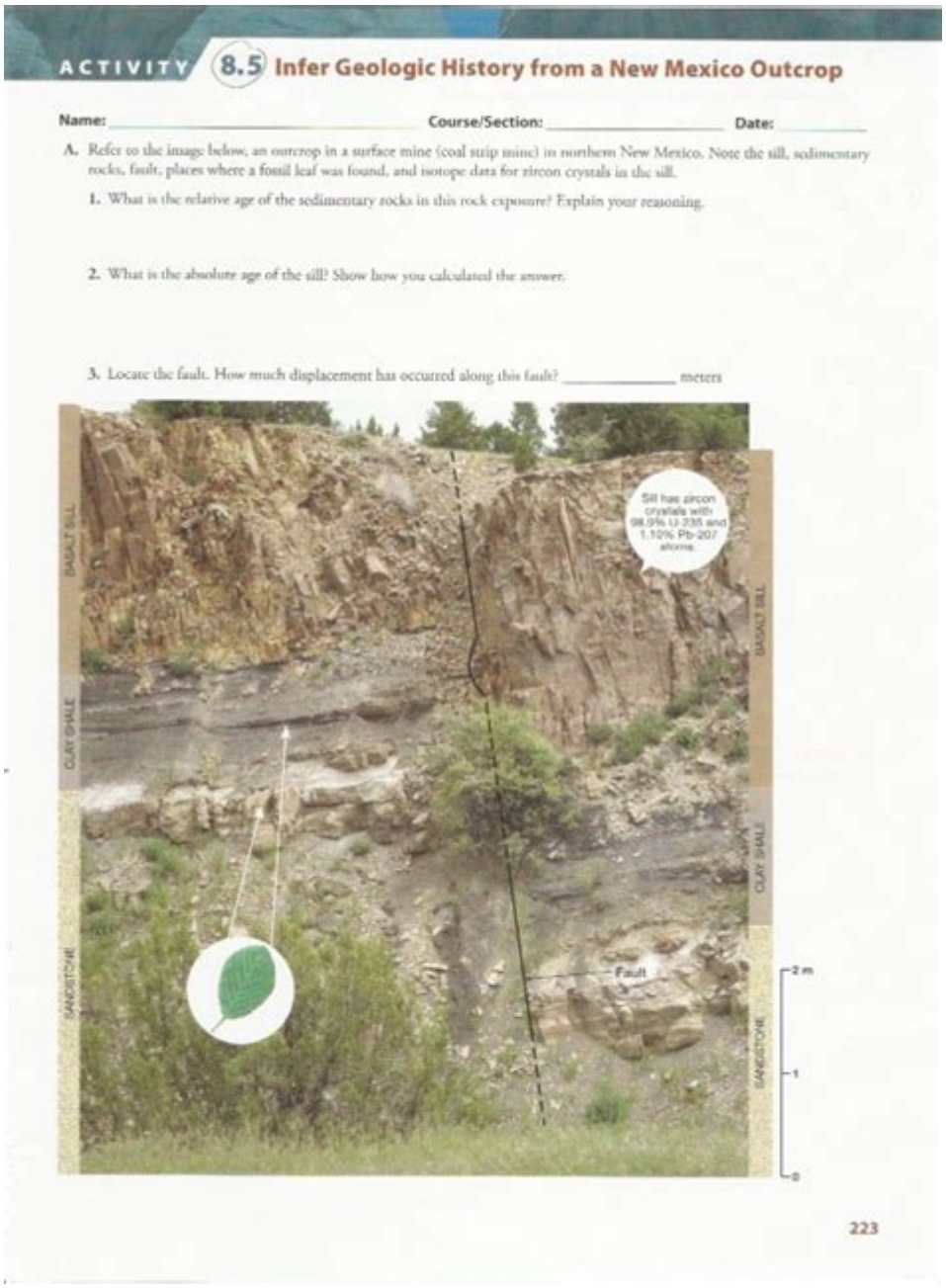
Infer Geologic History From A New Mexico Outcrop



ACTIVITY 8.5 Infer Geologic History from a New Mexico Outcrop

Name: _____ Course/Section: _____ Date: _____

A. Refer to the image below, an outcrop in a surface mine (coal strip mine) in northern New Mexico. Note the sill, sedimentary rocks, fault, places where a fossil leaf was found, and isotope data for zircon crystals in the sill.

