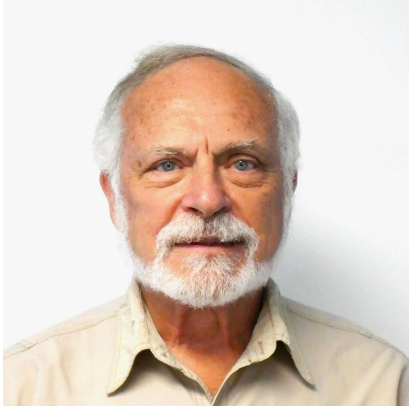
MGS Luncheon

Thursday, February 17th

11:45am – 1:00pm (in-person) 12:00-1:00pm (Zoom)



Your Meeting Your Way.
Join us **in-person at the Northern Hotel (19 N Broadway)** or **online via Zoom**

Luncheon: Arrive at 11:45am; lunch will be served at noon; talk starts at 12:15pm
Ticket Cost: $15 for members, $20 for non-members (guests), and $5 for students

RSVP to montanageologicalsociety@gmail.com

If you want to join us in-person, we need your RSVP by latest Sunday, February 13th!
If you prefer to join us on Zoom, RSVP by Wednesday, February 16th to receive the Zoom link

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Speaker: Eric H. Johnson

Johnson Geophysical, Billings, Montana

Tectonic History of the Bearpaw Mountains, North-Central Montana: Laramide Uplift, Volcanism, Gravity Slides, and Related Structures

The Eocene-Age Bearpaw Mountains are an elliptical dome formed by Laramide compression and uplift. The dome is the northernmost of a series of basement uplifts in Montana that include the Little Belt, Big Snowy, and Beartooth Mountains. The Bearpaw Mountains are located on the Great Falls Tectonic Zone (GFTZ), a northeast-trending suture zone formed by the collision between two Archean-age microplates. This crustal fracture may have provided paths of easy migration for mantle-derived phonolite lava flows and shonkinite intrusions present in the overlying mountains.

Pervasive gravity sliding on the flanks of the Bearpaw Mountains occurred on two bentonite beds in the Cretaceous upper Colorado Group. The gravity sliding coincided with rapid loading as 600-1500 m of volcanics accumulated on the uplifted dome. The best explanation for massive sheets of strata gliding down slopes of 3 degrees or less is the overpressure that developed in the bentonite layers due to the transformation of smectite (montmorillonite) to illite, creating superior seals and releasing structurally bound water to produce low-friction slip zones.

The strata above the detachment zones include the Upper Cretaceous Eagle Formation, a wide-spread shoreface sandstone unit 60 to 80 m thick, and the overlying Claggett Shale 125 to 175 m thick. The porous and permeable Eagle Sandstone, sandwiched between Claggett Shale and Colorado Shale source rocks, is a prolific reservoir for shallow biogenic gas. More than 500 BCFG have been produced from gravity-slide-induced structural traps 150 to 700 m deep.

The ubiquitous gravity sliding broke the overlying strata into a myriad of structural traps that surround the Bearpaw Mountains, extending more than 50 km both north and south. The extensive faulting produced pull-apart structures at the “heads” of the gravity slides and compressional structures in the “toes” of the slides. Vertical displacement between adjacent fault blocks can vary from 10 to 400 m.

The gravity slide-induced structures were postulated from early surface geologic mapping (1925-1950) and later confirmed by drilling wells for natural gas beginning in 1966. High resolution 2D and 3D seismic data have provided a more detailed understanding of the structural form and complexity of the gravity structures.

