

Geoscience Librarianship 101: Introduction & Instruction Tips



Presented by Emily C. Wild, Chemistry, Geosciences and Environmental Studies Librarian
ewild@princeton.edu

About the Instructor



Emily C. Wild

Schedule a Research Consultation :
Monday – Friday
email me ewild@princeton.edu

[Meet Our Specialists – Emily Wild](#)

<https://www.linkedin.com/in/emilycwild/>

<https://orcid.org/0000-0001-6157-7629>

Princeton University Library, 2018-Present

Chemistry, Geosciences and Environmental Studies Librarian

About 75% of my research inquires = worldwide USGS info

<http://library.princeton.edu> <http://geosciences.princeton.edu>

Emily Wild joined Princeton University Library in 2018 as the Chemistry and Geosciences Librarian. From 1996 to 2018, she was a hydrologist and librarian (physical scientist) at the U.S. Geological Survey. She has a Bachelor of Arts in Geology from Hartwick College and a Master of Library and Information Studies from the University of Rhode Island. Emily's scholarly interests include library instruction; reference, citation and data management; raw and geospatial datasets; and physical and laboratory sampling methods.

- Working remotely since March 2020
- Using GeoRef remotely since 1991
- Using libraries remotely since 1988

[From hurricanes to astrogeology: Princeton's geosciences librarian and collections serve national, international communities](#)



Research Consultant: students, faculty, researchers, public, companies

Library Instruction: Courses (CHM, GEO, AOS, ENV, WRI), Internal/External

Workshops: Professional Development Sessions, Wintersession

Collection Development (shaping the collections)

Selector (budgets & purchasing) ; (not contracts)

Subject Specialist : Chemistry, Geosciences, Environment & Energy

Department/Program Liaison: Chemistry, Geosciences, Princeton Environmental Institute (PEI)

Project Collaborator: Research Grant with Faculty (PEI)



Two Library Consortiums



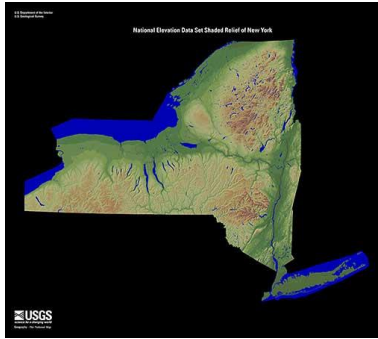
Ivy Plus Libraries Confederation: <https://ivpluslibraries.org/>

Participating Institutions

- [Brown University Library](#)
- [Columbia University Libraries](#)
- [Cornell University Library](#)
- [Dartmouth College Library](#)
- [Duke University Libraries](#)
- [Harvard University Libraries](#)
- [Johns Hopkins University Libraries](#)
- [Massachusetts Institute of Technology Libraries](#)
- [Princeton University Library](#)
- [Stanford University Libraries](#)
- [University of Chicago Library](#)
- [University of Pennsylvania Libraries](#)
- [Yale University Library](#)

Research Collections and Preservation Consortium (ReCAP) Libraries:
Columbia University,
Harvard University, New York Public Library, and Princeton University
<https://recap.princeton.edu/>

Why a Geosciences Librarian?



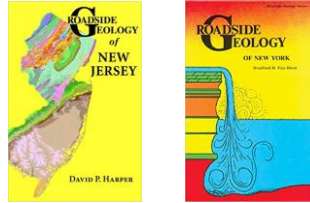
<https://eros.usgs.gov/image-gallery/shaded-relief/new-york>



HARTWICK COLLEGE

est. 1797

Professor Titus: The Catskill Geologist



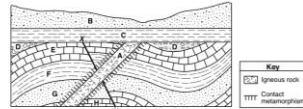
<https://www.usgs.gov/observatories/hawaii-an-volcano-observatory>

Hartwick Geology
<https://www.hartwick.edu/academics/academic-departments/geology-environmental-sciences-department/>

Hartwick Library
<https://www.hartwick.edu/academics/stevens-german-library/>

Now your answers to questions 44 and 45 on the table below and on your knowledge of Earth science. 26 The cross section below represents the bedrock structure of a section of Earth's crust. Letters A through H represent rock units. Line XY represents a fault. The rock layers have not been overturned.

Radioactive Isotope	Disintegration	Half-Life (years)
Carbon-14	$^{14}\text{C} \rightarrow ^{14}\text{N}$	5.7×10^3
Potassium-40	$^{40}\text{K} \rightarrow ^{40}\text{Ca}$	1.3×10^9
Uranium-235	$^{235}\text{U} \rightarrow ^{207}\text{Pb}$	7.1×10^8
Uranium-238	$^{238}\text{U} \rightarrow ^{206}\text{Pb}$	4.5×10^9
Rubidium-87	$^{87}\text{Rb} \rightarrow ^{87}\text{Sr}$	4.8×10^{10}



44. Which radioactive isotope takes the greatest amount of time to disintegrate?
(1) potassium-40 (2) uranium-235 (3) uranium-238 (4) rubidium-87

When did faulting along line XY occur?
(1) after the intrusion of rock unit A (2) after the deposition of rock units B, C, and D (3) after the formation of rock units E and F (4) before the formation of rock units G and H

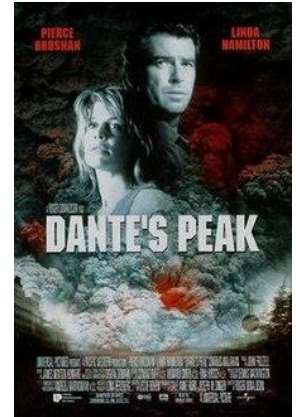


NYS DEC - Environmental Law Internship in College (Legal Research)



<https://www.usgs.gov/staff-profiles/emily-wild>

https://volcanoes.usgs.gov/vsc/file_mgr/file-153/FAQs.pdf



When working at the U.S. Geological Survey

- **General Public**
- **Teachers (K-12)**
- **College/University Professors**
- **City, County, State Natural Resource Managers**
- **Undergraduate & Graduate Students**
- **New Employees to Geosciences or Post-Docs**
- **Federal Science Agencies, Scientists & Attorneys**
- **Private Sector: Scientists & Attorneys**
- **International Governments & Institutions**
- **Experienced Library Users that need a refresher**

When working at Princeton University

- **Undergraduate & Graduate Students**
- **College/University Professors**
- **Librarians**
- **Post-Docs**
- **Federal Science Agencies, Scientists & Librarians**
- **Private Sector: Scientists & Librarians**
- **Finance Industry**
- **International Governments & Institutions**
- **City, County, State Natural Resource Managers**
- **Experienced Library Users that need a refresher**

How do I help?

- **Raw Data:** Real-Time, Continuous, Recent Partial Records, Historical
- **Calculated Data:** Equations, Software Results, Lab Results, and Model Results
- **Map Data:** Specific Location Information by Geosciences Topic
- **Citation Data:** Bibliographic Information for Reference Lists & TO FIND THE PUBLICATION

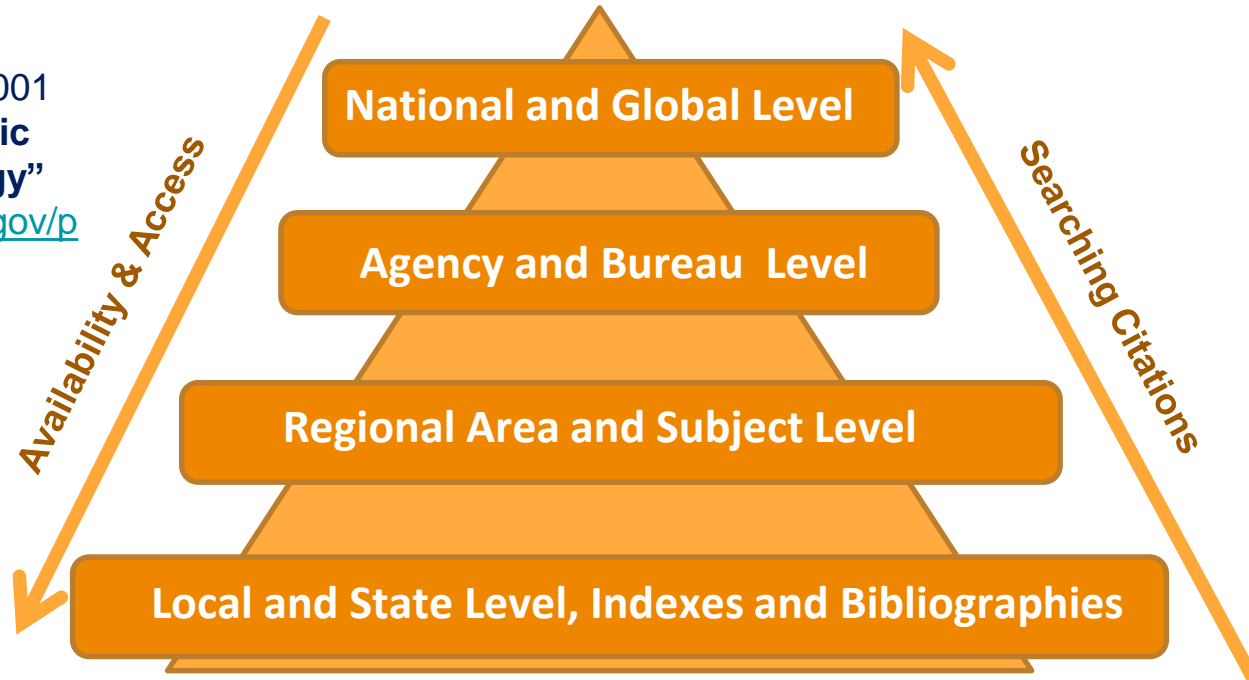
Modified from :

Wild and Havener, 2001

“**Online bibliographic sources in hydrology**”

<https://pubs.er.usgs.gov/publication/70023512>

Free & Open
Geosciences
Information
Sources





[Mount St. Helens, WA](#)



[Mount Pinatubo, Philippines](#)

Part 1. Introduction to Geoscience Librarianship: Research Consultations

- ❖ **What is Geoscience? Who are the Geoscientists?**
- ❖ **Geosciences Societies**
- ❖ **Geological Surveys**
- ❖ **University Presses**
- ❖ **Geosciences Publication Databases**

Part 2. Geoscience Instruction Tips

- ❖ **Using my USGS experiences at Princeton**
 - ❖ **Geologic & Hydrologic Overviews**
- ❖ **Instruction at Princeton University**

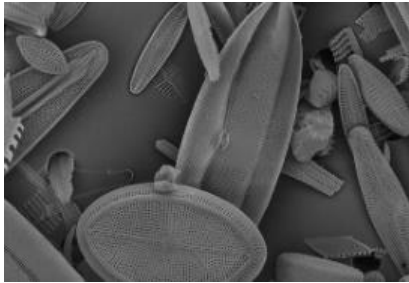
What is Geoscience?

From American Geosciences Institute (AGI) :

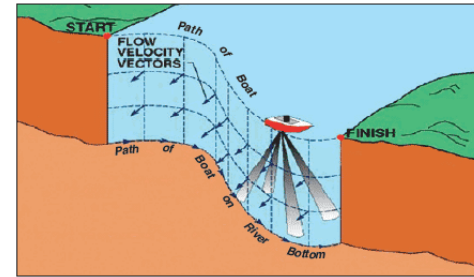
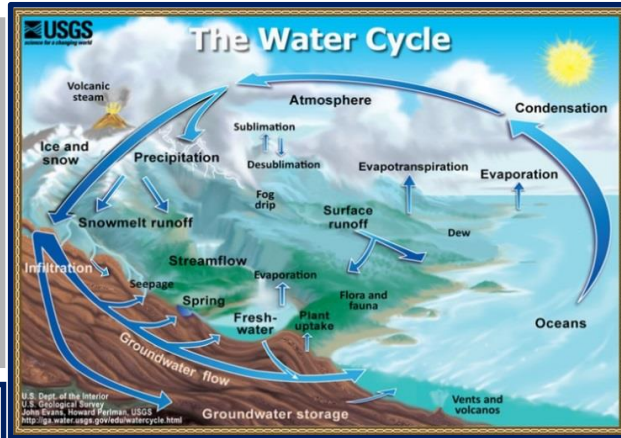
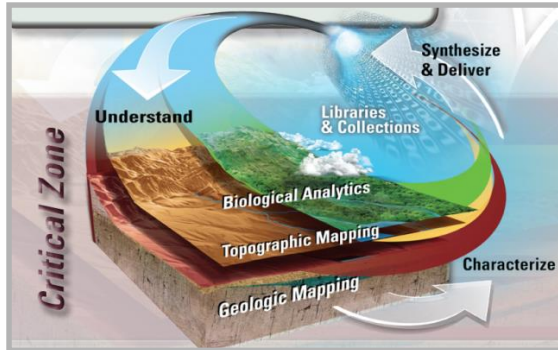
<https://www.americangeosciences.org/critical-issues/faq/what-is-geoscience>

Geoscience is the study of the Earth - **its oceans, atmosphere, rivers and lakes, ice sheets and glaciers, soils, its complex surface, rocky interior, and metallic core**. This includes many aspects of how living things, including humans, interact with the Earth. Geoscience has many tools and practices of its own but is intimately linked with the biological, chemical, and physical sciences.

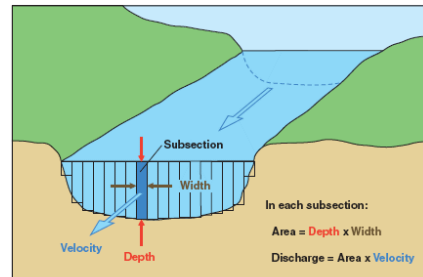
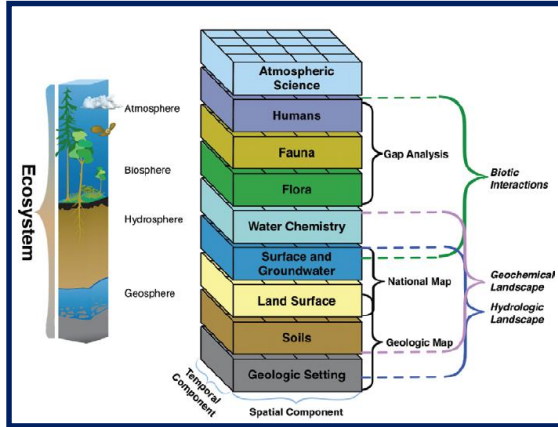
Geoscience investigates the past, measures the present, and models the future behavior of our planet. But it also involves the study of other planets, asteroids, and solar systems, both to better understand the Earth and to expand our knowledge of the universe.



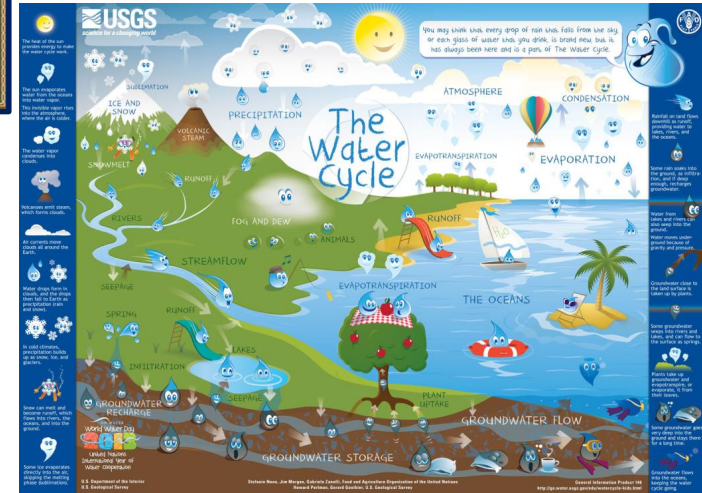
Geoscience is the study of the Earth - its oceans, atmosphere, rivers and lakes, ice sheets and glaciers, soils... = Atmospheric Science, Biology, Hydrology & Oceanography



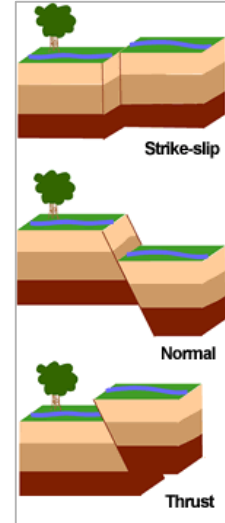
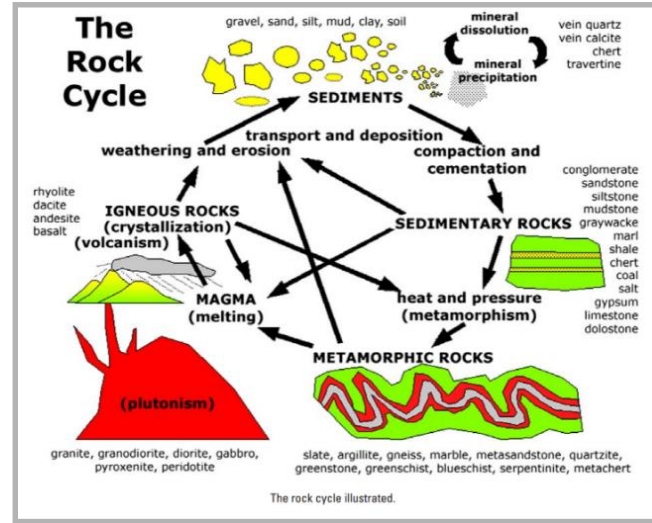
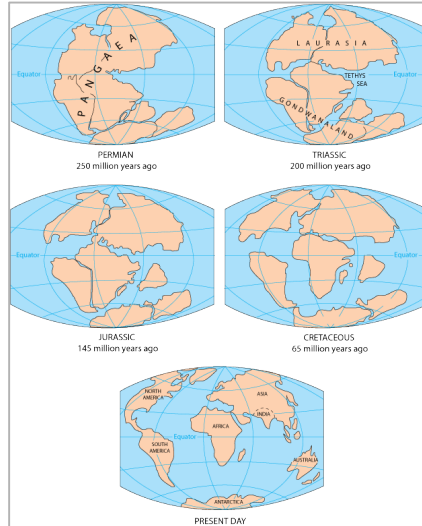
Acoustic Doppler Current Profiler (ADCP) mounted in a small watercraft, is used for measuring the discharge of a river. The ADCP acoustic beams are directed down into the water as it is guided across a river channel.



Current-meter discharge measurements are made by determining the discharge in each subsection of a channel cross section and summing the subsection discharges to obtain a total discharge.



Geoscience is the study of the Earth - ...its complex surface, rocky interior, and metallic core... = structural, earthquakes, mineralogy, petrology, geomagnetism, geochemistry, and geophysics



Igneous: Volcanic & Plutonic



Metamorphic: Gneiss & Marble



Sedimentary: Limestone & Sandstone

Who is a geoscientist?

