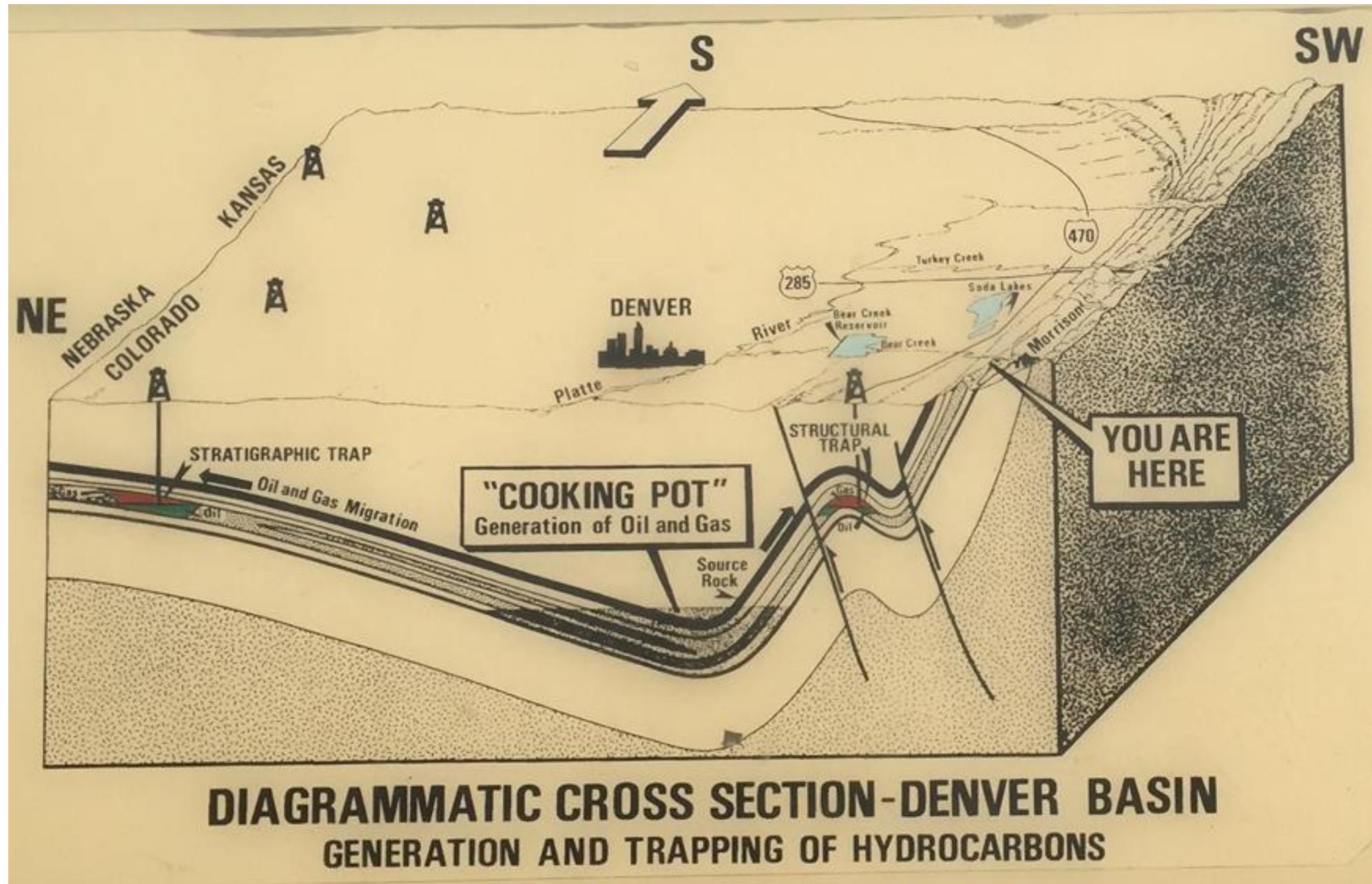


Seismic Analysis - Introduction

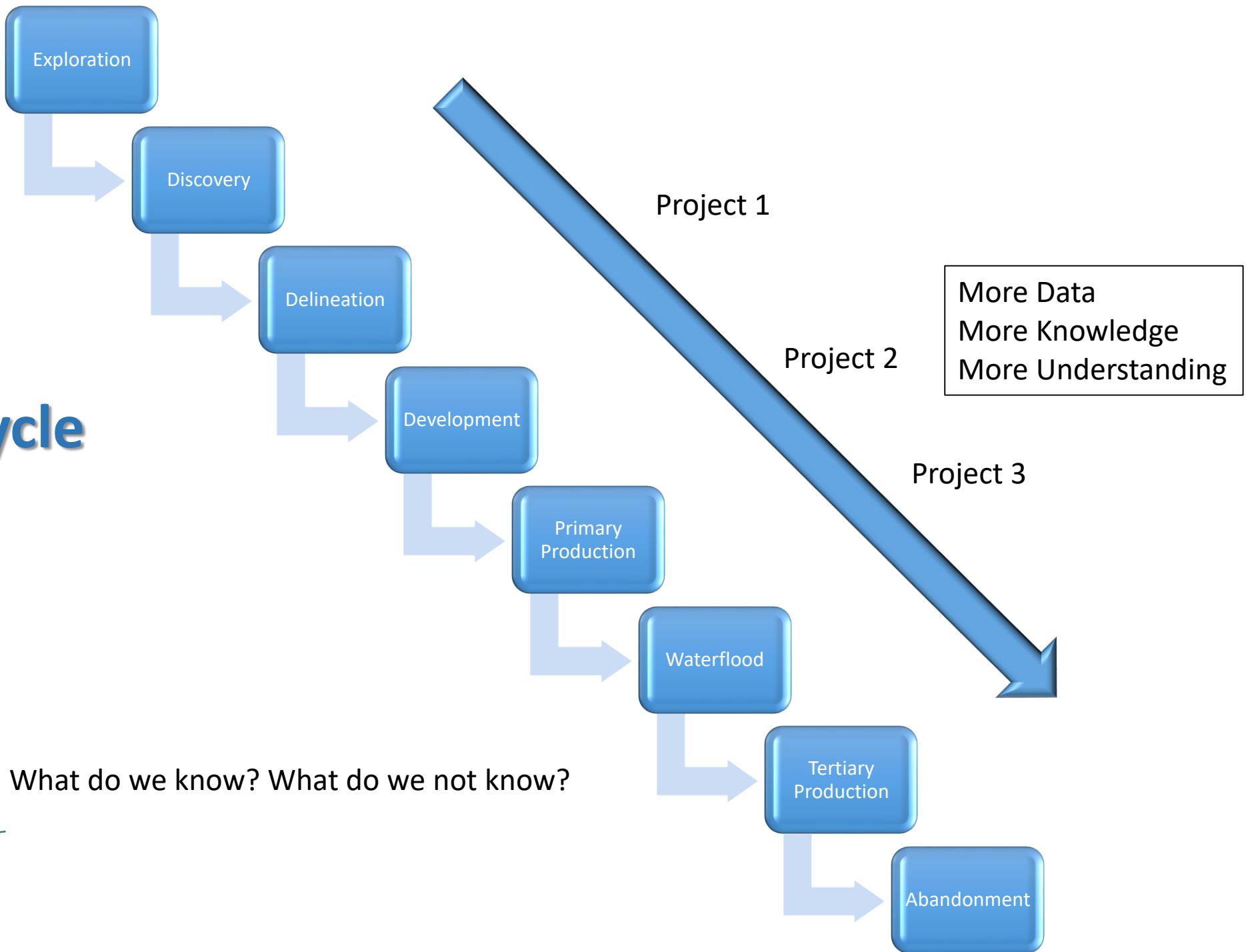
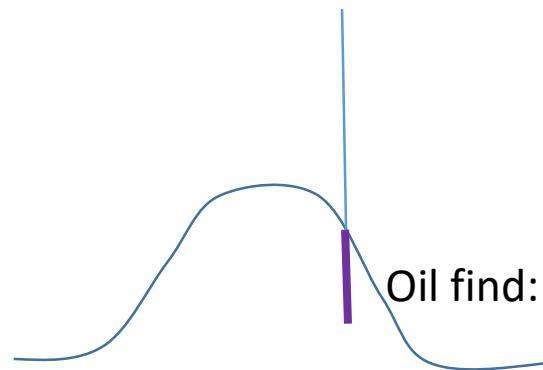


Oil & Gas Reservoirs

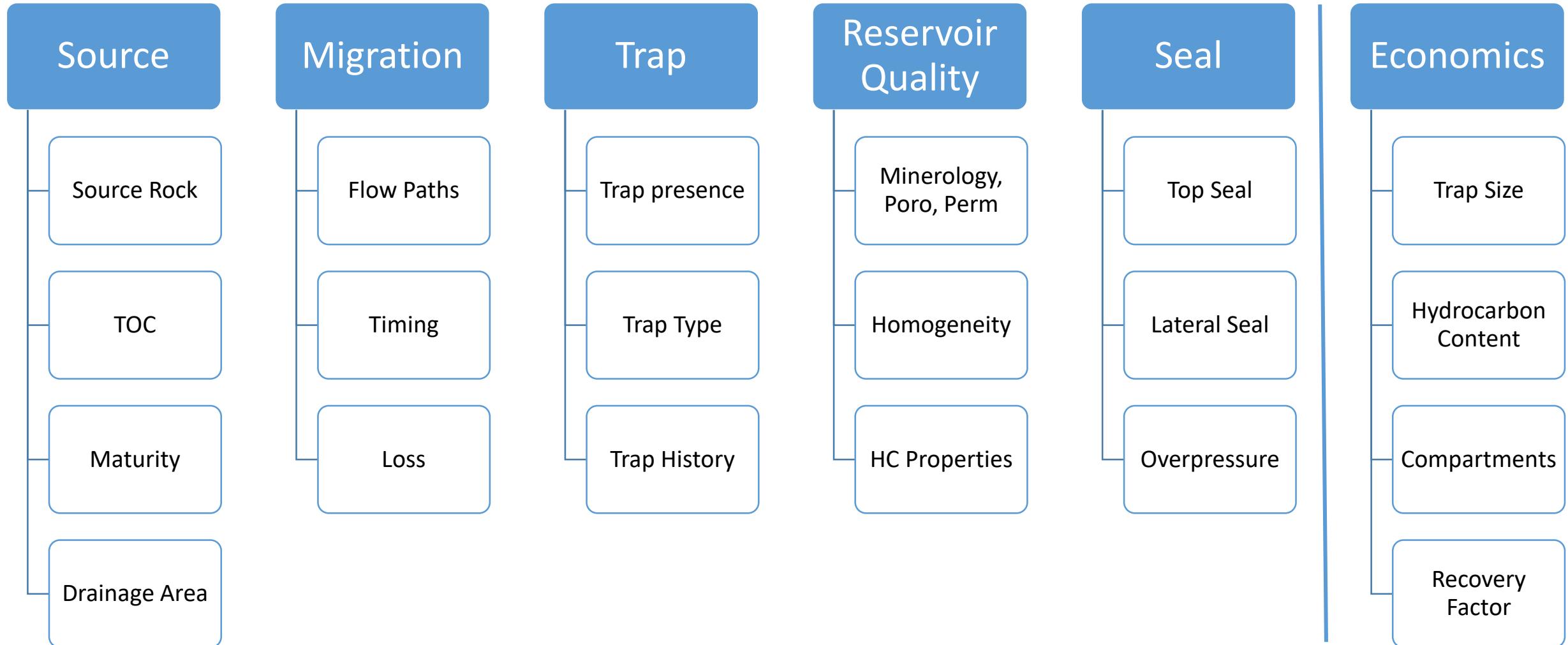
- Source
- Migration
- Trap
- Reservoir Quality
- Seal
- Economics



