Introduction

Rock successions can be named, analyzed and understood using two fundamentally different approaches. The first approach, lithostratigraphy, involves correlating similar lithotypes and “packaging” the rocks into lithostratigraphic units. Examples of formal lithostratigraphic units include groups, formations, and members (North American Commission on Stratigraphic Nomenclature (NACSN) 1983). The second approach, which incorporates time stratigraphy, involves the correlation of time markers through rocks of potentially varying lithologies and the packaging of rocks into units bounded by unconformities and other types of surfaces. Examples of formal lithostratigraphic units in a time-stratigraphic framework include allostratigraphers, outcrops, and allostratigraphers (NACSN, 1983). This paper outlines these concepts and discusses their application to strata in the foreland succession of the Western Canada Sedimentary Basin.

Lithostratigraphy, Sequence Stratigraphy, and Allostratigraphy

Allostratigraphy is defined as the packaging of rocks bounded by discontinuities within a time-stratigraphic framework (NACSN, 1983). These bounding discontinuities can include unconformities, ravines, surfaces, flooding surfaces, and omission surfaces (Bhattacharya and Walker, 1991a). The elevation of unconformities to a higher level of significance and then repackaging of the rocks into sequences using those surfaces embodies the sequence stratigraphic approach. “Sequence Stratigraphy is the study of rock relationships within a chronostratigraphic framework wherein the succession of rocks is cyclic and is composed of genetically related stratal units” (Posamentier et al., 1988).

Understanding generic relationships affords a better understanding of coeval depositional systems and hence more meaningful paleo-biotic reconstructions. Historically, much of the stratigraphic succession in the Western Canada Sedimentary Basin has been subdivided on a lithostratigraphic basis and many of the formation and member boundaries in both the Energy Resources Conservation Board (ERCB) and Atlas databases are diachronous across the basin. For example, by analyzing the Devonian Wimarwood-Woodbend strata, Switzer et al. (this volume, Chapter 12) used a time-marker approach and repackacked members across the basin in order to better map the genetic units, rather than utilizing the essentially lithostratigraphic ERCB and Atlas databases.

Figure 25.1 contrasts the two approaches as applied to the upper Cretaceous Dunagan Formation in northwestern Alberta. In the lithostratigraphic interpretation (Fig. 25.1a), the Dunagan Formation is shown as a sandy clastic wedge that interfingers with shales of the Shuswap Formation below and the Kaskapau Formation above. Further east, the Dunagan pinches out into shales of the Lac Biche Formation (Singh, 1983). Several marine tongues are shown within the Dunagan Formation.

Figure 25.1 & 2. Dunagan cross-sections. a & 2a. east-west/thick stratigraphic cross section, illustrating sandstone and Dunagan Formation passing eastward into shale of the Lac Biche Formation. b & 2b. northwest-southeast cross section showing subdivision into alloformations (alleforms A to D) and strata (units 1, 2, 3, 4, etc.; detailed in 2a). Diagram is based on interpretation of chronostatigraphically significant log markers interpreted as time-stratigraphic events (events based on Fig. 22). Bhatcsharya, this volume, and Bhattacharya and Walker, 1991a, SB. Sequence Boundary; TSE. Transgressive Surface of Erosion; ESLT, 3rd-order lowstand systems tracts. See text for further details.

Historical Perspective

Ideas regarding changes in base level as a control on sedimentation can be traced back to the work of Grabau (1906), Blackwelder (1929), and Barrell (1922, 1937). Their ideas were formalized into the concept of time-stratigraphy by Wheeler (1958), who recognized that the duration of hiatuses in sedimentary successions is as important as the rocks actually present. Wheeler (1958) identified the timing of geological cross sections in terms of time represented. An example of a time-stratigraphic diagram for the Dunagan example shown above is illustrated in Figure 25.2. Stoes (1963) applied Wheeler’s ideas to the North American craton and developed the concept of continent-wide unconformity-bounded units, which he termed sequences.

