Dark field microscopy: a new technique for extracting facies information from drill cuttings

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Drill cuttings are being increasingly utilized in industry for both exploration and development purposes. They represent a much larger and more complete data set than the available drill-core data set. They also contain a tremendous amount of potential reservoir and facies information. With proper training, accurate estimates can be made of total porosity, effective porosity, permeability, and reservoir quality from drill cuttings. However, facies analysis, particularly of carbonate rocks, is difficult using drill cuttings. This is because sedimentary structures, macrofossils, bioturbation, and other large scale features are not readily visible in mm-scale cuttings. The size of the cuttings combined with the cryptic nature of many carbonate rocks make it difficult to see textures and features.

Dark field microscopy is a transmitted-light illumination technique that significantly enhances facies analysis of carbonate rocks from drill cuttings. The technique "increases the information obtainable from low-contrast objects with structures that are poorly defined or very fine. Light rays meet the object at grazing incidence from below, and those which are then reflected or refracted into the objective cause edges and structural elements to appear bright on a dark background" (Stereomicroscopes: The Modular System: Leica, AG, 1995). Thus, unlike transmitted light which travels parallel to vertical boundaries, dark field light intersects vertical boundaries and enhances the contrast across boundaries.

As the series of comparative slides will show, the technique can be far more effective than incident light, transmitted light, and transmitted-light white-card viewing. With color-corrected light and a high-performance stereomicroscope, the technique allows the observation of microfabrics and features in chips at levels approaching thin-section resolution. Allochems, textures, packing, bioturbation, grain size, fractures and skeletal structure become much more apparent. In many instances, chips that appear to be plain mudstone are revealed to be coarse grainstones or packstones, or to have significant fabrics or textures. Special preparation of samples is not required. This makes dark field viewing much faster and cheaper than cutting thin sections. Furthermore, in contrast to thin sections, it can be done quickly on most chips in every sample interval. The result is a more thorough and accurate analysis of lithofacies and depositional environments.

The ability to switch easily and quickly between incident, transmitted, and dark field viewing is critical for detailed cutting analysis. It allows the observer to quickly and consistently tailor the observation technique to gain maximum information from drill cuttings. This, in turn, will work to reduce risk levels in both exploration and development programs.

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