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EDITED AND REVIEWED BY
Derek Keir,
University of Southampton, United Kingdom

*CORRESPONDENCE
Gang Rao,
raogangss@126.com

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Editorial: Lithosphere and surface processes of the Sichuan Basin and surrounding areas: resources and environmental effects

Gang Rao[1]*, Wei Chen[1], Dan-Ping Yan[2], Yuntao Tian[3], Bin Deng[4], Gang Luo[5] and Jonny Wu[6]

[1]School of Geoscience and Technology, Southwest Petroleum University, Chengdu, China, [2]School of Earth Sciences and Resources, China University of Geosciences, Beijing, China, [3]School of Earth Sciences and Engineering, Sun Yat-sen University, Zhuhai, China, [4]College of Energy Resources, Chengdu University of Technology, Chengdu, China, [5]School of Geodesy and Geomatics, Wuhan University, Wuhan, China, [6]Department of Geosciences, University of Arizona, Tucson, AZ, United States

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Editorial on the Research Topic
Lithosphere and surface processes of the Sichuan Basin and surrounding areas: resources and environmental effects

Recent strong to large earthquakes (e.g., 2008 M_w 7.9 Wenchuan, 2014 M_w 6.6 Lushan, 2017 M_w 6.5 Jiuzaigou, 2019 M_w 5.8 Changning, and 2022 M_w 6.6 Luding earthquakes) have occurred around the Sichuan Basin, central China, resulting in serious damage and deaths. In this regard, the identification and characterization of active structures are critical for seismic hazard assessment. Meanwhile, the growth of surrounding orogens with complex evolution histories have profound impacts on the thermal evolution, subsidence and sedimentary processes of the Sichuan Basin, where fertile oil and gas resources have been found at multiple levels within the upper several kilometers of sediments. Thus, the knowledge of the crust to mantle architecture, tectonics and landscape evolution has important implications for exploration of associated energy resources and environmental changes. The five original research articles gathered in this Research Topic provide new insights into rupturing mechanism of the most recent earthquake events, landscape evolution influenced by active tectonics, structural development and propagation in complex fold-and-thrust belts, as well as the coupling mechanism between mountain building and basin formation.

Based on the obtained >13,000 after-shocks and >2,000 pre-shocks of the 2022 Luding earthquake, Cai et al. conducted event relocation and three-dimensional *P*- and *S*-wave velocity structure inversion by double-difference tomography. The results of integrated analysis show that the mainshock initiated at 9.2 km depth and the Moxi section of the Xianshuihe fault is the seismogenic fault. Moreover, they speculate that the two high-velocity zones located to the northwest and southeast of the mainshock probably controlled its rupture extent.

Using a Burgers viscoelastic model, Tang et al. calculated the Coulomb stress change of the 2022 Lushan-Maerkang earthquake sequence and further discussed

the relationships between the historical earthquakes since 1900 in the eastern Tibetan Plateau. Importantly, they found that the 1955 M 7.6 Kangding and 2008 M_w 7.9 Wenchuan earthquakes contributed significant loading effects on the 2022 M_s 6.1 Lushan earthquake, but the 2013 M_w 6.6 Lushan earthquake had an unloading effect. Meanwhile, they emphasized the contribution of viscoelastic relaxation of the lower crust and upper mantle to fault stress level. Also, their findings have important implications for seismic potential assessments.

Through quantitative morphotectonic analyses, Wang D et al. investigated landscape evolution of the Xiaojiang region, southeastern Tibetan Plateau. Specifically, they compared river longitudinal profiles and the spatial variation in geomorphic indices including drainage basin asymmetry (*AF*), basin shape (*BS*), hypsometric integral (*HI*), normalized stream-length gradient (*SLK*), and the ratio of valley-floor width to valley height (*VF*) for 77 drainage basins in the study area. They conclude that tectonics has stronger influence on the spatial variation in landscape forms and evolution of the Xiaojiang Region is more strongly influenced by tectonics than erosion.

For structural evolution of the southwestern Sichuan fold-thrust belts, Wang Y et al. conducted discrete-element numerical simulations to test the influence of basal detachments with variable mechanical strengths and thicknesses. After comparing the obtained structural styles to the natural examples in detail, the model with a modest frictional basal detachment but a greater thickness is most similar to nature. The model results provide insights into the deformation propagation mechanism of the contractional fold-and-thrust belts with multiple detachment layers.

Wan et al. focused on the coupling mechanism between mountain building and basin formation in Jurassic. Through the integrated analysis, they found a limited control of mountain loading on basin subsidence. The Micangshan and Dabashan fold-thrust belts exerted control on basin subsidence only along their margins. They suggest that residual subsidence was likely induced by deep geodynamic processes.

In summary, the five high-quality papers complied in this Research Topic provide thought-provoking results on the lithosphere and surface processes of the Sichuan Basin and surrounding areas. More importantly, it is our hope that these studies provide directions for future investigations from different scientific communities in a region that contains rich energy resources but is also threatened by seismic hazards.

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GR: Writing–original draft, Writing–review and editing. WC: Writing–review and editing. D-PY: Writing–review and editing. YT: Writing–review and editing. BD: Writing–review and editing. GL: Writing–review and editing. JW: Writing–review and editing.

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Conflict of interest

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