The availability of high-quality seismic data, acquired for petroleum exploration during the latter half of the 20th century, provided a database that gave the geologist a continuous submerged image of stratigraphic relations in areas not previously accessible. Scientists at Exxon Production Research Co. recognized the stratigraphic significance of the seismic tool. In their landmark publications, Vail et al. (1977) recognized that major unconformities could be identified by reflection terminations on seismic data, and developed the concepts of sea stratigraphy. They termed the depositional units bounded by these unconformities seismic depositional sequences (Mitchum et al., 1977). Vail et al. (1977) also observed that there was a striking similarity of coastal geology between widely separated ocean basins. They suggested that the cause of this apparent synchronicity of events was global sea-level change (eustasy). Their observations led to the publication of global sea-level charts (Vail et al., 1977; Haq et al., 1987, 1988).

The application of these new stratigraphic principles to outcrop, core, and well log data has led to the broader concept of sequence stratigraphy (Wignall et al., 1988). With the publication of Jervey (1988), Loula (1980), Posamentier et al. (1988), Posamentier et al. (1988), Posamentier and Vail (1988), Sarg (1988), and Van Wagoner et al. (1990) the use of sequence stratigraphic concepts as a tool for lithology prediction came into its own. It also became apparent that sequence stratigraphic concepts were applicable at all spatial and temporal scales and could be applied using a variety of databases including conventional seismic, outcrop, and Bumen studies (e.g., Baum and Vail, 1988; Greenhal and Moore, 1988; Posamentier et al., 1992a; Wood et al., in press). A strength of the sequence stratigraphic concepts has been to allow integration of diverse databases including biostratigraphic data, geochemical data, and tectono-structural data (e.g., Leckie et al., 1990, 1992).

Sequence Stratigraphic and Allostratigraphic Principles

The recognition that lithostratigraphic units may be defined by chronostatigraphically significant surfaces has been incorporated into the North American Stratigraphic Code as allostratigraphy (NACSN, 1983). Allostratigraphy is a formally recognized way of defining and naming discontinuity-bounded rock successions without placing particular emphasis on which type of discontinuity should be used as the "fundamental" stratigraphic break. Allostratigraphic units, therefore, may include both unconformity-bounded depositional sequences, as defined by Mitchum (1977), and the genetic stratigraphic sequences proposed by Galloway (1989), which are based on marine flooding surfaces. Allostratigraphy represents a relatively generic way of defining and naming discontinuity-bounded rock successions and emphasizes mapability. Sequence stratigraphy represents a more powerful way of interpreting rock successions in the context of eustatic relative sea-level change (e.g., Posamentier and Vail, 1988; Posamentier et al., 1988).

Sequence stratigraphy has two fundamentally different, yet powerful, applications:

1. Model prediction. This involves the analysis of sequences for the purpose of extracting a eustatic signal and then correlating with the global sea-level curve to determine the age of the rocks. The implicit assumption is the inherent validity of published global sea-level curves (e.g., Haq et al., 1987), although these have been criticized by Summberhays (1986), Mull (1986), Hubbard (1988), and others.

2. Time-stratigraphy is compared with the eustatic chart of Haq et al. (1987) and suggests correlation with a global lowering of sea level. This indicates a possible post-glacial event.
SEQUENCE STRATIGRAPHY

2. Lithology prediction. This involves the analysis of stratigraphic successions for the purpose of understanding temporal and spatial relations between rocks in the context of relative sea-level change. The use of sequence stratigraphy for lithology prediction is thus indispensable of a belief in eustasy as the underlying mechanism. The key to success is the correct identification and correlation of chronostratigraphically significant surfaces. This approach requires the integration of facies successions and time-stratigraphy. The interplay between sediment flux and relative sea-level change, rather than just eustasy, allows for recognition of the importance of local factors such as tectonics and sedimentation rate (Jervey, 1988; Posamentier et al., 1988; Posamentier and Vail, 1986).

Key Surfaces

Key surfaces having chronostratigraphic significance are used to define sequence stratigraphic and allostratigraphic units that make up the stratigraphic succession. They are defined by upward termination of transgressive deposits, or their combination with the unconformity. In the absence of such an unconformity, these surfaces may be considered to be depositional sequences.

Sequences, Systems Tracts, Parasequence Sets, and Parasequences

Sequences are defined as genetically related strata bounded by unconformities or their equivalents (Vail, 1985; Gradstein, 1982).

