UTAH GEOLOGICAL ASSOCIATION NEWSLETTER

P.O. Box 526356 – Salt Lake City, UT 84152

The Utah Geological Association is a non-profit organization of geologists and other geoscientists that share a common interest in Utah's geology.

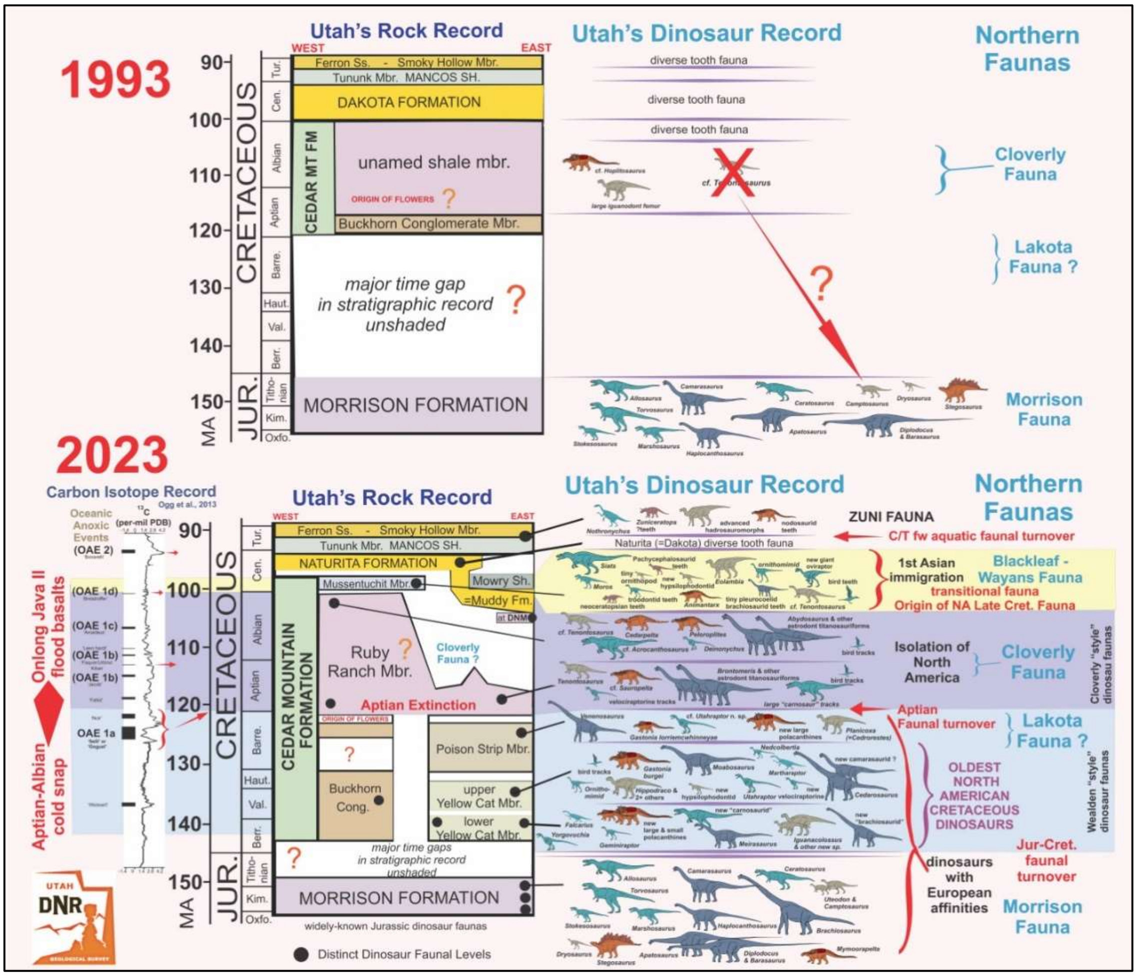
VOLUME 56, NUMBER 1 JANUARY 2024

JANUARY UGA LUNCHEON MEETING
11:30 am Lunch - 12:00 pm Presentation
MONDAY, JANUARY 8, 2024
UTAH DEPARTMENT OF NATURAL RESOURCES BUILDING
1594 W N Temple St, Salt Lake City, 1st Floor; Room 1040/1050

DAWN OF THE CRETACEOUS IN EASTERN UTAH

James I. Kirkland
Utah State Paleontologist, Utah Geological Survey

Over the past thirty years exploration of the terrestrial Mesozoic section in Utah has resulted in a more than fivefold increase in the known species of dinosaurs. A highly resolved temporal and sequence stratigraphic framework for these strata is facilitating the utility of these newly discovered dinosaur assemblages in geological, evolutionary, paleoecologic, and paleogeographic research. This is particularly true for the Lower Cretaceous Cedar Mountain Formation of Utah. Local subsidence due to salt tectonics in the northern Paradox Basin is responsible for this region of eastern Utah preserving a series of basal Cretaceous dinosaur faunas known nowhere else in North America documenting the last paleobiogeographic connections across the proto North Atlantic with



Europe for the first 22 million years of the Cretaceous. The Berriasian and Valanginian faunas of the Yellow Cat Member for the first time reveal that there was a major extinction of dinosaurs at the end of the Jurassic in both Europe and North America. Additionally, following the deposition of the Poison Strip Member, there was a medial lower Cretaceous extinction near the base of the Aptian stage. Aptian age strata in the lower Ruby Ranch Member in the Paradox Basin and Albian age strata in the upper Ruby Ranch west of the San Rafael Swell document the beginnings of the eastern foredeep basin resulting from the Sevier orogeny. Across both regions, the Ruby Ranch Member preserves a unique dinosaur assemblage spanning the last 20 million years of the Early Cretaceous indicating that North America was a largely isolated island continent. During the transition into the Late Cretaceous, the Mussentuchit Member of the western San Rafael Swell records the first immigration of Asian dinosaurs into North America and the last occurrences of a number of endemic North American dinosaur lineages documenting the origins of North Americas's Late Cretaceous dinosaur fauna.

Biography: Jim received his Ph.D. at Univ. of Colorado; was formerly with Dinamation International Society (1989-1999), and has been a consultant for numerous documentaries and museum exhibits. Since 1999, he has been the State Paleontologist with the Utah Geological Survey. An expert on the Mesozoic, he has spent 50 years excavating fossils across the southwestern US and Mexico authoring and coauthoring more than 90 professional papers. The reconstruction of ancient environments, biostratigraphy, paleobiogeography, paleoecology, and mass extinctions are some of his interests. He has discovered and taken part in describing 23 new dinosaurs including 5 ankylosaurs (3 more in manuscript), Cretaceous turiasaur sauropod, 5 ornithopods, 2 ceratopsians, and 10 theropods including the giant "raptor" *Utahraptor*. He has described and named many fossil mollusks, fossil fish, and several stratigraphic units. His researches into the lower and middle Cretaceous of Utah indicate that the last biogeographic connections to Europe were around 120 Ma and followed by 20 MA on an island continent, and utilizing Utah dinosaurs documented the origins of Alaska and the first great Asian-North American faunal interchange occurred at about 100 million years ago. With the funding of Utahraptor State Park will share with the public why salt tectonics resulted not just in Arches Nat. Park, but in Grand County, Utah preserving the two or more of the oldest Cretaceous dinosaur faunas in North America.

****** LUNCHEON LOCATION ******

Please join us at 11:30 am on **Monday January 8th** in the DNR Building Auditorium (*1594 W N Temple St, Salt Lake City, 1st Floor; Room 1040/1050.*) Lunch will be served at 11:30 followed by the speaker presentation at noon.

Please RSVP at the link below, so the UGA does not over order lunches, make sure to RSVP and pay for your lunch by **Thursday January 4th by 4 pm**. UGA will order enough food to cover those who RSVP. You are more than welcome to attend without having lunch.

https://utahgeology.org/events/july-2023-uga-luncheon

UGA Remote Meeting Info:

- Monday, January 08 · 12:00 – 1:30pm Mountain Time
- Google Meet link: https://meet.google.com/ihv-bxyx-xrh
- Or dial: (US) +1 520-815-1289 PIN: 196 674 907#

PRESIDENT'S MESSAGE

I hope this message finds all UGA Members and their loved ones feeling refreshed and eager to take on another calendar year. Because winter in northern Utah can be challenging with bone-chilling cold and valley-filling air pollution, our family typically heads south each season into the vast playground of the Colorado Plateau. This year, we spent the 2023 winter solstice in the Grand Staircase-Escalante National Monument area which provided much needed physical respite and time for personal reflection, something it never fails to do. The many wilds of southern Utah and beyond can be explored in relative comfort these days thanks to countless individuals and organizations who mildly tamed the backcountry for easier access to stunning scenery while retaining the appearance of untouched wilderness that many of us yearn for. I am forever thankful for the outstanding services provided by federal, state, and local land administration authorities whose tireless efforts are best expressed when they aren't noticed at all.

