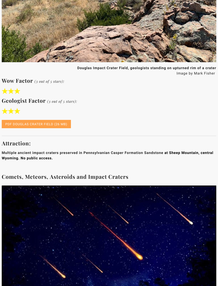
DOUGLAS CRATER FIELD



Douglas Impact Crater Field, geologists standing on upturned rim of a crater
Image by Mark Fisher

Wow Factor *(1 red hot ★ starry)*

★★★

Geological Factor *(1 red ★ starry)*

★★★

PDF DOUGLAS CRATER FIELD (26 MB)

Attraction:

Multiple ancient impact craters preserved in Pennsylvanian Casper Formation Sandstone at Sheep Mountain, central Wyoming. No public access.

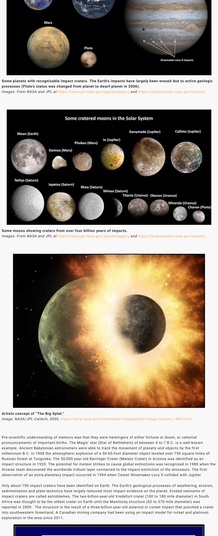
Comets, Meteors, Asteroids and Impact Craters

Modern Perseid meteor shower example, 2016.
Image: https://www.nasa.gov/mission_pages/station/multimedia/gallery/iss044e009644.html

Interplanetary objects have been orbiting in space since the origin of the solar system. Chunks of ice, rock, or metal traveling in outer space are called comets, meteors, or asteroids. Comets are composed of ice and dust, while meteors and asteroids are made of rock, minerals and/or metal. The latter two objects are differentiated by size, with the smaller being meteors. Asteroids are generally more than ten feet in length (3 m) and orbit around the Sun between Mars and Jupiter.

Collisions are common and impact craters are the result. When any of these celestial objects strike a solid planet or moon, they create a crater, or impact crater. Earth has a thin atmosphere, so most objects burn up before striking the surface and the composition of the impacted crust. Evidence of the bombardment is ubiquitous in our solar system.

The period from 4.6 to about 3.8 billion years ago is called the "Late Heavy Bombardment" by the large quantity of collisions with material left over from the creation of the planets and moons. The Earth's moon originated in a 4.5 billion-year-old collision event called "The Big Spike" when a Mars-sized object smashed into proto-Earth, ejecting a lot of material into Earth's orbit. That debris condensed into our moon.


