

Time-Lapse (4-D) Effect; Reservoir Strain and its Implication for Sanding: Example from Forties Field

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Reservoirs undergoing depletion in pressure and changes in fluid saturation can compact in response to increased effective stress. Such responses vary from compaction within the reservoir to dilation in the overburden shale, with the potential of causing weakening of the overburden, instability of wells and a long list of drilling challenges.

Time lapse (4D) seismic has found application not only for monitoring fluid front and compartmentalization studies, it also provides a means to study stress and strain changes associated with reservoir depletion in a time interval. Forties field 1988 and 2000 3D seismic surveys have been balanced to study the 4D effect between the time interval. Time lags observed vary from -7.0 to +0.5 ms. High time lag observed above the Charlie sandstone is due principally to increased stress in the Charlie sandstone, while the high strain in the Southern inter-channel area is due mainly to saturation change in the Upper main sand, where it is observed to be thickest.

Sand production and drilling problems remain a source of major concern in Forties field. While a number of factors, such as poor consolidation, well deviation through the reservoir, grain size and drawdown, contribute to sanding, we find that reservoir strain resulting from increasing effective stress plays a significant role in sand production and may also contribute to the long list of drilling challenges in the field.