Progress Energy - Image Digitization Report

Report Revision 005
Script Version 08

Submitted to:

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Abstract

Log digitization was contracted to the Geomechanics group at the University of Toronto. The sample lithofacies core logging form (layout) provided was that of D-066-I/094-B-16 for depths ranging between approximately 1933 m down to 2136 m.

The lithofacies core logging of Lily a-9-J/94-G-2 for depth ranging between 2065 m down to 2090 m and Talisman 200/c-65-F/94-B-8 for depth ranging between 2554 m down to 2576 m were then used for verification and debugging.

Summary of Report Changes

Revision No.	Remarks
Revision 02	Report was updated to include the new features in the script. Mainly, identifying contact surfaces, sediments, and the deposition environment.
Revision 03	Report was updated to include functionalities of the new script. Mainly, the change to optical character recognition (OCR) to identify the depositional environment and depth.
Revision 04	Report was updated to include functionalities of the new script. Mainly, the change to the facies code and the additional quality measures that limit user interference.
Revision 05	Report was updated to include functionalities of GUI and indicate the additional quality control measures being employed.

Summary of Script Changes

Version No.	Remarks
Version 02	• PDF conversion is completely housed within the script. • Code optimization. Split into different modules. • Modules run for different pixel columns as defined. • Identifies deposition bedding type.
Version 03	• Adjust scale based on DPI. • Code optimization. Algorithm changed. • Changed colours in terminal outputs. • PDF split into MediaBOX to obtain higher resolution images during template matching. • Template matching functional.
Version 04	• Write Sediment and Environment to CSV. • Code optimization. Algorithm changed.
Version 05	• Added the colour code of the matching templates overlay to the Python terminal output. • Scaling template to look for possible matches. • Fixed issue with different size (length) logs.
Version 06	• The identification of the scale is now automated. • The script uses OCR to identify the depth and the depositional environment. • Fixed issue with different size (length) logs. • Fixed issue of description spanning to the extremities of the log. • Change in algorithm of the script. • Vigorous quality control measures. • Parsing OCR data. • Return facies code.
Version 07	• Batch processing added. • Auxiliary script to create a folder structure for the PDFs. • Additional quality control measures. • Updated facies code. • Verification of Pixel ID for lithology colour. • Remove ”Blank Spaces” from LAS file.
Version 08	• GUI Introduced. • Supports multi-page PDFs. • Dictionaries and Lists managed in external CSV Files. • Reads PDF Information and identities embedded fonts.

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Disclaimer

The analysis is based on high quality images and optical character recognition (OCR).

The works performed were done using the degree of care and skill ordinarily exercised under similar conditions by reputable qualified Academic Research Institutes and Engineering Firms. No other warranty, expressed or implied is made as to the professional advice included in this report.

1 Introduction

The Geomechanics Group at the University of Toronto was provided a lithofacies core logging form (layout) for D-066-I/094-B-16 for depths ranging between approximately 1933 m down to 2136 m. The aim is to establish an image processing script that is capable of digitizing the information presented in the provided log and logs of similar layout. The lithofacies core logging of Lily a-9-J/94-G-2 for depth ranging between 2065 m down to 2090 m and Talisman 200/c-65-F/94-B-8 for depth ranging between 2554 m down to 2576 m were used for verification and debugging purposes.

Initially, the main objective was to develop a script that can identify lithofacies in the core log lithology column. The identification is based on the colour scheme incorporated in the provided log. An electronic copy of the lithofacies core logging form was provided on May 9, 2018. It is to our understanding that the lithofacies core logging form was prepared using Adobe Illustrator and does not contain any visually evident document control identification pertaining to the layout used.

Additionally, the script was expanded to identify the unconformities and flooding surfaces. The scope also extended to cover template matching to identify the various symbols in the sedimentary structure column and the depositional environments.

During the meeting held on July 25, 2018, new objectives for the script were identified. It was decided that the depositional environment was to define the layer interval and the lithofacies legend define the subcategory of that environment. In addition, the number of biogenic sedimentary structures within each interval was to be returned. This information is ultimately used to return the facies code.

An updated strategy for defining the facies code was provided on November 21, 2018. In this strategy, the lithology defined the layer intervals and *Claraia*, if present, was subcategorized.

This report provides a quick overview of the processes within the script *(version 08)*. It also addresses installation procedures, software prerequisites, output formats, verification, and limitations. The script is made user-friendly by implementing a graphical user interface (GUI) requiring minimal user input, and this is complemented with vigorous quality control (QC) measures to ensure that the data within the lithofacies core logging form is processed adequately. The script is not meant to be artificially intelligent.

2 Script

The script was written using Python 3.6 on the PyCharm integrated development environment (IDE). The code was verified on spyder3 IDE. For optimization and functionality, additional modules are required: *tkinter, pdfminer, scipy, itertools, Python Imaging Library (PIL), PyPDF2, operator, itemgetter, time, os, webcolors, csv, cv2, random, numpy, collections, wand, imutils, platform, argparse, sys, fnmatch* and *Counter*. The script runs in optical character recognition (OCR) mode (Section 2.1) and image analysis mode (Section 2.2). These modes are executed serially, returning the information needed to generate the output files (Section 7). The information within the output files is checked for coherence.

2.1 OCR Mode

The script reads through the entire log and identifies all the text boxes; returning the characters that were typed in them along with their bounding box location (in Point units (Pt.)). In all cases, the handle point of the Y direction is always set as the mid height of the bounding box. The text is then analysed and the recognized characters are interpreted to obtain information regarding the depth scale of the log (Section 2.1.1), and presence of keywords, in this case *Claraia* (Section 2.1.2). The keywords are handled in an external CSV (*keywords.csv*) file in the same folder.

Additional keywords can be added into the external CSV (*keywords.csv*) by editing the file in a text editor and words added on new lines. Note that each key word should be added onto a new line and must not contain any commas (,).

2.1.1 Depth Column

The information within the depth column is processed as integers. If any non-integer value is found, a warning is given and that value is ignored during further processing (Figure 2.1a). Each integer found is associated with a Pt. value in the log. By associating the integer (i.e. depth) value in the log, the Pts. in the log can be converted into depths by using a linear relationship.

To overcome the user issue or necessity to move the first or last depth integer in the column to avoid overlap within the horizontal lines (Figure 2.1b), or to indicate the end of the core (Figure 2.1c), the scales are based on the second depth from the top and the second last depth value. This functionality is overridden in the event that only two or three depths values are encountered in the depth column.

In some cases, the non-integer values and/or information from the adjacent column partially overlays the depths values (Figure 2.1d). This results in an incorrect depth scale, in fact the depth tends to become negative. In which case the script will terminate with a fatal error informing the user such discrepancy.

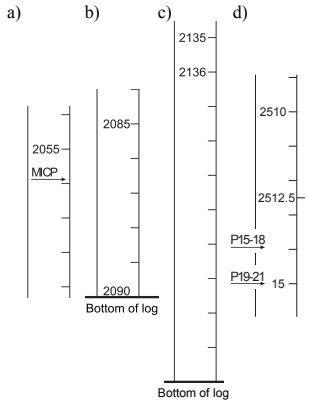


Figure 2.1: (a) Text in depth column. (b) and (c) Necessity to move text to avoid line at bottom of log. (d) Information overlaying the depth value.

2.1.2 Key Words

The strings in each text box are parsed for predefined keywords. In this case the key word is *Claraia* as it presents a criteria in the categorization of the facies code.

Since there is no specific column in which the key word may occur, the strings (in the text box) are searched for substrings (keywords). If the key word is encountered, the location of the textbox is returned and associated with a depth interval.

