Enhancing Structural Interpretation with Borehole Stress Data from Dipole Sonic

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Previous studies have evaluated in-situ borehole stresses evidenced by borehole elongation, breakout, and induced fracturing. These expressions of stress, however, are only sporadically present and are affected by matrix lithology, mud density, penetration rate, etc. Measurement of shear wave anisotropy using a dipole sonic logging tool can provide a continuous indication of borehole stress. Anisotropic stresses and fractures are the main causes of acoustic anisotropy in a horizontal isotropic formation penetrated by a vertical borehole. In the presence of such anisotropy, the shear waves (and dipole flexural waves) split into a fast and slow wave along orthogonal directions of polarization. The orientation of the fast shear pathway can be identified and output on a continuous basis. Spatial orientation of the borehole within the bedding planes can also produce anisotropic effects. Fast shear azimuth can be compared with structural dip from resistivity image data to identify beddingrelated effects. A new technique based on the analysis of the dipole dispersion curves can distinguish between intrinsic and stress-induced anisotropy. Once stress-induced anisotropy is identified, then the fast shear direction indicates the maximum stress direction. The use of the fast shear azimuth in structural interpretations can provide insight into subtleties that are not apparent by other means. Stress changes might be expected when crossing a fault in a reservoir. The forces that originally caused faulting could exist residually, especially in tectonically active areas. Inactive or recently ruptured faults would likely exhibit less stress change across the fault. A change in either the magnitude or orientation of stress might be expected as an active fault is traversed. Identification of a fault as active could enhance the understanding of the geologic model, leading to improved exploitation of the hydrocarbon reserves contained in the reservoir.