This thankfulness for public land service mirrors the deep appreciation I have for the UGA, an organization dedicated to our shared love of geology and all that it provides for us both professionally and spiritually. And much like the ghostly land stewards whose behind-the-scenes work heightens the wilderness experience, the UGA Board strives to provide meaningful meetings, social events, and awards to enhance the UGA membership experience. That reflection leads me to my core message this month: the UGA Board's vision for 2024. Our two main goals this year are to (1) strengthen *and grow* our membership base and (2) provide community-building opportunities through valuable learning and fulfilling social events.

Regarding Goal #1, I invite you to check your membership status on our website: https://utahgeology.org/. If you forgot to renew this past fall, your membership is likely in a 3-month grace period and, without renewal, you will stop receiving UGA communications. If you don't want to work through the website, email either Trae Boman (tboman@teamues.com) or me (eugenes@utah.gov) directly and we'll assist with your renewal personally. While you are renewing, consider becoming affiliated with the **Southern Utah Geological Association (SUGA)**. Your SUGA affiliation allows you to receive SUGA communications and doesn't cost you anything unless you want to contribute additional funds, which I encourage you to do! Any financial contributions to SUGA will go directly to their own operating expenses; this is a great way to show your support for our new Affiliate. I would also like to commend **Prof. Alex Tye** (UTU) and **Craig Morgan** (UGS retired) for their strong efforts in getting SUGA up and running. The UGA Board will meet with SUGA officers later this year to assess progress and I will provide more SUGA updates throughout this year, so watch this space.

Regarding #2, a few things… First, I want to remind everyone that the **2024 Utah Earth Science Teacher of the Year (TOTY) Award** is currently active. This award is granted annually to a K-12 teacher for excellence in the teaching of natural resources in the earth sciences. The 2024 TOTY Award grants $1500 to the winning teacher, who is also automatically entered in the regional contest sponsored by the Rocky Mountain Section of the American Association of Petroleum Geologists (AAPG). Several UGA-nominated Utah teachers have also won regional contests in recent years! The deadline is *Monday, January 15th*, so encourage anyone you know who is eligible to apply. The entry form and more information can be found on the UGA website at: https://utahgeology.org/outreach/teacher-of-the-year.

Second, please take note that the drive for **2024 Utah Geology Field Camp Scholarships** will begin soon. Every year, the UGA/UGF awards field camp scholarships to geology students from each eligible university in the State of Utah. Awards will be given at our April luncheon. Last year, we granted scholarships to 12 field camp-bound students from 6 different Utah universities. This is just one of the charitable activities that are result of **Utah Geological Foundation (UGF)** fundraising, so take a minute to reacquaint yourself with the UGF (see below) and consider a donation. https://utahgeology.org/foundation

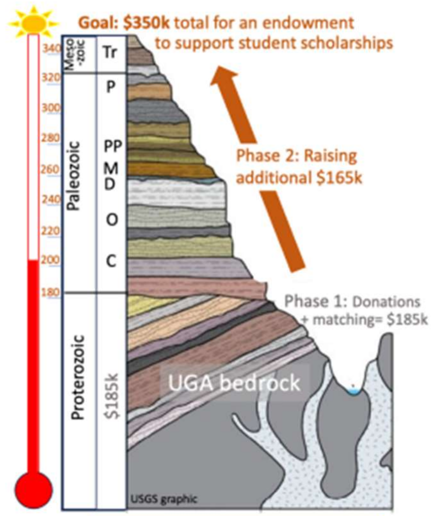
Finally, regarding Goal #2 (for now), I want to remind you that the UGA will host the **2024 Rocky Mountain Section AAPG Meeting** in Park City, Utah. **Tom Chidsey** (UGS retired) has generously volunteered as General Chair and, with the aid of his organizational committee, he is currently orchestrating exciting plenary talks, energy-focused technical sessions, and associated geological field trips across the state. As someone with insight on preliminary planning efforts, I can confidently say that this meeting will brilliantly showcase the grandeur of Utah's geology and broaden the outlook for Utah's energy sector in the future. The 2024 UGA "Guidebook" will comprise meeting materials such as field trip logs, extended abstracts, and full-length technical articles on meeting topics; this official UGA Publication Numbered Series volume will align with our new strategic plan that focuses on electronic media. The coming year is full of excitement and growth for the UGA.

Thank you for being a UGA member. The all-volunteer UGA Board and associated Committee Chairs exist to serve you and the organization. Do not hesitate to contact us with constructive criticism, requests for expansion of organizational offerings, or to ask how you can get involved with the UGA as a volunteer. Happy New Year!

