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Early Eocene Tectonics and Sedimentation in Northern Fossil Basin, Wyoming Overthrust Belt

The Tunp Member of the early Eocene Wasatch Formation in southwestern Wyoming was shed from rising thrust sheets as debris flows containing abundant, very poorly sorted to unsorted, coarse clastic material in a mudstone matrix. Deposition occurred on the margins of the northern Fossil basin as coalesced alluvial fans and fan deltas. Small braided streams traversed the surface of these fans and reworked debris flow material, but the resultant fluvial deposits are volumetrically minor.

Tunp Member deposits are preserved in three north-south-trending belts around the periphery of the northern Fossil basin. Each belt had a separate source in discrete highlands created by early Eocene motion on the Absaroka, Tunp, and Crawford thrust faults. These thrusts possessed unique characteristics of uplift style, provenance, and duration of in-situ weathering that are reflected by differences in clast lithology, size and rounding, as well as thickness and areal extent of the deposits resulting from each thrust.

The results of this study have several important implications about thrust belt development: (1) passive rotation of older thrusts by younger ones can provide an uplifted source for syntectonic sediments, (2) the tenet that major thrusts young in the direction of tectonic transport may be violated by the Tunp and Crawford thrusts in the Fossil basin area, and (3) those heretical faults (i.e., Tunp and Crawford) possess a similar geometry that is distinct from other thrust faults in the area.

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Tectonic Significance of Currant Creek Formation, North-Central Utah

The Currant Creek Formation is composed of conglomerate, sandstone, and fine-grained clastic rocks that crop out along the northwestern margin of the Uinta basin in north-central Utah. Lateral gradations in grain size define proximal, medial, and distal parts of coalescing alluvial-fan deposits that prograded eastward from the active Sevier-Laramide orogenic belt during Maestrichtian through Paleocene(?) time.

Paleocurrent directions indicate a dominant southerly transport direction and a minor easterly component. Strong east and southeasterly directions, measured in imbricated clasts and in sand lenses in conglomerate, indicate multiple source areas for the detritus. Source of the coarse-grained detritus in the Currant Creek Formation was the Charleston thrust sheet. Conglomeratic clasts are composed of Precambrian and Cambrian quartzite, chert derived from Cambrian and Mississippian carbonate beds, and Pennsylvanian sandstone. These rocks are exposed in the upper plate of the Charleston thrust near Deer Creek Reservoir, Mount Timpanogos, and Strawberry Reservoir. At Big and Little Cottonwood Canyons, the same rocks are exposed in the lower plate.

A large basement-cored east-verging anticline that is refolded around the Uinta Mountain structure is present in the Cottonwood region. By the time of its final emplacement, the "Cottonwood fold" likely formed a small mountain range. Erosional dissection was well under way and Carboniferous, Cambrian, and Precambrian beds were exposed.

The Charleston-Absaroka thrust rises in the stratigraphic section farther east, displacing Mesozoic rocks. Reworking of Cretaceous sandstone and shale flanking the newly uplifted western end of the Uinta arch also contributed sediment to southward-flowing streams.

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Stratigraphy and Facies Analysis of Upper Kaibab and Lower Moenkopi Formations in Southwest Washington County, Utah

Pre-Moenkopi karst topography formed on the nonresistant gypsum beds of the Harrisburg Member in the Beaver Dam Mountains of southwestern Utah. Local relief on the erosional surface may be more than 140 m (450 ft), forming potential unconformity traps with substantial closure.

Upper Permian and Lower Triassic rocks in the Beaver Dam Mountains accumulated on a gently westward-sloping continental shelf as both carbonate and clastic tidal-flat environments. Facies analysis shows seven lithofacies, including gypsum, dolomitic and calcareous mudstone, dolomitic and calcareous siltstone, dolomite, silty wackestone, fossiliferous packstone, and pelloidal-ooidal grainstone to packstone. Gypsum and dolomite facies formed mainly on supratidal flats. Packstone and grainstone rocks formed mainly on shoals, bars, and banks in the intertidal zone of a carbonate tidal flat. Mudstone and siltstone units formed mainly on muddy tidal flats.

High-displacement Basin and Range normal faults have uplifted the rocks, forming good exposures of the Permian and Triassic strata in the Beaver Dam Mountains and perhaps forming structural traps to the east. Stratigraphic traps may also occur throughout the Harrisburg and Shnabkaib members. Thick anhydrite beds form the cap. Grainstone, packstone, and dolomite units may be effective reservoir rocks. Source rocks include algal-rich wackestone and dolomite beds, fossiliferous units, including the underlying Fossil Mountain Member, and organic-rich mudstone units. Though trapping mechanisms are abundant in the Beaver Dam Mountains, oil exploration has not been very successful to date; this may be due, in part, to the difficulty of locating suitable traps.

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Deformation Consequences of Impingement of Foreland and Northern Thrust Belt (Palisades-Jackson Hole Area), Eastern Idaho and Western Wyoming

Structural studies in the Wyoming-Idaho segment of the Cordilleran thrust belt have provided insight into the nature and origin of the broad, east-facing salient west and southwest of Jackson, Wyoming. Changes in the orientation of regional fracture patterns and compression directions determined by dynamic analysis of calcite twins both indicate that the thrust sheets rotated into the salient in a counterclockwise direction. Furthermore, both field observations and calcite twin data show that there has been a large amount of subhorizontal, strike-normal deformation in the Prospect thrust sheet in the Teton Pass area, where the Prospect and Cache Creek thrusts are in direct contact. Subsurface evidence from Teton valley and the Hoback basin dates the Cache Creek thrust as older than the Prospect, Darby, and Absaroka thrusts.

Balanced cross sections drawn along deformation paths through the area show that movement on the Prospect thrust increases from less than 11 km (7 mi) near Victor, Idaho, to more than 37 km (23 mi) south of Jackson Hole. The fracture pattern and calcite twin data also show that the thrust sheets have rotated by as much as 40°. Palinspastic maps made by the sequential restoration of the cross sections show that prior to movement on the Prospect thrust, both the Darby and Absaroka thrusts curved gently to the northwest. As the Prospect sheet moved, it began to impinge upon the previously emplaced Teton-Gros Ventre uplift. The result was the rotation of the Prospect and piggyback Darby and Absaroka thrust sheets. The deformation due to this bending was taken up primarily by differential rotation of imbricate and main thrust sheets. An accurate understanding of the timing of these structural events relative to the timing of hydrocarbon generation and migration should be an essential factor in any exploration model of the area.

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Examination of Lower Jurassic Mudrocks Using Backscattered Electron Microscopy

The small size of many of the particles in mudrocks makes it almost impossible to image and identify them individually and in situ, using conventional light microscopy. Since the average mudrock contains about 60% clay minerals, an understanding of the physical and chemical characteristics of these minerals is central to the question of burial diagenesis and hydrocarbon generation. Much of the existing evidence concerning burial diagenesis relies on x-ray diffraction data (XRD), particularly with respect to the clay-sized ($< 2\ \mu m$) fraction of mudrocks. Backscattered electron techniques (BSE) in scanning electron microscopy (SEM) together with energy-dispersive x-ray microanalysis (EDX), XRD, and electron microprobe analysis, indicate that Lower Jurassic mudrocks from the North Sea basin contain many clay mineral stacks up to 150 μm long.