

Geology of Wyoming—nearly 4 billion years of Earth history

GEOL 4050, Instructor: A. W. Snoke (snoke@uwyo.edu)

Class meetings: MWF, 11:00–11:50 pm, Engineering Building, Room 3106

Office hours: M: 2:00–3:00 pm, W: 2:00–3:00 pm, Th: 2:00–3:00 pm or by appointment.

Note: Assigned readings are on the University Libraries e-reserves.

Recommended reference:

Bates, R. L., and Jackson, J. A., eds., 1984, *Dictionary of Geological Terms* (3rd edition): New York, Anchor Books, 571 p. *Apparently, copies of this book are available in the “Trade Book” section of the University Bookstore (First Floor).*

General references:

Love, J. D., and Christiansen, Ann Coe, 1985, *Geologic map of Wyoming*: U.S. Geological Survey, scale 1:500,000. (*A strongly recommended purchase.*)

Love, J. D., Christiansen, Ann Coe, and Ver Ploeg, A. J., 1993, *Stratigraphic chart showing Phanerozoic nomenclature for the State of Wyoming*: Geological Survey of Wyoming MS-41. (*This chart is very useful for sorting out the complex Phanerozoic stratigraphic nomenclature of Wyoming.*)

Snoke, A. W., Steidtmann, J. R., and Roberts, S. M., eds., 1993, *Geology of Wyoming* (2 volumes + map pocket): *Geological Survey of Wyoming Memoir No. 5*, 937 p. (*This set was reprinted in 2002, and now is available in soft-back cover with a CD containing all oversized foldout plates. Please see Mr. Brendon Orr in the S.H. Knight Geology Building, Room 135, if you wish to purchase a set of these volumes.*) *Please note that the purchase of these volumes is NOT required by the instructor—all pertinent papers from these volumes are available in the Brinkerhoff Earth Resources Information Center.*

*Snoke, A. W., 1997, Geologic history of Wyoming within the tectonic framework of the North American Cordillera, in Jones, R. W., and Harris, R. E., eds., *Proceedings of the 32nd Annual Forum on the Geology of Industrial Minerals: Wyoming State Geological Survey Public Information Circular 38*, p. 1–52. (*This summary is a revised and updated version of a paper originally published under the same title [Snoke, 1993] in *Geology of Wyoming*, Wyoming State Geological Survey Memoir 5, p. 2–56.*)

Note: In regard to the reading assignments, an "*" indicates a primary reading assignment. Thus, please put your emphasis (and time) on such an assignment and read/browse the other recommended readings as time is available. We will discuss the primary reading assignments in class.

August 27th – Overview of the course and a brief introduction to the geography and geology of Wyoming.

August 29th – Development of the Archean craton (Wyoming Province).

Reading assignment:

*Mueller, P. A., and Frost, C. D., 2006, The Wyoming Province: a distinctive Archean craton in Laurentian North America: *Canadian Journal of Earth Sciences*, v. 43, p. 1391–1397.

Frost, C. D., Fruchey, B. L., Chamberlain, K. R., and Frost, B. R., 2006, Archean crustal growth by lateral accretion of juvenile supracrustal belts in the south-central Wyoming Province: *Canadian Journal of Earth Sciences*, v. 43, p. 1533–1555.

Frost, C. D., and Frost, B. R., 1993, The Archean history of the Wyoming Province: *Geological Survey of Wyoming Memoir No. 5*, p. 59–76.

*Condie, K. C., and Kröner, A., 2008, When did plate tectonics begin? Evidence from the geologic record, in Condie, K.C., and Pease, V., eds., When did plate tectonics begin on planet Earth?: *Geological Society of America Special Paper 440*, p. 281–294.

August 31st – no class—Annual Rocky Mountain Field Trip (GEOL 4060) in progress.

September 3rd – no class—Labor Day—national holiday.

September 5th & 7th – *Continuation* of the development of the Archean craton (Wyoming Province).

September 10th, 12th, and 14th – Early Proterozoic accretion to the Wyoming Province.

Reading assignment:

*Houston, R. S., Duebendorfer, E. M., Karlstrom, K. E., and Premo, W. R., 1989, A review of the geology and structure of the Cheyenne belt and Proterozoic rocks of southern Wyoming, in Grambling, J. A., and Tewksbury, B. J., eds., Proterozoic geology of the southern Rocky Mountains: Boulder, Colorado, *Geological Society of America Special Paper 235*, p. 1–12.

