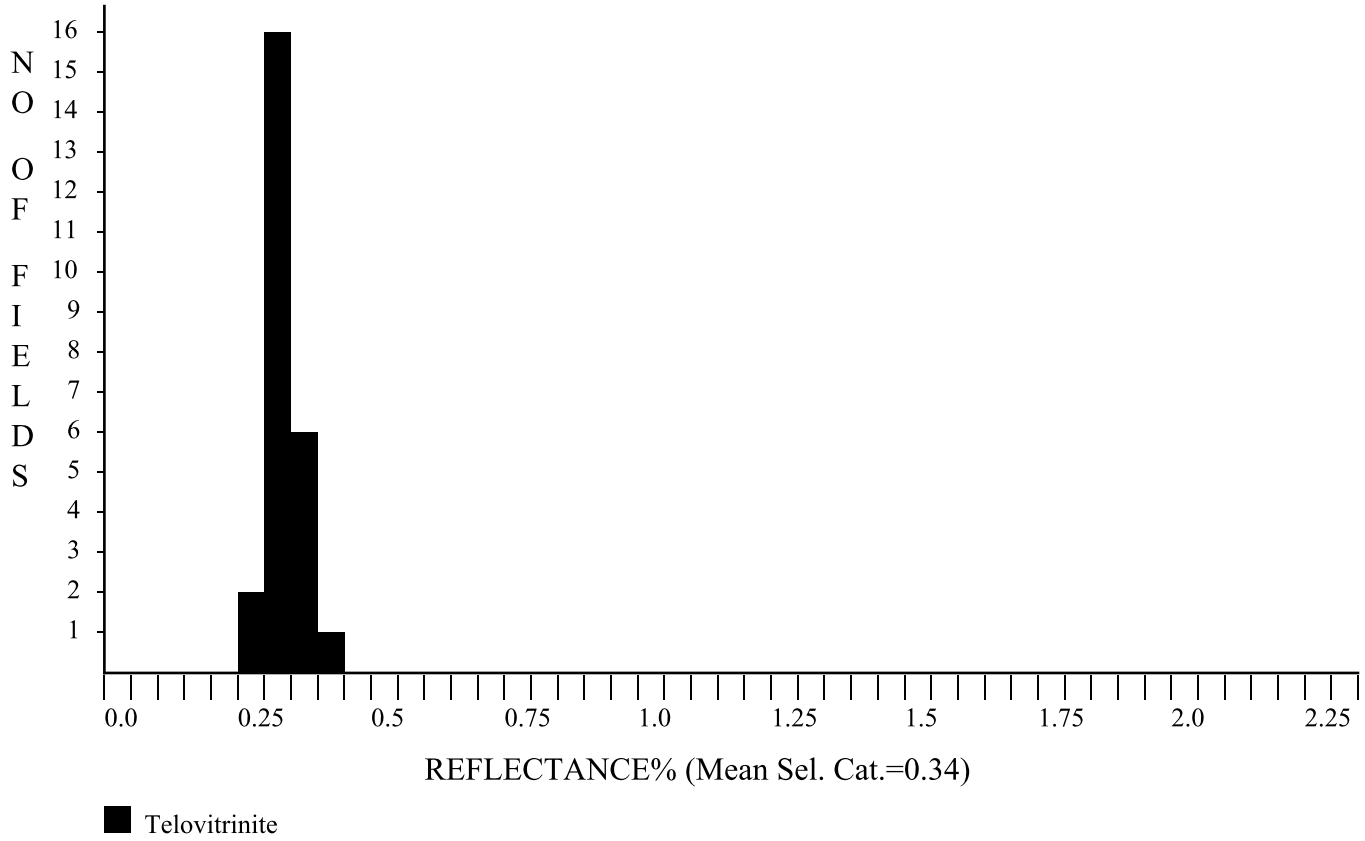
No. of Readings:	25
Mean of Selected Categories:	0.46
Standard Deviation of Selected categories:	0.048

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GSWA, 215248, Harvey-2, 1262.05m, Core(E1254)



Maceral Category	N	Mean	Standard Deviation
Telovitrinite	25	0.34	0.033
Total	25	0.34	0.033

