Introduction

The Cordilleran Connection

The connection between the Western Canada Sedimentary Basin and global plate tectonics lies in the Cordillera, because the origin and evolution of the Western Canada Sedimentary Basin was linked inextricably to the origin and evolution of the Cordillera, and thereby to the global plate tectonic processes that produced the Cordillera. Episodes of orogenic subsidence and sediment accumulation in the Western Canada Sedimentary Basin generally can be ascribed directly to the effects of concurrent episodes of orogenic deformation in the Cordillera (Porter et al., 1982), and, thereby, indirectly to the displacements between the North American craton and the adjacent lithospheric plates to the west of it that produced the Cordillera (Monger and Price, 1979). The main purpose of this chapter is the elucidation of the Cordilleran connection.

The Supracrustal Wedge

The Western Canada Sedimentary Basin, as viewed from the perspective of a cross section of the continental lithosphere, is a very thin, northeastward-tapering wedge of supracrustal rocks overlapping the Precambrian crystalline rocks that form the core of the North American craton. The thickness of this supracrustal wedge increases gradually southwestward, over a distance of between 600 and 1200 km, from a zero edge along the exposed margin of the Canadian Shield, to between 3 and 5 km at the northeastern margin of the foreland thrust and fold belt (Wright et al., this volume, Chapter 3), and even there it comprises only 10 to 15 percent of total thickness of about 40 km of continental crust (Richards, 1985).

The thickest and stratigraphically most complete part of the supracrustal wedge occurs farther west, in the eastern part of the Cordillera (Fig. 2.1), in the Rocky Mountain Foreland Thrust and Fold Belt and the eastern part of the Omineca Belt (Bally et al., 1966; Price, 1981; Price and Mounjouy, 1970; Thompson, 1979). Stratigraphic relations in this part of the supracrustal wedge are partly obscured by deformation, regional metamorphism and granitic plutons because this part of the wedge has been incorporated into the accretionary prism that separates the North American craton and its cover of accreted supracrustal rocks from the tectonic collage of allochthonous terranes that make up the main mass of the Cordillera. The supracrustal rocks within the accretionary prism have been detached from their basement and displaced northeastward. They were scraped off the North American craton and accreted to the overriding tectonic collage of allochthonous terranes. Although this part of the supracrustal wedge has been horizontally compressed and tectonically thickened by folding and imbricate thrust faulting, palinspastic reconstructions of the deformed rocks in the accretionary prism show that prior to the formation of the accretionary prism, the thickness of the supracrustal wedge increased southwestward relatively abruptly, over a distance of 200 km or less, from between 3 and 5 km at the present position of the northeastern margin of the foreland thrust and fold belt to between 10 and 15 km along the former position of the Paleozoic and early Mesozoic continental margin of North America (Bally et al., 1966; Price and Mounjouy, 1970; Thompson, 1979; Price, 1981; Price and Fermor, 1985). The birth, growth and deformation of this part of the supracrustal wedge is the main focus of this chapter because it holds the key to the understanding of the origin and evolution of the remaining undeformed part of the Western Canada Sedimentary Basin that lies east of the Rocky Mountain Foreland Thrust and Fold Belt, beneath the western plains.

Stages of Tectonic Evolution

Two main stages in the development of the Western Canada Sedimentary Basin are distinguished by a profound change in provenance of the clastic sediment preserved within the supracrustal wedge (Bally et al., 1966; Price and Mounjouy, 1970). A Late Proterozoic to Late Jurassic miogeoclinal-platform stage, during which the main external source of the sediment was to the northeast on (and beyond?) the present North American craton, has been correlated with the continental tilting and drifting that created the initial Cordilleran continental margin of the North American craton and its adjacent ocean basin, and subsequently, the continental terrace wedge (miogeoclinal) that was prograded outward from this "passive margin" (Stewart, 1972; Monger and Price, 1979). A Late Jurassic to Early Eocene foreland basin stage, during which the main source of sediment was to the southwest in the emerging Cordilleran mountain belt, has been correlated with the accretion of a tectonic collage of allochthonous oceanic terranes that occurred following the subduction of intervening oceanic lithosphere, and consequent closures of intervening ocean basins (Davis et al., 1976; Monger and Price, 1979). During the foreland basin stage, as a result of oblique collision between the accreted terranes and the North American craton, the outboard part of the miogeoclinal-platform component of the supracrustal wedge was detached from its basement, displaced northeastward, compressed and thickened. The weight of the displaced and tectonically thickened supracrustal rocks induced subsidence of the foreland basin (Price, 1973; Beaumont, 1981), and the associated uplift and erosion provided much of the sediment that accumulated in the foreland basin. This cannibalization of the supracrustal wedge continued as some of the older deposits of the foreland basin component were themselves detached from their North American basement, attached to the colliding accreted terranes, and uplifted and eroded to provide the sediment that formed some of the younger foreland basin deposits. The pattern of growth of the foreland thrust and fold belt, and of the foreland basin component of the supracrustal wedge, were effectively terminated by an episode of Early and Middle Eocene crustal extension in the central part of the Cordillera that marked the transition to the present-day plate tectonic regime (Ewing, 1980; Price, 1979; Price, 1986).
Contemporary Cordilleran Plate Tectonics