METEOR TERMINOLOGY
ASTEROIDS, METEOR SHOWERS, METEORITES AND METEORS
Meteoroid
Meteor
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Comet
Meteor Shower
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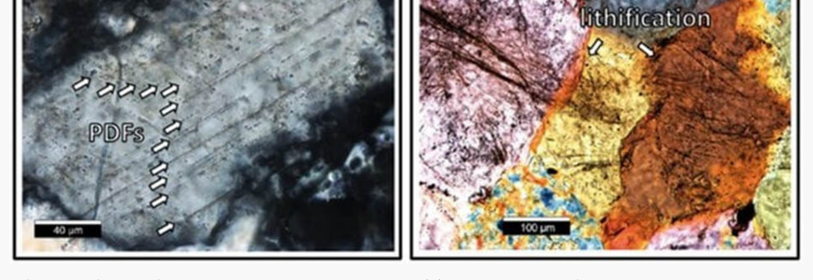
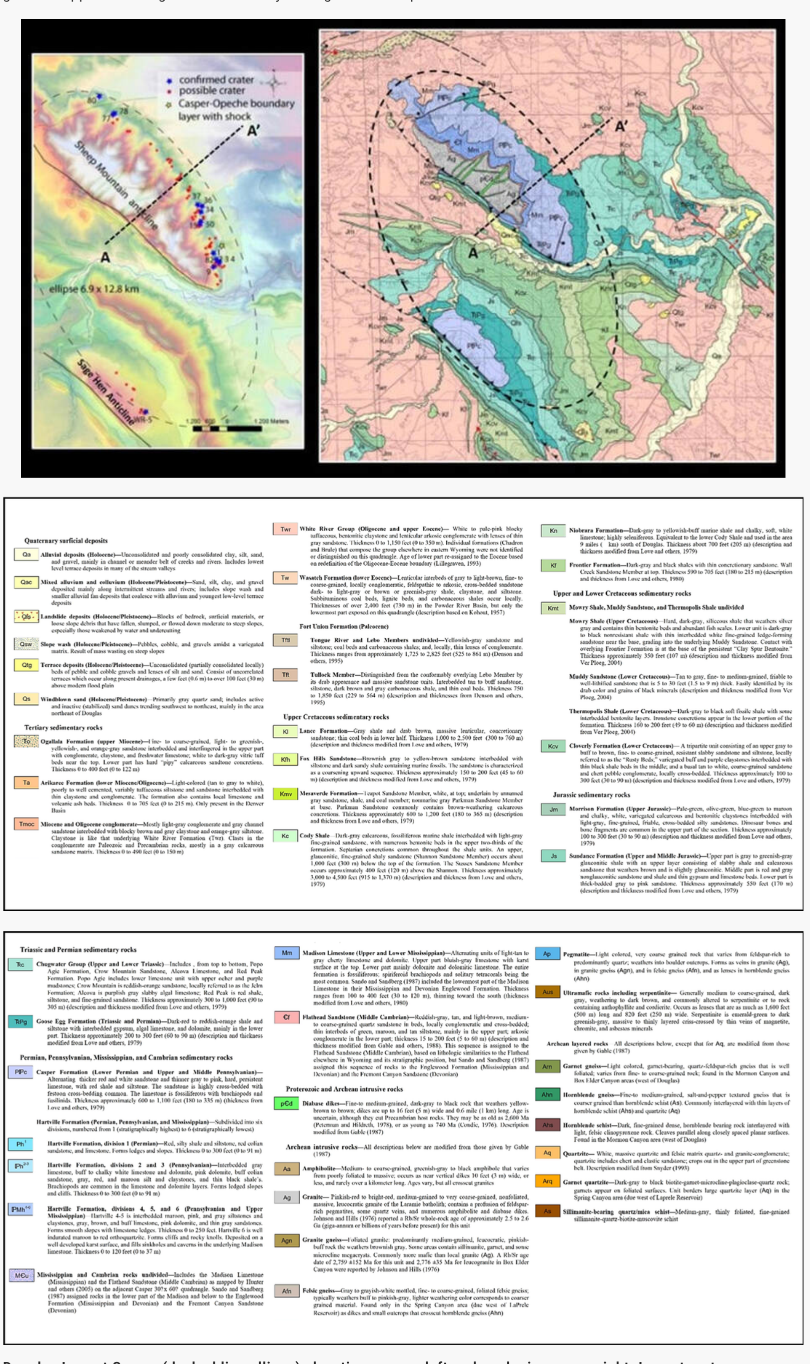
Meteoroid Stream
Meteoroid Stream