Reservoir Lifecycle and GGRE

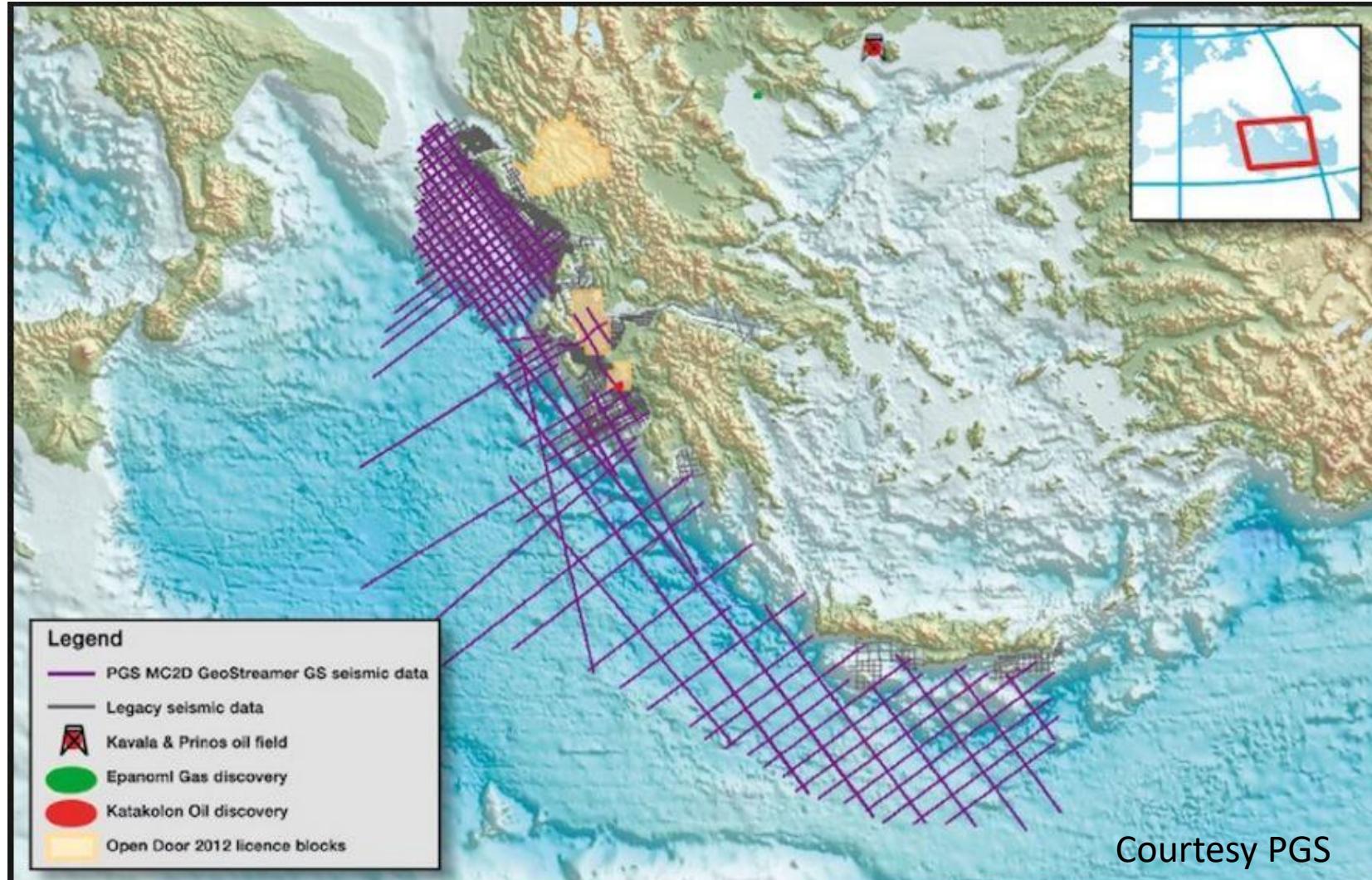


Exploration De-risking

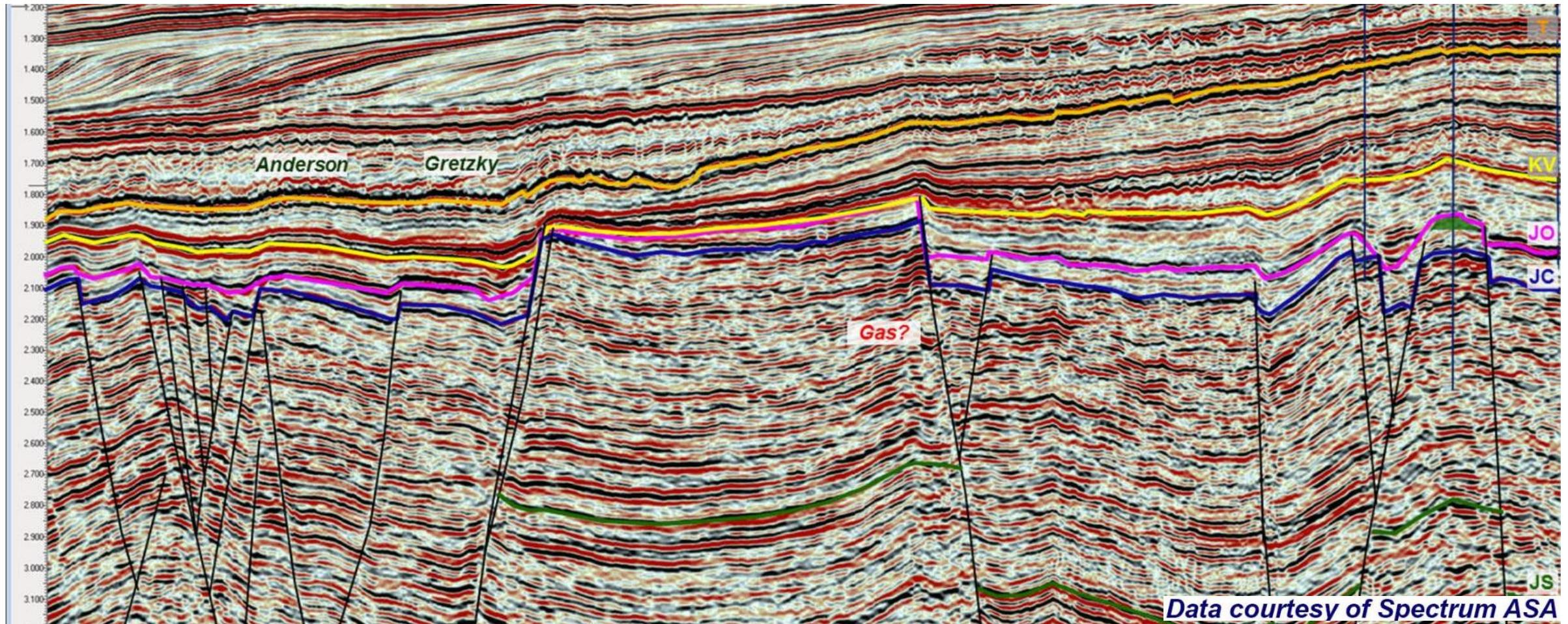


Exploration Information

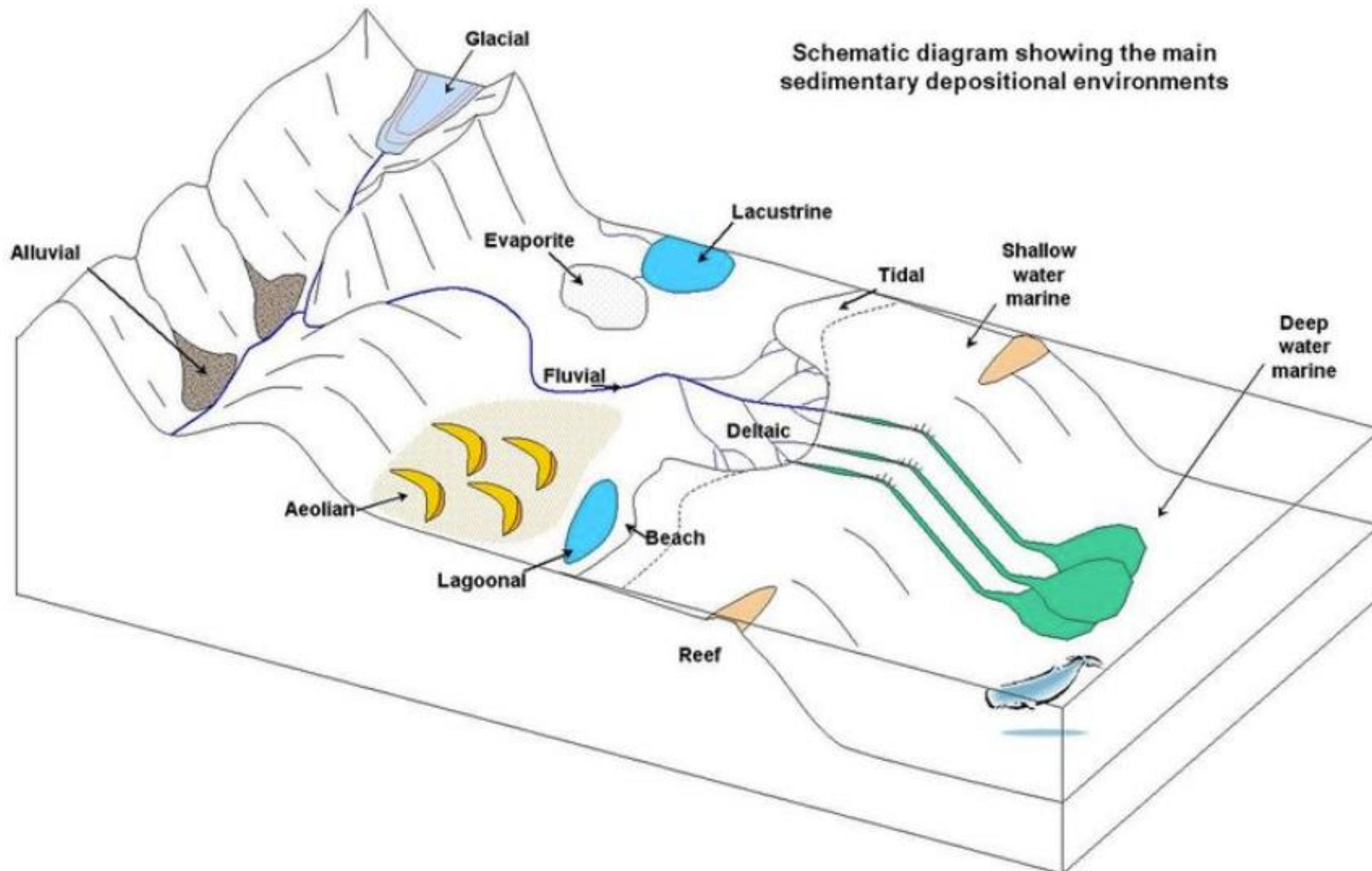
- Outcrops and Analogs
- Well Data and Logs
- Seismic Data