Each sequence is composed of systems tracts, which are defined as linked co-evolution deposits (Posamentier and Vail, 1977; and modified by Posamentier et al., 1988). A sequence consists of these systems tracts (Fig. 25). A Type I sequence consists of a lowstand systems tract (LST), a transgressive systems tract (TST), and a highstand systems tract (HST), and a Type II sequence consists of a shelf-margin systems tract (SMST), a transgressive systems tract (TST), and a highstand systems tract (HST). The Type I sequences develop in response to relative sea-level fall, whereas Type II sequences develop in response to slowdowns and then accelerations, relative sea-level rise (Posamentier et al., 1988). Type I sequences seem to be relatively common within the fill of the Albert Basin and consequently Type II sequences will not be considered here.

Parasequences comprise the building blocks of many of the sequence stratigraphic and allostratigraphic units discussed here. They are defined as genetically related strata bounded by flooding surfaces or their correlative surfaces (Van Wagoner et al., 1990) and are commonly characterized by a shoaling-upward succession. Parasequences, in turn, can be grouped into parasequence sets (Van Wagoner et al., 1990) whose stratigraphic patterns can be described as downslope or onlap (i.e., progradational, aggradational, or backstepping (i.e., retrogradational).

Sequences and Systems Tracts

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Systems tracts usually comprise a parasequence set characterized by a distinctive parasequence stacking pattern. Lowstand systems tracts (LST) are interpreted to have been deposited during relative sea-level falls and subaerial lowstands (Posamentier and Vail, 1988). LSTs are characterized by deposition below the level of the coastal plain or shelf and commonly have a basinward distribution (i.e., “downlap”). The LST may include lowstand shoreline, lowstand delta, and deep-water submarine fan, although the latter are rare within the Alberta Basin. Further landward the LST may be characterized by incised valleys. The stratigraphy of the lowstand facies is characterized by the early and middle LST comprises a downstepping (i.e., onlap) stacking pattern (Fig. 25) as the shoreline moves seaward (i.e., forced regression; Posamentier et al., 1990, in press). The LST LST may be characterized by an aggradational stacking pattern in response to slower sea-level rise in which the shoreline position does not change. Therefore, shoreline deposits are observed to be progressively more upward than the LST.

Transgressive systems tracts (TST) are interpreted to have been deposited during intervals of rapid relative sea-level rise (Posamentier and Vail, 1988). At this time sediment supply is exceeded by the rate of new space added on the shelf (i.e., new accommodation) and overall shoreline transgression occurs. Several parasequences may comprise the TST. Whereas each parasequence comprises a single parasequence or succession of parasequences, a transgressive systems tract is characterized by a progressive marine transgression relative sea-level rise in which the shoreline position does not change. Therefore, shoreline deposits are observed to be progressively more seaward than the TST.

Highstand systems tracts (HST) are inferred to have been deposited during intervals of relative sea-level rise (Posamentier and Vail, 1988). At this time the rate of new space added on the shelf exceeds the rate at which new space is added on the shelf, resulting in a shoaling-upward succession. The highstand systems tract characterizes the HST for the first time (i.e., progradation) in which shoreline sediments (with) successive parasequences lie in a progradational seaward progression (Fig. 25). Fluvial, shoreline, and deltaic depositional systems are most common in the HST. Shelly deltas and submarine fans are uncommon in the HST and are typically confined to the lowstand systems tract (LST).

Condensed sections are coeval facies equivalents seaward of all systems tracts, and develop beyond the influence of the most recent sea-level rise (Fig. 25). Such condensed sections are often present seaward of faults and are typically characterized by a “hot” gamma-ray log response and by low resistivity and low sonic log responses. Examples of condensed sections are observed in the Fisk and Shead Sand Member of the Ulrich Sandstone (Jervey, 1987; Camaioni and Vail, 1988).

The text consists of natural language paragraphs explaining the context and implications of sequence stratigraphy, with occasional references to specific studies and models. The text is structured to provide a coherent and detailed explanation of the concepts and principles underlying sequence stratigraphy, with a focus on the relationships between facies patterns and relative sea-level change. The text includes a discussion of the significance of sequence stratigraphy for understanding sedimentary basin evolution and the potential for using sequence stratigraphic units as a framework for stratigraphic analysis. The text also highlights the importance of understanding the tectonic and eustatic controls on sedimentary processes and their implications for the interpretation of sedimentary successions.

