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INVERSION OF CALCITE TWIN DATA FOR STRESS (2) :
EBSD AS A TOOL FOR DATA MEASUREMENTS

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Inversion of calcite twin data are known to be a powerful tool to reconstruct the past state(s) of stress in carbonate rocks of the crust, especially in fold-and-thrust belts and sedimentary basins.
Twin data measurements have been for long carried out optically using a Universal-Stage. This data collection is time-consuming and suffers from limitations and bias related to measurements of twin planes oblique at low angle or parallel to the thin section, or the unambiguous evaluation of the twinned/untwinned character of collected twin data.
EBSD (electron backscatter diffraction) is a well-known technique applied to characterize textures and microstructures of metals or deformed fine-grained rocks. The challenge is to define a strategy for measuring calcite-twin orientations that should be fast, without any loss of information, and which must reconcile (1) the need for a large amount of calcite twin data (3 mutually perpendicular thin sections and at least 30 crystals per thin section), (2) the spacing between EBSD spots, that should take into account (3) the small width of twin lamellae within grains deformed at low pressure and temperature and (4) the large size (usually several hundreds of microns) of twinned calcite grains used for stress analysis.
To date, these multiple requirements preclude any (classical) automatic twin data acquisition but instead imply a preliminary definition of the areas of the thin section to be scanned by the EBSD spots, including grain boundaries, because the stress inversion technique requires to know for each grain the orientations of the C axis and of the 3 potential e twin planes. In order to reconcile a perfectly polished surface as required by EBSD and the recognition of grain boundaries, we adopted the double etching technique (Herwegh, 2000) to first reveal grain and twin boundaries. Then, with a SEM and a very fine coating sample, the section is scanned using secondary electrons bin; each spot of interest is visually defined and its coordinates entered in a file later used to pilot automatically the EBSD spot.
This new procedure is applied on sections from natural samples; the EBSD data are converted and restored into the geographical framework and analyzed using the improved Etchecopar stress inversion technique. The results are compared to the results obtained from classical, optically-based measurements of the same sections using the Universal-stage. The advantages and limitations of this approach are discussed.