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Camille Parlangeau (1,2), Olivier Lacombe (1), Jean-Marc Daniel (2), and Sylvie Schueller (2)
(1) ISTeP, Université Pierre et Marie Curie (UPMC), Paris, France, (2) IFPEN, Rueil-Malmaison, France

INVERSION OF CALCITE TWIN DATA FOR PALEOSTRESS (1) :
IMPROVED ETCHECOPAR TECHNIQUE TESTED ON NUMERICALLY-GENERATED AND NATURAL DATA

Camille Parlangeau (1,2), Olivier Lacombe(1), Sylvie Schueller (2) and Jean-Marc Daniel (2) (camille.parlangeau@gmail.com)
(1) ISTeP, Université Pierre et Marie Curie (UPMC), Paris, France
(2) IFPEN, Rueil-Malmaison, France

Inversion of calcite twin data are known to be a powerful tool to reconstruct the past-state of stress in carbonate rocks of the crust, especially in fold-and-thrust belts and sedimentary basins. This is of key importance to constrain results of geomechanical modelling.
Without proposing a new inversion scheme, this contribution reports some recent improvements of the most efficient stress inversion technique to date (Etchecopar, 1984) that allows to reconstruct the 5 parameters of the deviatoric paleostress tensors (principal stress orientations and differential stress magnitudes) from monophase and polyphase twin data sets.
The improvements consist in the search of the possible tensors that account for the twin data (twinned and untwinned planes) and the aid to the user to define the best stress tensor solution, among others. We perform a systematic exploration of an hypersphere in 4 dimensions by varying different parameters, Euler's angles and the stress ratio. We first record all tensors with a minimum penalization function accounting for 20% of the twinned planes. We then define clusters of tensors following a dissimilarity criterion based on the stress distance between the 4 parameters of the reduced stress tensors and a degree of disjunction of the related sets of twinned planes. The percentage of twinned data to be explained by each tensor is then progressively increased and tested using the standard Etchecopar procedure until the best solution that explains the maximum number of twinned planes and the whole set of untwinned planes is reached.
This new inversion procedure is tested on monophase and polyphase numerically-generated as well as natural calcite twin data in order to more accurately define the ability of the technique to separate more or less similar deviatoric stress tensors applied in sequence on the samples, to test the impact of strain hardening through the change of the critical resolved shear stress for twinning as well as to evaluate the possible bias due to measurement uncertainties or clustering of grain optical axes in the samples.