1. What is the relative age of the sedimentary rocks in this rock exposure? Explain your reasoning.

2. What is the absolute age of the sill? Show how you calculated the answer.

3. Locate the fault. How much displacement has occurred along this fault? _____ meters

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Infer Geologic History from a New Mexico Outcrop: A Geologist's Guide

New Mexico's landscape is a breathtaking tapestry woven from eons of geological processes. Its dramatic cliffs, canyons, and mesas offer a captivating window into deep time. But how do geologists unravel the complex stories etched into these rock formations? This post serves as your guide to

deciphering the geologic history embedded within a New Mexico outcrop, providing practical techniques and insightful interpretations to help you become a better geological detective. We'll explore various techniques, from observing rock types and structures to understanding the principles of stratigraphy and geochronology. Get ready to unlock the secrets of the Southwest's geological past!

1. Identifying Key Rock Types: The Foundation of Interpretation

The first step in inferring geologic history is careful rock identification. New Mexico boasts a diverse range of rock types, each with its own formation story. For example:

Sedimentary Rocks: These rocks, like sandstones, shales, and limestones, tell tales of ancient environments. The grain size, sorting, and layering (bedding) of sandstones can indicate depositional environments such as rivers, deserts, or beaches. The presence of fossils within these rocks provides crucial information about past life forms and the age of the formation.

Igneous Rocks: Volcanic rocks (basalt, andesite) and intrusive rocks (granite, diorite) reveal past volcanic activity and tectonic events. The texture (fine-grained vs. coarse-grained) and mineral composition provide clues to the cooling history of the magma.

Metamorphic Rocks: Rocks transformed by heat and pressure (schist, gneiss, marble) indicate periods of mountain building or deep burial. The degree of metamorphism reflects the intensity of these events. Foliation (alignment of minerals) within metamorphic rocks can help determine the direction and magnitude of stress.

2. Stratigraphy: Unraveling the Sequence of Events

Stratigraphy, the study of rock layers (strata), is paramount in reconstructing geologic history. The principle of superposition states that in an undisturbed sequence, the oldest layers are at the bottom and the youngest at the top. However, many New Mexico outcrops show evidence of faulting, folding, and unconformities (gaps in the rock record) that complicate this simple principle. Identifying these structural features is key to understanding the complex history of deformation and erosion.

3. Structural Geology: Deciphering Deformation

Faults, folds, and joints are crucial indicators of tectonic activity. Faults represent fractures along which rocks have moved. Analyzing the displacement and orientation of fault planes can help determine the stress regime that caused the faulting. Folds, bends in rock layers, indicate compressional forces. The geometry of folds (anticlines and synclines) reveals the direction and

magnitude of these forces. Joints, fractures without significant displacement, often reflect stress release during uplift and erosion.

4. Geochronology: Dating the Rocks

While relative dating (determining the order of events) through stratigraphy is important, absolute dating (determining the numerical age) is crucial for creating a complete geologic timeline. Geochronological techniques, such as radiometric dating (using the decay of radioactive isotopes), can provide precise ages for igneous and metamorphic rocks. Dating volcanic ash layers within sedimentary sequences can provide age constraints for sedimentary rocks.

5. Paleontology: Clues from Fossils

Fossils provide invaluable insights into past life forms and environments. In New Mexico, fossils ranging from ancient marine invertebrates to dinosaurs can be found. Identifying and interpreting these fossils can help constrain the age of the rocks and reconstruct past ecosystems. For example, the presence of marine fossils in a high-elevation outcrop indicates past sea-level changes.

