Stacked lithotectonic units at the south-western end of line BW1-2800 indicate the Belcher antiform may be cored by a hinterland dipping or antiformal stack duplex. The youngest horses are truncated by a large graben (~25 km wide) likely associated with the opening of the Canada Basin (D3), suggesting the duplex may be an Ellesmerian (D2) structure. Shortening produced by the Brooks Range orogeny (D4) was accommodated by inversion along D3 extensional structures, and detachment folding in the Beaufort fold-thrust belt. The position of the lower fold envelope (dark blue) above the duplex, but below an apparent imbricate, suggests D2 structures locally control the geometry of D4 deformation. Below the fold belt, a conspicuous series of landward-dipping reflections, which we interpret as exhumed subcontinental lithospheric mantle, forms a shallow, structural trough ~30 km wide (extended outer marginal trough). The north-eastern end of the trough steps up ~2 sec/8 km to a package consistent with oceanic crust and Moho, while to the south-west, faults inside the trough side out and dip under continental crust along a surface we interpret as an outer marginal detachment (e.g. Pindell et al., 2014) associated with the opening of the Canada Basin (D3). If so, anastamosing subhorizontal reflections in the poorly imaged region below the trough may represent layered, mantle peridotite. (For explanation of deformation events D1–D4, see page 61.)

The eastern Beaufort Shelf of Arctic Alaska – offshore from the Arctic National Wildlife Refuge (ANWR) – is a unique tectonic setting in an underexplored petroleum province. Previous questions surrounding this margin can now be addressed with the acquisition of new, long-offset seismic reflection data.
New data reveals the deformation history of the Beaufort Basin through a complete Wilson cycle with implications for tectonic reconstructions and hydrocarbon potential.

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Stota within the BeaufortSPAN™ West survey area record a complete Wilson cycle, and at least four distinct phases of deformation, including the opening of the Franklin Basin (D1), Belcher range orogeny (D2), opening of the Canada Basin (D3), and the Brooks range orogeny (D4), as described by the tectonic summary table below.

Similarities with Mackenzie Delta

The passive continental margin formed during Jurassic to Early Cretaceous time with the break-up of Pangaea and opening of the Canada Basin (D1), later overprinting by the Paleogene Brooks range phase of contractional deformation (D2). The Beaufort fold-thrust belt (Helwig et al., 2011). During progressive oceanward migration beneath the shelf throughout the Cenozoic, the resultant tectonic wedge grew by deformation and incorporation of growth faulted older deposits while simultaneously overprinting by the Paleogene Brooks range phase of contractional deformation (D2) as described by the tectonic summary table below.

Shelf to Basin Geology

The geology of the northwestern Alaska Arctic margin is revealed by a 240 km seismic line (see main foldout line on preceding page) that ties the inner shelf to the Canada Basin. The line ties to the easternmost exploration well on the US Beaufort Shelf, the Amoco Belcher Ridge well, completed in 1989 (Spencer et al., 1992; Grantz et al., 2011). The stratigraphic interpretation of the line is based from different sources on the shelf and the deep basin. Stratigraphy beneath the shelf is tied to the ANRW (Arctic National Wildlife Refuge) coastal plain, the north-shore Canadian Beaufort shelf, and biostratigraphic data from the Belcher well and other exploration wells. Stratigraphy beneath the deep basin represents the distal slope of the Mackenzie delta. Displacement on the detachment within the Beaufort fold-thrust belt (Helwig et al., 2011). The structural style in the upper slope to proximal basin floor region is defined by detachment folds in the Beaufort fold-thrust belt that overprint all tectonic events and cycles of sedimentation within the Beaufort-Mackenzie margin. Sediments deposited during the Oligocene and Miocene are characteristic of continental margin sequence, with wedges of fine-grained sediments, including both deltaic and turbidite facies. The structural style in the upper slope to proximal basin floor region is defined by detachment folds in the Beaufort fold-thrust belt that overprint all tectonic events and cycles of sedimentation within the Beaufort-Mackenzie margin. Sediments deposited during the Oligocene and Miocene are characteristic of continental margin sequence, with wedges of fine-grained sediments, including both deltaic and turbidite facies.

References:


