Barostratigraphy for Basin Geopressure Analysis

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The utility of barostratigraphic sequences in basin modeling is demonstrated by its ability to improve structural definition, including identification of vertical [and lateral] compartmentalization, which supports better risk assessment of hydrocarbon prospects.

There are two basic component units in a barostratigraphic sequence. Although lithostratigraphy often acts as a control on barostratigraphy, barostratigraphic units can cross lithostratigraphic boundaries and are primarily influenced by permeability distribution.

Unit I, a pressure seal, is identified by an increasing (Ia) or decreasing (Ib) pore pressure gradient with depth, referred to as auxiobaric or penaibaric, respectively. Permeability is low enough to prevent or retard movement of interstitial water to a rate less than that required to maintain pressure equilibrium with the overlying hydrostatic section.

Unit II, a barostatic cell, is a reservoir-type interval that is sufficiently permeable to allow pressure to equilibrate, thus any pressure increase within such a unit is primarily dependant on depth and density of the trapped pore fluid, but is occasionally augmented by hydrocarbon buoyancy and lateral pressure transfer (centroid) effects.

When discussing seals, the barostratigraphic Unit I (a & b) each can be further defined according to the rate of pressure increase or decrease across the seal relative to the overburden gradient. Four 'qualities' of seals are observed. Type A or "Infragrade" seals increase or decrease pressure at a rate greater than hydrostatic but less than the lithostatic gradient. This is the most commonly observed seal type. Type B or "Equigrade" seals increase pressure equal to the increase in lithostatic gradient. This is the maximum pressure gradient due solely to compaction disequilibrium. Overgrade seals (Type C) increase or decrease pressure at a rate greater than the lithostatic gradient. Pressuring mechanisms may include compaction disequilibrium, but always require an additional mechanism(s) to attain such a rapid increase. Type D or "Ultragrade" units are diagnostic of superseals where pressure increases in a stepwise fashion across the non-porous non-permeable interval.

In this stratigraphic schema, The Woodford Shale is a basal seal that allows very high overpressure in an overlying barostatic cell (Unit II) to regress back to hydrostatic values very rapidly. Such a shale superseal would be classed as a penaibaric superseal or Unit IbD.