The present-day plate tectonic regime provides an active model for outlining the role of plate tectonics in the orogenic evolution of the present time. The active western boundary of the North American Plate consists of three contrasting segments (see Fig. 2.2). The southern segment is a subduction zone, along which slabs of oceanic lithosphere of the Juan de Fuca Plate, and its recent offshore the Explorer Plate, are slipping northwestward under the overriding continental lithosphere of the Pacific Plate. This segment is characterized by subduction of accretionary wedges, and is bounded by deep-seated submarine canyons and basins. The middle segment comprises the laterally persistent tectonostrophic assemblages that are dominated by oceanic volcanic arcs. They are bordered by the Trench system (which is a deep-seated subduction zone) and the continental lithosphere of the North American Plate. The eastern segment is characterized by the accretion of basaltic oceanic crust and the formation of new continental lithosphere.

Cordilleran Terranes

Most of the Canadian Cordillera consists of a tectonic "collage" of allochthonous terranes (Fig. 2.1), each of which is characterized by a geologic history that is different from those of the others. These terranes include the Kootenay, Chilcotin, and Okanagan terranes, which are composed of blocks of continental crust that have been accreted to the North American Plate at different times. The Kootenay terrane, for example, is composed of a sequence of oceanic crust and mantle rocks that were accreted to the North American Plate during the Late Cretaceous.

Paleomagnetic measurements can be used to estimate lateral displacements between a suspect terrane and North America (or another suspect terrane) provided that the magnetization can be dated and referred to the appropriate paleohorizon-related datum, and that accurate, well-dated paleomagnetic data are available. For example, paleomagnetic measurements from Upper Triassic and Lower Jurassic bedded volcanic and sedimentary rocks in a mid-Cretaceous-aged arc were used to determine the displacement of the terrane relative to North America. Similarly, paleomagnetic measurements from the Columbia River Basalt Group, which is a basaltic lava flow that extends from the eastern United States to the Pacific Ocean, were used to determine the displacement of the terrane relative to North America.

Hypotheses about the places of origin of the accreted terranes are controversial. Some researchers believe that the terranes originated in the western Pacific Ocean, while others believe that they originated in the eastern Pacific Ocean. The hypothesis that the terranes originated in the western Pacific Ocean is supported by paleomagnetic data, which indicate that the terranes were rotated clockwise relative to North America. The hypothesis that the terranes originated in the eastern Pacific Ocean is supported by geologic data, which indicate that the terranes were rotated counterclockwise relative to North America.

Reconstructions of Late Mesozoic-Tertiary Plate Motions

Reconstructions of Late Mesozoic-Tertiary plate motions are based on the analysis of sea-floor magnetic anomaly patterns and the tracks of mantle hot spots (Engelsberg et al., 1985). These reconstructions are widely used to study the tectonic evolution of the North American Plate and the surrounding regions. The North American Plate has undergone several major tectonic events, including the formation of the North Atlantic Ocean and the opening of the North Pacific Ocean.

Orogeny and Terrane Accretion/Collision

The North American continent has grown laterally in the Cordilleran region, possibly by more than 1500 km, as the plate has accreted to the North American Plate.

