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A novel approach for oceanic spreading terrain classification at the Mid-Atlantic Ridge using Eigenvalues of high-resolution bathymetry

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Terrain classification at slow-spreading ridges has been a topic of interest since the significant discovery of mantle rocks exhumed by detachment faults in various segments of the Mid-Atlantic spreading axis. These rocks commonly form domed massifs, so-called core complexes, in contrast to the linear fault-bounded abyssal hills of magmatic spreading terrains. However, there is still limited quantitative description of these two distinct structures. We present analysis of high-resolution bathymetry data 21-24 N over the Mid-Atlantic Ridge and its derivatives to highlight the shapes and directionality of the two oceanic crust features. We assign an optimized 8 arc-minute (~14.8 km) window, mimicking the average size of core complexes, in which we compute the Eigenvalues from each cell within the window based on its directionality and slope. We use the two most dominant Eigenvalues – representing the window's overall horizontal directionality – to compute eccentricity values and weight them with the sine of the slope. From the computation, we found that areas with weighted eccentricity of 0-0.6 represent the omnidirectional terrains that result from tectonic activities; 0.6-0.9 represents the extended terrain or the buffer zone between the tectonic and magmatic terrains; values >0.9 highlight bidirectional magmatic terrains. Based on this classification, we found significantly more evidence of detachment faulting west of the spreading axis compared to the eastern side. This analysis also highlights neo-volcanic activity that started at around 2 Ma that propagates to the south, cutting a fracture zone before it became inactive. The result contributes to a new approach in mining information from high-resolution bathymetry data to assess oceanic spreading type and its symmetry at a slow-spreading ridge through time.