UGA President
Eugene Szymanski
eugenes@utah.gov

UGF

UTAH GEOLOGICAL FOUNDATION



UGF NEWS: ***2023 was a good year for UGF***, and we express our deepest thanks to all our UGF donors (list below) who got us off to such a great start! We surpassed our Phase 1 milestone of raising $185k for an endowment to fund student scholarships. For this new year in Phase 2 of our UGF campaign, we are striving to raise an additional $165k for a total of $350k. As shown in the Grand Canyon graphic (right), we have moved past the basement rock and are well into the Cambrian section. All gifts are welcome. Legacy gifts can also make a huge difference. Find more details on the UGF website: visit https://utahgeology.org/foundation/donate-to-ugf.

Donation checks can be sent to:
Utah Geological Foundation
1244 E Spring Ridge Drive
Sandy, UT 84094

On behalf of the ***Utah Geological Foundation Board***

Paul Anderson, President
Elise Erler, Secretary
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Marjorie Chan, Board Member
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UGF Donors as of 12.23.23 (note: apologies if anyone inadvertently got left off, please contact us).

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UGF Federal Tax ID number is 87-3778675. *Note: All donors may be listed periodically unless donors specifically request to remain anonymous.*

NEW MEMBERS APPROVED BY THE UGA BOARD

Mallory McNeill, UVU, Student Membership

THE GEOLOGY OF THE INTERMOUNTAIN WEST VOLUME 10

The *Geology of the Intermountain West* (GIW) has been publishing article since 2014. In 2023, eight articles were published in volume 10 for a total of 276 pages. The articles ranged from thrust faults and related folds near Kanarraville to the Morrison Formation in central Montana. We also published three articles that were originally part of a UGA numbered publication series. Please check out the GIW website at https://utahgeology.org/publications/geology-of-the-intermountain-west for volume 10 and all previous volume articles. Below are the Tittles, authors, and abstracts from the volume 10 (2023) articles to tickle your interest.

The Kanarra Fold-Thrust Structure—The Leading Edge of the Sevier Fold-Thrust Belt, Southwestern Utah by William J. Chandonia, and John P. Hogan

Abstract

The multiple origins proposed for the Kanarra anticline in southwestern Utah as a drag-fold along the Hurricane fault, a Laramide monocline, a Sevier fault-propagation fold, or a combination of these processes, serve to muddy its tectonic significance. This in part reflects the structural complexity of the exposed eastern half of the fold. The fold evolved from open and up-right to overturned and tight, is cross-cut by multiple faults, and was subsequently dismembered by the Hurricane fault. The western half of the fold is obscured because of burial, along with the hanging wall of the Hurricane fault, beneath Neogene and younger sediments and volcanics. We present the results of detailed bedrock geologic mapping, and geologic cross sections restored to Late Cretaceous time (prior to Basin and Range extension), to demonstrate the Kanarra anticline is a compound anticline-syncline pair inextricably linked with concomitant thrust faulting that formed during the Sevier orogeny. We propose the name Kanarra fold-thrust structure to unambiguously identify the close spatial and temporal association of folding and thrusting in formation of this prominent geologic feature. We identify a previously unrecognized thrust, the Red Rock Trail thrust, as a forelimb shear thrust that was in a favorable orientation and position to have been soft-linked, and locally hard-linked, with the thrust ramp of the basal detachment to form a break thrust. The east verging Red Rock Trail thrust is recognized by a distinctive cataclasite in the Lower Jurassic Navajo Sandstone. The hanging wall of the Red Rock Trail thrust is displaced eastward over the Middle Jurassic Carmel Formation and Upper Cretaceous formations and can be traced for at least 27 km and possibly farther. We contend the Kanarra fold-thrust structure unambiguously defines the leading edge of the Sevier fold-thrust belt in southwestern Utah. Stratigraphic relationships in the southern and northern part of the Kanarra fold-thrust structure constrain its development between the early and late Campanian (about 84 to 71 Ma) but possibly younger. In southwestern Utah, initial movement along the Iron Springs thrust at about 100 Ma (Quick and others, 2020) and subsequent eastward advancement of the Sevier deformation front to the Red Rock Trail thrust at about 84 to 71 Ma coincided with well-documented magmatic flare ups in the Cordilleran arc in the hinterland of the Sevier fold-thrust belt. This temporal relationship between magmatic flare ups and thrusting is consistent with a close correspondence between arc-related processes and episodic foreland deformation.