The keywords are handled in an external CSV (*keywords.csv*) file in the same folder. Additional keywords can be added into the external CSV (*keywords.csv*) by editing the file in a text editor and words added on new lines. Note that each key word should be added onto a new line and must not contain any commas (,).

2.2 PNG Mode

This part of the script analyses the PDF after it is converted to a picture (PNG). This part is used to (1) analyse the location of the horizontal lines (300 DPI Image) (Section 2.2.1), (2) return the RGB of the lithology column (300 DPI Image) (Section 2.2.2), and (3) identify matching locations of the template (600 DPI Partial Image) (Section 2.2.3).

In some cases, the PDF returns an image with a black background (inverted image). In such case, the slightly different colours are due to the use of a different PDF conversion engine. The user is warned with regards to the inverted image and that the outputs need to be manually and thoroughly assessed.

2.2.1 Horizontal Lines

There are two locations where the horizontal lines have to be evaluated: at the "depositional environment" (X-Pixel 1595 to X-Pixel 2465) and at the "remainder of the log" (X-Pixel 785 to X-Pixel 1530). During this process, the script will initially run and identify the Y-position of all the black pixels located along X-Pixel 2110 and X-Pixel 1525. Once returned, the script will group consecutive black pixels into one group and the centre point of each group will be defined. At each of these locations, the script will run to ensure that either: (1) all the X-pixels within the respective range at that Y-position are black, or (2) if only white and black are identified, then the ratio of black to white should be above 50 %. This would accommodate both solid black or dashed horizontal lines (Figure 2.2).

If the number of lines returned in the depositional environment and the remainder of the log differ by 1, the script will execute based on the lines encountered in the "remainder of the log" with a message displayed that the information should be analysed with care. However, if they differ by more than 1, the script will throw a warning and proceed using the intervals obtained from the "remainder of the log". The warning message will indicate the locations of the lines causing the issue which should be assessed in the output CSV to ensure consistency.

2.2.2 Lithology & Grain Size

Figure 2.2 presents an overview of the processing steps within the script. The script reads through an entire column, of one pixel width (by default the Pixel is set as 765), in the "Lithology & Grain Size" column returning RGB information within each pixel. The RGB information is converted to the nearest colour in the RGB spectrum. Once there is a match, the returned information is compared to the dictionary of predefined values that were built based on the provided legend. The dictionary also includes white and black which would correspond to blank space and horizontal lines, respectively. In the event that the colour was not found in the dictionary, the value of that pixel is replaced by the matching value preceding it. Once this is complete, the black lines are addressed by splitting the thickness of each line into two parts. Each part is then associated with the layer above and below that respective line.

The current dictionary that designates the colours to the depositional environment, blank space, or black horizontal lines is shown in Table 2.2. Each of these colours has a unique identifier in the RGB spectrum. Additional colours and their respective depositional environment can be added into the external CSV (*litho_legend.csv*) by editing the file in a text editor. The colours and their respective depositional environment should be separated by a comma (,) with no leading spaces. The corresponding RGB spectrum is managed in the *defined_color_map.csv* and the spectrum should be inserted in the format *R, G, B*.

Table 2.1: Colours codes

Description	Colour name	RGB Code
Laminated Bedded Resedimented Bioclasts	skyblue	135, 206, 235
	cornflowerblue	112, 156, 207
Bituminous F-C Siltstone	sandybrown	244, 164, 96
	goldenrod	218, 165, 32
Bituminous F-M Siltstone	tan	210, 180, 140
	darkkhaki	189, 183, 107
	rosybrown	181, 150, 117
Sandy F-C Siltstone to Silty VF Sandstone	khaki	240, 230, 140
Phosphatic - Bituminous Sandy Siltstone to Breccia	darkseagreen	143, 188, 143
Calcareous - Calcispheric Dolosiltstone	plum	221, 160, 221
	mediumvioletred	165, 71, 134
Blank Space	white	255, 255, 255
Horizontal Line	black	0, 0, 0
	darkslategray	55, 52, 53

In the event that the generated colour column is entirely white and/or black and white, it is evident that the default pixel used is incorrect. In such case, the script will re-execute using a Pixel that is 5 Pixels to the left of the default Pixel. The script will continue to reiterate until the colour column contains colours apart

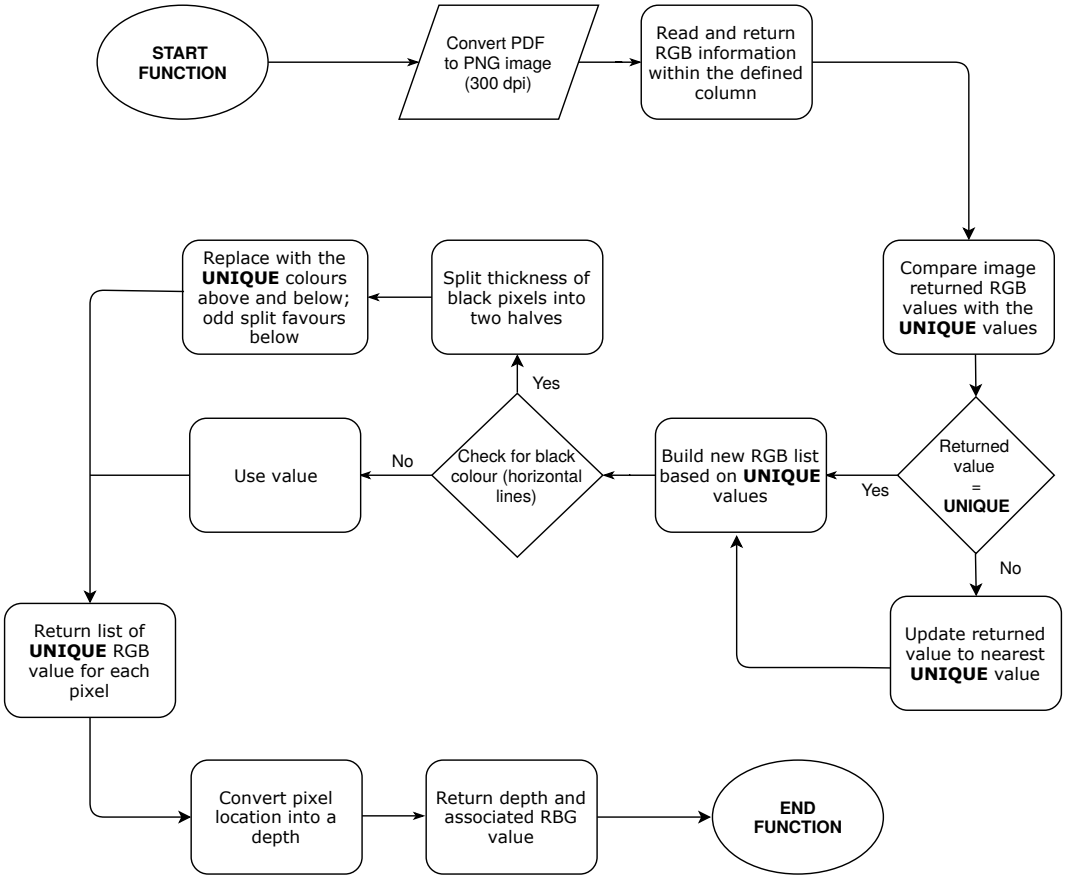


Figure 2.2: Lithology & Grain Size - Process Overview

from black and white.