6. Integrating Evidence: Building a Comprehensive Story

Inferring the geologic history of a New Mexico outcrop requires integrating all the evidence gathered from the previous steps. This involves carefully analyzing rock types, interpreting stratigraphic relationships, assessing structural features, incorporating geochronological data, and considering paleontological findings. The goal is to develop a coherent narrative that explains the formation, deformation, and evolution of the outcrop through time.

Conclusion:

Unraveling the geologic history of a New Mexico outcrop is a challenging but rewarding endeavor. By combining careful observation, a solid understanding of geological principles, and the application of various analytical techniques, we can piece together the complex story written in the rocks. The breathtaking landscapes of New Mexico offer a unique opportunity to explore deep time, offering a fascinating journey into the Earth's dynamic past.

FAQs:

1. What equipment do I need to study a New Mexico outcrop? Basic equipment includes a rock hammer, hand lens, compass, geologic map, and field notebook. More advanced techniques may

require specialized equipment like a GPS, spectrometer, or sampling tools for geochronology.

2. Are there any safety concerns when studying outcrops? Yes, always prioritize safety. Be aware of unstable rock formations, extreme weather conditions, and potential hazards like rattlesnakes. Inform someone of your plans and location before venturing out.

3. Where can I find more information about New Mexico geology? The New Mexico Bureau of Geology and Mineral Resources is an excellent resource, offering maps, publications, and geological data.

4. Can I collect rock samples from New Mexico outcrops? Collecting samples may be restricted depending on the location. Always check for any regulations or permits required before collecting specimens.

5. How can I contribute to geological research in New Mexico? Volunteer with geological organizations, participate in citizen science projects, or contact universities and research institutions conducting fieldwork in the region.

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infer geologic history from a new mexico outcrop: *Rock Fractures and Fluid Flow* Committee on Fracture Characterization and Fluid Flow, Commission on Geosciences, Environment and Resources, Division on Earth and Life Studies, National Research Council, 1996-09-10 Scientific understanding of fluid flow in rock fractures--a process underlying contemporary earth science problems from the search for petroleum to the controversy over nuclear waste storage--has grown significantly in the past 20 years. This volume presents a comprehensive report on the state of the field, with an interdisciplinary viewpoint, case studies of fracture sites, illustrations, conclusions, and research recommendations. The book addresses these questions: How can fractures that are significant hydraulic conductors be identified, located, and characterized? How do flow and transport occur in fracture systems? How can changes in fracture systems be predicted and controlled? Among other topics, the committee provides a geomechanical understanding of fracture formation, reviews methods for detecting subsurface fractures, and looks at the use of hydraulic and tracer tests to investigate fluid flow. The volume examines the state of conceptual and mathematical modeling, and it provides a useful framework for understanding the complexity of fracture changes that occur during fluid pumping and other engineering practices. With a practical and multidisciplinary outlook, this volume will be welcomed by geologists, petroleum geologists, geoengineers, geophysicists, hydrologists, researchers, educators and students in these fields, and public officials involved in geological projects.

infer geologic history from a new mexico outcrop: The Age of the Earth G. Brent Dalrymple, 1991 A synthesis of all that has been postulated and is known about the age of the Earth

infer geologic history from a new mexico outcrop: *Geologic History of Utah* Lehi F. Hintze, 1973

infer geologic history from a new mexico outcrop: Atlas of Migmatites E. W. Sawyer, 2008 Migmatites are highly heterogeneous rocks found in high-grade metamorphic environments; they are commonly encountered in the continental crust. Until now, many geologists have been deterred from working with migmatites because of their complex appearance and an unhelpful non-genetic nomenclature. In his Atlas of Migmatites, Dr. Edward Sawyer provides genetically based

definitions and a system of nomenclature with which it will be possible to describe and map migmatites effectively and to understand how combinations of factors and processes produce a bewildering morphological diversity. Migmatites are produced by partial melting; to aid the reader in the identification of migmatites, the author describes and illustrates microstructures that can be used to infer the presence of melt or a melt-producing reaction. He also describes how geochemical data can be used to infer petrological processes involved in migmatite development. This book includes the results from two decades of research in whole-rock geochemistry, partial melting, microstructural analysis and experimental deformation of partially molten rocks. It contains information from an outcrop through to a grain scale. Exceptionally well illustrated, with 272 colour plates and accompanying detailed captions, the Atlas provides descriptions and analyses of migmatites not previously available.

