AAPG Annual Convention
Salt Lake City, Utah
May 11-14, 2003

Wesley K. Wallace, University of Alaska, Fairbanks, AK

Geometry and Evolution of Detachment Folds in Deformed Foreland Basin Deposits of the Brooks Range Foothills, Northern Alaska

Detachment folds form the upper part of a gently tapered wedge in foreland basin deposits at the leading edge of the Brooks Range fold-and-thrust belt. A competent unit of alternating thick sandstone and shale intervals, the Nanushuk Group, is folded above a very thick incompetent interval. Wide synclines with rounded to flat bottoms separate cuspate anticlines that are cut locally by thrust faults. As in many deformed foreland basins, cores of anticlines are only rarely exposed or clearly defined in seismic data, yet they must be interpreted correctly to assess structural geometry, evolution, and shortening. Structural thickening within the incompetent unit probably occurred somewhere between two end-member models to form the folds: 1) sub-map-scale folding, faulting, and layer-parallel shortening and 2) second-order map-scale folds and imbricate thrust faults beneath a passive roof thrust. Map-scale imbrication and folding are evident in some outcrops and seismic lines, particularly where competent units are locally present within the incompetent interval. Exposures of the incompetent interval rarely show sufficient sub-map scale internal shortening to account for the overlying folds. These observations suggest that structural relief beneath Nanushuk anticlines resulted in the incompetent interval mainly by the formation and eventual thrust breakthrough of second-order detachment folds. Presence of a competent unit within the incompetent interval apparently favored but was not necessary for this behavior. Local evidence for syndepositional folding suggests that fold geometry and growth were also influenced by accumulation of thicker, coarser-grained deposits in synclines relative to thinner, finer-grained deposits or erosion in narrow anticlines.