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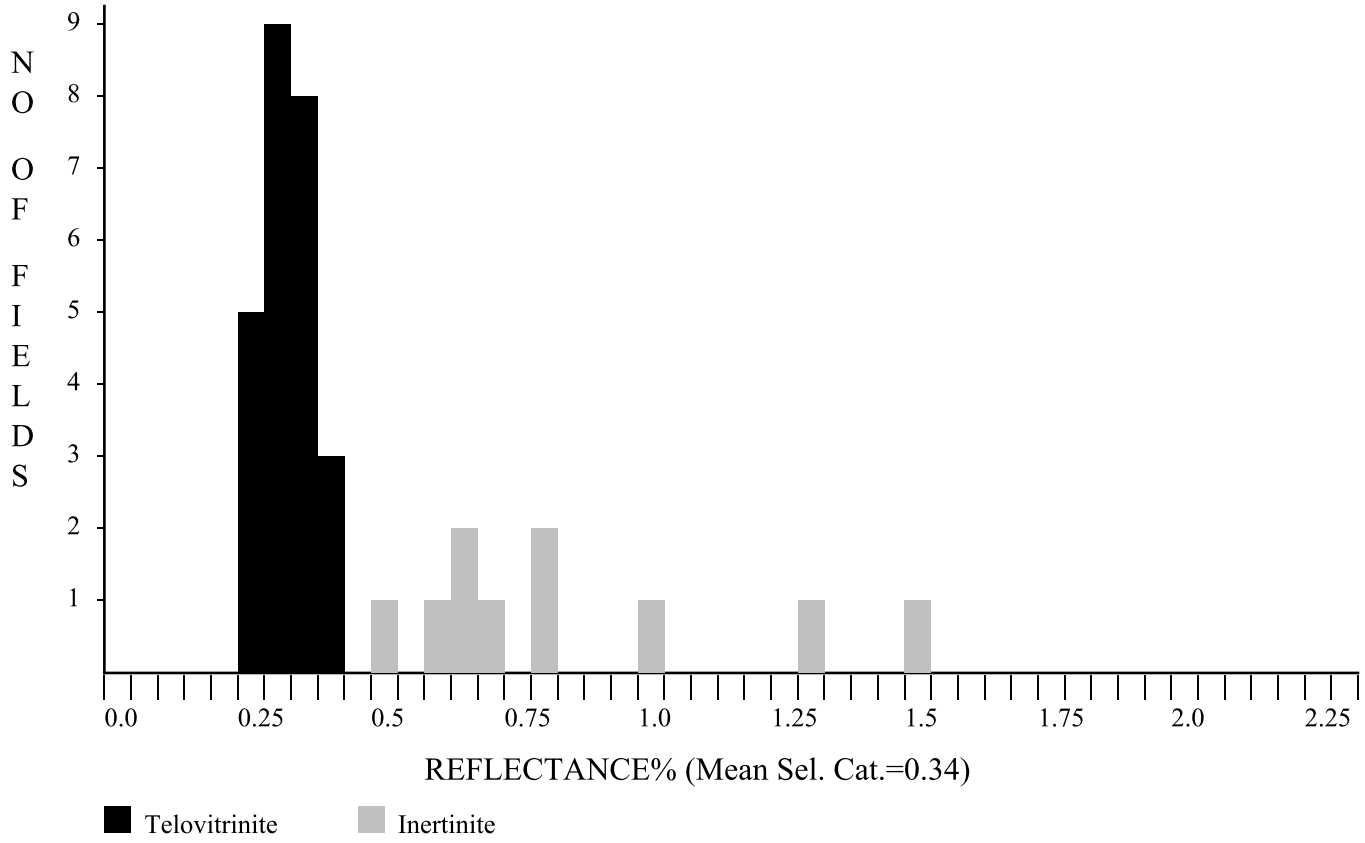
No. of Readings:	25
Mean of Selected Categories:	0.34
Standard Deviation of Selected categories:	0.033

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GSWA, 215247, Harvey-2, 1260.6m, Core(E1255)



Maceral Category	N	Mean	Standard Deviation
Telovitrinite	25	0.34	0.045
Inertinite	10	0.87	0.313
Total	35	0.49	0.296

Selected categories: Telovitrinite:

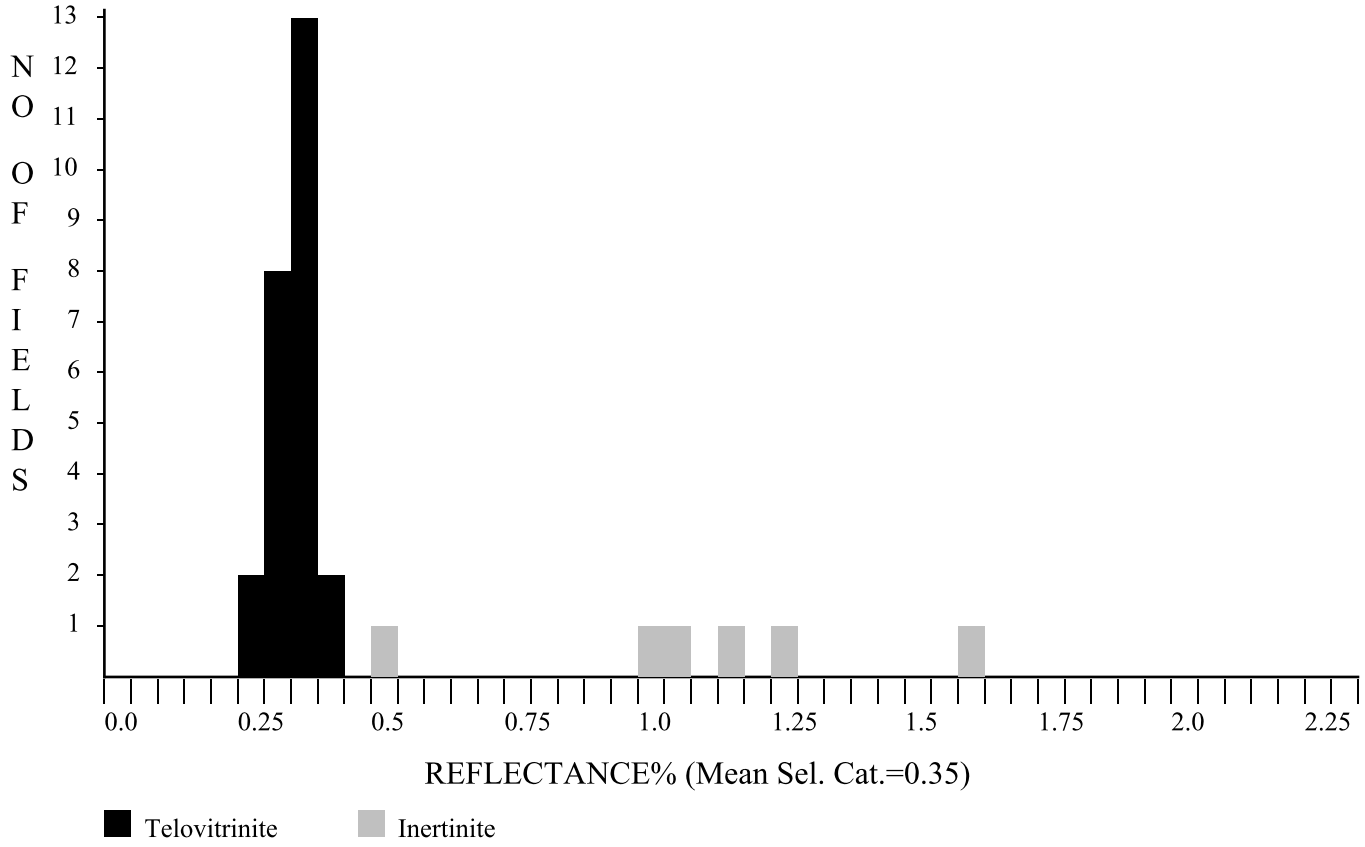
No. of Readings:	25
Mean of Selected Categories:	0.34
Standard Deviation of Selected categories:	0.045

