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PALEODRAINAGE PATTERN AND LATE-OROGENIC BASINS OF THE CANADIAN CORDILLERA

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ABSTRACT

Recent models for the tectonic evolution of the Canadian Cordillera can be tested by relating uplift of the orogenic core zones to the depositional record of the foreland and successor basins, but this requires a comprehensive understanding of paleodrainage.

The Canadian Cordillera is made up of two orogens: the Columbian Orogen on the east and the Pacific Orogen on the west. Most of the late-orogenic molasse deposits are related to the Columbian Orogen (Omineca Crystalline Belt and Rocky Mountain Belt). In the Columbian Orogen three structural elements placed controlling restraints on late-orogenic drainage: uplifts, re-entrants and salients, and longitudinal intramontane fault zones. The uplift boundary can be defined as a zone of great vertical displacement of pre-orogenic sedimentary and volcanic rocks and probable involvement of terrane intruded or metamorphosed in Precambrian time. The uplift boundary separated the aggradational molasse basins from the erosional domain of the drainage system. Most of the clastic sediment derived from the uplifted core zone was transported by rivers flowing in longitudinal, intramontane valleys. These rivers merged near re-entrants of the uplift boundary and discharged their load into elongate molasse basins. During growth of folds and thrust faults within the orogen, valleys near the structural re-entrants constituted the shortest dispersal paths between the rising core zones and the subsiding foreland and successor basins. The area in front of the regional re-entrants (Crowsnest, Peace, Liard, and Peel on the east side; Chukachida and Thompson on the west side) therefore display the best developed molasse deposits in foreland basins to the east and successor basins to the west. From the structural salients only short, though locally vigorous, streams issued directly into the late-orogenic basins.

The molasse of the Columbian foreland basin displays two upward coarsening megacycles: an uppermost Jurassic through Lower Cretaceous cycle (Kootenay-Blairmore Assemblage), and an Upper Cretaceous through Oligocene cycle (Belly River-Paskapoo Assemblage). Regional drainage during deposition of the first cycle was directed to the north, whereas during the second cycle streams flowed predominantly to the southeast. Straight drainage lines connecting the re-entrants with the depositional basins are probably valid concepts for the earliest stages of uplift only. Progressive growth of folds and thrust faults in the Rocky Mountain Belt, and faulting near intramontane valleys, produced curved and even U-shaped river systems, which merged near re-entrants and effected thorough mixing of compositionally diverse sediment loads. The molasse of the successor basins reflects progressive unroofing of the crystalline core zone. The two cycles of the Columbian foreland are similar to molasse sequences in the Alps and seem to reflect two phases of isostatic uplift related to repeated intervals of tectonic crustal thickening.

INTRODUCTION

During the past five years the authors have been involved in the study of tectonics and sedimentation in parts of the Canadian Cordillera in British Columbia and Alberta. One of us has recently synthesized the evolution of eugeosynclinal successor basins of the Intermontane Belt (Eisbacher, 1974). The discussion resulting from this compilation, and the new tectonic subdivision of the Canadian Cordillera by Wheeler and Gabrielse (1972) in the aftermath of plate-tectonic models, has led us to consider the total effect of tectonic uplift on late-orogenic sedimentation during the growth of both the Columbian and Pacific Orogens.

Major parts of the Canadian Cordillera are still known in little more than rudimentary fashion, but with delineation of the major tectonic belts shown in figure 1 it is now possible to study the interaction of different segments of the two orogens that previously were seen only in terms of more or less characteristic cross-sections (Douglas *et al.*, 1970). Much of the information included in this study has been recently acquired. Acknowledgement for help from various sources can therefore be considered only a poor substitute for the debt we owe to many fellow Canadian geologists whose stimulating discussions or unpublished contributions have encouraged our work. The following individuals have greatly aided our effort: F. G. Young, J. F. Lerbekmo, R. A. Rahmani, C. J. Yorath, H. Gabrielse, H. Tipper, and D. F. Stott contributed unpublished information; D. J. Tempelman-Kluit, H. U. Bielenstein, G. C. Taylor, D. K. Norris, R. A. Price, J. D. Aitken, J. Monger, and A. Okulitch discussed tectonic problems with us; H. Meixner and R. Dumas helped with compilation and drafting. Discussion by one of us (G.H.E.) with H. Fuchtbauer and F. B. Van Houten convinced us of the usefulness of the term "molasse" in de-