Time Concept

The text proposes a time concept for sedimentary successions that is based on the interpretation of well-log data. This time concept is based on the assumption that the correlation lines correspond to physically continuous surfaces and hence time-markers. Where available, time markers such as bentonites or bioturbational spikes should be used in conjunction with discontinuity surfaces in sequence stratigraphic correlations. The absolute duration of unconformities and other chronostratigraphically significant surfaces can be estimated using a combination of biostratigraphic, geochemical, and radiometric dating methods. Isochronous surfaces in the context of sequence stratigraphy are defined as unique surfaces, which may have an uncertainty of about 1 million years (e.g., Brachyterme and micrite fossils of the Cretaceous Western Interior Seaway allow further relative subbasin, which may be used to absolute geochronologic time scales. Many of the theoretical time concepts, however, are based on the time-stratigraphic resolution, and it may be possible to show only the relative timing of events.

Sequence Stratigraphy of the Passive Margin Versus the Foreland Basin Successions

The text discusses the differences in sequence stratigraphic patterns observed on the passive margin versus those observed in foreland basin settings. The text highlights the importance of understanding the tectonic and eustatic controls on sedimentary processes and their implications for the interpretation of sedimentary successions. The text also emphasizes the need for a comprehensive understanding of the relationships between facies patterns and relative sea-level change, with a focus on the significance of sequence stratigraphy for understanding sedimentary basin evolution and the potential for using sequence stratigraphic units as a framework for stratigraphic analysis.

The text concludes by emphasizing the importance of understanding the tectonic and eustatic controls on sedimentary processes and their implications for the interpretation of sedimentary successions. The text highlights the need for a comprehensive understanding of the relationships between facies patterns and relative sea-level change, with a focus on the significance of sequence stratigraphy for understanding sedimentary basin evolution and the potential for using sequence stratigraphic units as a framework for stratigraphic analysis.
During the Precambrian, Paleoic and into the Early Jurassic, the Western Canadian Sedimentary Basin could be characterized as a depocenter situated on a passive or trailing-edge continental margin (Kent, this volume, Chapter 7). The part of the basin presently available for study in the subsurface comprises intercalated shelf deposits of the cratonic platform (Fig. 25.3B). Most of the presumed deeper water sedimentary rocks deposited farther seaward are presently eroded away or lie exposed in the Rocky Mountains. Examples of sequence development in the passive margin succession are documented in Henderson (1989) and Gibson and Barley (1988).

With the onset of thrust faulting from the west during the Jurassic, a foreland basin began to form along the ancestral Rockies (Price, this volume, Chapter 2). The stratigraphic arrangements of the subsequent basin fill are distinctly different from those developed on the preceding passive margin (Fig. 25.5A). The foreland basin was characterized by a ramp margin. A ramp margin is characterized by a relatively low-gradient shelf without an apparent shelf/slope break.

The foreland basin is characterized by subsidence due to flexural loading by thrust sheets, wherein subsidence decreases in a seaward direction away from the fold and thrust belt, in marked contrast to passive margin settings, where subsidence increases in a seaward direction (Fig. 25.5A). In much of the Lower Cretaceous section, the foreland basin took a similar pathway westward from our presently preserved "window to the world"; we commonly do not see much effect of this eastward decrease of rate of subsidence, except in northeast British Columbia (Hayes et al., this volume, Chapter 19). Consequently, the effect of "backward rotation" of the section due to high subsidence rates westward plays a minor role on the stratigraphic architecture of most of the rocks we can observe in the basin during this interval. In contrast, however, the "window to the world" in the Upper Cretaceous section includes a section closer to the foreland basin trough and is characterized by a wedge of thick evaporites westward to the fold and thrust belt (e.g., Lockie et al., this volume, Chapter 20; Dawson et al., this volume, Chapter 24) suggesting closer proximity to the contemporaneous thrust sheets. Consequently, the "backward rotation" of the section can play a significant role in this part of the section.

Another distinctive aspect of this foreland basin is that in marked contrast with the predecessor passive/margin basin is that two provenance elements exist: one from the fold and thrust belt to the west and one from the stable craton to the east. As the basin deepened during the middle Cretaceous, the foreland trough migrated eastward, the western provenance came to dominate the fill. The proportion of easterly derived sediment decreases upsection and westward, with a component for much of the Upper Cretaceous and Tertiary.

