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There's More Than One Way to Build a Point Bar: Multiple Growth Processes in River-Channel Point Bars

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Point bars tend to generate sandy lobate side-attached bars that fill channels laterally and are the driving constructional feature of channel meandering. The standard "normal" model for point bar growth presumes periodic shingling of the convex inner channel bend during discrete, repetitive, and periodic flow events with sheet-form sand layers that cover much of the wetted bend surface. Repetition of this process produces sandy bodies partitioned with regularly spaced, gently dipping, bar-extensive surfaces. This long-standing model is confirmed from field studies.

More recent field examination of active point-bars in the Missouri and Powder rivers and Cretaceous Rocks of Dinosaur Provincial Park argues that this "normal" process is not alone. At least four additional processes also produce point-bar forms, and each of these processes preserves contrasting internal structure. These processes include counter, fragmentary, muddy-normal, and mid-channel-accretion point bars. Counter point bars are the only of these four processes previously reported in the literature. Counter-point-bar accretion occurs by forced decoupling of the cut-bank flow and accretion along the cut-bank face. This produces concave accretion surfaces in strata typically much muddier than normal convex-accretion bars. Fragmentary bar accretion results from accretion events of unit bars. High-frequency reorientation of the accretion surface causes these unit bars to be dissected. Only a limited extent of the unit bar and accretion surface is preserved. These reorientations of the bar depositional surface are on the order of three degrees in dip with 20 -50 degree reorientations of strike, and appear to be driven by erratic flood regimes. The result is a bar lacking in vertically or laterally continuous accretion surfaces, with high degrees of truncation in unit bar deposits, and a high internal bar complexity. The muddy-normal point bar has continuous accretion surfaces like the "normal" traditionally modeled point bar, but deposits within the point bar are dominated by mud instead of sand. Accretion surfaces are arranged in sets that contrast by at least 10 degrees in strike, with more river-normal oriented segments being sandier and more obliquely oriented set being muddier. Likewise, mud intervals include transport structures. The muddy intervals in these bars thus appear to reflect periodic reorientation of the point bar between lower and higher shear orientations after protracted consistent flow conditions with the mud deposited from transport rather than waning-flow draping. Lastly, a lobate sandy body mimicking a true point bar may form in otherwise braided systems by preferential accretion of mid-channel bars to the inside bend of a braided river that meanders. These tend to form sets of amalgamated sandy mid-channel bars into point-bar shapes that have mounded accretion surfaces at various orientations.

Each of these forms are common, and each includes long internal hiatal surfaces that result in total bar accretion rates that are much slower than rates of short-term bar growth. The fragmentary bars are also prone to low levels of completeness in preservation, approximately 50%.