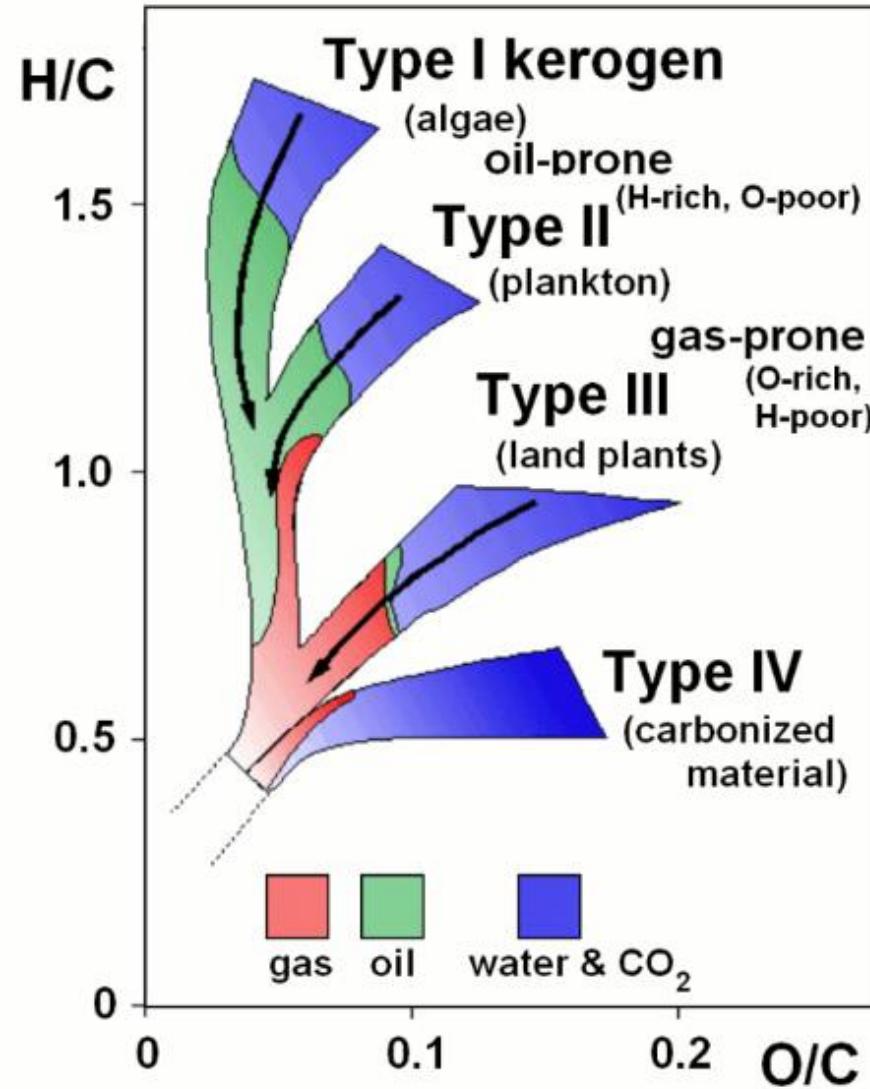
Exploration Seismic Data – 2D line



Main Sedimentary Depositional Environments

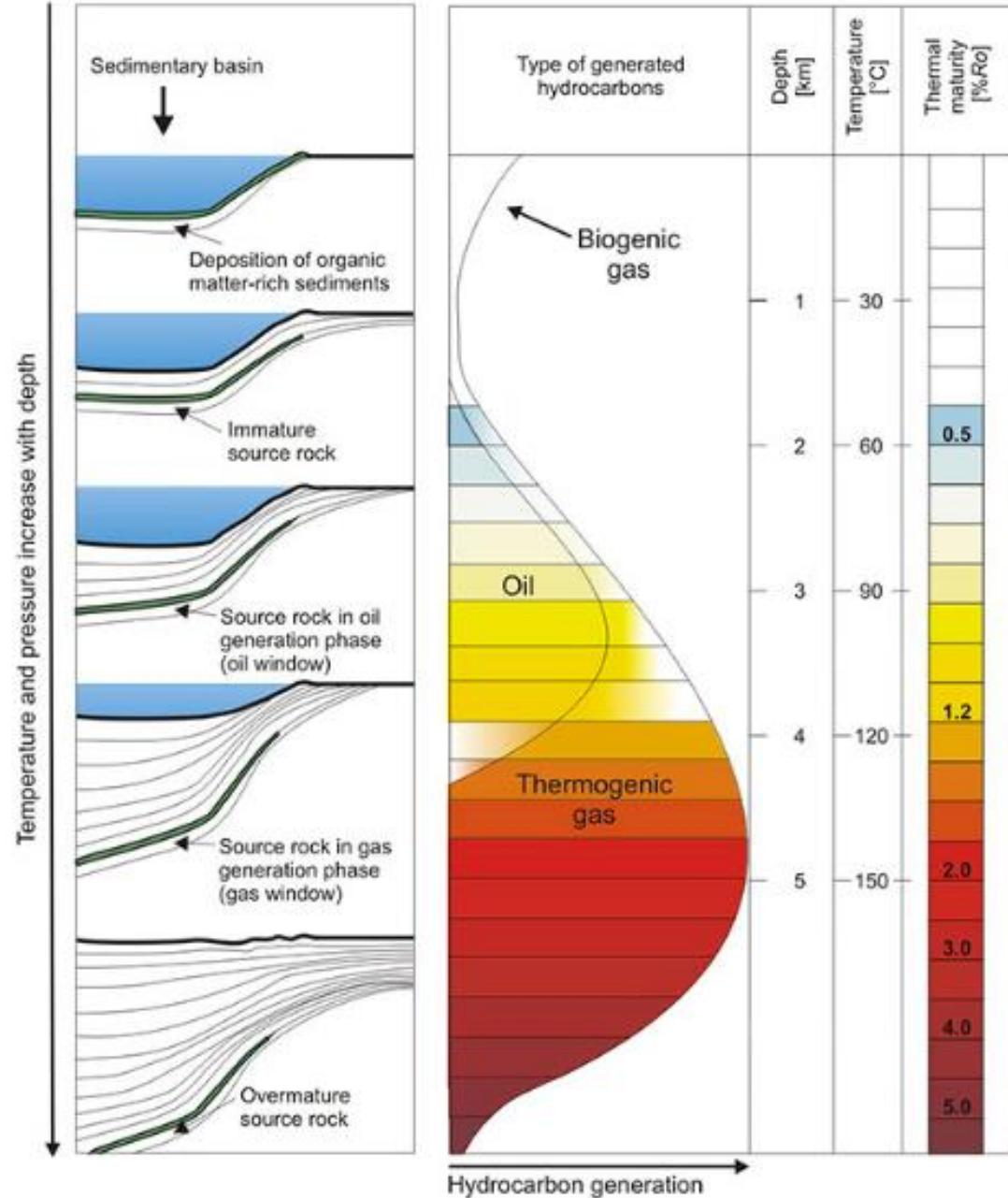
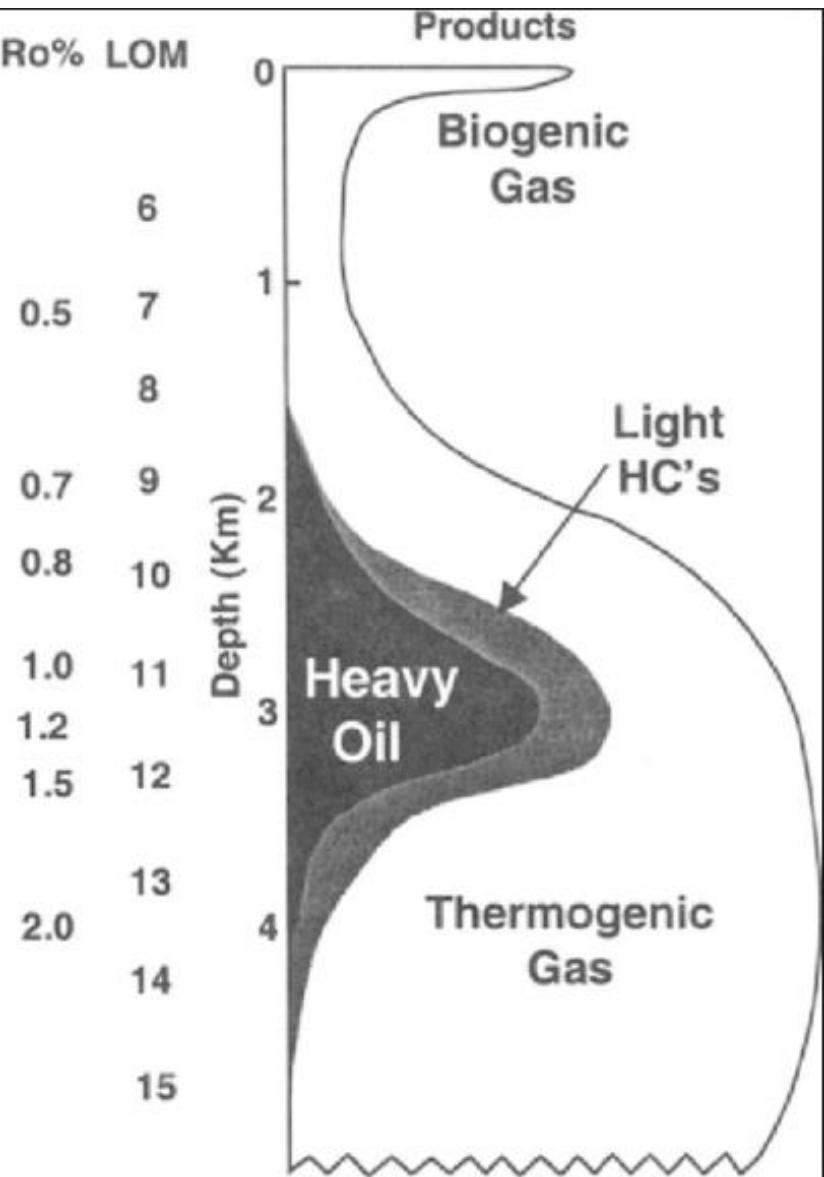
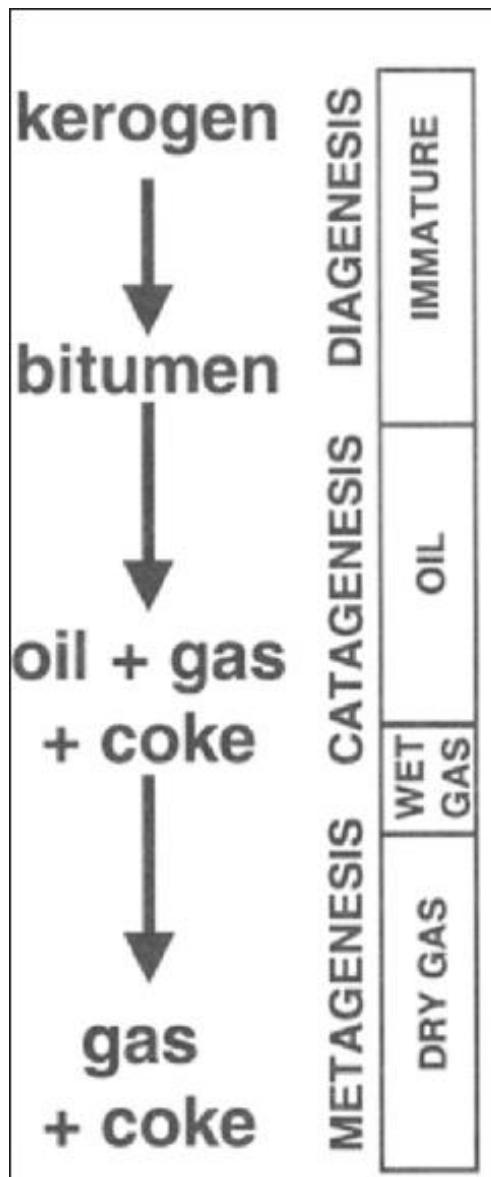


