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LATE QUATERNARY GLACIO-EUSTATIC SEQUENCES AND STRATAL PATTERNS IN THE MAHAKAM DELTA

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ABSTRACT

Late Quaternary eustatic cycles have formed small-scale depositional sequences in the Mahakam delta. Even though each of these units occur on a scale normally associated with parasequences, they exhibit all the attributes of larger scale third-order sequences and are bounded by sequence boundaries formed during eustatic sea-level fall and by maximum flooding surfaces during sea-level rise. However, because of the high frequency and asymmetry of these eustatic cycles, as well as the rapid rates of sea-level rise and fall, several features within these sequences differ from those of published models.

3D seismic amplitude maps show the existence of narrow, incised valleys dissected by dendritic erosion patterns similar to those observed in modern alluvial systems. When sea-level falls, the distributary channels of the highstand delta are converted into incised fluvial valleys and the physiography of the lowstand fluvial valleys is inherited from that of the previous highstand delta. In the case of the Mahakam, the size and geometry of the incised valleys are the same as that of the deltaic distributaries and form relatively straight channels, with widths on the order of 1 to 1.5 km and depths of incision attaining 30 m.

During falling sea level, the delta continues to prograde, stepping downward and seaward over the shelf. This lowstand delta is difficult to distinguish from the highstand delta and no obvious onlap surface separates the two systems tracts, which are in physical continuity. As sea level continues to fall, the distributaries on the lowstand delta plain become incised and an unconformity surface is superimposed on the top of the lowstand delta. In this case it is unlikely that the initial sequence boundary, i.e. the downlap surface beneath the prograding lowstand delta, will be identified.

When rapid eustatic sea-level rise occurs, thin transgressive marine muds and carbonates accumulate on the fluvially-dissected lowstand delta plain. Because of the rapid rate of sea-level rise and the low tide range, the transgressive deposits are thin and do not fill the incised valleys, which remain as prominent valley systems on the transgressed shelf. At stillstand, the highstand delta progrades, downlapping the underlying maximum flooding surface and filling the shelf valleys with prodelta mud. These thick, prodelta muds form a very effective seal for the lowstand channel-fill sand in the valley thalwegs.

Each depositional sequence comprises two episodes of deltaic progradation: the early lowstand, and the highstand systems tract. It is very difficult to distinguish between these two systems tracts, and to a large extent the physiography of the lowstand will be inherited from that of the previous highstand. In terms of stratal patterns, the highstand and the lowstand will form a single prograding delta unit. As the basin subsides, these units will superimposed and will be isolated by the maximum flooding surfaces.

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