2.2.3 Template Matching - Biogenic Sedimentary Structure

Figure 2.3 presents an overview of the processing steps for the template matching within the script. This method works by finding a match for the template within the main image. The accuracy of the match is currently set to higher than 70 %. Initially, the script will crop the PDF file into respective columns (in this case the biogenic sedimentary structure), then convert them into PNG images at a resolution of 600 DPI. The folder containing the templates (patterns) is loaded (Figure 2.4). The script then iterates through every image in the template folder and looks for matches within the main image, including scaled versions of the matches (Scale between 70% to 130%, at 10% increments). The match is made taking into consideration the predefined threshold. In order to avoid duplicate matches of the same pattern caused by pixelation, a distance of half the minimum length of the diagonal of all the template images is set between matches. The location of the successful matches is then returned and overlaid on top of the main image in the form of rectangles (Figure 2.3).

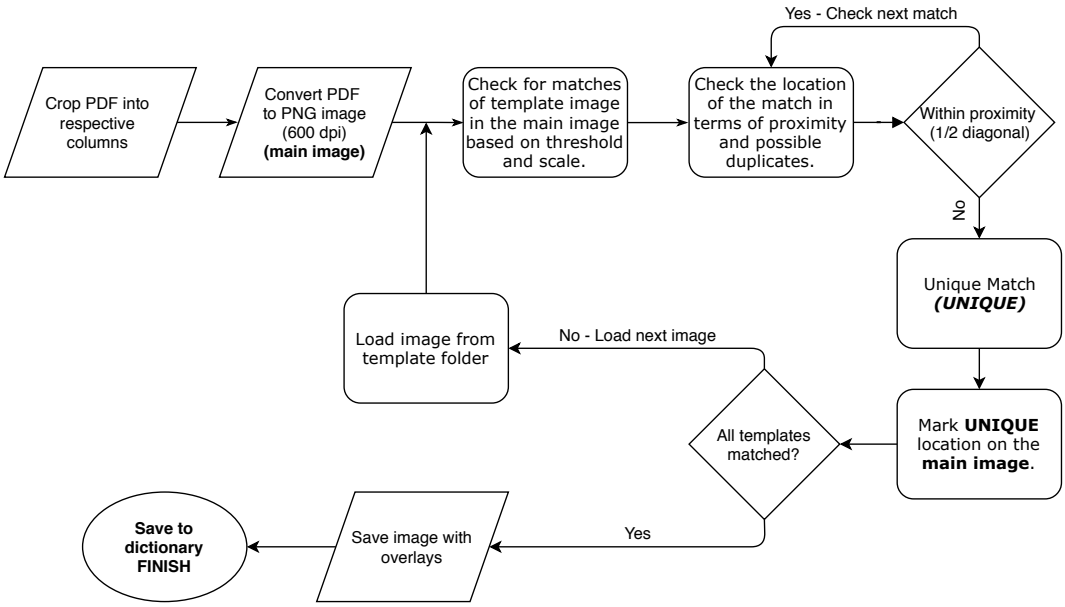


Figure 2.3: Template Matching - Process Overview

Figure 2.4: Sample of templates (patterns) used in matching

2.3 Facies Code

During the population of the data into respective layering sequence, as shown in Section 7, the data is analysed to return the facies code. The facies code provided correspond to the following conventions in the script (Table 2.2).

Table 2.2: Facies codes

Facies Code	Description (Abbreviation)	Script Convention	
		Lithology Colour	Key Word
1	Lower Shoreface (LS)	khaki	-
2	Distal - Proximal Offshore Transition (OT)	sandybrown, goldenrod	-
3	Offshore (O)	tan, darkkhaki, rosybrown	-
4	Hemipelagite (H)	plum, mediumvioletred	-
5A	Bioclastic Tempestites (generally T)	skyblue, cornflowerblue	-
5B	Biostrome	skyblue, cornflowerblue	Claraia
6	Offshore/ Transgressive Lag (O or T.Lag)	darkseagreen	-

3 Prerequisite

3.1 Python

The script was written in Python 3.6, an interpreted high-level programming language. Python can be installed by following the instructions on Python.org. Majority of the modules required for this script are installed with Python; however additional modules need to be installed using *pip*. *Pip* can be downloaded and installed by following the instructions at PyPA - pip.

Once *pip* is installed, the following command can be executed on command prompt (Windows) or as a super user (*sudo*) in terminal (Linux - Ubuntu).

$ pip install tkinter Pillow webcolors PyPDF2 wand imutils opencv-python argparse pdfminer pdfminer3

4 External Files

The script uses external CSV files to build information needed in the identification of the environments. There are three main files to be maintained and are detailed hereafter.

4.1 Lithofacies Legend CSV

This script builds a dictionary based on the information in the *litho_legend.csv*. Additional colours and their respective depositional environment can be added into the external CSV (*litho_legend.csv*) by editing the file in a text editor. The colours and their respective depositional environment should be separated by a comma (,) with no leading spaces. The content of the CSV currently includes the value in Table 4.1.

4.2 RGB CSV

In a similar manner, the R, G, B spectrum list is built from an external CSV file. Additional colours can be added into the external CSV (*defined_color_map.csv*) by editing the file in a text editor. The colours should be added in the format *R, G, B* with each colour being on a new line. The contents of the CSV file are presented in Table 4.2

4.3 Keyword CSV

Additional keywords can be added into the external CSV (*keywords.csv*) by editing the file in a text editor and words added on new lines. Currently, the external CSV only contains *Claraia*.

5 Graphical User Interface

A Graphical User Interface (GUI) was built to make the script more user friendly (Figure 5.1). The GUI allows for a single PDF file execute or executing the script on an entire folder.

Table 4.1: External CSV - Facies codes

Colour	Lithofacies
tan darkkhaki rosybrown	Bituminous F-M Siltstone
goldenrod sandybrown	Bituminous F-C Siltstone
khaki	Sandy F-C Siltstone to Silty VF Sandstone
darkseagreen	Phosphatic - Bituminous Sandy Siltstone to Breccia
mediumvioletred plum	Calcareous - Calcispheric Dolosiltstone
skyblue cornflowerblue	Laminated Bedded Resedimented Bioclasts
white	Blank Space
black darkslategray	Hz Line

Table 4.2: External CSV - RGB Spectrum

R	G	B
R	G	B
210	180	140
244	164	96
135	206	235
240	230	140
143	188	143
221	160	221
218	165	32
189	183	107
255	255	255
0	0	0
181	150	117
55	52	53
165	71	134
112	156	207

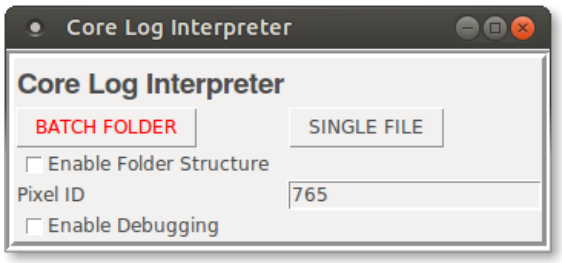


Figure 5.1: Instance of GUI

- Single File Execution. In this case a dialog box will appear asking the user to choose the PDF to be processed.
- Batch Execution. In this case a dialog box will appear and prompt the user to choose the directory to be processed. This will allow the script to iterate through all the subfolders of the path passed and execute the script for each PDF file encountered. The script is equipped with event handling, and will skip over PDFs that can not be processed. Once, the entire directory has been processed, a summary of the PDFs that were skipped will be returned to the Terminal window.

5.1 Additional Features

The GUI has some additional (optional) features that may aid the user.

- Enable Folder Structure. The script adheres to a strict folder structure, where the PDF and the templates folder should be included in the same folder. This option helps organize the PDF's in such a manner.
- Pixel ID. Override the default Pixel for the lithology colour. The default as Pixel ID 765.
- Enable Debugging. Advanced function to show additional information during the execution of the script to assist in debugging.

5.2 Execution

In order to execute the script, the script file should be opened and executed within the *Python3* user interface.

