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Carboniferous and Permian Sedimentation and Tectonics in Central and Eastern Idaho

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The primary expression of Ancestral Rocky Mountains tectonism in Idaho is seen in the reactivation of the Antler orogenic belt. The structural style and orientation of this older thrust and transtensional system controlled the development of distal northwestern Ancestral Rocky Mountains uplifts and basins. Three distinct basin systems formed in Carboniferous and Permian time (Figure 1), the Early and middle Mississippian Copper Basin in central Idaho, a regional Pennsylvanian to Early Permian Oquirrh-Wood River Basin that extended from central Idaho southward into north-central Utah, and the Early and Late Permian Phosphoria Basin in eastern Idaho. Organic-rich carbonaceous mudrocks deposited in these three basin systems during times of siliciclastic sediment starvation. In each case ocean circulation was restricted by the periodically reactivated Antler highland. Only the Permian Phosphoria Basin developed demonstrable petroleum source-rocks. Reservoir facies are present in both the Copper Basin and Oquirrh-Wood River basin, in strata deposited in deep-water fan systems.

West of the Mississippian carbonate platform and ocean-facing ramp, the Kinderhookian to Meramecian Copper Basin Group filled a rapidly subsiding, fault-bounded basin (Figure 2 and 3). These strata are exposed in the Pioneer Mountains of south-central Idaho. The Copper Basin Group includes the west-derived Kinderhookian Little Copper Formation lowstand fan, east-derived calc-turbidites of the Kinderhookian Drummond Mine Limestone highstand fan, and south-derived Kinderhookian through Chesterian deep-water fan-delta conglomeratic turbidites to delta-top deposits of the Argosy Creek Formation. The Drummond Mine Limestone records the large positive Kinderhookian carbon-isotope excursion recognized in coeval carbonates from Nevada, Utah, Iowa, and Belgium, and which likely signals a period of enhanced organic carbon burial in basins worldwide (Saltzman et al., 2000). The southern part of the Copper Basin Group trough subsided very rapidly in Kinderhookian time, due to transtensional normal faulting, superposed on a regional western Antler thrust load, which produced a broad foreland basin.

Pennsylvanian and Permian rocks (Des Moinesian to Leonardian mixed carbonate-siliciclastic submarine fan, braid delta and patch reef deposits) of the Sun Valley and Oquirrh Groups were deposited in the Oquirrh-Wood River Basin (Figure 4). Much of the well-sorted quartzose sand was derived from reworking of erg deposits to the north and east in Montana. The Wood River basin overlapped the front of the latest Devonian Antler allochthon in south-central Idaho north of the Snake River Plain and the Oquirrh Basin overlies Antler foreland basin deposits (Manning

Canyon Shale) south of the Plain. Tectonic subsidence of the Oquirrh-Wood River basin is interpreted as produced by a crustal load from reactivated east-vergent thrusting within the Roberts Mountains allochthon to the west.

The Leonardian to Guadalupian Phosphoria Formation of eastern Idaho was deposited in an epicratonic successor basin on the western margin of North America, inboard of the Humboldt Highland (recurrently reactivated Antler highland). It thus immediately post-dates the final phases of Pennsylvanian and Early Permian Ancestral Rocky Mountain tectonism. Denitrifying redox conditions developed in the bottom water, below approximately 150-m depth (Piper and Link, 2002). This, coupled with high rates of organic-matter deposition contributed to the accumulation of a world class phosphate deposit and important petroleum source rock. To the east, in eastern Wyoming, was an evaporitic sabkha system, the Goose Egg Basin, that was separated from the Phosphoria Basin by an approximately 250-km-wide carbonate platform above the Big Horn, The platform would have restricted exchange of seawater between the two basins. Similarly, the remnant of the Antler Highland likely restricted exchange of seawater between the Phosphoria Basin and the open ocean.

Thus, recurrently during Carboniferous and Permian time, distal Ancestral Rockies crustal strain was manifest by reactivated loading of the Antler thrust allochthon, which in turn promoted restricted circulation in basins to the east, affording development of organic-rich mudrock and locally coarse-grained deep-water fan systems.

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Figure 1. Stratigraphic units present in several thrust sheets and mountain ranges of east-central Idaho (from Link and Janecke, 1999, Figure 3).

Figure 3. Stratigraphic column for the Copper Basin Group, Pioneer Mountains, south-central Idaho (from Link et al., 1996, Figure 5).

Figure 2. Paleogeographic settings for deposition of the Copper Basin Group. Simplified from Figure 11 of Link et al. (1996).

Figure 4. Paleotectonic map of the western United States during Virgilian to Wolfcampian time. Redrawn from Geslin (1998).