infer geologic history from a new mexico outcrop: *Annals of the Former World* John McPhee, 2000-06-15 The Pulitzer Prize-winning view of the continent, across the fortieth parallel and down through 4.6 billion years Twenty years ago, when John McPhee began his journeys back and forth across the United States, he planned to describe a cross section of North America at about the fortieth parallel and, in the process, come to an understanding not only of the science but of the style of the geologists he traveled with. The structure of the book never changed, but its breadth caused him to complete it in stages, under the overall title Annals of the Former World. Like the terrain it covers, Annals of the Former World tells a multilayered tale, and the reader may choose one of many paths through it. As clearly and succinctly written as it is profoundly informed, this is our finest popular survey of geology and a masterpiece of modern nonfiction. Annals of the Former World is the winner of the 1999 Pulitzer Prize for Nonfiction.

infer geologic history from a new mexico outcrop: Ancient Landscapes of Western North America Ronald C. Blakey, Wayne D. Ranney, 2017-10-03 Allow yourself to be taken back into deep geologic time when strange creatures roamed the Earth and Western North America looked completely unlike the modern landscape. Volcanic islands stretched from Mexico to Alaska, most of the Pacific Rim didn’t exist yet, at least not as widespread dry land; terranes drifted from across the Pacific to dock on Western Americas’ shores creating mountains and more volcanic activity. Landscapes were transposed north or south by thousands of kilometers along huge fault systems. Follow these events through paleogeographic maps that look like satellite views of ancient Earth. Accompanying text takes the reader into the science behind these maps and the geologic history that they portray. The maps and text unfold the complex geologic history of the region as never seen before. Winner of the 2021 John D. Haun Landmark Publication Award, AAPG-Rocky Mountain Section

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Andrew D. Miall, 2013-06-29 Sequence stratigraphy represents a new paradigm in geology. The principal hypothesis is that stratigraphie successions may be subdivided into discrete sequences bounded by widespread unconformities. There are two parts to this hypothesis. First, it suggests that the driving forces which generate sequences and their bounding unconformities also generate predietable three-dimensional stratigraphies. In re cent years stratigraphie research guided by sequence models has brought about fundamental im provements in our understanding of stratigraphie processes and the controls of basin architecture. Sequence models have provided a powerful framework for mapping and numerieal modeling, enabling the science of stratigraphy to advance with rapid strides. This research has demonstrated the importance of a wide range of processes for the generation of cyclie sequences, including eustasy, tectonics, and orbital forcing of climate change. The main objective of this book is to document the sequence record and to discuss our current state of knowledge about sequence-generating processes.

infer geologic history from a new mexico outcrop: Basin and Range John McPhee, 1982-04-01 The first of John McPhee's works in his series on geology and geologists, Basin and Range is a book of journeys through ancient terrains, always in juxtaposition with travels in the modern world—a history of vanished landscapes, enhanced by the histories of people who bring them to light. The title refers to the physiographic province of the United States that reaches from eastern Utah to eastern California, a silent world of austere beauty, of hundreds of discrete high mountain ranges that are green with junipers and often white with snow. The terrain becomes the setting for a lyrical evocation of the science of geology, with important digressions into the plate-tectonics revolution and the history of the geologic time scale.