*$ python3 full_path_of_python_to_**Main_Window.py***

6 Execution Time and Outputs

The script was executed on an 8 thread Intel® Core™ i7-6700 CPU @ 4.00GHz desktop computer running Linux Ubuntu 16.04.4 LTS. The average time taken to analyse the log and produce the required output is presented in Table 6.1.

Table 6.1: Execution Time

Log Name	Depth Interval	Execution Time on Linux Ubuntu
Talisman 200/c-65-F/94-B-8	2554 m to 2576 m	14.14 seconds
Lily a-9-J / 94-G-2	2001 m to 2320 m	8 minutes and 7 seconds

7 Output Format

7.1 Terminal

The script is interactive in a way, as it keeps the user informed of any problems met during execution. It also highlights possible errors and locations that should be further addressed or evaluated by the user. The respective logs and the typical terminal outputs associated with them are presented in Section 10.

7.2 LAS File

The script outputs the information into a *.csv* file format that can be easily opened and further processed. The output is returned as layers of predefined thickness, as defined by the user (Table 7.1), currently set at 0.1 meter intervals.

Table 7.1: LAS Sequence - Sample output

Depth (m)	Facies Code	Lithology	No. Biogenic	Percentages
2559.6	3	Bituminous F-M Siltstone	0	'Bituminous F-M Siltstone', 100
2559.7	3	Bituminous F-M Siltstone	0	'Bituminous F-M Siltstone', 100
2559.8	3	Bituminous F-M Siltstone	0	'Bituminous F-M Siltstone', 100
2559.9	2	Bituminous F-C Siltstone	4	'Bituminous F-C Siltstone', 53, 'Bituminous F-M Siltstone', 47
2560.0	2	Bituminous F-C Siltstone	4	'Bituminous F-C Siltstone', 53, 'Bituminous F-M Siltstone', 47
2560.1	2	Bituminous F-C Siltstone	4	'Bituminous F-C Siltstone', 53, 'Bituminous F-M Siltstone', 47

7.3 Layered Sequence File

The script outputs the information into a *.csv* file format that can be easily opened and further processed. The output is returned as a layered sequence that is governed the horizontal lines (Table 7.2). The lithology

at mid height is also returned along with the percentage value of the various lithology within that depth sequence.

Table 7.2: Layered Sequence - Sample output

From (m)	To (m)	Environment	Lithology at mid height	No. Biogenic	Percentages
2098.0	2098.1	UNKNOWN	Calcareous - Calcispheric Dolosiltstone	0	'Calcareous - Calcispheric Dolosiltstone', 100
2098.1	2099.7	UNKNOWN	Bituminous F-M Siltstone	0	'Bituminous F-M Siltstone', 100
2099.7	2100.1	UNKNOWN	Calcareous - Calcispheric Dolosiltstone	0	'Calcareous - Calcispheric Dolosiltstone', 51, 'Bituminous F-M Siltstone', 49
2100.1	2100.3	Claraia	Laminated Bedded Resedimented Bioclasts	0	'Laminated Bedded Resedimented Bioclasts', 100

7.4 Image Format Output

For easy visual identification and QC, the script produces an image with an overlay of the matched biogenic sedimentary structures. The overlay is colour coded indicating the locations of the detected matches of the template image on the main image (Figure 7.1).

8 Script Verification

Several depths along the provided lithofacies core logging form were used for verification purposes. Three examples were considered to validate and check the robustness of the script.

- Pixelation within layer. In this case, the script will consider it to be one continuous layer (Figure 8.1).
- Pixelation at boundary. In this case, the script will correspond the pixels above and below the thick horizontal black line to the layer above and below the line, respectively (Figure 8.2).
- Frequent layering. In this case, the script was able to handle the frequent layering with no additional user interference or significant computational time (Figure 8.3).

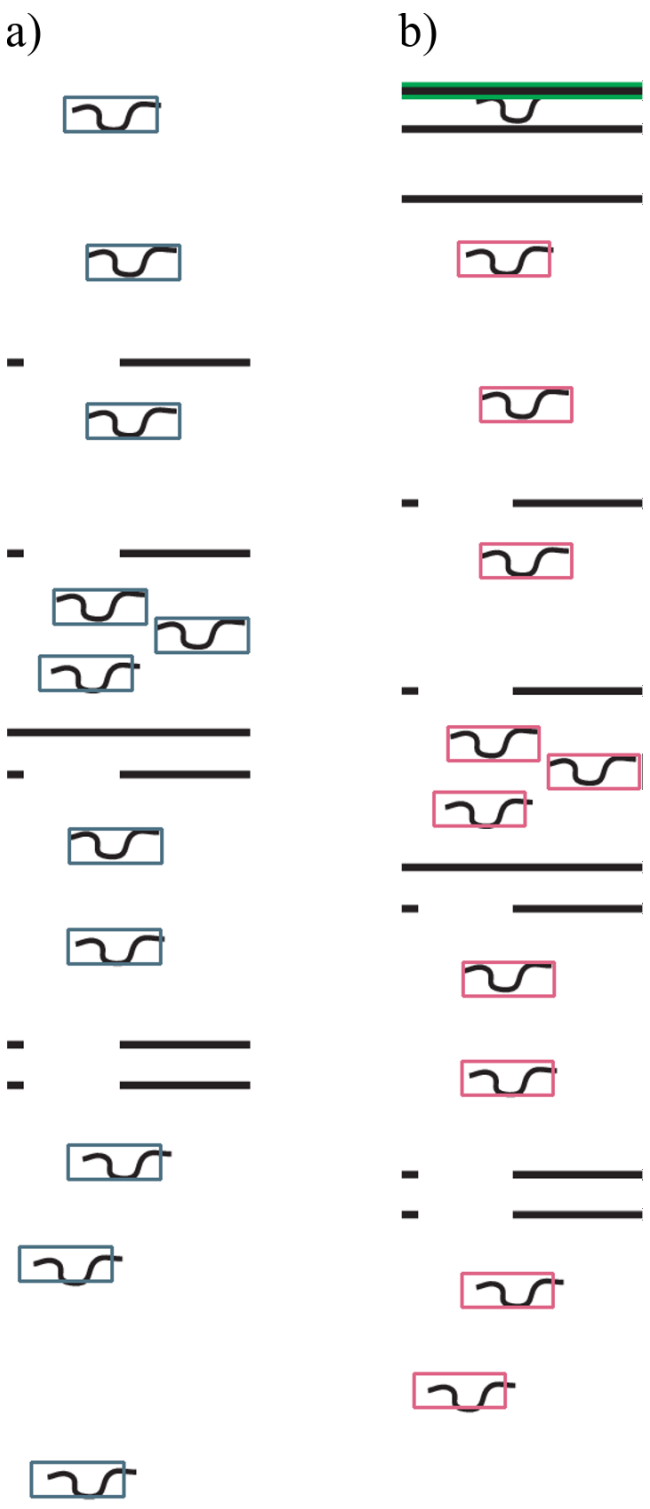


Figure 7.1: Example of template match output. (a) shows a good template match, while (b) shows a bad template match in the first biogenic feature as it is covered by the green flooding surface line.