This interpretation of the paleomagnetic data has been challenged by May and Butler (1986) who have argued for a re-appraisal of the Jurassic apparent polar wander curve for North America, that Stikinia was at essentially the same latitude relative to the Late Jurassic and Early Cretaceous as it was in the Mesozoic. This hypothesis has been challenged by Butler et al. (1989) who have argued for a more gradual migration, with the plateau moving northward and eastward over a period of several million years. This hypothesis is supported by the paleontological data, which indicate that the plateau moved northward and eastward over a period of several million years.
characterized by widespread granitic magmatism, crustal thickening and uplift that has exposed extensive regional metamorphism and plutonism as well as outcropping thrust and fold belts on both flanks. The Omineca Belt occupies the suture zone between Intermontane Supercraton and the North American Cordilleran margin. The Coast Belt occupies the suture zone between Insular Supercraton and Intermontane Supercraton. Intermontane Supercraton formed prior to the end of the Triassic by the amalgamation of the Klamath, Cache Creek Terrane, Queen estia, and Slide Mountain Terrane (Fig. 2.3), the latter having already been thrust over Kootenay Terrane and stitched to it by crosstrust Pennsylvanian intrusive rocks (Klepacki and Wheeler, 1980). Pock- ton and Aitken (1989) have argued that a widespread basal Jurassic (Sinemurian) phosphorite unit up to 10 m thick in the Cordilleran Molasse Basin in the western interior of the basin is interpreted as the metamorphic basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province. The metamorphic basement is a major feature of the basin and has been interpreted to be the basement to the Mesozoic Basin and Range Province.
Thus the Rocky Mountain Foreland Thrust and Fold Belt is a transpressional accretory prism. It consists of supracrustal rocks that were scraped off the North American plate and accreted to an overriding tectonic collage of allochthonous terranes that collided obliquely with North America from Middle Jurassic to Middle Eocene time. Palinspastic reconstructions of the accretory prism provide the framework for outlining the pre-collisional tectonic history of the Cordilleran miogeoclinal and the evolution of the foreland basin, which developed as the collisions were underway and the accretory prism was forming.

Rocky Mountain Foreland Thrust and Fold Belt

Palinspastic Reconstruction of the Foreland Thrust and Fold Belt

Figures 2.6 and 2.7 illustrate a palinspastic reconstruction of the Rocky Mountain Foreland Thrust and Fold Belt at 46° 45' N latitude. Details concerning the data and interpretations upon which the structure section and palinspastic section are based have been published (Price, 1981) and are not repeated here, but several salient features of the sections do require comment. The Triassic to Paleocene rocks in Figure 2.7 include the foreland basin component of the supracrustal wedge that filled the Western Canada Sedimentary Basin. The Cambrian to Permian rocks, and probably the Upper Proterozoic (Windermere Supergroup) rocks, are well preserved, mature miogeoclinal platform component of the supracrustal wedge. Along the line of structure section W-E the "hinge zone" between the platform (which is characterized by a thin upper Paleozoic sequence, a very thin Cambrian to Middle Devonian sequence and no Upper Proterozoic strata) and the miogeoclinal (which is dominated by a very thick Cambrian to Middle Devonian sequence underlain by variable thicknesses of Upper Proterozoic rocks) coincides approximately with the Bourgou Thrust Fault (Figs. 2.6, 2.7). In the palinspastic reconstruction (Fig. 2.7) the "hinge zone" coincides with the present position of the west flank of the Purcell Anticlinorium (the Kootenay Arc). Price (1981) noted that the west flank of the Purcell Anticlinorium is basically a crustal-scale monocline flexure marking a change in level of exposure involving an aggregate thickness of about 2 km of stratigraphic section from the lower part of the Middle Proterozoic Purcell (Beloi) Supergroup on the east side to the Triassic-Jurassic volcanogenic rocks of Quenness on the west side, and that it coincides with a strong gradient in the Bouguer gravity anomaly field and a westward decrease in the depth to the base of the crust, as well as the palinspastically restored position of the "hinge zone" between the platform and the miogeoclinal. On the basis of these relations Price (1981) suggested that the west flank of the Purcell Anticlinorium is a crustal-scale fault-bend fold along the ramp marking the early Paleozoic rifted margin of the North American craton, that the thick section of lower Paleozoic miogeoclinal strata accumulated eastward of this ramp on a basement of tectonically attenuated continental crust or oceanic crust, and that this section of lower Paleozoic platformal strata accumulated inboard of the ramp on a normal thickness of unfaulted continental crust (Figs. 2.5, 2.7).

