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Syn-to post-accretionary tectonic history of the wedge-top Epiligurian Units (Northern Apennines, Italy) as constrained by structural and remote sensing analysis

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The Epiligurian wedge-top basins of the Italian Northern Apennines fold and-thrust belt have been thoroughly investigated in the past from a sedimentological and paleogeographic perspective leading to the identification of several regional unconformities and the appreciation of their significance to track down the complex evolution of the accretionary wedge. Among these, a major Burdigalian unconformity has been recognised as a key regional element marking an abrupt shift from a deep marine (pre-Burdigalian) to platform (post-Burdigalian) environment during the progressive uplift of the accretionary wedge. We integrate these studies by providing a solid structural framework wherein to set this evolution. We investigated the pattern and the kinematics of the deformation structures deforming the Epiligurian Units both in the pre- and post-Burdigalian sequences exposed in the Emilia-Romagna Region of the Northern Apennines. Field investigations were integrated with the remote sensing of lineaments mapped at the regional scale to unravel the significance of the Burdigalian unconformity during the thickening and later dismantling of the Northern Apennines wedge. Fieldwork data document the existence of different structures and lineament trends affecting the pre- and post-Burdigalian sedimentary sequences. For example, the lowermost units of the pre-Burdigalian sequence are affected by top-to-the SE, NE-SW-striking reverse faults defined by planar slip surfaces associated with thin clastic damage zones. These reverse faults are cut across by scattered normal faults accommodating centimetric to decimetric throws and associated with clusters of disaggregation deformation bands. The post-Burdigalian succession, instead, is affected by more systematic trends of both reverse and normal faults. The reverse faults are oriented either NE-SW or WNW-ESE, with a general NW or NE tectonic transport, respectively. The crosscutting normal faults strike from NW-SE to NE-SW and are associated with extension-oriented NE-SW and NW-SE, respectively. Normal faults are locally decorated by calcite slickenfibres and syn-kinematic calcite veins, documenting structurally controlled circulation of mineralising paleofluids. All the structures affecting both the pre- and post-Burdigalian sequences are linked to a tectonic evolution encompassing syn-orogenic compression and post-orogenic extension, with the latter accompanied by local instabilities during overall thinning of the transiently supercritical wedge. To assess the significance of our results on a regional scale, a remote sensing analysis of tectonic and morphological lineaments was performed by systematically mapping lineaments within a study area of 200 km² at an observation scale varying from 1:50.000 to 1:5.000. Statistical analysis of open-access dataset focused on

reverse and normal faults, confirming the significant lineament orientation variations indicated by field data. NE-SW striking normal and reverse faults define the pre-Burdigalian dataset, whereas NE-SW-striking normal faults and NW-SE-striking compressional structures define the post-Burdigalian dataset. Preliminary results from the combination of field and remote sensing made it possible to not only differentiate tectonic and morphological elements and to identify the preferential trend of deformation structures, but to also conclude that the polyphasic tectonic evolution of the Epiligurian Units during the NE-verging accretion of the Northern Apennines wedge accommodated significant changes in stress field orientation and faulting regime in the pre- and post-Burdigalian period.