The stratigraphic architecture of basin margins is strongly influenced by shelf gradients. In a ramp-type margin, such as characterized the Cretaceous and younger exposures of the basin profile is broken only by the relatively steep shelf edge. Lowstand deposits commonly are represented by basally isolated shallows rather than by the deep-water turbidite deposits more common in passive margin settings. Unconformities or sequence boundaries in ramp-type settings may be expressed as zones of sedimentary bypass (e.g., Posamentier et al., 1992b), by incised valleys (e.g., van Wagener et al., 1990), or by sharp-based shoreface successions (e.g., Plint, 1988). The processes by which these isolated shelf deposits have been produced is referred to as a foreland recession (Posamentier et al., 1992b). As an example of a lowstand shoreline formed in response to a forced regression is shown in Figure 25.4.

In the Western Canada Foreland Basin, highstand deposits that occur in the western proximal basin settings are commonly not readily accessible for study as they were the first deposits to be overprinted by advancing thrust sheets. We assume that the landward margin of much of the Western Canada Foreland Basin is also a lowstand, with minor to no development of a highstand facies. The effect of subsequent tectonic uplift and deformation (Fig. 25.5A). In addition, even when portions of the landward margin of the basin are preserved, the infilling sedimentary sequences commonly exhibit thick marine facies (e.g., Belly River Formation, Dawson et al., this volume, Chapter 24) in which recognition of sequence-boundary discontinuities, particularly, are found to be determined. The part of the foreland basin most easily studied is thus the distal end, which commonly contains only Foreland basin strata are likely to have a strong tectonic overprint on the nature of the stratigraphic successions preserved. Nonetheless, in the Western Canada Foreland Basin, with a sediment source from both the fold and thrust belt to the west as well as the craton to the east, a eustatic fall may have different effects in different areas. Eustatic fall may result in a relative sea-level fall yielding a Type II unconformity on the slowly subsiding eastern cratonic side of the seaway, whereas in the more actively subsiding western part, the same eustatic fall may result only in a decelerated relative sea-level rise yielding a Type III unconformity. Because of the difficulty of recognizing a seaward shift in onlap, the Type II unconformity may be easily missed. Consequently, the nature of the sequence-boundary surfaces as well as the internal stratigraphic architecture of successions is dependent on the position in the basin. During active tectonism, foreland basin subsidence may dominate, resulting in an overall relative rise of sea level. During periods of tectonic quiescence, the foreland basin may experience onlap as a result of isostatic re-equilibrium resulting in a relative sea-level fall and redistribution of coarse sediments farther into the basin center (Ehlerer, 1988).

A eustatic rise of sea level may also be enhanced in the foreland basin, particularly for the foreland basin, as a result of the pumped tectonic subsidence. This may result in more extensive flooding and other transgressive surfaces (Swift et al., 1987).

Selected Examples of Sequence Stratigraphic and Allostratigraphic Applications in the Foreland Basin Succession

The sequence framework for North America as defined by Stoss (1983) has been adapted for the present study. This sequence stratigraphic example includes many examples of depositional sequences (in the sense of Mitchum, 1977) and is most of which are also in this atlas. Other examples of depositional sequence interpretations in the Western Canada Foreland Basin include Lockie (1988), Paddy and Cadoro (members of the 

As a general rule, many of the significant reservoirs in the foreland basin fill are associated with unconformities inferred to have formed during relative sea-level rise. Examples include the Simonette channel-fill and Waskahkabana estuarine-delt deposits within the Dunvegan Formation (Bhtatchaarya, 1989, this volume, Chapter 22) and the Crystal channel-fill deposits within the Joacan lower and middle forefan in the Viking Formation (Reineck et al., this volume, Chapter 21; Allen and Posamentier, 1991; Posamentier and Chamberlain, in press). Reservoirs within units underlain by transgressive deposits produced during relative sea-level rise also are significant. Examples of these reservoirs include the Carnot Creek Member of the Cardium Formation (Brenton and Mathieson, 1980), and strata within the transgressive systems tract at Joacan Field in the Viking Formation (Posamentier and Chamberlain, in press). Productive sandstones of the Coke Creek Member of the Kaskapau Formation lie within a transgressive systems tract (Lockie et al., this volume, Chapter 20).