The Concrete *Diplodocus* of Vernal—A Cultural Icon of Utah by Michael P. Taylor, Steven D. Sroka, and Kenneth Carpenter

Abstract

Although many casts have been made of the Carnegie Museum's iconic *Diplodocus*, initially in plaster and more recently in various plastics, one stands alone as having been cast in concrete. This skeleton, made from the original Carnegie molds starting in 1956–1957, was unveiled at the Utah Field House of Natural History in Vernal, Utah, in 1957, and stood outside the museum for three decades. The fate of the molds after this casting is uncertain. The concrete *Diplodocus* was the museum's icon for 32 years until the weather damage became too great. The cast was then taken down and repaired, and fresh molds made from it by Dinolab in Salt Lake City. From these molds, a new replica was cast in water-expanded polyester and mounted inside the Field House. This cast was moved to the Field House's new location in 2004 and was remounted in the atrium, but

the old concrete cast could not be easily remounted and was instead transferred to the Prehistoric Museum at Price, Utah. It has, however, yet to be remounted there, as it awaits a new building for the museum. Meanwhile, the new molds have been used to create more Diplodocus casts that are mounted in Japan and elsewhere, and have also furnished missing parts of the iconic rearing Barosaurus skeleton in the atrium of the American Museum of Natural History in New York City. Thus, the concrete Diplodocus of Vernal has become one of the most influential of all *Diplodocus* specimens, second only to the Carnegie original.

Snow Drought and Monsoon Floods—Hydrological Extremes in the Cedar Valley Watershed During Water Year 2021, Southwestern Utah by Erich R. Mueller, Garrett P. Sudweeks, Shadrach A. Ashton, and Micah C. Olson

Abstract

Water year 2021 was a year of extremes in the Cedar Valley watershed of southern Utah, with snow drought resulting in extremely low snowmelt runoff of Coal Creek and intense monsoon rainfall resulting in several floods in different parts of the valley. Winter snow accumulation was depressed throughout southern Utah, perhaps due to La Nina conditions affecting winter storm trajectories. Coal Creek, the principal stream providing surface water to Cedar Valley, typically receives most of its annual flow from snowmelt runoff, but in 2021 had a peak snowmelt discharge 15% to 25% of that recorded in the previous two years and the third lowest snowmelt runoff on record. Following this extremely low snowmelt runoff period, more than 10 floods of Coal Creek occurred following monsoon storms in July and August that exceeded the 2021 snowmelt peak. Additionally, several thunderstorms produced rainfall rates in exceedance of the 100-year event and induced flooding within Cedar City and the town of Enoch. Flood inundation modeling using HEC-RAS and high-resolution topographic data showed good agreement with field and pubic-survey data on the high-water stage during the Enoch flooding, and demonstrated that the flooding was likely exacerbated by the low topography and limited drainage potential in flooded areas. Whereas the monsoon storms improved soil moisture and helped alleviate drought conditions, they also resulted in urban flooding and did little to replenish the regional water supply.

The March 2020, M_w 5.7 Magna, Utah, Earthquake—Documentation of Geologic Effects and Summary of New Research by Adam I. Hiscock,

Emily J. Kleber, Adam P. McKean, Ben A. Erickson, Greg N. McDonald, Richard E. Giraud, Jessica J. Castleton, and Steve D. Bowman
Abstract
The March 18, 2020, Mw 5.7 Magna earthquake was the largest earthquake in Utah since the 1992 ML 5.8 St. George earthquake. The Magna earthquake occurred in the northwest corner of the Salt Lake Valley, home to 1.2 million people. Immediately following the earthquake, the Utah Geological Survey organized teams to collect perishable field data on the geologic effects of ground shaking near the epicenter, as well as establish a web-based digital clearinghouse to collect, distribute, and archive data related to the earthquake. This earthquake also coincided with the beginning of the COVID-19 global pandemic, which added extra challenges to our earthquake response. Teams used a small, unmanned aircraft system to obtain aerial photos and videos of geologic effects to supplement ground-based reconnaissance. The observed geologic effects of ground motions from the Magna earthquake include liquefaction in the form of sand boils, tension cracks, lateral spreading, and localized subsidence. No primary surface fault rupture was observed. The areas with the highest observed concentration of liquefaction features were close to the shore of Great Salt Lake and near the epicenter, northeast of the town of Magna. Photos and other documentation of the geologic effects associated with this earthquake are critical in helping to understand the hazards associated with moderate magnitude earthquakes in the Wasatch Front region. The earthquake sequence and associated geologic effects were well documented, due to the proximity to a major metropolitan area and the mainshock and aftershocks occurring within the densest part of the Utah Regional Seismic Network. In the two years since the earthquake, numerous studies have been published documenting and interpreting data to characterize the Magna event and discuss how new data add to what is known about seismic hazards along the Wasatch Front.