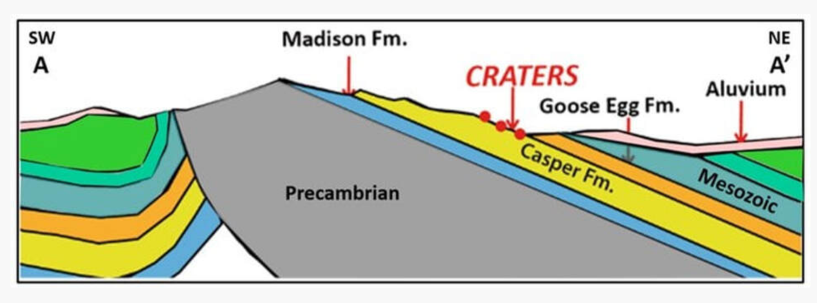


Deformation features from Sheep Mountain Crater number 1: (A) Cross-cutting and fluid-decorated planar deformation features (PDFs) in quartz grain, spacing is 3.5 micrometers on average: (H) Shock-lithification of quartz grains at indentation and interlocking sites.
Image: Kenkmann, T., Sundell, K.A., and Cook, D., 2018, Evidence for a large Paleozoic Impact Crater Strewn Field in the Rocky Mountains: Scientific Reports 8, Fig. 5A & 5H, p. 8; https://www.nature.com/articles/s41598-018-31655-4

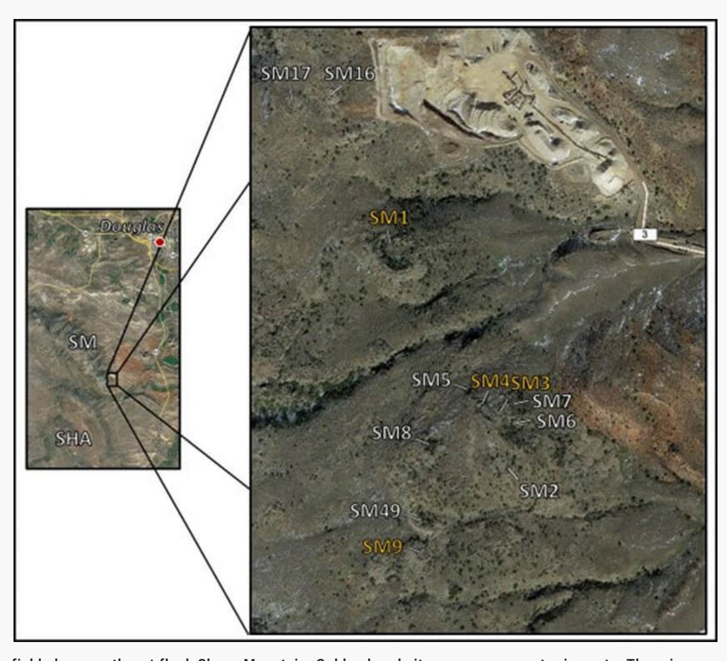
The craters are exposed on the northeast flanks of Sheep Mountain and Sage Hen Anticline. Both anticlines were formed during the Laramide Orogeny that occurred about 70 million years ago. The craters occur in the uppermost Pennsylvanian Casper Formation at the contact with the overlying Opeche Shale Member, Goose Egg Formation. This gives an approximate age of 280 million years ago for the impact.



Douglas Impact Swarm (dashed line ellipse) elevation map on left and geologic map on right. Impact craters are restricted to the uppermost Casper Formation.
Image: Left: After Schulze, T., Kenkmann, T., Poelchau, M.H., Sundell, K.A., and Cook, D., 2019, Douglas Impact Crater Strewn Field, WY, USA: A Progress Report: Large Meteorite Impacts VI 2019 (LPI Contrib. No. 2136) 5036.pdf, Fig. 1, p. 206; https://www.hou.usra.edu/meetings/lmi2019/pdf/5036.pdf;
Image Right: After McLaughlin, J.F., and Ver Ploeg, A.J., 2008, Geologic map of the Douglas 30' x 60' quadrangle, Converse and Platte counties, Wyoming: Wyoming State Geological Survey Map Series 83, scale 1:100,000; McLaughlin, J.F., and Ver Ploeg, A.J., 2008, Geologic map of the Douglas 30' x 60' quadrangle, Converse and Platte counties, Wyoming: Wyoming State Geological Survey Map Series 83, scale 1:100,000; https://www.wsgs.wyo.gov/products/wsgs-2008-ms-83.pdf.

