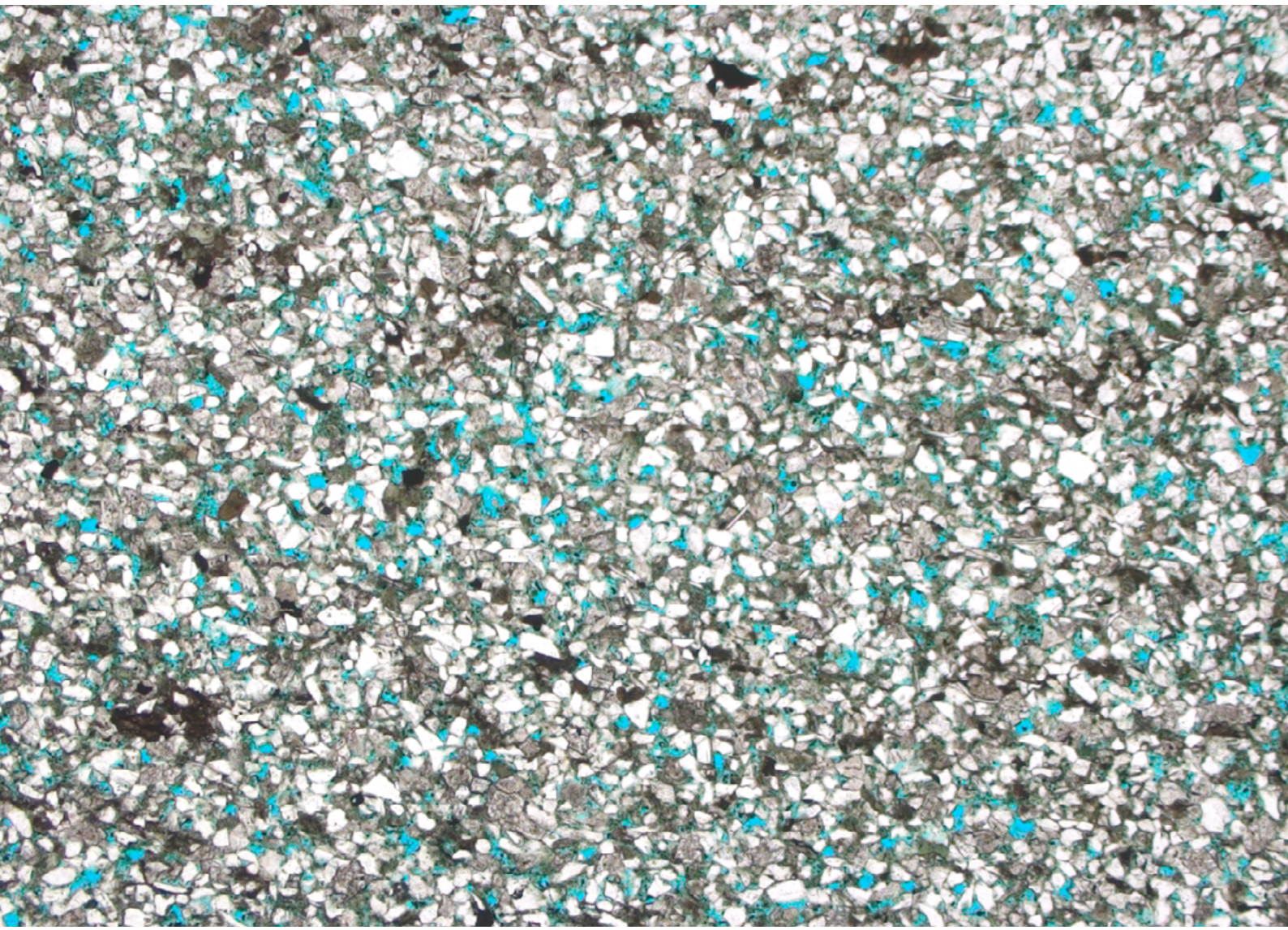

ZEISS Axio Scan. Z1

High Throughput Imaging of Geological Slides

We make it visible.

ZEISS Axio Scan. Z1

High Throughput Imaging of Geological Slides

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The microscopical examination of thin sectioned and polished geological samples with a polarized light microscope is a well-known technique. Nowadays, because of increasing demand from the oil and gas industry, higher throughput in processing and digitalizing samples must be achieved. In recent years, fully automated and boxed systems, such as ZEISS Axio Scan.Z1, have been developed. The development of these new microscope types has made it possible to achieve a much higher throughput in digitalizing and analyzing thin sections. In this note, the ZEISS Axio Scan.Z1 is used to show how easily petrographic thin sections can now be imaged, especially with regard to high throughput.