Potential Drilling Hazards for Wells Targeting the Cane Creek Shale, Pennsylvanian Paradox Formation, Paradox Fold and Fault Belt, Southeastern Utah and Southwestern Colorado by Thomas C. Chidsey, Jr.

Abstract
The Cane Creek shale of the Pennsylvanian Paradox Formation represents a major target for oil and gas in the Paradox fold and fault belt of the northern Paradox Basin of southeastern Utah and southwestern Colorado. Early exploration and development attempts resulted in blowouts due to

unexpected gas-bearing intervals and casing collapses caused by salt flowage in the Paradox Formation. These problems represent some of the types of drilling hazards that could be expected when planning Cane Creek wells. Horizontal drilling first used in the early 1990s changed the Cane Creek shale play from one of mostly drilling failures to a more successful commercial play.

Depending on the location, exploratory Cane Creek wells may penetrate a section that ranges in age from Cretaceous through Pennsylvanian. Drilling in the region often encounters a wide variety of lithologies (carbonates, shale, mudstone, sandstone, and evaporites) and associated potential hazards that may include: (1) swelling clays, (2) high porosity-permeability or fractured zones resulting in lost circulation or excessive mudcake buildup, (3) "kicks" due to the influx of reservoir fluid (oil, water, or gas) into the wellbore, (4) uranium-rich zones, (5) washouts, (6) hole deviation, sticking, and other well-integrity problems, (7) chert, and (8) overpressured intervals. In addition, natural carbon dioxide, which flows from the partially human-made Crystal Geyser near some Cane Creek wellsites, represents an unusual drilling hazard if encountered in the northernmost part of the fold and fault belt.

Using the lessons learned from the recently completed research well, State 16-2 (renamed the State 16-2LN-CC, API No. 43-019-50089, after the horizontal leg was drilled), and other wells in the region, drilling engineers and operators can better plan for potential hazards when exploring for hydrocarbons in the Cane Creek shale or deeper targets (Mississippian Leadville Limestone and Devonian Elbert Formation) in the fairly remote, relatively sparsely explored Paradox fold and fault belt. The goal is to de-risk wells, lower expenses, and mitigate problems before they occur. The expected results are safer and more successful drilling of wells to the Cane Creek shale and deeper reservoirs ultimately leading to additional commercial hydrocarbon discoveries in the region.

Utah Geosite—The Salina Canyon Unconformity, a Classic Example of Missing Time by Shelley Judge, Emmett Werthmann, Cristina Millan, Michael Braunagel, and Erica Maletic

Abstract

Salina Canyon, Utah, reveals a spectacular angular unconformity along an east-west transect through the southern part of the Wasatch Plateau. This region of Utah is well known as the eastern extent of Sevier orogenesis, but it also includes subsequent extensional overprinting. Earliest descriptions of this unconformity were published by Dutton (1880) and Spieker (1946,

1949), and work continues today. Field relationships expose many classic stratigraphic and sedimentologic features of erosional surfaces. Due to the geometry of the progressive unconformity onto the topographic high of the Sanpete-Sevier Valley antiform, the angular discordance of strata results in a gap in time of greater than 107 million years in the west, decreasing toward the east to about 39 million years and finally to less than 17 million years. Paleosols and small-scale channels/scours with infilled basal conglomerates are also prominent along the unconformity, as are several mine adits. Because of its abundant geologic features, the Salina Canyon unconformity is a superb teaching and learning space for geoscientists and outdoor naturalists.

The John Wesley Powell Fossil Track Block—Theropod Tracks with Ornithopod-Like Morphology from the Early Jurassic Navajo Sandstone, Glen Canyon National Recreation Area, Utah-Arizona by Andrew R.C. Milner, Vincent L. Santucci, John R. Wood, Tylor A. Birthisel, Erica Clites, and Martin G. Lockley

