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Tectonic and Climatic Forcing Of High-Frequency Sequence Stratigraphy: Processes and Products in Fluvial Environments

SPEAKER:

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ABSTRACT:

Stratigraphic studies are yielding increasing evidence for sequence controls operating over time scales of 10³-10⁴ years. High-frequency tectonism (in tectonically-active basins) and high-frequency glacioeustasy generate sequences by the forcing of changes in accommodation.

Orbital forcing of climate change causes latitudinal shifting of climate belts, with consequent effects on sedimentary environments, including changes in temperatures, atmospheric and oceanic circulation, biological productivity, and other factors. In nonmarine settings, climatic fluctuations in rainfall lead to changes in vegetation and sediment yield, with effects on fluvial sedimentation patterns, including channel style, and overbank facies.

Orbital forcing has been called a sedimentary pacemaker, and offers potential for the development of a high-precision time scale. However, the building of an orbital time scale from the ancient rock record requires assumptions about the constancy of orbital periods and the completeness of the stratigraphic record which it may not be possible to satisfy.

In the rock record, cycles driven by orbital forcing have long been recognized, going back to the definition of Mid-Continent cyclothems in the 1930s. More recently, mapping in many basins, such as the Cretaceous of the Western Interior, has indicated that changes in climate, without any effects on eustatic sea level, have generated a high-frequency sequence stratigraphy. Such cyclicity may provide many markers for high-precision mapping, but in nonmarine settings the superimposition of autogenic channel migration and avulsion processes may be on a time scale unrelated to orbital forcing and may result in a highly fragmentary record of climatic cyclicity.

BIOGRAPHY

Andrew Miall obtained his B.Sc. at the University of London (UK) in 1965, and his Ph.D. at the University of Ottawa in 1969. He was employed by J. C. Sproule and Associates and by Shell Canada until in 1972 he joined the Arctic Islands section of the Geological Survey of Canada, Calgary, where he worked on regional basin studies. In 1979 he moved to the University of Toronto, and is founding incumbent of the Gordon Stollery Chair in Basin Analysis and Petroleum Geology. Andrew was elected a Fellow of the Royal Society of Canada and a Distinguished Fellow of the Geological Association of Canada in 1995. In 2004 he was a recipient of the American Association of Petroleum Geologists Grover E. Murray Distinguished Educator Award.