Kerogen (Organic Material) Types:

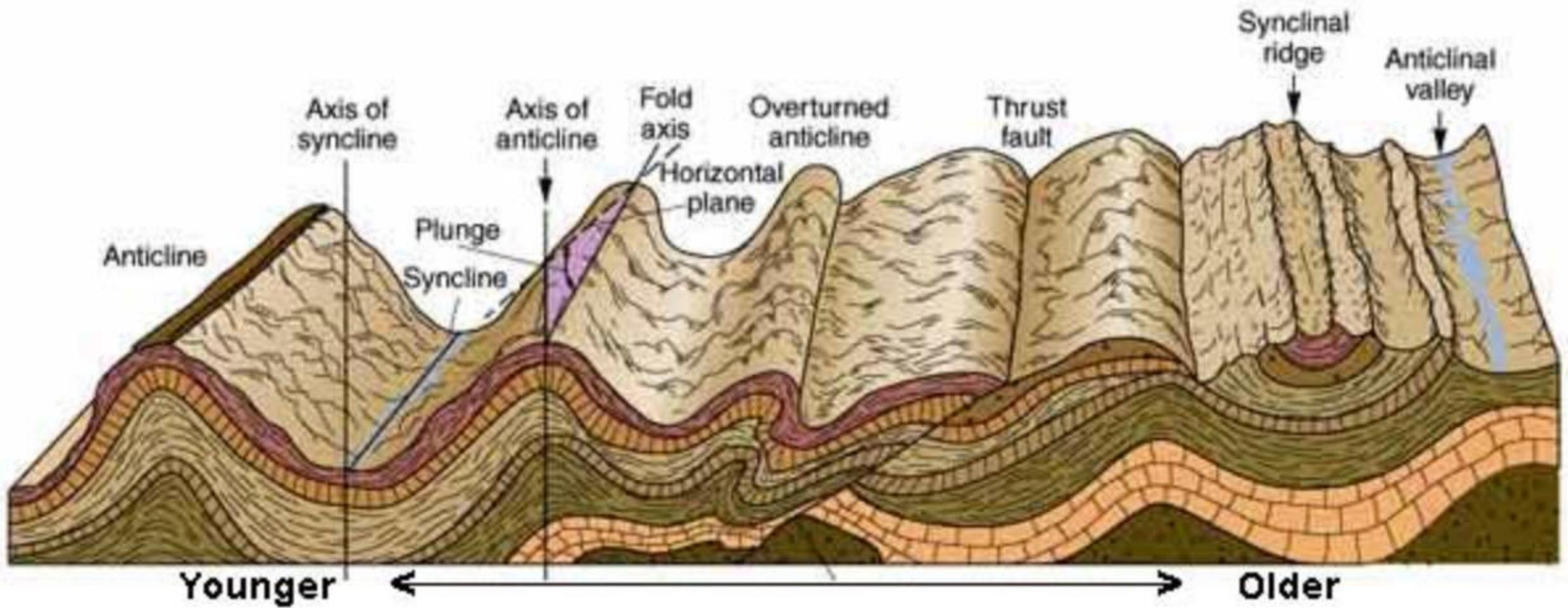
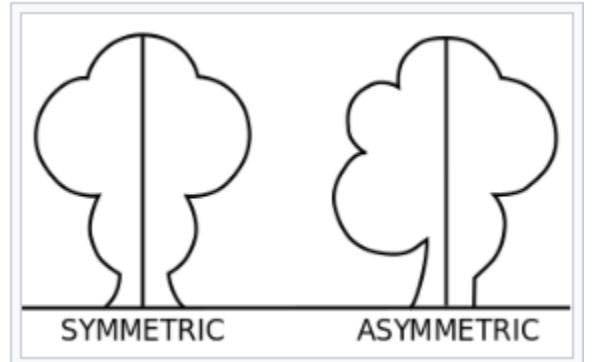


Kerogen type	Predominant hydrocarbon potential	Amount of hydrogen	Typical depositional environment
I	Oil prone	Abundant	Lacustrine
II	Oil and gas prone	Moderate	Marine
III	Gas prone	Small	Terrestrial
IV	Neither (primarily composed of vitrinite) or inert material	None	Terrestrial(?)

