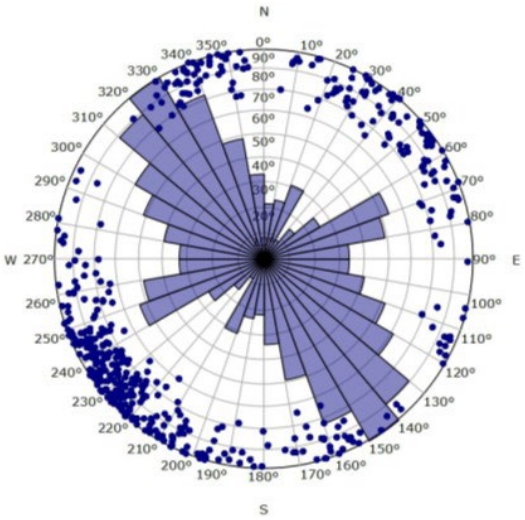
Compact™ Microimager Tool Unlocks Stratigraphic and Structural Features in Horizontal Coal Seams, Results Help Evaluate Borehole Stability



Based on the Stereonet plot of cleats along the well, the dominant face cleat aligned with the maximum horizontal stress (σ_{Hmax}) in a NW-SE direction, while the subordinate butt cleat, oriented perpendicular to the face cleat, aligned with the minimum stress (σ_{Hmin}) in a NE-SW direction.

Objectives

- Differentiate types of sedimentary and structural features along the horizontal borehole image log.
- Determine the frequency and orientation of each sedimentary and structural features based on Schmidt Stereonet.
- Identify maximum and minimum horizontal stress from cleats orientation.

Our Approach

- Weatherford deployed a 2.4-in. OD CMI tool in horizontal water-based mud boreholes to obtain high-resolution borehole image data alongside other petrophysical data. The excellent borehole coverage and high-resolution imaging capabilities of the CMI enables enhanced reservoir characterization for more informed reservoir decisions.
- Depth and time raw data was processed by the Interpretation and Evaluation Services (IES) team, which includes corrections for magnetic declination, tool speed variations, and pad orientation to ensure accurate image representation for generating both static and dynamic 360° resistivity-based borehole images.
- The borehole image log was interpreted by dip picking along the image and classified into sedimentary (bedding) and structural (cleat, fracture, dyke) features. The bedding could be picked within coal seams defined by density less than 1.8 g/cc. Cleats could be picked if the feature oriented at a high angle (>75°) to coal bedding orientation. Fractures could be identified either conductive (open) or resistive (closed). Dykes could be interpreted based on the intrusion through coal seams.

LOCATION
Australia

WELL TYPE
Exploratory

PRODUCTS/SERVICES
- Wireline services
- Interpretation and Evaluation Services
- Compact microimager (CMI) tool

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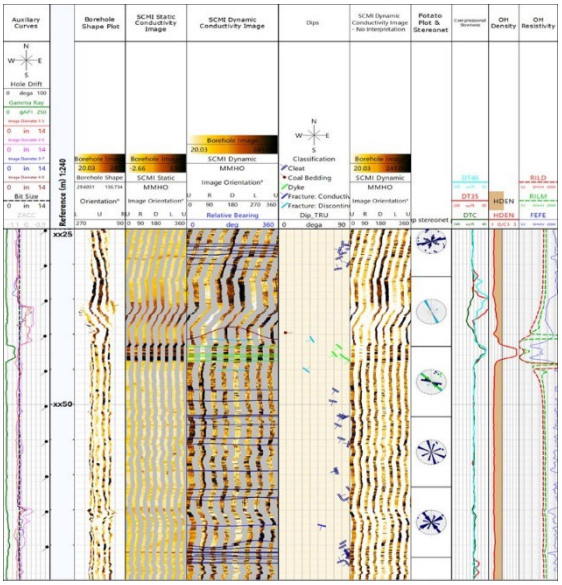
Our Approach (continued)

- The features were then analyzed in the Schmidt Stereonet to determine frequency and orientation. Types of rose diagrams were determined based on type of features (i.e., azimuth for sedimentary features and strike for structural features).
- Maximum and minimum horizontal stresses were determined from orientation of the cleats. The dominant face cleat aligned with the maximum horizontal stress (σ_{Hmax}), while the subordinate butt cleat, oriented perpendicular to the face cleat, aligned with the minimum stress (σ_{Hmin}).

Value to Customer

- The utilization of the CMI tool along the horizontal borehole associated with the interpretation provided by the IES team helped the customer clearly distinguish and determine sedimentary and structural features based on static and dynamic image log.
- Based on the Schmidt Stereonet plot, the frequency and orientation could be applied for detailed interactive structural analysis (i.e., bedding dip determination, fracture detection and evaluation, fracture frequency, etc.).
- Enhanced visualization of the cleats in the horizontal borehole image log could be the indicator of in-situ stress properties which can reveal the face and butt of the cleats in coal seams. In addition, this interpretation helps evaluate borehole stability as well as enable detailed 3D modelling.



At a depth of xx25 to xx75 m, cleats were dominantly identified with a high-angle dip orientation and a NW-SE dyke intruded coal seams between the depth of xx40 to xx45 m could be identified based on higher gamma ray, sonic velocity and density, and lower resistivity compared to coal seams.