DIGITAL MAPPING TECHNIQUES 2025

The following was presented at DMT '25
May 18 - 21, 2025

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2025)
http://ngmdb.usgs.gov/info/dmt/

This presentation, "Mapping with Clarity: Stratigraphic Notes and a Texas Limestone Debut," introduces the formalization of the newly defined Mill Springs Limestone Submember, part of the Point Peak Member of the Upper Cambrian Wilberns Formation within the Moore Hollow Group in central Texas. This new submember is characterized by distinctive microbialite boundstones, which were historically referred to as "stromatolites," forming discontinuous bioherm clusters with significant vertical relief and unique internal textures. The presentation also provides geological context, including stratigraphic columns, cross-sections, Cambrian paleogeography, and a simplified depositional model for the Point Peak Member. The motivation for formalizing this submember is to aid current and future geologic mapping efforts by providing a recognizable and mappable unit at a 1:24k scale. The presentation is meant to highlight the benefit of using Stratigraphic Notes as a publication venue. It provides a high-quality publication venue for short papers highlighting stratigraphic studies, changes in stratigraphic nomenclature, and explanations of stratigraphic names and concepts used on published geologic maps (or other studies). Stratigraphic nomenclature changes published in Stratigraphic Notes will ultimately be incorporated into the National Geologic Map Database's Geolex system. State geologic surveys should consider this a valuable tool and part of their arsenal of geologic publications.

Mapping with Clarity: Stratigraphic Notes and a Texas Limestone Debut

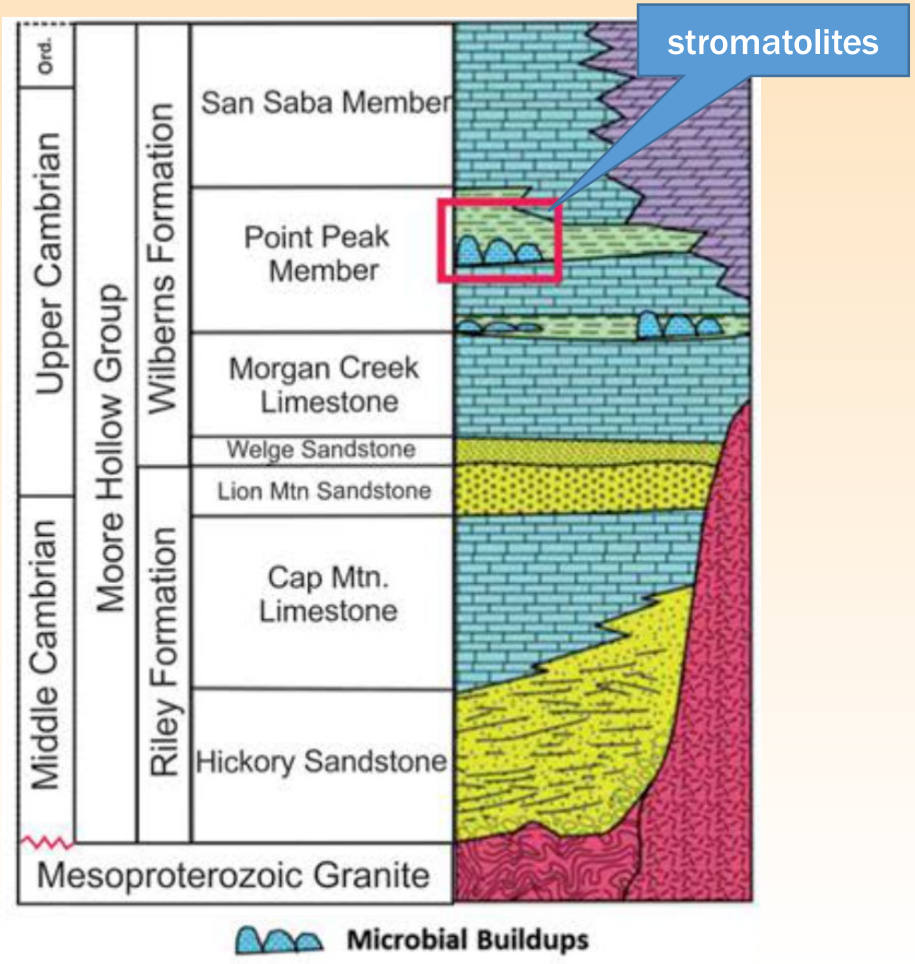
Brian B. Hunt

Bureau of Economic Geology, Jackson School of Geosciences, UT Austin

Digital Mapping Techniques 2025

Norman, OK

Stratigraphic Column
Llano Uplift, central Texas.



Figures from Khanna et al., 2020; Stratigraphic column originally from Kyle and McBride, 2014;

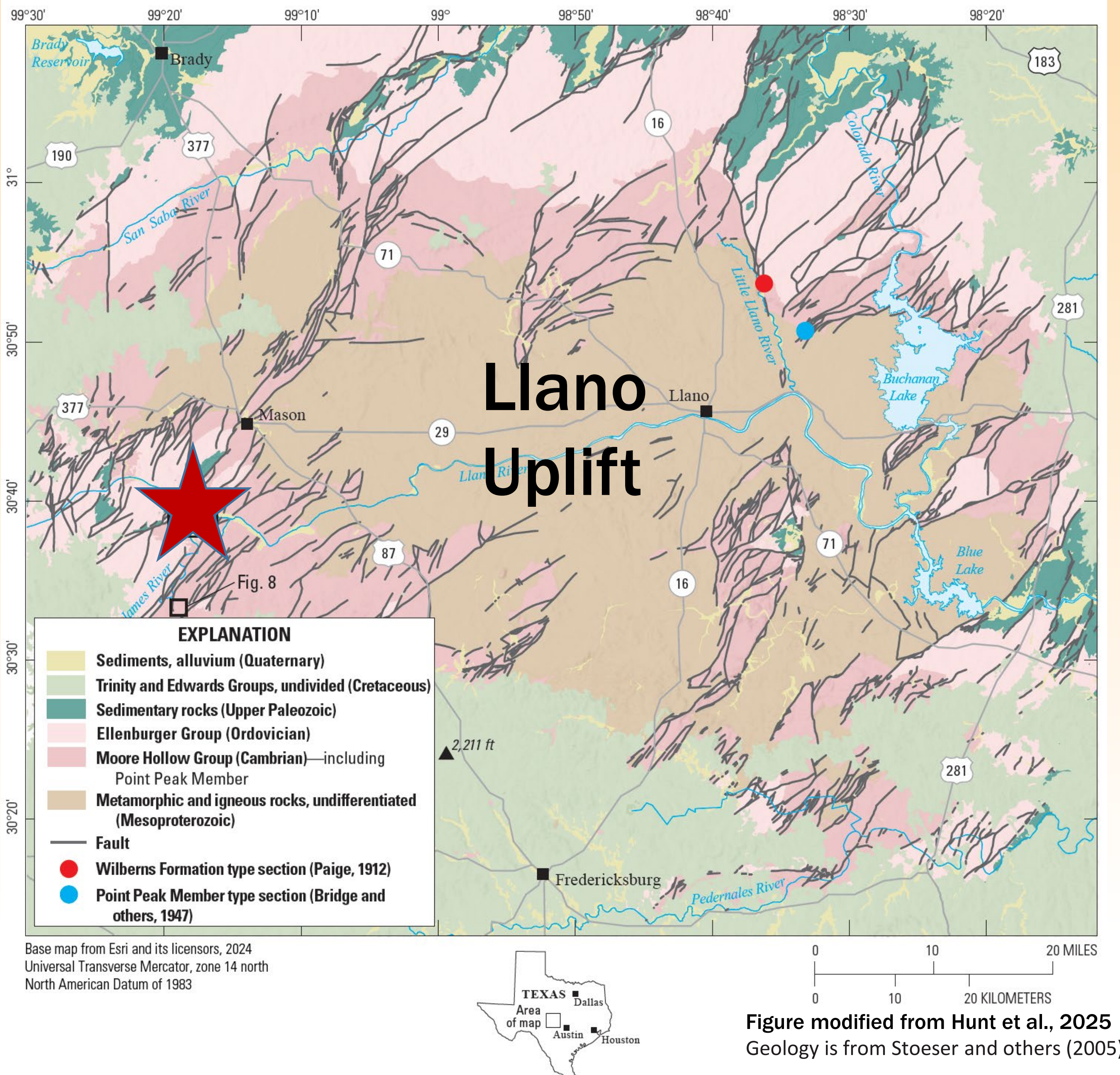


Figure modified from Hunt et al., 2025
Geology is from Stoeser and others (2005).