Allostratigraphic subdivisions have been proposed recently for the Viking (Fig. 25.6a; Boren and Walker, 1991; Dunvegan (Fig. 25.1b; Bhtatchaarya and Walker, 1991a); Cardinal (Fig. 25.7; Pimentel et al., 1986), and Marchyshyn and Muskinli formations (this volume, Fig. 20.23; Plint, 1990). The bounding unconformities for these allostratigraphic units include both channel-mouth and unconformities. In the Viking and Dunvegan, the new allostratigraphic units incorporate facies originally included in the associated deltaic facies but now interpreted as being genetically associated with the sandstone facies. The occurrence of major unconformities within these sandstone formations also suggests that previous lithostress-stratigraphic correlations incorporate strata that belong to different sequences and that are not genetically related.

a. Viking allostratigraphy

viking allostratigraphy

b. Cardinal allostratigraphy

Cardinal allostratigraphy

Figure 25.3. Basin-fill patterns in a. foreland basin with a ramp margin, and b. passive margin with a shelf/slope break. P, prod-shaped leveed units; W, wedge-shaped highland units.

Figure 25.5a. Viking allostratigraphy (after Boren and Walker, 1991).


Figure 25.6. Viking sequence stratigraphy (after Plint, 1990).
Cardium-related Strata. Highstand deposits comprising the Blackstone and lowstand deposits of the Cardium Formation overlie the Second White Specks condensed section. Within the Cardium Formation, Plint et al. (1986) have recognized seven extensive erosional surfaces. Several of these surfaces are overlain by basi-

Cretaceous-Tertiary.

Upper Cretaceous-Tertiary.

to date there have been few sequence-oriented studies of the Upper Cretaceous and Tertiary strata in the Western Canada Sedimentary Basin. Recent work by Ainsworth and Walker (1991) recognized discontinuity-bounded units associated with the Bear-

Conclusions.

Fundamentally, sequence stratigraphy and allostratigraphy rep- resent an approach to subdividing stratigraphic units on the basis of bounding discontinuities interpreted to have characteristic stratigraphic significance. Bounding discontinuities may be identified by anomalous facies relations, changes in stratigraphic configuration, and biostratigraphic breaks. This contrasts with lithostratigraphic units, in which stratigraphic units (e.g., formations) are distinguished pri-

Next to the east, the shale members of the Bearpaw wedge are the most prominent. The shale members form a series of stacked, thick shale members that dip to the east and are truncated by the overlying Upper Cretaceous-Tertiary stratigraphy.

Bell Boy.

Shale.

Sand.

Conclusions.

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Stratal geometry and associated sedimentary deposits that develop during the foreland basin phase of the Western Canada Sedimentary Basin (Late Jurassic to Tertiary) are distinctly different from those that characterize the passive margin succession (Precordian, Paleozoic, and Triassic to Early Jurassic). The foreland basin was characterized by a gently sloping sea floor without a discrete shelf/slope break. Consequently, deep-water lowstand deposits, such as turbidite submarine fans, are rare.

More typically, lowstand deposition is characterized by basinally isolated lowstand shelf deposits commonly without preserved shelf/channel systems. Basingly isolated sandstones and conglomerates in both the Viking and Cardium have been interpreted previously as offshore basins, deposited tens to hundreds of kilometers from the nearest presently preserved shorelines and thought to be gradationally rooted in underlying shelf mudstones and sandstones. The newer sequence-based interpretations sug-

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unconformity separates the two lithofaces. Thus the previously interpreted "offshore basins" have been reinterpreted as lowstand shelf deposits, recognized in response to a relative sea-level fall. These interpretations embody the sequence stratigraphic approach, which recognizes the importance of unconformities and relative changes in sea level in controlling seabed geometry and facies distribution.

Incised valley deposits are observed within the foreland basin succession, though they are less common than on passive margins. With the exception of Lower Cretaceous Mannville strata (Hayes et al., this volume, Chapter 19), sandy highstand deposits that commonly occur in proximal basin settings are not readily accessible for study in this foreland basin because they would have been the first deposits to be overridden by the advancing thrust sheets (Fig. 25.5a). Consequently, preserved highstand deposits in the Alberta Basin are characterized by thick shales containing condensed sections, such as the Fish Scales and 1st and 2nd White Specks of the Colorado/Alberta Group.

The wedge-shaped geometry of much of the foreland basin fill reflects strongly asymmetrical subsidence that increases to the west. Although basin shape is dominated by tectonic subsidence, eustasy has some control on the stratigraphic architecture of infilling sediments and the timing of the sequence-bounding unconformities. Several of the economically important sand units, such as the Viking and Cardium formations, have been correlated with third-order eustatic falls and have been interpreted as lowstand depo-

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