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Comparing Point Counting & Image Analysis in Sandstone North Carnarvon Basin, Australia

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Abstract. Point counting is a statistical method of estimating the proportion of different mineral occurrences and porosity in a thin section slide using a petrographic microscope. Image analysis can be used for the same purpose but uses computer imaging technology and thin section photomicrographs.
A study comparing these two methods was performed on three wells in the North Carnarvon Basin, WNW Australia. Both methods produced similar results; however, the image analysis technique is much faster, needs little expertise and only requires a PC and thin section photomicrographs. This makes the image analysis method much more accessible to most working geoscientists. The results can be very helpful for checking routine core analysis results and for differentiating micro- and macro- porosity systems.

Keywords: Point Counting, Image Analysis, Thin Section

1. Introduction

The North Carnarvon Basin, in west-northwest Australia, has proven to be a major hydrocarbon province. A combination of tectonic rifting and basin deposition has contributed to the generation, migration, and entrapment of hydrocarbons in Triassic to Early Cretaceous sediments.

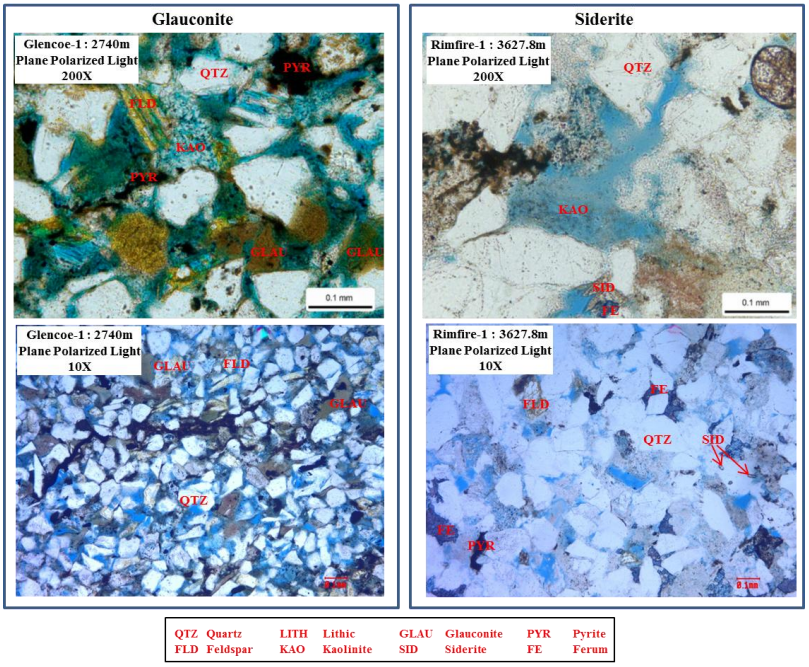

Fig. 1: Thin Sections from Various Reservoirs

The feldspathic litharenite, sublitharenite and subarkose Triassic sandstone reservoirs are interpreted to have been deposited in a fluvio-deltaic environment. The reservoirs are moderately sorted, medium to coarse

grained sand with porosity ranges of 10-30%. Thin sections from Rimfire-1 and Nimblefoot-1 were used in this study from this interval.

The feldspathic litharenite Jurassic sandstone reservoirs are interpreted to have been deposited in a low to middle shoreface environment. The reservoirs are well sorted, very fine sand to fine grained sand with porosity ranges of 5-25%. Thin sections from Glencoe-1 were used in this study from this interval.

The subarkose Early Cretaceous sandstone reservoirs are interpreted to have been deposited in a shelfal marine environment. The reservoir is moderately to well sorted, fine to medium sand, with porosity up to 28%. Thin sections from Nimblefoot-1 were used in this study from this interval.

Figure 1 shows examples of thin sections from these different reservoir intervals.

2. Estimating Mineral and Porosity Percentages

In determining the percentage of minerals and porosity thin sections were used. The thin section slides for the wells in this study were prepared for Hess Australia by Core Lab Australia and are kept at the Department of Minerals & Petroleum of Western Australia. In this study, 67 thin sections from Glencoe-1, Nimblefoot-1, and Rimfire-1 wells were used. The procedure followed for all thin sections was:

- Identify minerals present;
- Determine mineral and porosity abundances through point counting and image analysis;
- Measurement of grain size and sorting – seen visually under the microscope or from photomicrographs.

2.1. Petrographic microscope minerals and porosity identification

A petrographic microscope with objectives of 5X, 10X and 40X with a circular rotating stage and scales was used to point count the thin sections. Plane polarized light and cross polarized light was used to identify the minerals and porosity.

A representative thin section with average grain size of fine to medium sand was selected and point counted with various counts in order to determine the number of counts to be used for the study. Below is a histogram showing the percentages of quartz, feldspar and lithics estimated based on 50, 100, 200, 300 and 400 counts. It appears that a stable result could be obtained when more than 200 counts/thin section was used. For this study all thin sections were point counted at 300 counts.

