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Differential uplift and incision of the Yakima River terraces, central Washington State, USA

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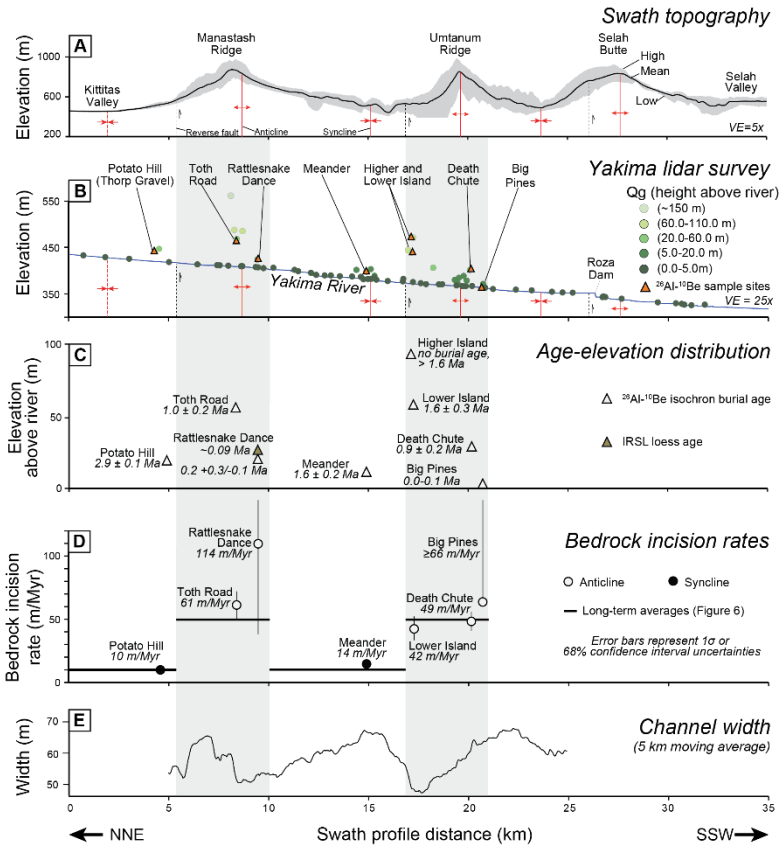
The fault-related Yakima folds deform Miocene basalts and younger deposits of the Columbia Plateau in central Washington State, USA. Geodesy implies ~2 mm/yr of NNE-directed shortening across the folds, but until now the distribution and rates of Quaternary deformation among individual structures has been unclear. South of Ellensburg, Washington, the Yakima River cuts a ~600-m deep canyon across several Yakima folds, preserving gravel-mantled strath terraces that record progressive bedrock incision and related rock uplift.

Here, we integrate cosmogenic isochron burial dating of the strath terrace gravels with lidar analysis and field mapping to quantify rates of Quaternary differential incision and rock uplift across two folds transected by the Yakima River: Manastash and Umtanum Ridge (Figure 1a-e). Isochron burial ages from *in situ* produced ^{26}Al and ^{10}Be at seven sites across the folds date episodes of strath terrace formation over the past ~2.9 Ma. Average bedrock incision rates across the Manastash (~88 m/Myr) and Umtanum Ridge (~46 m/Myr) anticlines are roughly four to eight times higher than rates in the intervening syncline (~14 m/Myr) and outside the canyon (~10 m/Myr).



The contrasting rates demonstrate differential bedrock incision driven by ongoing Quaternary rock uplift across the folds at rates corresponding to ~0.13 and ~0.06 mm/yr shortening across postulated master faults dipping 30 ± 10° S beneath the Manastash and Umtanum Ridge anticlines, respectively. The reported

Quaternary shortening across the anticlines accounts for ~10% of the ~2 mm/yr geodetic budget, suggesting that other Yakima structures actively accommodate the remaining contemporary deformation.

Figure 1: Profiles across Manastash and Umtanum Ridge anticlines