Houston, R. S., 1993, Late Archean and Early Proterozoic geology of southeastern Wyoming: *Geological Survey of Wyoming Memoir No. 5*, p. 79–116.

Duebendorfer, E. M., and Houston, R. S., 1987, Proterozoic accretionary tectonics at the southern margin of the Archean Wyoming craton: *Geological Society of America Bulletin*, v. 98, p. 554–568.

September 17th – Middle Proterozoic magmatism and other Proterozoic events.

Reading assignment:

*Hoffman, P. F., 1989, Speculations on Laurentia's first gigayear (2.0 to 1.0 Ga): *Geology*, v. 17, p. 135–138.

September 19th, 21st, and 24th – Paleozoic stratigraphic framework.

Reading assignment:

*Boyd, D. W., 1993, Paleozoic history of Wyoming: *Geological Survey of Wyoming Memoir No. 5*, p. 164–187.

Chronic, J., McCallum, M. E., Ferris, C. S., Jr., and Egger, D. H., 1969, Lower Paleozoic rocks in diatremes, southern Wyoming and northern Colorado: *Geological Society of America Bulletin*, v. 80, p. 149–156.

September 26th – Finish up lecture material (if necessary) and review/questions regarding Test #1

September 28th – Test #1.

October 1st & 3rd – Early Mesozoic stratigraphic framework.

Reading assignment:

*Picard, M. D., 1993, The early Mesozoic history of Wyoming: *Geological Survey of Wyoming Memoir No. 5*, p. 210–248.

Picard, M. D., 1997, Mesozoic history of Wyoming, in Jones, R. W., and Harris, R. E., eds., Proceedings of the 32nd Annual Forum on the Geology of Industrial Minerals: *Wyoming State Geological Survey Public Information Circular 38*, p. 73–105. (This paper is an updated and expanded version of [Picard, 1993]).

October 5th & 8th – Western Interior Cretaceous basin.

Reading assignment:

*Steidtmann, J. R., 1993, The Cretaceous foreland basin and its sedimentary record: *Geological Survey of Wyoming Memoir No. 5*, p. 250–271.

Molenaar, C. M., and Rice, D. D., 1988, Cretaceous rocks of the Western Interior Basin, in Sloss, L. L., ed., Sedimentary Cover — North American Craton; U.S.: Boulder Colorado, Geological Society of America, *The Geology of North America*, v. D-2, p. 77–82.

October 10th and 12th – Foreland fold-and-thrust belt (Sevier orogenic belt).

Reading assignment:

*Royse, F., Jr., 1993, An overview of the geologic structure of the thrust belt in Wyoming, northern Utah, an eastern Idaho: *Geological Survey of Wyoming Memoir No. 5*, p. 272–311.

Lageson, D. R., and Schmitt, J. G., 1994, The Sevier orogenic belt of the western United States: recent advances in understanding its structural and sedimentological framework, in Caputo, M. V., Peterson, J. A., and Franczyk, K. J., eds., *Mesozoic systems of the Rocky Mountain region, USA: The Rocky Mountain Section, Society of Economic Paleontologists and Mineralogists, Denver, Colorado*, p. 27–64.

October 15th, 17th, and 19th – Foreland Laramide-style deformation.

Reading assignment:

*Brown, W. G., 1993, Structural style of Laramide basement-cored uplifts and associated folds: *Geological Survey of Wyoming Memoir No. 5*, p. 312–371.

*Erslev, E. A., 1993, Thrusts, back-thrusts, and detachment of Rocky Mountain foreland arches, in Schmidt, C. J., Chase, R. B., and Erslev, E. A., eds., Laramide basement deformation in the Rocky Mountain foreland of the western United States: *Geological Society of America Special Paper 280*, p. 339–358.

October 22nd and 24th – Green River Formation—A Middle Eocene lake system.

Reading assignment:

*Surdam, R. C., and Wolfbauer, C. A., 1975, Green River Formation, Wyoming: a playa-lake complex: *Geological Society of America Bulletin*, v. 86, p. 335–345.

Eugster, H. P., and Hardie, L. A., 1975, Sedimentation in an ancient playa-lake complex: the Wilkins Peak member of the Green River Formation of Wyoming: *Geological Society of America Bulletin*, v. 86, p. 319–334.