Background

Thin section microscopy can be described as a small sample but with a high information value. Petrographic analysis of thin sections with a polarizing light microscope provide the geologist with an in-depth look into the chemical and physical properties of a particular rock sample, e.g. a detailed description of the texture, composition of minerals, sedimentary structures, grain framework and types and distribution of the porosity. With this information, the geologist is able to study the details and relationships of sediments that have a direct impact on a large number of exploration problems. Additional micro paleontological examinations of thin sections can be used for biostratigraphy and paleo-environmental analyses. Micro- and nano-fossils in sedimentary rocks were used to determine the age of the rock formation and to draw relationships between the different drillings. Combined with seismic profiles and other geological data sets, these tools were used to search for hydrocarbons in exploration and to analyze the character of the reservoir.

Figure 1 *ZEISS Axio Scan.Z1*

Figure 2 *Tray magazine of ZEISS Axio Scan.Z1*

Technical solution

ZEISS Axio Scan.Z1 (Figure 1) offers a modular design that can be upgraded in the field from an entry level to a high end device. The system has a capacity of up to 50 slides for 28 mm x 48 mm slides (for standard microscope slides of

1" x 3" a 100 slide capacity can be used). Each slide can be equipped with a barcode (1D or 2D) for recognition and archiving of the digitalized slides.
The advanced ZEISS tray concept (Figure 2) and the extremely reliable components of ZEISS Axio Scan.Z1 offer the user a robust scan process. The slide and tray detection is already completed inside the magazine; therefore the system is not sensitive to preparation problems, e.g. over standing coverslips, breaking edges of slides, etc. due to the movement of the slides in their defined trays and not in their actual form. The system accepts high tolerances regarding the dimensions of the slides (standards from US and ISO are covered), e.g. the Giessener format, 1"x3" and 2"x3" slides. Customization of trays for other slide dimensions is also possible.
ZEISS Axio Scan.Z1 uses an overview camera for sample detection and navigation on the sample. The system offers up to two cameras for imaging in order to obtain the best results for Brightfield / Polarization (3 chip camera for perfect color reproduction and resolution) and Fluorescence images (e.g. Orca flash for high sensitivity and fast scanning).
Samples can be imaged with Brightfield, Polarization (Figure 3) and Fluorescence / Ring aperture contrast.
ZEISS Axio Scan.Z1 contains a built-in internal LED illumination light source for transmitted light and can be equipped with an additional Colibri 2 and / or HXP 120 for Fluorescence illumination. As a result, the bright field or polarization channel can be combined with additional fluorescence channels.
The image acquisition of ZEISS Axio Scan.Z1 is based on the ZEN blue imaging software concept with integrated ZEN modules for Image Analysis and Open Application Development (OAD). A web-based data management and the remote viewing via ZEN browser offer the possibility to archive the images and share them with additional experts around the world.
ZEISS Axio Scan.Z1 provides a reliable image quality thanks to a geometric calibration, which ensures the proper scaling and the exact parfocality and parcentricity of different objectives. An optional additional special slide for color calibration will ensure of a consistent color output and the white balancing. The scan speed for a sample size of 15x15 mm² @ 0.22 µm / pixel (according to 20x objective) is around 4 min for the focus map and the scan process of the slide for Brightfield imaging modality. For polarization the scan speed for a sample size of 15x15 mm² @ 0.22 µm / pixel is around 12 min.

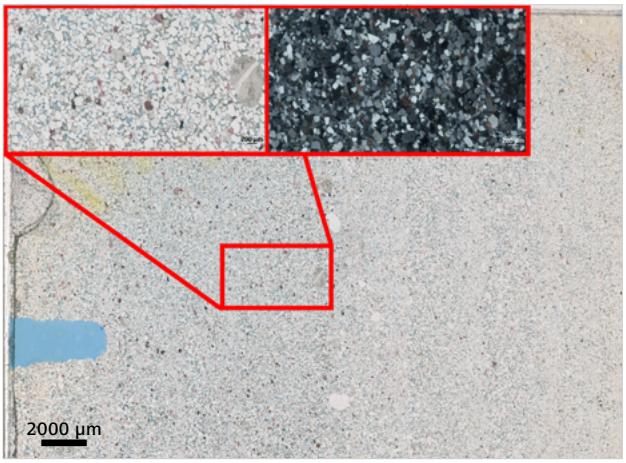

Figure 3 *Thin section, 20x Objective, measured with Axio Scan.Z1 in transmitted light brightfield and polarization.*

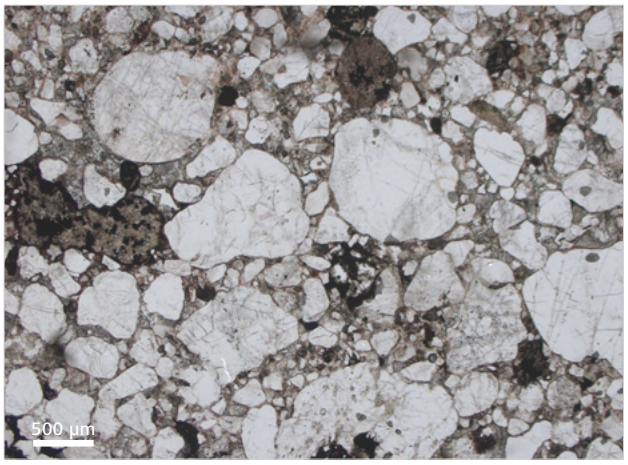

Figure 4 *Oil bearing rock, uncolored, 2.5x pol objective, brightfield transmitted light.*