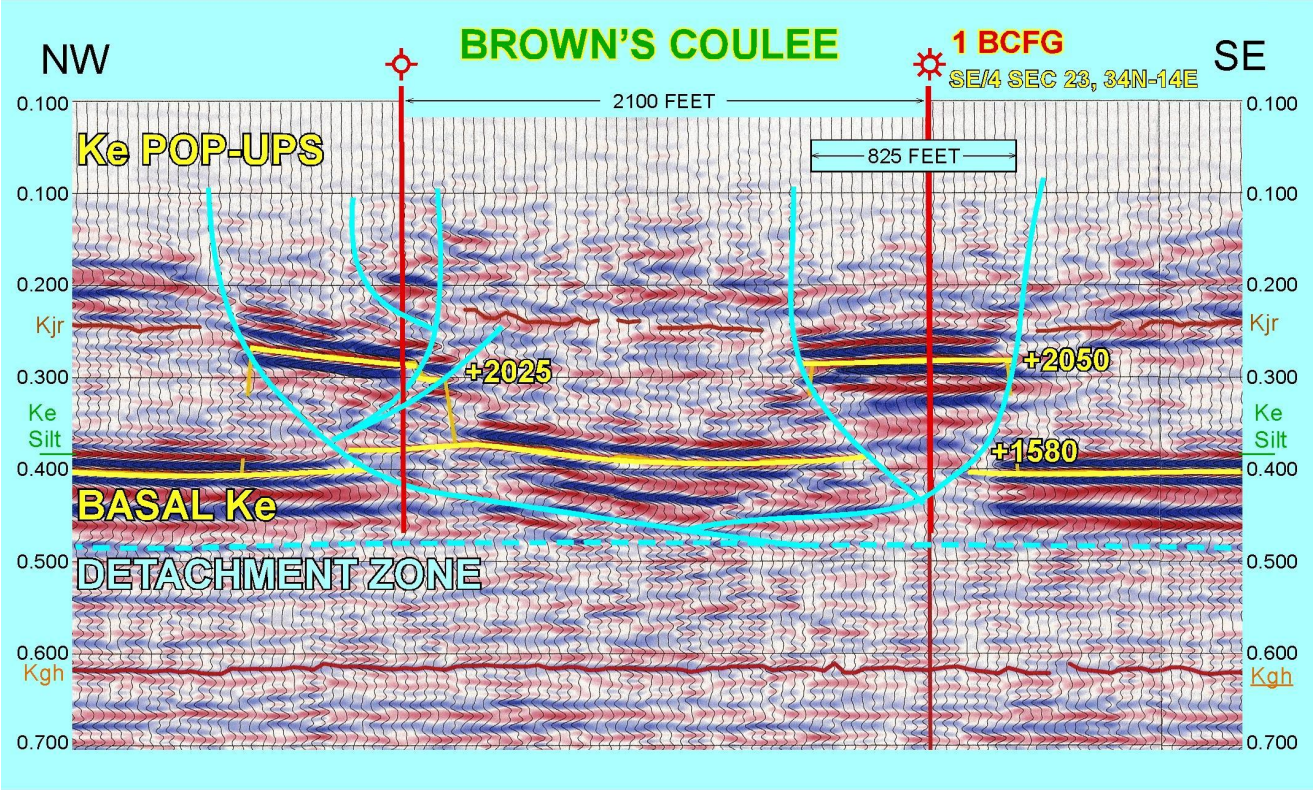

Figure above: *A seismic section showing "toe of the slide" structures. Landslide compression is from the southeast (right). Eagle strata (strong reflectivity) depths in wells are shown as elevations in feet. The basal Eagle Sandstone (Ke) at 0.400 seconds is about 1,400 ft (425 m) deep.*

Biography

Eric H. Johnson is an oil and gas professional with 48 years in exploration and development. He is a Registered Professional Geologist in Wyoming (PG-1317) and an expert witness for geological, geophysical, and petroleum engineering matters (Montana and Wyoming).

Eric started his career as an exploration geophysicist for Union Oil Company (Unocal), in Los Angeles, Indonesia, Louisiana, and Wyoming from 1973 to 1981. Since his move to Billings, MT, in 1982, he worked for several oil companies and the Bureau of Land Management (BLM). Since 1997 Eric worked as an independent consulting geologist/geophysicist, evaluating and developing oil and gas plays throughout Montana and the Williston Basin.

Eric authored publications and presented talks on seismic interpretation, regional geological studies, and oil and gas field studies. He co-edited the Montana Geological Society 2-volume publication, *'Montana/Alberta Thrust Belt and Adjacent Foreland'* in 2000 and the Nevada Petroleum Society text book, *'Oil Fields of Nevada'* published in 1994 which received the 'Landmark Publication Award' from the Rocky Mountain Section of the AAPG in 2014.

Eric received his B.S. in Geophysical Engineering from the Montana College of Mineral Science and Tech. In 1971, and his M.S. in Geophysics from the University of Utah in 1975.