Figure 2.7. Structure section (lower) and palinspastic section (upper) along line W-E of Figure 2.6 (modified after Price, 1981). The thickness of the supracrustal rocks below the Late Jurassic horizontal sea-level datum in the palinspastic section defines the depth to the Early Proterozoic crystalline basement immediately prior to tectonic subsidence that resulted from the load imposed on the lithosphere by tectonic thickening of the supracrustal rocks during thrusting and folding. In the palinspastic section, the thick Cambrian to Devonian shales of the miogeoclinal, and the underlying thick sequence of Proterozoic rocks are considered to be basement west of the present locus of the Purcell and Kootenay Arcs.
Corridillere Miogeocline

There is a close correlation between the location of the miogeocline-platform 'hinge zone' and the eastern limit of Upper Proterozoic-Windermere-bounding rocks. This indicates that the locus of the early Paleozoic margin of the North American continent was defined by the Late Proterozoic rift that was responsible for the accommodation of the Windermere basin. From an morphoclinic standpoint, the Windermere Group, northward from section W-E (Fig. 2.6) to the Mackenzie Mountains, the locus of both the miogeocline-platform 'hinge zone' and the eastern limit of Windermere strata within the displaced hanging wall of the Trans-Hudson orogen (the accretionary prism) follows the western Front Ranges of the Rocky Mountains, but south of section W-E both the miogeocline-platform 'hinge zone' and the eastern limit of Windermere strata displace southward to the eastern flank of the Trans-Hudson orogen. New global geologic reconstructions of Goodway (Dalziel, 1991, Moors, 1991), which indicate that southeastern Australia was adjacent to western North America in latest Proterozoic time, provide support for the correlation by Bell and Jeffries (1977), Jeffries (1976, 1983), and Elgusjarvi (1983) of the Belt-Purcell and Windermere stratigraphies of Australian Cordillera值班 major stratigraphic coincident with the major orogenic rocks in south-central Australia, and for the conclusion (Bend and Konin, 1984) that the rift-drift transition that marked the initiation of sea-floor spreading and the development of an early Paleozoic oceanic basin adjacent to western North America occurred at the end of the Proterozoic. Ross (1991) argued that the Windermere Superstage may record one or more early cycles of crustal extension and thermal subsidence of attenuated lithosphere prior to the episode of drift that established the Paleozoic crustal extension over the stable craton (the Saucy Sequence); however, similarities in Upper Proterozoic stratigraphy between the Cordillere miogeocline and south-central Australia presumably indicate that the rift-drift transition that separated the two Precambrian cratons occurred after deposition of the Windermere Superstage.

The Windermere Superstage appears to record a unusually long interval of (intermediate?) intracratonic rifting (750-755 Ma) preceding actual continental separation and drift of North America and Australia in earliest Cambrian time. In this respect the evolution of the pre-Cordillere margin of North America may resemble the evolution of the continental margins of the North Atlantic, where a protracted interval of rifting, dating back to the mid-Paleozoic, occurred without either the formation of subduction zones or the beginning of significant continental drift. The transgressive overstep of the North American craton by the Saucy Sequence, which marked the birth of the Western Cordillere Sedimentary Basin, can be attributed to regional isostatic response of the lithosphere to loads imposed on it at the newly formed continental margin (Bend and Konin, 1984). These 'loads' include both the effects of cooling and thermal contraction of hot lithosphere that had been expelled beneath and adjacent to the newly formed margin during rift and sea-floor spreading, and of the weight of the sediments that were deposited along the continental margins.

A second major episode of subduction occurred on the North American continental margin to prior to the beginning of major Late Cretaceous seaward spreading. This was the second major episode of subduction that occurred in the region of the Cordillere miogeocline and passive margins such as those bordering the modern Atlantic Ocean. It was on this basis that Dynes and Price (1979) argued that an oceanic arc and margin basin probably lay obducted from the continental margin during early Paleozoic time.

Migrating Depo-axis

The paragene of growth and evolution of the foreland basin can be illustrated by comparing the records of subduction that are preserved in a series of stratigraphic sections of the foreland basins across the Rockies in the Cordillere, that late Cenozoic volumes of rock that have been eroded from the thrust and fold belt since thrusting began, and that up to 10 km of rock has been eroded since the thrusting stopped.