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GSWA, 215245, Harvey-2, 1312.2m, Core(E1256)



Maceral Category	N	Mean	Standard Deviation
Telovitrinite	25	0.35	0.034
Inertinite	6	1.12	0.335
Total	31	0.50	0.338

Selected categories: Telovitrinite:

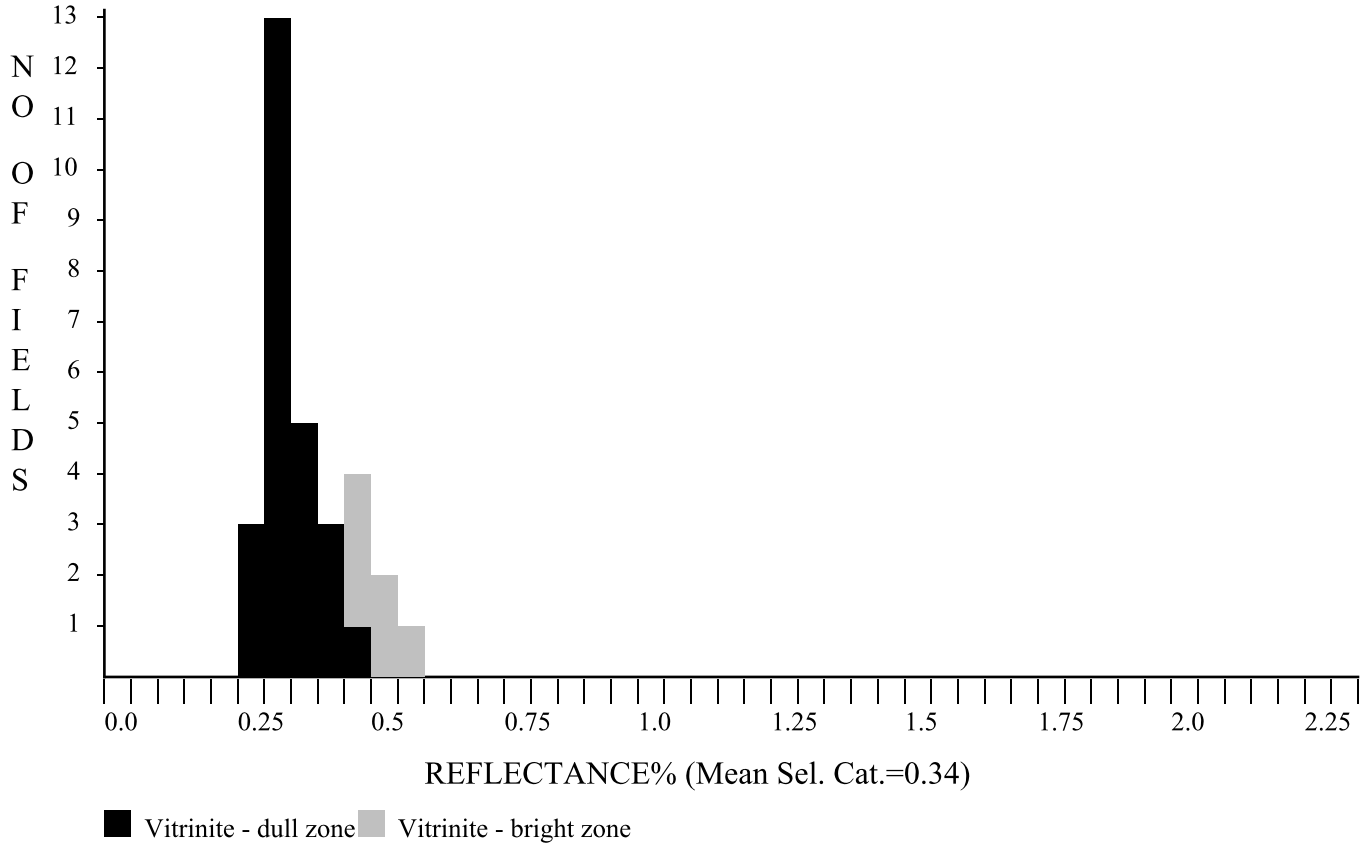
No. of Readings:	25
Mean of Selected Categories:	0.35
Standard Deviation of Selected categories:	0.034