- ❖ Biologists
- ❖ Biogeochemists
- ❖ Cartographers
- ❖ Chemists
- ❖ Engineers
- ❖ Geologists
- ❖ Hydrologists
- ❖ IT Specialists
- ❖ Librarians
- ❖ Mathematicians
- ❖ Physicists
- ❖ Physical Scientists
- ❖ Seismologists
- ❖ Volcanologists
- ❖ And more!



USGS
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SCIENCE PRODUCTS NEWS CONNECT ABOUT

SEARCH

Susan M Hall



Susan Hall is the uranium resource specialist at the US Geological Survey. She leads a project that estimates uranium remaining unmined in the US to help determine if potential supply is adequate to fuel US nuclear reactors.

Biography

Career History and Highlights:

Dr. Hall is an economic geologist at the USGS Central Energy Resources Science Center based in Denver, Colorado. She is the uranium resource specialist for the USGS, leading the uranium resource evaluation project for the US and also working on uranium environmental issues. She began her career with USGS in 2000 after 20 years working in the mining industry. Both in industry and at USGS she strongly advocates applied science—using cutting edge analytic techniques to help answer important questions of ore deposit genesis and mining impacts.

Geologist

Central Region
Email: susanhall@usgs.gov
Phone: 303-236-1656
Fax: 303-236-0459
<https://orcid.org/0000-0002-0931-8694>

Dr. Hall has revitalized the USGS uranium resources program; planning, securing funding and initiating the first comprehensive, domestic uranium resource assessment since 1980. When she began this project, the efficacy of the USGS mineral resource assessment methodology was in question. She designed a unique proof-of-concept assessment, independently applying and/or evaluating the most widely accepted methods to evaluate uranium in the southern Texas Coastal Plain. She then analyzed the results, and for older methodology was able to test the predictions against production, to select an assessment methodology. Through a network of collaborators, she is now working to expand more traditional resource assessments to include assessments of

<https://www.usgs.gov/staff-profiles/susan-m-hall>

<https://pubs.er.usgs.gov/search?q=susan+hall>

Critical analysis of world uranium resources

<https://pubs.er.usgs.gov/publication/sir20125239>

Is this citation in GeoRef? **Yes**

Web of Science? **No**

Scopus? **No**

GeoscienceWorld? **No**

AAPG Datapages? **No**

Princeton University Library? **Yes** with link!

USGS Library? **No** (in Pubs Warehouse)



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SCIENCE PRODUCTS NEWS CONNECT ABOUT

SEARCH

Peter George Chirico



Pete Chirico is the Associate Director of the U.S. Geological Survey's Geology and Paleoclimate Science Center in Reston, VA. He also leads the USGS Special Studies project as a research scientist focused on terrain analysis and geomorphological mapping.

Biography

Pete Chirico is the Associate Director of the U.S. Geological Survey's Geology and Paleoclimate Science Center in Reston, VA. In over 20 years at USGS, he has focused his research on the geography and geomorphology of elicit small-scale mining of diamonds and mineral deposits in conflict zones and during complex emergencies. He has worked extensively with the U.S. Department of State, U.S. Department of Defense, U.S. Agency for International Development, the United Nations, and the Kimberley Process to understand how diamonds and other natural resource exploitation contribute to funding conflicts. While his regional expertise is Sub-Saharan Africa, he has led or been a member of more than 30 field expeditions throughout Central America and the Caribbean, the Middle East, and Africa. He is author or co-author of over 50 peer reviewed scientific reports and journal articles in the fields of geography, geomorphology, remote sensing, and natural resources in conflict zones. Pete also serves as scientific and technical advisor to the Office of Threat Finance Countermeasures in the Department of State's Bureau of Economic and Business Affairs.

Associate Director and Supervisory Geographer

Florence Bascom
Geoscience Center
Email: pchirico@usgs.gov
Phone: 703-648-6900

ResearchGate Profile: https://www.researchgate.net/profile/Peter_Chirico

<https://www.usgs.gov/staff-profiles/peter-george-chirico>

<https://pubs.er.usgs.gov/search?q=Peter+Chirico>

The Central African Republic Diamond Database—A geodatabase of archival diamond occurrences and areas of recent artisanal and small-scale diamond mining

<https://pubs.er.usgs.gov/publication/ofr20181088>

Is this citation in GeoRef? **Yes**

Web of Science? **No**

Scopus? **No**

GeoscienceWorld? **No**

AAPG Databases? **No**

Princeton University Library? **No**

USGS Library? **No** (in Pubs Warehouse)

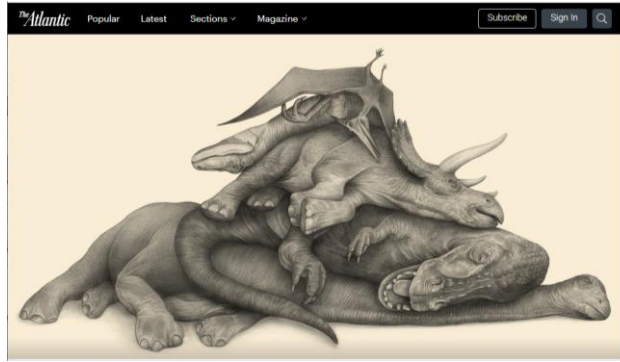
Example: Princeton University: Department of Geosciences



Climate scientist Gabriel Vecchi: Climate crisis contributes to intensity of storms

How Has Climate Change Affected Hurricane Dorian?

Princeton University/Geophysical Fluid Dynamics Laboratory



The Nastiest Feud in Science

A Princeton geologist has
endured decades of ridicule for
arguing that the fifth extinction
was caused not by an asteroid but
by a series of colossal volcanic
eruptions. But she's reopened
that debate.

Deccan Volcanism caused the mass extinction 66 million years ago

Gerta Keller

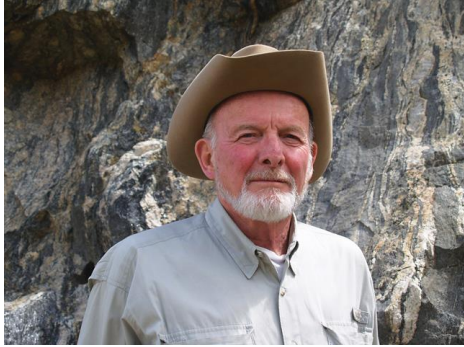


Princeton Environmental Research

A Half-Century at the Forefront

Princeton University's research across the spectrum of environmental issues is making pivotal contributions to solving some of humanity's toughest problems. Our impact is built on a legacy of personal commitment, intellectual leadership, perseverance and innovation.

Who is a geoscientist?



John C. Reed, Jr. “Jack”

<https://www.earthmagazine.org/article/down-earth-john-jack-reed-jr>

Generalized Geologic Map of the United States, Puerto Rico, and the U.S. Virgin Islands

<https://pubs.usgs.gov/atlas/geologic/>

Database of the Geologic Map of North America: Adapted from the Map by J.C. Reed, Jr. and others (2005)

Data Series 424

Prepared in cooperation with the Geological Society of America

By: Christopher P. Garrity and David R. Soller



<https://ngmdb.usgs.gov/gmna/>

Who helped me at USGS in Denver?

USGS Energy:
<https://www.usgs.gov/energy-and-minerals/energy-resources-program/>

[Christopher J Schenk](#)
[Susan M Hall](#)
[Robert Zielinski](#)
[Raymond Obuch](#)

[Geoffrey S Ellis](#)
[Timothy S Collett](#)
[Kristen Marra](#)
[Seth Haines](#)
[Stanley Paxton](#)
[Debra K Higley](#)
[Michael D Lewan](#)
[Paul Lillis](#)
[Chris Potter](#)
[Tracey Mercier](#)

USGS Minerals: <https://www.usgs.gov/energy-and-minerals/mineral-resources-program>

Geology, Geophysics, and Geochemistry Science Center
<https://www.usgs.gov/centers/gggsc>

[Jonathan Caine](#)
[Lyndsay B Ball](#)
[Benjamin J Drenth](#)
[Carol A Finn](#)
[JoAnn Holloway](#)
[V. J. Grauch](#)
[Christopher Holm-Denoma](#)
[Craig A Johnson](#)
[Erin Marsh](#)
[Anjana K Shah](#)
[Steven M Smith](#)
[Matthew Granitto](#)
[Erin Marsh](#)
[Gregg A Swayze](#)
[Cliff D Taylor](#)
[Bradley S Van Gosen](#)
[Thomas J Casadevall](#)
[George N Breit](#)
[Edward A du Bray](#)
[Karl V Evans](#)
[Todd K Hinkley](#)

[Anna Burack Wilson](#)
[Martin Goldhaber](#)
[Paul A Bedrosian](#)
[Cyrus J Berry](#)
[Benjamin Bloss](#)
[William B Ferguson](#)
[Poul Emsbo](#)
[Raymond Kokaly](#)
[Andrew H Manning](#)
[Karen Lund](#)
[Celestine Mercer](#)
[Burke Minsley](#)
[Jean M Morrison](#)
[Rae Ann Orkild-Norton](#)
[William Ridley](#)
[Mary Ellen Benson](#)
[Douglas B Yager](#)
[Ryan D Taylor](#)
[Russell G Tysdal](#)

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SCIENCE PRODUCTS NEWS CONNECT ABOUT

Energy Resources Program

Research
Gulf Coast Framework Studies, Geochemistry, Geologic CO2 Utilization, Economics, Environmental Aspects, and more

Discover our

HOME

SCIENCE
DATA AND TOOLS
MAPS
PUBLICATIONS

Home
The Energy Resources Program conducts research and assessments to advance the understanding of the Nation's energy resources. We study processes critical to the formation, accumulation, occurrence and alteration of geologically based energy resources; prepare resource assessments; and evaluate the environmental and socioeconomic effects of energy resource occurrence, production and use.

USGS
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SCIENCE PRODUCTS NEWS CONNECT ABOUT

Geology, Geophysics, and Geochemistry Science Center

HOME

SCIENCE
DATA AND TOOLS
MAPS
PUBLICATIONS
SOFTWARE
MULTIMEDIA
NEWS

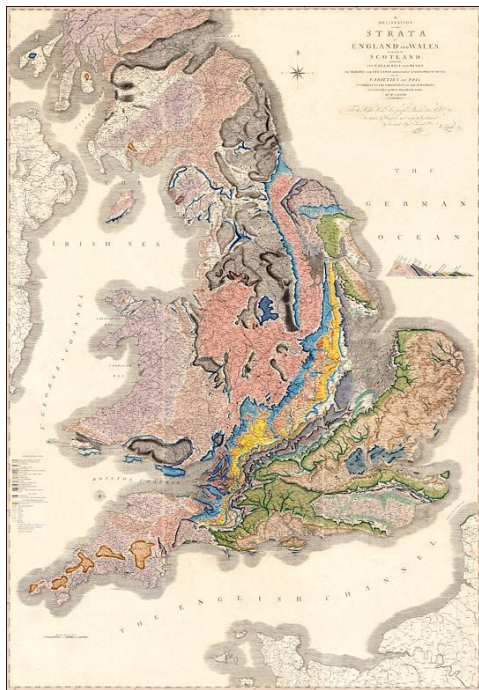
Home
Welcome to the Geology, Geophysics, and Geochemistry Science Center (GGGSC) located in Lakewood, Colorado on the Denver Federal Center. At GGGSC, we apply expertise in geology, geophysics, and geochemistry to interdisciplinary efforts in support of the USGS mission to address the Nation's important earth science issues, with an emphasis on mineral resources.

Laboratories

Science Branches
Our strong science portfolio integrates regional and economic geology with a broad range of geophysical, geochemical, analytical expertise. Our center has four scientific branches.

Geosciences Societies

A Geological Map of England and Wales and Part of Scotland, first published in 1815



<http://www.strata-smith.com/>



The
Geological
Society



The Geological Society of London is the UK's national society for geoscience, providing support to over 12,000 members in the UK and overseas. <https://www.geolsoc.org.uk/>

Lyell
Collection



Geological Society
Publications

<https://www.lyellcollection.org/>

Open Access Collection:

<https://www.lyellcollection.org/cc/open-access-collection>



Geoscience Information Society

GEONET Email List

<http://www.geoinfo.org/e-mail-list/>
Or email me: ewild@princeton.edu

Newsletter

<http://www.geoinfo.org/newsletter/>

Proceedings:

<http://www.geoinfo.org/proceedings/>

[Free access - Search the Geologic Guidebooks of North America Database](#)

Geoscience Information Society (GSIS)

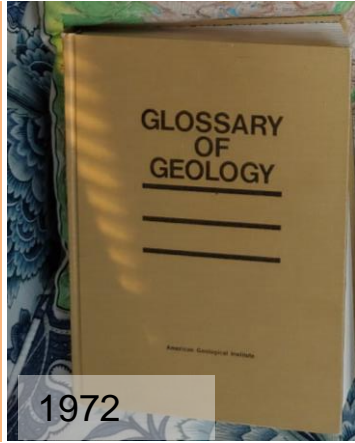
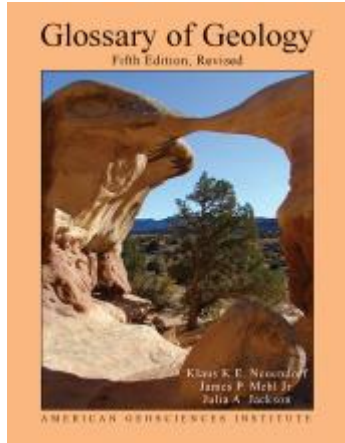
<http://www.geoinfo.org/>

The Geoscience Information Society (GSIS) facilitates the exchange of information in the geosciences through cooperation among scientists, librarians, editors, cartographers, educators, and information professionals.

Member Society of American Geosciences Institute (AGI) <https://www.americangeosciences.org/member-societies>

Associated Society of Geological Society of America (GSA) https://www.geosociety.org/GSA/About/Who_We_Are/Associated_Societies/GSA/About/Associated_Societies.aspx

Geosciences Societies



1972

<https://www.americangeosciences.org/pubs/glossary>

Example:

Glossary of Geology – Online for Princeton University

<https://catalog.princeton.edu/catalog/8875615>

Open-Access Journals / Series:

<https://www.americangeosciences.org/information/georef/open-access-journals>



American Geosciences Institute (AGI)

<https://www.americangeosciences.org/>

Policy & Critical Minerals: <https://www.americangeosciences.org/policy-critical-issues>



<https://www.americangeosciences.org/information/georef>

The GeoRef database, established by the American Geosciences Institute in 1966, provides access to the geoscience literature of the world. GeoRef is the most comprehensive database in the geosciences and continues to grow by more than 100,000 references a year. The database contains over 4 million references to geoscience journal articles, books, maps, conference papers, reports and theses. You can gain access to this vast amount of information through searching on the worldwide web, online, or on GeoRef CDs.



American Geosciences Institute (AGI) : Member Societies <https://www.americangeosciences.org/member-societies>

The Member Societies of AGI

[AASP - The Palynological Society](#)

[American Association of Geographers](#)

[American Association of Petroleum Geologists](#)

[American Geophysical Union](#)

[American Institute of Hydrology](#)

[American Institute of Professional Geologists](#)

[American Meteorological Society](#)

[American Rock Mechanics Association](#)

[Association for the Sciences of Limnology and Oceanography](#)

[Association for Women Geoscientists](#)

[Association of American State Geologists](#)

[Association of Earth Science Editors](#)

[Association of Environmental & Engineering Geologists](#)

[Clay Minerals Society](#)

[Council on Undergraduate Research](#)

[Geo-Institute of the American Society of Civil Engineers](#)



American Geosciences Institute (AGI) : Member Societies
<https://www.americangeosciences.org/member-societies>

[Geochemical Society](#)

[Geological Association of Canada](#)

[Geological Society of America](#)

[Geological Society of London](#)

[Geoscience Information Society](#)

[History of Earth Sciences Society](#)

[International Association of Hydrogeologists/U.S.](#)

[National Chapter](#)

[International Medical Geology Association](#)

[International Medical Geology Association](#)

[Karst Waters Institute](#)

[Mineralogical Society of America](#)

[Mineralogical Society of Great Britain and Ireland](#)

[National Association of Black Geoscientists](#)

[National Association of Geoscience Teachers](#)

[National Association of State Boards of Geology](#)

[National Cave and Karst Research Institute](#)



American Geosciences Institute (AGI) : Member Societies <https://www.americangeosciences.org/member-societies>

[National Earth Science Teachers Association](#)

[National Speleological Society](#)

[Paleobotanical Section of the Botanical Society of America](#)

[Paleontological Research Institution](#)

[Paleontological Society](#)

[Petroleum History Institute](#)

[Seismological Society of America](#)

[SEPM \(Society for Sedimentary Geology\)](#)

[Society for Mining, Metallurgy & Exploration](#)

[Society of Economic Geologists](#)

[Society of Exploration Geophysicists](#)

[Society of Independent Professional Earth Scientists](#)

[Society of Mineral Museum Professionals](#)

[Society of Vertebrate Paleontology](#)

[Soil Science Society of America](#)

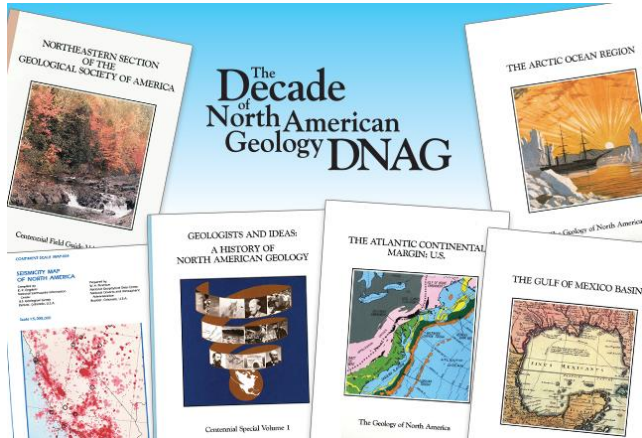
[The Society for Organic Petrology](#)

[United States Permafrost Association](#)

https://www.geosociety.org/GSA/Publications/GSA/Pubs/GSA_Publications.aspx

<https://pubs.geoscienceworld.org/>

<https://pubs.geoscienceworld.org/gsa>



THE
GEOLOGICAL
SOCIETY
OF AMERICA®

<https://www.geosociety.org/>

26–30 October
GSA 2020
CONNECTS ONLINE

<https://community.geosociety.org/gsa2020/home>

Ex: The geology of North America [electronic resource] : an overview
: <https://catalog.princeton.edu/catalog/9959130>

