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Acquiring Microresistivity Borehole Images in Deviated and Horizontal Wells Using Shuttle-Deployed Memory Tools

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Abstract

Borehole images have broad applications in geological, petrophysical, and geomechanical studies. The advent of the small-diameter memory resistivity micro imaging tool improves operational efficiency in a broad range of well types. In spite of the tool's small size and weight, its design provides coverage and image quality that matches or exceeds that of previous generation imaging tools. It is deployed with or without a wireline and is not constrained by wireline data transmission rates because data are recorded to internal memory. Deploying the tool inside the drillpipe on the well shuttle facilitates access into highly deviated wells and past bad hole conditions without compromising borehole coverage.

Finding fractures in deep and tight rocks has become a high priority among explorationists around the world. Recent discoveries have shown that fractures can play an important role in the productivity of low-permeability plays, such as coalbed methane or shale gas. The only logging technology with the resolution to detect and identify these small features within the reservoirs is borehole imaging, where 2 mm details can be visualized.

Deviated wells in the Western Canadian Sedimentary Basin were logged using memory borehole imaging tools. The tools were housed inside a special drill collar while running in the hole, allowing rotation and circulation and were deployed using a messenger system and pressure pulses. The tools recorded microresistivity data to memory as the drillpipe was then tripped to surface. In all wells data was recovered, processed, and interpreted using software specially developed for this new memory-based technology. The resulting images were the equal of electrical borehole images obtained using conventional wireline deployment.

Using the memory imaging tool housed in the special drill collars protects the tools while tripping into the well. Since there is no wireline and no wet latches the shuttle system is more robust than conventional tool-pusher systems. This reduces risk and logging operation time while simultaneously delivering high-resolution borehole images that allow these fractured reservoirs to be properly evaluated.

Introduction

From a production point of view, most reservoirs have anisotropic behavior. Heterogeneities induced by sedimentological, structural, and diagenetic processes are among the causes of such anisotropy. Optimizing reservoir recovery requires reliable models of sedimentary rocks. Capturing these heterogeneities is crucial for precise geological and reservoir modeling. Borehole imaging is regarded as a powerful tool to study the depositional setting of sedimentary rocks, delineate reservoir characteristics, derive rock properties, and assess their potential to produce hydrocarbons.

Finding fractures in deep and tight rocks has become a high priority among explorationists and developers around the world. Recent discoveries have shown that fractures can play an important role in the productivity of low-permeability formations. This is because they form an interface with the rock matrix that is many times greater than that provided by the borehole. The only logging technology with the resolution to detect and identify these small features within the reservoirs is borehole imaging, where details 2 mm or smaller can be visualized. The development of new, smaller, and lighter tools allows production companies to have this type of high-resolution data in almost every well where it is requested. Among these new developments is an imaging tool that can be conveyed using a shuttle system, giving drillers the option to acquire information with low risk and high efficiency.