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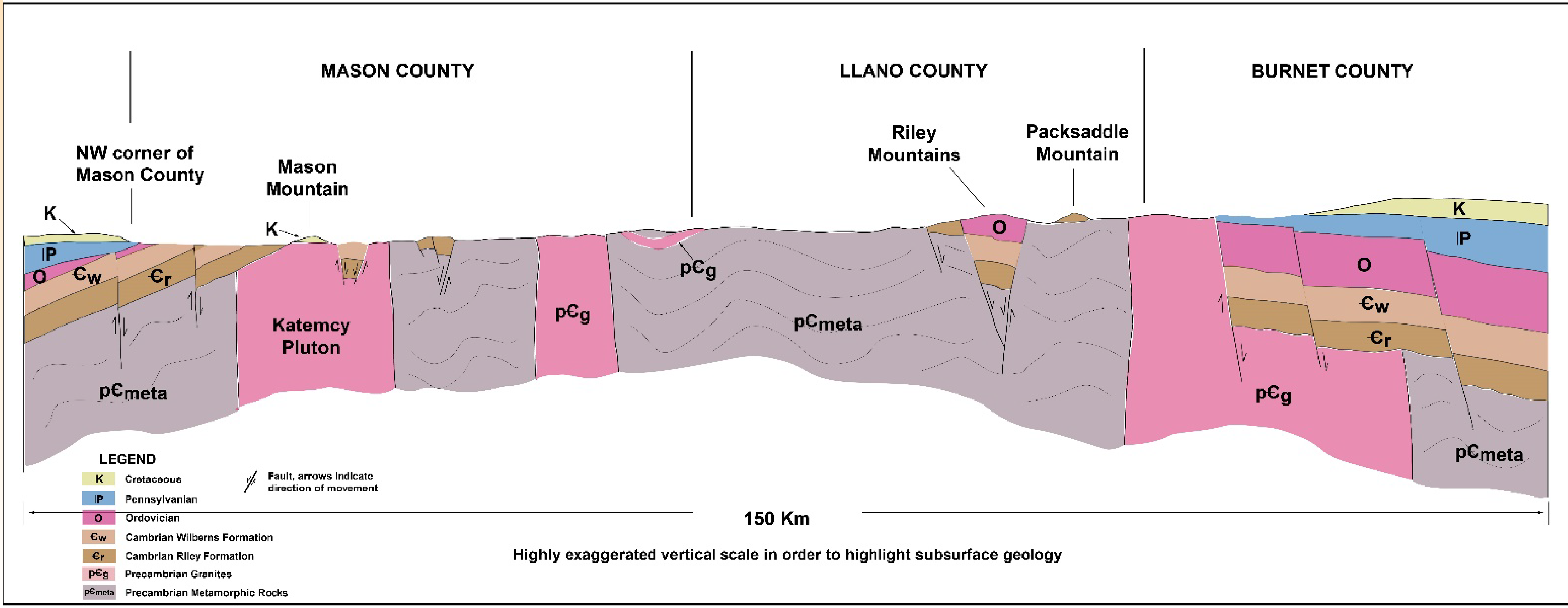
Cross Section—Llano Uplift, Texas



Schematic cross section across the Llano Uplift. Figure modified from Brann Johnson.

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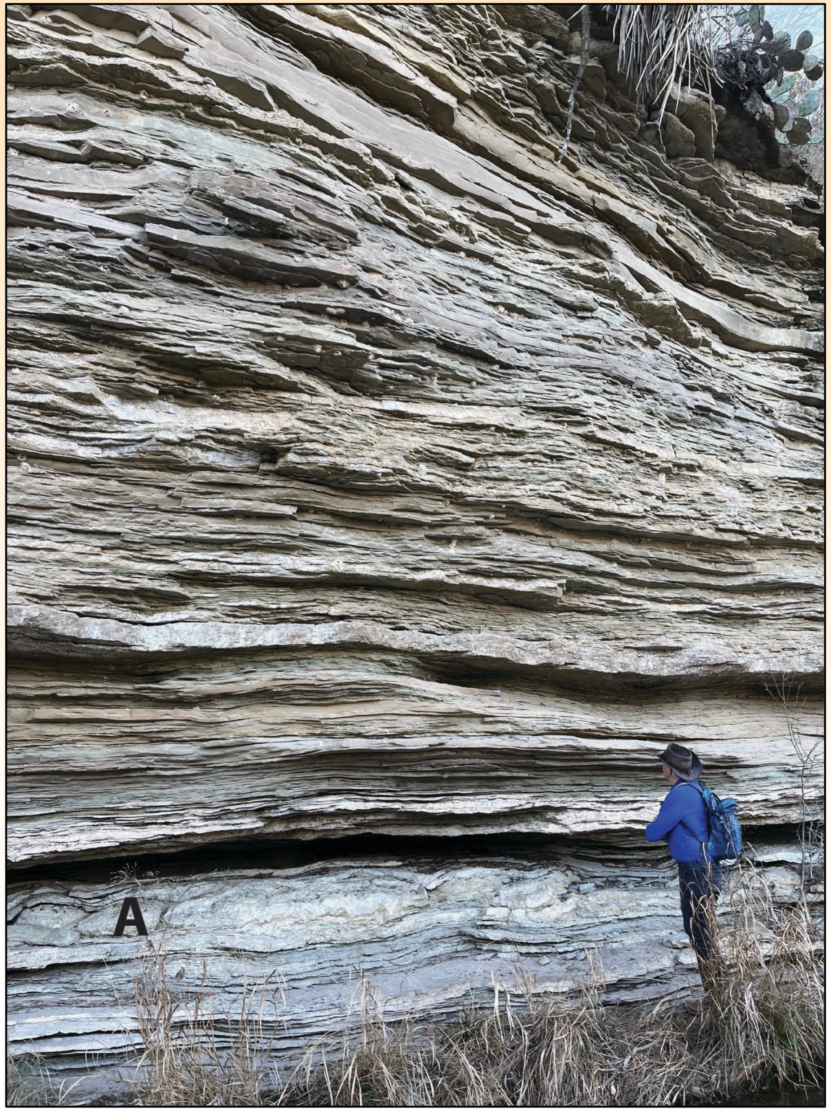
Point Peak Member (Wilberns Fm.)

thinly bedded heterolithic mixed clastic and carbonate strata



"Stromatolites"

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Lumping vs Splitting

"…allows the mind to carve out a piece of the world that is cognitively meaningful and manageable"

Lumping occurs when units are predictable.

Splitting occurs when relationship between groups is unpredictable.

-Tikoff & Shipley, 2025

PLACES THAT REVEAL
THE GEOLOGICAL MIND

Figure 1. A photo of the Grand Canyon from the south rim. Photo by E.M. Nelson.

Grand Canyon, USA: Lumping and Splitting to Make Sense of a (Somewhat) Predictable World

Basil Tikoff*,[1] and Thomas F. Shipley[2]

Geology logline: *The exposures of the Grand Canyon allow conceptual lumping and splitting of the space (rocks units) and time (events); different hypotheses for canyon formation illustrate different conceptual temporal lumping and splitting of the erosional events.*

Cognitive science logline: *Predictability underlies two important geological reasoning processes: (1) Presence versus absence and (2) Lumping versus splitting.*

Standing on the rim of the canyon, you viscerally experience the name—it feels big in a way that pictures do not capture. The immensity of absence, which is the Grand Canyon, is conveyed across all of the senses. For instance, the soundscape of the rim is not silence; you can hear the wind. Yet the sound quality is unfamiliar; absent are the common echoes from nearby surfaces. The space of the canyon is so immense that echoes disappear.

The Grand Canyon's ubiquity in geology and popular culture reflects, in part, the clarity with which stories of time are written in its space. At its most basic, it is a very large hole in the ground. The vast amount of missing rock was eroded by the seemingly small river at the bottom of the canyon. Certainly, part of the grandeur of the canyon lies in its ability to illustrate the power of water to erode vast amounts of stone little by little.

The aesthetic appeal is enhanced by the horizontal geological layers that occur at the same elevations on both sides of the canyon. Other canyons offer one or two layers that can be followed across; for example, the Mississippian Redwall limestone generally forms a steep cliff partway up and the Cambrian Bright Angel shale always forms a flat area near the bottom. In contrast, the Grand Canyon offers an entire section of rock with multiple distinguishable units. Because it is all visible, one can easily take the intellectual leap that the

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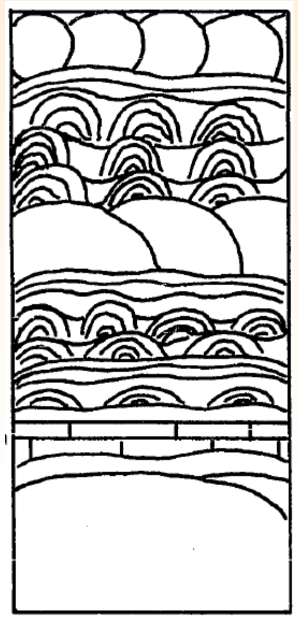
CITATION: Tikoff, B., and Shipley, T.F., 2025, Grand Canyon, USA: Lumping and splitting to make sense of a (somewhat) predictable world: GSA Today, v. 35, p. 4–8, https://doi.org/10.1130/GSATG106GM.1.

Terminology

Stromatolite- Attached lithified sedimentary growth structures with well-defined laminations (Grotzinger and Knoll, 1999)

Microbialite Boundstones

Microbialites are in-place lithified organo-sedimentary deposits that form as a result of benthic microbes trapping and binding sediment, which forms a locus for mineral precipitation (Riding, 2011).