Subsidence of the Western Canada Sedimentary Basin during the cordillere flexure can be quantitatively determined. The upper Cretaceous strata of the North American lithosphere under the weight of the tectonically thickened supercrustal rocks of the foreland thrust and fold belt (Price, 1977). As the crustal plate interactions with the Pacific basin thinned and the overlying Pleistocene ice sheet melted, the foreland flexure induced the weight of the tectonically prograding foreland accretionary prism produced a migrating moraine that trapped the detrital outwash eroded from the emerging foreland thrust and fold belt (Fig. 2.8).
Cretaceous Blainmore Group, and, therefore, that the Lewis Thrust Sheet was still at least 8 km thick. Some additional, but indeterminate, thickness of Mesozoic strata had already been eroded from this part of the thrust and fold belt in the interval of more than 20 Ma since earliest Eocene time, when the accretionary prism had stopped growing because of the onset of regional extension in the interior of the Cordillera (Peters, et al., 1980). Accordingly, the time-depth curve of Figure 2.5, which takes into account the sediment eroded from the Lewis thrust sheet since the beginning of the Oligocene, may provide a more realistic portrayal of the subsidence history of this part of the foreland basin.

The third cumulative subsidence curve (Fig. 2.5c) is for a location near the margin of the foreland fold and thrust belt along the line of section W-E (Fig. 2.6). The autochthonous Eocene strata at this locality are overlain by tectonically thickened Mesozoic strata beneath the west-verging Waldron Fault (Fig. 2.7). On the basis of variations in the moisture content of near-surface coal seams, Nurkowski (1984) estimated that between 1 and 2 km more sediment has been eroded from this area than from areas farther east in the Interior Plains. The cumulative subsidence curve of Figure 2.5c is an attempt to accommodate the effects of both known tectonic thickening and the estimated minimum post-thrusting erosional removal. Superimposition of the three cumulative subsidence curves (Fig. 2.5e) illustrates the variations in amount of subsidence and of uplift and erosion from locality to locality across the foreland basin during various stages in its evolution. It shows how the locus of maximum subsidence migrated northeastward with time as the accretionary prism was tectonically protruded over the flanks of the continental crust.

Figure 2.10 Tintina Trough (TT) - Northern Rocky Mountain Trench (NRMT) fault zone and Fraser River (FR)-Siletz River (SC) fault zone in stereographic projection control on axis of best fitting small-circle (great) for TT-NRMT fault zone. Numbered ticks along the red fault traces are points along TT-NRMT and FR-SC fault zones that were used to calculate the best fitting small-circles. Long green dashed line is best fitting small-circle curve for points 1-34 in inset at left of F.L. Gordon et al., (1977). a. SW-NE structure section section through the Pacific-Atlantic Flathead well (modified after F.L. Gordon et al., 1977) seen SW-NE in Figure 2.6 for location of section. Presentation of the Lower Cretaceous Blainmore Group below Upper Eocene-Lower Oligocene fanglomerates in Flathead valley grison implies that the Lewis thrust sheet was still more than 8 km thick at the end of the Eocene (57 Ma), more than 50 Ma after the termination of thrusting and folding at 80 Ma. The superposition of curves a, b, and c illustrates the eastward migration of depo-axis of the foreland basin.

Oblique Collision, Transpression and Transtension

Mid-Cretaceous to Early Eocene Transpression

Oblique collision between North America and the accreted superteranes were driven by oblique convergence with adjacent oceanic lithosphere (Engbretson et al., 1980). They involved transpressional and transtensional deformation, including the development of large strike-slip faults within the Cordillera, and lateral transformations between strike-slip faulting and either thrust faulting and folding or extensional faulting (Monnier and Price, 1979; Price, 1979; Price and Carmichael, 1986; Price et al., 1985). Lateral transformations between strike-slip faulting and thrust faulting and folding during mid-Cretaceous to late Eocene right-lateral transtension had a profound influence on lateral variations in the size of the Rocky Mountain Foreland Thrust and Fold Belt and in the amount of subsidence in the foreland basin.