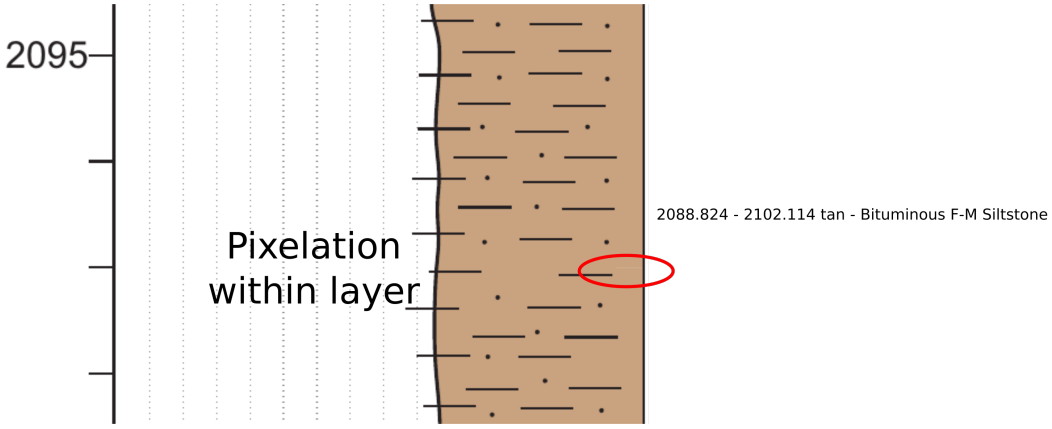


Figure 8.1: Pixelation within layer

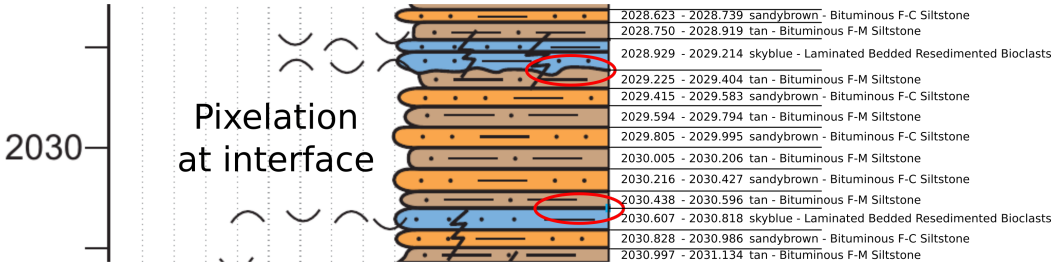


Figure 8.2: Pixelation at interface

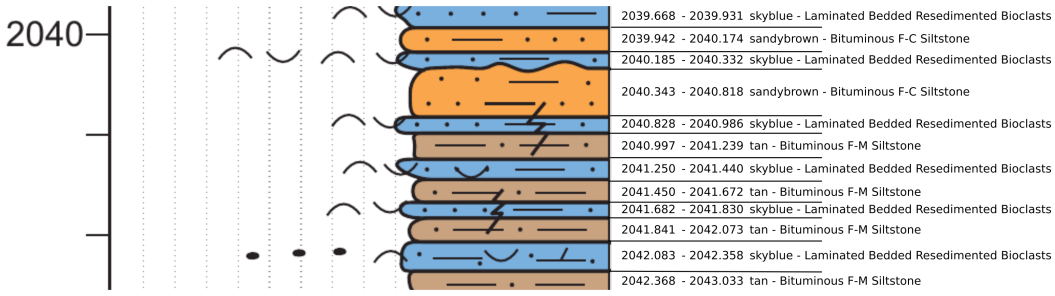


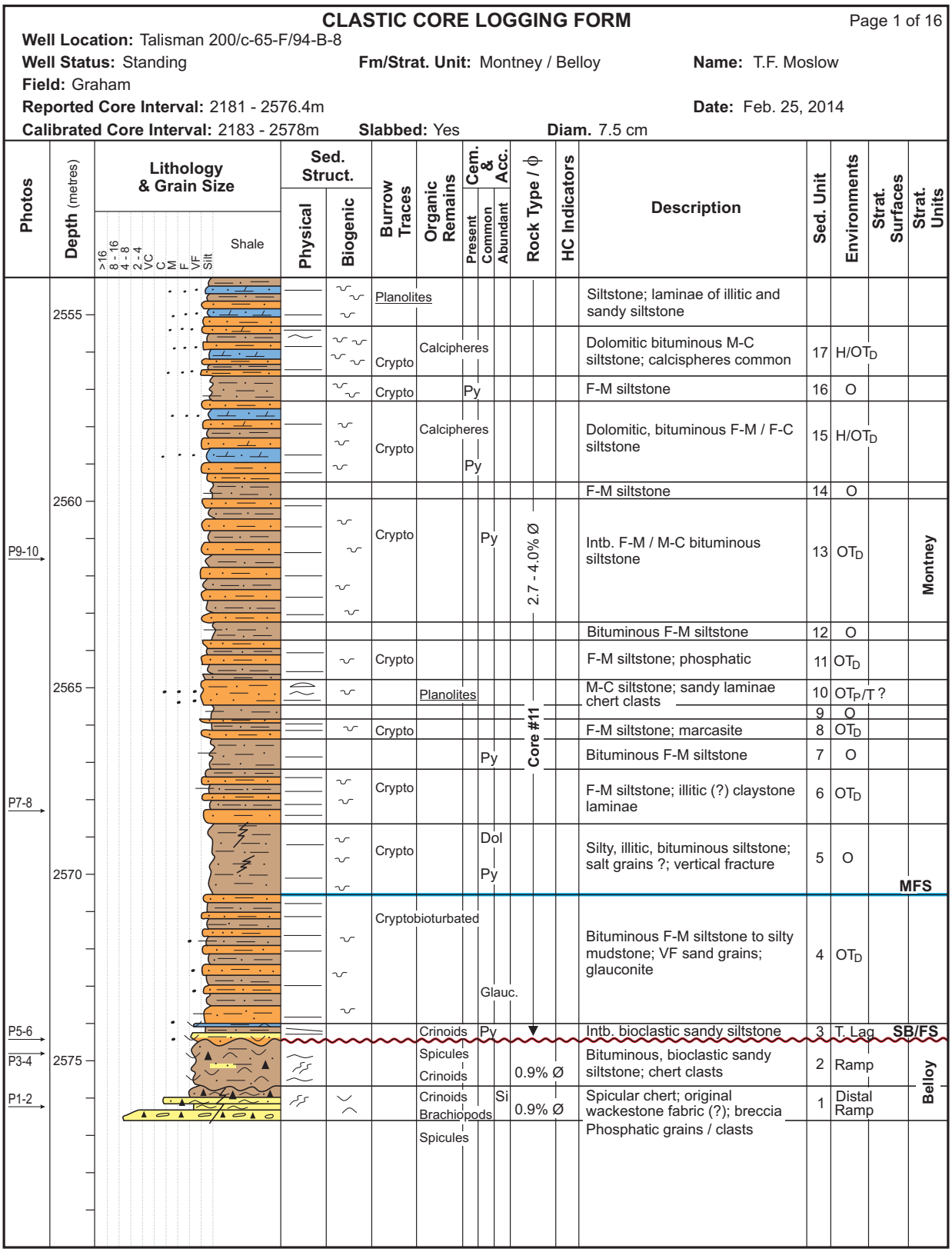
Figure 8.3: Frequent layering

9 Script Limitations

The script and associated Python modules have several limitations. Some of which are discussed below:

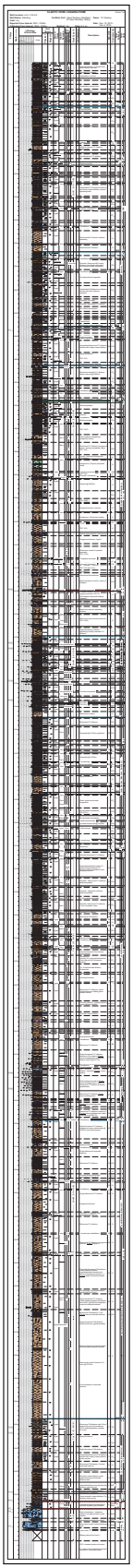
- The script is not interactive, thus all colours and templates have to be identified before executing the code. However, provided that the same layout and legends are followed, this does not constitute as a limitation.
- The templates (patterns) have to preserve the reference pattern within the main image. Currently, scaled versions of the template image are supported, however, distorted, covered or skewed patterns are not supported.
- The script will fail to execute in the event that fonts are not embedded as they are identified as paths which are not compatible with the OCR.
- The script will fail to execute if the templates folder is not located as a sub directory in the folder containing the PDF.

