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The Stress Regime of the Beaufort-Mackenzie Basin, Canada

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The contemporary stress regime of Beaufort-Mackenzie Basin was investigated using publicly available information gathered during the drilling and testing of exploration wells over the past four decades. Breakout analyses from 4-arm dipmeter logs run in 87 wells document widespread SSW-NNE compression in the Beaufort Mackenzie Basin. Density logs from 108 wells show that the vertical stress, S_V, decreases in magnitude across the Beaufort Shelf to the north, due to the lesser consolidation of the offshore sediments, compared to those beneath the onshore areas. Leak off test pressures and pressure integrity test pressures measured in 158 wells indicate that S_{Hmin} does not decrease in magnitude in the offshore sediments and actually exceeds S_V locally. Drill stem tests and repeat formation tests provided accurate pore fluid pressures, P_0. Mud densities of the drilling fluids allowed the pore pressure profiles of wells to be characterised and values estimated. Effective vertical stresses pressures ($S_V - P_0$) and effective horizontal stresses ($S_{Hmin} - P_0$) were then calculated and mapped across the basin. The effective vertical stresses decrease northwards. The contour configuration suggests that they may have played a role earlier in weakening deeper sediments to allow the observed Cenozoic folding and thrusting.

The Beaufort-Mackenzie Basin abuts the northern Canadian Cordillera, where earthquakes and global positioning studies document north northeastward overthrusting of the craton. The stress signature of the Beaufort-Mackenzie Basin is fully compatible with the latter findings and suggests that regional overthrusting may be in the process of becoming established in the basin.