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Exhumation and stress history in the sedimentary cover during Laramide thick-skinned tectonics assessed by stylolite roughness analysis.

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Basement-involvement in shortening in forelands has a strong impact on the overlying sedimentary cover. The basement influences namely the geometry of folds and structures, the stress evolution and the nature and pathways for fluid migrations. However, these influences are poorly documented in context where the basement/cover interface is shallow (<6 km). This contribution presents the reconstruction of paleostress and vertical burial history of the Palaeozoic sedimentary strata affected by the Sevier-Laramide deformation at the front of the Rocky Mountains, in the Bighorn Basin (Wyoming, USA).

Stylolite populations have been considered as part of an extensive microstructure investigation including also fractures, striated microfaults and calcite twins in key major structures such as the Sheep Mountain Anticline, the Rattlesnake Mountain Anticline, and the Bighorn Mountains Arch. Stylolite recognized in the field are clearly related to successive stages of deformation of the sedimentary cover, including fold development. We further apply a newly developed roughness analysis of pressure-solution stylolites which grant access (1) to the magnitude of the vertical principal stress, hence the maximum burial depth of the strata based on sedimentary stylolites, (2) to the principal stress orientations and regimes based on tectonic stylolites and (3) ultimately to the complete stress tensor when sedimentary and tectonic stylolites can be considered coeval. This approach was then coupled to mechanical properties of main competent formations exposed in the basin.

Results of stylolite paleopiezometry, compared and combined to existing paleostress estimates from calcite twins and to exhumation reconstruction from low-temperature thermochronology, unravel the potential of the method to refine the structural history at the structure- and basin-scale. On top of the advances this case study adds to the methodology, the quantified reconstruction of stress-exhumation evolution in such a broken-foreland context offers a unique opportunity to discuss how thick-skinned tectonics impacts stress distribution in the sedimentary cover.