10 Logs and Terminal Output



```
PDF Engines Corel PDF Engine Version 14.0.0.701 CorelDRAW, Made by Phil on 20140419
Font List => {'/QUJOUL+ArialMT,Bold', '/VKZTNJ+ArialMT', '/ZYZXQK+ArialNarrow'}
LOADING Talisman c-65-F_Page 1.pdf. Please be patient...
PAGE 1 DIMENSIONS is [-0.0, -0.0, 612.0, 792.0] points.
PDF PAGE 1 / 1 LOADED.
PDF OCR COMPLETED.

Name:    T.F. Moslow
Well Location:   Talisman 200/c-65-F/94-B-8
Date:    Feb. 25, 2014
Fm/Strat. Unit:          Montney / Belloy

Depths Values in the Depth Column checked

Pt. Location in the Depth Column checked

Processed Depth Column - OCR Mode.
Coeff : -0.044 x + 2580.793.

Pt. : OCR Depth value
131 Pt. : 2575 meters
245 Pt. : 2570 meters
358 Pt. : 2565 meters
472 Pt. : 2560 meters
586 Pt. : 2555 meters

Processed Environments (Key Word) - OCR Mode

No Keyword Found in log

Processing Hz lines - PNG Mode
Image Loaded - Dimensions 2550 px X 3300 px @ 300 dpi.
Pixel to Point ratio is: 4.167

Processed Hz lines - PNG Mode

Identified Layers
Depth from (m) : Depth to (m)
2546.685 : 2550.307
2550.307 : 2553.986
2553.986 : 2555.292
2555.292 : 2556.634
2556.634 : 2557.306
2557.306 : 2559.478
2559.478 : 2559.933
2559.933 : 2563.242
2563.242 : 2563.729
2563.729 : 2564.791
2564.791 : 2565.473
2565.473 : 2565.854
2565.854 : 2566.388
2566.388 : 2567.202
2567.202 : 2568.666
2568.666 : 2570.569
2570.569 : 2574.037
2574.037 : 2574.449
2574.449 : 2575.713
2575.713 : 2576.638
2576.638 : 2580.048

Processing color column - PNG Mode

Image Loaded - Dimensions 2550 px X 3300 px @ 300 dpi.
Pixel to Point ratio is: 4.17
```


```
No. of existing colors in Pixel ID 765 column is: 29
Looking up a total of 14 defined colors.

User defined Colors:

RGB: (210, 180, 140)    - Closest RGB colour name: tan
RGB: (244, 164, 96)     - Closest RGB colour name: sandybrown
RGB: (135, 206, 235)    - Closest RGB colour name: skyblue
RGB: (240, 230, 140)    - Closest RGB colour name: khaki
RGB: (143, 188, 143)    - Closest RGB colour name: darkseagreen
RGB: (221, 160, 221)    - Closest RGB colour name: plum
RGB: (218, 165, 32)     - Closest RGB colour name: goldenrod
RGB: (189, 183, 107)    - Closest RGB colour name: darkkhaki
RGB: (255, 255, 255)    - Closest RGB colour name: white
RGB: (0, 0, 0)  - Closest RGB colour name: black
RGB: (181, 150, 117)    - Closest RGB colour name: rosybrown
RGB: (55, 52, 53)       - Closest RGB colour name: darkslategray
RGB: (165, 71, 134)     - Closest RGB colour name: mediumvioletred
RGB: (112, 156, 207)    - Closest RGB colour name: cornflowerblue

Processed color column

Processing TEMPLATES - PNG Mode
Found 5 templates in folder

Image Loaded - Dimensions 208 px X 6600 px @ 600 dpi.
Pixel to Point ratio is: 4.17
Found 27 matches.
Detected image saved.


Processing CSV Information
READING ENVIRONMENT
EVERYTHING in ENVIRONMENT HAS BEEN MATCHED
EMPTY ENTRIES FOUND IN ENVIRONMENT ARE BEING POPULATED AS 'UNKNOWN'

FINAL OUTPUT
LAYER INTERVAL FORMAT

Depth interval output file written

FINAL OUTPUT
LAS FORMAT

LAS output file written

FINAL OUTPUT
MODIFIED LAS FORMAT

MODIFIED LAS output file written

Total Execution time: 37.48 seconds
```

```
PDF Engines Corel PDF Engine Version 18.1.0.661 CorelDRAW X8, Made by Samantha Mackie on 20180820
Font List => {'/EKXWMB+ArialMT', '/RADKSM+ArialNarrow', '/BZOMZC+Arial-BoldMT'}

Unembedded Fonts
LOADING a-9-J_94-G-2_(revised).pdf. Please be patient...
PAGE 1 DIMENSIONS is [-0.0, -0.0, 612.0, 7650.0] points.
PDF PAGE 1 / 1 LOADED.
PDF OCR COMPLETED.

Date:    Dec. 10, 2015 -
Fm/Strat. Unit:          Upper Montney (Spathian)
Name:    T.F. Moslow
Well Location:   a-9-J / 94-G-2

Depths Values in the Depth Column checked
Status 12 - Possible error in scale of Pt. Location.
Values are [114 113 114 114 114 114 113 114 114 114 113 114 114 114 113 114 114 114
 114 113 114 114 114 113 114 114 114 113 114 114 114 113 114 114 114 114
 113 114 114 114 113 114 114 114 113 114 114 114 114 113 114 114 114 113
 114 114 114 113 114 114 114 114 113  91]

Processed Depth Column - OCR Mode.
Coeff : -0.044 x + 2324.933.

Pt. : OCR Depth value
112 Pt. : 2320 meters
226 Pt. : 2315 meters
339 Pt. : 2310 meters
453 Pt. : 2305 meters
567 Pt. : 2300 meters
681 Pt. : 2295 meters
795 Pt. : 2290 meters
908 Pt. : 2285 meters
1022 Pt. : 2280 meters
1136 Pt. : 2275 meters
1250 Pt. : 2270 meters
1363 Pt. : 2265 meters
1477 Pt. : 2260 meters
1591 Pt. : 2255 meters
1705 Pt. : 2250 meters
1818 Pt. : 2245 meters
1932 Pt. : 2240 meters
2046 Pt. : 2235 meters
2160 Pt. : 2230 meters
2274 Pt. : 2225 meters
2387 Pt. : 2220 meters
2501 Pt. : 2215 meters
2615 Pt. : 2210 meters
2729 Pt. : 2205 meters
2842 Pt. : 2200 meters
2956 Pt. : 2195 meters
3070 Pt. : 2190 meters
3184 Pt. : 2185 meters
3297 Pt. : 2180 meters
3411 Pt. : 2175 meters
3525 Pt. : 2170 meters
3639 Pt. : 2165 meters
3752 Pt. : 2160 meters
3866 Pt. : 2155 meters
3980 Pt. : 2150 meters
4094 Pt. : 2145 meters
4208 Pt. : 2140 meters
4321 Pt. : 2135 meters
4435 Pt. : 2130 meters
4549 Pt. : 2125 meters
4663 Pt. : 2120 meters
4776 Pt. : 2115 meters
4890 Pt. : 2110 meters
5004 Pt. : 2105 meters
5118 Pt. : 2100 meters
5231 Pt. : 2095 meters
5345 Pt. : 2090 meters
5459 Pt. : 2085 meters
5573 Pt. : 2080 meters
5687 Pt. : 2075 meters
5800 Pt. : 2070 meters
5914 Pt. : 2065 meters
6028 Pt. : 2060 meters
6142 Pt. : 2055 meters
6255 Pt. : 2050 meters
6369 Pt. : 2045 meters
6483 Pt. : 2040 meters
6597 Pt. : 2035 meters
6710 Pt. : 2030 meters
6824 Pt. : 2025 meters
6938 Pt. : 2020 meters
7052 Pt. : 2015 meters
7166 Pt. : 2010 meters
7279 Pt. : 2005 meters
7370 Pt. : 2001 meters

Processed Environments (Key Word) - OCR Mode

Depth (m) : Environment (Key Word)
2100.193 : Claraia
2210.347 : Claraia
2214.960 : Claraia
```


