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Tectonic control on the alluvial fan sizes in the Menderes Massif, Western Anatolia (Turkey): Implications for relative tectonic assessment, erosion proxies, and fluvial signatures in tectonically active landscapes

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Orogenic belts are a system of complex connections and feedbacks where climatic, tectonic and erosional processes play significant roles. Orogenic systems affect not only the carbon cycle and thereby the climate change through regional uplift, physical and chemical weathering and also contributes to the soil formation via the sediments they produce. The analyses of these macro geomorphological units and the sediments they produce enable to obtain quantitative information for understanding the effects of tectonic and climatic processes additionally their impact on the civilizations. The Mid-Holocene erosion in the Southern section of the Menderes Massif is responsible for one of the greatest sediment redistributions in Turkey and further caused rapid alluvial filling of ancient port cities such as Miletus, Myous and Priene which are away in 40 km from the modern coastline today. In this study, we analyzed the control of relative tectonic activity between fault segments on fan sizes to characterize the differential erosional contribution of northern and southern sections of the Büyük Menderes River: First, we present mountain fronts and stream morphology of the different fault segments as a proxy for fault activity degree assessment to document spatial tectonic activity pattern of the catchments. Second, we related the computed volume of alluvial fans with segmentation-related activity classification of sub-catchments to demonstrate spatial variations in the proportion of erosion associated with the level of relative activity between fault segments in the Central and Southern Menderes Massif. Two key observations in this region emphasize the importance of tectonics on the efficiency of surface processes in spatially: (1) Faults bounding Southern Massif is included low to moderate tectonic activity classes while fault segments bounding Central Menderes Massif has relatively high or very high tectonic activity, where the total size of the fans are an order of magnitude higher than the southern section. (2) Formation of larger alluvial fans in the Central Massif due to high sedimentation rate caused lateral migration of the trunk river course to the south. Overall, we document a strong tectonic control on erosion and channel slopes in the Central Menderes Massif. Furthermore, we observed that the presence of half-grabens in the Southern Menderes Massif is primarily limited the alluvial fan sizes and damping sediment mass transport, which is primarily responsible for leading the balance between differential erosion, sediment routing and transient storage in the Menderes Massif. This study was supported by TÜBITAK grant #116Y077.