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Fluvial Morphodynamics of Kampar River, Sumatra, Indonesia

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The relationship between alluviation and environmental change in tropical fluvial environments remains extremely poorly known, especially over late Pleistocene to Holocene time scales. At the same time, new developments in dating allow more precise quantification of associated deposits, opening up the opportunity to determine the alluvial history and relate it to environmental change. The Kampar River is a meandering tropical river in Sumatra island, Indonesia. This river has a gentle slope, gravel bed-river, and their bends migrate because of bank erosion. Fluvial dynamics are recorded by vertically and laterally changing sediment facies due to bend growth. This study develops a chrono-stratigraphical framework at the time scale of the Late Quaternary for the Kampar River to better understand its long-term fluvial dynamics and flooding frequency relative to changing climate and vegetation. We applied sedimentological analysis utilizing XRD and granulometry analysis to investigate mineralogy and facies changes. However, sedimentological analysis is insufficient to correlate sediment facies because this river is highly dynamic. Therefore, the reconstruction of morpho-dynamics in the meandering river is a challenge. Satellite images and drone imagery are utilized to document the geometry of the river. Then, to clarify the chrono-stratigraphy, sediment dating becomes essential. Due to the challenging characteristics of quartz optical stimulated luminescence (OSL), we applied infra-red stimulated luminescence (IRSL) of K-feldspar to constrain a chronology for the fluvial deposits. As a result, we concluded that sediment deposition began with a sediment channel dominated by gravel deposits in this study. It is then gradually transformed to low amplitude point bars reflected in lateral accretion deposits characterized by fining-upward sandy gravels. The onset of large-scale flooding is reflected in more intensive bend-growth and also evidence of overbank deposition. Chute bar formation was also identified, characterized by gravelly sand with a basal lag deposit. Preliminary dating suggests fluvial aggradation spanning Late Pleistocene – Holocene time scales. We highlight the potential for these new dating methods in studying Holocene fluvial dynamics in highly active tropical river systems sensitive to climatic shifts.