

Rock nature versus fault nurture in the control of fault behavior

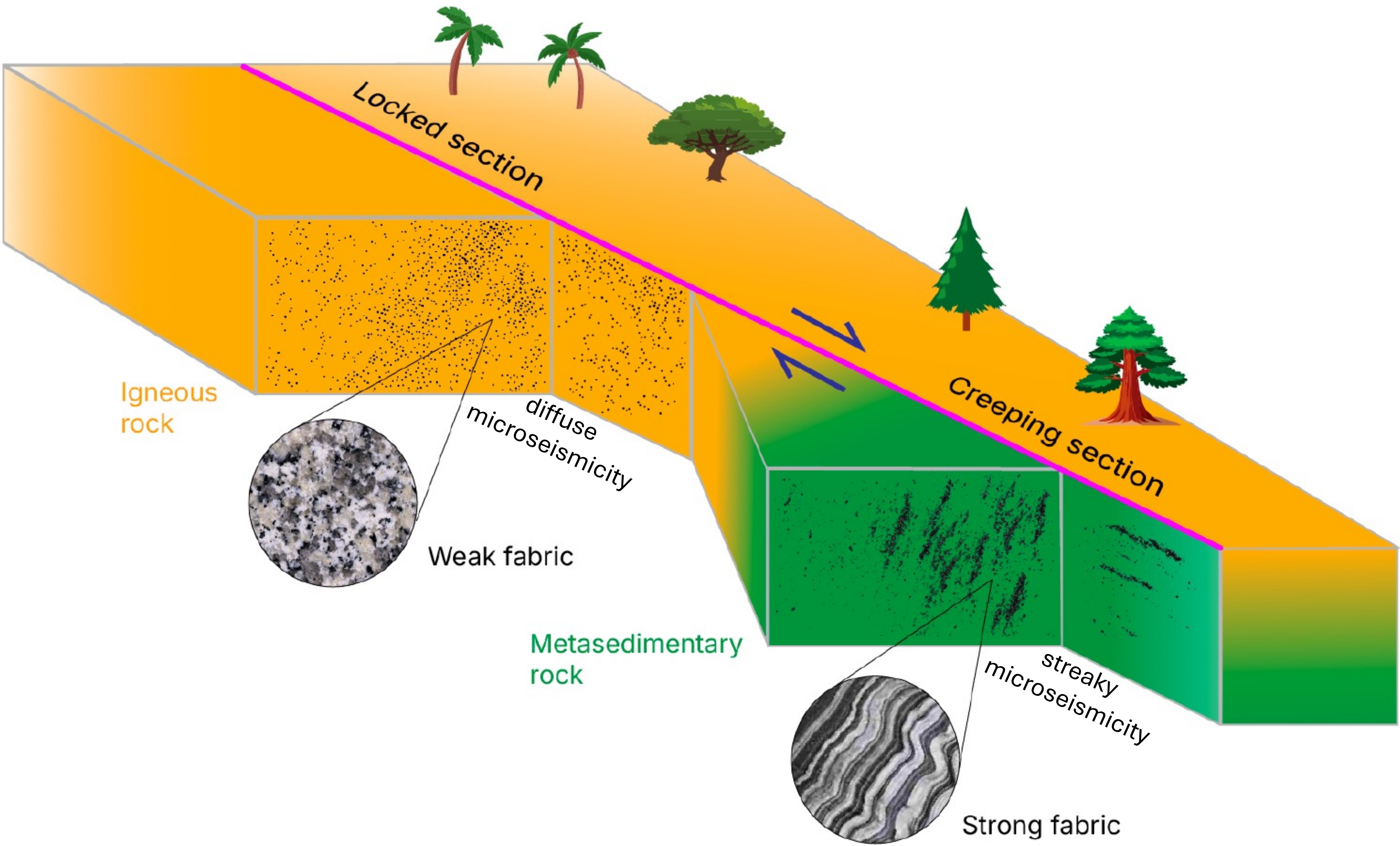


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Main finding:

