Journal of Structural Geology, Vol. 5, No. 3/4, p. i, 1983
Pergamon Press Ltd. Printed in Great Britain

PREFACE

WITHIN the last decade or so, geologists have made many measurements of permanent tectonic strain in rocks, using deformed objects of known initial shape or orientation. The basis for such measurements has been the theory of homogeneous strain, it being argued that strain is usually homogeneous on the scale of a rock sample. Studies on a regional scale have shown that the state of strain is often heterogeneous, sometimes markedly so, the strain ellipsoids being distributed in patterns which are characteristically associated with certain tectonic structures, or are diagnostic of certain processes. Thus there is a current interest in studying natural strain patterns and their occurrence. Furthermore, each pattern results from a unique displacement field which can, in principle, be calculated mathematically. For this and other reasons, much is to be learned from studying the theory of heterogenous strain.

The first international meeting on the subject of strain patterns was a workshop (Table Ronde) organized by P. Cobbold at the University of Rennes (France) from 13 to 14 May 1982. The meeting was sponsored by the Centre National de la Recherche Scientifique, the Tectonic Studies Group (U.K.) and the University of Rennes. It attracted 82 participants from 10 countries. The programme included 25 informal lectures, 19 posters and 4 practical demonstrations. The audience at lectures was seated in a U-shaped pattern, facing the speaker. All these arrangements led to a relaxed informal atmosphere and a free interchange of ideas. The meeting proper was followed by two day-excursions, one to the South Armorican Shear Zone (led by P. Choukroune), the other to the Ile de Groix (led by P. Cobbold and C. Audren).

The Centre National de la Recherche Scientifique contributed 40,000 FF towards travelling expenses of contributors. The University of Rennes provided lecture facilities and 5000 FF towards secretarial expenses and refreshments. The contributors wish to thank P. Cobbold and all the staff and students at Rennes for organising such an enjoyable and memorable Table Ronde. The following are some conclusions drawn from the meeting:

(1) There is a large body of available theoretical work on deformation and strain, although much of it needs reprocessing before it becomes useful to the structural geologist.
(2) There is no general consensus on the best terminology and nomenclature, nor is there ever likely to be one, although a few names and symbols appear to be in the process of becoming adopted by a majority of specialists. A notable example is the use of capital letters and lower-case letters for quantities in the undeformed and deformed states, respectively. Another example is the use of "c" for the reciprocal quadratic stretch (Cauchy's) tensor, represented by the strain ellipsoid.
(3) Much is to be gained by constructing theoretically valid models of strain fields and comparing these with natural patterns.
(4) The Mohr circle is a very practical tool for illustrating and analysing strains and rigid rotations in a deformation field.
(5) Compatibility equations are powerful, but as yet rather obscure, tools for analysing variations in strain and rotation.
(6) The use of finite elements is a powerful and practical method of removing strains, although further work needs to be done on examples where there are volume changes.
(7) Natural volume changes continue to be difficult to detect and even more difficult to measure.
(8) There are as yet few regional studies in which strain has been measured at frequent intervals. Thus there are few examples of well-defined natural strain patterns. This is mainly due to a lack of adequate strain gauges.
(9) Discontinuities, especially faults, are difficult to deal with, especially if the throws are unknown, as they often are in nature.

This Special Issue *Strain Patterns in Rocks* contains 21 contributions from the Rennes meeting, and one in addition. Papers have been arranged on two broad themes, homogeneous to heterogeneous strain, and strain theory to geological strain patterns. Many contributions include both theory and natural examples so the issue has not been subdivided formally into chapters.

The issue begins with techniques of strain measurement (Lloyd, Ribeiro *et al.*, Lacassin & van den Driessche), an orthographic analysis of deformation (De Paor) and two applications of the Mohr circle to inhomogeneous deformation (Means, Cutler & Elliott). It continues with methods of strain removal (Cobbold & Percevault), a general transformation to simulate heterogeneous strain states (Hirsinger & Hobbs), the significance of isotropic points (Brun) and detection of volume changes (Gratier). Analyses of strain discontinuity at interfaces (Cobbold) and strain refraction through contrasting layers (Treagus) are presented, followed by strain patterns in ductile shear zones (Inglès) and at the tips to shear and thrust zones (Coward & Potts). The remaining contributions describe natural strain patterns: in mylonite zones (Mawer), in granites (Choukroune & Gapais, Schwerdtner *et al.*), in Alpine nappes (Harris *et al.*, Siddans), in linearly anisotropic rocks (Watkinson), in an ice cap (Hudleston) and in a boudin model (Hildebrand-Mittlefehldt).

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