Deformation Microstructures And Mechanisms In Minerals And Rocks

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SIMONE CHEN

Microstructures, Mechanics and Anisotropy Springer
The deformed microstructures of both irradiated and unirradiated Fe-9Cr uniaxial tensile specimens have been examined to identify controlling mechanisms. Deformation following irradiation is found to occur in poorly defined channels, causing formation of discrete steps at surfaces and delineated by nonuniformly distributed highly elongated voids. Deformation is by motion of a/2111 dislocations, which interact with and decompose irradiation-induced a100 loops. The structure formed after extensive deformation consists of highly complex cell walls and moderate densities of individual slip dislocations.
Deformation Mechanisms, Rheology and Microstructures Wiley
Microtectonics is the interpretation of small-scale deformation structures in rocks. They are studied by optical microscope and contain abundant information on the history and type of deformation and metamorphism in a rock and are therefore used by most geologists to obtain data for large-scale geological interpretations. This advanced textbook contains a large number of photographs and explanatory drawings, special chapters on related techniques, a chapter on microgauges and a simple, non-mathematical treatment of continuum mechanics with practical examples. Special terms are explained in boxes. This textbook is suited for independent use during optical studies on microstructures as a reference manual and as a manual for short courses.
Elsevier
The deformed microstructures of irradiated F82H uniaxial tensile specimens have been examined following irradiation in the High Flux Reactor (HFR) to 2.6 dpa at 327°C in order to identify controlling mechanisms. Deformation following irradiation is found to occur in poorly defined channels, causing formation of discrete steps at surfaces, similar to that in unirradiated steel. Deformation is by motion of individual a/2 111 dislocations.
A Practical Guide to Rock Microstructure Springer Science & Business Media
This book gathers selected papers from the Chinese Materials Conference 2018 (CMC2018) held in Xiamen City, Fujian, China, on July 12–16, 2018. The Chinese Materials Conference (CMC) is the Chinese Materials Research Society's most important conference series and has been held annually since the early 1990s. The 2018 edition consisted of 32 domestic symposia, 2 international symposia and 1 international materials forum. This proceedings book covers the fields of powder metallurgy, advanced aluminum alloys, advanced magnesium alloys, superalloys, metal matrix composites, space materials science and technology, as well as nanoporous metal materials, and presents recent original research findings from more than 300 research groups at various universities and research institutes.
Novel Materials with Unprecedented Mechanical Properties CRC Press
The deformed microstructures of both irradiated and unirradiated Fe-9Cr uniaxial tensile specimens have been examined to identify controlling mechanisms. Deformation following irradiation is found to occur in poorly defined channels, causing formation of discrete steps at surfaces and delineated by nonuniformly distributed highly elongated voids. Deformation is by motion of a/2111 dislocations, which interact with and decompose irradiation-induced a100 loops. The structure formed after extensive deformation consists of highly complex cell walls and moderate densities of individual slip dislocations.
Physics and Engineering of Metallic Materials ASTM International
Tensile strength, fatigue strength and ductility are important properties of nanostructured metallic materials, which make them suitable for use in applications where strength or strength-to-weight ratios are important. Nanostructured metals and alloys reviews the latest technologies used for production of these materials, as well as recent advances in research into their structure and mechanical properties. One of the most important issues facing nanostructured metals and alloys is how to produce them. Part one describes the different methods used to process bulk nanostructured metals and alloys, including chapters on severe plastic deformation, mechanical alloying and electrodeposition among others. Part two concentrates on the microstructure and properties of nanostructured metals, with chapters studying deformation structures such as twins, microstructure of ferrous alloys by equal channel angular processing, and characteristic structures of nanostructured metals prepared by plastic deformation. In part three, the mechanical properties of nanostructured metals and alloys are discussed, with chapters on such topics as strengthening mechanisms, nanostructured metals based on molecular dynamics computer simulations, and surface deformation. Part four focuses on existing and developing applications of nanostructured metals and alloys, covering topics such as nanostructured steel for automotives, steel sheet and nanostructured coatings by spraying. With its distinguished editor and international team of contributors, Nanostructured metals and alloys is a standard reference for manufacturers of metal components, as well as those with an academic research interest in metals and materials with enhanced properties.
Design of Tough, Transformation-Strengthened Composites and Structures John Wiley & Sons
This book is a systematic guide to the recognition and interpretation of deformation microstructures and mechanisms in minerals and rocks at the scale of a thin section. Diagnostic features of microstructures and mechanisms are emphasized, and the subject is extensively illustrated with high-quality color and black and white photomicrographs, and many clear diagrams. After introducing three main classes of deformation microstructures and mechanisms, low- to high-grade deformation is presented in a logical sequence in Chapters 2 to 5. Magmatic/submagmatic deformation, shear sense indicators, and shock microstructures and metamorphism are described in Chapters 6 to 8, which are innovative chapters in a structural geology textbook. The final chapter shows how deformation microstructures and mechanisms can be used quantitatively to understand the behavior of the earth. Recent experimental research on failure criteria, frictional sliding laws, and flow laws is summarized in tables, and palaeopiezometry is discussed. Audience: This book is essential to all practising structural and tectonic geologists who use thin sections, and is an invaluable research tool for advanced undergraduates, postgraduates, lecturers and researchers in structural geology and tectonics.
