Unraveiling the Deformation Parameters of the Orós Shear Zone Through a Mathematical Approach, Borborema Province (NE Brazil)

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The previous works in the Orós shear zone (OSZ) reported a dextral kinematic parameter (Sá et al. 1995; Macedo et al. 1998; Caby et al. 1995). However, the OSZ has an ambiguous kinematic parameter on their N–S segment. Both dextral and sinistral indicators are present throughout their length. This conflict in the sense of rotation is a characteristic of the preeminence of non-simple shear deformation (Fossen and Cavalcante, 2017). Statistically, there is a predominance of sinistral indicators given mainly by rotated porphyroclasts (70,2%). The foliation present in the Banabuiú pluton also shows a predominance of NE–SW over the NW–SE directions, which can also be in response to the sinistral kinematics of the OSZ. The progressive deformation in non-simple shear zones is different from simple shear zones regarding coaxiality (non-coaxial or coaxial), which is better described by the kinematic vorticity number (Wk). Wk is an instantaneous flow parameter that represents the link between the change in the shape of the strain ellipsoid and the rotation (Fossen and Cavalcante, 2017). Using vorticity of flow to decipher the kinematic significance of fabrics in deformed rocks is a requirement to determine the degree of non–coaxiality, the vortical and stretching flow components applying numerical quantities, for instance, the vorticity number (Truesdell, 1953; Means et al. 1980). We applied two methods to estimate kinematic vorticity (Wk). The rotated–porphyroclast (Wallis et al. 1993), is calculated from the critical aspect ratio (R = long axis/short axis) and the angle from the macroscopic foliation (θ) to locate the critical threshold (Rc), at which elongate porphyroclasts are in a stable position. The other is the Rigid Grain Net (RGN, Jessup et al. 2007) which uses semi-hyperbolas to estimate the area of porphyroclast stability. Instead of using the aspect ratio (Rc), RGN uses the shape factor (B*), which is defined by B* = (Mx2 – Mn2) / (Mx2 + Mn2), where the Mx and Mn are the long and short axes of the ellipse, respectively. The Wk = B*. The mylonites from ENE-WSW segment yielded an approximate value of 48% (from Wk = 0.712, Law et al. 2004) and the N-S ones an approximate value of 58% (from Wk = 0.62). According to Sanderson and Marchini (1984), it represents a pure shear-dominated transpressional shear zone, which also agrees with the graphical representation from Fossen and Tikoff (1993; 1994), plotting the analyzed samples in the pure shear-dominated transpression field. We combined, finite strain and vorticity data, to estimate the thinning (S) of the shear zone recorded throughout the geological time (Wallis et al. 1993). For the OSZ ENE–WSW segment, thinning values ranged from 1.06 to 1.10, which means that the original thickness of the segment was 1.06–1.10 times the present width, approximately 6 to 10% of thinning. For the N–S segment, thinning values range from 1.08 to 1.19, which means 8 to 16% of thinning.