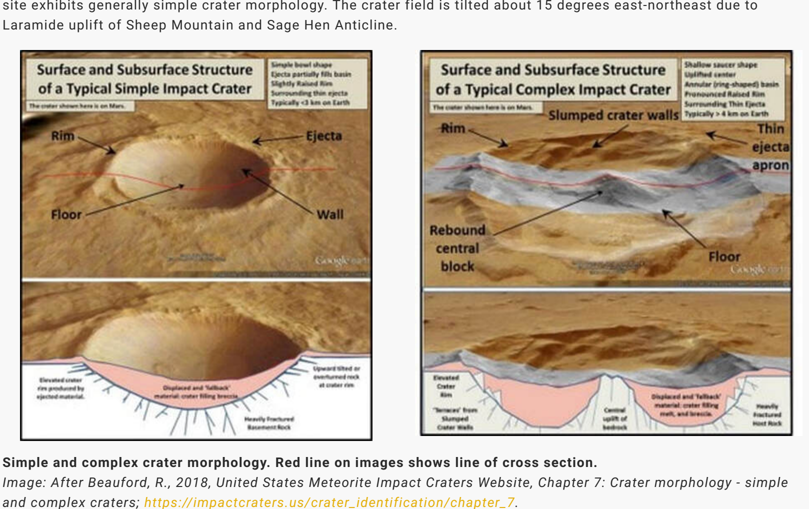


Sheep Mountain cross section AA' showing impact crater site and the asymmetric structure of the Laramide anticline.
Image: After Kenkmann, T., Sundell, K.A., and Cook, D., 2018, Evidence for a large Paleozoic Impact Crater Strewn Field in the Rocky Mountains: Scientific Reports 8, Fig. 1, p. 3; https://www.nature.com/articles/s41598-018-31655-4.

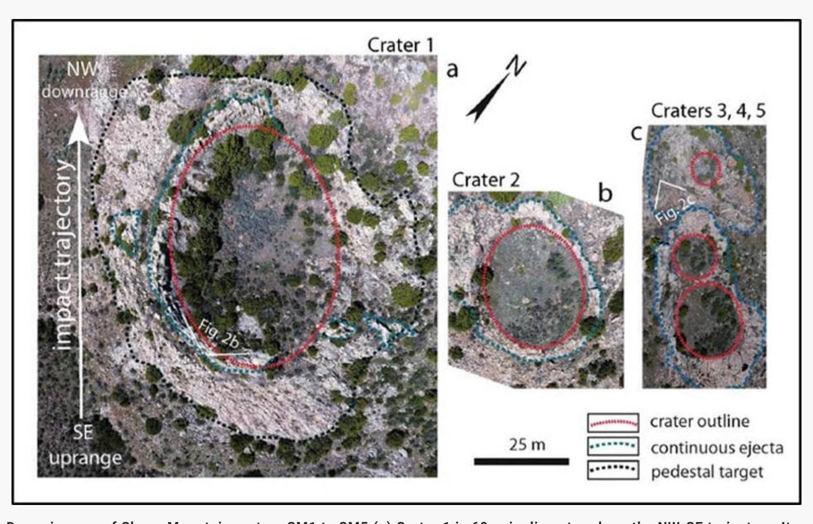


Crater field along southeast flank Sheep Mountain. Gold colored sites are proven crater impacts. There is a quarry in the upper center of the image (Pinnacle Materials Inc, Douglas quarry). Abbreviations: SHA = Sage Hen Anticline; SM = Sheep Mountain.
Image: After Kenkmann, T., Sundell, K.A., and Cook, D., 2018, Evidence for a large Paleozoic Impact Crater Strewn Field in the Rocky Mountains: Scientific Reports 8, Fig. 3, p. 5; https://www.nature.com/articles/s41598-018-31655-4

Meteoroids strike the Earth at high velocity between 25,000 mph (11 km/s) and 150,000 mph (70 km/s), or about 4 to 23 times the speed of sound. Two kinds of impact craters are recognized: simple and complex. The Douglas impact site exhibits generally simple crater morphology. The crater field is tilted about 15 degrees east-northeast due to Laramide uplift of Sheep Mountain and Sage Hen Anticline.