Temperature and Strain-rate Effects on Deformation Mechanisms in Irradiated Stainless Steel Cambridge University Press
Study of microstructures is an indispensable component of understanding structural geology of any terrain. A number of 'new' microscopic structures such as 'flanking microstructures', trapezoid-shaped mineral grains, reversal of ductile shear sense, micro-duplexes, V-pull aparts, and new minerals nucleating inside host minerals have recently been described in individual manuscripts. However, for the sake of brevity, microstructural papers cannot show all possible variation in their morphology. The proposed book aims to present these structures with attractive colour photographs. Each photomicrograph will have a comprehensive caption. The book also presents grain boundary migration, boudins, symptoms of metamorphic retrogression, and how well known shear sense indicators (S-C fabrics, mineral fish etc.) vary in morphology in serial-sections. The target audience is for graduate and postgraduate geosciences students and researchers of structural geology.
Preferred Orientation in Deformed Metal and Rocks Springer Science & Business Media
Essential reading for undergraduate and graduate students of petrology and structural geology.
POSTIRRADIATION DEFORMATION MICROSTRUCTURES IN FERRITIC Fe-9Cr Springer Science & Business Media
A superalloy, or high-performance alloy, is an alloy that exhibits excellent mechanical strength at high temperatures. Superalloy development has been driven primarily by the aerospace and power industries. This compilation of papers from the Twelfth International Symposium on Superalloys, held from September 9-13, 2012, offers the most recent technical information on this class of materials.
A Photographic Atlas Springer Nature
This book consists of 18 papers on deformation mechanisms, rheology and tectonics. The main approaches include experimental rock deformation, microstructural analysis, field structural studies, analogue and numerical modelling. New results on various topics are presented, ranging from brittle to ductile deformation and grain-scale to lithospherescale mechanisms. The volume contains review papers on several major current topics, such as the rheology of the lithospheric mantle and the mechanisms of exhumation of high-pressure tectonic units, as well as research papers on kinematic and mechanical analysis of rock deformation and related new techniques. Several contributions emphasize the increasing ability and wish of researchers to strengthen the links between small-scale physical mechanisms and large-scale tectonics. The volume will be of interest to academic and industrial researchers in the fields of structural geology, interactions between metamorphism, fluids and deformation, and large-scale tectonic processes.
Small Specimen Test Techniques MDPI
This collection of papers presents recent advances in the study of deformation mechanisms and rheology and their applications to tectonics. Many of the contributions exploit new petrofabric techniques, particularly electron backscatter diffraction, to help understand the evolution of rock microstructure and mechanical properties. Papers in the first section (lattice preferred orientations and anisotropy) show a growing emphasis on the determination of elastic properties from petrofabrics, from which acoustic properties can be computed for comparison with in-situ seismic measurements. Such research will underpin geodynamic interpretation of large-scale active tectonics. Contributions in the second section (microstructures, mechanisms and rheology) study the relations between microstructural evolution during deformation and mechanical properties.
The Relationships Between High Temperature Deformation Mechanisms, Microstructures and Mechanical Properties in Titanium Alloys Deformation Microstructures and Mechanisms in Minerals and Rocks
Analysis of the deformation microstructures in ion-irradiated stainless steel shows twinning to be the predominant deformation mode at room temperature. Dislocation channelling also occurs under slow strain rate conditions. Stresses required for twinning were calculated by the model of Venables and are compatible with observed yield stresses in neutron-irradiated material if loops are the principal twin source. Computation of the expected radiation hardening from the defect structure, based on a simple model, is consistent with yield strengths measured on neutron-irradiated steels. Lower yield stresses and greater thermal energy at 288 C lessen the probability of twinning and dislocation channeling becomes the primary deformation mode at the higher temperature. However, preliminary early results show that some twinning does occur in the irradiated stainless steel even at the higher temperature when higher strain rates are used.
Deformation Mechanisms, Rheology and Tectonics Geological Society of London
Interpretation of Micromorphological Features of Soils and Regoliths, Second Edition, provides researchers and students with a tool for interpreting features observed in soil thin sections and through submicroscopic studies. After an introduction and general overview, micromorphological aspects of regoliths (e.g., saprolites, transported materials) are highlighted, followed by a systematic and coherent discussion of the micromorphological expression of various pedogenic processes. The book is written by an international team of experts in the field, using a uniform set of concepts and terminology, making it a valuable interdisciplinary reference work. The following topics are treated: freeze-thaw features, redoximorphic features, calcareous and gypsiferous formations, textural features, spodic and oxic horizons, volcanic materials, organic matter, surface