infer geologic history from a new mexico outcrop: Mass-transport Deposits in Deepwater Settings R. Craig Shipp, Paul Weimer, Henry W. Posamentier, 2011 Historically, submarine-mass failures or mass-transport deposits have been a focus of increasingly intense investigation by academic institutions particularly during the last decade, though they received much less attention by geoscientists in the energy industry. With recent interest in expanding petroleum exploration and production into deeper water-depths globally and more widespread availability of high-quality data sets, mass-transport deposits are now recognized as a major component of most deep-water settings. This recognition has lead to the realization that many aspects of these deposits are still unknown or poorly understood. This volume contains twenty-three papers that address a number of topics critical to further understanding mass-transport deposits. These topics include general overviews of these deposits, depositional settings on the seafloor and in the near-subsurface interval, geohazard concerns, descriptive outcrops, integrated outcrop and seismic data/seismic forward modeling, petroleum reservoirs, and case studies on several associated topics. This volume will appeal to a broad cross section of geoscientists and geotechnical engineers, who are interested in this rapidly expanding field. The selection of papers in this volume reflects a growing trend towards a more diverse blend of disciplines and topics, covered in the study of mass-transport deposits.

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straightforwardly written and provides a good overview on the wide field of Quaternary dating methods..." JOURNAL OF QUATERNARY SCIENCE, January 2007

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infer geologic history from a new mexico outcrop: Alluvial Fans Adrian M. Harvey, Anne E. Mather, Martin R. Stokes, 2005 Alluvial fans are important sedimentary environments. They trap sediment delivered from mountain source areas, and exert an important control on the delivery of sediment to downstream environments, to axial drainages and to sedimentary basins. They preserve a sensitive record of environmental change within the mountain source areas. Alluvial fan geomorphology and sedimentology reflect not only drainage basin size and geology, but change in response to tectonic, climatic and base-level controls. One of the challenges facing alluvial fan research is to resolve how these gross controls are reflected in alluvial fan dynamics and to apply the results of studies of modern fan processes and Quaternary fans to the understanding of sedimentary sequences in the rock record. This volume includes papers based on up-to-date research, and focuses on three themes: alluvial fan processes, dynamics of Quaternary alluvial fans and fan sedimentary sequences. Linking the papers is an emphasis on the controls of fan geomorphology, sedimentology and dynamics. This provides a basis for integration between geomorphological and sedimentological approaches, and an understanding how fluvial systems respond to tectonic, climatic and base-level changes.

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infer geologic history from a new mexico outcrop: Characterization, Modeling, Monitoring, and Remediation of Fractured Rock National Academies of Sciences, Engineering, and Medicine, Division on Earth and Life Studies, Board on Earth Sciences and Resources, Committee on Geological and Geotechnical Engineering, Committee on Subsurface Characterization, Modeling, Monitoring, and Remediation of Fractured Rock, 2021-01-29 Fractured rock is the host or foundation for innumerable engineered structures related to energy, water, waste, and transportation. Characterizing, modeling, and monitoring fractured rock sites is critical to the functioning of those infrastructure, as well as to optimizing resource recovery and contaminant management. Characterization, Modeling, Monitoring, and Remediation of Fractured Rock examines the state of practice and state of art in the characterization of fractured rock and the chemical and biological processes related to subsurface contaminant fate and transport. This report examines new developments, knowledge, and approaches to engineering at fractured rock sites since the publication of the 1996 National Research Council report Rock Fractures and Fluid Flow: Contemporary Understanding and Fluid Flow. Fundamental understanding of the physical nature of fractured rock has changed little since 1996, but many new characterization tools have been developed, and there is now greater appreciation for the importance of chemical and biological processes that can occur in the fractured rock environment. The findings of Characterization, Modeling, Monitoring, and Remediation of Fractured Rock can be applied to all types of engineered infrastructure, but especially to engineered repositories for buried or stored waste and to fractured rock sites that have been contaminated as a result of past disposal or other practices. The recommendations of this report are intended to help the practitioner, researcher, and decision maker take a more interdisciplinary approach to engineering in the fractured rock environment. This report describes how existing tools-some only recently developed-can be used to increase the accuracy and reliability of engineering design and management given the interacting forces of nature. With an interdisciplinary approach, it is possible to conceptualize and model the fractured rock environment with acceptable levels of uncertainty and reliability, and to design systems that maximize remediation and long-term performance. Better scientific understanding could inform regulations, policies, and implementation guidelines related to infrastructure development and operations. The recommendations for research and applications to enhance practice of this book make it a valuable resource for students and practitioners in this field.