Simple and complex crater morphology. Red line on images shows line of cross section.
Image: After Beauford, R., 2018, United States Meteorite Impact Craters Website, Chapter 7: Crater morphology - simple and complex craters; https://impactcraters.us/crater_identification/chapter_7.

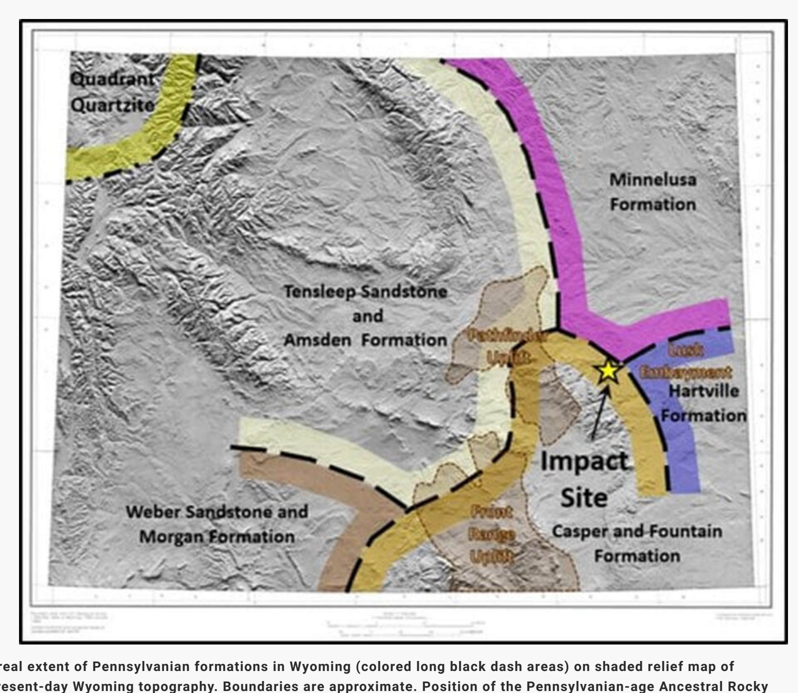


Drone images of Sheep Mountain craters SM1 to SM5 (a) Crater 1 is 60 m in diameter along the NW-SE trajectory. Its NE flank is eroded. Crater 1 samples have shocked quartz grains. (b) Crater 2 has a 31 m long axis and ovoid shape. The apparent overturned flap is well-preserved downrange. (c) Craters 3, 4 and 5 interfere with each other and together form a highly elliptical cavity in NW-SE direction. Crater 5 possibly formed by ricochet of the projectile. Dotted red and blue lines outline the crater cavities and the preserved ejecta blankets, respectively.
Image: Kenkmann, T., Sundell, K.A., and Cook, D., 2018, Evidence for a large Paleozoic Impact Crater Strewn Field in the Rocky Mountains: Scientific Reports 8, Fig. 4, p. 7; https://www.nature.com/articles/s41598-018-31655-4

