Funny Things Meanders Do: Process and Variability in Modern and Ancient Point Bars

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Abstract

The generation of point bars by lateral accretion during lateral expansion and downstream translation of river meanders is a well described process, and a primary means for generation of sandy bar reservoirs within fluvial strata. Further examination of this process in modern and ancient settings points, however, to a wide variation on this simple theme.

Detailed mapping within the Missouri River system reveals a particularly wide diversity of meander style. These styles include prior known translation, expansion, and counter point bars, and three additional variations: wavering meanders, spin-out meanders, and meander pile ups. Wavering meanders superficially resemble point-bar meanders but form in braided rivers and do not grow by lateral accretion. Instead, these form by repeated accretion of mid-channel bars to the channel bank in otherwise braided reaches.

Since the mid-channel bars can accrete to either the outer or inner bank, the meander can grow in both outward and inward directions, and may thus "waver". Also within the braided section occur highly contorted meanders. These occur locally and randomly in both time and space and record short sections of braided river that are temporarily compressed into single-thread channels. The energy within the system exceeds the stability of sustained meandering. The loop is characterized by rapid point-bar accretion that generates complexly compound forms. After this brief "spin out", the meander is quickly cut off, and the river returns to its normal braided pattern.

Meander pile-ups occur where tips of normal expanding and/or translating meanders encounter bedrock constrictions. Here, bedload transport is locally concentrated. Sedimentation forces accelerated bar growth in the area around the constriction. Likewise, downstream bar translation is stopped. Meanders "pile up" on the floodplain preserving multiple and abundant crosscutting meanders with hair-pin form. Meanders can grow by intermittent accretion or erosion/accretion cycles. Examination of 3D point bar deposits in the ancient accordingly shows a wide variety of muddy and fragmented point bars that diverge from the classic sandy point bar model with regularly spaced and parallel accretion surfaces, reflecting the high complexity of process in point bar development and river meandering.