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infer geologic history from a new mexico outcrop: The Elements of Geology William Harmon Norton, 2009-03-31 William Harmon Norton was Professor of geology at Cornell University. Norton wrote this textbook wanting to develop the relationship between causes and their effects in a clear cut manner. Norton stresses the importance of the teacher using field study and observation along with the text. The book is divided into three sections. External geology concentrates on weather, glaciers, wind etc. Internal geology studies the earthżs crust, earthquakes, volcanoes etc. The final section, historical geology, covers carboniferous, Mesozoic, tertiary, etc.

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infer geologic history from a new mexico outcrop: *3-D Structural Geology* Richard H. Groshong, 2006-07-09 The book includes new material, in particular examples of 3-D models and techniques for using kinematic models to predict fault and ramp-anticline geometry. The book is geared toward the professional user concerned about the accuracy of an interpretation and the speed with which it can be obtained from incomplete data. Numerous analytical solutions are given that can be easily implemented with a pocket calculator or a spreadsheet.

infer geologic history from a new mexico outcrop: *Physical Geology* Steven Earle, 2016-08-12 This is a discount Black and white version. Some images may be unclear, please see BCCampus website for the digital version.This book was born out of a 2014 meeting of earth science educators representing most of the universities and colleges in British Columbia, and nurtured by a widely shared frustration that many students are not thriving in courses because textbooks have become too expensive for them to buy. But the real inspiration comes from a fascination for the spectacular geology of western Canada and the many decades that the author spent exploring this region along with colleagues, students, family, and friends. My goal has been to provide an accessible and comprehensive guide to the important topics of geology, richly illustrated with examples from western Canada. Although this text is intended to complement a typical first-year course in physical geology, its contents could be applied to numerous other related courses.

infer geologic history from a new mexico outcrop: Sedimentology and Stratigraphy Gary Nichols, 2013-04-30 This fully revised and updated edition introduces the reader to sedimentology and stratigraphic principles, and provides tools for the interpretation of sediments and sedimentary rocks. The processes of formation, transport and deposition of sediment are considered and then applied to develop conceptual models for the full range of sedimentary environments, from deserts to deep seas and reefs to rivers. Different approaches to using stratigraphic principles to date and correlate strata are also considered, in order to provide a comprehensive introduction to all aspects of sedimentology and stratigraphy. The text and figures are designed to be accessible to anyone completely new to the subject, and all of the illustrative material is provided in an accompanying CD-ROM. High-resolution versions of these images can also be downloaded from the companion website for this book at: www.wiley.com/go/nicholssedimentology.

infer geologic history from a new mexico outcrop: *Geological Interpretation of Aeromagnetic Data* Leigh R. Rankin, David J. Isles, 2013

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infer geologic history from a new mexico outcrop: Geologic Maps Edgar W. Spencer, 2017-10-20 Geologic maps supply a wealth of information about the surface and shallow subsurface of the earth. The types of materials that are present in a location and the three-dimensional structure of the bedrock both can be gleaned from a clearly prepared geologic map. Geologists, civil and environmental engineers, land-use planners, soil scientists, and geographers commonly use geologic maps as a source of information to facilitate problem solving and identify the qualities of a region. Maps reveal the position of many types of natural hazards, indicate the suitability of the land surface for various uses, reveal problems that may be encountered in excavation, provide clues to the natural processes that shape an area, and help locate important natural resources. Suitable for lab courses in structural geology as well as field geology work, Spencer describes representative examples of features found on geologic maps and outlines procedures for interpretation and projection. Geometric techniques are explained using a step-by-step approach. Coverage of mapping methods includes tools that provide necessary data, such as Google Earth, GPS, GIS, LiDAR maps, drones, and aerial photographs. Challenging and engaging exercises throughout the text involve students in the mapping process and stimulate an appreciation of the extent and precision of information presented in geologic maps. Regional geology is an important component of lab and field mapping projects. As such, the Third Edition includes new maps of the Gulf of Mexico Coastal Plain, Rocky Mountain Front Range, Yellowstone region, Moab, Utah, Shenandoah National Park, and Hawai'i. A new chapter devoted to tectonic maps also broadens students' exposure. Ed Spencer brings over 45 years of teaching experience to the text along with valuable insight and clarity into the interpretation and preparation of geologic maps.