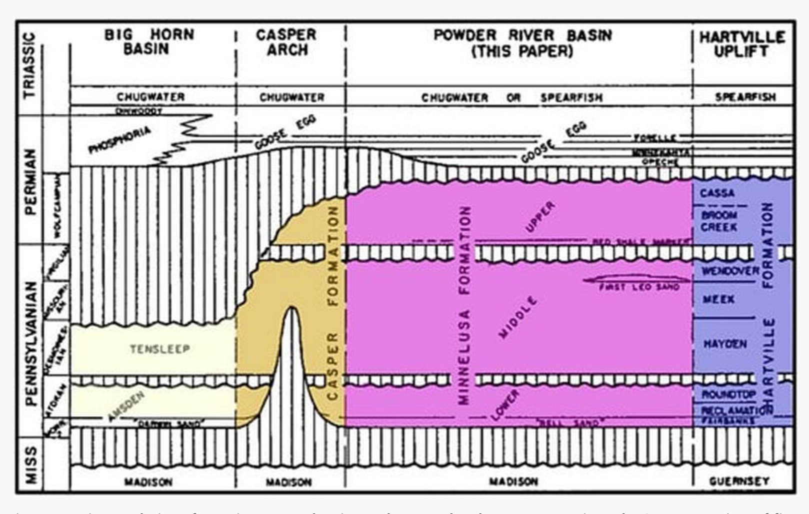
Dr. Kent Sundell on vertical sandstone rim of crater pointing toward the center of the crater.
Image by Mark Fisher

The Casper Formation is one of the units in the Pennsylvanian system located on the Wyoming shelf. This region (Wyoming Straits) was periodically flooded by a shallow arm of the Panthalassic Ocean that connected to the Midcontinent Sea. It is comprised of a mixed clastic and carbonate sequence deposited on the shelf along the east flank of the Pathfinder Uplift (Ancestral Rockies) and west of the Lusk Embayment. The uppermost Casper Formation at the impact site exhibits eolian sand dune deposition on the Wyoming shelf. Comparison of the Douglas impact craters and rocks to other craters suggest that the Casper Formation was not covered by water during impact, but the pore space did contain water.

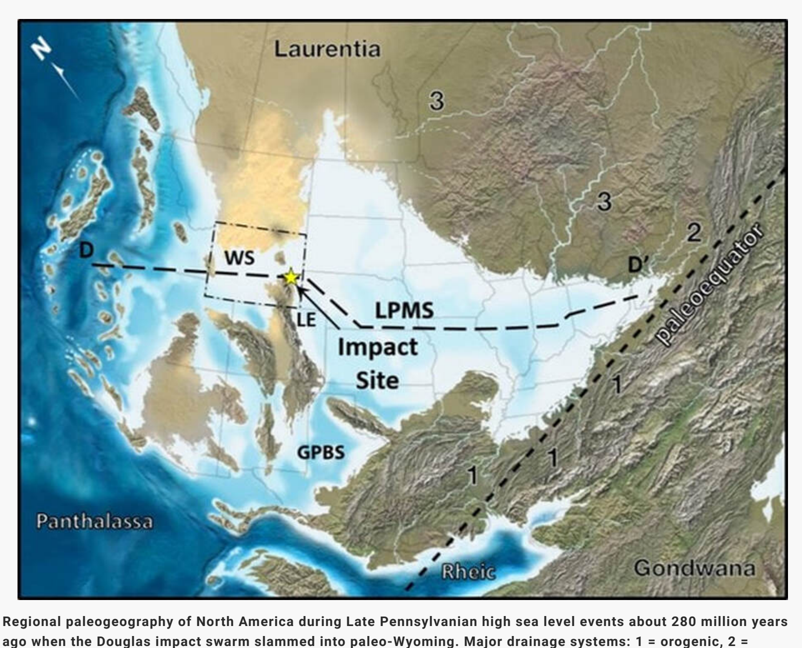
The continental collision and suturing between Gondwana and Laurentia was nearing completion by the close of the Pennsylvanian system when the Douglas impactor swarm collided with paleo-Wyoming. For 70 million years Earth would have a single supercontinent called Pangea ("all earth") that was surrounded by the Panthalassic Ocean. Pangea would begin to breakup about 200 million years ago at the beginning of the Jurassic Period.



