

Qualitative estimates of reservoir heterogeneity from borehole imaging techniques.

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Early recognition of the presence and nature of reservoir heterogeneity is essential to the optimal economical development of hydrocarbon pools. Vertical and lateral variations in porosity and permeability dictate the nature of fluid flow within the reservoir. The earlier reservoir heterogeneity is recognized and incorporated into the reservoir model the greater the potential economic benefits. Fundamental decisions such as whether to develop a reservoir by vertical or horizontal wells, well placement and well spacing all tend to be based on early geological models and assumptions about the degree of reservoir heterogeneity.

Conventional open hole log suites tend to give good quantitative estimate of the physical properties (including porosity) of the reservoir rock but are more petrophysical than geological in nature. Borehole image logs provide a means to directly observe geological features and textures from high resolution electrical or ultrasonic measurements. These measurements are processed into a map of the borehole wall allowing the interpretation of geological features, analogous to what has been traditionally done from core and outcrop. Historically, borehole images have been primarily used to aid in the interpretation of large scale structural features and depositional environments with reservoir characterization a secondary objective. Yet the direct observation of geological features can lead to valuable insights into the reservoir characteristics of the rock.

Features such as bedding, cross-bedding, shale clasts or dispersed clays can be directly observed from the borehole images and incorporated into depositional models to make predictions of directional permeability. Secondary porosity as fenestral or vuggy porosity and open fractures can be identified. The orientation of observed fractures and faults can help predict areas of the reservoir likely to be compartmentalized.

Examples of borehole images from both vertical and horizontal wells will illustrate how reservoir heterogeneity can be identified and used as an aid towards optimal resource recovery.