infer geologic history from a new mexico outcrop: The Geology of Ore Deposits John M. Guilbert, Charles F. Park, Jr., 2007-02-09 Modern civilizations dependence upon an increasing volume and diversity of minerals makes the search for new ore deposits ever more difficult. Now available from Waveland Press, Guilbert & Parks text presents ideas, principles, and data fundamental for beginning economic geologists to understand the genesis and localization of ore deposits and of the minerals associated with them. The authors comprehensively describe the physical and chemical characteristics of ore deposits and correlate them with environments and conditions of deposition, since ore deposits are best interpreted as extensions of the environments responsible for their enclosing rocks. Examples and illustrations emphasize structural, chemical, and temporal controls and encourage the three-dimensional thinking used by productive explorationists as they face unsolved problems. This upper-level undergraduate text is fully illustrated and meticulously indexed. Its reliable, authoritative coverage assumes an upper-level command of chemistry and physics, as well as mineralogy, petrology, and structural geology. Outstanding features . . . develops and combines the abilities of the explorationist and of the researcher of ore-forming processes structures the geologic descriptions into groupings recognized by researchers

and explorers alike builds confidence, revitalizes curiosity, and encourages expanded thinking emphasizes that the days of easy discovery of outcropping ores are not over includes revised, expanded, and updated descriptions of districts

infer geologic history from a new mexico outcrop: Vertebrate Paleontology in Utah David D. Gillette, 1999 The 52 papers in this vary in content from summaries or state-of-knowledge treatments, to detailed contributions that describe new species. Although the distinction is subtle, the title (Vertebrate Paleontology in Utah) indicates the science of paleontology in the state of Utah, rather than the even more ambitious intent if it were given the title “Vertebrate Paleontology of Utah” which would promise an encyclopedic treatment of the subject. The science of vertebrate paleontology in Utah is robust and intense. It has grown prodigiously in the past decade, and promises to continue to grow indefinitely. This research benefits everyone in the state, through Utah’s muse ums and educational institutions, which are the direct beneficiaries.

infer geologic history from a new mexico outcrop: Fundamentals of Geomorphology Richard John Huggett, 2011-03-15 This extensively revised, restructured, and updated edition continues to present an engaging and comprehensive introduction to the subject, exploring the world’s landforms from a broad systems perspective. It covers the basics of Earth surface forms and processes, while reflecting on the latest developments in the field. Fundamentals of Geomorphology begins with a consideration of the nature of geomorphology, process and form, history, and geomorphic systems, and moves on to discuss: structure: structural landforms associated with plate tectonics and those associated with volcanoes, impact craters, and folds, faults, and joints process and form: landforms resulting from, or influenced by, the exogenic agencies of weathering, running water, flowing ice and meltwater, ground ice and frost, the wind, and the sea; landforms developed on limestone; and landscape evolution, a discussion of ancient landforms, including palaeosurfaces, stagnant landscape features, and evolutionary aspects of landscape change. This third edition has been fully updated to include a clearer initial explanation of the nature of geomorphology, of land surface process and form, and of land-surface change over different timescales. The text has been restructured to incorporate information on geomorphic materials and processes at more suitable points in the book. Finally, historical geomorphology has been integrated throughout the text to reflect the importance of history in all aspects of geomorphology. Fundamentals of Geomorphology provides a stimulating and innovative perspective on the key topics and debates within the field of geomorphology. Written in an accessible and lively manner, it includes guides to further reading, chapter summaries, and an extensive glossary of key terms. The book is also illustrated throughout with over 200 informative diagrams and attractive photographs, all in colour.

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