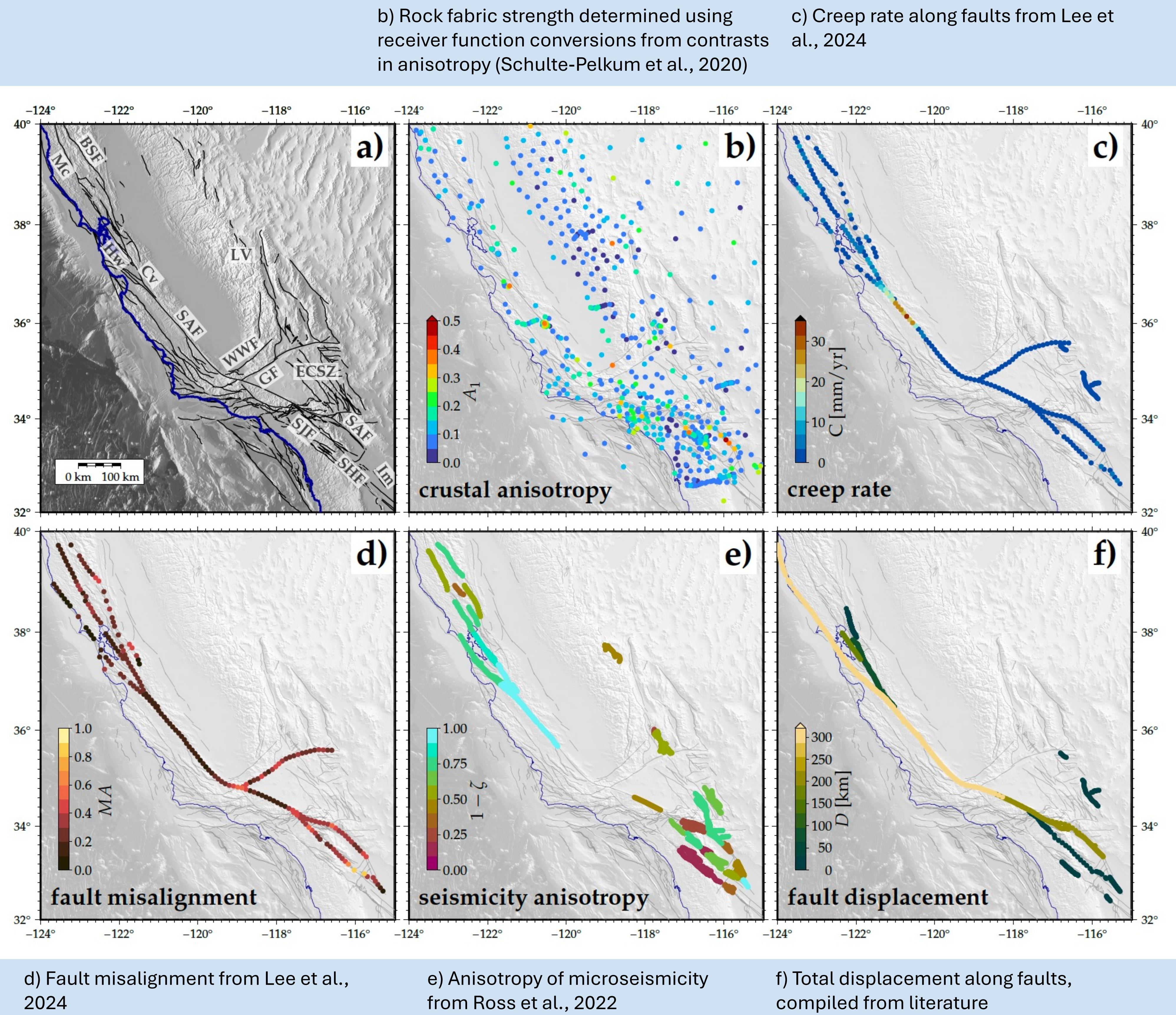
Fault rock fabric strength, **creep** rate, and streakiness of **microseismicity** are spatially **correlated** in the SAF system