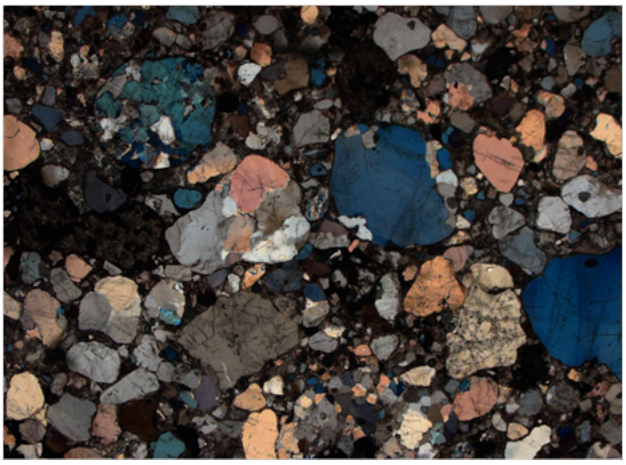

Figure 5 *Oil bearing rock, uncolored, 2.5x pol objective, transmitted polarized light.*

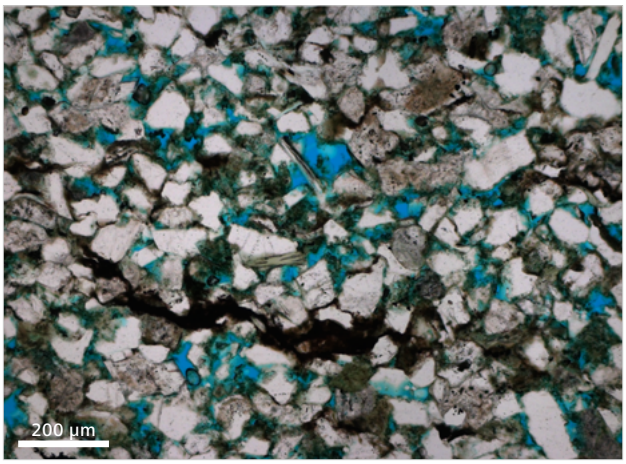

Figure 6 *Oil bearing rock, blue epoxy dye in pore spaces, 10x pol objective, brightfield transmitted light.*

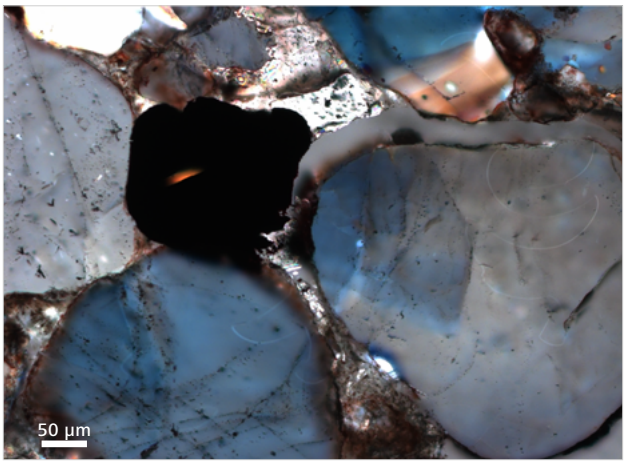

Figure 7 *Oil bearing rock, 20x pol objective, transmitted polarized light.*

Results

The information from the thin sections can be measured with different contrasting methods. Transmitted light brightfield illumination (Figure 4) provides the greatest amount of information on the thin section. Geologists are able to measure grain size, identify shape, color and surrounding pore space.

Using a blue epoxy impregnating the space between rock forming grains (Figure 6), pore space is easily detected and measured using image processing techniques. Total percentages of pore space, as well as the average pore size, are critical measurements made during this process.

Crossed polarization (Figure 5) reveals mineralogical data by providing birefringent properties of the different mineral types. Often, geologists toggle between linear polarization and cross-polarization for interpretation.

Circular polarization (Figure 7) provides images in which the birefringent structures will always appear with their highest interference colors independently of the structure azimuth against the vibration directions of polarizer and analyzer. This makes the use of rotating stages somewhat superfluous. The use of circular polarized light allows grain borders to be contrasted effectively and grain size to be easily measured.

Summary

In the oil and gas industry, automated microscope systems such as ZEISS Axio Scan.Z1 provide high magnifications (from 25x up to 400x) and high resolution (NA up to 0.9) to analyze and archive thin sections from drilling cores. The images of the thin sections can be recorded with different contrasting techniques (brightfield, polarization and fluorescence) in a row, with superb resolution and contrast, to obtain the greatest amount of information from the sample in a very short time. Results of up to 50 petrographic slides can be achieved in row in order to increase the productivity. All results are reproducible over time and across systems with the advanced calibration of the automated microscopic system.

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