DELINEATING STRUCTURAL STYLES AND GEOMORPHOLOGICAL PATTERNS USING SATELLITE IMAGERY AND SEISMIC IMAGES FOR AN IMPROVED INTERPRETATION IN A FOLD THRUST BELT AND ADJACENT FOREDEEP OF PAKISTAN

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Abstract

We combined a number of datasets to provide an enhanced and improved tectono-geomorphological and structural image using satellite imagery coupled with seismic images. The present study was carried out using the USGS ASTER DEM (30 m), Landsat 8 (OLI/TIRS) and 2D (strike & dip) seismic reflection profiles of the study area. Different band combinations and directional filters methods were used to identify the major structural styles in the area and were correlated with the subsurface seismic images for an enhanced interpretation. The panchromatic band (Band-8) was applied to the Landsat 8 satellite images in order to enhance the spatial resolution from 30 m to 15 m which aided in the investigation and comparative analysis of tectonic geomorphology and structural styles. Drainage patterns of Zindapir Anticline (ZA), Sakhi Sarwar (SS), Sulaiman Foredeep (SF) and Kingri Fault (KF) areas were generated using Strahler order of streams. The results suggested a combination of the dendritic network with a minor component of trellis pattern for ZP and SF areas hence proposing a more stratigraphic/lithological control, whereas the KF area indicated an element of a rectangular pattern suggesting a more structural influence in the western part in comparison to the eastern region. The presence of water gaps (WaGs) and active drainage network indicate lateral growth and propagation directions of the ZP and SS frontal anticlines following the Paleocene Epoch. The geomorphic evidences coupled with satellite data show that SFB is tectonically active. The stream courses are deflected or guided due to active folds and tectonics in the area characterized by the distinct fluvial erosional pattern on the flanks/limbs of ZA. The satellite imagery combined with 2D seismic images portray a compressional structural geometry of the area indicating a combination of mostly symmetrical folds, probably overturned at places, and reverse faults. 2D seismic images indicate amplitude anomalies at structural highs while the structural lows are indicated by dipping reflectors. Steep dips occur in some seismic reflection profiles, however, gentle dips are prevalent, particularly towards the SF area. The ZP is a highly deformed area whereas SF region is less deformed with reduced tectonic disturbances based on seismic images as indicated by parallel, continuous reflectors with negligible structural discontinuities across the basin. The eastern Sulaiman Fold Belt (SFB) is characterized by a series of north-south trending structural highs and lows developed during the Paleogene, and the area experienced folding, uplift, and subsequent erosion. Evidence from the study suggests that compressional deformation, uplift and erosion played a significant role in shaping of the structural and depositional architecture of the basin. It is proposed that the deformation in the SFB during the late Paleogene is related to the Indian-Eurasian oblique collision, while the subsequent late Tertiary collision of Indian Plate with the Afghan Block (an accreted part of southern Eurasia) further ensued compressive deformation. The results from this study elucidate the possible models proposed for this compressional regime with prevailing wrenching by presenting different dataset from previous studies for the surface and subsurface and are in agreement with the styles proposed for this area by previous researchers.