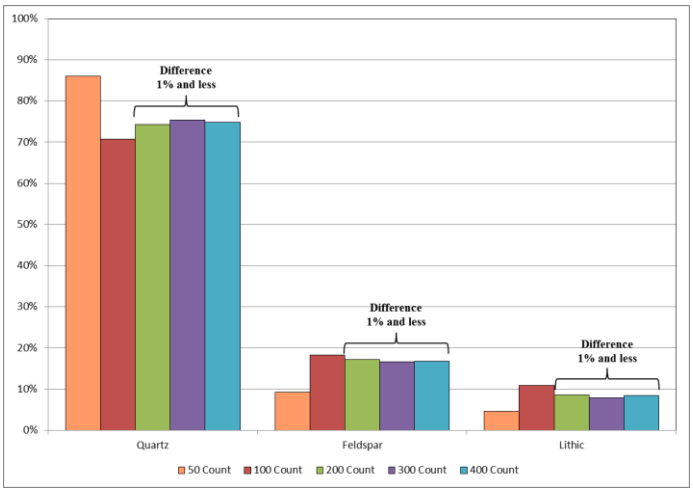

Fig. 2: Histogram of Point Counting Counts

2.2. Image analysis

Image analysis was used on selected plane polarized photomicrographs, with the main criteria being high resolution and properly exposed images. The freeware used was JMicrovision v1.27 which was developed by Nicolas Roduit from 2002-2008 requires no special image analysis skills. It is very intuitive and similar in feel to many photo editing software packages.

The image analysis uses the pixel colour and intensity from the photomicrograph to differentiate between various minerals and porosity. The user needs to select the of red, green and blue colour value intensity from a histogram that is extracted from the photomicrograph for each mineral type. Once done the software automatically calculates the percentage of each group. Because of changes in thin section thickness and photograph exposures, some adjustment to these cut-offs is required for each photomicrograph but because the results of changes are displayed instantly it is a quick process.

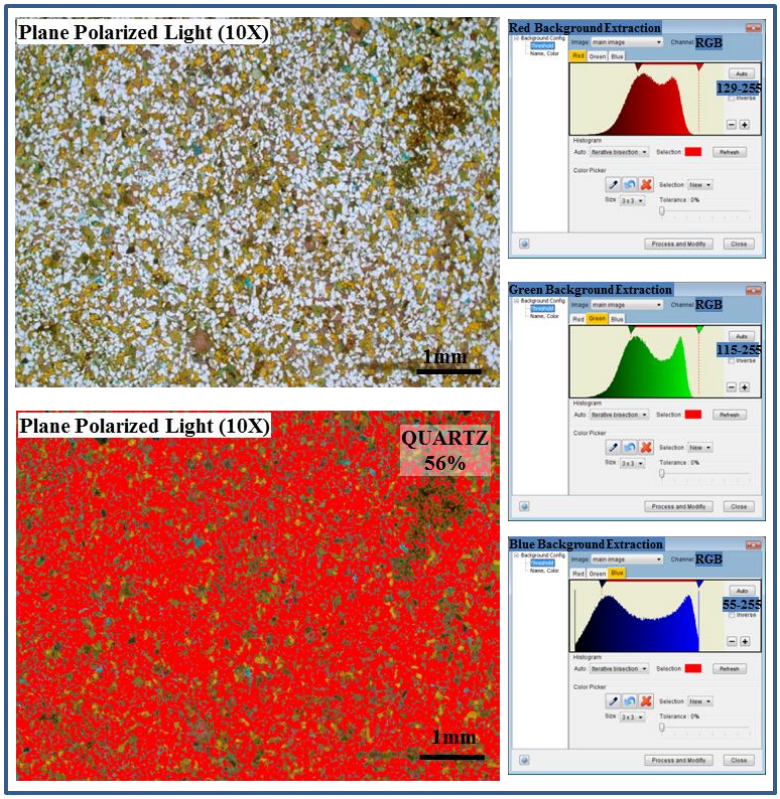

Fig. 3: Extraction Method in JMicrovision v1.27. Thin Section Glencoe-1, Depth=2754 m