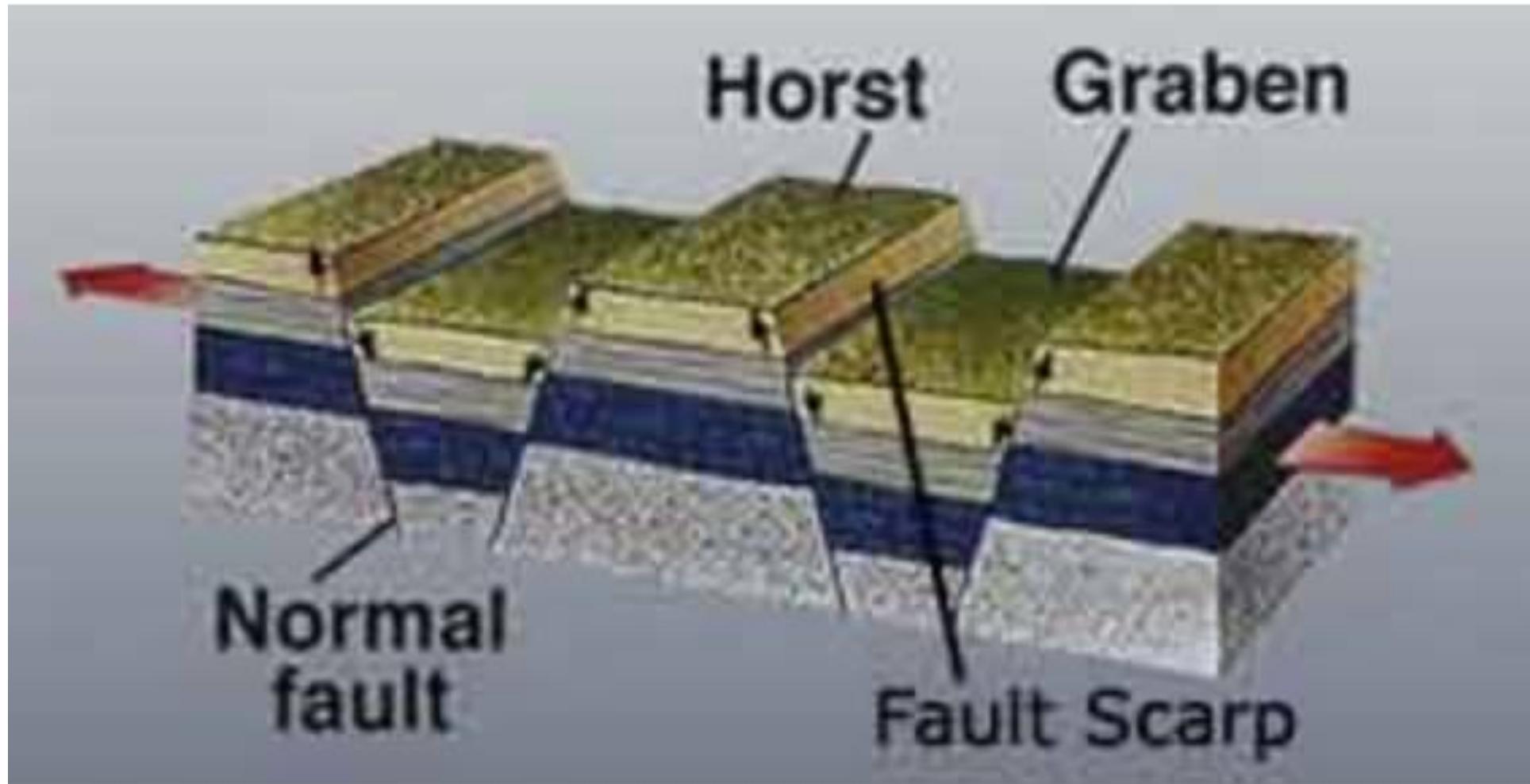
Oil Maturation Window



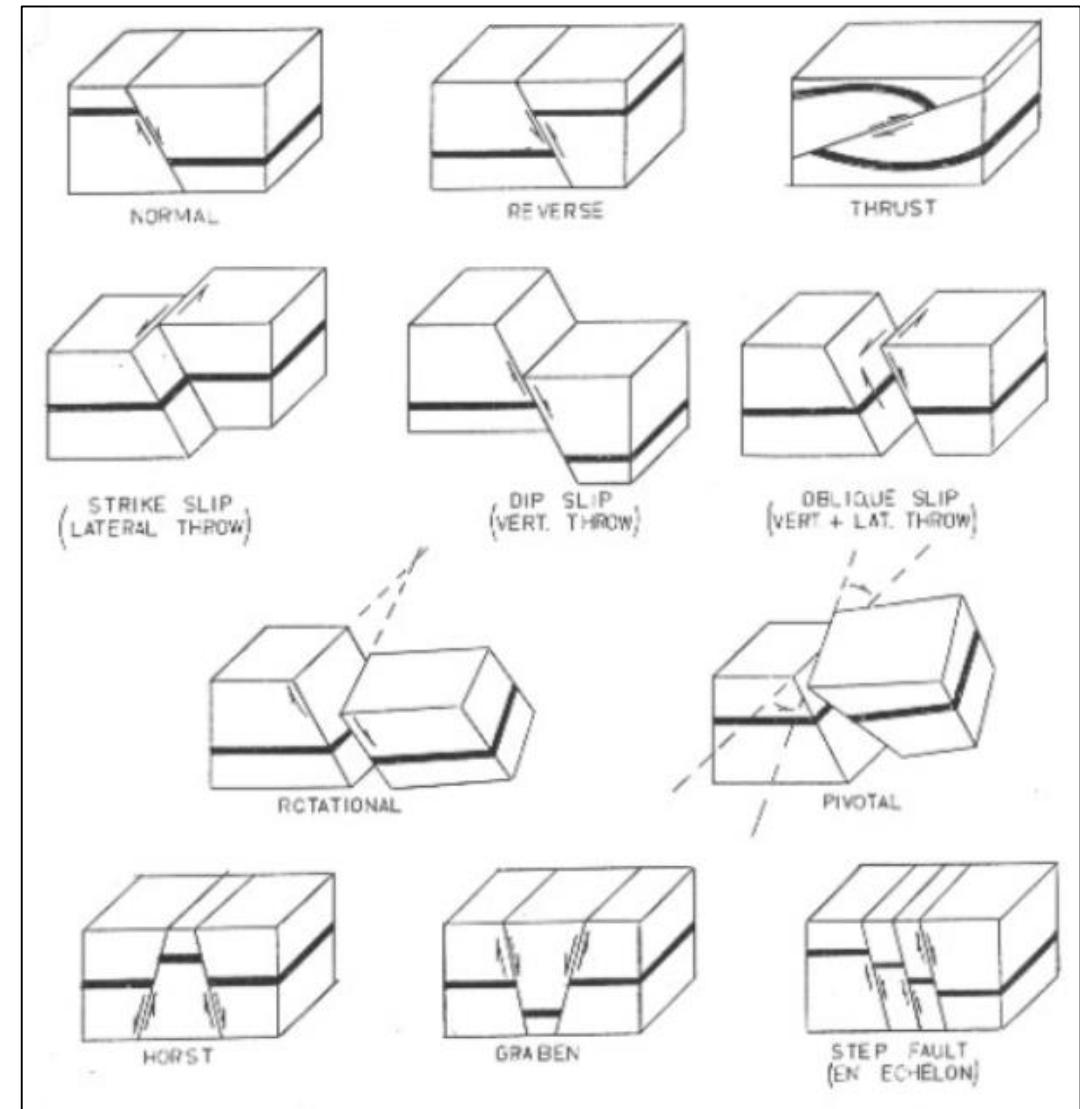
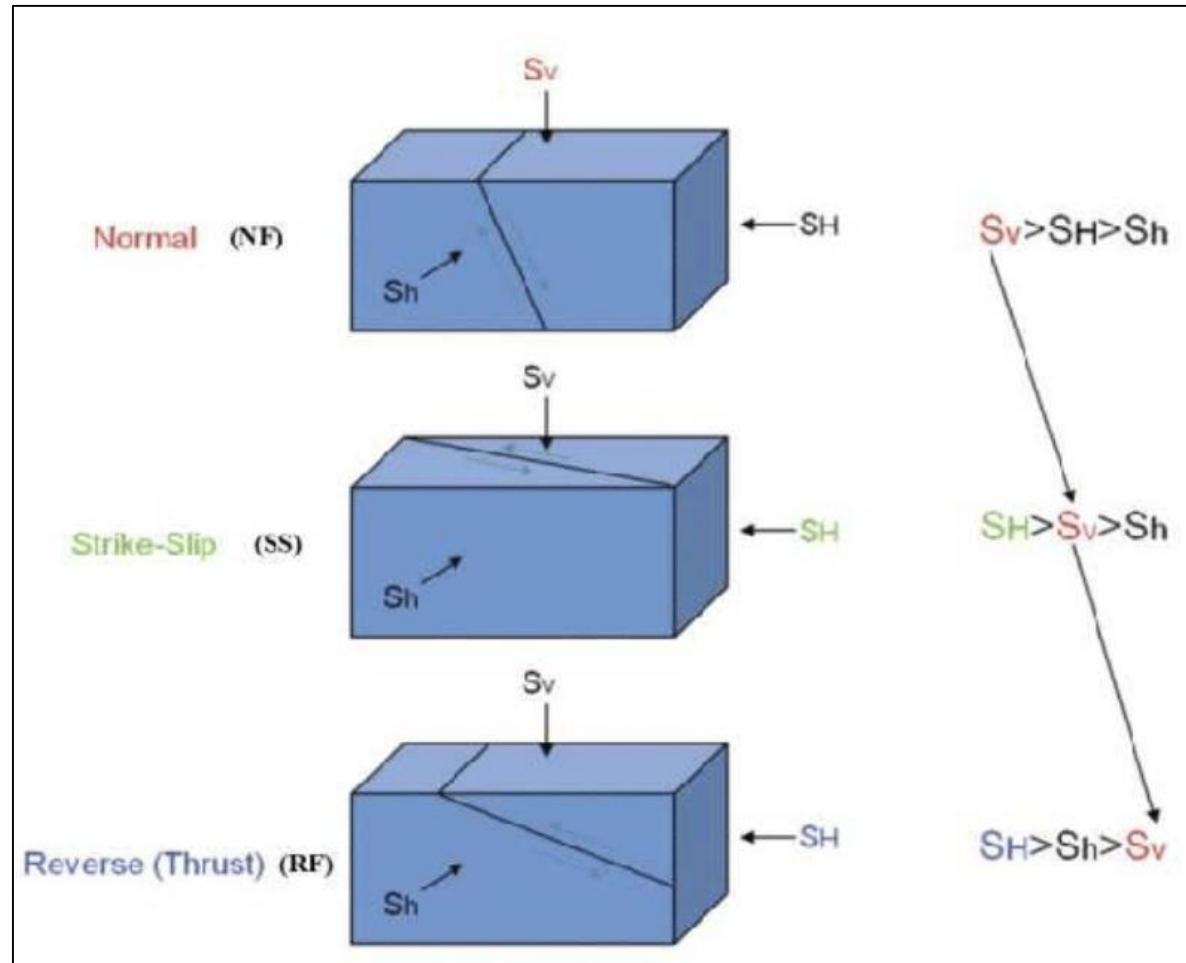
Stress/Folding - Anticline/Syncline/Faults



Extensional Horst/Graben



Stress \rightarrow Fracture/Fault Slip \rightarrow Seismic Expression



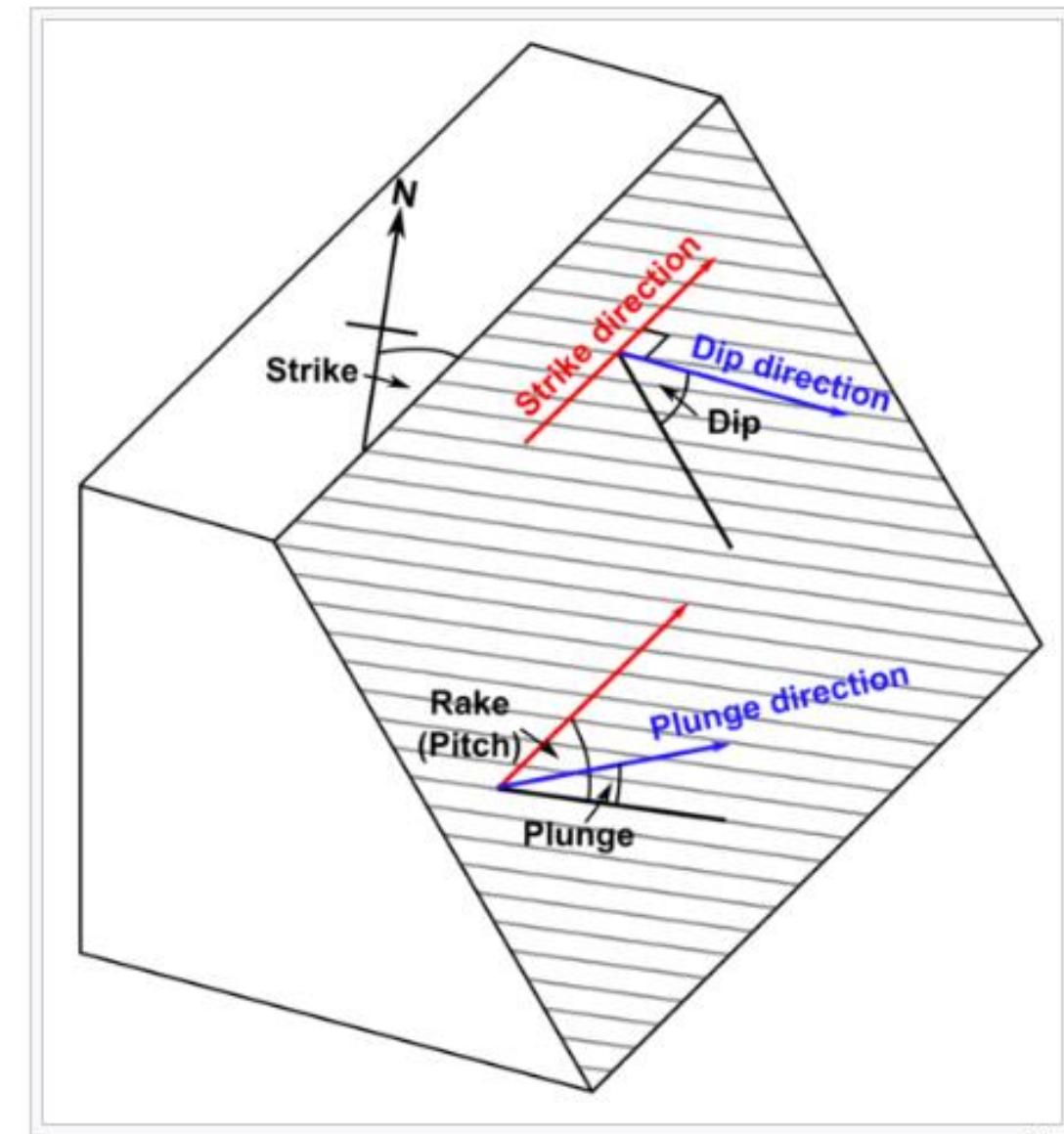
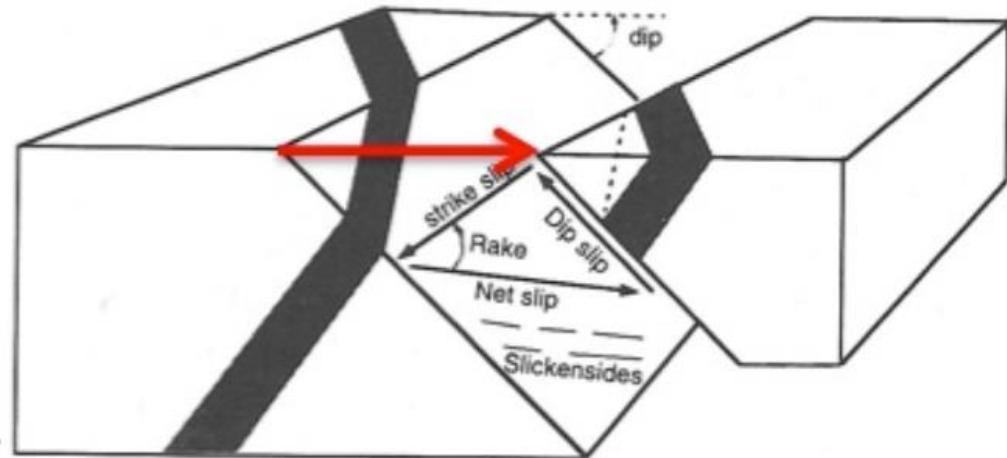
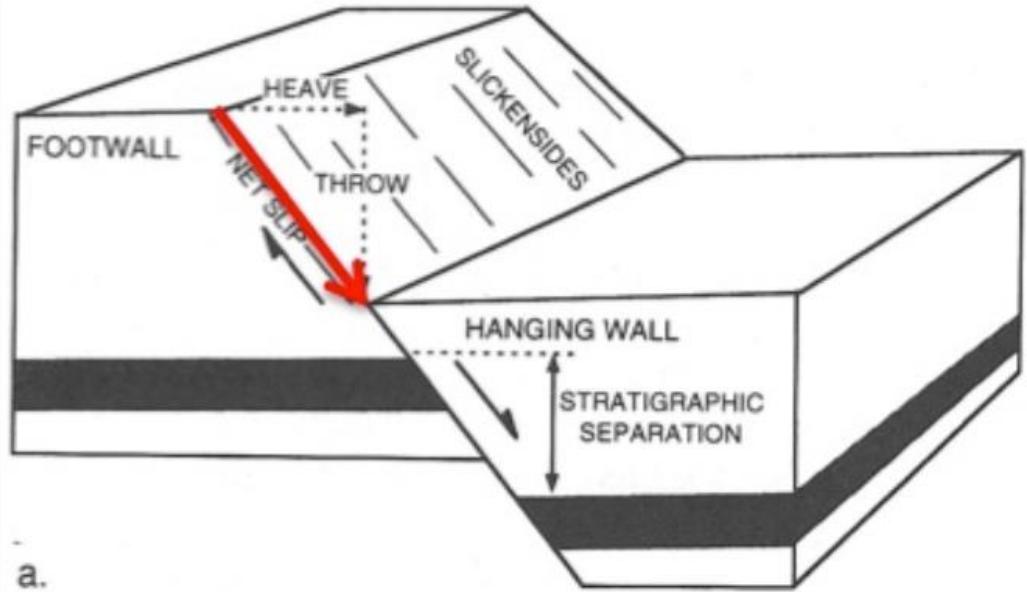
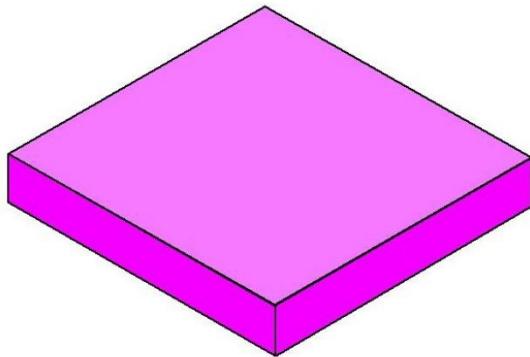


