HGS DINNER MEETING

On The Scales, Causes and Applications of Stratigraphic Sequences

HGS Dinner Meeting - September 13, 1993
Social Period, 5:30 p.m., Dinner and Meeting, 6:30 p.m.
Post Oak Doubletree Inn

The global stratigraphic record can be divided into unconformity-bounded sequences on many different scales. There is no evidence that these scales follow a simple progression in duration, thus it is inappropriate to refer to them as first, second or n-th "order". Instead, I suggest that we look at sequences in the context of the different dynamics that probably drove their genesis, and that we refer to them with names honoring those pioneers in stratigraphy who brought their existence to our atention.

The longest time scale sequences currently recognized are those with duration of four to five hundred million years. They probably reflect the alternating global states of full continental assembly ("Pangean states") and fragmentation. These sequences are probably controlled by the dynamic topographic effects of continental fragments "rafting" away from high areas of hot mantle towards subduction zones of cold mantle. In addition, there are the effects of eustatic sea level variations driven by young versus old sea floor crust. I suggest we refer to these long-term sequences as Wilson sequences.

Sequences of a duration of about one hundred million years were early recognized on the North American craton and are now well accepted. These are the Sloss sequences. Like the Wilson sequences, these shorter ones probably also owe their origin to a strong component of vertical tectonics. Sloss and Wilson sequences are the domain of those members of the petroleum geological community who analyze "new ventures" or regional assessments.

Vail sequences range in duration from one to a few tens of millions of years. A number of mechanisms affecting the relative elevation of land and sea operate in this range of time scales. For example, growth and decay of orogenic belts, continental margin cooling and subsidence, mantle plumes, variations in sea floor spreading rates, etc. Some recently-proposed hypothetical mechanisms such as intraplate stress variations and very long-term variations in the Earth's orbit may also play a role, but the origin of most Vail sequences probably lies in more classical causes. Vail sequences are the domain of the exploration teams who aim to map source rocks, seals and reservoirs from conventional seismic reflector geometries.

At the short-period end of the spectrum are the Milankovitch sequences. There are well-understood variations in the Earth's orbital parameters on time scales from 20,000 to 40,000 years. The corresponding insolation variations have created climatic cycles which have driven changes in sediment supply, lake- and sea-level elevations, ground water tables, water column stratification and chemistry, and other characteristics. Depositional sequences due to one or a combination of these changes are widely recognized; many may be globally correlatable. Most production geologists work with Milankovitch sequences. Issues related to fluid flow through reservoirs, location of sites for step-out and infill drilling, and secondary and tertiary recovery techniques are all fundamentally related to our ability to predict Milankovitch sequence architecture ahead of the drill bit.

Dag Nummendal -

Biographical Sketch

Dag Nummendal was born in Norway, a long time ago. Dag was educated at the University of Oslo (M.Sc.) and the University of Illinois (Ph.D. '74), served in a research position at the University of South Carolina, and has been at Louisiana State University since 1978, where he currently is a professor in the Department of Geology and Geophysics.

Most of Dag's early work dealt with the sedimentary dynamics of modern coastal and shallow marine depositional environments, including the Texas coast and shelf. For the past 10 years most of his work has focused on sequence stratigraphic concepts and their applications to the interpretation of Cretaceous marine strata in the Rocky Mountains.