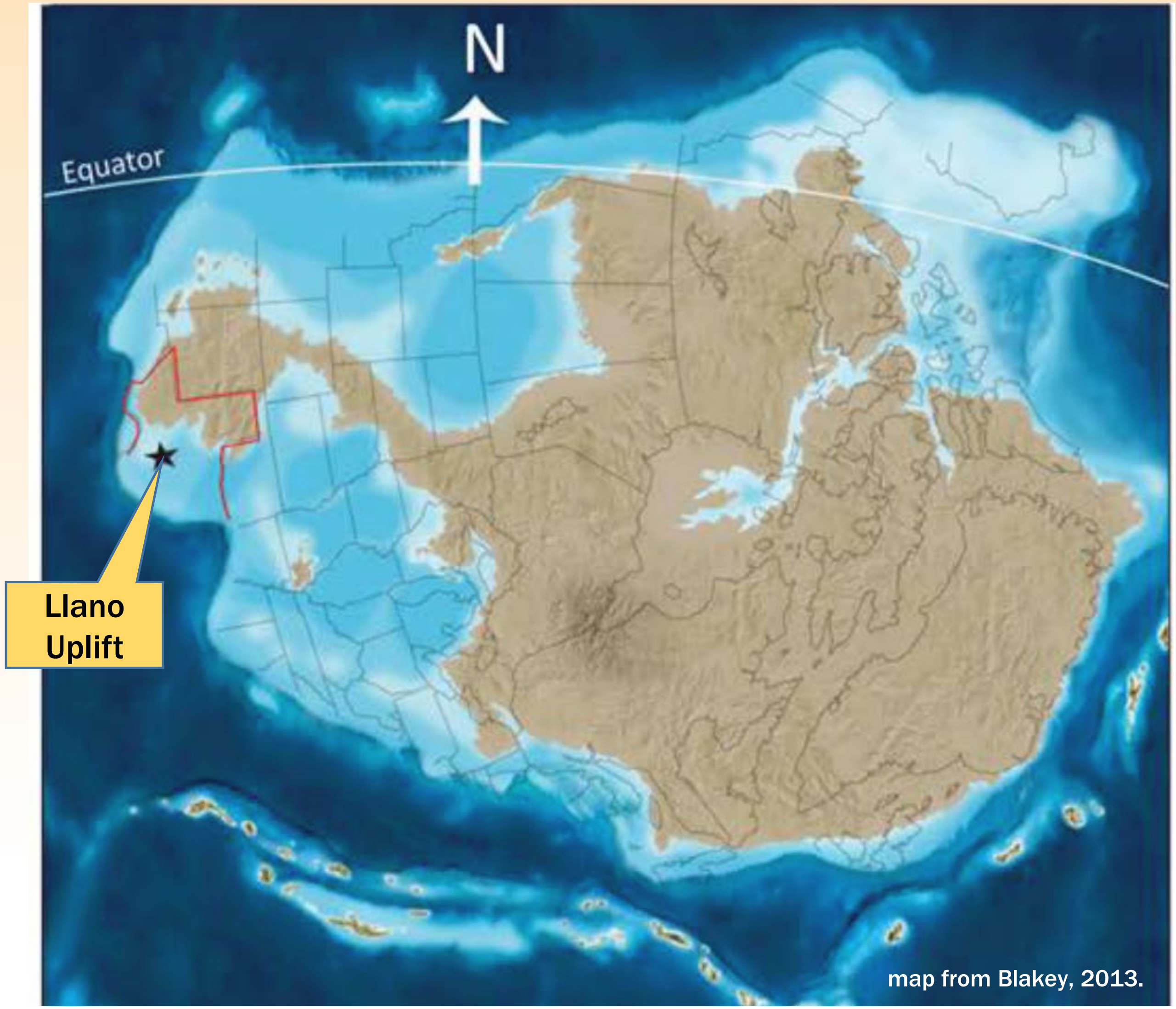


Autochthonous, carbonate-dominated rock where original components were organically bound at the time of deposition and showed some relief

Cambrian Paleogeography

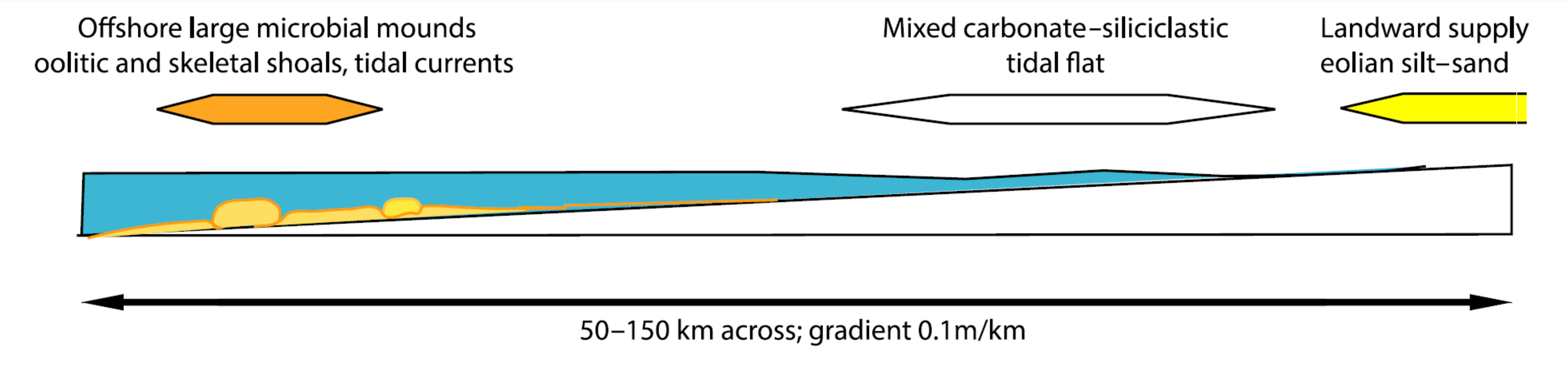
- Widespread passive margins (post breakup of Rodinia)
- Greenhouse conditions in late Cambrian, first-order high stand flooding
- Sauk transgression or Sauk megasequence (Cambrian-Ordovician)
- "Great American Carbonate Bank", an epicontinental sea formed on a shallow and extensive shelf.

-(Ewing, 2016)



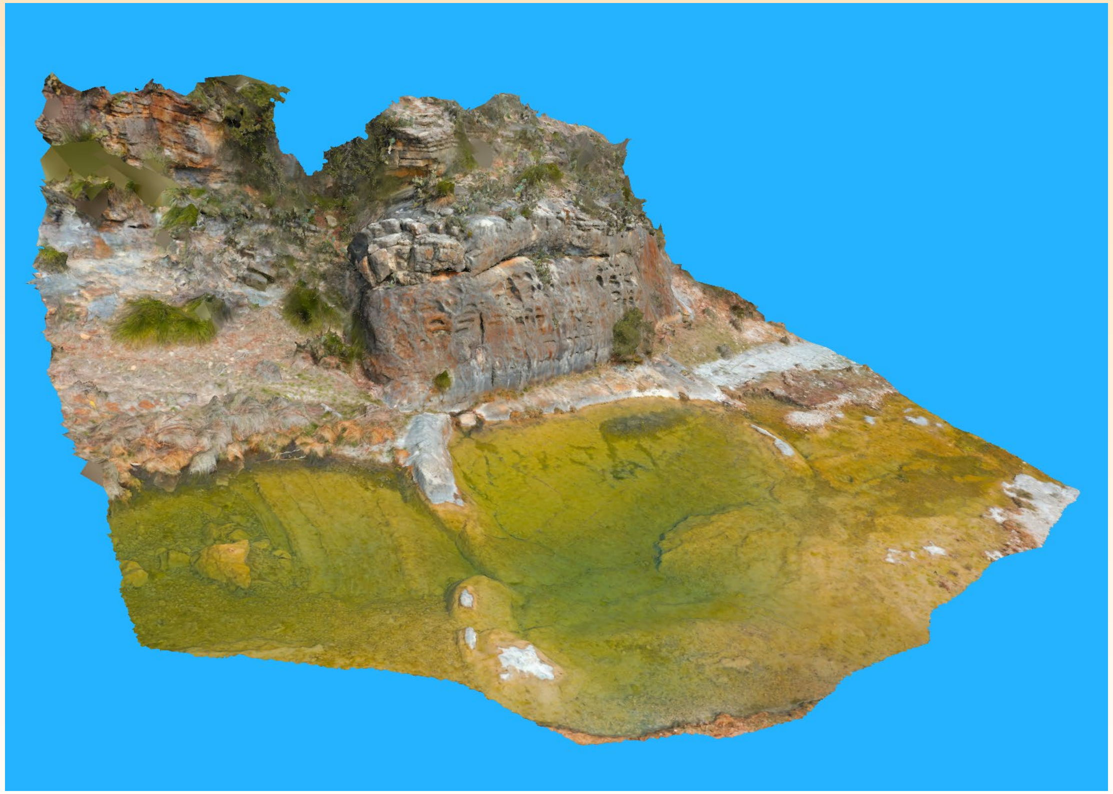
map from Blakey, 2013.