Illustration of measurement conventions for planar and linear structures

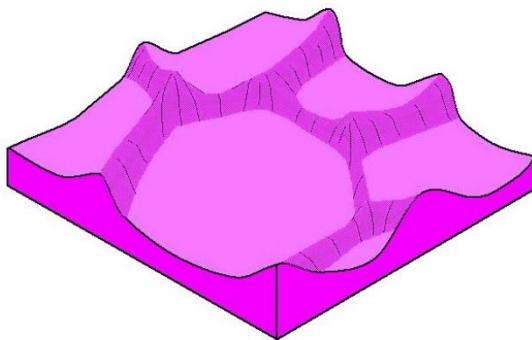
Salt & Salt Tectonics: Creep/Stress/Deformation

Cartoon showing formation of salt domes from initially uniform thickness salt layer due to loading

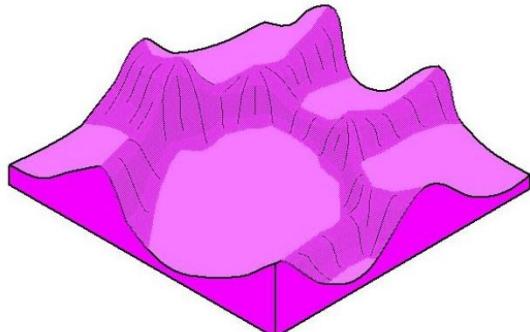
Initial constant thickness salt layer



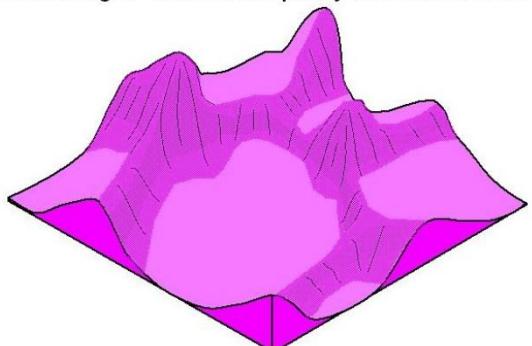
Salt moves into network of ridges



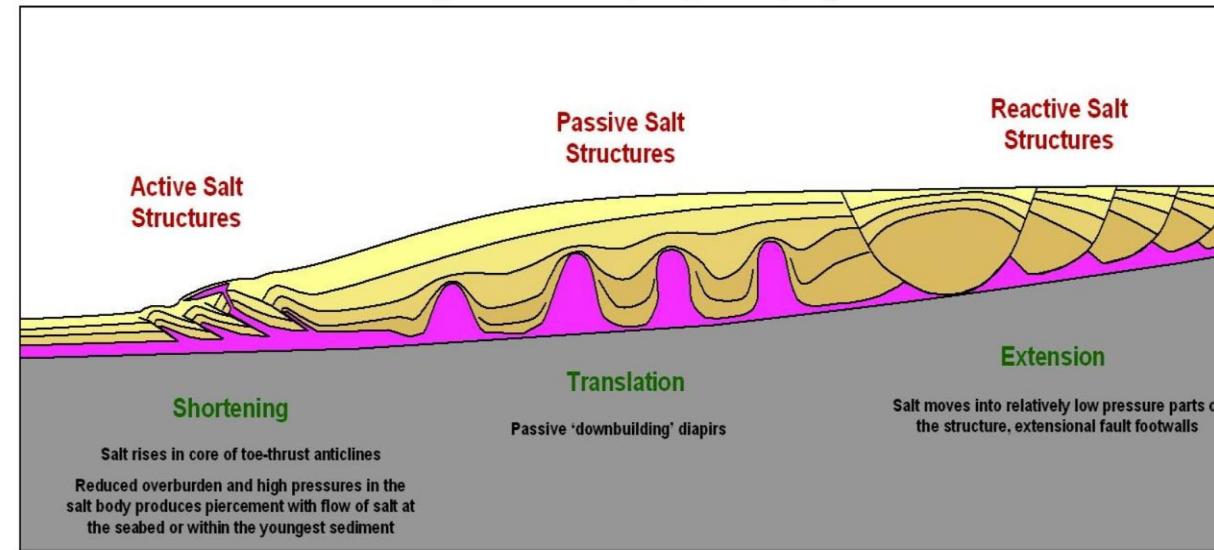
Ridges continue to grow as salt withdraws from the intervening lows – salt domes start to form at nodes