1. [AASP - The Palynological Society](#)
2. [American Association of Petroleum Geologists](#) (AAPG)
3. [American Geophysical Union](#) (AGU)
4. [American Institute of Professional Geologists](#) (AIPG)
5. [American Quaternary Association](#) (AMQUA)
6. [American Rock Mechanics Association](#) (ARMA)
7. [Association for the Sciences of Limnology and Oceanography](#) (ASLO)
8. [American Water Resources Association](#) (AWRA)
9. [Asociación Geológica Argentina](#) (AGA)
10. [Association for Women Geoscientists](#) (AWG)
11. [Association of American State Geologists](#) (AASG)
12. [Association of Earth Science Editors](#) (AESE)
13. [Association of Environmental & Engineering Geologists](#) (AEG)
14. [Association of Geoscientists for International Development](#) (AGID)
15. [Blueprint Earth](#) (BE)
16. [The Clay Minerals Society](#) (CMS)
17. [Colorado Scientific Society](#) (CSS)
18. [Council on Undergraduate Research Geosciences Division](#) (CUR)
19. [Cushman Foundation](#) (CF)
20. [Environmental & Engineering Geophysical Society](#) (EEGS)
21. [European Association of Geoscientists & Engineers](#) (EAGE)
22. [European Geosciences Union](#) (EGU)
23. [Geobiological Society](#) (GBS)
24. [Geochemical Society](#) (GS)
25. [Geologica Belgica](#) (GB)
26. [Geological Association of Canada](#) (GAC)
27. [Geological Society of Africa](#) (GSAF)
28. [Geological Society of Australia](#) (GSAus)
29. [Geological Society of China](#) (GSC)
30. [Geological Society of London](#) (GSL)
31. [Geological Society of South Africa](#) (GSSA)
32. [Geoscience Information Society](#) (GISIS)
33. [Geoscience Society of New Zealand](#) (GSNZ)
34. [German Geological Society](#) (GV)
35. [Groundwater Resources Association of California](#) (GRA)
36. [History of Earth Sciences Society](#) (HESS)
37. [International Association for Geoscience Diversity](#) (IAGD)
38. [International Association for Promoting Geoethics](#) (IAPG)
39. [International Association of Emergency Managers](#) (IAEM)
40. [International Association of GeoChemistry](#) (IAGC)

41. [International Association of Hydrogeologists](#) (IAH)
42. [International Association of Limnogeology](#) (IAL)
43. [International Medical Geology Association](#) (IMGA)
44. [International Society for Aeolian Research](#) (ISAR)
45. [Israel Geological Society](#) (IGS)
46. [Karst Waters Institute](#) (KWI)
47. [Microanalysis Society](#) (MAS)
48. [Mineralogical Association of Canada](#) (MAC)
49. [The Mineralogical Society](#) (MS)
50. [Mineralogical Society of America](#) (MSA)
51. [Minnesota Ground Water Association](#) (MGWA)
52. [National Association of Black Geoscientists](#) (NABG)
53. [National Association of Geoscience Teachers](#) (NAGT)
54. [National Association of State Boards of Geology](#) (ASBOG®)
55. [National Cave and Karst Research Institute](#) (NCKRI)
56. [National Earth Science Teachers Association](#) (NESTA)
57. [National Ground Water Association](#) (NGWA)
58. [National Speleological Society](#) (NSS)
59. [Nepal Geological Society](#) (NGS)
60. [Nigerian Society of Physical Sciences](#) (NSPS)
61. [Paleontological Research Institution](#) (PRI)
62. [Paleontological Society](#) (PS)
63. [Seismological Society of America](#) (SSA)
64. [Sigma Gamma Epsilon](#) (SGE)
65. [Sociedad Geológica Mexicana, A.C.](#) (SGM)
66. [Società Geologica Italiana](#) (SGI)
67. [Society for American Archaeology](#) (SAA)
68. [Society for Environmental Geochemistry and Health](#) (SEGH)
69. [Society for Mining, Metallurgy & Exploration](#) (SME)
70. [SEPM](#) (Society for Sedimentary Geology)
71. [Society for the Preservation of Natural History Collections](#) (SPNHC)
72. [Society of Economic Geologists](#) (SEG)
73. [Society of Exploration Geophysicists](#) (SEG)
74. [Society of Vertebrate Paleontology](#) (SVP)
75. [Soil Science Society of America](#) (SSSA)
76. [Western Interior Paleontological Society](#) (WIPS)

<https://www.aapg.org/>

<http://archives.datapages.com/data/index.html>



This is a screenshot of the AAPG Datapages Inc. Archives website. The page has a dark blue header with the AAPG logo and 'Datapages, Inc. Archives' text. Below the header, there are navigation links for 'Home', 'Search', 'Browse', and 'Subscribe'. The main content area is titled 'Search the Archives' and includes a list of checked categories such as 'AAPG Books Ahead of Print', 'AAPG Bulletin', and 'AAPG Special Publications Group'. There are several search input fields for 'Full Text', 'Title', 'Author', 'Abstract', and 'References'. A 'Year' field is set to 'yyyy' to 'yyyy'. The 'Sort by' dropdown is set to 'Relevance' and the 'Sort order' dropdown is set to 'Descending'. The 'Results' field shows '25' per page. There are 'SEARCH' and 'CLEAR' buttons, along with a 'Search Tips' link. On the right side of the search area, there are three promotional boxes: 'Digitizing Volumetrics Interpretation', 'SCA SURFACE CONSULTANTS', and 'Datapages Exploration Objects'.

**Rocky Mountain Group:
Earth Science Bulletin (WGA) 1968-1988, Four
Corners Geological Society 1952-2010, Grand
Junction Geological Society 1960-2012, Montana
Geological Society 1950-2006, North Dakota
Geological Society 1952-1993, Rocky Mountain
Association of Geologists 1937-2006, Rocky
Mountain Section (SEPM) 1979-2003, Saskatchewan
Geological Society 1958-2015, The Mountain
Geologist (RMAG) 1964 to present, Utah Geological
Association 1950-2010, Utah Geological Survey
1988-2012, Williston Basin Symposia 1956-1998,
Wyoming Geological Association 1946-2011**

Journal of Geophysical Research

- [Atmospheres](#)
- [Biogeosciences](#)
- [Earth Surface](#)
- [Oceans](#)
- [Planets](#)
- [Solid Earth](#)
- [Space Physics](#)
- [Journal of Geophysical Research \(1896-1977\)](#)

News 20 October 2020

[Biggest Risk to Surface Water After a Wildfire? It's Complicated](#)

<https://eos.org/>

Research Spotlight 23 October 2020

[Rising Seas and Agriculture Created Wetlands Along the U.S. East Coast](#)

- [AGU Advances](#) **Open Access**
- [Earth's Future](#) **Open Access**
- [Earth and Space Science](#) **Open Access**
- [Geochemistry, Geophysics, Geosystems](#)
- [GeoHealth](#) **Open Access**
- [Geophysical Research Letters](#)
- [Global Biogeochemical Cycles](#)
- [Journal of Advances in Modeling Earth Systems \(JAMES\)](#) **Open Access**
- [Paleoceanography and Paleoclimatology](#)
- [Radio Science](#)
- [Reviews of Geophysics](#)
- [Space Weather](#) **Open Access**
- [Space Weather Quarterly](#)
- [Tectonics](#)
- [Water Resources Research](#)

GSW Publishers


- [AASP -The Palynological Society](#)
- [American Association of Petroleum Geologists](#)
- [Association of Environmental & Engineering Geologists](#)
- [Cambridge University Press](#)
- [Canadian Institute of Mining, Metallurgy & Petroleum](#)
- [Canadian Science Publishing](#)
- [Canadian Society of Petroleum Geologists](#)
- [Clay Minerals Society](#)
- [Cushman Foundation for Foraminiferal Research](#)
- [E. Schweizerbart'sche Verlagsbuchhandlung Science Publishers](#)

Publishers

- [Earthquake Engineering Research Institute](#)
- [Environmental & Engineering Geophysical Society](#)
- [European Association for Geochemistry](#)
- [Geological Society of America](#)

- [Geological Society of London](#)
- [Geological Society of South Africa](#)
- [GeoScienceWorld](#)
- [Gulf Petrolink](#)
- [Micropaleontology Press](#)
- [Mineralogical Association of Canada](#)
- [Mineralogical Society of America](#)
- [Mineralogical Society of Great Britain and Ireland](#)
- [Pacific Section AAPG](#)
- [Paleontological Society](#)
- [Seismological Society of America](#)
- [SEPM Society for Sedimentary Geology](#)
- [Societa Geologica Italiana](#)
- [Société Géologique de France](#)
- [Society of Economic Geologists](#)
- [Society of Exploration Geophysicists](#)
- [Soil Science Society of America](#)
- [University of Wyoming](#)





The screenshot shows the website for the Geological Survey of Japan (GSJ). The header includes the GSJ logo and name in both Japanese and English. A navigation menu lists 'GSJ HOME', 'About GSJ', 'Our Activities', 'Publications and Database', 'Geological Hazards', and 'Learning and Education'. The main content area is titled 'Geoscience Organizations of the World' and includes a sub-header 'Directory of Geoscience Organizations of the World' by the Research Planning Office for Geological Survey of Japan, AIST. A large satellite-style map of the world is displayed. A sidebar on the left contains a list of links: 'About GSJ', 'Our Activities', 'Purchase guide', 'Publications and Database', 'Geological Hazards', 'Learning and Education', 'GSJ Database', 'Collection of links', 'Earth Science Magazine', and 'Geoscience Organizations of the World'. At the bottom of the page, there are language options: 'English | Japanese | PDF (in English) [March 2020] (6MB)'.



Afghanistan

Afghanistan Geological Survey

Afghanistan Geological Survey building, next to slaughter house, Jalalabad road, District 9, Kabul

Email: wasy54@yahoo.com

WWW Page: <http://www.bgs.ac.uk/afghanminerals/>



Albania

Albanian Geological Survey

Rruga e Kavajës, Nr.153, Tiranë

Phone: +355-4 222 578

Fax: +355-4 229 441

Email: vrtes12001@yahoo.com

WWW Page: <http://www.gsa.gov.al/>



Algeria

Algerian Geological Survey Agency (ASGA)

(Agence du Service Géologique de l'Algérie)

Ministry of Industry and Mines

Tour B, Val d'Hydra, Alger

Phone: +213-21 48 85 09

Fax: +213-21 48 84 64

Email: asga@asga.dz

WWW Page: <http://www.asga.dz>

National Agency for Mining Activities (ANAM)

(Agence Nationale des Activités Minières)

Siège du Ministère de l'Energie, Tour B Val d'Hydra, Alger

Phone: +213-21 48 85 50

Fax: +213-21 48 83 27/48 85 53

Email: anam@anam.gov.dz

WWW Page: <http://www.anam.gov.dz>

U.S. Geological Survey (USGS)

Ecosystems

- Status and Trends Program
- Fisheries Program
- Wildlife Program
- Environments Program
- Invasive Species Program

Energy and Mineral Resources

- Mineral Resources Program
- Energy Resources Program

Natural Hazards

- Earthquake Hazards Program
- Volcano Hazards Program
- Landslide Hazards Program
- Global Seismographic Network
- Geomagnetism
- Coastal/Marine Hazards and Resources

Core Science Systems

- National Geospatial Program
- National Cooperative Geologic Mapping Program
- Science Synthesis, Analysis, and Research Program



<https://www.usgs.gov/>



Water Resources

- Groundwater and Streamflow Information Program
- National Water Quality Program
 - National Water-Quality Assessment Project (NAWQA)
 - National Atmospheric Deposition Program
 - USGS-National Park Service Water-Quality Partnership
- Water Availability and Use Science Program
- Water Resources Research Act Program



STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION



NY Power Authority



Colorado Geological Survey:

<https://coloradogeologicalsurvey.org/>

New Jersey Geological and Water Survey:

<https://www.nj.gov/dep/njgs/>

New York Geological Survey:

<http://www.nysm.nysed.gov/research-collections/geology>

Rhode Island Geological Survey:

<https://web.uri.edu/geo/rhode-island-geological-survey/>

Utah Geological Survey : <https://geology.utah.gov/>

Washington Geological Survey:

<https://www.dnr.wa.gov/geology>



The Washington Geology Library was created in 1935, and was mandated to collect, archive, and provide access to materials on the geology of Washington State. In addition, publications on tsunamis and emergency management are collected on behalf of the [NOAA National Tsunami Hazard Mitigation Program](#). The library has more than 80,000 items in its collection. Less than a quarter of the collection is available online. Links to those items can be found in the [library catalog](#). A visit to the library is required to view the rest of the collection. [Contact us](#) about additional ways to access materials.

“Puppies”

Timefulness: How Thinking Like a Geologist Can Help Save the World



"A profound meditation on the richness, depth and entanglements of geologic time."
—WALL STREET JOURNAL



TIMEFULNESS
HOW THINKING LIKE A GEOLOGIST
CAN HELP SAVE THE WORLD



MARCIA BJORNERUD

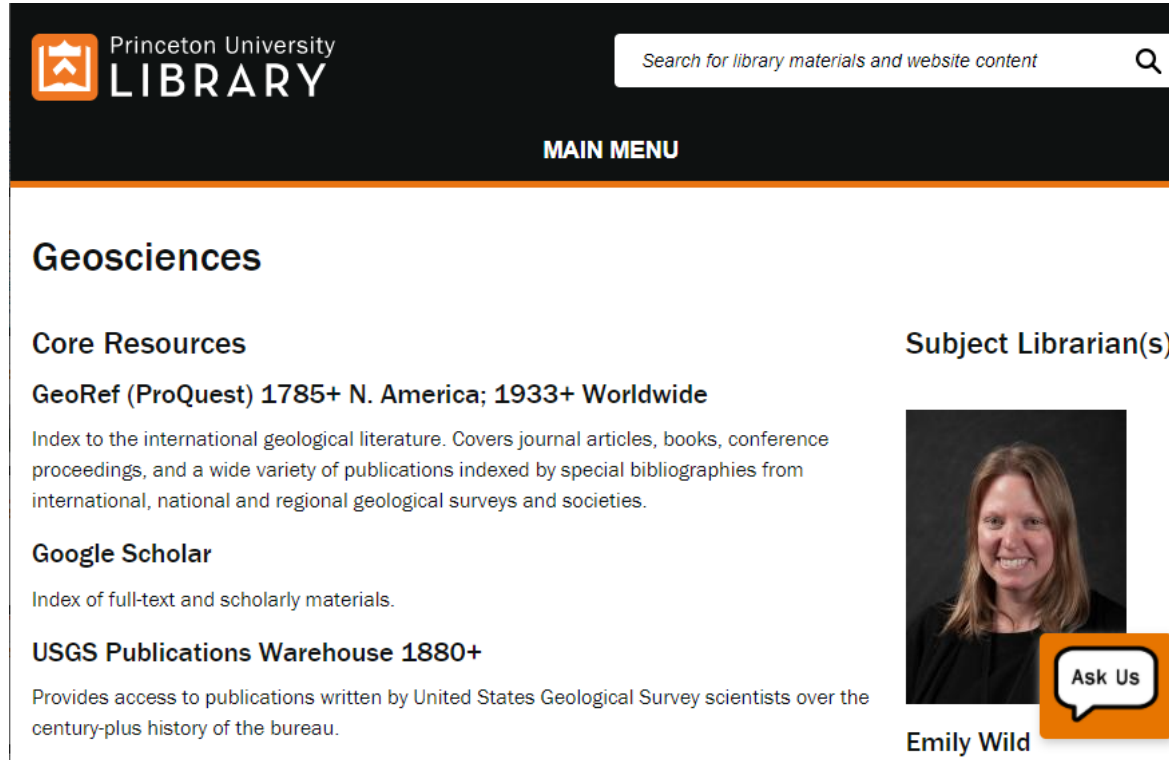
<https://press.princeton.edu/books/paperback/9780691202631/timefulness>

Earth Science:
<https://press.princeton.edu/subjects/earth-science>

New York:
<https://press.princeton.edu/search?search=new+york>

<https://library.princeton.edu/research/databases>

<https://library.princeton.edu/databases/subject/geosciences>



Princeton University
LIBRARY

Search for library materials and website content

MAIN MENU

Geosciences

Core Resources

GeoRef (ProQuest) 1785+ N. America; 1933+ Worldwide

Index to the international geological literature. Covers journal articles, books, conference proceedings, and a wide variety of publications indexed by special bibliographies from international, national and regional geological surveys and societies.


Google Scholar

Index of full-text and scholarly materials.

USGS Publications Warehouse 1880+

Provides access to publications written by United States Geological Survey scientists over the century-plus history of the bureau.

Subject Librarian(s)



Ask Us

Emily Wild

Geosciences = Grey Literature = More indexing and availability from free sources – commercial databases do not always index free

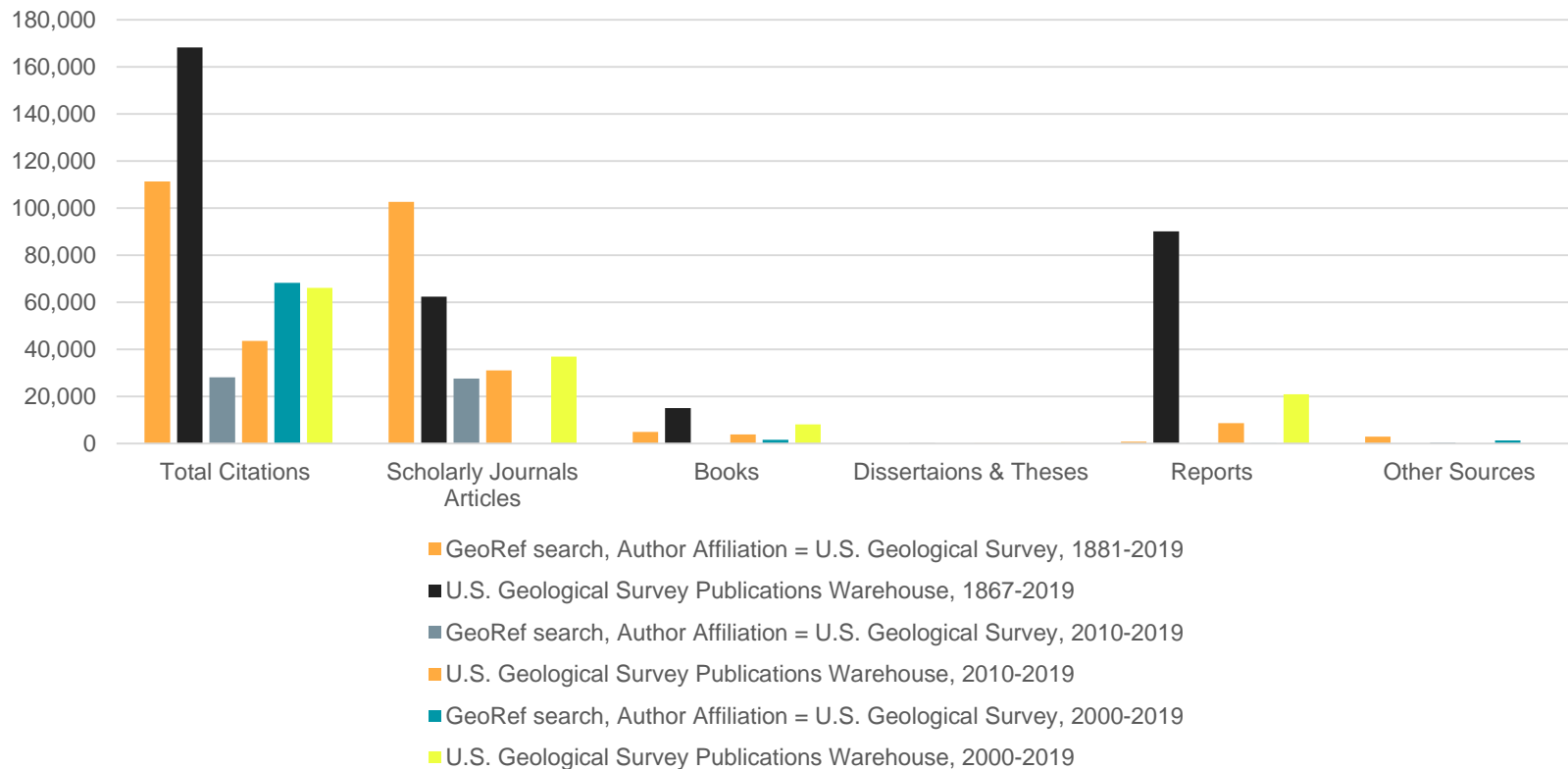
Main Commercial Science Publishers:

**Springer
Wiley
Elsevier**

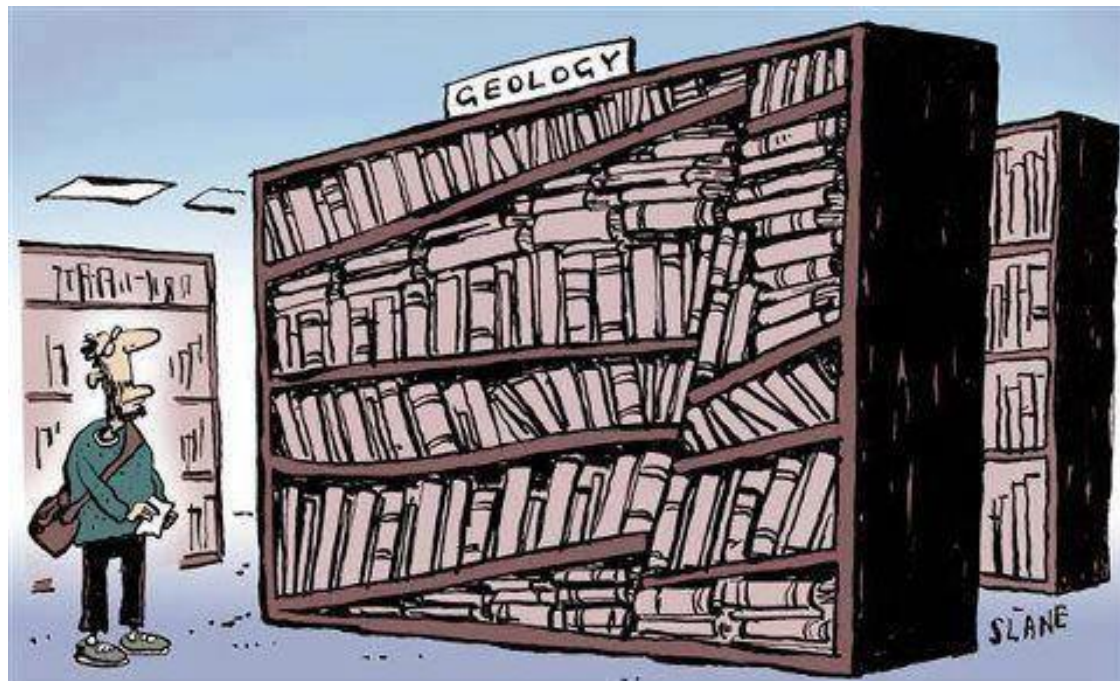
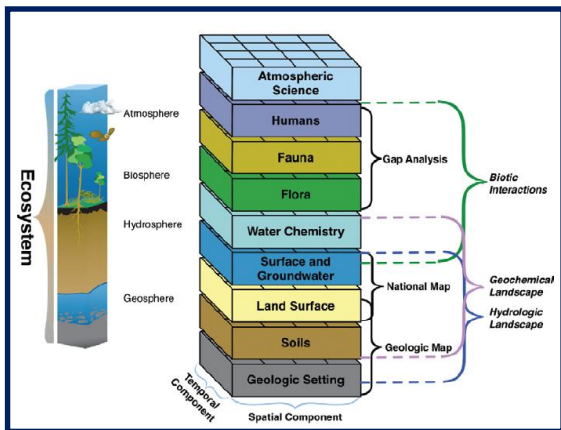
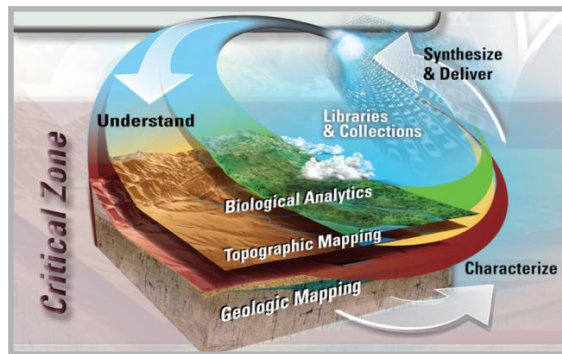
Main Commercial Science Databases:

**Web of Science
Scopus**

Discovery of USGS Publications by Affiliation in GeoRef vs. the USGS Publications Warehouse (Official Government Database for USGS Publications)



Part 2: Geosciences Library Instruction



Very Happy to be in New Jersey (Shore) and to be near home (New York), but often asked about...

Worked about 23 years at the U.S. Geological Survey (USGS) : hired after 1995 RIF, left because of 2018 RIF (Reduction In Force: <https://www.opm.gov/policy-data-oversight/workforce-restructuring/reductions-in-force/> ; <https://eos.org/articles/usgs-library-cuts-would-harm-research-education-say-scientists>)

About 13 years as a USGS Hydrologist: NH-VT & MA-RI offices (now New England office)

- ❖ Outreach coordinator for USGS Massachusetts-Rhode Island Office & Ask A Geologist
- ❖ Surface Water, Groundwater, Water Use (Water Quantity), Water Quality, Coastal Waters

10 years as a USGS Librarian (Physical Scientist) in Denver, Colorado

- ❖ Reference & Research Consultations
- ❖ Teaching workshops: Map & Compass, GPS, USGS Library Instruction
- ❖ Ask USGS, Ask A Librarian, Ask A Geologist
- ❖ Subject Matter Expert (SME), 2012-2017 = 8-hour course available on Department of the Interior (DOI) University: <https://doiu.doi.gov/> and
- ❖ 2017-2018: Live & recorded sessions through the Federal Depository Library Program (FDLP)

Past webinars, U.S. Geological Survey (USGS)

USGS Library Materials for Natural Hazards <https://www.fdlp.gov/usgs-library-materials-for-natural-hazards>

USGS Library Materials for Water Resources Information <https://www.fdlp.gov/usgs-library-materials-for-water-resources-information>

USGS Library Materials for Earth's Age <https://www.fdlp.gov/usgs-library-materials-for-earth-s-age>

USGS Library: Indexes, catalogs, and other bibliographic tools, a day in the life of a reference librarian <https://www.fdlp.gov/usgs-library-indexes-catalogs-and-other-bibliographic-tools-a-day-in-the-life-of-a-reference-librarian>

USGS Library: Oil, Gas, Coal, Uranium, and Minerals Maps and Data <https://www.fdlp.gov/usgs-library-oil-gas-coal-uranium-and-minerals-maps-and-data>

USGS Library: Using USGS Image, Map, and Data Products for Information Inquiries <https://www.fdlp.gov/usgs-library-using-usgs-image-map-and-data-products-for-information-inquiries>

Since 1884, Princeton University has participated in the Federal Depository Library Program (FDLP): <https://www.fdlp.gov/>

FDLP Academy Training Repository : <https://www.fdlp.gov/fdlp-academy/fdlp-academy-training-repository>

Upcoming Chemistry, Geosciences, and Environmental Studies webinars

December 17, 2020 at 2 p.m. : From the Rocks to the Stocks - Library Research with a Geosciences Librarian and a Finance Librarian

November 24, 2020 at 2 p.m. : Using Art Sources for Chemistry, Geosciences, and Environmental Studies Library Research <https://www.fdlp.gov/news-and-events/4756-webinar-using-government-art-sources-for-chemistry-geosciences-and-environmental-studies-library-research>

October 29, 2020 at 2 p.m. : Library Research for Natural Hazard Events: Earthquakes, Hurricanes, Volcanoes, and Wildfires - To register for this free webinar, please refer to: <https://libcal.princeton.edu/event/7165734> or <https://www.fdlp.gov/news-and-events/4696-webinar-library-research-for-natural-hazard-events-earthquakes-hurricanes-volcanoes-and-wildfires>

Past Chemistry, Geosciences, and Environmental Studies webinars, Princeton University

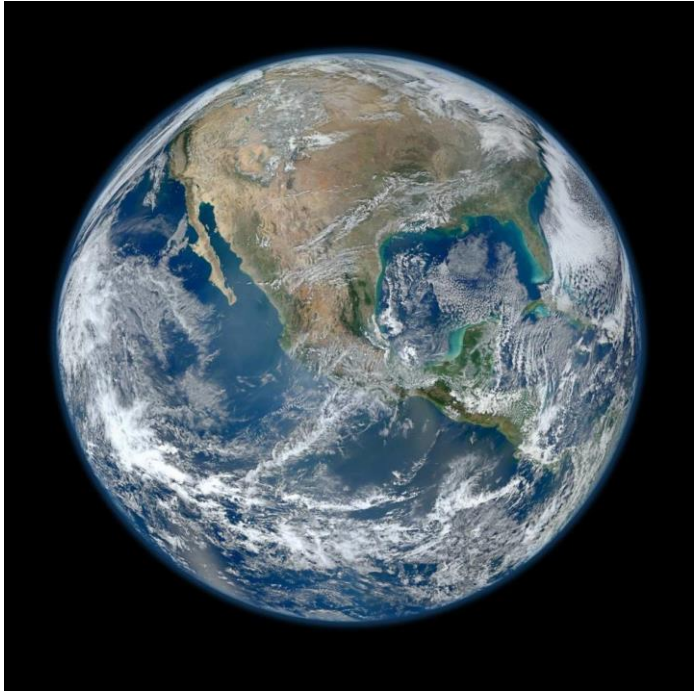
September 2020 : Pharmaceutical Research Sources Available for COVID-19 <https://www.fdlp.gov/pharmaceutical-research-sources-available-for-covid-19>

August 2020: Library Research for Energy, Minerals, and Uranium Resources <https://www.fdlp.gov/library-research-for-energy-mineral-and-uranium-resources>

July 2020 : Library Research for Atmospheric and Oceanic Sciences (Including Climate Change) <https://www.fdlp.gov/library-research-for-atmospheric-and-oceanic-sciences-including-climate-change>

March 2020: Library Research for Water Resources <https://www.fdlp.gov/library-research-for-water-resources>

January 2020: Introduction to Geosciences Library Research <https://www.fdlp.gov/introduction-to-geosciences-library-research>



<https://www.usgs.gov/media/images/blue-marble-image-earth>

At Princeton - Undergraduates in Departments & Programs:

Chemistry: <https://chemistry.princeton.edu/>

Geosciences: <https://geosciences.princeton.edu/>

Environmental Studies: <https://environment.princeton.edu/>

Policy: <https://cpree.princeton.edu/>

Engineering: <https://acee.princeton.edu/>

Finance: <https://bcf.princeton.edu/>

Writing Seminars:

<https://writing.princeton.edu/undergraduates/writing-seminars>

How? 10 seconds?

"I spent 2 weeks trying to find that information, how did you find it in 10 seconds?" – Asked by many library users

Earthquakes in New York & New Jersey area, 1900-present

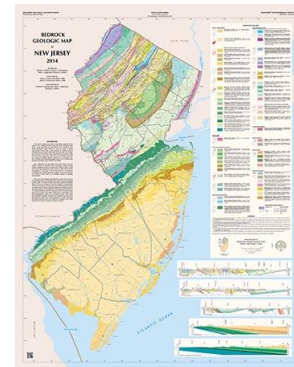
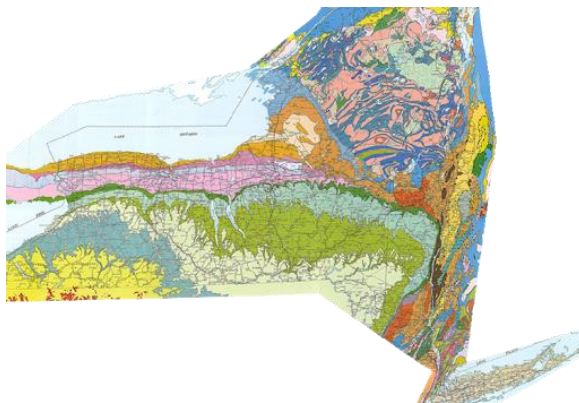
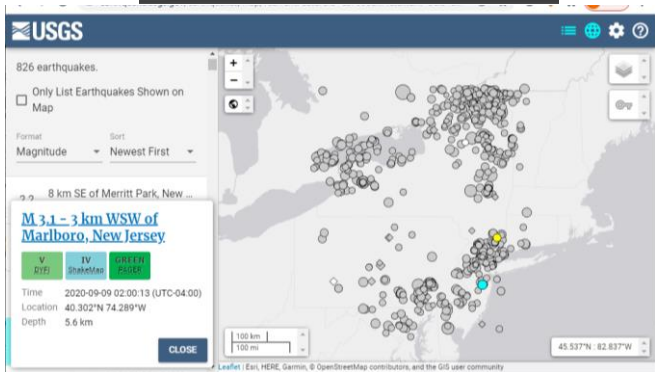


Latitude & Longitude Searches

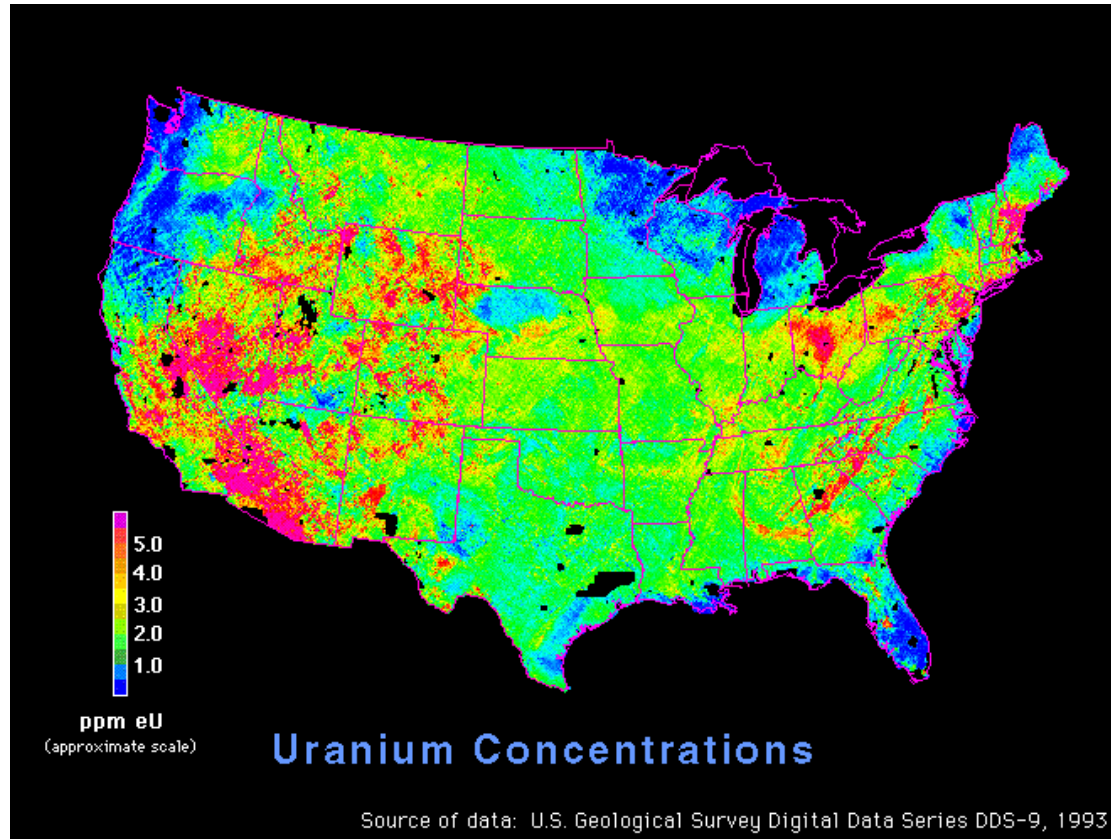
Geology (and Hydrology) Maps for New York & New Jersey : GeoPDFs, TIFFs, JPGs, KMZs
USGS National Geologic Map Database

New York Maps New York Geologic Units

New Jersey Maps New Jersey Geologic Units



Uranium-238 Concentrations across United States from NURE

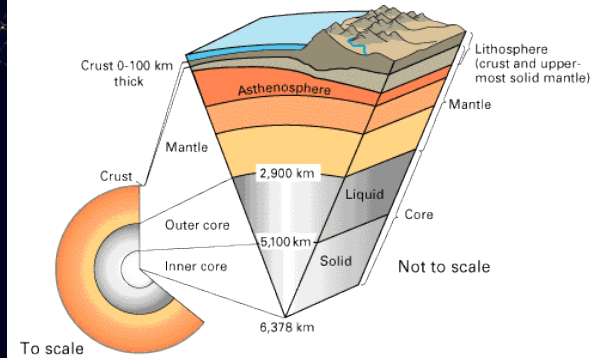


Earth

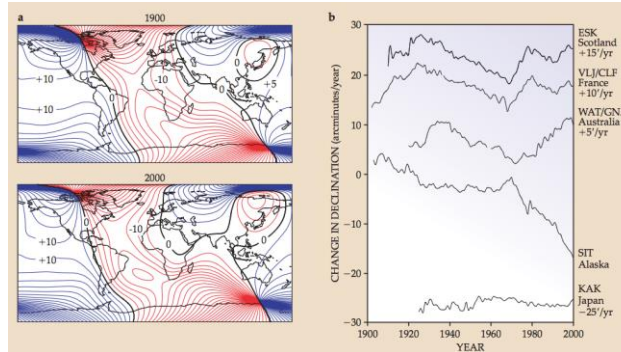


Blue Marble

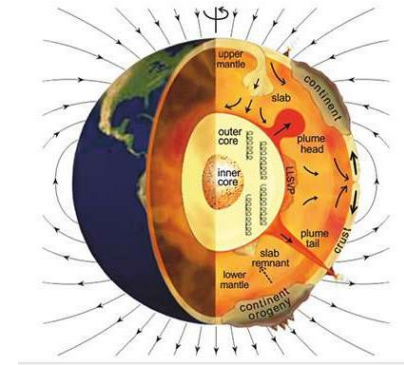
<https://www.usgs.gov/media/images/blue-marble-image-earth>