Simplified Depositional Model
Point Peak Member



From Lehrmann et al., 2020

3D (SFM) Models



https://storage.googleapis.com/a369/MASON/MODELS/DROXROCK/index.html

https://storage.googleapis.com/a369/MASON/MODELS/GRANDDAUGHTERS/index.html

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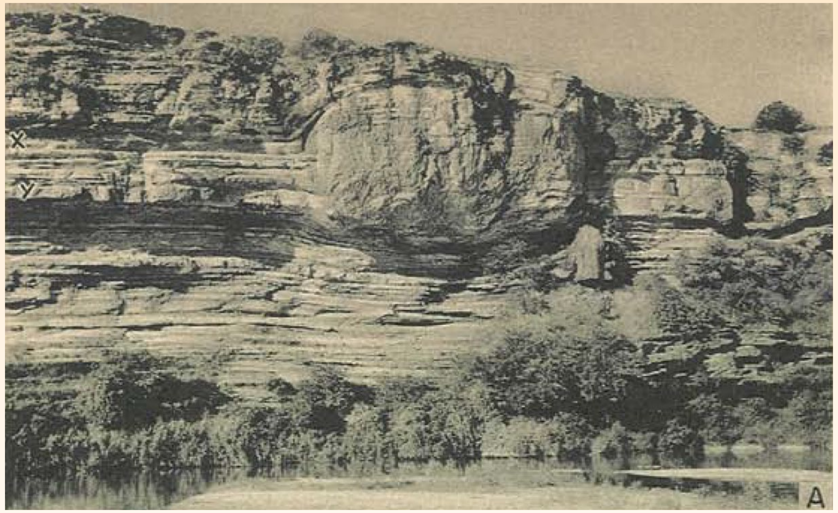
Courtesy of Andre Droxler

"Stromatolites" have had an Abiding Interest

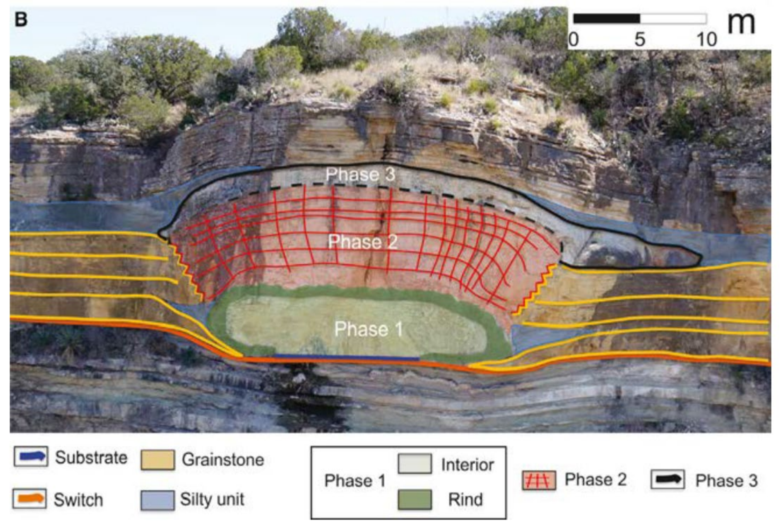
Fig. 7. A large concretion on the Llano River.

Deen, 1923



A stromatolitic bioherm

Cloud & Barnes, 1948



Khanna, et al., 2019

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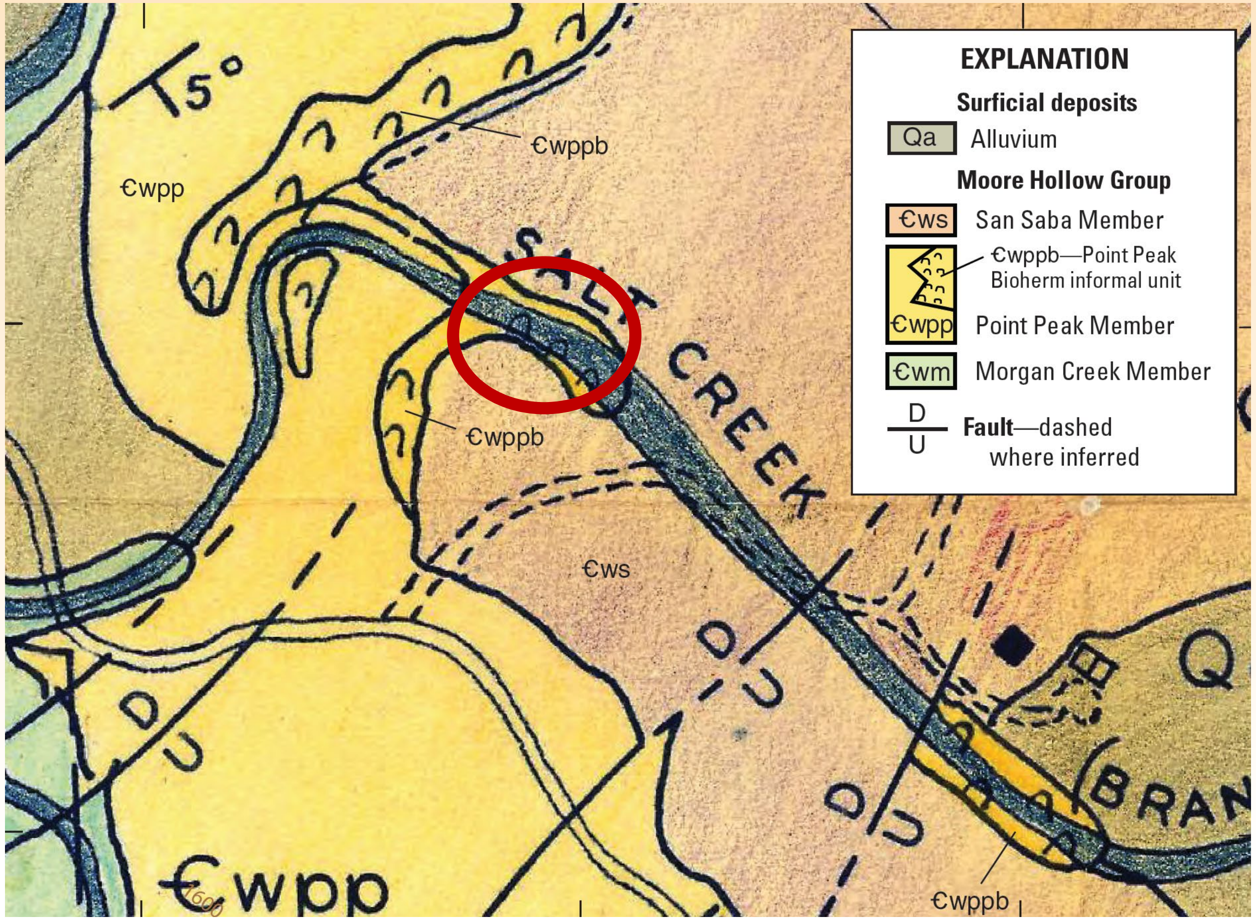
Point Peak Bioherms Mapped in unpublished theses, Mason County, Tx

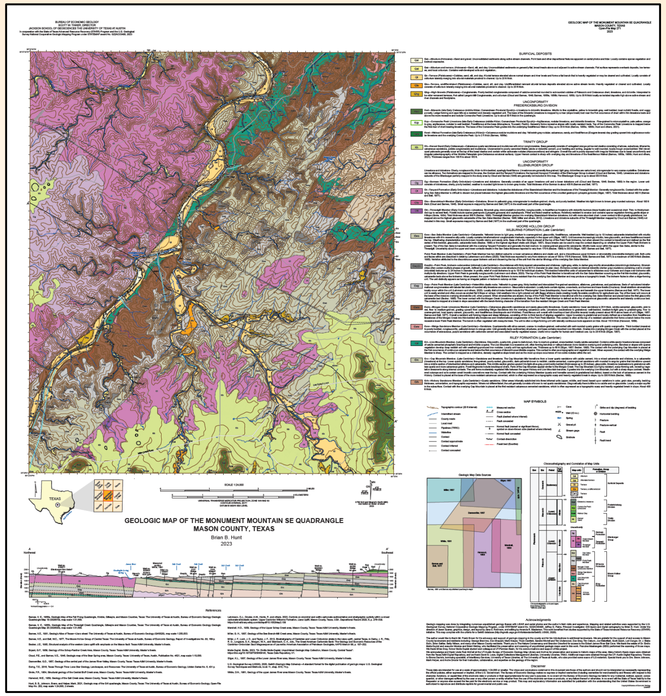


Harwood (1959)

1. Alexander (1952);
2. Polk (1952);
3. Duvall (1953);
4. Fritz (1954);
5. Grote (1954);
6. Sliger (1957);
7. Miller (1957);
8. Dannemiller (1957);
9. Fuller (1957);
10. Bryant (1959);
11. Harwood (1959);
12. Pool (1960);
13. Becker (1985); and
14. Spincer (1997)

