Geoscience Librarianship 101: Introduction & Instruction Tips

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

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

- 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
Chemistry, Geosciences and Environmental Studies Librarian

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?

New York State, 9th Grade, Earth Science


Professor Titus: The Catskill Geologist

https://www.hartwick.edu/academics/academic-departments/geology-environmental-sciences-department/

Hartwick Geology

https://www.usgs.gov/observatories/hawaiian-volcano-observatory

Hartwick Library

https://www.hartwick.edu/academics/stevens-german-library/

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

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

Who do I help?

“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

“Princeton in the nation’s service and the service of humanity”
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
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.
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!

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)

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)
Who is a Geoscientist?

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

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

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

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Mary Ellen Benson
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Ryan D Taylor
Russell G Tysdal

Geology, Geophysics, and Geochemistry Science Center
https://www.usgs.gov/centers/gggsc
A Geological Map of England and Wales and Part of Scotland, first published in 1815

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/

https://www.lyellcollection.org/

Open Access Collection: https://www.lyellcollection.org/cc/open-access-collection

http://www.strata-smith.com/
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](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](https://www.geosociety.org/GSA/About/Who_We_Are/Associated_Societies/GSA/About/Associated_Societies.aspx)
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.

Open-Access Journals / Series:
https://www.americangeosciences.org/information/georef/open-access-journals
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

https://www.americangeosciences.org/member-societies
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
Ex: The geology of North America [electronic resource] : an overview
: https://catalog.princeton.edu/catalog/9959130
**Geological Society of America (GSA) Associated Societies**

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** (GSIS)
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)
Geological Society of America (GSA) Associated Societies

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 (MSA)
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)
Rocky Mountain Group:
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

Research Spotlight  23 October 2020
Rising Seas and Agriculture Created Wetlands Along the U.S. East Coast
Where do societies index and publications available?
https://pubs.geoscienceworld.org/

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
- 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
Geological Surveys of the World

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

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

https://www.usgs.gov/
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
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
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)

- Total Citations
- Scholarly Journals Articles
- Books
- Dissertations & Theses
- Reports
- Other Sources

- GeoRef search, Author Affiliation = U.S. Geological Survey, 1881-2019
- U.S. Geological Survey Publications Warehouse, 1867-2019
- GeoRef search, Author Affiliation = U.S. Geological Survey, 2010-2019
- U.S. Geological Survey Publications Warehouse, 2010-2019
Part 2: Geosciences Library Instruction
Geosciences Library Instruction

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


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)
Geosciences Library Instruction

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


USGS Library Materials for Water Resources Information [https://www.fdlp.gov/usgs-library-materials-for-water-resources-information](https://www.fdlp.gov/usgs-library-materials-for-water-resources-information)


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


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


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](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](https://www.fdlp.gov/library-research-for-water-resources)

At Princeton - Undergraduates in Departments & Programs:

Chemistry: [https://chemistry.princeton.edu/](https://chemistry.princeton.edu/)

Geosciences: [https://geosciences.princeton.edu/](https://geosciences.princeton.edu/)

Environmental Studies: [https://environment.princeton.edu/](https://environment.princeton.edu/)

Policy: [https://cpree.princeton.edu/](https://cpree.princeton.edu/)

Engineering: [https://acee.princeton.edu/](https://acee.princeton.edu/)

Finance: [https://bcf.princeton.edu/](https://bcf.princeton.edu/)

Writing Seminars: [https://writing.princeton.edu/undergraduates/writing-seminars](https://writing.princeton.edu/undergraduates/writing-seminars)
“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

Geology (and Hydrology) Maps for New York & New Jersey: GeoPDFs, TIFFs, JPGs, KMZs

USGS National Geologic Map Database

New York Maps  New Jersey Maps

New York Geologic Units  New Jersey Geologic Units

Latitude & Longitude Searches
Uranium-238 Concentrations across United States from NURE

Source of data: U.S. Geological Survey Digital Data Series DDS-9, 1993
Earth

Blue Marble
https://www.usgs.gov/media/images/blue-marble-image-earth


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

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

https://pubs.usgs.gov/gip/dynamic/inside.html
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
USGS Geologic Time
2018 Divisions of Geologic Time—Major Chronostratigraphic and Geochronologic Units

~4.6 Billion Years

Geologic Time - International Commission on Stratigraphy

International Chronostratigraphic Chart, 2020: [https://stratigraphy.org/chart](https://stratigraphy.org/chart)
Igneous Rocks

Major Chemical Elements Forming Igneous Rocks

<table>
<thead>
<tr>
<th></th>
<th>Rhyolite</th>
<th>Dacite</th>
<th>Andesite</th>
<th>Basalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>68-77%</td>
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<td></td>
<td></td>
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<tr>
<td>63-68%</td>
<td></td>
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<tr>
<td>52-63%</td>
<td></td>
<td></td>
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<tr>
<td>48-52%</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>SiO$_2$</th>
<th>TiO$_2$</th>
<th>Al$_2$O$_3$</th>
<th>FeO</th>
<th>MnO</th>
<th>MgO</th>
<th>CaO</th>
<th>Na$_2$O</th>
<th>K$_2$O</th>
<th>P$_2$O$_5$</th>
</tr>
</thead>
</table>

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.