<https://pubs.usgs.gov/gip/dynamic/inside.html>

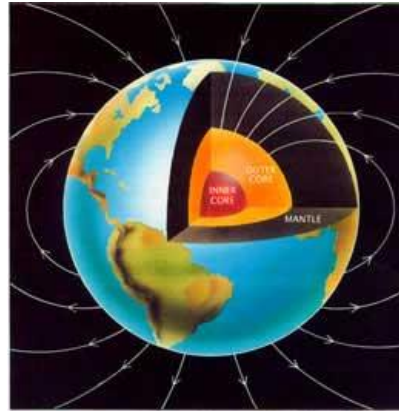
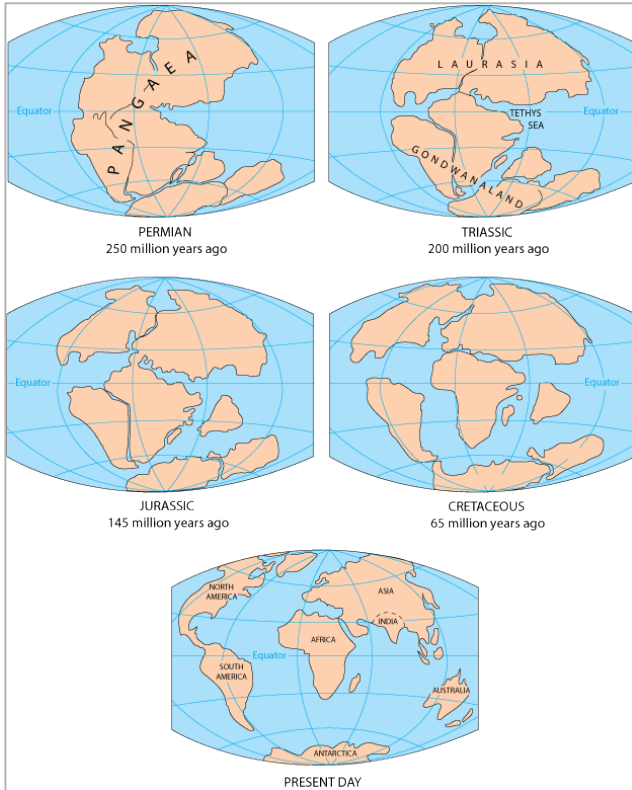


<https://www.usgs.gov/natural-hazards/geomagnetism>



<https://phys.org/news/2018-06-insight-earth-crust-mantle-outer.html>

Earth's History



Types of Rocks Found in Earth

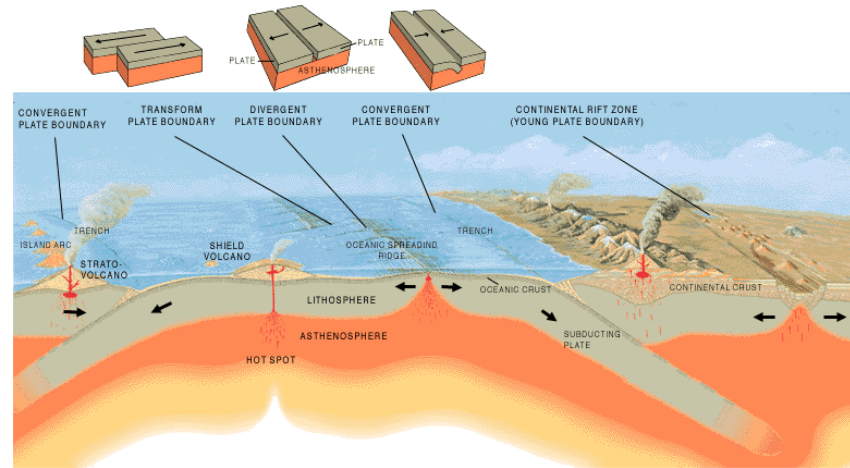
Crust: Silicic rocks, Andesite, Basalt

Upper Mantle: Peridotite, Eclogite, Olivine, Spinel, Garnet, Pyroxene, Perovskite, Oxides

Lower Mantle: Magnesium and Silicon Oxides

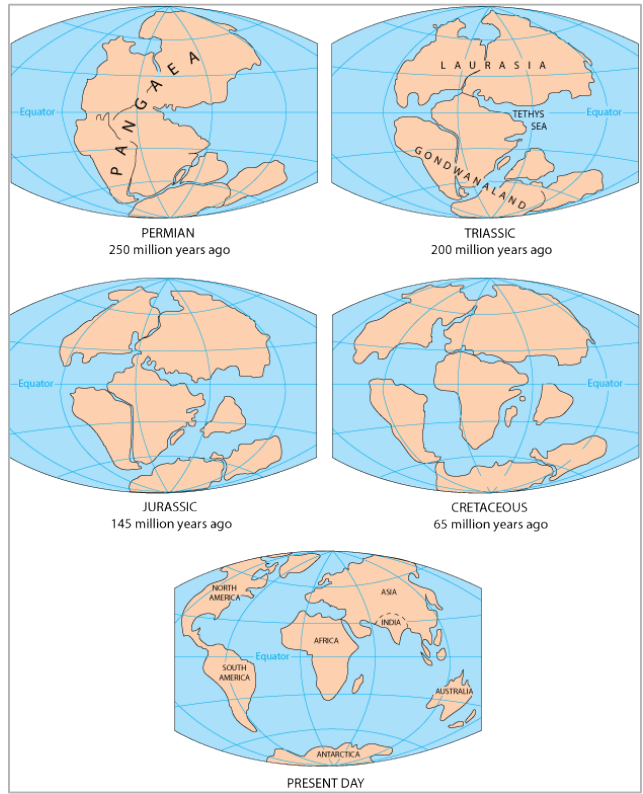
Outer Core: Iron+Oxygen, Sulfur, Nickel Alloy

Inner Core: Iron+Oxygen, Sulfur, Nickel Alloy



<https://pubs.usgs.gov/gip/dynamic/dynamic.html>

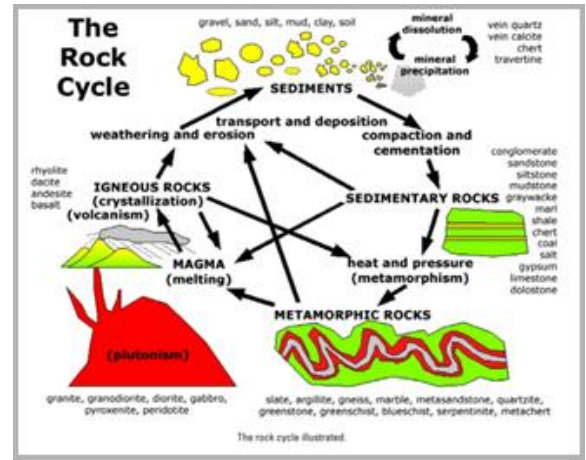
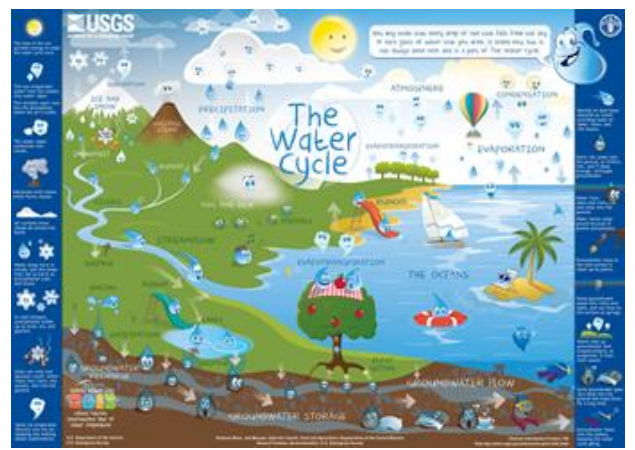
Geology & Hydrology



<https://www.usgs.gov/natural-hazards/geomagnetism>



<https://pubs.usgs.gov/gip/dynamic/dynamic.html>



USGS Geologic Time

2018 Divisions of Geologic Time— Major Chronostratigraphic and Geochronologic Units

EONOTHEM / EON	ERATHEM / ERA	SYSTEM/SUBSYSTEM / PERIOD/SUPERPERIOD	SERIES / EPOCH	Age estimates of boundaries in mega-annum (Ma) unless otherwise noted	
Cenozoic (Cz)	Quaternary (Q)	Holocene			
			Pleistocene		
	Neogene (N)	Pliocene		2.588*	
		Miocene		5.332 ± 0.005	
		Eocene			
	Tertiary (T)	Paleogene (P)	Oligocene		23.03 ± 0.05
			Eocene		33.9 ± 0.1
		Paleocene	Eocene		55.8 ± 0.2
			Oligocene		65.5 ± 0.3
			Paleocene		

EONOTHEM / EON	ERATHEM / ERA	SYSTEM/SUBSYSTEM / PERIOD/SUPERPERIOD	SERIES / EPOCH	Age estimates of boundaries in mega-annum (Ma) unless otherwise noted
Phanerozoic	Mesozoic (Mz)	Cretaceous (K)	Upper / Late	65.5 ± 0.3
			Lower / Early	99.6 ± 0.9
		Jurassic (J)	Upper / Late	145.5 ± 4.0
			Middle	161.2 ± 4.0
			Lower / Early	175.6 ± 2.0
		Triassic (Tr)	Upper / Late	199.6 ± 0.6
			Middle	228.7 ± 2.0*
			Lower / Early	245.0 ± 1.5
			Lower / Early	251.0 ± 0.4

~4.6 Billion Years

EONOTHEM / EON	ERATHEM / ERA	SYSTEM/SUBSYSTEM / PERIOD/SUPERPERIOD	SERIES / EPOCH	Age estimates of boundaries in mega-annum (Ma) unless otherwise noted
Paleozoic (Pz)	Carboniferous (C)	Permian (P)	Lopingian	251.0 ± 0.4
			Guadalupian	260.4 ± 0.7
		Pensylvanian (P)	Cisuralian	270.6 ± 0.7
			Upper / Late	299.0 ± 0.8
			Middle	307.2 ± 1.0*
		Mississippian (M)	Lower / Early	311.7 ± 1.1
			Upper / Late	318.1 ± 1.3
		Devonian (D)	Middle	328.3 ± 1.6*
			Lower / Early	345.3 ± 2.1
			Upper / Late	359.2 ± 2.5
	Middle		385.3 ± 2.6	
	Lower / Early		397.5 ± 2.7	
	Silurian (S)	Pridoli	416.0 ± 2.8	
		Ludlow	418.7 ± 2.7	
		Wenlock	422.9 ± 2.5	
		Llandovery	428.2 ± 2.3	
		Upper / Late	443.7 ± 1.5	
	Cambrian Ordovician (O)	Middle	460.9 ± 1.6	
		Lower / Early	471.8 ± 1.6	
		Upper / Late	488.3 ± 1.7	
Middle		501.0 ± 2.0		
Lower / Early		513.0 ± 2.0		
		542.0 ± 1.0		

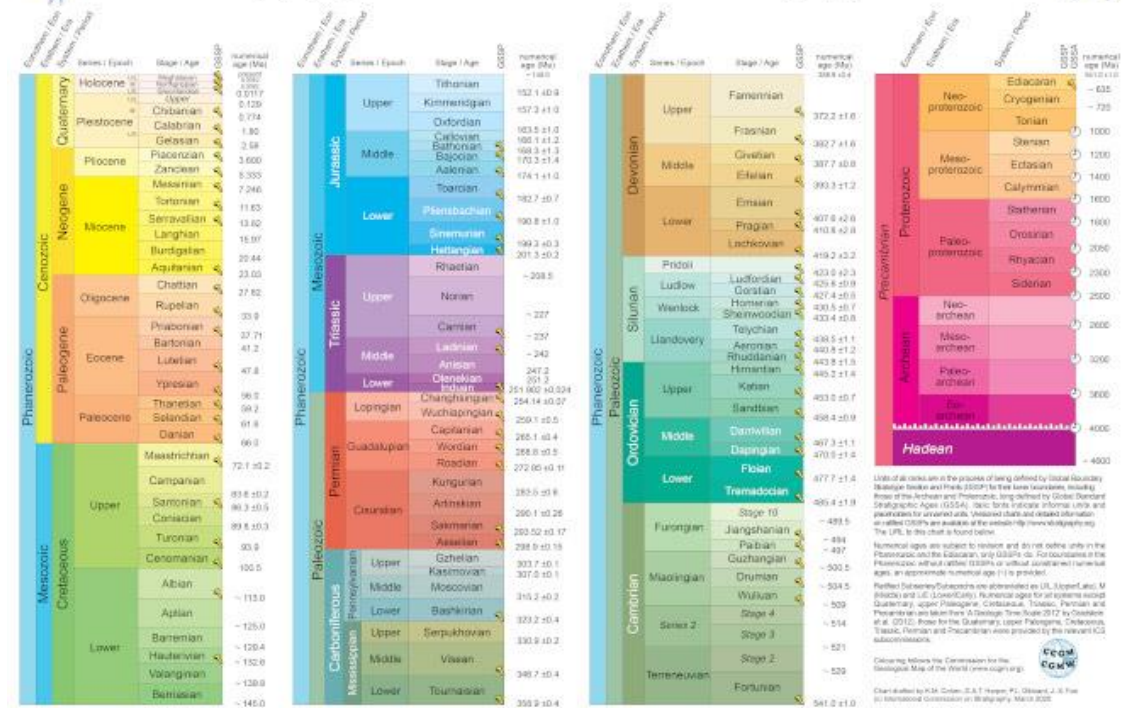
EONOTHEM / EON	ERATHEM / ERA	SYSTEM / PERIOD **	Age estimates of boundaries in mega-annum (Ma) unless otherwise noted
Proterozoic (E)	Neoproterozoic (Y)	Ediacaran	635*
		Cryogenian	
		Tonian	850
		Stenian	1000
		Ectasian	1200
	Paleoproterozoic (X)	Calymmian	1400
		Statherian	1600
		Orosirian	1800
		Rhyacian	2050
		Siderian	2300
		2500	

EONOTHEM / EON	ERATHEM / ERA	SYSTEM / PERIOD **	Age estimates of boundaries in mega-annum (Ma) unless otherwise noted
Hadean (pA)	Eoarchean		~4600*
Archean (A)	Paleoarchean		3600
			3200
	Mesoarchean		2800
	Neoarchean		2500

Lexicon: United States, Canada, and Mexico (North America) <https://ngmdb.usgs.gov/Geolex/search>

Geologic Time - International Commission on Stratigraphy

International Chronostratigraphic Chart, 2020: <https://stratigraphy.org/chart>



List of all units and the position of being defined by lower boundary (stage/epoch) and upper boundary (stage/epoch) for the lower boundary, including those of the Archaean and Proterozoic, long defined by Global Boundary Stratigraphic Columns (GSC), plus some evidence, informal units and parameters for various units. Unpublished data and detailed information on other OSDPs are available at the website <http://www.stratigraphy.org>. The URL to this chart is found below.

Numerical ages are subject to revision and do not define units in the Phanerozoic and the Ediacaran, but define only the boundaries in the Phanerozoic without either OSDPs or without correlation to numerical ages. An approximate numerical age (t) is provided.

Revised Suberian/Palaeoarchaean are abbreviated as ULL, Super-Late, M (Archaean) and ULL (Lower/Early) Archaean ages for all systems except Suberian; upper Proterozoic: Cambrian, Triassic, Permian and Pleistocene are taken from A Geological Time Scale 2012 by Gradstein et al. (2012). Dates for the Quaternary, Upper Paleolithic, Cenozoic, Tertiary, Permian and Carboniferous were provided by the relevant ICS sub-commissions.

Coloring follows the Commission for the Stratigraphic Map of the World (www.csmw.org/).

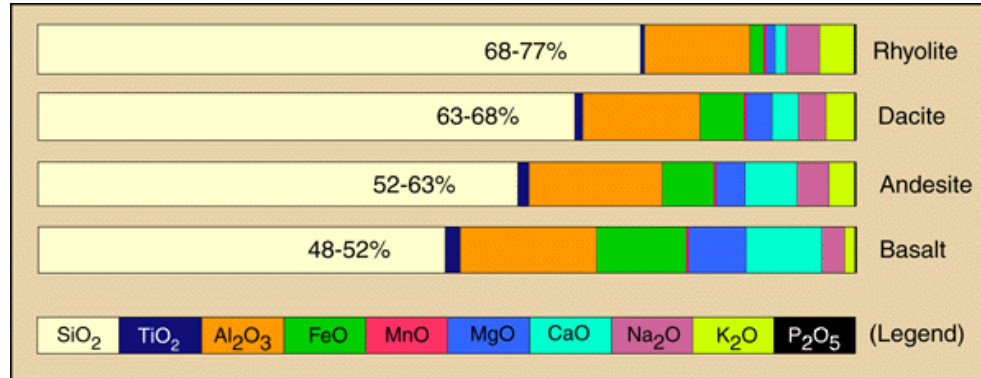
Chart drafted by R.M. Cohen, J.A.F. Harper, P.G. Meade, J.J. Beil in International Commission on Stratigraphy, March 2020.

In collaboration with: P. F. Raven, S.C. Chivers, P.J. A. Van, J.J. Beil (2019) updated. The ICS International Chronostratigraphic Chart, Edinburgh, 2019, 204 pp.

URL: <http://www.stratigraphy.org/ICSDates/ICSDatedChron2020-03.pdf>

Igneous Rocks

Major Chemical Elements Forming Igneous Rocks



June 6, 2018 The vigorous lava fountain at Fissure 8 reached heights of 45 m (150 ft) as shown in this image taken around 9:30 AM.

Eruption of Mount St. Helens. Oblique aerial view of the eruption of May 18, 1980, which sent volcanic ash, steam, water, and debris to a height of 60,000 feet.