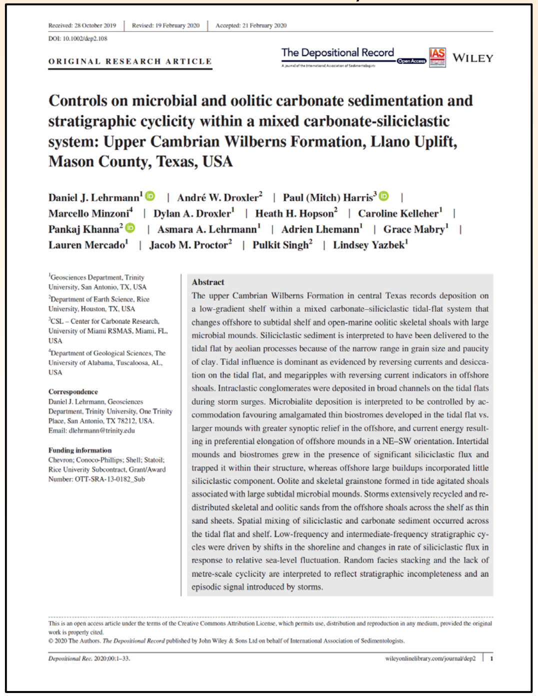
Motivation to Formalize Submember

1. Distinctive, readily recognizable attributes are mappable at a 1:24k scale--formal recognition of such a submember would aid current (open-file) and future geologic mapping (STATEMAP program).
2. Unit comprises a unique lower Paleozoic stratigraphic interval of interest for regional depositional and paleoenvironmental studies.



Khanna et al., 2020

Lehrmann et al., 2020



Bureau of Economic Geology

Stratigraphic Notes

Short papers that highlight stratigraphic studies, changes in stratigraphic nomenclature, and explanations of stratigraphic names and concepts used on published geologic maps.

Content ultimately will be incorporated by National Geologic Map Database personnel into Geolex, https://ngmdb.usgs.gov/Geolex/.

USGS
science for a changing world

Stratigraphic Notes—Volume 1, 2022

Professional Paper 1879–1

U.S. Department of the Interior
U.S. Geological Survey

Stratigraphic Notes—Volume 1, 2022
Edited by Randall C. Orndorff, Nancy R. Stamm, and David R. Soller
U.S. Geological Survey Professional Paper 1879–1, 2023

Chapter A

"Stratigraphic Notes"—An Outlet For Stratigraphic Studies

By Randall C. Orndorff, Nancy R. Stamm, and David R. Soller

Introduction

Welcome to the resurrected series of U.S. Geological Survey (USGS) reports on stratigraphy, entitled "Stratigraphic Notes"; this initial volume is called "Stratigraphic Notes—Volume 1, 2022." For several decades, until the mid-1990s, the USGS published volumes of short papers that highlighted stratigraphic studies, changes in stratigraphic nomenclature, and explanations of stratigraphic names and concepts used on published geologic maps. The purpose was to encourage formal documentation on these topics. Today (2023) the need for such documentation has become especially important because of the increasing number of published field-trip guidebooks and open-file reports that use new or updated stratigraphic nomenclature; however, field-trip guidebooks and open-file reports cannot be referenced as authoritative documentation of stratigraphic studies because the North American Stratigraphic

(Brock, 2017). A major challenge to t
how (and rectifying, if necessary) stra
across states. As the geoscience comm
to reconcile stratigraphic changes acr
that range from geopolitical to litholo
Notes" series can be an outlet for for
or updated nomenclature that then ca
(https://ngmdb.usgs.gov/Geolex/), wh
Geologic Map Database's (NGMDB
Many issues related to human-define
map areas (for example, state lines, q
are real—stratigraphy does change la
changes, changes in sedimentation ra
sea level, and changes in paleoenviro
"Stratigraphic Notes" can provide a p
these interpretations as they affect str
We are serving as editors of the "

Stratigraphic Notes—Volume 1, 2022
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U.S. Geological Survey Professional Paper 1879–1, 2023

Chapter B

Suggestions for Proposing Changes in Nomenclature in Papers Submitted to "Stratigraphic Notes"

By Nancy R. Stamm

Introduction

The "Stratigraphic Notes" series is intended to be an

Designation of Reference (Section, Locality, or Area)

A reference (section, locality, or area)[1] may be designated

Stratigraphic Notes: Volume 2

Introducing...

Mill Springs Limestone Submember (New) of the Point Peak Member, Wilberns Formation, Moore Hollow Group, Texas

Stratigraphic Notes—Volume 2, 2025
Edited by Randall C. Orndorff, Nancy R. Stamm, and David R. Soller
U.S. Geological Survey Professional Paper 1879–2, 2025

Chapter C

Mill Springs Limestone Submember (New) of the Point Peak Member, Wilberns Formation, Moore Hollow Group, Texas

By Brian B. Hunt,[1] André W. Droxler,[2] Daniel J. Lehrmann,[3] and Pankaj Khanna[4]

Abstract

This study proposes a new mappable unit, the Mill Springs Limestone Submember, within the Upper Cambrian Point Peak Member of the Wilberns Formation of the Moore Hollow Group in the Llano Uplift, central Texas. The submember is characterized by thick microbial boundstones that distinguish it from the thinly bedded heterolithic mixed clastic and carbonate strata of the Point Peak Member. The submember contains discontinuous individual bioherms up to 4.5 meters (m) thick, and cluster up to 15 m thick. The Mill Springs Limestone generally occurs in the upper and middle portions of the Point Peak, from west to east in the study area, and when present is mappable at the quadrangle (1:24,000) scale. In the western part of the study area the Peak Member contains facies that reflect a shift from tidal-flat deposition in the lower part of the Point Peak, to more open, outer-shelf conditions in the upper part of the Point Peak and development of thick bioherms characteristic of the Mill Springs Limestone Submember. The new designation aids geologic mapping and future paleoenvironmental studies.

Introduction

We propose a new mappable unit, the Mill Springs Limestone Submember, within the Upper Cambrian Point Peak Member of the Wilberns Formation of the Moore Hollow Group in the Llano Uplift, central Texas. The Point Peak Member is a heterolithic mixed siliciclastic-carbonate unit about 45 meters (m) thick on average. The new submember is comprised of discontinuous individual and clustered microbial boundstones (bioherms) that generally occur in the upper and middle to lower portions of the Point Peak, from west to east in the study area, respectively (refer to fig. 1 of Khanna and others [2019]). Thin stratiform boundstones (biostromes) are found discontinuously in the lower portion of the Point Peak Member but are not considered part of the submember. These bioherms in the Point Peak and associated rocks, recognized informally since Comstock (1889), have been the focus of numerous stratigraphic studies (Deen, 1923; Ahr, 1967, 1971; Barnes and Bell, 1977; Hopson, 2018; Khanna, 2017; Khanna and others, 2019, 2020; Lehrmann and others, 2020; Lee and Riding, 2022) and appear in a number of fieldtrip guide books (for example, Ruppel and Kerans, 1987; Droxler, 2021).

It is important to designate the Mill Springs Limestone as a submember because of distinctive, readily recognizable attributes mappable at a regional scale that collectively comprise a unique lower Paleozoic stratigraphic interval of abiding interest. Formal recognition of such a submember would aid current and future geologic mapping (STATEMAP program) of the Point Peak Member (for example, Hunt and others, 2022a, b; Hunt, 2023a, b), and with mapped aerial extents, it can allow for regional paleoenvironmental studies.

Setting

The Point Peak Member of the Wilberns Formation crops out within the Llano Uplift in central Texas. The Llano Uplift is an erosionally breached structural dome that forms a topographic depression because of the low weathering of relatively less resistant Mesoproterozoic (circa [ca.] 1.3 to 1.0 Ga) igneous and metamorphic basement rock exposed in its core (Mosher, 1998). The basement rocks are in turn overlain by the relatively more resistant Paleozoic and Mesozoic sedimentary strata (fig. 1; Barnes, 1981).

In the Llano Uplift area, Upper Cambrian to Lower Ordovician sedimentary rocks are divided, respectively, into the Moore Hollow and Ellenberger Groups (Cloud and Barnes, 1948; Barnes and Bell, 1977). The Cambrian–Ordovician boundary is in the uppermost part of the Moore Hollow Group (Barnes and Bell, 1977; Miller and others, 2012). The Upper Cambrian Moore Hollow Group is generally divided into the predominantly siliciclastic Riley Formation (about 260 m thick) and the overlying predominantly carbonate Wilberns Formation. The Wilberns Formation, approximately 190 m thick, is further subdivided into the Welge Sandstone, Morgan Creek Limestone, Point Peak (subject of this paper), and San Saba Members. The Point Peak Member is approximately 45 m thick on average and locally up to 65 m thick (Barnes and Bell, 1977).

