

Geological framework of the Beaufort-Mackenzie Basin.

J. Dixon*, J.R. Dietrich, D.H. McNeil and L.S. Lane
Geological Survey of Canada, Calgary

The Beaufort-Mackenzie Basin formed on a post-rift continental margin. Rifting began in the Jurassic and continued to the end of the Albian, eventually resulting in the opening of Canada Basin. From the Cenomanian to the late Tertiary compressional tectonics predominated (Lane and Dietrich, 1995).

The southeast basin margin consists of a series of down-to-basin, crustal-scale listric faults, the innermost of which defines the seaward margin of the Eskimo Lakes Arch. Along the southwest margin, Late Cretaceous and Tertiary compressional overprinting masks the original rifted margin. A number of uplifts and depressions flank the southeast margin and although these are largely late Cretaceous to Tertiary in age many are reactivated older features.

Within the basin there are four broad structural domains, distinguished by the style of deformation. Along the southwest margin, the basin is characterized by arcuate folds, commonly associated with north to northeast directed thrust faults. Three large tectonic elements are present within this area, these are the Demarcation sub-basin and the associated Herschel High, and the Blow River High. The central part of the basin, underlying Mackenzie Delta and the nearshore, is characterized by north to northwest trending folds and east to northeast trending listric faults. Two prominent zones of large listric faults are present, the Taglu and Tarsiut-Amauligak fault zones. In the western and central far offshore there are east-trending folds with very long axes. The final structural domain is in the eastern part of the basin where there is little or no folding and only minor faulting.

The sedimentary and structural history of the basin can be viewed as a series of five tectono-stratigraphic packages separated by regional unconformities (Dixon et al., 1992; Dixon, 1996). These unconformities mark the culmination of periods of deformation and are dated as late Maastrichtian, Early, Middle and Late Eocene, Late Oligocene and Late Miocene. The late Maastrichtian unconformity marks the shift of sedimentation from the craton to the continental margin. Subsequent sedimentation shifted from the southwest margin in the Paleocene eastward to the central margin in the Eocene and northwards during the Oligocene to Miocene. A major late Miocene unconformity marks the end of significant tectonism in the basin and the subsequent sedimentary succession is largely undeformed. The Pliocene depocentre shifted northwards and the thick accumulation of sediment has created the modern Beaufort shelf-slope system.

The combination of thick deltaic to deep-water sediments, compressional folding and faulting, and listric growth faults has resulted in numerous potential structural traps for hydrocarbons, of which only a small percentage have been tested.

References

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