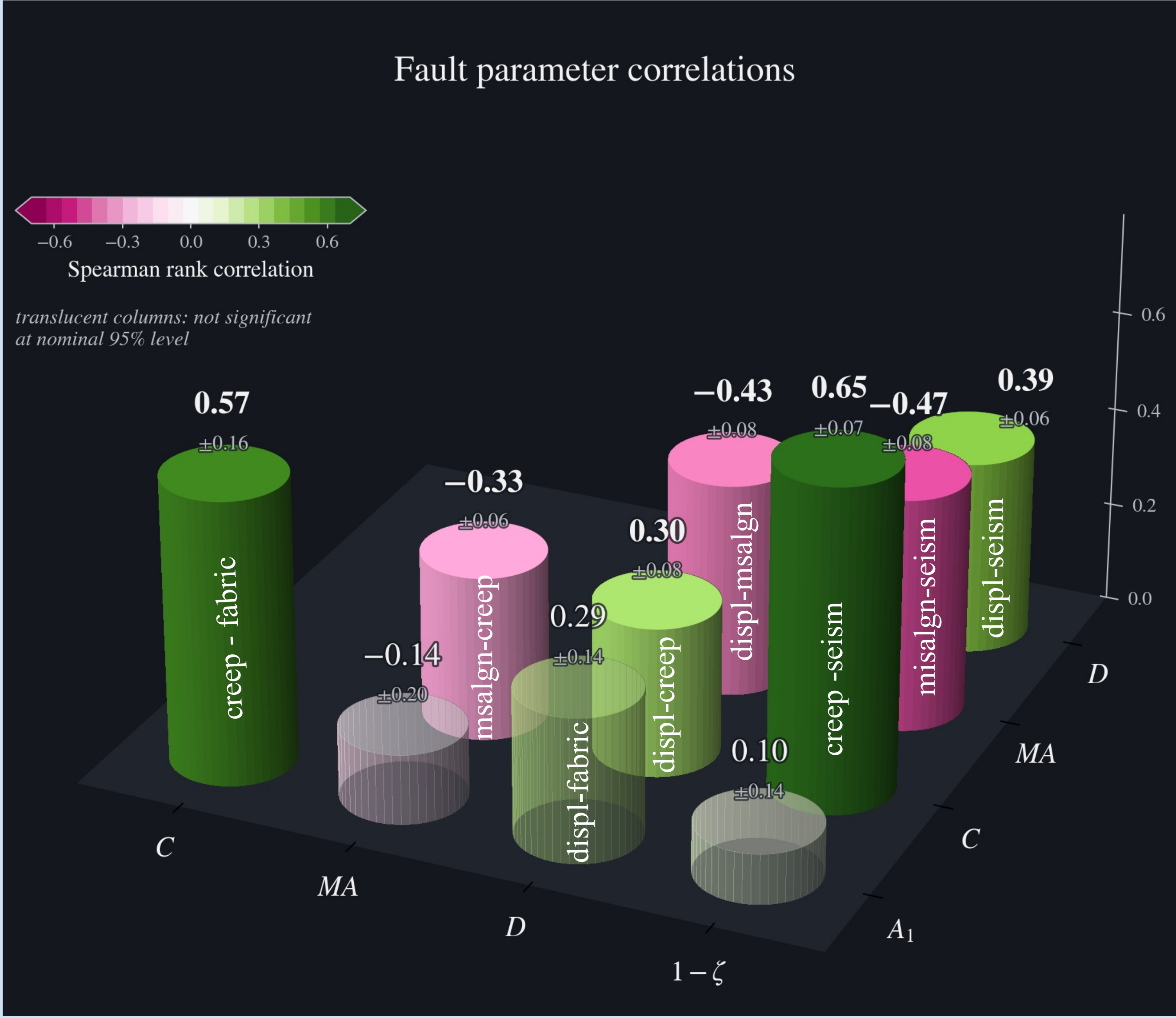
We interpret this as evidence that **lithology** (rock nature) is at least as important in controlling fault behavior as fault **evolution** (nurture)

The contestants

We calculate correlations along fault traces for these parameters within 5 km of the fault trace:



The scores



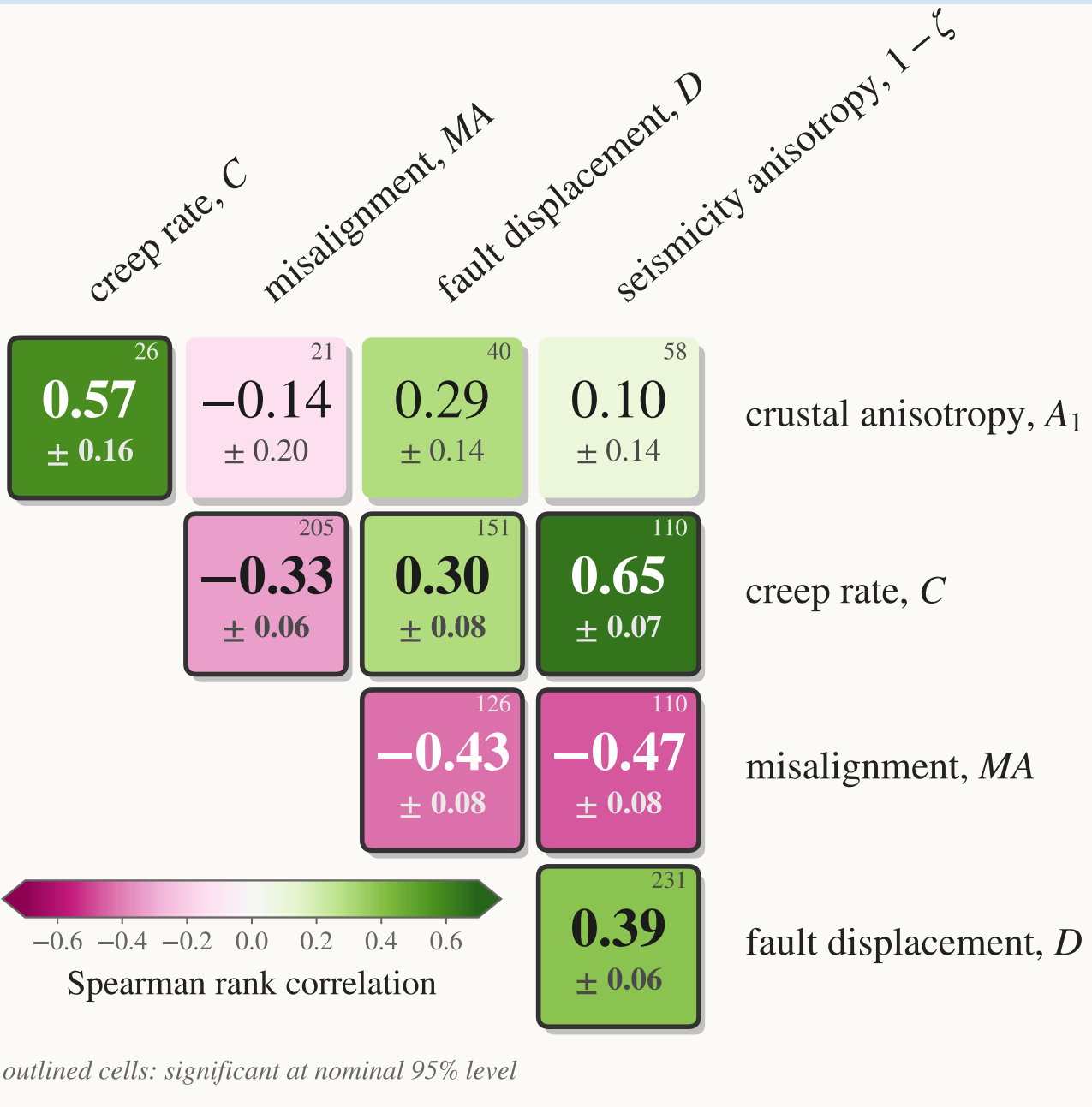
Strongest correlations:

Rock **fabric** strength (A1) – **creep** rate

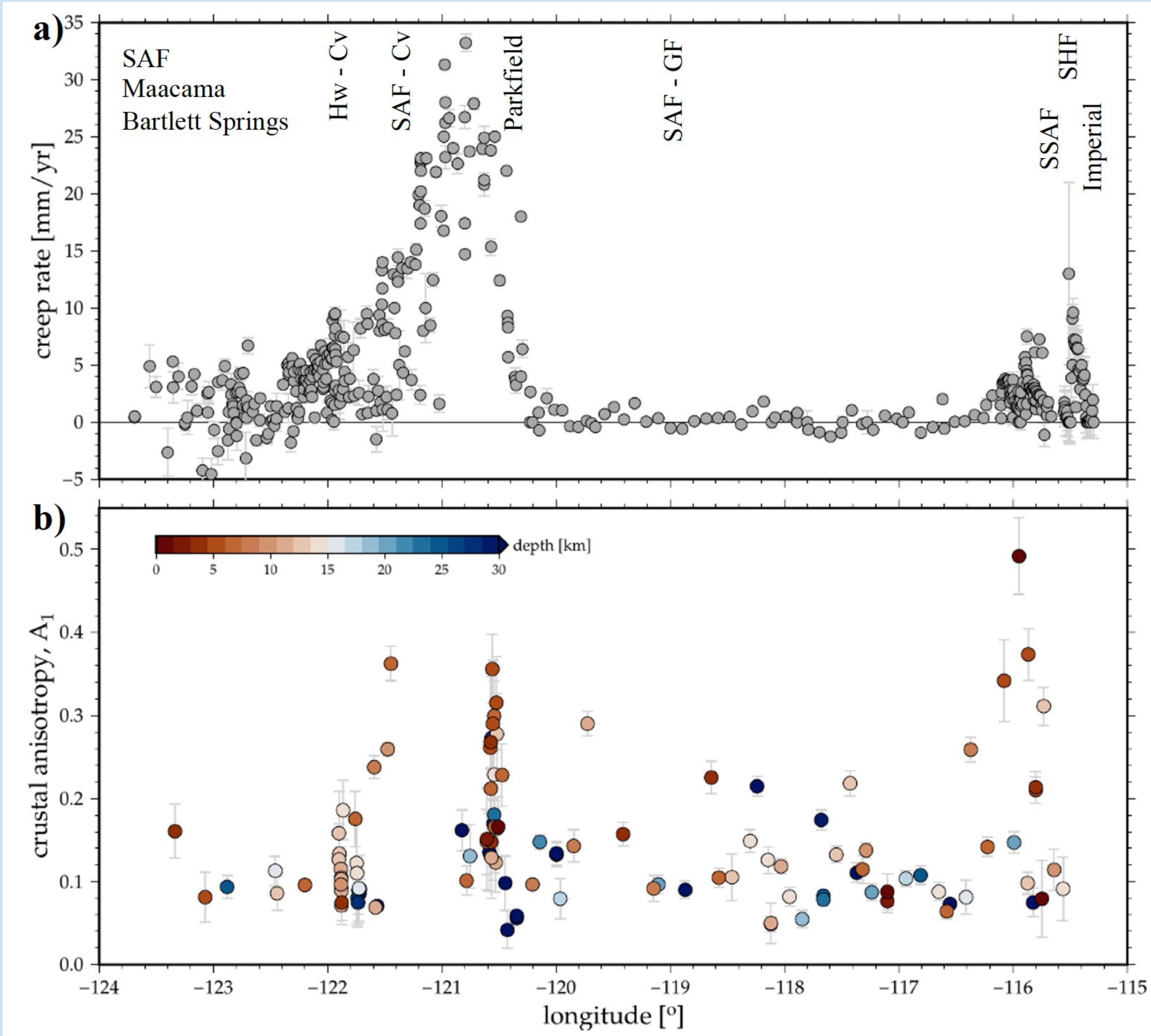
Microseismicity streakiness **1-ζ** – **creep** rate

These are nearly twice as strong as fault **misalignment** – **creep** rate (Lee et al. 2024), so geometric effects seem weaker

Comparable intermediate values involving total fault displacement (maturity)
Weak correlation between A1 and 1-ζ may be due to poor overlap of data coverage



Example profile: Creep rate and rock fabric strength



Example profile following branches of the San Andreas system from NW (left) to SE (right). Top – creep rate (raw values from compilation by Johnson et al., 2022). Bottom – rock fabric strength from receiver functions within 5 km of the faults, colored by depth of the fabric contrast. Note correspondence between creeping sections and fabric strength especially in the upper to middle crust.

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References: Johnson, K. M., J. R. Murray, C. Wespestad (2022), SRL 93, 3151–3169, doi: 10.1785/0220220186; Lee, Tsai, Hirth, Chatterjee, Trugman (2024), Nature 631, doi:10.1038/s41586-024-07518-6; Ross, Ben-Zion, Zaliapin (2022), GJI 231, 10.1093/gji/ggac189; Schulte-Pelkum, Ross, Mueller, Ben-Zion (2020), JGR-Solid Earth 125, doi:10.1029/2020JB019525