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GSWA, 215242, Harvey-2, 1337.1m, Core(E1257)



Maceral Category	N	Mean	Standard Deviation
Vitrinite - dull zone	25	0.34	0.046
Vitrinite - bright zone	6	0.51	0.043
Total	31	0.38	0.079

Selected categories: Vitrinite - dull zone:

No. of Readings:	25
Mean of Selected Categories:	0.34
Standard Deviation of Selected categories:	0.046

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Dr Peter Crosdale (MAIG)
Director, ERC
8th April, 2015

APPENDIX - PLATES

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

E1252A Coal, vitrite (Eu-ulminite), Rv max = 0.36%, reflected white light, X50
E1252B Same as E1252A, in fluorescence mode
E1252C Corpohuminite associated with Eu-ulminite, Rv max = 0.40%, reflected white light, X50
E1252D Same as E1252C, in fluorescence mode

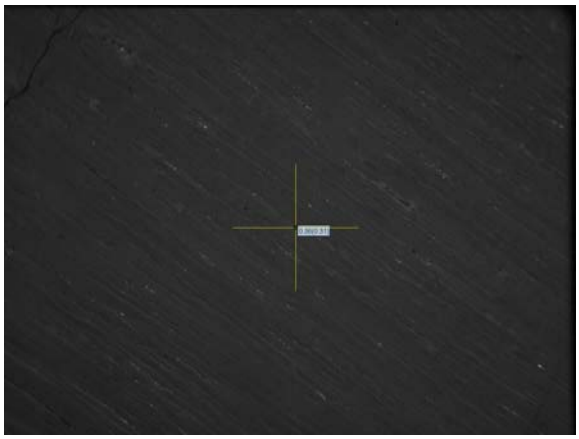
E1253A Detrovitrinite in argillaceous siltstone, Rv max = 0.50%, reflected white light, X50
E1253B Same as E1253A, in fluorescence mode
E1253C Sporinite in argillaceous siltstone, reflected white light, X50
E1253D Same as E1253C, in fluorescence mode
E1253E Inertite coal, reflected white light, X50

E1254A Vitrite coal, Rv max = 0.36%, reflected white light, X50
E1254B Same as E1254A, in fluorescence mode
E1254C Fluorescing mineral matter in cleats in coal, reflected white light, X50
E1254D Same as E1254C, in fluorescence mode

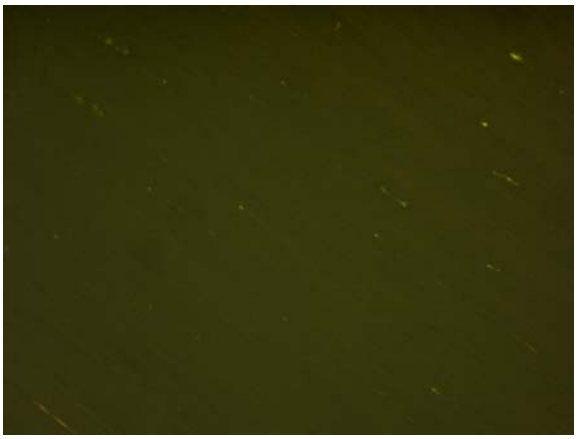
E1255A Weathered/altered vitrite (Texto-ulminite) coal, Rv max = 0.39%, reflected white light, X50
E1255B Same as E1255A, in fluorescence mode
E1255C Unweathered inertodetrinite in weathered vitrinite matrix in coal, reflected white light, X50
E1255D Same as E1255C, in fluorescence mode
E1255E Corpohuminite relatively unaffected bu weathering, Rv max = 0.36%, reflected white light, X50

E1256A Relatively unweathered/altered vitrite coal, Rv max = 0.36%, reflected white light, X50
E1256B Same as E1256A, in fluorescence mode
E1256C Coal textinite, Rv max = 0.37%, reflected white light, X50
E1255D Coal Eu-ulminite, Rv max = 0.44%, reflected white light, X50