October 26th – Finish up lecture material (if necessary) and review/questions regarding Test #2.

October 29th – Test #2.

October 31st and November 2nd – Absaroka volcanic province.

Reading assignment:

*Sundell, K. A., 1993, A geologic overview of the Absaroka volcanic province: *Geological Survey of Wyoming Memoir No. 5*, p. 480–506.

Below is an interesting set of short papers on the interpretation of the depositional environment of the Yellowstone “fossil forests”—a good example of scientific debate.

- *Fritz, W. J., 1980, Reinterpretation of the depositional environment of the Yellowstone “fossil forests”: *Geology*, v. 8, p. 309–313.
- *Retallack, G., 1981, Comment on ‘Reinterpretation of the depositional environment of the Yellowstone fossil forests’: *Geology*, v. 9 (February issue), p. 52–53.
- *Fritz, W. J., 1981, Reply to Comment on ‘Reinterpretation of the depositional environment of the Yellowstone fossil forests’: *Geology*, v. 9 (February issue), p. 53–54.
- *Yuretich, R. F., 1981, Comment on ‘Reinterpretation of the depositional environment of the Yellowstone fossil forests’: *Geology*, v. 9 (April issue), p. 146.
- *Fritz, W. J., 1981, Reply to Comment on ‘Reinterpretation of the depositional environment of the Yellowstone fossil forests’: *Geology*, v. 9 (April issue), p. 147.
- *Yuretich, R. F., 1984, Yellowstone fossil forests: New evidence for burial in place: *Geology*, v. 12, p. 159–162.
- *Fritz, W. J., 1984, Comment on ‘Yellowstone fossil forests: New evidence for burial in place’: *Geology*, v. 12 (October issue), p. 638–639.
- *Yuretich, R. F., 1984, Reply to Comment on ‘Yellowstone fossil forests: New evidence for burial in place’: *Geology*, v. 12 (October issue), p. 639.

November 5th and 7th – Heart Mountain detachment.

Reading assignment:

- *Hauge, T. A., 1993, The Heart Mountain detachment, northwestern Wyoming: 100 years of controversy: *Geological Survey of Wyoming Memoir No. 5*, p. 530–571.
- *Pierce, W. G., 1987, The case for tectonic denudation by the Heart Mountain fault—A reponse: *Geological Society of America Bulletin*, v. 99, p. 552–568.

November 9th and 12th – Cenozoic stratigraphy and tectonics.

Reading assignment:

- *Lillegraven, J. A., and Ostresh, L. M., Jr., 1988, Evolution of Wyoming's early Cenozoic topography and drainage patterns: *National Geographic Research*, v. 4, p. 303–327.
- *Blackstone, D. L., Jr., Late Cretaceous and Cenozoic history of Laramie Basin region, southeast Wyoming, in *Geological Society of America Memoir 144*, p. 249–279.
- Lillegraven, J. A., 1993, Correlation of Paleogene strata across Wyoming—A users' guide: *Geological Survey of Wyoming Memoir No. 5*, p. 414–477.

November 14th and 16th – Geomorphic evolution of Wyoming, especially late Cenozoic exhumation.

Reading assignment:

- *Mears, B., Jr., 1993, Geomorphic history of Wyoming and high-level erosion surfaces: *Geological Survey of Wyoming Memoir No. 5*, p. 608–626.
- *Knight, S. H., 1953, Summary of the Cenozoic history of the Medicine Bow Mountains, Wyoming: *Wyoming Geological Association 8th Annual Field Conference Guidebook*, p. 65–76.
- *Evanoff, E., 1990, Early Oligocene paleovalleys in southern and central Wyoming: evidence of high local relief on the late Eocene unconformity: *Geology*, v. 18, p. 443–446.

November 19th – Glacial geology of Wyoming.