The Tintina Trench-Northern Rocky Mountain Trench (TT-NRMT) fault, along which there has been 450 km of right-lateral strike-slip in the Yakima since mid-Cretaceous time (Brodie, 1967; Trespalacios, 2007), dies out along the southern Rocky Mountain Trench south of 56o N latitude (Fig. 2.10). From east-central Alaska to about 55o N latitude the TT-NRMT fault follows an almost perfect small-circle trajectory (as it must if it is a strike-slip fault, on which the slip must, by definition, lie parallel to the spherical surface of the Earth), but south of 56o N latitude, a conspicuous
The southward transformation of right-lateral strike-slip on the TT-NRMT fault zone into compressional deformation in the southeastern Canadian Rockies was the dominant influence on the evolution of the Cordilleran foreland basin during Late Cretaceous and Paleocene time because it controlled the amount of horizontal compression and vertical thickening of the supracrustal rocks in the foreland thrust and fold belt and thereby the amount of isostatic subsidence imposed on the North American lithosphere by the weight of the tectonically thickened supracrustal rocks. The net subsidence of the basement beneath the Rocky Mountain Foreland Thrust and Fold Belt since the Late Jurassic, and the net uplift of the surface can be estimated by comparing a palinspastic section of the thrust and fold belt, in which the horizontal datum is the boundary between the marine strata of the Eocene Formation and the non-marine strata of the Kootenay Group, with the corresponding structure section (Price, 1973). The palinspastic section gives the depth to the basement, as it was in the Late Jurassic, just prior to the beginning of isostatic subsidence in response to the weight of tectonically thickened supracrustal rocks and of the weight of the sediment in the foreland basin, whereas the structure section gives the present depth to the basement and the present elevation of the surface along the same line of section after about 60 Ma of erosion and isostatic uplift that followed the termination of thrusting and folding in the foreland belt at the beginning of the Eocene. The net subsidence of the basement and the net uplift of the surface are clearly illustrated by superimposing the palinspastic section on the structure section, using sea level as the common datum. Five structure sections that have been analyzed in this way illustrate the contrast in amount of subsidence between the southern Canadian Rockies and the part of the Canadian Rockies that lies north of 56° N latitude (see Fig. 2.14). They show that beneath the Alberta segment of the Canadian Rockies, south of 56° N latitude, the net subsidence of the basin ranges from 2 to 3 km in the northeast to 5 to 6 km in the southwest, whereas in the northeastern British Columbia segment, north of 56° N latitude, it is about one-fifth that amount.

The southward transformation of right-lateral strike-slip on the TT-NRMT fault zone into compressional deformation, and the consequent deeper basement subsidence in the southern Canadian Rockies, is matched by a concomitant southward increase in the amount of Late Cretaceous and Paleocene subsidence of the foreland basin (see Figs. 2.14 - 2.16). The conspicuous change in the pattern of subsidence in the foreland basin that occurred between the Coronation and the Campanian (see Ledeczi et al., this volume; Chapter 20; Bhattacharya, this volume; Chapter 22; Krause et al., this volume; Chapter 23; and Dawson et al., this volume, Chapter 24) can be ascribed directly to the initiation of displacement on the TT-NRMT fault system and the transformation of that displacement south of 56° N latitude into the oblique convergence and the thrusting and folding that formed the southern Canadian Rockies. The palinspastic map of Figure 2.14 shows the distribution of the displaced terranes in the Canadian Cordillera at 58 Ma, prior to Early and Middle Eocene strike-slip faulting and crustal extension. The map was prepared by compensating for the effects of: 1) about 125 km of east-west crustal stretching in south-central British Columbia (Price, 1979; Tempelman-Kluit and Parkinson 1986; Parrish et al., 1988), 2) about 100 km of right-lateral strike-slip on the TT-NRMT, Yakalnon-Ross Lake, and Fraser River-Straight Creek fault systems, and 3) about 100 km of right-lateral strike-slip on the Shakwak-Denali Fault system (Elskicsher, 1976; Larghere 1978), part of which was linked to the Chatham Straight Fault, and part of which may have extended along the Coast Plutonic Complex into the Yakalnon-Ross Lake fault system. The arrows on the palinspastic map of Figure 2.14 illustrate the relations between the right-lateral strike-slip faulting that was accompanied by minor horizontal convergence and thrusting and folding in the northeastern Canadian Cordillera and the oblique terrane convergence, large-scale thrusting and folding, and the pronounced foreland basin subsidence that occurred along the southeastern Canadian Cordillera (south of 56° N latitude). These relations characterize this tectonic regime of right-lateral transpressional regime that dominated the evolution of the Canadian Cordillera and the western Canada Sedimentary Basin in Late Cretaceous and Paleocene time.