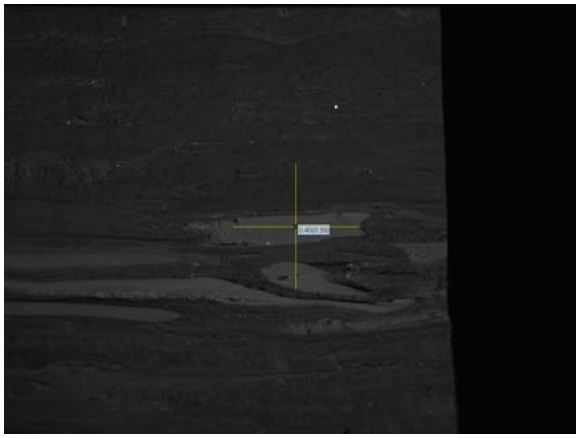
E1257A Dull (?unoxidized) zone in vitrite coal, Rv max = 0.30%, reflected white light, X50
E1257B Same grain, bright zone, Rv max = 0.58%, reflected white light, X50
E1257C Pyrite replacing organic matter in coal, reflected white light, X50



E1252A Coal, vitrite (Eu-ulminite), Rv max = 0.36%, reflected white light, X50



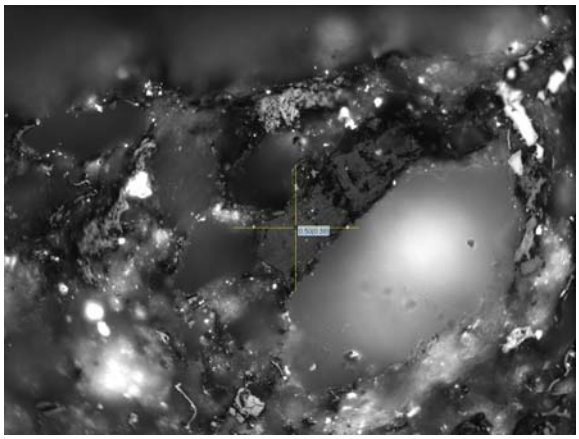
E1252B Same as E1252A, in fluorescence mode



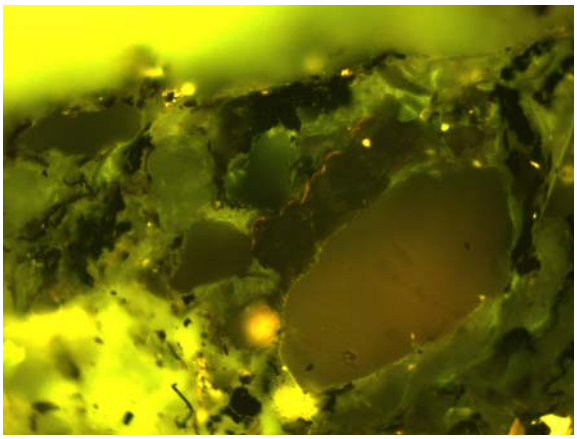
E1252C Corpohuminite associated with Eu-ulminite, Rv max = 0.40%, reflected white light, X50



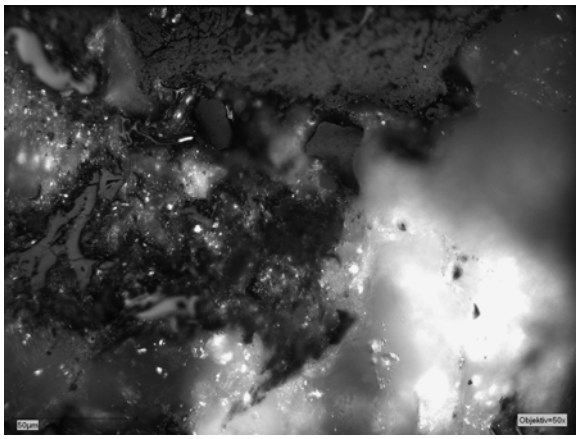
E1252D Same as E1252C, in fluorescence mode



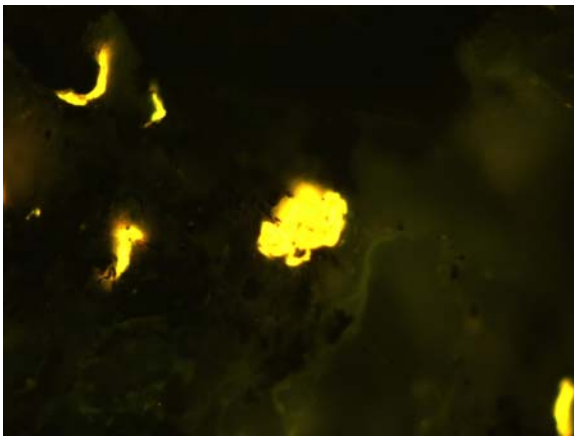
E1253A Detrovitrinite in argillaceous siltstone, Rv max = 0.50%, reflected white light, X50



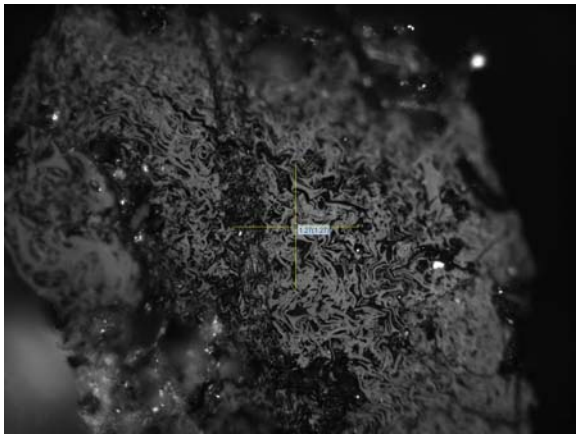
E1253B Same as E1253A, in fluorescence mode