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.
Outreach & Education

Labs & Periodic Table of Elements

Abundant Elements in the Earth’s Crust

Oxygen, O
Silicon, Si
Aluminum, Al
Iron, Fe
Calcium, Ca
Sodium, Na
Potassium, K
Magnesium, Mg

Los Alamos National Laboratory
http://periodic.lanl.gov/
**International Union of Pure and Applied Chemistry (IUPAC)**


Worth the Weight: New Table Aims to 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
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

Examples:
1895: The constitution of the silicates, USGS Bulletin 125
[https://pubs.er.usgs.gov/publication/b125](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](https://pubs.er.usgs.gov/publication/b220)


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

Biographical Memoir of Frank Wigglesworth Clarke 1847-1931:

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.

Beryl (a beryllium-aluminum silicate)
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
Where is Earth’s Water?

- **Oceans**: 96.5%
- **Freshwater**: 2.5%
  - Groundwater: 30.1%
  - Surface/other freshwater: 1.2%
- **Other saline water**: 0.9%
- **Atmosphere**: 3.0%
- **Living things**: 0.26%
  - Rivers: 0.49%
  - Swamps, marshes: 2.6%
  - Soil moisture: 3.8%
- **Total global water**: 99.3%


Cretaceous Western Interior Seaway. Colorado was covered by a shallow, temperate sea.

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

Geological Investigation of the Alluvial Valley of the Lower Mississippi River, Fisk, 1944:
https://ngmdb.usgs.gov/Prodesc/proddesc_70640.htm
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

*Available for most languages on Earth

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

https://water.usgs.gov/edu/watercycle.html
North America WaterWatch
https://watermonitor.gov/naww/
Streamflow Characteristics at Streamgages in Northern Afghanistan and Selected Locations

By Scott A. Olson and Tara Williams-Setter

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.
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.
Earth Today

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/
Hydrology Basics

https://water.usgs.gov/ogw/aquifer/atlas.html

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.
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.
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/
SIMULATED CHANGES IN WATER LEVEL IN THE MINJUR AQUIFER, RIYADH AREA, SAUDI ARABIA

by

James F. Williams III and Ibrahim Al-Salaby

Prepared in cooperation with the
United States–Saudi Arabia Joint Economic Commission

1982


Geologic Map of the Northern Harrat Rahat Volcanic Field, Kingdom of Saudi Arabia


Prepared to accompany
U.S. Geological Survey Scientific Investigations Map 3428
Saudi Geological Survey Special Report SGS–SP–3013–2

https://pubs.er.usgs.gov/search?q=Kingdom+of+Saudi+Arabia

https://pubs.er.usgs.gov/publication/sim3428
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.
National Geologic Map Database: https://ngmdb.usgs.gov

Geology and Hydrology Maps

TopoView = Topographic Maps

Publications Warehouse: https://pubs.usgs.gov

ScienceBase.gov

Data.usgs.gov

DataOne (Earth Data) https://www.dataone.org/

Earth As Art!

Earth As Art 1 : https://eros.usgs.gov/image-gallery/earth-art-1

Earth As Art 2 : https://eros.usgs.gov/image-gallery/earth-art-2

Earth As Art 3 : https://eros.usgs.gov/image-gallery/earth-art-3

Earth As Art 4 : https://eros.usgs.gov/image-gallery/earth-art-4

Earth As Art 5 : https://eros.usgs.gov/image-gallery/earth-art-5

Earth As Art 6 : https://eros.usgs.gov/image-gallery/earth-art-6

https://eros.usgs.gov/image-gallery
E&E News (Subscription): https://www.eenews.net/


Eos: https://eos.org/

Eurekalert!: https://www.eurekalert.org/

Earth Science: https://www.eurekalert.org/subject/earthscience.php

Rocky Mountains: https://www.rmag.org/publications/publications/

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

ADAPTATION
Sand shortages expose beaches to rising seas

ELECTRIC VEHICLES
Study reveals why buyers shun EVs

CAMPAIGN 2020
In a debate first, environmental justice took center stage
In 1783, the building served as the nation's capitol, housing the Continental Congress from June to November.