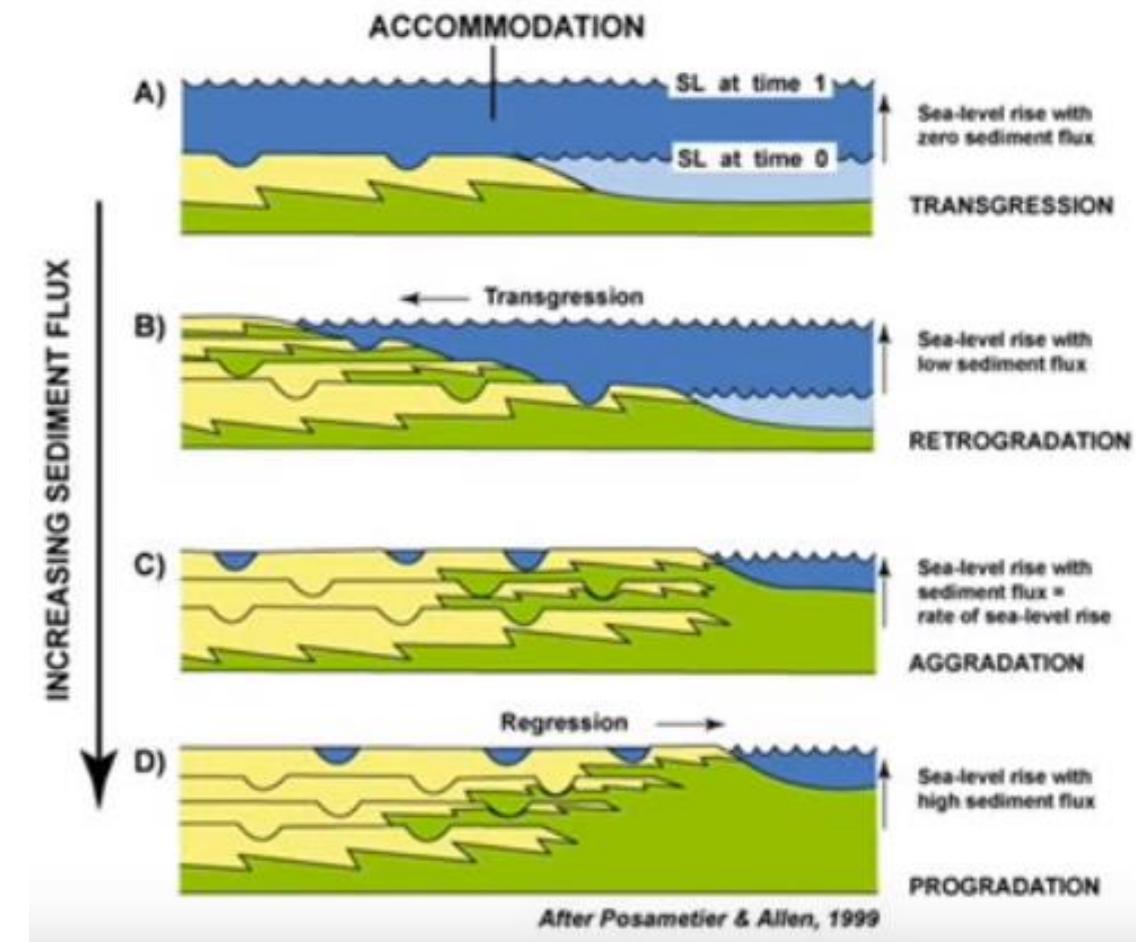
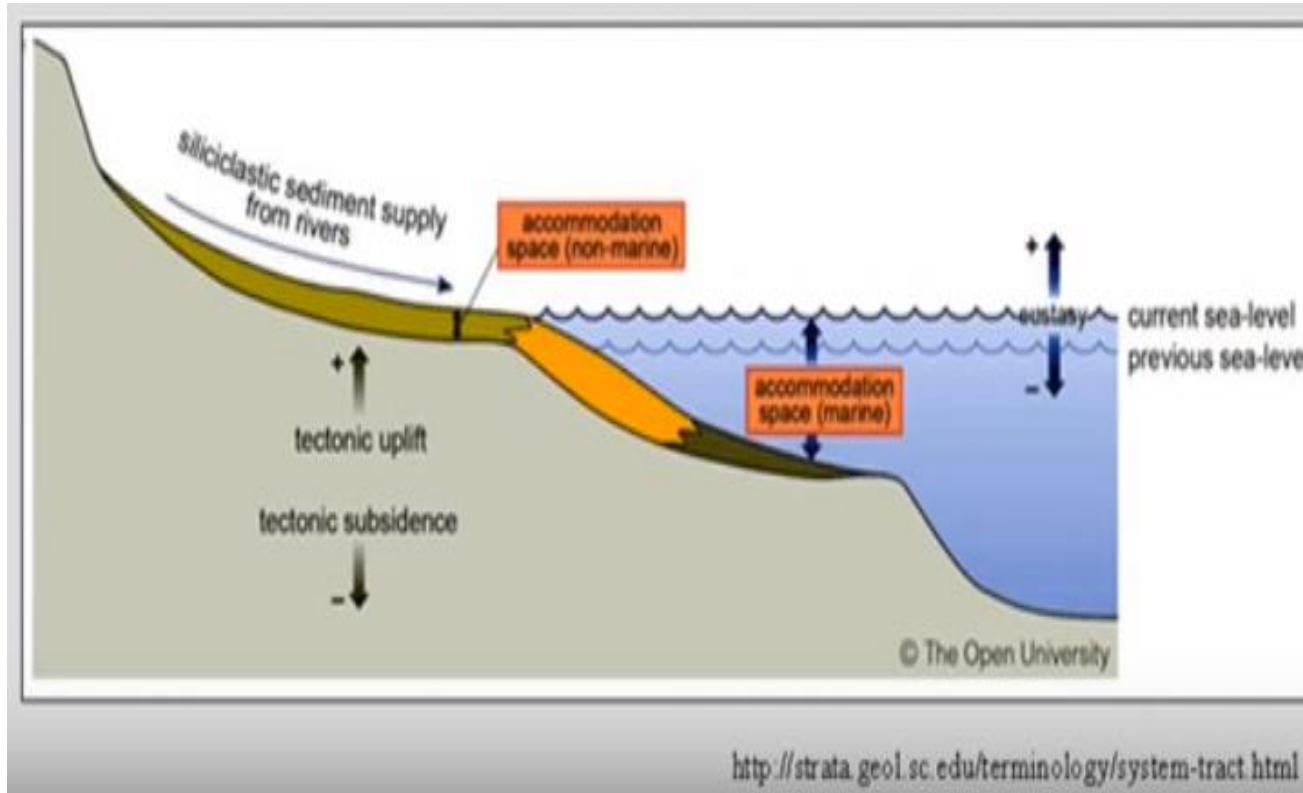
Salt domes continue to grow at the expense of previously formed ridges – salt now completely withdrawn from lows



Cartoon showing types of salt structure associated with a passive margin building out over a salt layer e.g. Gabon, Angola



Deposition & Sequence Stratigraphy



Sequences and Terminations

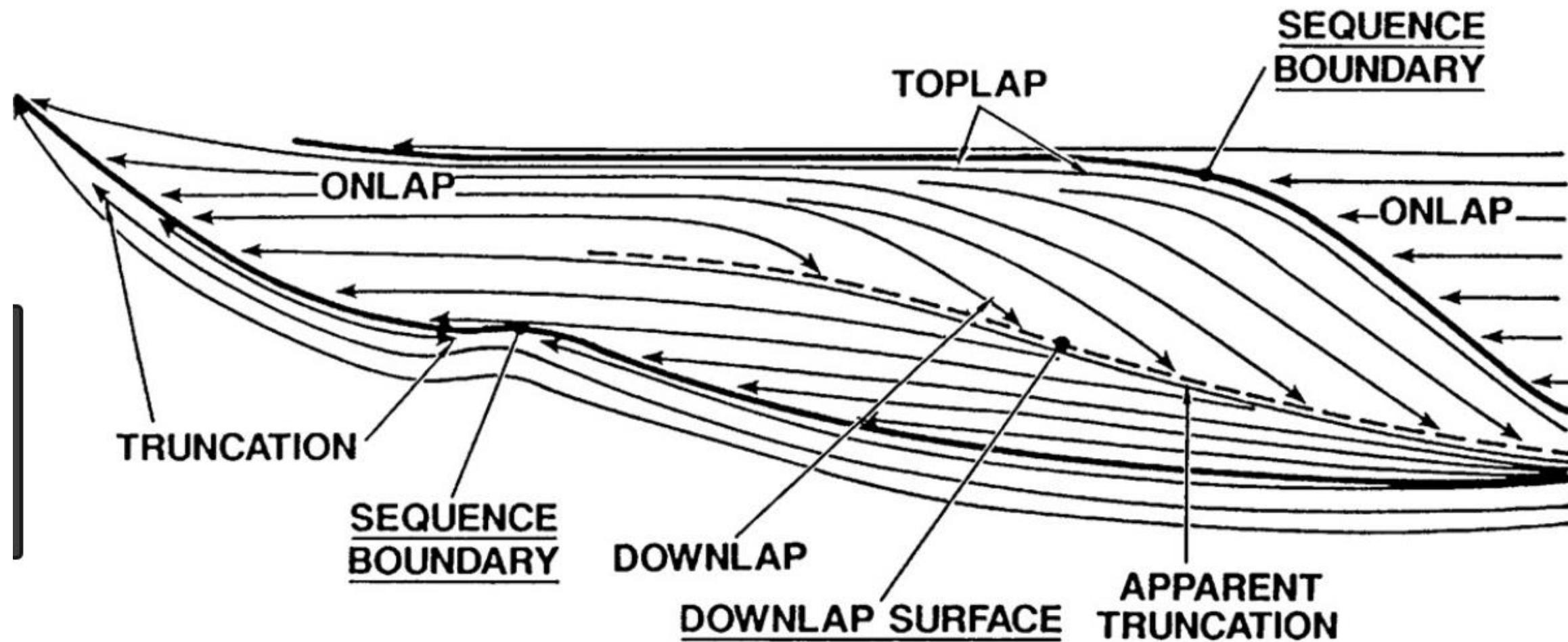
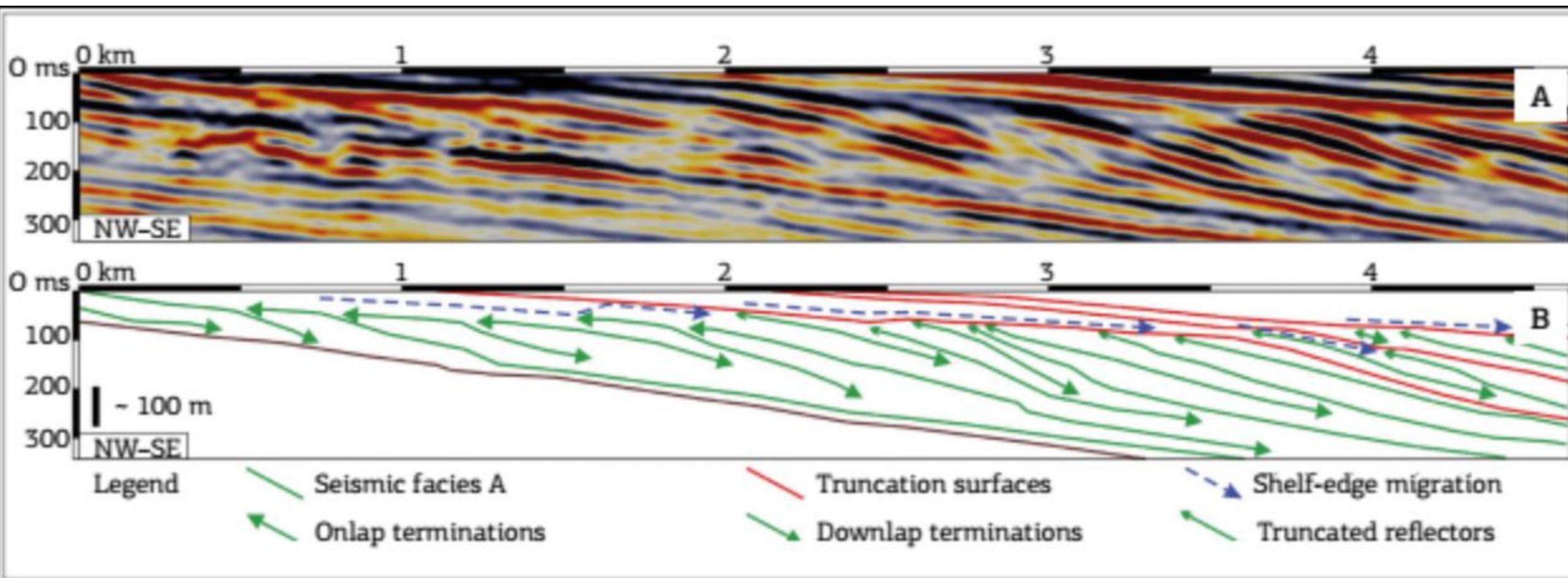
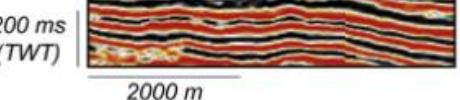
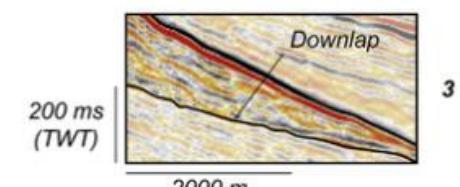
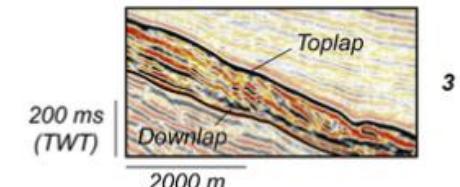
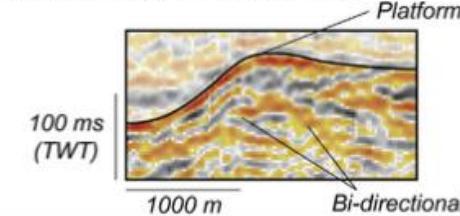
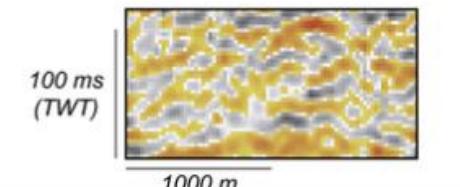


Diagram showing reflection termination patterns and types of discontinuities. From Vail, 1987. Reprinted by permission of AAPG.

