# Concept of Sequence Stratigraphy and Case Studies in India

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## Abstract

Sequence stratigraphy provides a genetic, process-based approach to understanding sedimentary successions by integrating relative sea-level changes, sediment supply, and tectonics. It enables interpretation of depositional architecture and prediction of facies distribution in subsurface and outcrop settings. This paper outlines fundamental concepts of sequence stratigraphy, including systems tracts and bounding surfaces, and highlights their application in hydrocarbon exploration, basin analysis, and resource evaluation. Case studies from major Indian sedimentary basins, Krishna–Godavari, Mumbai Offshore, Cauvery, Cambay, Kutch, and Rajasthan—demonstrate the value of sequence stratigraphic frameworks in regional geological interpretation and hydrocarbon prospect assessment.

## Introduction

Sequence stratigraphy emerged as an important paradigm in the late 20th century, emphasizing genetic relationships among sedimentary strata rather than purely lithological or temporal correlations (Vail et al., 1977; Catuneanu, 2006). The concept focuses on unconformity-bounded stratigraphic units that reflect cycles of base-level rise and fall. Since the 1990s, sequence stratigraphic methods have been increasingly applied across Indian sedimentary basins to improve hydrocarbon exploration and reservoir characterization (Raju et al., 2010; Chakraborty, 2015). Establishing a basin-wide sequence framework assists in predicting reservoir bodies, identifying stratigraphic traps, and understanding source–seal distribution.

## Concept Description

Sequence stratigraphy is defined as the study of genetically related strata within a chronostratigraphic framework bounded by unconformities or their correlative conformities (Mitchum, 1977; Catuneanu et al., 2011). A sequence comprises relatively conformable strata deposited during a complete cycle of sea-level change.

The key systems tracts include the Lowstand Systems Tract (LST), Transgressive Systems Tract (TST), Highstand Systems Tract (HST), and Falling Stage Systems Tract (FSST).

- **LST:** Basinward-prograding sediments deposited during low sea level.
- **TST:** Retrogradational facies formed during sea-level rise.
- **HST:** Progradational stacking during high sea level.
- **FSST:** Forced-regressive units associated with sea-level fall.

Sequence boundaries, typically represented by unconformities, record major shifts in depositional conditions and are key to sequence interpretation. Parasequences,smaller-scale shallowing-upward cycles provide higher-resolution subdivision within systems tracts. Sequence stratigraphy supports hydrocarbon exploration, basin analysis, paleogeographic reconstruction, and aquifer studies (Emery & Myers, 1996; Catuneanu et al., 2019).

**Case Studies in India**

**• Krishna–Godavari Basin**

This passive margin basin contains second- and third-order depositional sequences from the Late Jurassic to Recent. Transgressive–regressive cycles influence clastic and carbonate distribution, while critical sequence boundaries help locate Cretaceous–Tertiary reservoir sands. Integration of sequence concepts with seismic data aided discoveries such as the D6 block (Rao & Mani, 2006; Raju et al., 2010).

**• Mumbai Offshore Basin**

A rift–drift basin with Paleocene–Recent sedimentation, the Mumbai Offshore Basin hosts multiple depositional sequences linked to syn-rift and post-rift phases. Understanding its systems tracts has improved delineation of stratigraphic traps and reservoir architecture within major producing fields such as Bombay High (Basu et al., 2014; Singh et al., 2018).

**• Cauvery Basin**

Well-log and seismic-based sequence interpretations in this basin reveal multiple transgressive–regressive cycles controlling reservoir sandstone and carbonate distribution. The Albian–Cenomanian sandstones and Eocene carbonates act as significant reservoirs whose geometry corresponds to sequence boundaries (Chakraborty, 2015; Rajasekhar et al., 2020).

**• Cambay Basin**

This Paleogene rift basin exhibits repeated transgressive–regressive successions. Systems tracts defined through core and well-log analysis explain the distribution of lignite, coal, and hydrocarbon-bearing zones. The Ankleshwar Formation's depositional patterns reflect sea-level fluctuations (Basu & Raju, 2012; Deshmukh et al., 2019).

**• Kutch Basin**

Outcrop-based analyses identify several Cretaceous–Tertiary sequences bounded by major unconformities. These sequences serve as analogs for offshore exploration and improve understanding of basin evolution and depositional facies (Rai et al., 2015; Pathak & Patel, 2021).

**• Rajasthan Basin**

The Barmer–Sanchor sub-basin contains well-defined third-order sequences controlling hydrocarbon distribution, particularly within the Barmer Hill Formation. Integrating seismic and sedimentological data supports prediction of reservoir geometry and improves exploration models (Bhardwaj et al., 2016).

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