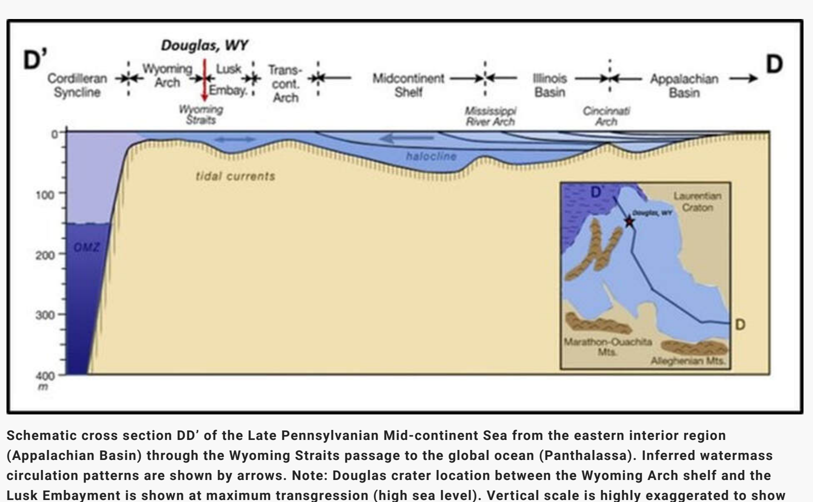
Areal extent of Pennsylvanian formations in Wyoming (colored long black dash areas) on shaded relief map of present-day Wyoming topography. Boundaries are approximate. Position of the Pennsylvanian-age Ancestral Rocky Mountains relative to existing ranges and basins in Wyoming is shown (brown shaded region). Douglas impact crater field shown by yellow star on the southeast flank of Pathfinder Uplift, west of the Hartville Formation depocenter in the Lusk Embayment.
Image: After Base: Kathleen Edwards, K. and Batson, R.M., 1990, Experimental digital shaded-relief maps of Wyoming: U.S. Geological Survey IMAP 1846, Plate 2; https://pubs.usgs.gov/imap/1846/plate-2.pdf; Data: Mallory, W.W., 1967, Pennsylvanian and Associated Rocks in Wyoming: U.S. Geological Survey Professional Paper 554-G, Fig.2, p. G4 and Fig. 4, p. G5; https://pubs.usgs.gov/pp/0554g/report.pdf.



Diagrammatic correlation of Permian-Pennsylvanian rocks central and eastern Wyoming. The Casper consists of fine- to medium-grained, massive to thin cross-bedded, well cemented sandstones, calcareous sandstones, and limestones that interfinger with the arkose of the Fountain Formation adjacent to the Pathfinder and Front Range Uplifts, Ancestral Rocky Mountains.
Image: After Foster, D.I., 1958, Summary of the Stratigraphy of the Minnelusa Formation, Powder River Basin, Wyoming: Wyoming Geological Association Powder River Basin of Wyoming; 13th Annual Field Conference Guidebook, Fig. 1, p. 39.