2215.619 : **Claraia**
2217.649 : **Claraia**
2218.086 : **Claraia**
2218.848 : **Claraia**
2219.447 : **Claraia**
2220.551 : **Claraia**
2221.377 : **Claraia**
2223.461 : **Claraia**
2223.742 : **Claraia**
2224.935 : **Claraia**
2225.258 : **Claraia**
2225.843 : **Claraia**
2227.733 : **Claraia**
2227.735 : **Claraia**
2230.795 : **Claraia**
2235.113 : **Claraia**
2238.506 : **Claraia**
2242.475 : **Claraia**
2255.741 : **Claraia**
2255.775 : **Claraia**
2259.740 : **Claraia**
2262.085 : **Claraia**
2270.607 : **Claraia**
2271.037 : **Claraia**
2295.793 : **Claraia**
Negative Image
Converting Image
*-1.png

Processing Hz lines - PNG Mode
Image Loaded - Dimensions 2550 px X 31876 px @ 300 dpi.
Pixel to Point ratio is: 4.167
LINE IN ALL PNG AND ENV PNG DO NOT MATCH
PROCEED WITH CAUTION
The following depths indicate discrepancy
Check Horizontal Depths at: [2048.5343767143054, 2049.103988788827, 2051.530114291419, 2052.7800963438417, 2053.6345144556244, 2051.99424

