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Strain Ellipsoid Determination Based on a Cretaceous Crocodyliform Fossil

Determinação de Deformação Elipsóide em um Crocodyliforme Fóssil do Cretáceo

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Strain determination is usually possible by the analyses of linear or angular features present in rocks that attest their deformation. In the absence of direct evidence, the distortion of fossil materials preserved within the rock can be used to approximate the strain states. A distorted crocodyliform fossil of the genus *Baurusuchus* Price, 1945, collected in the General Salgado municipality (specimen MPMA 64-0002/04), São Paulo state, was used in an attempt to determine the orientation of the strain ellipsoid in the sandstone block in which it is preserved. Previous information of the strain state was unavailable from macroscopic lithological structures. Using the assumption of homogeneous strain, we employed the principle of alteration of angular features at simple shear, measuring orientation of planes that were originally orthogonal. With a Brunton compass, strike and dip data were measured for symmetry planes, such as the sagital plane in the skull and in two sets of vertebrae (planes of the neural spines), as well as of features originally orthogonal to these planes, respectively the skull roof and the planes containing the transverse processes in the vertebrae. The measurements were possible only because the fossil is still associated with its matrix, and thus the spatial relations between bones were maintained in most of the specimen. However, the block was broken in two portions during collecting and transport, separating a main slab with most of the fossil, from a secondary one, with more fragmentary elements. A first problem emerged, as part of the measurements must be taken on the secondary slab, to avoid superposition of data. Recognizable breakage lines, representing former contact between the two slabs, were also measured to serve as axes to re-orientate the measurements taken on the secondary slab, so to them coincide with the orientations of the main slab. Rotation of this data used specially devised grids based on the Schmidt and Billings equal area nets. The angular shear strain (ψ) was obtained directly from stereographic projections, in three surfaces normal to the intersection lines of the symmetry planes, allowing to the calculation of the strain states in these surfaces. Then, strain data for these surfaces were converted for three perpendicular planes, calculating the reciprocal quadratic extensions (λ'), and proceeding to the determination of the three principal ellipsoid axes. Although was possible to determine a strain ellipsoid, it is tied only with the orientation of the fossil bones, and was impossible to correlate it to field evidence (if any is available), once the fossil was collected without orientation data in situ. The strain ellipsoid obtained attests distortion of the sandstone, probably due to compaction of adjacent rock layers of smaller grain size as well as by sedimentary overburden. However, other fossil bones in the same block, lacking signs of deformation, suggest that the assumptions of homogeneous strain are probably false, leading to doubt in the accuracy of the resulting ellipsoid, what could rule out the possibility to correctly restore, with mathematical support, the shape of the distorted fossil.