horizons, laterites, surface crusts, salt minerals, biogenic and pedogenic siliceous materials, other authigenic silicates, phosphates, sulphidic and sulphuric materials, and features related to faunal activity. The last chapters address anthropogenic features,archaeological materials and palaeosoils. Updates the first exhaustive publication on interpretation of micromorphological features, with some new chapters and with a larger number of additional references Covers related topics, making micromorphology more attractive and accessible for geomorphologists, archaeologists and quaternary geologists Includes thematic treatment of a range of soil micromorphology fields and broadens its applications Features input from a multi-disciplinary team, ensuring thorough coverage of topics related to soil science, archaeology and geomorphology

From Minerals to the Lithosphere Elsevier

This is a richly illustrated reference book that provides a unique, comprehensive, and up-to-date survey of the rocks and structures of fault and shear zones. These zones are fundamental geologic structures in the Earth's crust. Their rigorous analysis is crucial to understanding the kinematics and dynamics of the continental and oceanic crust, the nature of earthquakes, and the formation of gold and hydrocarbon deposits. To document the variety of fault-related rocks, the book presents more than six hundred photographs of structures ranging in scale from outcrop to submicroscopic. These are accompanied by detailed explanations, often including geologic maps and cross sections, contributed by over 125 geoscientists from around the world. The book opens with an extensive introduction by Arthur W. Snoke and Jan Tullis that is itself a major contribution to the field. Fault-related rocks and their origins have long been controversial and subject to inconsistent terminology. Snoke and Tullis address these problems by presenting the currently accepted ideas in the field, focusing on deformation mechanisms and conceptual models for fault and shear zones. They define common terminology and classifications and present a list of important questions for future research. In the main, photographic part of the book, the editors divide the contributions into three broad categories, covering brittle behavior, semi-brittle behavior, and ductile behavior. Under these headings, there are contributions on dozens of subtopics with photographs from localities around the world, including several "type" areas. The book is an unrivaled source of information about fault-related rocks and will be important reading for a broad range of earth scientists, including structural geologists, petrologists, geophysicists, and environmental specialists. Originally published in 1998. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905.