Abstract
A large fallen block of Early Jurassic Navajo Sandstone located at Lake Powell, within Glen Canyon National Recreation Area, south-central Utah, displays natural casts of vertebrate tracks. The footprints occur on at least three track-bearing horizons preserved on and between stromatolitic sandstone beds. Two large, parallel trackways, plus a third, divergent trackway, on the main track layer (MTL) superficially resemble ornithopod footprints; however, they were produced by large-sized theropod dinosaurs, rather than ornithischians, and we identify these as *Eubrontes*.
Small coelophysoid theropod tracks (Grallator) are the most common vertebrate ichnofossils on all track-bearing horizons, with approximately 50 footprints preserved on the MTL, six on the highest surface, and three on thinner float slabs stratigraphically lower in section. An additional 12 tracks in three trackways of *Anchisauripus* size occur on the MTL, but they superficially resemble *Kayentapus* in having wider divarication angles than typical *Anchisauripus*. The MTL also preserves at least five closely associated tetradactyl footprints that we identify as cf. *Brasilichnium*. A nearby, smaller fallen block preserves distinct *Batrachopus* tracks, which are rare in eolian environments.
The microbial (possibly endoevaporitic) mats and stromatolitic horizons on which the animals had walked produced a distinct ichnomorphologic variation because of substrate consistency and the elastic properties of the mats, resulting in differential compaction of the bedding surfaces. Lithic

compaction of the finer-grained sediments between denser, more resistant sandstone beds pre- and/or post-lithification resulted in additional deformation of the tracks, followed by natural erosion. We interpret these natural cast footprints on the MTL as possible transmitted tracks. The track-bearing, microbial-mat surfaces represent interdunal pooling of water, probably during periods of increased precipitation and/or rising water tables during wet seasons.

Stratigraphy, Sedimentology, and Paleoclimatic Proxies of the Upper Jurassic Morrison Formation of Central Montana by Dean R. Richmond

Abstract

Since the discovery of dinosaurs in the late 19th century, the Upper Jurassic Morrison Formation has received considerable scholarly attention. However, the formation in central Montana needed to be sufficiently investigated. Recent dinosaur excavations from exposed Morrison strata on the southern flank of Spindletop dome near the town of Grass Range, Montana, prompted a review of the formation's geology, paleobotany, and paleoclimate. A review of historical stratigraphic measurements of the formation in Montana reveals a considerable variance in measured thicknesses. Stratigraphic measurements and regional log data indicate that the formation averages 71 m thick across central Montana. A new regional isopach map of the formation from well-log data illustrates a broad distributive fluvial system that migrated from the southwest toward the northeast. The formation is divided into two informal facies in the study area: lower and upper depositional facies. The lower depositional beds represent the mud-rich distal-most distributive fluvial facies that overlies the stranded muddy tidal flat of the Swift Formation. An increased sandstone:mudstone ratio and small isolated fluvial channel and crevasse splay beds indicate that the upper depositional beds represent the slow progression of the distributive fluvial system. However, a review of the regional field stratigraphy and well-log data did not provide a regional correlatable facies change to warrant subdividing the formation into members.

The stratigraphic positions and climatic interpretations for lithologic, faunal, and floral paleoclimatic proxies are specified. The compilation of climate proxy data from central Montana demonstrates that the climate in this region was wetter than in southern parts of the Morrison foreland basin. The climatic proxies signify that the environmental conditions were variable