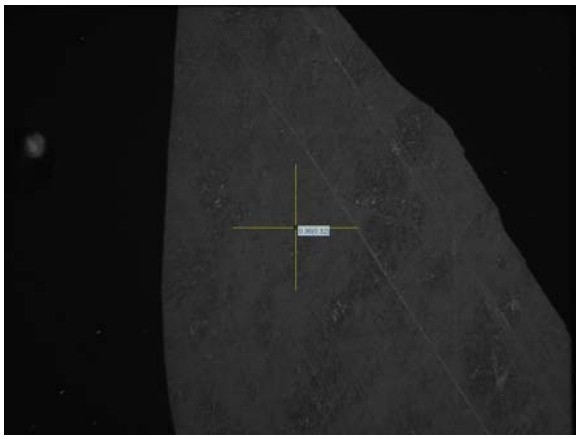
E1253C Sporinite in argillaceous siltstone, reflected white light, X50



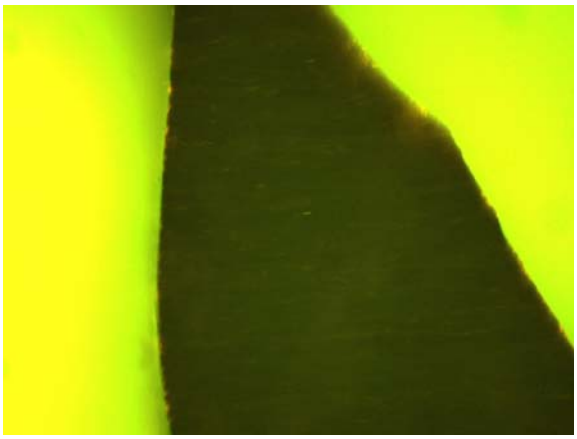
E1253D Same as E1253C, in fluorescence mode



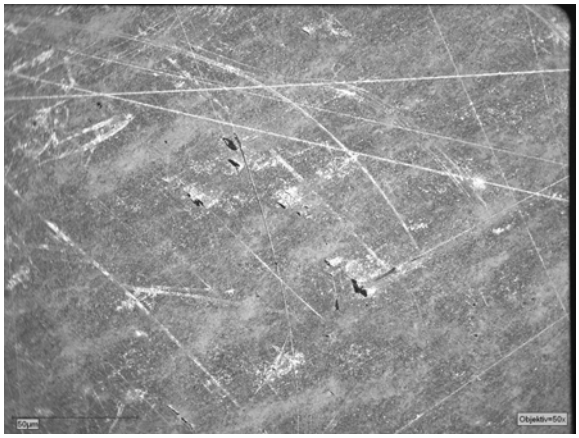
E1253E Inertite coal, reflected white light, X50



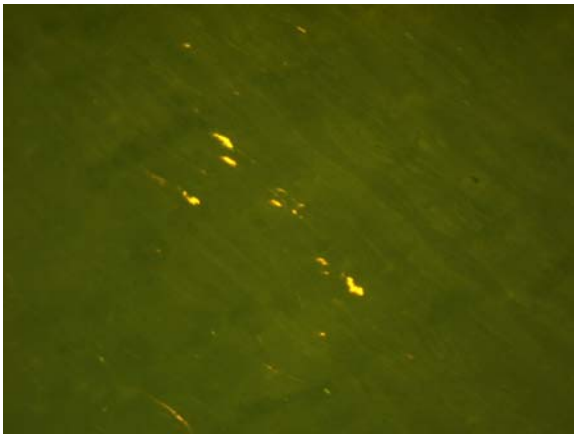
E1254A Vitrite coal, Rv max = 0.36%, reflected white light, X50



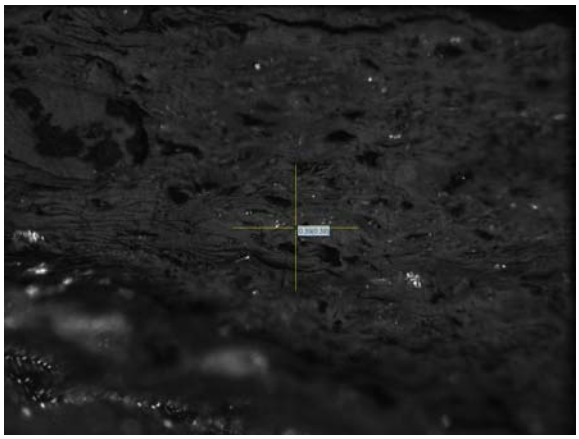
E1254B Same as E1254A, in fluorescence mode