An Integrated Framework for Structural Geology Geological Society of London

Mylonites form in response to high rates of strain within deep ductile shear zones, which are the extensions at depth of surface faults, thrusts and fault breccias, They can have many different mineralogical compositions and are therefore defined on their textural appearance. This atlas provides high definition images of a large number of different mylonites allowing students and geologists to correctly classify them with greater ease. It also provides insights into the interpretation of mylonitic fabrics to answer questions such as; from what type of rock did this mylonite derive? What were the metamorphic circumstances during mylonitization? What was the intensity of deformation?, and What was the sense of shear? This book will complement the very successful textbook "Microtectonics" by Passchier and Trouw.

Microtectonics Geological Society of London

Microstructural Geochronology Geochronology techniques enable the study of geological evolution and environmental change over time. This volume integrates two aspects of geochronology: one based on classical methods of orientation and spatial patterns, and the other on ratios of radioactive isotopes and their decay products. The chapters illustrate how material science techniques are taking this field to the atomic scale, enabling us to image the chemical and structural record of mineral lattice growth and deformation, and sometimes the patterns of radioactive parent and daughter atoms themselves, to generate a microstructural geochronology from some of the most resilient materials in the solar system. First compilation of research focusing on the crystal structure, material properties, and chemical zoning of the geochronology mineral archive down to nanoscale Novel comparisons of mineral time archives from different rocky planets and asteroids and their shock metamorphic histories Fundamentals on how to reconstruct and date radiogenic isotope distributions using atom probe tomography Microstructural Geochronology will be a valuable resource for graduate students, academics, and researchers in the fields of petrology, geochronology, mineralogy, geochemistry, planetary geology, astrobiology, chemistry, and material science. It will also appeal to philosophers and historians of science from other disciplines.

Deformation Mechanisms, Rheology and Tectonics John Wiley & Sons

Rock microstructures provide clues for the interpretation of rock history. A good understanding of the physical or structural relationships of minerals and rocks is essential for making the most of more detailed chemical and isotopic analyses of minerals. Ron Vernon discusses the basic processes responsible for the wide variety of microstructures in igneous, sedimentary, metamorphic and deformed rocks, using high-quality colour illustrations. He discusses potential complications of interpretation, emphasizing pitfalls, and focussing on the latest techniques and approaches. Opaque minerals (sulphides and oxides) are referred to where appropriate. The comprehensive list of relevant references will be useful for advanced students wishing to delve more deeply into problems of rock microstructure. Senior undergraduate and graduate students of mineralogy, petrology and structural geology will find this book essential reading, and it will also be of interest to students of materials science.

Ductile Shear Zones Springer

This volume provides an introduction to the texture analysis of deformed materials and explores methods of determining and interpreting the preferred orientation of crystals in deformed polycrystalline aggregates.**The book reviews: 1) the techniques, procedures, and theoretical basis for the accumulation and analysis of orientation data; 2)the processes by which polycrystals deform and the microstructural mechanisms responsible for the development of the preferred orientation; 3) the textures in specific systems and application of principles to the solution of specific problems.**With a combination of metallurgic and geologic applications, Preferred Orientation in Deformed Metals and Rocks: An Introduction to Modern Texture Analysis will be an important source book for students and researchers in materials science, solid state physics, structural geology, and geophysics.**FROM THE PREFACE: Determination and interpretation of the preferred orientation of crystals in deformed polycrystalline aggregates (in this volume also referred to as texture) has been of longstanding concern to both materials scientists and geologists. A similar theoretical background--such as the dislocation theory of crystal plasticity--has been the basis of understanding flow in metals and rocks; and similar determinative techniques--including microscopy and x-ray diffraction--have been used to study textures and microstructures. Whereas many of the fundamental principles have been established early this century by scientists such as Jeffery, Sachs, Sander, Schmid, Schmidt, and Taylor, only in recent years has knowledge reached a level that provides a quantitative framework which has replaced a largely phenomenological approach. This is expressed in the sudden new emphasis on textural studies, as documented by the large number of recent publications.**This volume contains material to serve as an introduction for those who wish to enter this field as well as reviews for those who are already engaged in advanced research....**The book is divided into three parts. The first (Chapters 2*b17) deals with techniques, procedures, and theoretical bases for the accumulation and analysis of orientation data. The second (Chapters 8*b112) introduces processes by which polycrystals deform and the microstructural mechanisms responsible for the development of the preferred orientation. All those chapters emphasize basic principles and apply to metals as well as to minerals. The third part (Chapters 13*b126) illustrates textures in specific systems and the application of the principles set out in the earlier chapters to the solution of specific problems. Readers of these chapters will quickly become aware that metals have been more exhaustively studied than minerals; but they will also realize that, because of their structural symmetry, metals are in general much simpler than rocks and that the intepretation of metal textures is less involved. An extensive list of relevant references provides access to much of the original literature on textures....

