Yakataga fold-and-thrust belt: Structural geometry and tectonic implications of a small continental collision zone

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Collision of the Yakutat terrane with southern Alaska has created a collisional fold-and-thrust belt along the Pacific-North America plate boundary. This south-vergent fold-and-thrust belt formed within continental sedimentary rocks but with the same vergence and in the tectonic position normally occupied by an accretionary wedge. Exposure of progressively older rocks northward reflects that the fold-and-thrust belt forms a southward tapered wedge that increases in structural relief and depth of erosion northward. Narrow, sharp anticlines separate wider, flat-bottomed synclines. Relatively steep thrust faults commonly cut the forelimbs of anticlines. Fold shortening and fault displacement both generally increase northward, whereas fault dip generally decreases northward. The coal-bearing lower part of the sedimentary section serves as a detachment for both folds and thrust faults. The folded and faulted sedimentary section defines a regional south dip of about 8°. The structural relief combined with the low shortening of the sedimentary section suggest that the underlying basement is structurally thickened. I interpret this thickening to have been accommodated by a passive roof duplex in which basement horses are separated by a roof thrust with a backthrust sense of motion from the overlying folded and thrust-faulted sedimentary cover. Basement horses are ~7 km thick, based on the thickness between the inferred roof thrust and the top of the basement in offshore seismic reflection data. This thickness is consistent with the depth of the zone of seismicity onshore.

The inferred zone of detachment and imbrication of basement corresponds with the area of surface exposure of the fold-and-thrust belt within the Yakutat terrane and with the Wrangell subduction zone and arc farther landward. By contrast, to the west, crust of the Yakutat terrane has been carried down a subduction zone that extends far landward with a gentle dip, corresponding with a gap in arc magmatism, anomalous topography, and the rupture zone of the 1964 great southern Alaska earthquake. I suggest that detachment and imbrication of basement combined with coupling in the fold-and-thrust belt has allowed the delaminated dense mantle lithosphere to subduct with a steeper dip than to the west, where buoyant Yakutat terrane crust remains attached to the subducted lithosphere. According to this interpretation, the Wrangell subduction zone is lithosphere of the Yakutat terrane, not Pacific Ocean lithosphere that has been subducted beneath the Yakutat terrane. The Pacific-North America plate boundary would be within the northern deformed part of the Yakutat terrane, not along the boundary between the undeformed southern part of the Yakutat terrane and oceanic crust of the Pacific Ocean. The plate boundary is a zone of distributed deformation in which a part of the convergent component is accommodated within the fold-and-thrust belt in the northern part of the Yakutat terrane, but most of the motion is partitioned between convergence on the Chugach-St. Elias thrust fault that forms the northern boundary of the Yakutat terrane, and the dominantly right-lateral strike-slip Bagley Icefield fault just to the north.