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Morphostructural characterization of the Charco basin and its surrounding areas in the Chihuahua segment of north Mexican Basin and Range Province

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The Chihuahua Basin and Range (CBR) is the eastern branch of the northern Mexican Basin and Range Province that, from a morphostructural point of view, presently is one amongst the lesser-known zones of the southern portion of the North America Basin and Range Province. The study area covers an approximately 800 km2-wide portion of the CBR and encompasses the fault-bounded Charco basin and its surrounding areas.
The bedrock of the area pertains to the large siliceous-igneous province of the Sierra Madre Occidental and consists of volcanoclastic rocks including Oligocene dacite, rhyolite, rhyolitic tuffs, and polimitic conglomerates. The region is characterized by a series of NW-SE oriented valleys delimited by tilted monoclinal blocks bounded by high angle, SW-dipping, normal faults. Abrupt changes in elevation, alternating between narrow faulted mountain chains and flat arid valleys or basins are the main morphological elements of the area. The valleys correspond to structural grabens filled with Plio-Pleistocene continental sediments. These grabens are about 10 km wide, while the extensional fault system extend over a distance of more than 15 km. The mountain ranges are in most cases continuous over distances that range from 10 to 70 km including different branches of the extensional and transfer faults. The morphogenesis is mainly erosive in character: erosional landforms (such as rocky scarps, ridges, strath-terraces, erosional pediment, reverse slopes, landslide scar zones, litho-structural flat surfaces) dominate the landscape. In contrast, Quaternary depositional landforms are mainly concentrated within the flat valleys or basins. The Quaternary deposits consist of wide alluvial fans extending to the foot of the main ridges, fluvial and debris-slope deposits.
The morphostructural characterization of the area integrated different methodologies, including: i) geomorphological and structural field analyses; ii) remote sensing and geo-morphometric investigations based on aerial photos and Digital Elevation Models (a 28x28 m DEM and high-resolution LIDAR dataset in key sites), and iii) geophysical investigations (high resolution reflection seismic profiling combined with refraction seismic tomography).
The main outputs of this research are as follows: i) the Charco basin master-faults and their conjugate extensional system were geometrically characterized and their main associated landforms mapped and described; ii) the morphostratigraphic correlations amongst both deformed and tectonically unaffected Quaternary deposits revealed that the Charco basin master fault has been inactive over the Holocene; iii) the main extensional fault system is associated with conjugate faults, oriented approximately SSW-NNE, that segmented the Charco basin master faults and favored the deposition of the most recent piedmont fans along the eastern margin of the basin; iv) the local morphostructures had played a dominant influence on the Quaternary evolution of both drainage network and relief landforms.