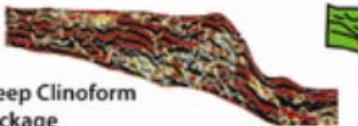
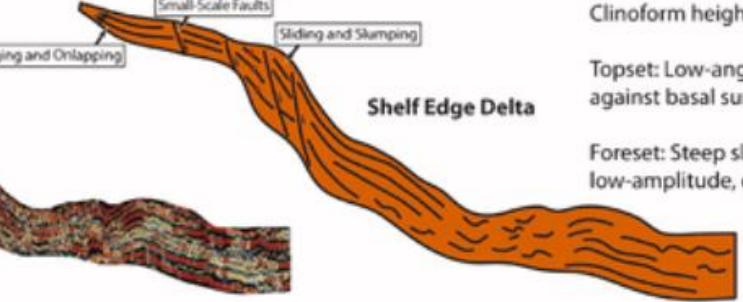
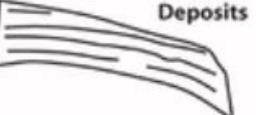
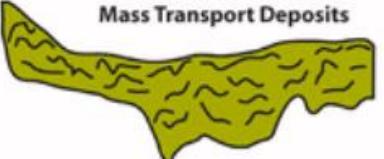
Examples of Seismic Expressions of Sequences



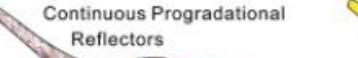
Examples of Seismic Expressions of Sequences

Seismic facies	Reflection characteristics	Interpretation(s)
SF1 - Parallel seismic reflectors (Basin) 	Sub-horizontal to horizontal parallel reflections Continuous High amplitude	Deep volcanic shelf (Peri-platform carbonates)
SF2 - Parallel seismic reflectors (Platform) 	Wavy to horizontal parallel reflections Continuous High amplitude	Lagoon (Platform rimmed by barrier reef) Inner-platform (Open platform)
SF3 - High-angle clinoforms (oblique parallel) 	Downlap of lower reflection terminations Oblique parallel clinoforms Semi-continuous to continuous Moderate to high amplitude	Slope (Carbonate shedding)
SF4 - High-angle clinoforms (sigmoid) 	Downlap and toplap of reflection terminations Sigmoidal clinoforms Semi-continuous Moderate to high amplitude	Slope (Carbonate progradation)
SF5 - Mounded seismic reflectors 	Bi-directional downlap of reflection terminations Mound shape (convex-up) Discontinuous to semi-continuous Low to moderate amplitude	Barrier reef (Platform margin) Patch reef (Platform interior)
SF6 - Chaotic seismic reflectors 	Chaotic to wavy reflections Discontinuous (highly disrupted) Low amplitude	Shoal (Platform margin) Apron (Platform interior)

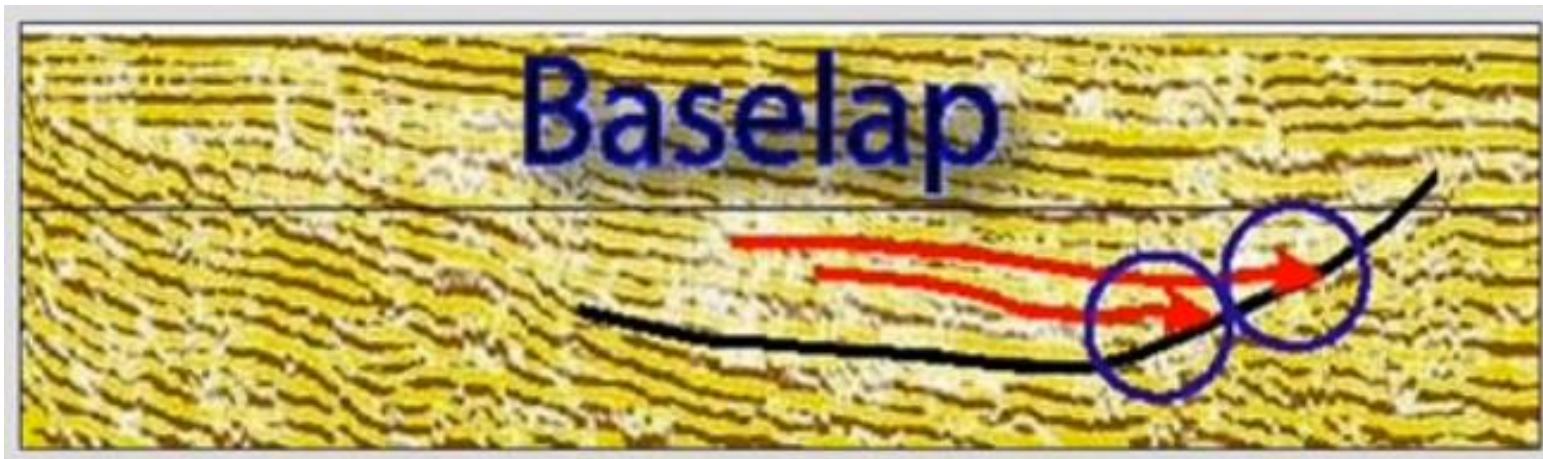
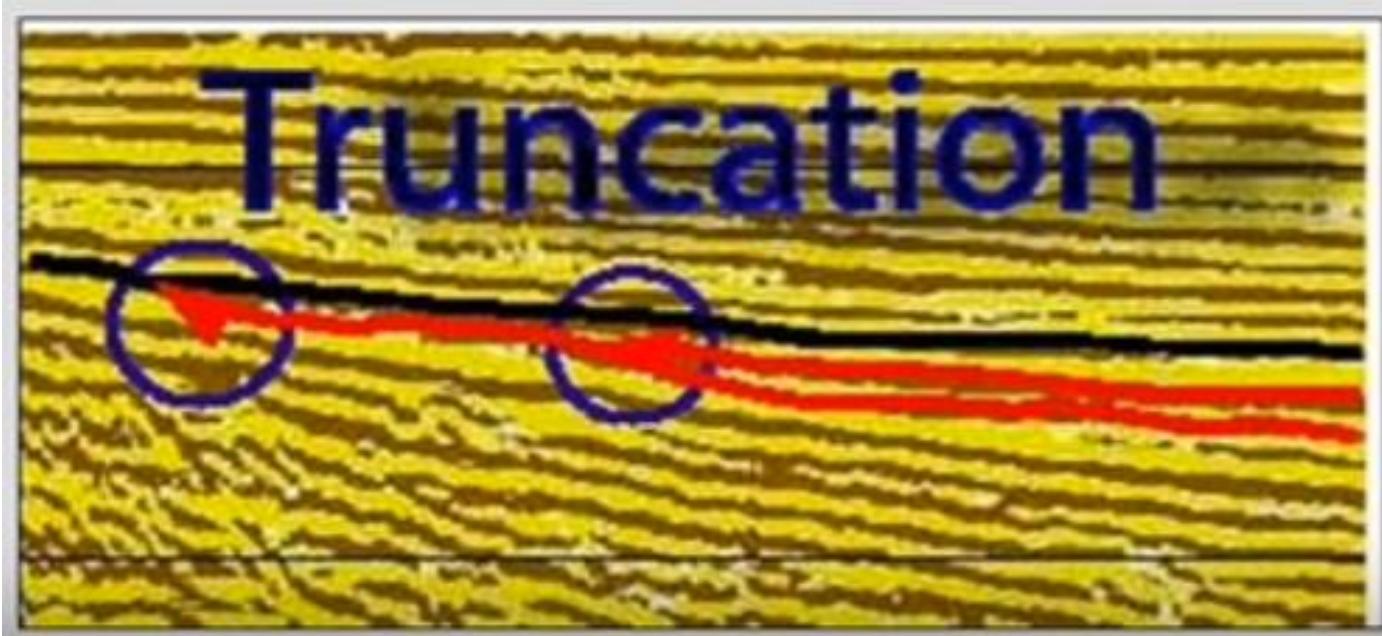
Examples of Seismic Expressions of Sequences & Facies

SF	Seismic Facies Description	
1	 Steep Clinoform Package	 Outer Shelf Delta
2	 Sigmoid Clinoform Package	 Shelf Edge Delta
3	 Onlapping Wedge	 Slope Fan Deposits
4	 Continuous and Parallel Reflectors	 Prodelta/Upper Slope Deposits
5	 Chaotic Seismic Facies	 Mass Transport Deposits
6	 Gull-Wing Seismic Facies	 Levee Channel Deposits

Examples of Seismic Expressions of Sequences & Facies

SF	Seismic Facies Description		Formation
1	 Progradational Filling	 Incised Valleys or Ancient River	Developed on Paleo Uplift, Gentle Slope, Representing Stratigraphic Denudation and River Rejuvenation
	 Composited Filling		SQEls1 SQEls2 SQEls3
2	 S-type Progradational Reflectors	 Delta Deposition (Longitudinal)	Developed on the Gentle Slopes, the Subsidence Rate > the Sedimentary Rate
3	 Continuous Progradational Reflectors	 Fan Delta Deposition (Longitudinal)	Developed at the steep slopes or footwall of basin controlling fault
4	 Chaotic Reflectors	 Clastic Flow Deposition (Longitudinal)	Developed under the flexure slope break belt, with a distance from flat bottom of the basin
5	 Broom-like Progradational Reflectors	 Nearshore Subaqueous Fan	Developed at the footwall of basin controlling fault or paleo uplift during tectonic movement period, new accommodation rate is greater than the deposition rate
6	 Small Dome Reflectors	 Sub-lacustrine Fan	Developed at the lower part of slope break belt or flat footwall of secondary fault
7	 Low Frequency Strong Amplitude Continuous and Parallel Reflectors	 Deep Lake	Deep Lacustrine Area
8	 Intermediate Frequency Medium - Weak Amplitude Continuous and Parallel Reflectors	 Shallow Lake	Half-deep to Deep Lacustrine Area
			SQEls1 SQEls2 SQEls3

Examples of Truncations & Sequences



Incised Valley Seismic Cross-section

