Combined stress and deformation analyses of heterogeneous calcite twin data: Theory

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The mechanical twinning in calcite results in simple shearing along twin lamellae, allowing us to evaluate the shear strain of a calcite grain from the widths and orientations of the lamellae (Conel, 1962). Based on this principle, tectonic strains were evaluated in various areas in the world using Groshong’s (1972) least-square technique. However, it is difficult to separate deformations from such a calcite aggregate that experienced polyphase tectonics.

This problem was solved in this work by combining the methods of stress and strain analyses of calcite twins. First, the orientation data from twin lamellae were inverted to determine non-dimensional deviatoric stress tensors by means of fuzzy clustering of the data; and the number of stresses to be read from a sample was determined through a Bayesian information criterion. The fuzzy clustering yielded the probabilities of each twin lamella to be formed by the detected stresses.

Using the probabilities, we classified the twin lamellae into groups, the members of which were formed in the same tectonic phase (though the time sequence of the phases cannot be determined). The classification allowed us to evaluate the strain and rotation tensors of the calcite sample during each tectonic phase.

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