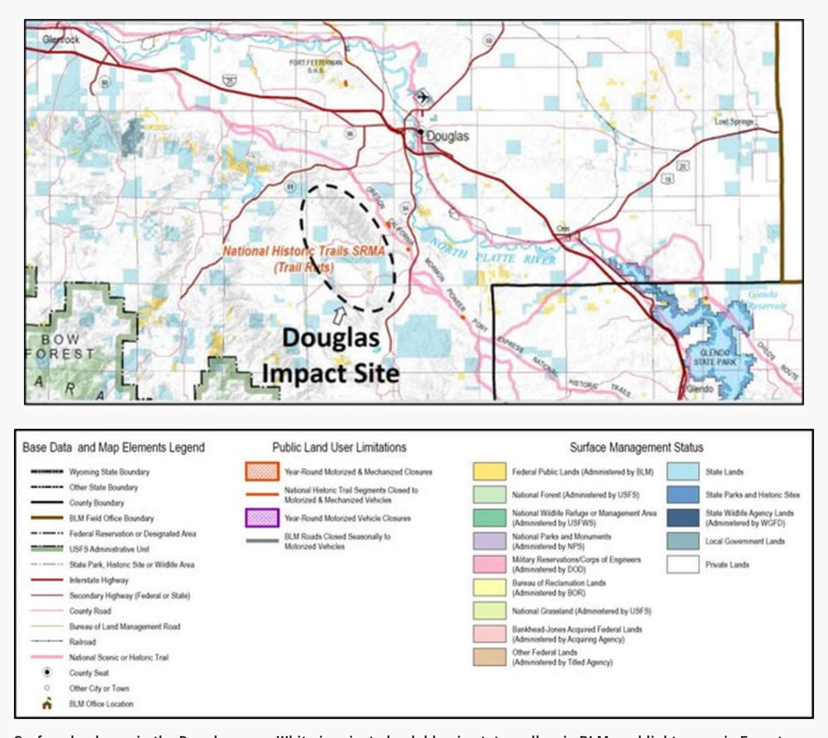


Regional paleogeography of North America during Late Pennsylvanian high sea level events about 280 million years ago when the Douglas impact swarm slammed into paleo-Wyoming. Major drainage systems: 1 = orogenic, 2 = foreland basin, and 3 = cratonic. Note connections to the global ocean through (1) an elongate, serpentine corridor in the Greater Permian Basin region, and (2) a broad, shallow and only intermittently open strait across the Wyoming Shelf. Abbreviations: GPBS = Greater Permian Basin Seaway; LE = Lusk Embayment; LPMS = Late Pennsylvanian Midcontinent Sea; WS = Wyoming Straits. N arrow represents paleonorth. Wyoming outline by black dot-dashed line. Cross section DD' shown by black long dashed line. The Late Pennsylvanian paleoequator shown by black short dashed line. Douglas crater impact site shown by yellow star.
Image: After Algeo, T.J., Heckel, P.H., Maynard, J.B., Blakey, R.C., and Rowe, H., 2008, Modern and Ancient Epeiric Seas and the Super-estuarine Circulation Model of Marine Anoxia, in Pratt, B.R. and Holmden, B., Editors, 2008, Geological Association of Canada Special Paper 48: Dynamics of Epeiric Seas, Fig. 4, p. 16; http://homepages.uc.edu/~algeot/Algeo-etal-GAC-2008-off.pdf.



Schematic cross section DD' of the Late Pennsylvanian Mid-continent Sea from the eastern interior region (Appalachian Basin) through the Wyoming Straits passage to the global ocean (Panthalassa). Inferred watermass circulation patterns are shown by arrows. Note: Douglas crater location between the Wyoming Arch shelf and the Lusk Embayment is shown at maximum transgression (high sea level). Vertical scale is highly exaggerated to show ocean features.
Image: After Algeo, T.J., Heckel, P.H., Maynard, J.B., Blakey, R.C., and Rowe, H., 2008, Modern and Ancient Epeiric Seas and the Super-estuarine Circulation Model of Marine Anoxia, in Pratt, B.R. and Holmden, B., Editors, 2008, Geological Association of Canada Special Paper 48: Dynamics of Epeiric Seas, Fig. 6, p. 20; http://homepages.uc.edu/~algeot/Algeo-etal-GAC-2008-off.pdf.

Note: The Douglas Impact Crater swarm lies on private property and there is no access at this time. There are occasional geology field trips to visit these craters. Dr Kent Sundell at Casper College, co-author of the paper on this site is the best contact about upcoming field trips (ksundell@caspercollege.edu). The landowners have graciously allowed scientists to study these craters, please do not trespass.



Surface land map in the Douglas area. White is private land, blue is state, yellow is BLM, and light green is Forest Service.

After BLM Casper Field Office, 2019, Seasonal & Year-Round BLM Public Land User Limitations Georeferenced Map; https://www.blm.gov/sites/blm.gov/files/Casper_FO_PublicLandUserLimitations.pdf.

Whoopie ti yi yo, git along little dogies
You know that Wyoming will be your new home

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