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Automated Core Imaging: Opportunities for Integrating Hyperspectral Mineralogy and Structural Orientation Data for More Robust Structural Interpretations

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Automated core imaging technologies are transforming how geoscientists log core. Multisensor platforms collect visual, geochemical, and/or mineralogical data, making informed geologic and engineering decisions in near real time. New developments also allow for measurements of core morphology and structural features (fractures, faults, and veins) that can provide vital information for the successful exploration and development of ore deposits.

Traditional practice requires geoscientists to collect structural data manually, from macro- or microscale inspection. This is labor intensive, time consuming, and can lead to incomplete or inconsistent results. The ability to automatically measure the orientation of structures in drill core using digital data sets including photographs or digital surface models is a significant advancement. These automated methods increase not only the speed and efficiency of data collection but also the density of structural measurements that can be collected downhole. While orientations of these features are important, the ability to integrate key structural and hyperspectral mineralogical data from logging systems provides an opportunity to maximize value from recovered core and make better, informed geologic and engineering decisions.

Here, we present a new approach to structural data collection by integrating mineralogical data from a hyperspectral imaging system to automatically identify structures in drill core. Structural identification and orientation measurements are completed using previously established contouring, morphological filtering, and adaptive feature thresholding methods. Data are derived from coregistered, high-resolution, 3D profiler and core imagery from an automated hyperspectral imaging system. Because the hyperspectral mineralogy data is coregistered, the mineralogy of structures can be integrated with their orientation values. This method determines the spatial extents of structural features in the image, then applies a series of multiple-distance buffers to a set of regions proximal to the defined structural feature. A query of the coregistered, hyperspectral mineralogical data can then be performed within these buffered distances. The outputs are integrated structural orientation measurements with hyperspectral mineralogical data that can be used to delineate fracture sets or vein types even in deposits with seemingly uniform structural orientations (Fig. 1).

The accurate characterization of structural features is key to predicting the geotechnical behavior of an orebody. These data are fundamental for mine planning decisions and affect the economics of ore recovery. Additionally, these data are used by exploration teams to map vein distribution and density and understand fluid pathways, controls on mineralization, and deposit geometry. Combining structural and mineralogical data to assist in mineral exploration is common; however, innovation in the automated data acquisition of these key data sets provides a novel, fit-for-purpose solution. The application of automated core imaging technology to structural measurements provides the opportunity for increased and targeted data points to be acquired over shorter time frames, improving sampling statistics to provide robust data sets for informed decision-making.

Fig. 1. Example of open joint structural orientations from an orogenic gold deposit measured using an automated hyperspectral imaging system (Corescan's HCI System) showing the orientation only (A) and the orientations colored by primary hyperspectral alteration assemblage within and immediately proximal (within 5 mm) to the structure (B).