Deformation Microstructures and Creep Mechanisms in Advanced ZR-Based Cladding Under Biazal Loading Geological Society of London

Ductile-to-brittle fault zones reveal mineralogical processes that are thought to be responsible for the mechanical behavior of faults. I examined a pervasively deformed zone within the Jurassic to Cretaceous accretionary complex of southern Alaska that preserves hydrothermal alteration, dissolution precipitation, carbonaceous material (CM), clay minerals, and intracrystalline plasticity, all of which influence the strength of a fault. I characterized microstructures by SEM and EBSD, determined compositions by XRD, XRF, and Raman spectroscopy for one carbon-rich sample, and dated whole rock, rotated K-feldspar, and metamorphic muscovite by 40Ar/39Ar thermochronology to constrain the timing and conditions of accretion, uplift, and deformation recorded by this fault zone. I interpret the specific mineralogy and complex network of deformation microstructures as a result of multiple deformation events. Highest-temperature deformation recorded within the shear zone is lower greenschist facies (400-450°C). Quartz-rich clasts preserve deformation lamellae, grain bulges, sweeping undulose extinction, pressure solution, and brittle fractures characteristic of low grade (300-400°C) at the brittle-ductile transition. Brittle overprint is expressed by fractures cross-cutting the stretched quartz phacoids, and black fault rock that has entrained stretched quartz grains. Raman spectroscopy places precipitation of the CM at ~300°C. I therefore associate the fault-rock fabrics with progressive down-temperature deformation as the fault was exhumed. I suggest that pressure solution and mineral alteration in all fault-zone samples, as well as quartz and phyllosilicate preferred orientation in a subset of the samples, indicate aseismic slip. Growth of clay and precipitation of CM reduced the friction coefficient, lowering the frictional strength and influencing the dynamic behavior of this fault zone. Constraining the relative timing of the different slip behaviors is hard to determine. It is possible they were active at the same time, especially with the increase of width and complexity at the deeper part of the fault. What is preferentially preserved in the rock record is the latest stage of slip. Pseudotachylite structures generated during earthquakes, however, are rarely preserved due to their susceptibility to alteration. In my field area, consequent exhumation and cooling lead to progressive down-temperature brittle deformation and strong hydrothermal alteration, which could have eradicated any evidence for frictional melting. Using 40Ar/39Ar thermochronometry alongside regional and local age constraints, I was able to provide some insight on timing of fault-zone and local tectonic activity. The fault lies between the McHugh Complex and Valdez Group, the two main components of the Jurassic to Cretaceous Chugach accretionary prism whose development and disruption is still debated. I interpret that fault activity lasted from ca. 120 Ma to ca. 60 Ma., and was followed by two stages of accelerated uplift and cooling during ca. 40 Ma and ca. 20 Ma. The cease of major fault activity after ca. 60 Ma, the lack of pervasive strike-slip motion indicators, and the presence of undeformed Eocene dikes as well as Eocene sediments deposited on top of both the McHugh Complex and Valdez Group, suggest they were deposited in proximity and were in place in Southern Alaska at the start of the Eocene epoch.