Reading assignment:

- *Mears, B., Jr., 1997, Glaciation of the Wyoming mountains and Pleistocene permafrost in the basin floors, in Jones, R. W., and Harris, R. E., eds., Proceedings of the 32nd Annual Forum on the Geology of Industrial Minerals: *Wyoming State Geological Survey Public Information Circular 38*, p. 107–114.
- *Mears, B., Jr., 2001, Glacial records in the Medicine Bow Mountains and Sierra Madre of southern Wyoming and adjacent Colorado, with a traveler's guide to their sites: Wyoming State Geological Survey Public Information Circular No. 41, 26p.
- Elias, S. A., 1996, *The Ice-age history of National Parks in the Rocky Mountains*: Washington, D. C., Smithsonian Institution Press, p. 84–114 (Yellowstone National Park), 115–135 (Grand Teton National Park).
- Richmond, G. M., 1965, Glaciation of the Rocky Mountains, in Wright, H. E., Jr., and Frey, D. G., ed., *The Quaternary of the United States*: Princeton, N. J., Princeton University Press, p. 217–230. (The classic summary paper.)

November 21st & 23rd – no class, Thanksgiving Break.

November 26th – Evolution of the Teton Range and Fault.

Reading assignment:

- *Love, J. D., Reed, J. C., Jr., Christiansen, R. L., and Stacy, J. R., 1973, *Geologic block diagram and tectonic history of the Teton region, Wyoming–Idaho*: U. S. Geologic Survey Miscellaneous Geologic Investigation Map I-730.

Love, J. D., Reed, J. C., Jr., and Pierce, K. L., 2003, *Creation of the Teton Landscape: A Geologic Chronicle of Jackson Hole and the Teton Range (2nd edition)*: Moose, Wyoming, Grand Teton Natural History Association, 131p.

*Smith, R. B., Byrd, J.O.D., and Susong, D. D., 1993, The Teton fault, Wyoming: seismotectonics, Quaternary history, and earthquake hazards: *Geological Survey of Wyoming Memoir No. 5*, p. 628–667.

November 28th — Finish up lecture material (if necessary) and review/questions regarding Test #3.

November 30th – Test #3.

December 3rd, 5th, & 7th – Yellowstone magmatism and tectonics.

Reading assignment:

*Pierce, K. L., and Morgan, L. A., 1992, The track of the Yellowstone hot spot: volcanism, faulting, and uplift, in Link, P. K., Kuntz, M. A., and Platt, L. B., eds., *Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179*, p. 1–53.

*Smith, R. B., and Braile, L. W., 1993, Topographic signature, space-time evolution, and physical properties of the Yellowstone-Snake River Plain volcanic system: the Yellowstone hotspot: *Geological Survey of Wyoming Memoir No. 5*, p. 694–754.

Good, J. M., and Pierce, K. L., 1996, *Interpreting the landscapes of Grand Teton and Yellowstone National Parks—Recent and ongoing geology*: Moose, Wyoming, Grand Teton Natural History Association, 58p.

Hendrix, M. S., 2011, *Geology Underfoot in Yellowstone Country*: Missoula, Mountain Press Publishing Company, 302p.

FINAL EXAMINATION (Comprehensive): December 14th, 10:15 pm–12:15 pm.

Grading: There will be three tests during the semester (see above for the dates of these tests—these dates are fixed). There will also be an **optional** comprehensive final exam. On the last day of class (December 7th), your test #3 will be returned to you and at that time you will know your final grade based on the three tests during the semester. If you wish to accept that grade, you are not required to take the comprehensive final exam. If you wish to improve your grade, you can take the final exam (December 14th, 10:15 pm–12:15 pm—**this is the only time that the final exam will be offered**). The comprehensive final exam will be a 100-point exam—just as the three tests during the semester. I will take your three highest scores (on the three tests and final exam; 3 out of 4) to calculate your final grade. Thus even if you do worst on the final exam than any of the “during semester” tests, your final grade for the course will **not** be impacted (i.e., lowered). If you choose not to take one of the three “during semester” tests, you must take the comprehensive final exam.

Statement on Academic Dishonesty: Academic honesty is expected, and dishonesty will not be tolerated and can lead to expulsion from the College and University. Both the University and College have websites discussing this in detail. Uniregs can be found at:

<http://www.uwyo.edu/legal/Uniregs/ur802.htm>. The college policy is at:http://www.uwyo.edu/a&s/Appeals_Dishonesty/Guidelines_Dishonesty.

Statement on Learning Disability: If you have a physical, learning, or psychological disability that requires accommodations, please let me know as soon as possible. You will need to register with, and provide documentation of your disability to: University Disability Support Services (UDSS) in SEO, room 330 Knight Hall, 766-6189, TTY: 766-3073.