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Spatial strain distribution along continental transform faults: insights from morphometric analyses of the Düzce and Mudurnu Valley segments (North Anatolian Fault, NW Turkey)

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Continental transform faults are generally known to have widely distributed structures and sparse seismicity, in opposite to their oceanic counterparts. The North Anatolian Shear Zone (NASZ) is an ideal example, where the total deformation is shared between multiple structures especially during its evolutionary stages. The North Anatolian Fault (NAF), the most prominent member of the NASZ, started to form of about 11 Ma in the east and propagated to the west, reaching to the Marmara Sea only a few hundred thousand years ago. This principal displacement zone generally extends as a single strand from its easternmost tip to the west until Bolu for about 900 km. To the west of Bolu, it bifurcates into two branches, Düzce and Mudurnu Valley segments, delimiting the Almacık Flake (AF) respectively to the north and south. Although there is a considerable number of multi-disciplinary studies on the kinematics and history of active faulting within and around the AF, we still have gaps in our knowledge on (a) the ratio of strain distribution, (b) time of formation of bounding fault segments and (c) their evolutionary stages.

In order to fulfil some parts of this gap, we studied the major morphometric indices, including hypsometric curve and integral (HI), asymmetry factor (Af), channel concavity (θ), chi (χ) and knickpoint analyses on drainage basins across the whole AF and all surrounding fault segments. Our goal is not only to document the comparative tectonic effect of the bounding fault segments on the topography, but also to test any potential cumulative morphological response to pre- and post-peak structures, especially along the Düzce Segment. Almost all of 83 extracted drainage basins yield high HI values, usually ranging between 0.4 and 0.72, and suggest a rejuvenating morphology compatible with the general 'uplift hypothesis' for the AF. In more details, θ and χ values point out the strong and confined effect of the active bounding faults. Moreover, knickpoints do not show evidence for any pre-peak structures rather than recent active faulting. This may be result of limited size, thus ages, of drainage basins, which are cut by bounding faults at both sides of the AF. Alternatively, these fault segments may be older than previous assumptions, whereas the effect of pre- and post-peak shear structures on topography has already been erased mainly by external processes. On the other hand, χ values, based on 0.45 reference θ, suggest a high incision along the western sections of the Mudurnu Valley Segment, which may indicate a strain transfer from north to south. Nevertheless, the breach of a landslide dam of about 5750 years ago and the strong incision of the Mudurnu River following this event to

the south of the AF, as suggested by previous studies, can be another reason for this anomaly. Briefly, our preliminary results suggest a strong tectonic control on the AF’s topography mainly due to the activity of the bounding structures. We do not see any morphometric evidence for the secondary (pre- and post-peak) faults in the near past of the NASZ around the AF.