[1] Bureau of Economic Geology, The University of Texas at Austin
[2] Rice University
[3] Trinity University
[4] Indian Institute of Technology

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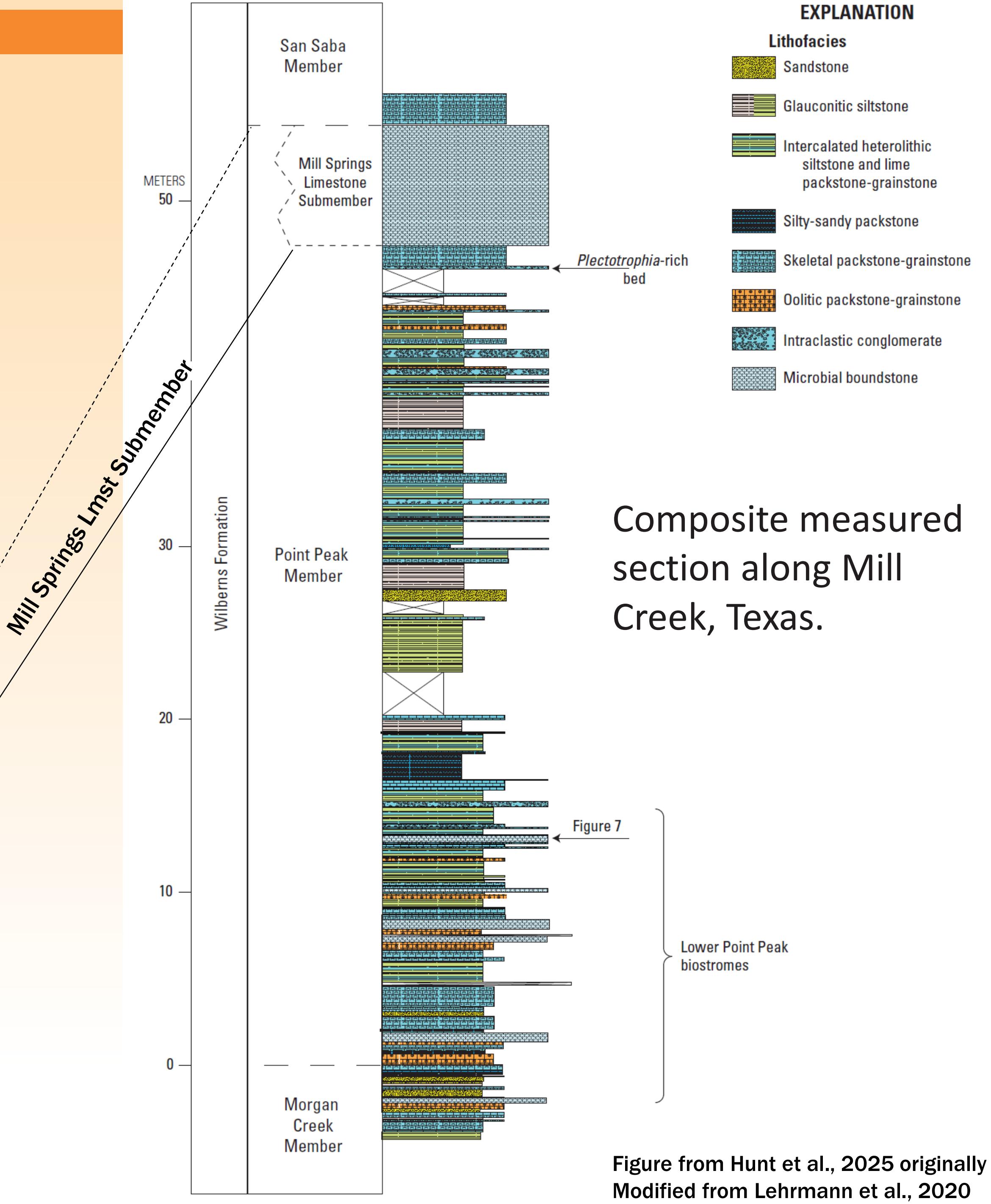
Type Section

Llano River, Mason Co., Tx



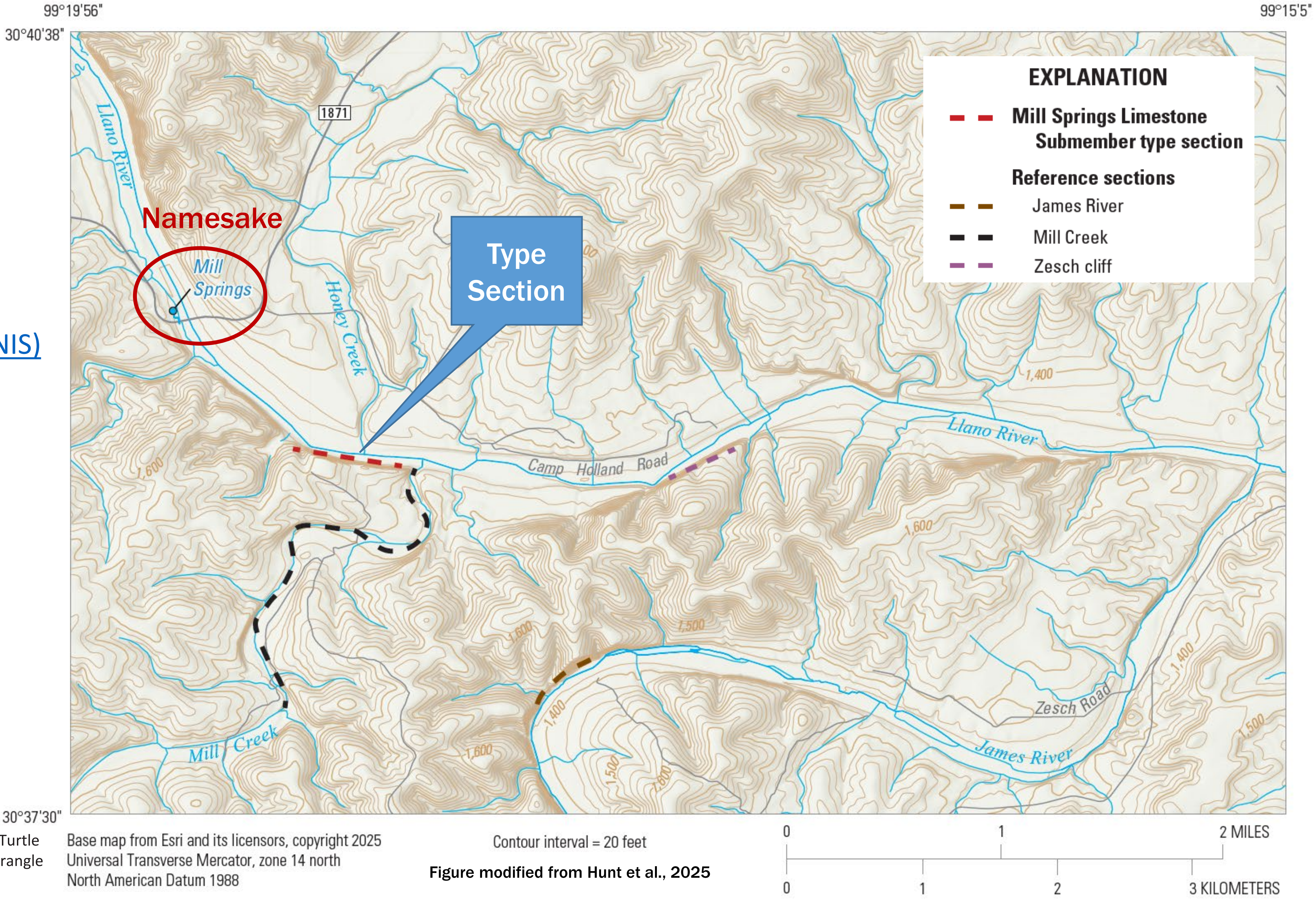
Composite measured section along Mill Creek, Texas.

Figure from Hunt et al., 2025 originally Modified from Lehrmann et al., 2020

Bureau of Economic Geology

Type Section

[Geographic Names Information System (GNIS)]