Abundant Elements in the Earth's Crust

Oxygen, O

Silicon, Si

Aluminum, Al

Iron, Fe

Calcium, Ca

Sodium, Na

Potassium, K

Magnesium, Mg

Periodic Table of Elements

A Resource for Elementary, Middle School, and High School Students

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Period 1	1 H 1.008																	2 He 4.003
Period 2	3 Li 6.94	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
Period 3	11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
Period 4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.79
Period 5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.96	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
Period 6	55 Cs 132.9	56 Ba 137.3	*	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.5	81 Tl 204.38	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
Period 7	87 Fr (223)	88 Ra (226)	**	104 Rf (261)	105 Db (268)	106 Sg (271)	107 Bh (270)	108 Hs (277)	109 Mt (276)	110 Ds (281)	111 Rg (280)	112 Cn (285)	113 Uut (284)	114 Fl (289)	115 Uup (288)	116 Lv (293)	117 Uus (294)	118 Uuo (294)

Lanthanide Series*	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinide Series**	89 Ac (227)	90 Th 232	91 Pa 231	92 U 238	93 Np (243)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

Alkali metals	Lanthanides
Alkaline earth metals	Actinides
Transition metals	Nonmetals
Post-transition metals	Halogens
Metalloid	Noble gases

Los Alamos National Laboratory

<http://periodic.lanl.gov/>

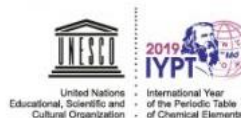
IUPAC Periodic Table of the Elements

1 H hydrogen 1.008 (1.0078, 1.0082)																	18 He helium 4.0026						
3 Li lithium 6.94 (6.938, 6.947)	4 Be beryllium 9.0122	Key: atomic number Symbol name conventional atomic weight standard atomic weight														13 B boron 10.81 (10.806, 10.821)	14 C carbon 12.011 (12.009, 12.012)	15 N nitrogen 14.007 (14.006, 14.008)	16 O oxygen 15.999 (15.999, 16.000)	17 F fluorine 18.998	10 Ne neon 20.180		
11 Na sodium 22.990	12 Mg magnesium 24.305 (24.304, 24.307)																	13 Al aluminium 26.982	14 Si silicon 28.086 (28.084, 28.088)	15 P phosphorus 30.974	16 S sulfur 32.06 (32.059, 32.071)	17 Cl chlorine 35.45 (35.446, 35.457)	18 Ar argon 39.948 (39.962, 39.963)
19 K potassium 39.098	20 Ca calcium 40.078(4)	21 Sc scandium 44.956	22 Ti titanium 47.867	23 V vanadium 50.942	24 Cr chromium 51.996	25 Mn manganese 54.938 (54.938, 54.942)	26 Fe iron 55.845 (55.845(2))	27 Co cobalt 58.933	28 Ni nickel 58.693	29 Cu copper 63.546 (63.546(2))	30 Zn zinc 65.38	31 Ga gallium 69.723	32 Ge germanium 72.630(8)	33 As arsenic 74.922	34 Se selenium 78.9718	35 Br bromine 79.904 (79.901, 79.907)	36 Kr krypton 83.798(2)						
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224(2)	41 Nb niobium 92.906	42 Mo molybdenum 95.94	43 Tc technetium	44 Ru ruthenium 101.07(2)	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60(3)	53 I iodine 126.90	54 Xe xenon 131.29						
55 Cs caesium 132.91	56 Ba barium 137.33	57-71 lanthanoids	72 Hf hafnium 178.49(2)	73 Ta tantalum 180.95	74 W tungsten 183.84	75 Re rhenium 186.21	76 Os osmium 190.23(3)	77 Ir iridium 192.22	78 Pt platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38, 204.38(1)	82 Pb lead 207.2	83 Bi bismuth 208.98	84 Po polonium	85 At astatine	86 Rn radon						
87 Fr francium	88 Ra radium	89-103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium	113 Nh nihonium	114 Fl flerovium	115 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganeson						



57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium	62 Sm samarium 150.36(2)	63 Eu europium 151.96	64 Gd gadolinium 157.25(3)	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.05	71 Lu lutetium 174.97
89 Ac actinium	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

For notes and updates to this table, see www.iupac.org. This version is dated 1 December 2018.
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Standard Atomic Weights, 2017 from International Union of Pure and Applied Chemistry (IUPAC) <http://ciaaw.org/atomic-weights.htm>

CIAAW

 COMMISSION ON
ISOTOPIC ABUNDANCES AND ATOMIC WEIGHTS

 INTERNATIONAL UNION OF
PURE AND APPLIED CHEMISTRY

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STANDARD ATOMIC WEIGHTS

Standard atomic weights are CIAAW recommended values for atomic weights applicable to all normal materials. Since 1902, the Commission regularly publishes critical evaluation of atomic weights of elements and below is the most recent definitive table of the standard atomic weights.

STANDARD ATOMIC WEIGHTS 2017

Z	Symbol	Element	Standard Atomic Weight	Notes
1	H	hydrogen	[1.007 84, 1.008 11]	m
2	He	helium	4.002 602(2)	g r
3	Li	lithium	[6.938, 6.997]	m
4	Be	beryllium	9.012 1831(5)	
5	B	boron	[10.806, 10.821]	m
6	C	carbon	[12.0096, 12.0116]	
7	N	nitrogen	[14.006 43, 14.007 28]	m
8	O	oxygen	[15.999 03, 15.999 77]	m
9	F	fluorine	18.998 403 163(6)	
10	Ne	neon	20.1797(6)	g m

Citation

The most recent Standard Atomic Weights are presented in this Table and they are based on the "Atomic Weights 2013" report and on the subsequent revisions that were made by the CIAAW in 2015 and in 2017. The IUPAC Technical Report "Atomic weights of the elements 2017" will be published in the *Pure and Applied Chemistry*.

This Table can be cited as follows:
CIAAW. **Atomic weights of the elements 2017**. Available online at www.ciaaw.org.

There are three broad groups of elements depending on what is the main cause of the uncertainty of their standard atomic weights:

- (1) well-documented natural variations of isotopic abundances,
- (2) our ability to determine the isotopic abundances, and
- (3) our ability to precisely determine the atomic masses of the isotopes.

Elements in the first category are distinguished by an interval standard atomic weight.


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Worth the Weight: New Table Aims to Clarify Variable Atomic Weight Values

Release Date: MARCH 7, 2017

The new table includes both standard and conventional atomic weights values to clarify that many atomic weights have natural variation and to provide single values for chemical education use.

Those left confused by recent updates to the table of standard atomic weights, whose values appear on the periodic table of elements, have reason to celebrate.

Three scientists from the U.S. Geological Survey, the International Union of Pure and Applied Chemistry (IUPAC), and the Brookhaven National Laboratory have prepared a new table meant to clarify atomic weights.

For the first time, a single table containing both four-digit standard atomic weight values and conventional atomic weight values, for those elements with standard atomic weights given as intervals, is available, making it easier for teachers to demonstrate that the atomic weights of many elements have natural variation and are not constants of nature. Additionally, students and others can select a single value for molecular calculations.

The atomic weights of more than half of the elements have some variability. To indicate this, in 2009 and 2011 the Commission on Isotopic Abundances and Atomic Weights, of the IUPAC, replaced single-value standard atomic weight values with atomic weight intervals for 12 elements, whose variations are well known: hydrogen, lithium, boron, carbon, nitrogen, oxygen, magnesium, silicon, sulfur, chlorine, bromine, and thallium. For example, the four-digit standard atomic weight of sulfur became the interval [32.06, 32.08].

This change, while representative of the true atomic weights of elements, presented its own problem: teachers and students did not know what value to use in classroom problems, like molecular calculations. With the new table, teachers can easily demonstrate to students that several chemical elements have variable atomic weight values depending upon their source, and when a single value is needed, such as for molecular calculations, the same row in the table indicates that the single-value conventional atomic weight can be used.

"As a young student of chemistry, I was taught that the atomic weights of the elements on the periodic table were constants of nature," said Tyler Coplen, Director of the Reston Stable Isotope Laboratory. "It took me decades to discover that standard atomic weights of a dozen elements are variable and should be displayed as intervals in textbooks. These are old variations."



For sulfur, the four-digit conventional atomic weight is 32.06 and the standard atomic weight is the interval [32.06, 32.08]. (Public domain.)

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USGS News: Everything
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Worth the Weight: New Table Aims to Clarify Variable Atomic Weight Values

<https://www.usgs.gov/news/worth-weight-new-table-aims-clarify-variable-atomic-weight-values>

Journal of Chemical Education:

Clarifying Atomic Weights: A 2016 Four-Figure Table of Standard and Conventional Atomic Weights

<https://pubs.acs.org/doi/10.1021/acs.jchemed.6b00510>

Chemistry!

Frank Wigglesworth Clarke: A chemist that determined the composition of Earth's Crust ; "Father of Geochemistry"

- One of the Founders of the American Chemical Society (ACS), (President of ACS in 1901)
- Worked at USGS from 1873 to 1925, USGS Atomic Weights Series

U.S. Geological Survey Publications: <https://pubs.er.usgs.gov/search?q=Frank+Wigglesworth+Clarke>

Examples:

1895: The constitution of the silicates, USGS Bulletin 125

<https://pubs.er.usgs.gov/publication/b125>

1903: Mineral analyses from the laboratories of the United States Geological Survey, 1880 to 1903, USGS Bulletin 220:

<https://pubs.er.usgs.gov/publication/b220>

1908: The data of geochemistry, USGS Bulletin 330 <https://pubs.er.usgs.gov/publication/b330>

1924: The composition of the river and lake waters of the United States, USGS PP 135

<https://pubs.er.usgs.gov/publication/pp135>

Biographical Memoir of Frank Wigglesworth Clarke 1847-1931:

<http://www.nasonline.org/publications/biographical-memoirs/memoir-pdfs/clarke-frank-w-1847-1931.pdf>

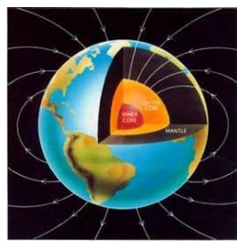


Beryl (a beryllium-aluminum silicate)



Uranophane. Monoclinic crystallography. Uranophane is one of the many secondary uranium minerals. It is unusual in being a silicate but it shows the bright yellow color of the secondary uranium ores.

The Water on Earth

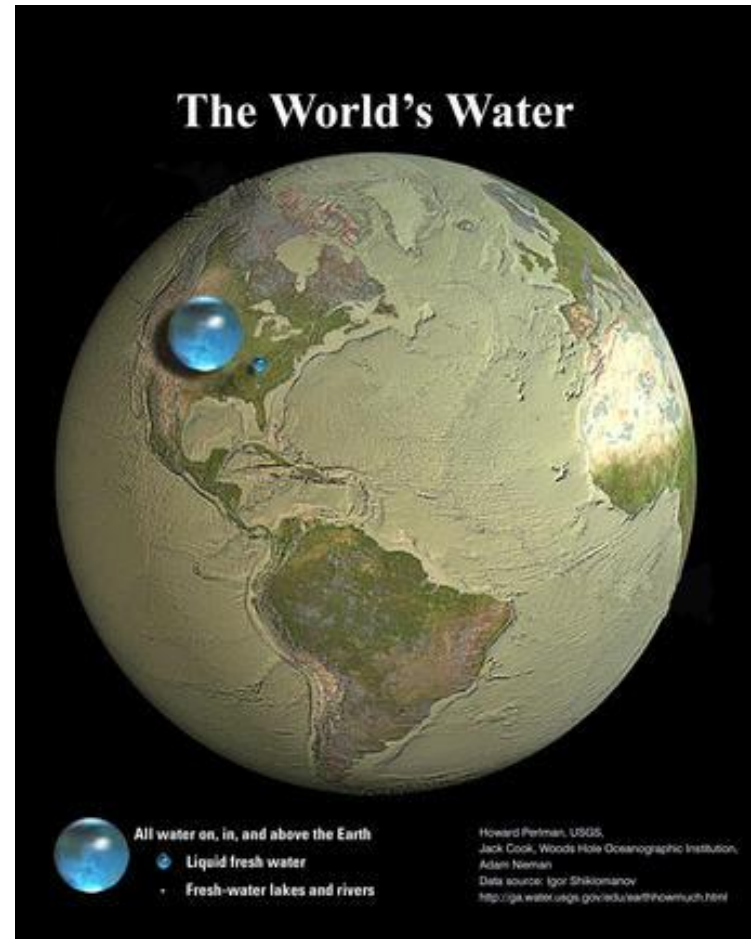


All Earth's freshwater, liquid fresh water, and water in lakes and rivers

Spheres showing:

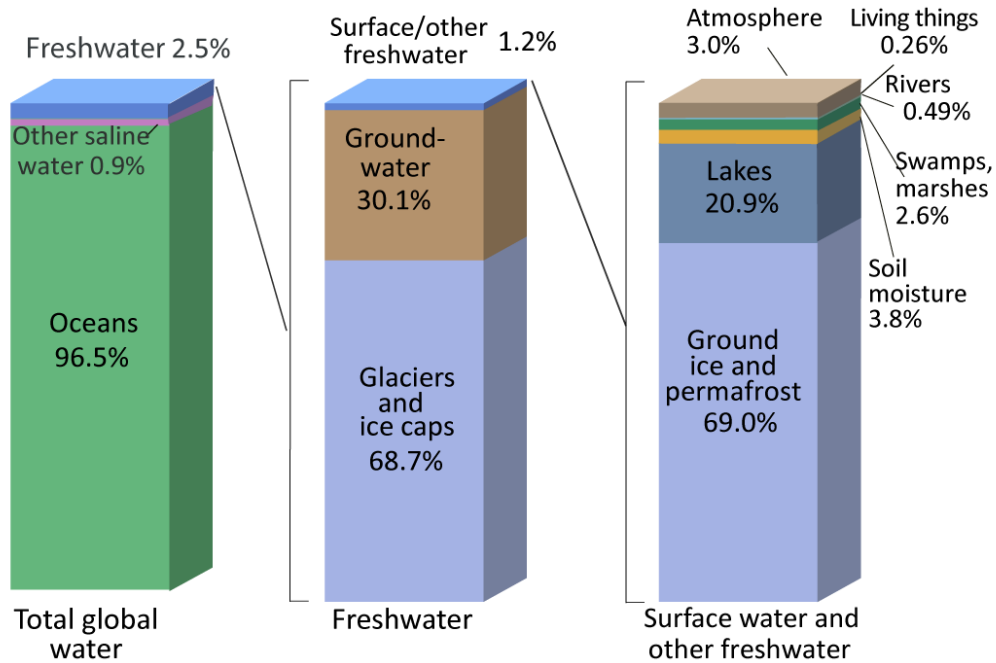
- (1)** All water (sphere over western U.S., 860 miles in diameter)
- (2)** Fresh liquid water in the ground, lakes, swamps, and rivers (sphere over Kentucky, 169.5 miles in diameter), and
- (3)** Fresh-water lakes and rivers (sphere over Georgia, 34.9 miles in diameter).

<https://www.usgs.gov/media/images/all-earths-water-a-single-sphere>

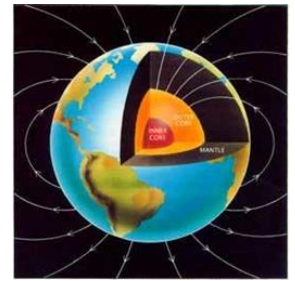


The Water on Earth

Where is Earth's Water?



Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, *Water in Crisis: A Guide to the World's Fresh Water Resources*. (Numbers are rounded).



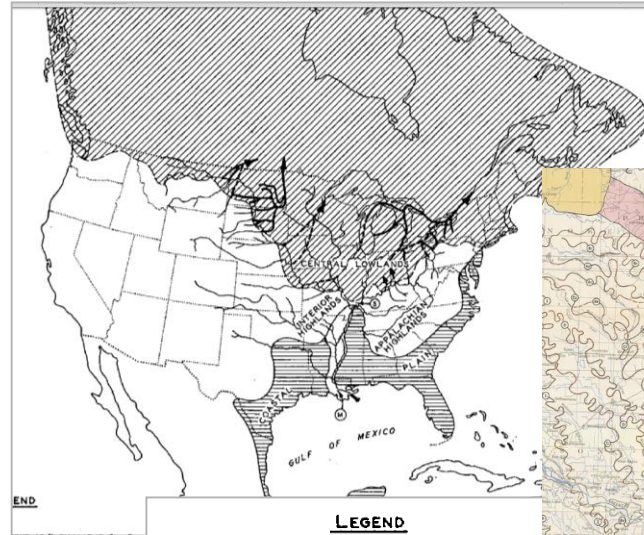
https://www.usgs.gov/special-topic/water-science-school/science/where-earths-water?qt-science_center_objects=0#qt-science_center_objects



Cretaceous Western Interior Seaway.

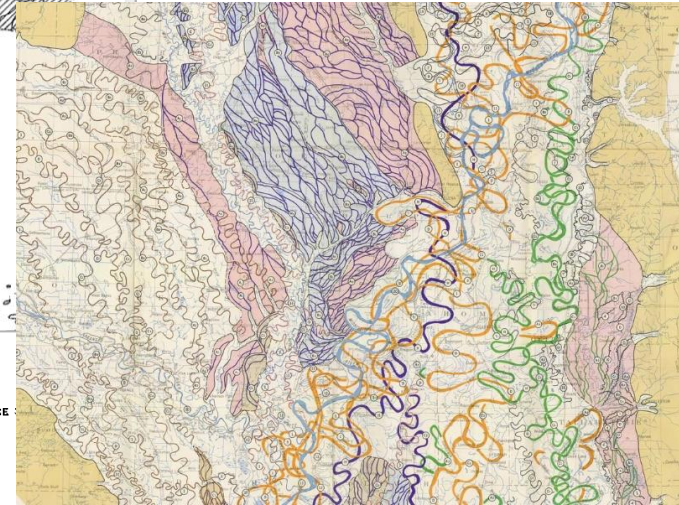
Colorado was covered by a shallow, temperate sea.

<https://pubs.usgs.gov/pp/1561/report.pdf>



LEGEND

- MAXIMUM EXTENT OF PLEISTOCENE ICE
- EXISTING ICE SHEETS
- COASTAL PLAIN
- MISSISSIPPI RIVER DRAINAGE SYSTEM
- PRE-GLACIAL DRAINAGE RECONSTRUCTED
- PRE-GLACIAL DRAINAGE HYPOTHETICAL
- SHAWNEETOWN RIDGE
- MISSISSIPPI RIVER ALLUVIAL VALLEY

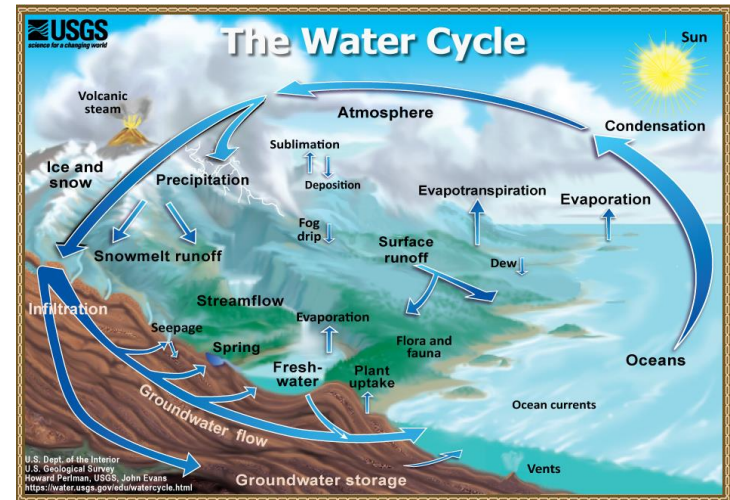


[26. Plate 15 \(Sheet 2\): Stream courses in the alluvial valley -- north-central part](#)

What is Hydrology?

