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Uniform pattern of normal faulting at the temporally distributed centers of eruption along the path of the Yellowstone hotspot

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The northeasterly migration of the Yellowstone hotspot (YHS) has led both to the successive eruption of lava from a temporally ordered set of calderas, and related thermally-induced normal faulting along the Snake River Plain (SRP) over the past 16.6 Ma. We have applied a series of structural and statistical methods to analyze the spatial distribution and orientation of the normal faults to understand the kinematics of the mid-Tertiary-Quaternary faulting event along the SRP in the northern Rockies.

The azimuths of the linear directional mean (LDM) and the directional (autocorrelation) anisotropy ellipses in the semivariograms, applying Ordinary Kriging, for different sets of normal fault traces give an estimate for the horizontal component of extension for normal faulting. The sub-parabolic spatial pattern of the normal fault LDMs, and their sub-parallel alignment with the minor axes of the Standard Deviation Ellipses (SDEs) in and around different caldera, suggest uniform normal faulting during thermally-induced extensions along the SRP.
The asymmetric, sub-parabolic distribution of the spatial trajectories (form lines) of the LDMs and the major axes of the directional (anisotropy) ellipses of the traces of normal faults in the youngest three calderas are similar to the reported parabolic distribution of earthquake epicenters along active normal faults around the YHS. The parallelism of the axis of the sub-parabolic pattern with the trajectories of the LDMs, the major axes of the directional anisotropy ellipses, and the deduced extension directions for each caldera, suggest systematic and progressive normal faulting due to the thermal regime of the hotspot as it migrated to the northeast. This implies that the age of normal faulting progressively decreases to the northeast.