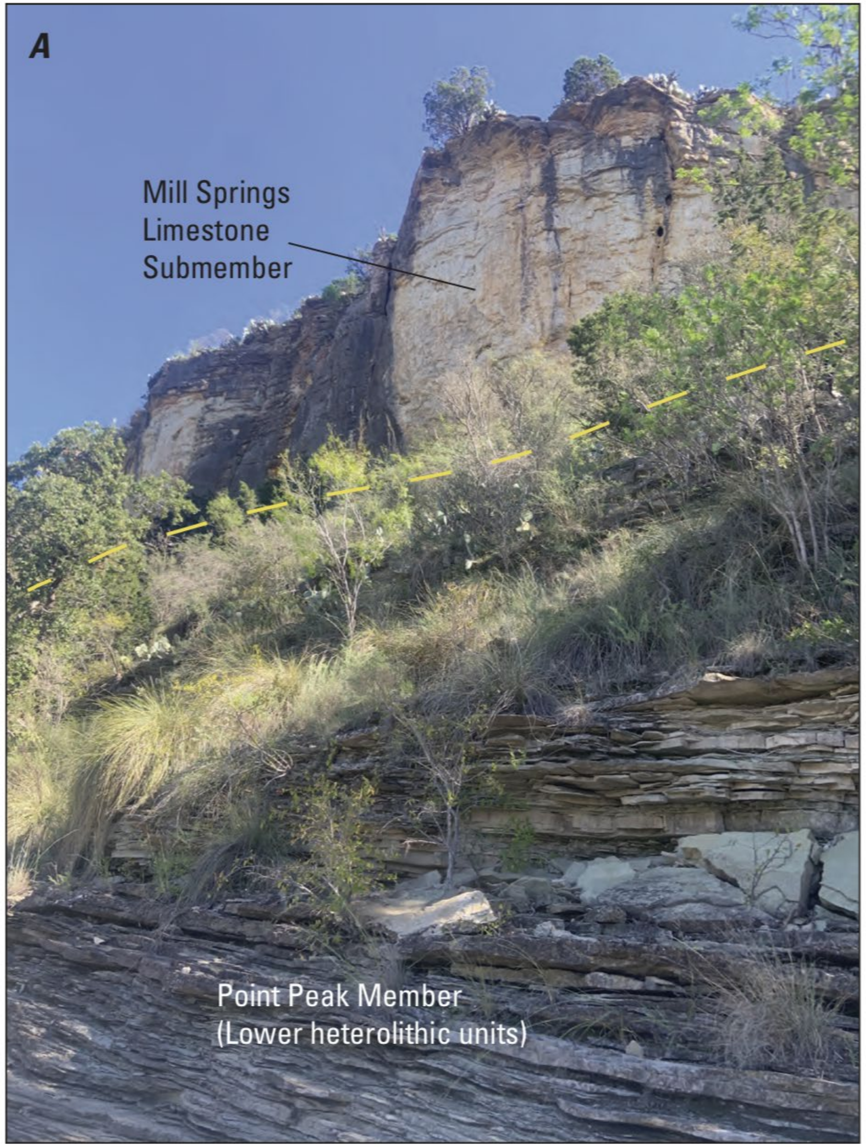
U.S. Geological Survey Turtle Creek 7.5-minute quadrangle Mason County, Texas.

Base map from Esri and its licensors, copyright 2025
Universal Transverse Mercator, zone 14 north
North American Datum 1988

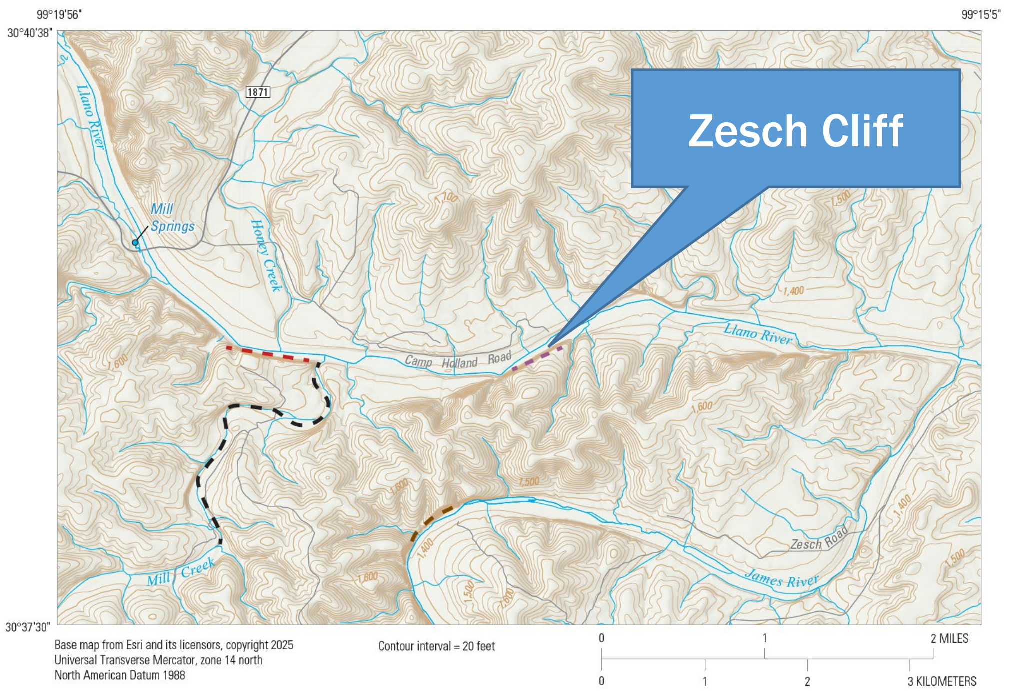
Contour interval = 20 feet

Figure modified from Hunt et al., 2025

Reference Section



Zesch Cliff, Figure from Hunt et al., 2025



Mill Springs Limestone Submember (New)

Salt Creek, Mason Co. Tx

Microbialite boundstone. Forms discontinuous clusters of bioherms…individual bioherms have up to 4.5 m of vertical relief but can locally produce thicknesses up to 30 m when clustered.

Drone imagery courtesy of Kyle Martin and Andre Droxler

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Mill Springs Limestone Submember (New)

James River, Mason Co. Tx

Bioherms are fine-grained defined by a white limestone outer structure up to 10 m in diameter (plan view).

Interior of darker gray to orange-gray internal dolomitic mudstone with numerous oval to circular textures up to 0.6 m in diameter.

Mill Springs Limestone Submember (New)

Core from James River, Mason Co. Tx

…contains stromatolitic and thrombolitic textures..