Hydrology is the study of water encompasses the occurrence, distribution, movement and properties of the waters of the Earth and their relationship with the environment within each phase of the hydrologic cycle (water cycle)

<https://water.usgs.gov/edu/hydrology.html>



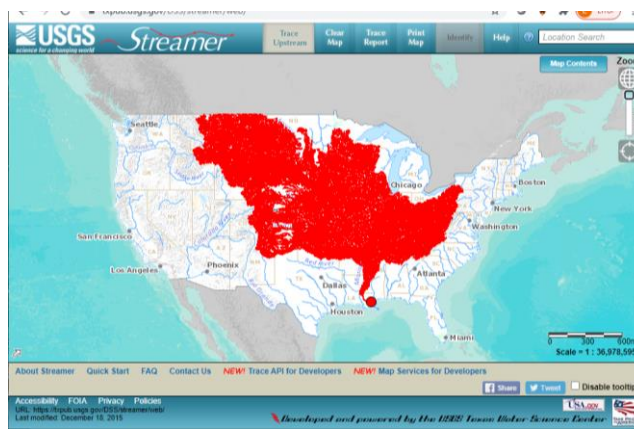
<https://water.usgs.gov/edu/watercycle-kids.html>

* Available for most languages on Earth

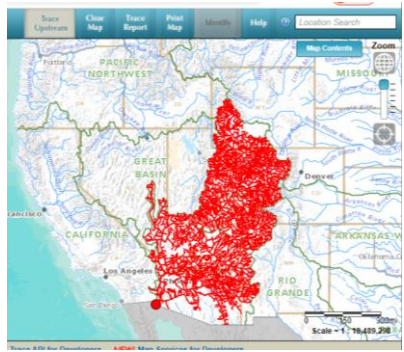
<https://water.usgs.gov/edu/watercycle.html>

Hydrology Basics

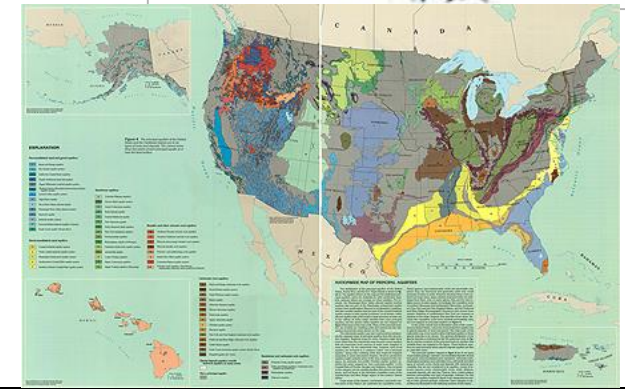
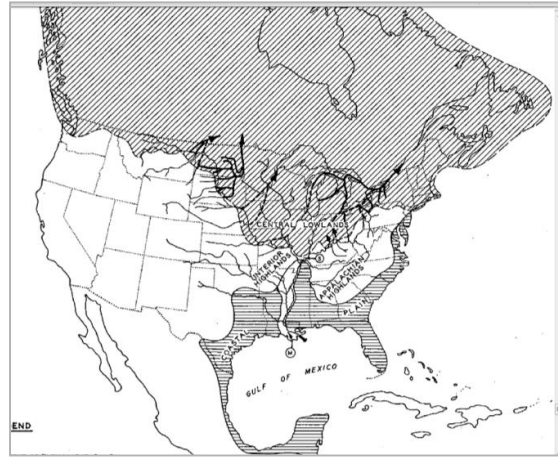
<https://txpub.usgs.gov/DSS/streamer/web/>



Downstream Trace



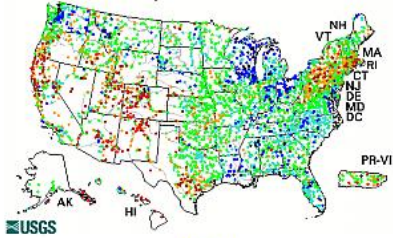
Upstream Trace



Hydrology Basics

Current Streamflow

Saturday, October 24, 2020 10:30ET



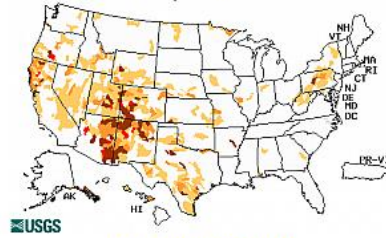
Flood

Saturday, October 24, 2020 10:30ET



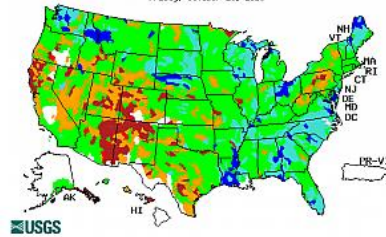
Drought

Friday, October 23, 2020



Past Flow/Runoff

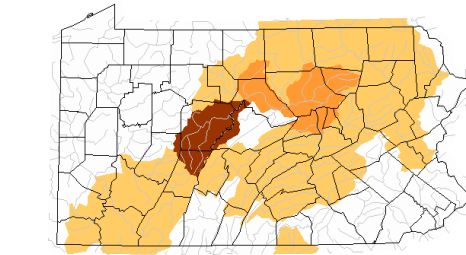
Friday, October 23, 2020



Search USGS streamgage

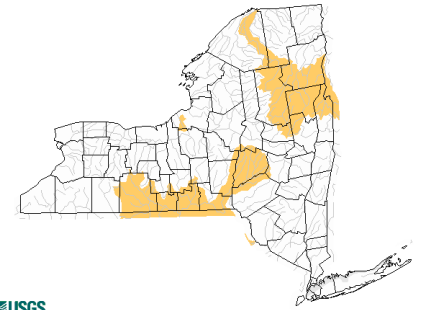
USGS WaterWatch

Friday, October 23, 2020



USGS

Friday, October 23, 2020

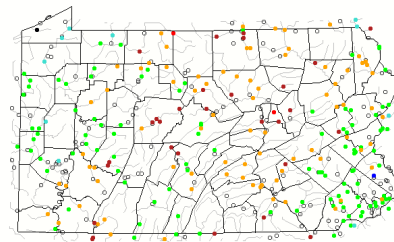


USGS

Explanation - Percentile classes

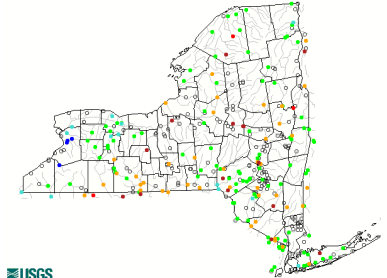
Low	<=5	6-9	10-24
Extreme hydrologic drought	Severe hydrologic drought	Moderate hydrologic drought	Below normal

Saturday, October 24, 2020 11:30ET



USGS

Saturday, October 24, 2020 11:30ET

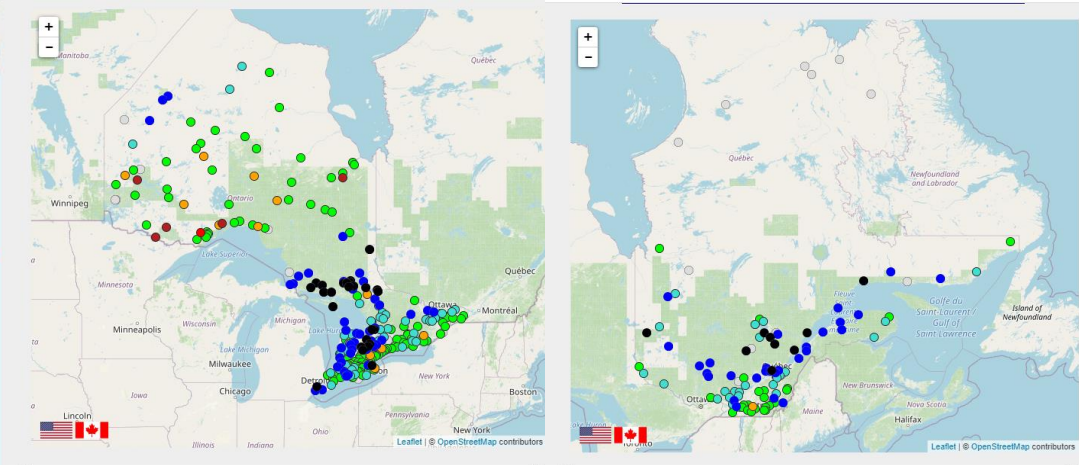
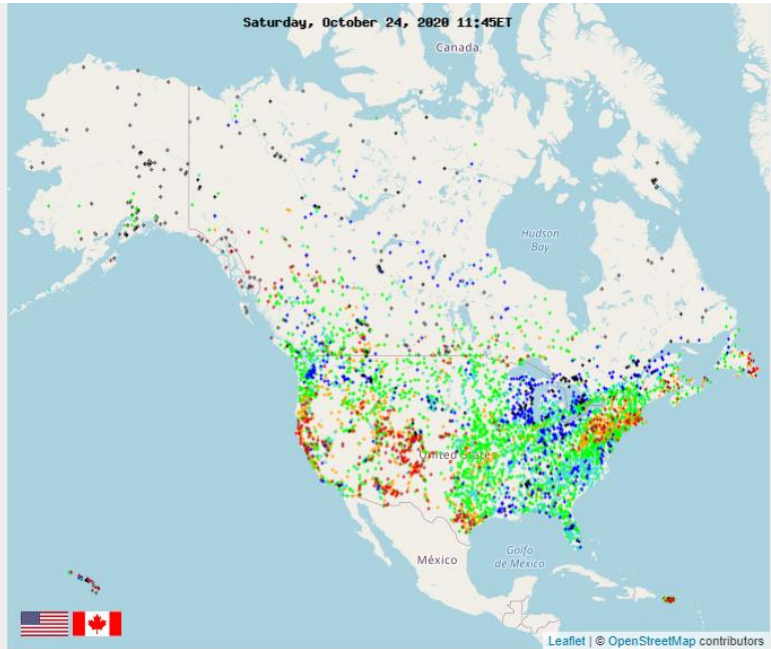


USGS

Explanation - Percentile classes

●	●	●	●	●	●	●	○
Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

Hydrology Basics



North America WaterWatch

<https://watermonitor.gov/naww/>

Explanation - Percentile classes							
	●	●	●	●	●	●	○
Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High	Not-ranked



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Data Series 529

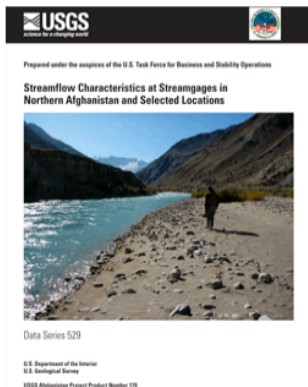
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Prepared under the auspices of the U.S. Task Force for Business and Stability Operations

Streamflow Characteristics at Streamgages in Northern Afghanistan and Selected Locations

By Scott A. Olson and Tara Williams-Sether

ABSTRACT



Statistical summaries of streamflow data for 79 historical streamgages in Northern Afghanistan and other selected historical streamgages are presented in this report. The summaries for each streamgage include (1) station description, (2) graph of the annual mean discharge for the period of record, (3) statistics of monthly and annual mean discharges, (4) monthly and annual flow duration, (5) probability of occurrence of annual high discharges, (6) probability of occurrence of annual low discharges, (7) probability of occurrence of seasonal low discharges, (8) annual peak discharges for the period of record, and (9) monthly and annual mean discharges for the period of record.

First posted September 8, 2010

- [Report PDF \(5.60 MB\)](#)

For additional information contact:

[Chief](#),

International Water Resources Branch

U.S. Geological Survey

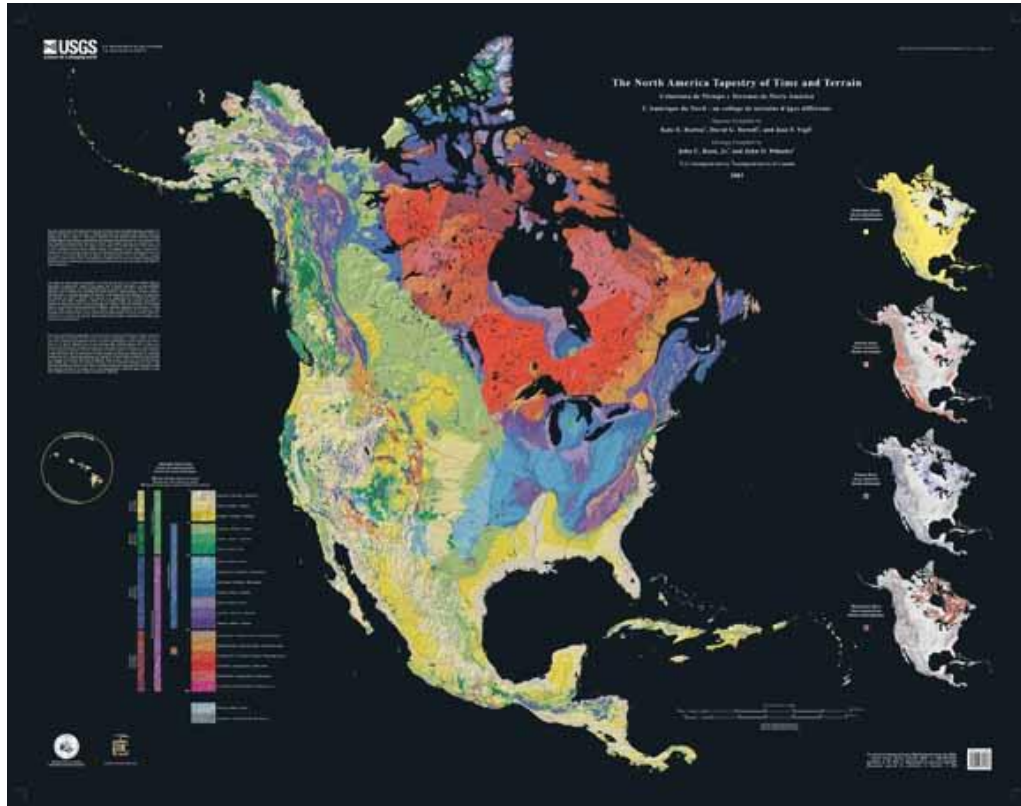
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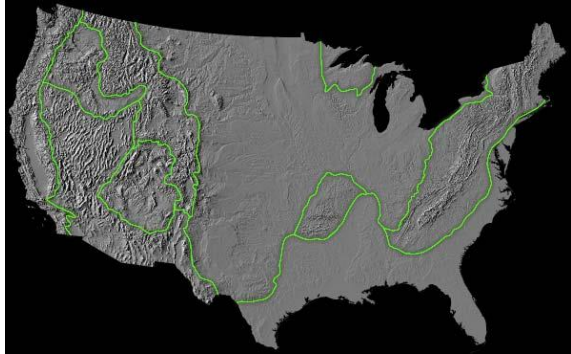
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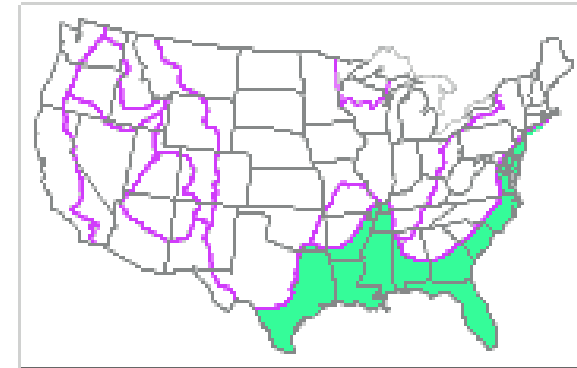
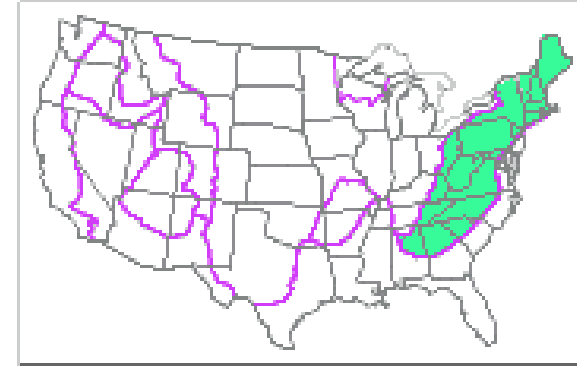


The North America Tapestry of Time and Terrain (1:8,000,000 scale) is a product of the US Geological Survey in the I-map series (I-2781). This map was prepared in collaboration with the Geological Survey of Canada and the Mexican Consejo Recursos de Minerales.

Geologic Provinces

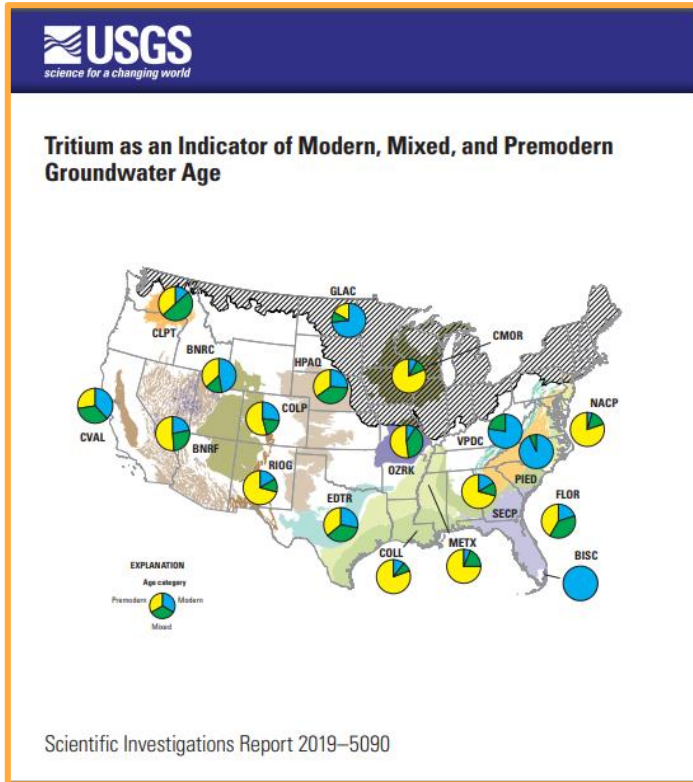


- Atlantic Plain Province
- Appalachian Highlands Province
- Laurentian Upland Province - Superior Upland
- Interior Plain Province
- Ouachita-Ozark Interior Highlands
- Rocky Mountains
- Colorado Plateau Province
- Columbia Plateau Province
- Basin and Range Province
- Pacific Province
- Alaska
- Hawai'i



<https://pubs.usgs.gov/imap/i2720/>

Groundwater Age: <https://www.usgs.gov/mission-areas/water-resources/science/groundwater-age>



Why does groundwater age matter? Young groundwater is more likely than old groundwater to have contaminants from recent manmade sources, such as pesticides, nitrate, and solvents, because those chemicals were applied to or released on the landscape when the young groundwater recharged the aquifer. For example, water that entered the aquifer after 1950 is more likely than older water to contain the herbicide atrazine, whose use has increased since that time. On the other hand, old groundwater is more likely than young groundwater to have contaminants from natural sources, such as metals and radionuclides, because old groundwater can spend thousands of years in contact with and reacting with aquifer rocks and minerals that might contain these elements. The geochemical processes that frequently occur in old water, such as **redox reactions**, can profoundly affect groundwater quality.