The palinspastic map of Figure 2.15 shows the relation between thickness variations in the Early Cretaceous part of the foreland basin and the distribution of the displaced terranes in the Canadian Cordillera at 80 Ma, prior to the Late Cretaceous and Paleocene right-lateral strike-slip on the TT-NRMT fault system, part of which was transformed southeastward into oblique compression, but part of which apparently was linked via the Finlay and Agnica faults into the suture zone between Quenselrias and Sulina (Gabrielse,
Figure 2.13: Net subsidence of the basement (widely spaced vertical ruling) and net uplift of the surface (closely spaced vertical ruling) due to formation of the Rocky Mountain thrust and fold belt in southwestern Alberta, as estimated by superimposing the palynostratigraphic sections (upper panels) on the structure sections (middle panels) using the present-day sea level of the structure section and the Late Jurassic horizontal sea-level datum of the palynostratigraphic section as a common datum. The difference in depth to the basement at the present time and in Late Jurassic time is the net subsidence (i.e., the total subsidence less the amount of erosion and eustatic uplift that has occurred since the thrusting and folding). The net uplift of the surface is the difference between the present topographic profile and the Late Jurassic sea-level datum. a. Section 1 of Figure 2.12 (after Price, 1981). b. Section 2 of Figure 2.12 (after Price, 1981). c. Section 3 of Figure 2.12 (after Price and Mounsey, 1975). d. Section 4 of Figure 2.12 (after Mounsey, 1986). e. Section 5 of Figure 2.12 (after Thompson, 1981).
Figure 2.14 End of Late Cretaceous and Paleocene tectonic regime of right-lateral transpression: major faults are restored to 58 Ma. Heavy broken lines mark locus of future Early and Middle Eocene faults. Heavy solid lines mark Tintina Northern Rocky Mountain Trench Fault system with 100 km of Early and Middle Eocene right-lateral strike-slip displacement eliminated. Isopachs in plains show the main locus of Late Cretaceous and Paleocene foreland basin subsidence adjacent to restraining bend in Tintina Northern Rocky Mountain Trench right-lateral fault system.

Figure 2.15 End of Middle Jurassic to mid-Cretaceous tectonic regime of terrane collision and accretion; major right-lateral transform faults and the horizontal convergence across the foreland thrust and fold belt are restored to 50 Ma. Heavy broken lines mark locus of future right-lateral transform faults; isopachs show main locus of foreland basin subsidence during deposition of the Lower Cretaceous (Aptian) Bullwark Group and equivalents.
Three stages in the tectonic co-evolution of the southern Canadian Cordillera and the foreland basin component of the Western Canada Sedimentary Basin are illustrated schematically in Figure 2.16: a) an Early Cretaceous and (?); Late Jurassic stage of terrane collision, indentation, and lateral escape (Fig. 2.16a); b) a Late Jurassic and Paleocene stage of right-lateral transpression dominated by strike-slip in the north and by compression in the south (Fig. 2.16b); and c) an Early and Middle Eocene stage of right-lateral transpression dominated by strike-slip in the north and extension in the south (Fig. 2.16c). The major shift in the locus of foreland basin subsidence that occurred between the first and the second stages was due to a change in patterns of relative movement of the accreted terranes and the resulting major shift in the locus of compression, tectonic thickening and northeasterly displacement of the miogeoclinal rocks. At the beginning of the Eocene, subsidence of the foreland basin was replaced by isostatic uplift and erosion because the change from transpressional deformation to transversional deformation between North America and the accreted terranes shut off the convergence between the accreted terranes and North America that was driving the growth of the foreland thrust and fold belt and, therefore, of the foreland basin. Displacement between North America and the main mass of the Cordilleran accreted terranes ended in the Middle Eocene at about 42 Ma, presumably because of global rearrangement in the pattern of relative movement of lithospheric plates that is clearly marked by the pronounced bend in the Hawai’i-Emperor seamount chain.
Cordilleran Tectonics


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