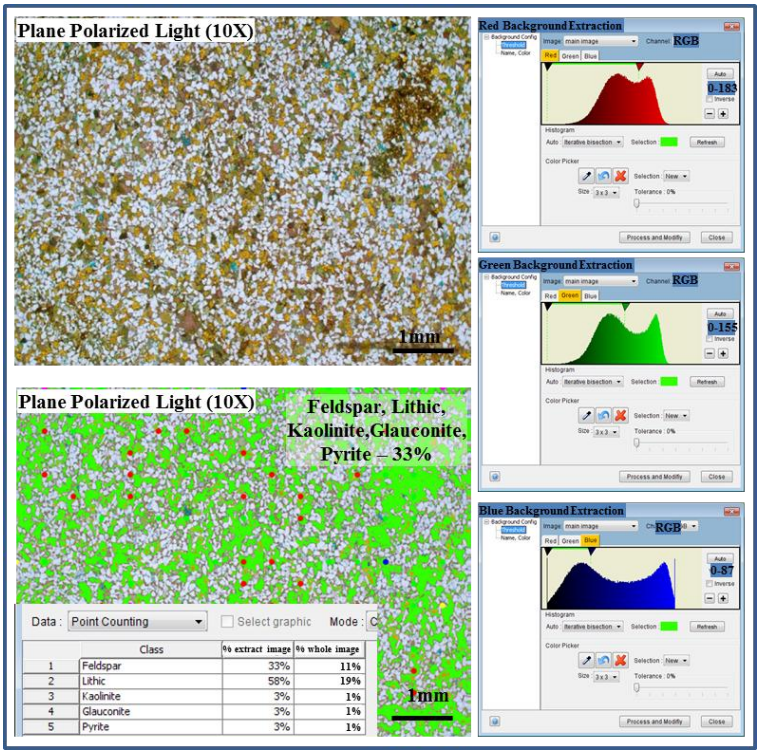

Fig. 4: Extraction Method in JMicrovision v1.27. Thin Section Glencoe-1. Depth=2754 m

In Figure 3, a high intensity range of red, green and blue colours are selected in order to quantify the mineral quartz that is present in the photomicrograph and the percentage of the occurrence is automatically calculated.

In some cases, depending on the quality of the photomicrograph and as well as the actual mineral types, certain minerals could not be separated from others using image analysis alone. An example is shown in Figure 4 where a lower intensity range of red, green and blue colours is used to capture feldspar; however, other minerals including kaolinite, glauconite and pyrite could not be filtered out. In these cases a hybrid approach which combined image analysis and point counting was used.

2.3. Point counting & image analysis comparison

Point counting is a very time consuming and tedious task, while image analysis can be done quickly and with similar results. Figure 5 shows some examples from various settings and grain sizes that show the favourable comparison of the two methods for estimating the percentage of quartz, feldspar, lithic and porosity.

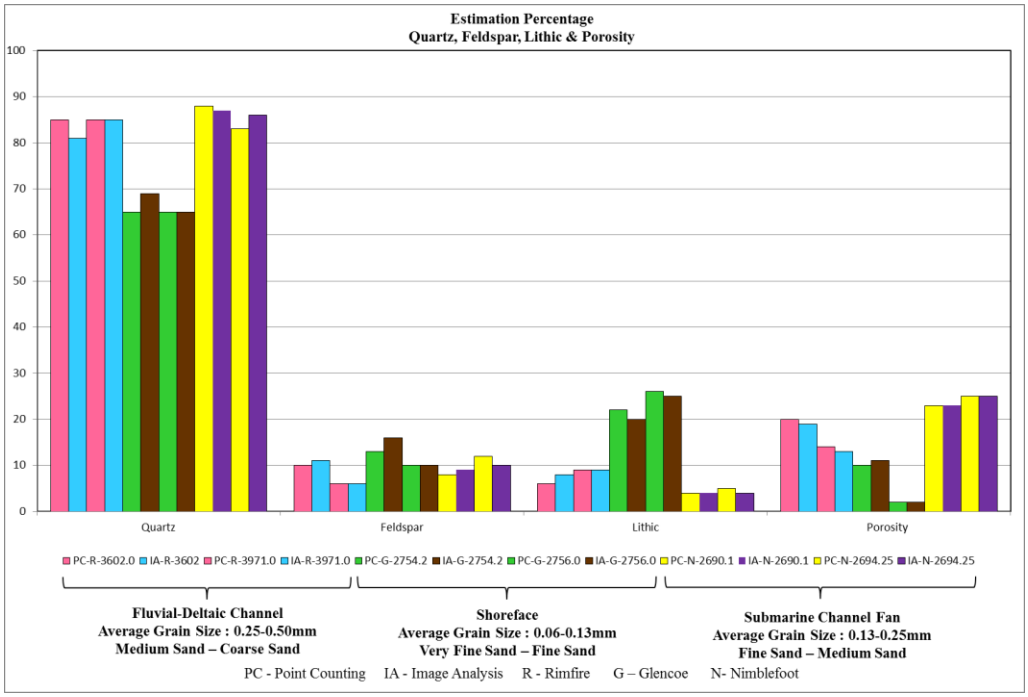

Fig. 5: Comparing Results of Point Counting and Image Analysis for Estimation of Fraction of Quartz, Feldspar, Lithic and Porosity.

3. Results

Image analysis is a tool that can quantify minerals and porosity fractions very quickly and accurately and only requires a PC, freeware and photomicrographs. With basic petrographic skills the user can: quantify mineral distributions, and estimate porosity, both macro-porosity and micro-porosity (commonly found in minerals like kaolinite). This information can be important in depositional environment and provenance studies, and hydrocarbon volume and deliverability estimates.

4. Conclusion

It is recommended for Geoscientists to use the image analysis method for a quicker result in quantifying the minerals and porosity for analysis of a reservoir.

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