<https://pubs.er.usgs.gov/publication/sir20195090>

Introduction 7

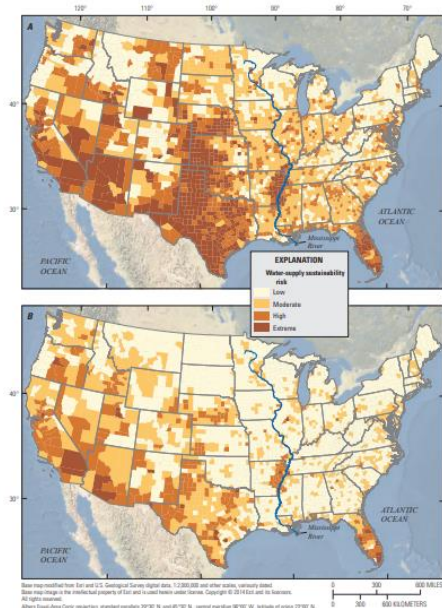


Figure 1. Water-supply sustainability risk index for the conterminous United States in 2050 linking water demand A, to population growth, increases in power generation, and climate change and B, to population growth and increases in power generation. Modified from Roy and others (2012).

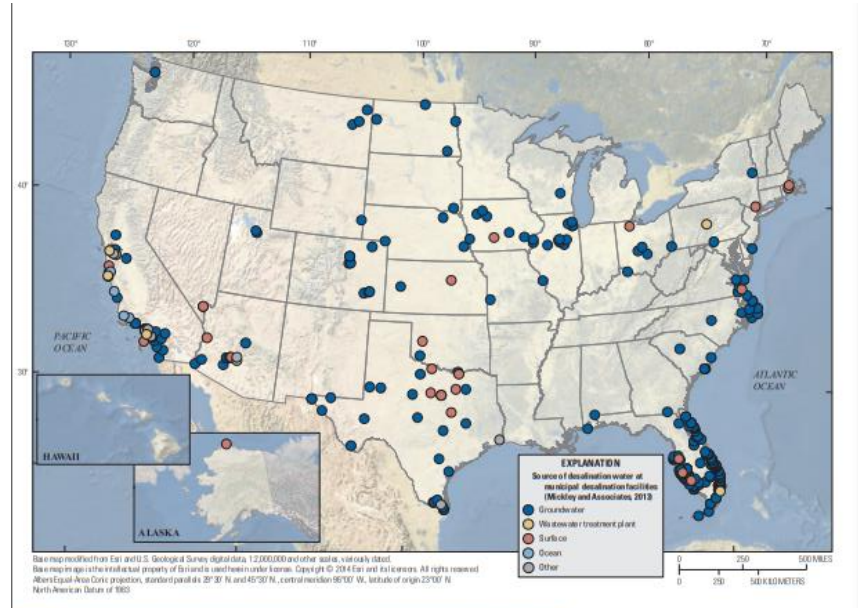


Figure 2. Locations and sources of desalination water at municipal desalination facilities in the United States in 2010.

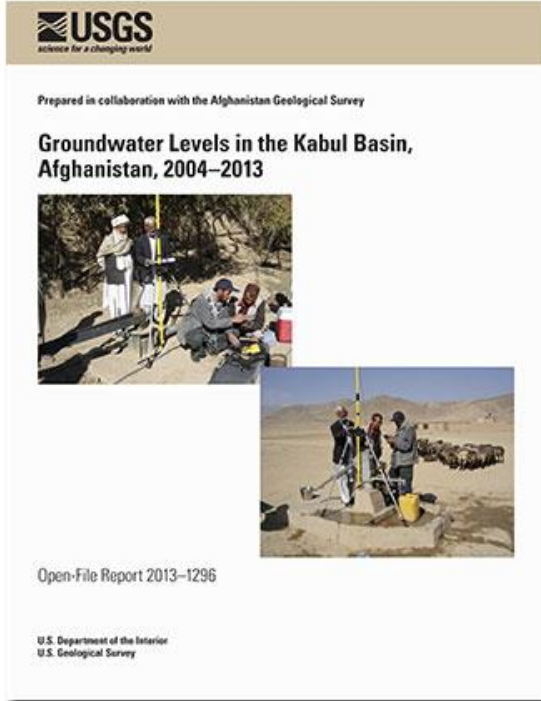
Figure 2. Locations and sources of desalination water at municipal desalination facilities in the United States in 2010

Groundwater Levels in the Kabul Basin, Afghanistan, 2004–2013

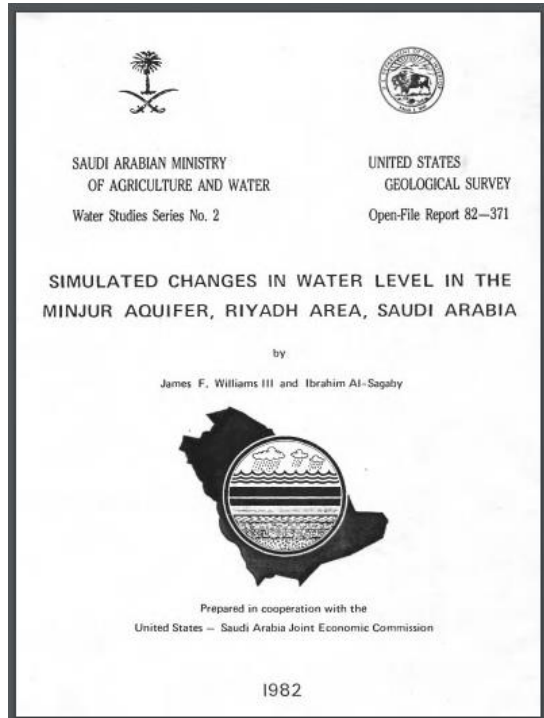
By Mohammad R. Taher, Michael P. Chornack, and Thomas J. Mack

Abstract

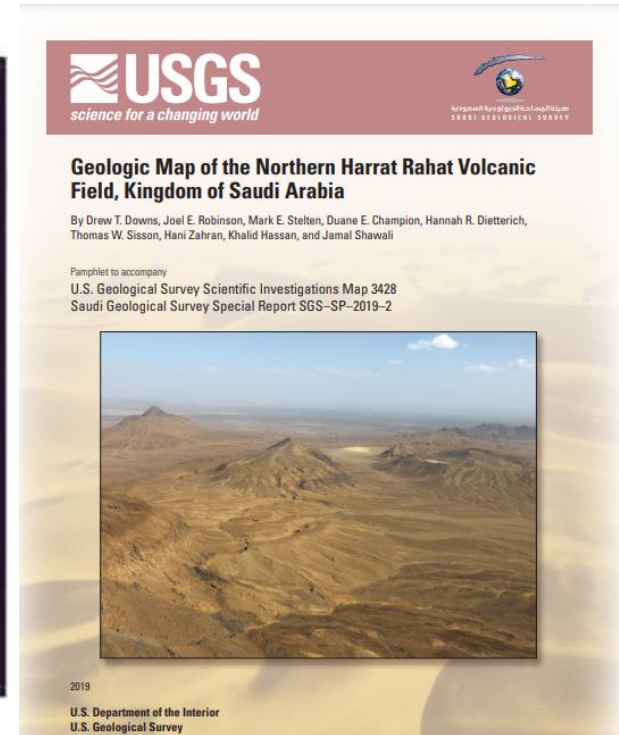
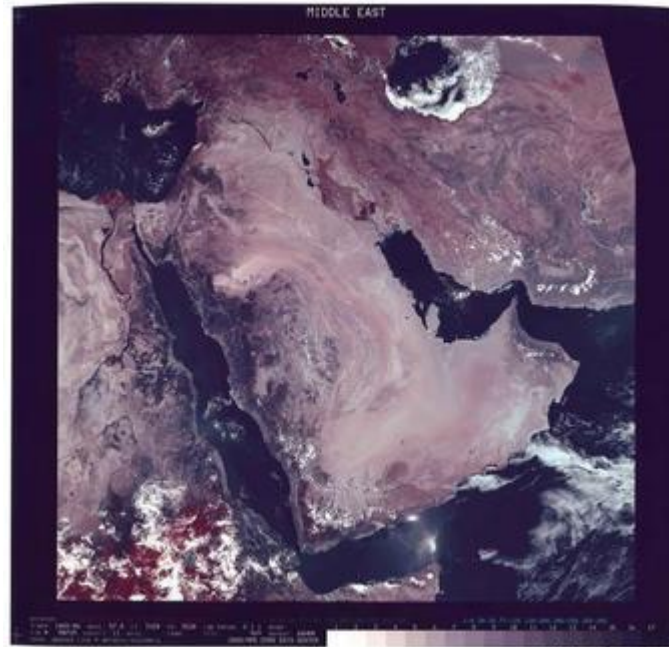
The Afghanistan Geological Survey, with technical assistance from the U.S. Geological Survey, established a network of wells to measure and monitor groundwater levels to assess seasonal, areal, and potentially climatic variations in groundwater characteristics in the Kabul Basin, Afghanistan, the most populous region in the country. Groundwater levels were monitored in 71 wells in the Kabul Basin, Afghanistan, starting as early as July 2004 and continuing to the present (2013). The monitoring network is made up exclusively of existing production wells; therefore, both static and dynamic water levels were recorded. Seventy wells are in unconsolidated sediments, and one well is in bedrock. Water levels were measured periodically, generally monthly, using electric tape water-level meters. Water levels in well 64 on the grounds of the Afghanistan Geological Survey building were measured more frequently. This report provides a 10-year compilation of groundwater levels in the Kabul Basin prepared in cooperation with the Afghanistan Geological Survey.



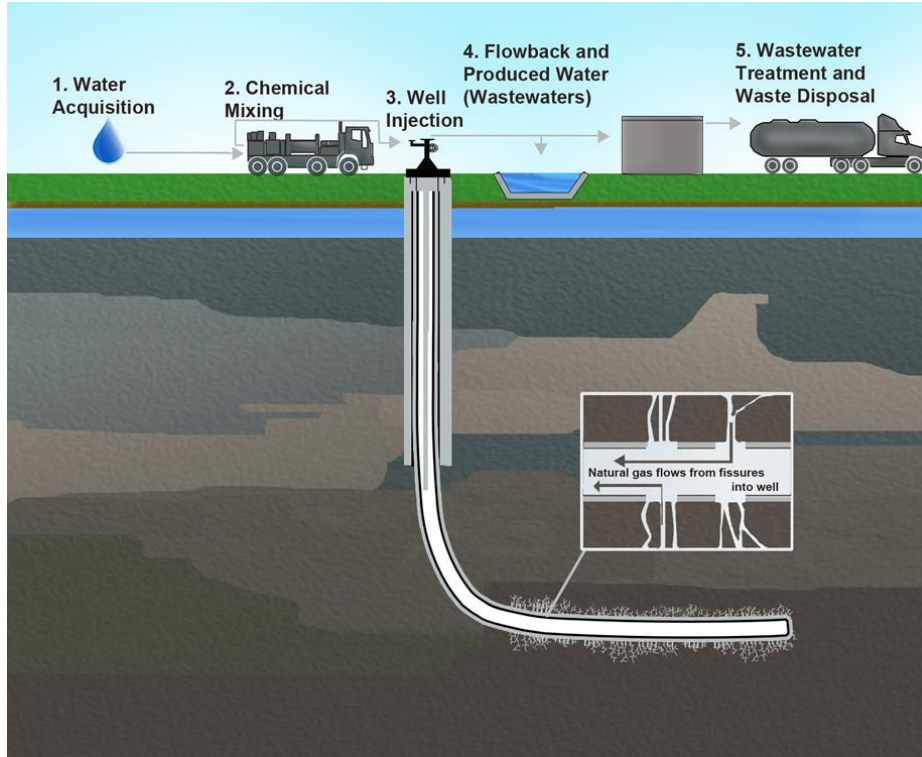
<https://pubs.usgs.gov/of/2013/1296/>



<https://pubs.usgs.gov/of/1982/0371/report.pdf>



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Hydraulic fracturing (informally known as hydrofracking, fracking, fracing, or hydrofracturing) is a process that typically involves injecting water, sand, and (or) chemicals under high pressure into a bedrock formation via a well. This process is intended to create new fractures in the rock as well as increase the size, extent, and connectivity of existing fractures.

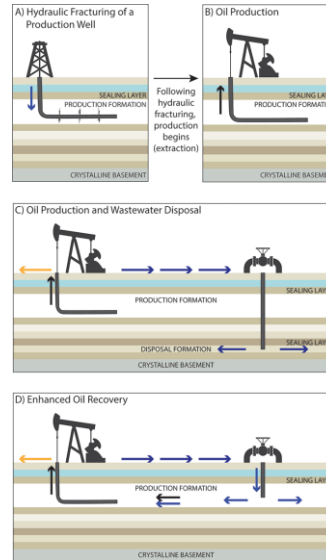
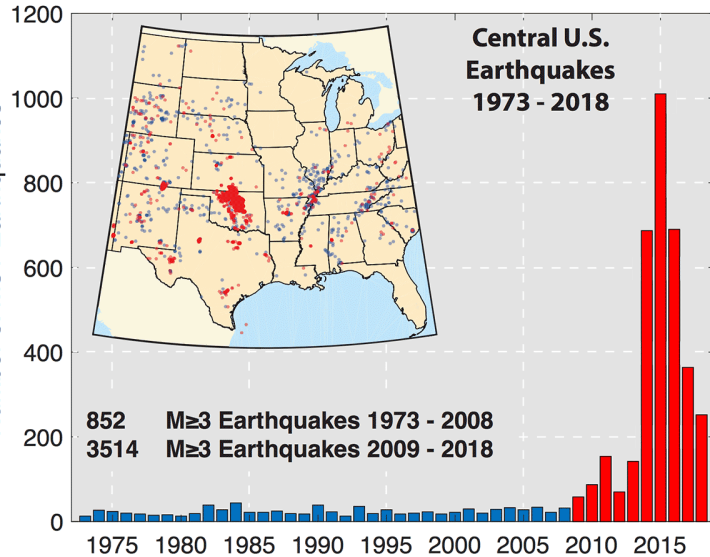
Hydraulic fracturing is a well-stimulation technique used commonly in low-permeability rocks like tight sandstone, shale, and some coal beds to increase oil and/or gas flow to a well from petroleum-bearing rock formations. A similar technique is used to create improved permeability in underground geothermal reservoirs. A form of hydraulic fracturing is also used in low permeability sediments and other tight subsurface formations to increase the efficiency of soil vapor extraction and other technologies used in remediating contaminated sites.

Energy Program: Environmental Aspects



Produced Waters Database

The primary objective of this project is to provide information on the volume, quality, impacts, and possible uses of water produced during generation and development of energy resources (particularly hydrocarbons) as well as related fluids injected into reservoirs for energy development and associated waste disposal.



USGS Publications Access Points

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<https://ngmdb.usgs.gov>

Geology and Hydrology Maps

TopoView = Topographic Maps

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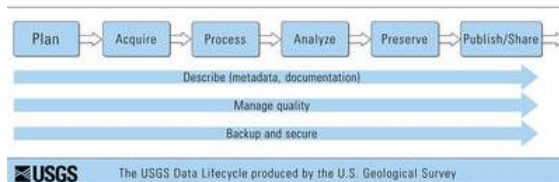
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[Drought forecasting for streams and groundwaters in northeastern United States](#)
Samuel H. Austin, Robert W. Dudley
2019, Fact Sheet 2019-3015



Faundeen, J.L., Burley, T.E., Carlino, J.A., Govoni, D.L., Henkel, H.S., Holl, S.L., Hutchison, V.B., Martín, Elizabeth, Montgomery, E.T., Ladino, C.C., Tessler, Steven, and Zolly, L.S., 2013, The United States Geological Survey Science Data Lifecycle Model: U.S. Geological Survey Open-File Report 2013–1265, 4 p., <http://dx.doi.org/10.3133/ofr20131265>

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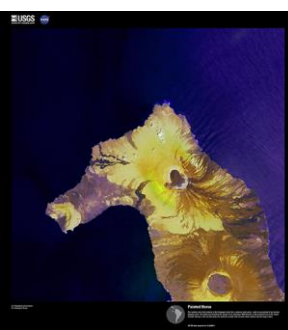
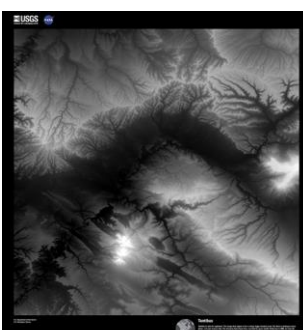
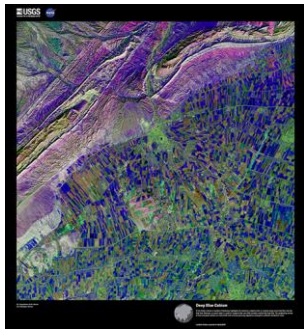
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Earth Science:

<https://www.eureka!ert.org/bysubject/earthscience.php>

Rocky Mountains:

<https://www.rmag.org/publications/publications/>

Yale E360: <https://e360.yale.edu/>



ADAPTATION

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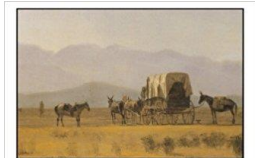
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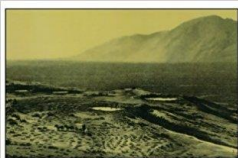
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<https://journalism.princeton.edu/people/john-mcphee/>



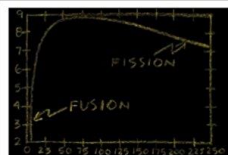
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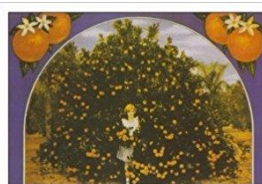
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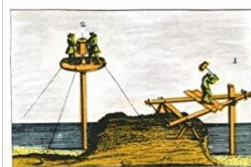
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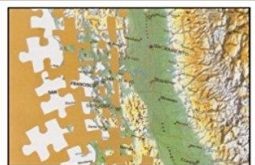
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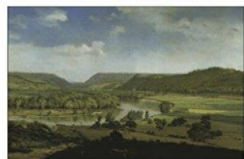
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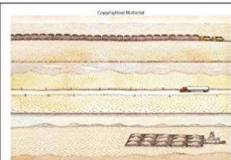
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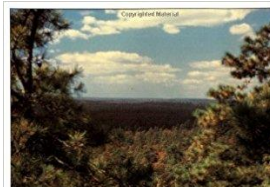
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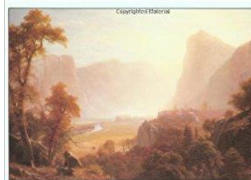
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The Survival of the Bark Canoe



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Uncommon Carriers



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Encounters with the Archdruid

Thank you!

Questions?



Nassau Hall, Princeton University

In 1783, the building served as the nation's capitol, housing the Continental Congress from June to November.