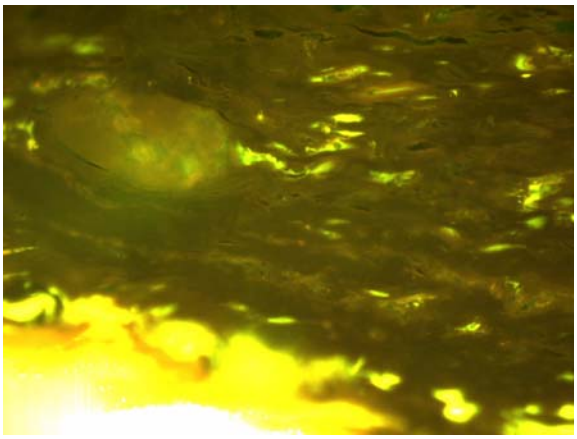
E1254C Fluorescing mineral matter in cleats in coal, reflected white light, X50



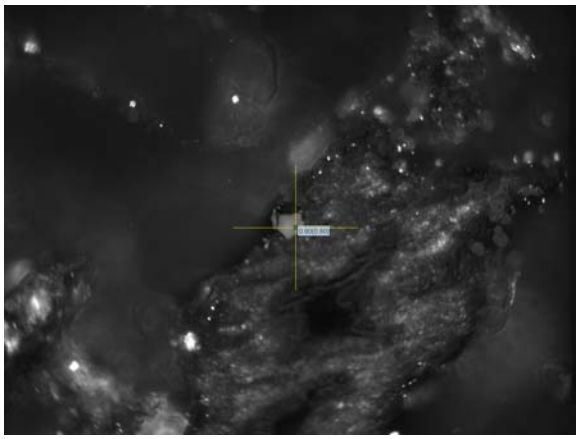
E1254D Same as E1254C, in fluorescence mode



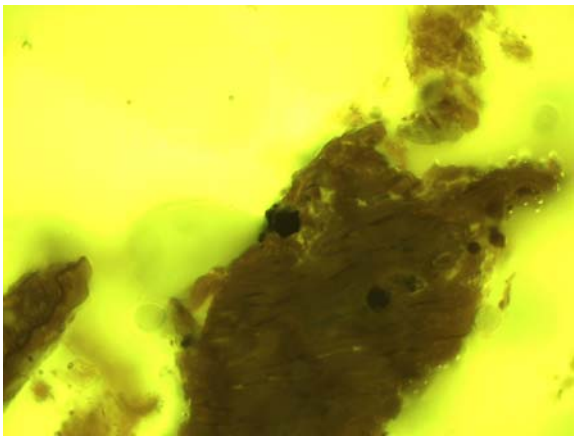
E1255A Weathered/altered vitrite (Texto-ulminite) coal, Rv max = 0.39%, reflected white light, X50



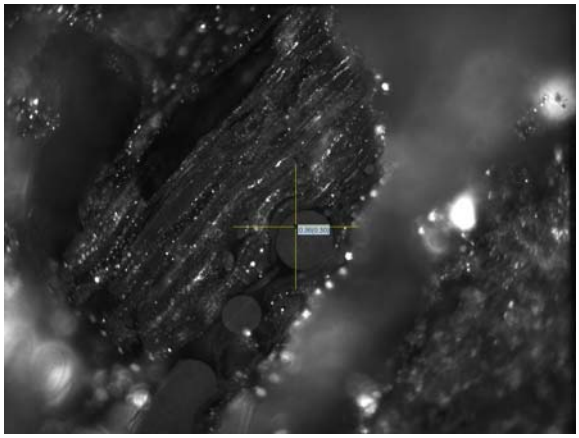
E1255B Same as E1255A, in fluorescence mode



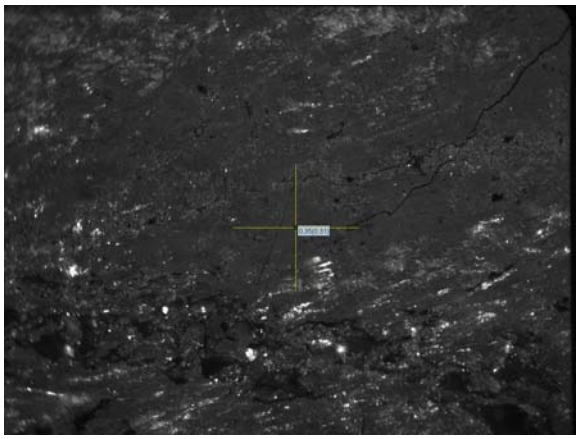
E1255C Unweathered inertodetrinite in weathered vitrinite matrix in coal, reflected white light, X50



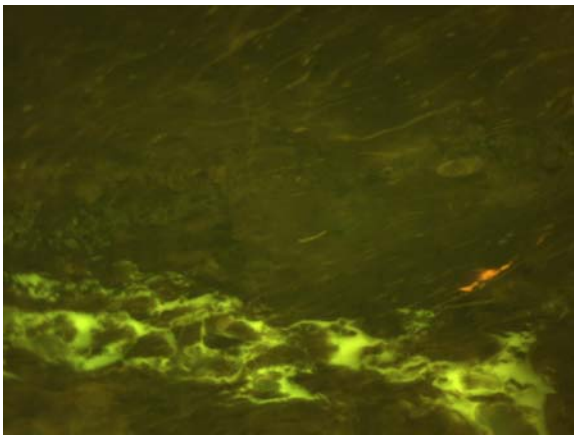
E1255D Same as E1255C, in fluorescence mode