Processed Hz lines - PNG Mode

Identified Layers
Depth from (m) : Depth to (m)
1989.717 : 1990.096
1990.096 : 1993.329
1993.329 : 1997.000
1997.000 : 2001.014
2001.014 : 2001.278
2001.278 : 2002.739
2002.739 : 2003.308
2003.308 : 2004.358
2004.358 : 2004.806
2004.806 : 2005.666
2005.666 : 2006.742
2006.742 : 2007.427
2007.427 : 2007.686
2007.686 : 2007.849
2007.849 : 2009.300
2009.300 : 2009.505
2009.505 : 2010.159
2010.159 : 2010.381
2010.381 : 2010.740
2010.740 : 2011.499
2011.499 : 2011.874
2011.874 : 2012.628
2012.628 : 2012.839
2012.839 : 2014.379
2014.379 : 2014.780
2014.780 : 2017.891
2017.891 : 2018.092
2018.092 : 2018.361
2018.361 : 2018.830
2018.830 : 2019.832
2019.832 : 2020.455
2020.455 : 2020.687
2020.687 : 2021.699
2021.699 : 2022.417
2022.417 : 2023.144
2023.144 : 2023.429
2023.429 : 2024.632
2024.632 : 2025.012
2025.012 : 2025.391
2025.391 : 2025.708
2025.708 : 2026.731
2026.731 : 2026.984
2026.984 : 2027.269
2027.269 : 2029.822
2029.822 : 2030.201
2030.201 : 2030.855
2030.855 : 2031.056
2031.056 : 2032.058
2032.058 : 2032.311
2032.311 : 2032.575
2032.575 : 2032.997
2032.997 : 2035.043
2035.043 : 2035.486
2035.486 : 2036.314
2036.314 : 2036.583
2036.583 : 2037.258
2037.258 : 2040.075

```
2040.075 : 2040.317
2040.317 : 2041.815
2041.815 : 2042.617
2042.617 : 2043.260
2043.260 : 2043.524
2043.524 : 2045.670
2045.670 : 2046.040
2046.040 : 2046.235
2046.235 : 2048.534
2048.534 : 2049.104
2049.104 : 2051.530
2051.530 : 2051.994
2051.994 : 2052.780
2052.780 : 2053.635
2053.635 : 2054.674
2054.674 : 2055.106
2055.106 : 2055.633
2055.633 : 2055.960
2055.960 : 2056.161
2056.161 : 2056.398
2056.398 : 2057.295
2057.295 : 2057.912
2057.912 : 2058.133
2058.133 : 2058.418
2058.418 : 2058.735
2058.735 : 2059.378
2059.378 : 2060.043
2060.043 : 2060.349
2060.349 : 2060.691
2060.691 : 2060.939
2060.939 : 2063.555
2063.555 : 2065.697
2065.697 : 2066.329
2066.329 : 2066.867
2066.867 : 2069.030
2069.030 : 2069.272
2069.272 : 2070.496
2070.496 : 2070.718
2070.718 : 2071.234
2071.234 : 2071.730
2071.730 : 2072.026
2072.026 : 2072.353
2072.353 : 2072.500
2072.500 : 2073.339
2073.339 : 2073.903
2073.903 : 2074.072
2074.072 : 2074.388
2074.388 : 2075.770
2075.770 : 2076.619
2076.619 : 2077.416
2077.416 : 2077.606
2077.606 : 2078.808
2078.808 : 2078.988
2078.988 : 2081.266
2081.266 : 2082.943
2082.943 : 2085.622
2085.622 : 2086.561
2086.561 : 2086.725
2086.725 : 2089.198
2089.198 : 2089.483
2089.483 : 2090.369
2090.369 : 2090.760
2090.760 : 2090.918
2090.918 : 2093.397
2093.397 : 2095.074
2095.074 : 2095.907
2095.907 : 2096.139
2096.139 : 2097.969
2097.969 : 2098.106
2098.106 : 2099.747
2099.747 : 2100.148
2100.148 : 2100.316
2100.316 : 2100.538
2100.538 : 2102.352
2102.352 : 2103.091
2103.091 : 2104.820
2104.820 : 2105.390
2105.390 : 2107.890
2107.890 : 2108.201
2108.201 : 2109.071
2109.071 : 2109.346
2109.346 : 2110.527
2110.527 : 2111.118
2111.118 : 2111.503
2111.503 : 2111.814
2111.814 : 2114.810
2114.810 : 2115.042
2115.042 : 2115.358
2115.358 : 2116.946
2116.946 : 2117.331
2117.331 : 2117.995
2117.995 : 2118.365
2118.365 : 2119.873
2119.873 : 2120.095
2120.095 : 2122.679
2122.679 : 2122.900
2122.900 : 2124.709
2124.709 : 2125.464
```


```
2125.464 : 2126.445
2126.445 : 2126.645
2126.645 : 2126.867
2126.867 : 2127.088
2127.088 : 2128.048
2128.048 : 2128.301
2128.301 : 2128.607
2128.607 : 2128.829
2128.829 : 2129.746
2129.746 : 2129.957
2129.957 : 2130.358
2130.358 : 2130.548
2130.548 : 2131.307
2131.307 : 2131.571
2131.571 : 2131.782
2131.782 : 2132.046
2132.046 : 2132.310
2132.310 : 2132.784
2132.784 : 2133.923
2133.923 : 2134.530
2134.530 : 2134.704
2134.704 : 2135.089
2135.089 : 2135.358
2135.358 : 2136.582
2136.582 : 2136.888
2136.888 : 2137.700
2137.700 : 2137.958
2137.958 : 2138.649
2138.649 : 2139.008
2139.008 : 2139.187
2139.187 : 2139.382
2139.382 : 2139.620
2139.620 : 2140.158
2140.158 : 2141.044
2141.044 : 2142.309
2142.309 : 2142.510
2142.510 : 2144.071
2144.071 : 2144.387
2144.387 : 2147.130
2147.130 : 2147.415
2147.415 : 2148.090
2148.090 : 2148.396
2148.396 : 2149.229
2149.229 : 2149.461
2149.461 : 2149.978
2149.978 : 2150.157
2150.157 : 2151.908
2151.908 : 2152.109
2152.109 : 2152.794
2152.794 : 2153.079
2153.079 : 2154.556
2154.556 : 2154.883
2154.883 : 2156.613
2156.613 : 2156.803
2156.803 : 2157.103
2157.103 : 2157.267
2157.267 : 2158.501
2158.501 : 2158.902
2158.902 : 2159.092
2159.092 : 2161.871
2161.871 : 2163.280
2163.280 : 2163.512
2163.512 : 2164.556
2164.556 : 2164.777
2164.777 : 2165.758
2165.758 : 2166.017
2166.017 : 2166.339
2166.339 : 2167.436
2167.436 : 2168.617
2168.617 : 2168.839
2168.839 : 2169.529
2169.529 : 2169.682
2169.682 : 2170.832
2170.832 : 2171.054
2171.054 : 2171.402
2171.402 : 2172.594
2172.594 : 2172.857
2172.857 : 2176.739
2176.739 : 2176.961
2176.961 : 2178.680
2178.680 : 2178.997
2178.997 : 2180.953
2180.953 : 2181.708
2181.708 : 2183.902
2183.902 : 2184.092
2184.092 : 2184.693
2184.693 : 2185.885
2185.885 : 2186.085
2186.085 : 2187.034
2187.034 : 2187.309
2187.309 : 2187.499
2187.499 : 2189.123
2189.123 : 2189.566
2189.566 : 2190.220
2190.220 : 2190.463
2190.463 : 2191.623
2191.623 : 2191.866
2191.866 : 2192.066
```


```
2192.066 : 2192.446
2192.446 : 2193.664
2193.664 : 2195.536
2195.536 : 2197.319
2197.319 : 2197.752
2197.752 : 2199.466
2199.466 : 2199.745
2199.745 : 2203.511
2203.511 : 2204.598
2204.598 : 2205.874
2205.874 : 2206.697
2206.697 : 2207.572
2207.572 : 2208.031
2208.031 : 2209.460
2209.460 : 2209.798
2209.798 : 2210.157
2210.157 : 2210.557
2210.557 : 2211.718
2211.718 : 2211.981
2211.981 : 2214.112
2214.112 : 2217.414
2217.414 : 2217.730
2217.730 : 2218.078
2218.078 : 2219.655
2219.655 : 2222.899
2222.899 : 2224.608
2224.608 : 2224.819
2224.819 : 2225.082
2225.082 : 2225.404
2225.404 : 2226.359
2226.359 : 2226.897
2226.897 : 2228.648
2228.648 : 2229.006
2229.006 : 2229.260
2229.260 : 2233.300
2233.300 : 2234.154
2234.154 : 2234.977
2234.977 : 2235.283
2235.283 : 2237.171
2237.171 : 2239.766
2239.766 : 2240.831
2240.831 : 2241.770
2241.770 : 2242.308
2242.308 : 2242.667
2242.667 : 2244.122
2244.122 : 2244.323
2244.323 : 2249.069
2249.069 : 2250.035
2250.035 : 2253.616
2253.616 : 2253.858
2253.858 : 2257.814
2257.814 : 2258.468
2258.468 : 2265.736
2265.736 : 2266.743
2266.743 : 2270.135
2270.135 : 2293.710
2293.710 : 2297.138
2297.138 : 2299.691
2299.691 : 2301.031
2301.031 : 2302.887
2302.887 : 2304.564
2304.564 : 2305.213
2305.213 : 2307.402
2307.402 : 2308.889
2308.889 : 2309.438
2309.438 : 2309.865
2309.865 : 2311.526
2311.526 : 2313.124
2313.124 : 2315.197
2315.197 : 2315.951
2315.951 : 2317.249
2317.249 : 2317.660
2317.660 : 2317.803
2317.803 : 2320.071
2320.071 : 2324.016

Processing color column - PNG Mode

Image Loaded - Dimensions 2550 px X 31876 px @ 300 dpi.
Pixel to Point ratio is: 4.17
No. of existing colors in Pixel ID 765 column is: 117
Looking up a total of 14 defined colors.

User defined Colors:

RGB: (210, 180, 140)    - Closest RGB colour name: tan
RGB: (244, 164, 96)     - Closest RGB colour name: sandybrown
RGB: (135, 206, 235)    - Closest RGB colour name: skyblue
RGB: (240, 230, 140)    - Closest RGB colour name: khaki
RGB: (143, 188, 143)    - Closest RGB colour name: darkseagreen
RGB: (221, 160, 221)    - Closest RGB colour name: plum
RGB: (218, 165, 32)     - Closest RGB colour name: goldenrod
RGB: (189, 183, 107)    - Closest RGB colour name: darkkhaki
RGB: (255, 255, 255)    - Closest RGB colour name: white
RGB: (0, 0, 0)  - Closest RGB colour name: black
RGB: (181, 150, 117)    - Closest RGB colour name: rosybrown
RGB: (55, 52, 53)       - Closest RGB colour name: darkslategrey
RGB: (165, 71, 134)     - Closest RGB colour name: mediumvioletred
```


```
RGB: (112, 156, 207)    - Closest RGB colour name: cornflowerblue

Processed color column
Negative Image
Converting Image
*-1.png

Processing TEMPLATES - PNG Mode
Found 5 templates in folder

Image Loaded - Dimensions 209 px X 63751 px @ 600 dpi.
Pixel to Point ratio is: 4.17
Found 207 matches.
Detected image saved.


Processing CSV Information
READING ENVIRONMENT
EVERYTHING in ENVIRONMENT HAS BEEN MATCHED
PLEASE CHECK 2214.112 - ['Claraia', 'Claraia']
Considered as similar environment - Claraia
PLEASE CHECK 2218.078 - ['Claraia', 'Claraia', 'Claraia']
Considered as similar environment - Claraia
PLEASE CHECK 2219.655 - ['Claraia', 'Claraia']
Considered as similar environment - Claraia
PLEASE CHECK 2222.899 - ['Claraia', 'Claraia']
Considered as similar environment - Claraia
PLEASE CHECK 2226.897 - ['Claraia', 'Claraia']
Considered as similar environment - Claraia
PLEASE CHECK 2253.858 - ['Claraia', 'Claraia']
Considered as similar environment - Claraia
PLEASE CHECK 2258.468 - ['Claraia', 'Claraia']
Considered as similar environment - Claraia
PLEASE CHECK 2270.135 - ['Claraia', 'Claraia']
Considered as similar environment - Claraia
EMPTY ENTRIES FOUND IN ENVIRONMENT ARE BEING POPULATED AS 'UNKNOWN'

FINAL OUTPUT
LAYER INTERVAL FORMAT

Depth interval output file written

FINAL OUTPUT
LAS FORMAT

LAS output file written

FINAL OUTPUT
MODIFIED LAS FORMAT

MODIFIED LAS output file written

Total Execution time: 9 minutes and 30 seconds
```