

## Sedimentary Basins and Petroleum Systems

### I. Overview / Definitions

- a. Sedimentary Basin - area of Earth's crust underlain by thick sequence of sedimentary rocks preserved in the geologic record
  - i. Common locations for hydrocarbon accumulations
  - ii.  $10^2$  to  $10^4$  square kilometers in area
  - iii. Basin refers to accumulation of sediments, does not necessarily refer to the surface topography above; sedimentary basins can underlie mountain ranges
  - iv. Depositional and tectonic history of sedimentary basins favorable for development of source-maturity-migration-trapping of hydrocarbons
    1. Basin subsidence, burial and heat flux conducive to producing hydrocarbons
    2. subsiding basins ideal locations for marine biomass production and preservation, depending on climate conditions
- b. Basin Characteristics
  - i. marine vs. non-marine sedimentary basins
  - ii. associated with tectonic subsidence of basin floor and sediment accumulation
  - iii. syndepositional vs. post-depositional tectonic deformation
  - iv. Geometry - variable depending on tectonic setting
    1. oval / circular shaped
    2. elongate "troughs"
    3. open ended embayments
    4. symmetrical vs. asymmetrical
  - v. crustal subsidence over time, with concomitant sediment accumulation
- c. Depocenter of Basin - central zone of subsidence and thickest accumulation of sediments

### II. Basin Formation Mechanisms

- a. Thermal Contraction - cooling and subsidence of Earth's crust and upper Mantle
  - i. cratonic sags
- b. Crustal Extension - crustal stretching and thinning
  - i. Rift basins
  - ii. Strike-slip basins
- c. Crustal Compression
  - i. subduction-related forearc basins
- d. Crustal Loading - isostatic subsidence
  - i. sediment loading on crust results in positive feedback of isostatic subsidence into asthenosphere
    1. thrust belt forebulge
    2. passive margin loading

### III. Classification of Sedimentary Basins vs. Tectonic Setting

- a. Cratonic Basins - not located at plate boundaries
  - i. Intracratonic Sag - thermal contraction and subsidence in plate interiors
    1. e.g. Michigan Basin, Williston Basin of North Dakota

- ii. Passive Margin Coastal - marginal marine sediment loading and isostatic subsidence
    - 1. e.g. Gulf Coast, Atlantic Coast
- b. Convergent Tectonic Basins - subduction related, compressional
  - i. Forearc Basins
    - 1. sediment loading and subsidence between subduction trench and volcanic arc
    - 2. complex accretionary tectonics
  - ii. Backarc Basins
    - 1. back arc extension and sedimentation; inboard of volcanic arc
  - iii. Thrust Belt - forebulge basins
    - 1. e.g. Appalachian basin, Wyoming basins, Himalayan foredeep
- c. Divergent Tectonic Basins - rifting related, extensional
  - i. Rift Basins - e.g. Red Sea, East African Rift, Rio Grande
    - 1. fault bounded basins with down-dropped blocks
    - 2. elongate shapes common
    - 3. symmetric/asymmetric grabens
  - ii. Aulacogens - failed rift basins
    - 1. e.g. lower Mississippi Valley, Missouri-Tennessee "Reel Foot Rift"
- d. Transcurrent Tectonic Basins - transform, strike-slip tectonics
  - i. Transtensional tectonics, rift-like faulting between strands of strike-slip fault zones
  - ii. e.g. Ridge Basin, California, San Andreas