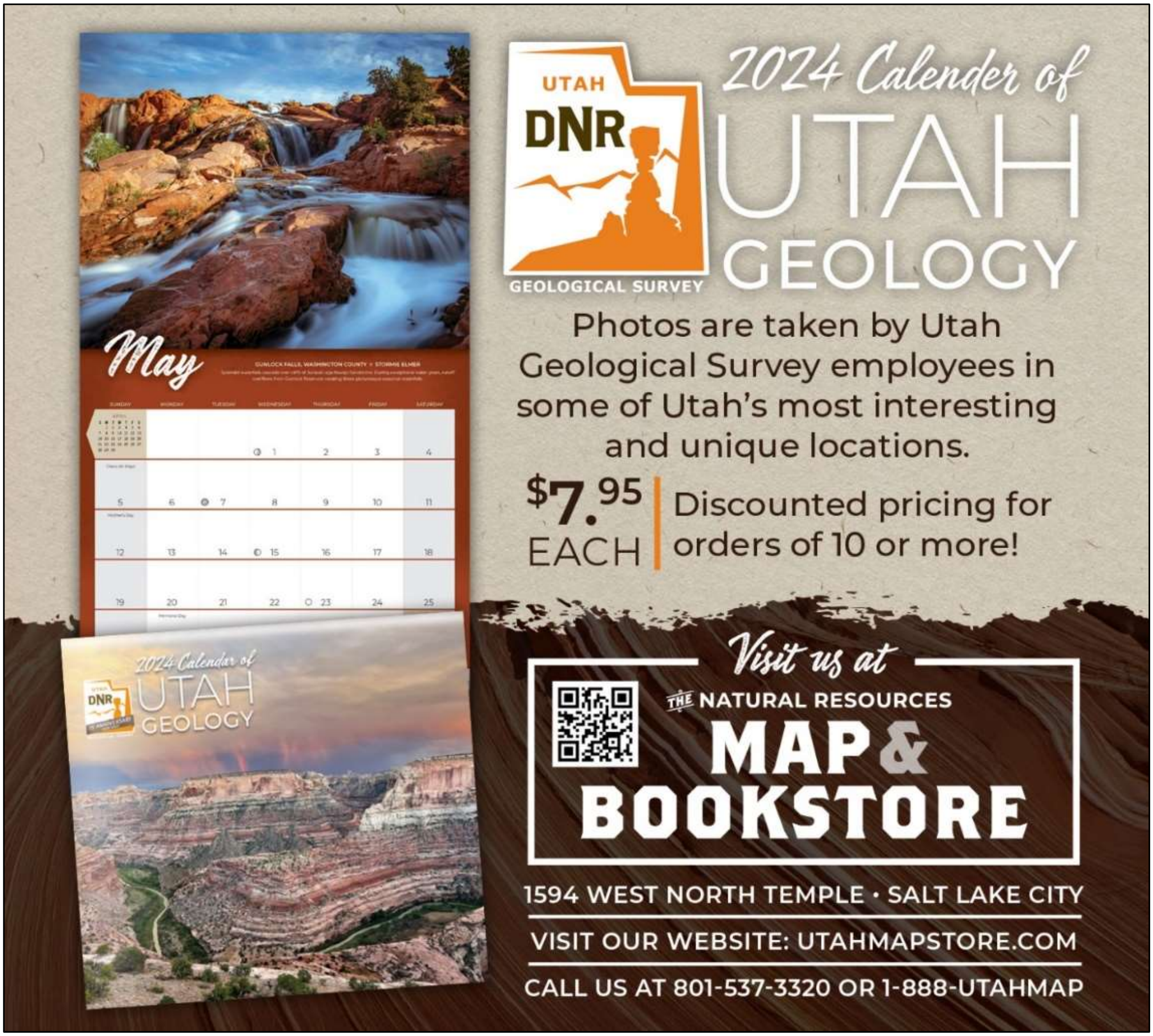
during the Late Jurassic in central Montana, displaying changing temperatures with mesic and xeric intervals of unknown duration.

NEW FROM THE UTAH GEOLOGICAL SURVEY

Lithium Brine Analytical Database of Utah: Second Edition, by Andrew Rupke and Taylor Boden, 3 p., **OFR-758**, https://doi.org/10.34191/OFR-758
Summary
This report and accompanying database is a compilation of analytical data that includes lithium concentrations from brine samples collected in Utah. The purpose of this database is to catalog the potential lithium resources in Utah.

Interim Report on the Great Salt Lake Lithium Resource, by Andrew Rupke, 14 p., OFR-759, https://doi.org/10.34191/OFR-759.
Summary
This report documents a brief evaluation of the potential lithium resource in Great Salt Lake and leans heavily on historical data from the Utah Geological Survey's GSL brine chemistry database from the 1960s through the 1990s; limited recent data are also available. Estimates in this report are not intended to be used as a resource estimate for potential mineral production and are not intended to represent indicated, measured, or inferred resources as they are legally defined.

Survey Notes - Volume 56, no.1, January 2024, https://doi.org/10.34191/SNT-56-1
Summary: Check out the latest issue of Survey Notes featuring articles on the study of incoming and outgoing groundwater in the Bryce Canyon region, the future of geologic mapping in Utah, an article on the elevation and geology of Kings Peak, a new GeoSights location, and much more.



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(Unless otherwise indicated, area code is 801)

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Geology of the Intermountain West (UGA's open-access journal)

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David A. Wavrek, dwavrek@petroleumsystems.com 801-322-2915

State Mapping Advisory Committee

Bill Loughlin, bill@loughlinwater.com 435-649-4005

Earthquake Safety Committee

Chair Grant Willis, grantwillis@utah.gov 537-3355

UGA Web Site

http://www.utahgeology.org

Webmaster Paul Inkenbrandt, paulinkenbrandt@utah.gov 537-3361

Scholarship Golf Tournament

Rick Ford, rford@weber.edu 915-3188

John South, jsouth@utah.gov 385-266-2113

UGA Newsletter

Newsletter Editor William Lund, UGA.Newsletter@gmail.com 435-590-133