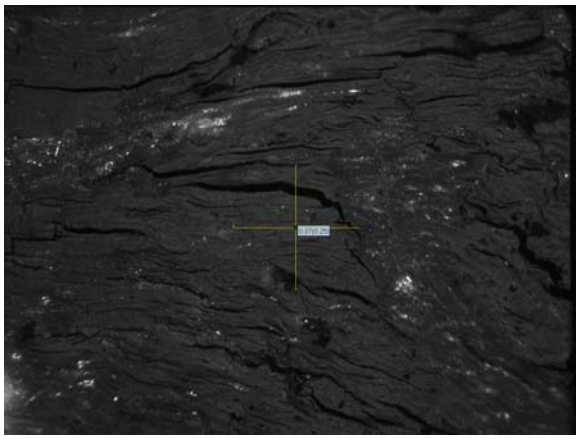
E1255E Corpohuminite relatively unaffected by weathering, Rv max = 0.36%, reflected white light, X50



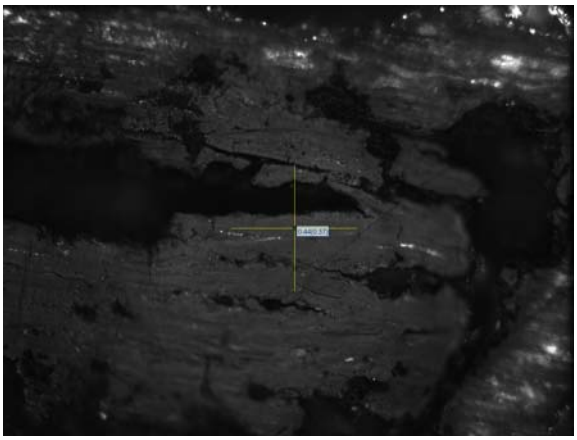
E1256A Relatively unweathered/altered vitrite coal, Rv max = 0.36%, reflected white light, X50



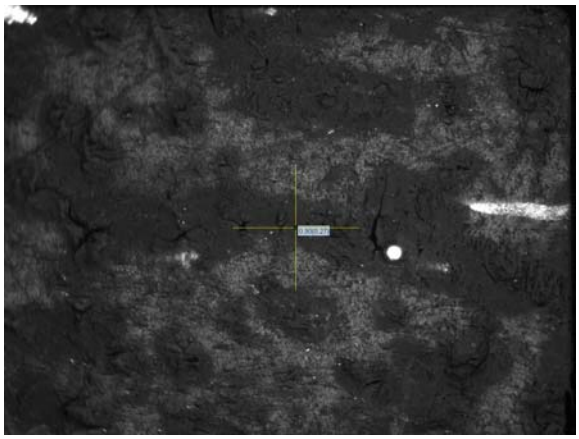
E1256B Same as E1256A, in fluorescence mode



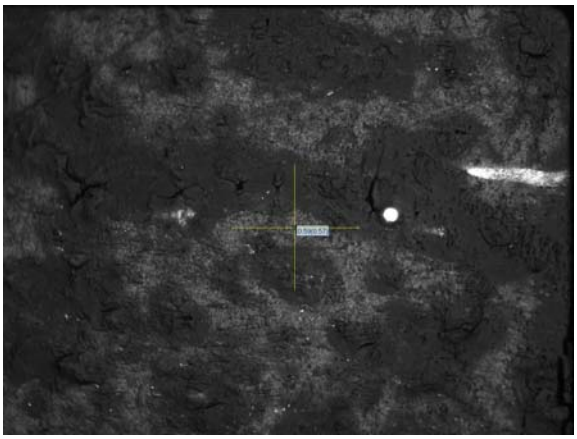
E1256C Coal textinite, Rv max = 0.37%, reflected white light, X50



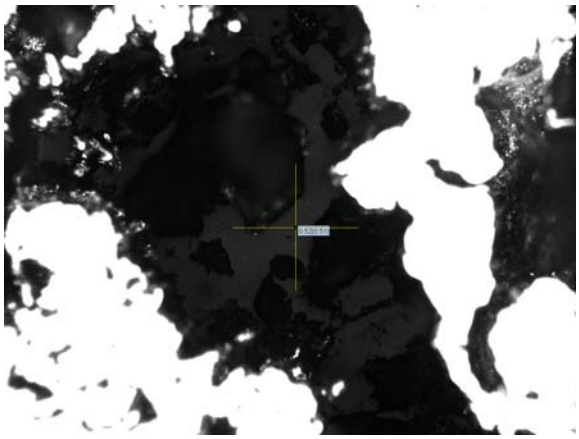
E1255D Coal Eu-ulminite, Rv max = 0.44%, reflected white light, X50



E1257A Dull (?unoxidized) zone in vitrite coal, Rv max = 0.30%, reflected white light, X50



E1257B Same grain, bright zone, Rv max = 0.58%, reflected white light, X50



E1257C Pyrite replacing organic matter in coal, reflected white light, X50