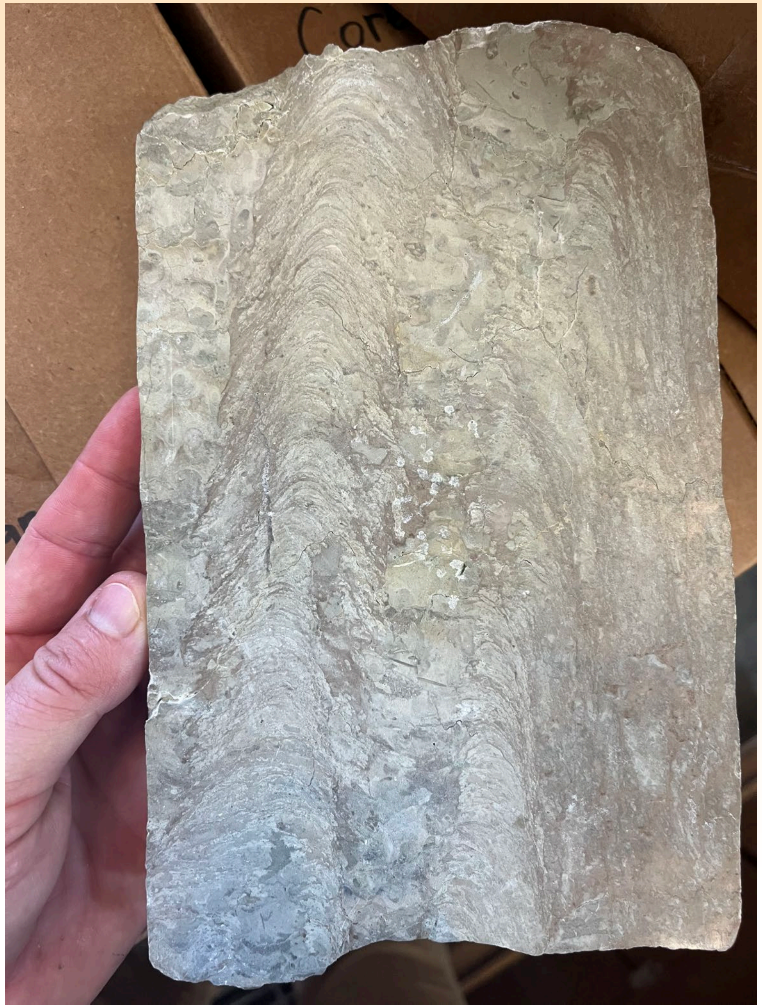


Photo of core sample at the UT-BEG CRC. Core collection donated by Andre Droxler

Bureau of Economic Geology

James River, Mason County, Texas

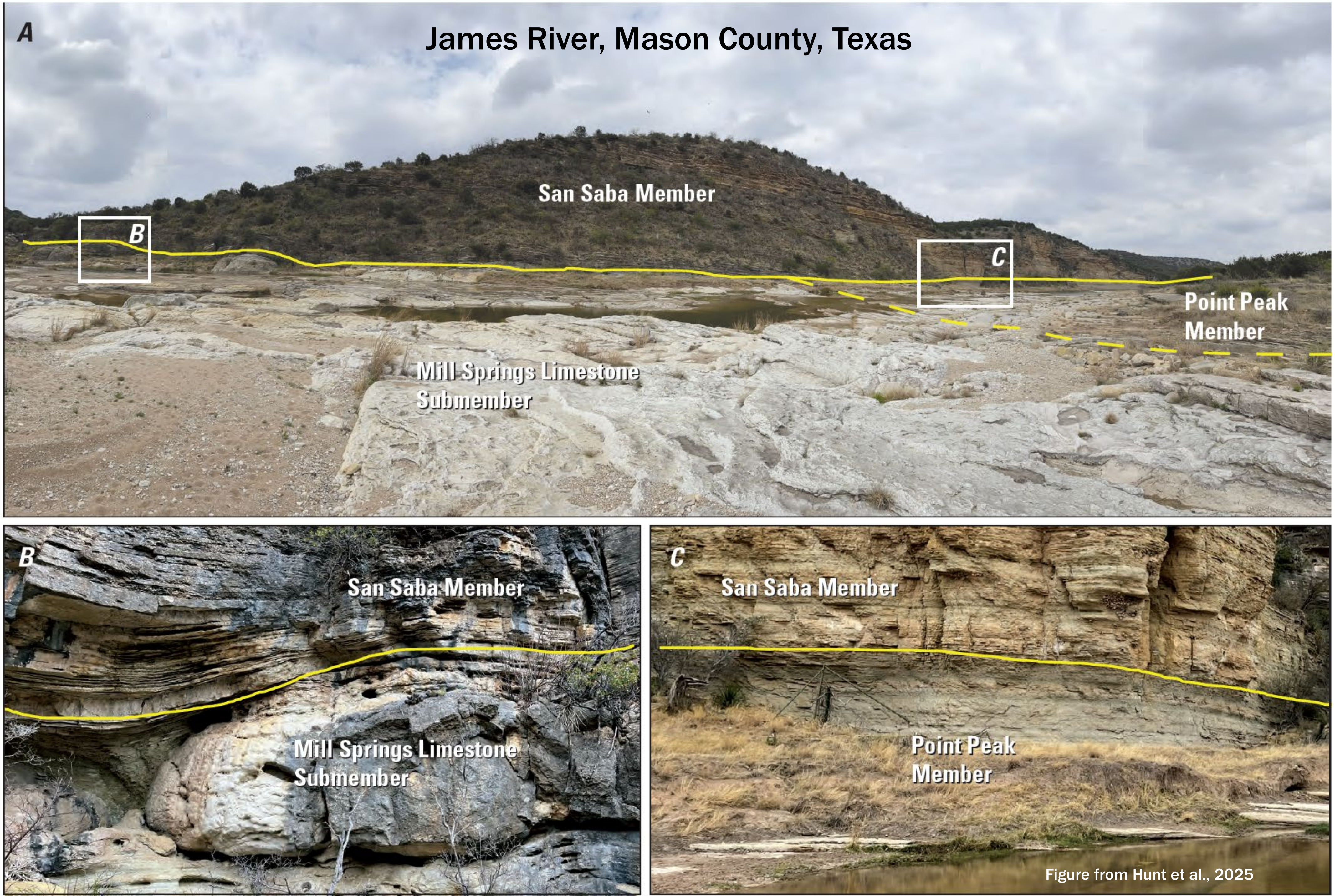
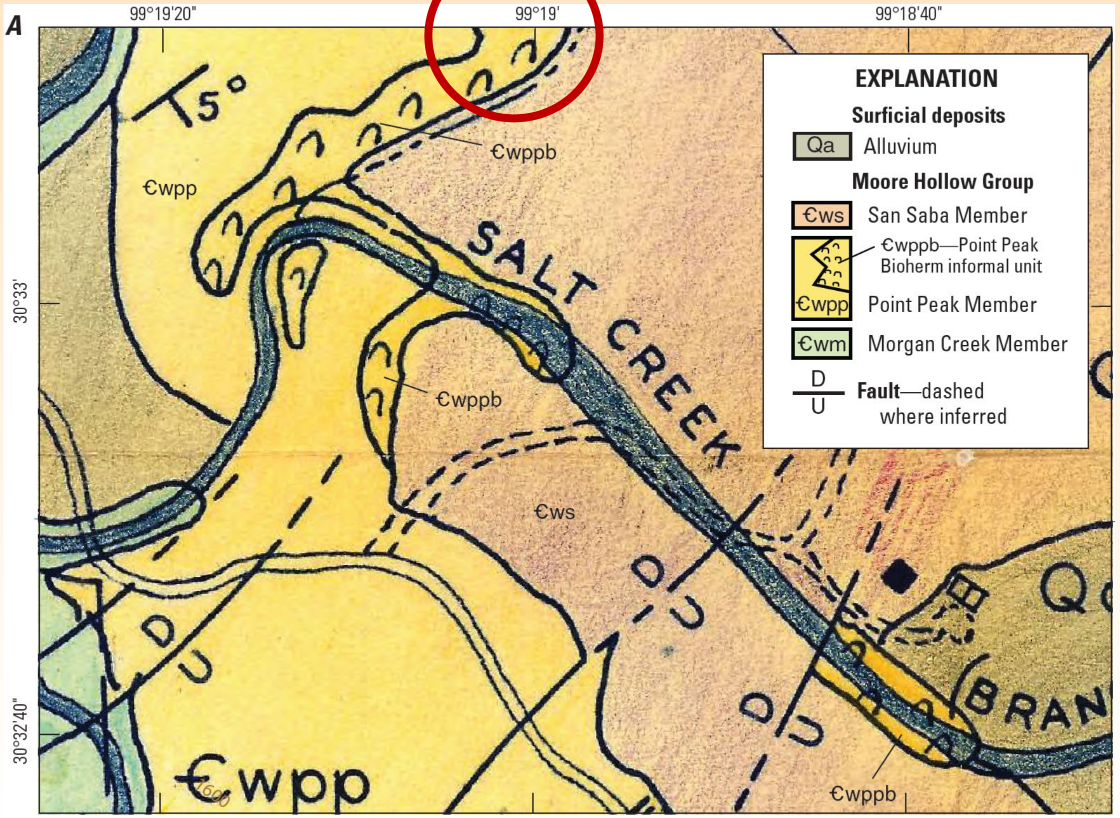


Figure from Hunt et al., 2025

Geologic Map

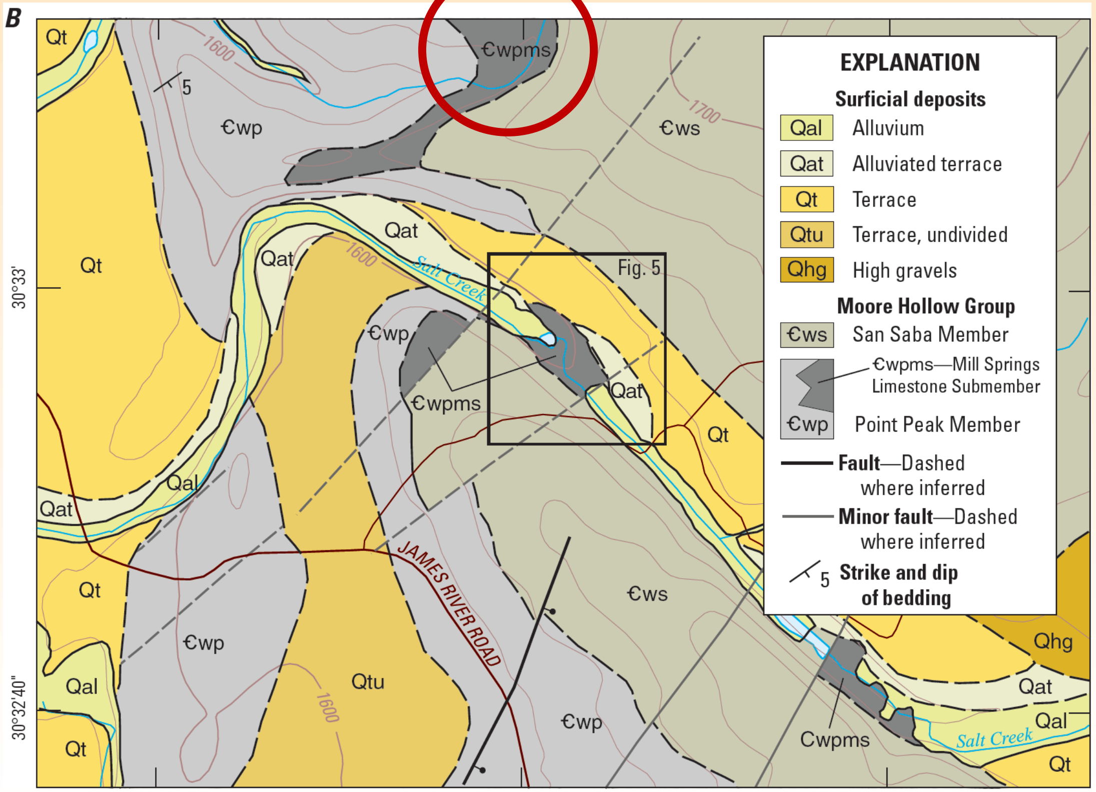
Portion of Monument Mnt Quadrangle, Mason, Tx

Cwppb



Hardwood, 1959

Cwpms



Hunt, 2023

0 250 500 METERS
0 660 1,320 FEET

Figures modified from Hunt et al., 2025

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Take Away: Stratigraphic Notes

- **Robust and Effective Outlet with Visibility**
- **Provides a framework for stratigraphic revisions that leads to Improved Mapping**

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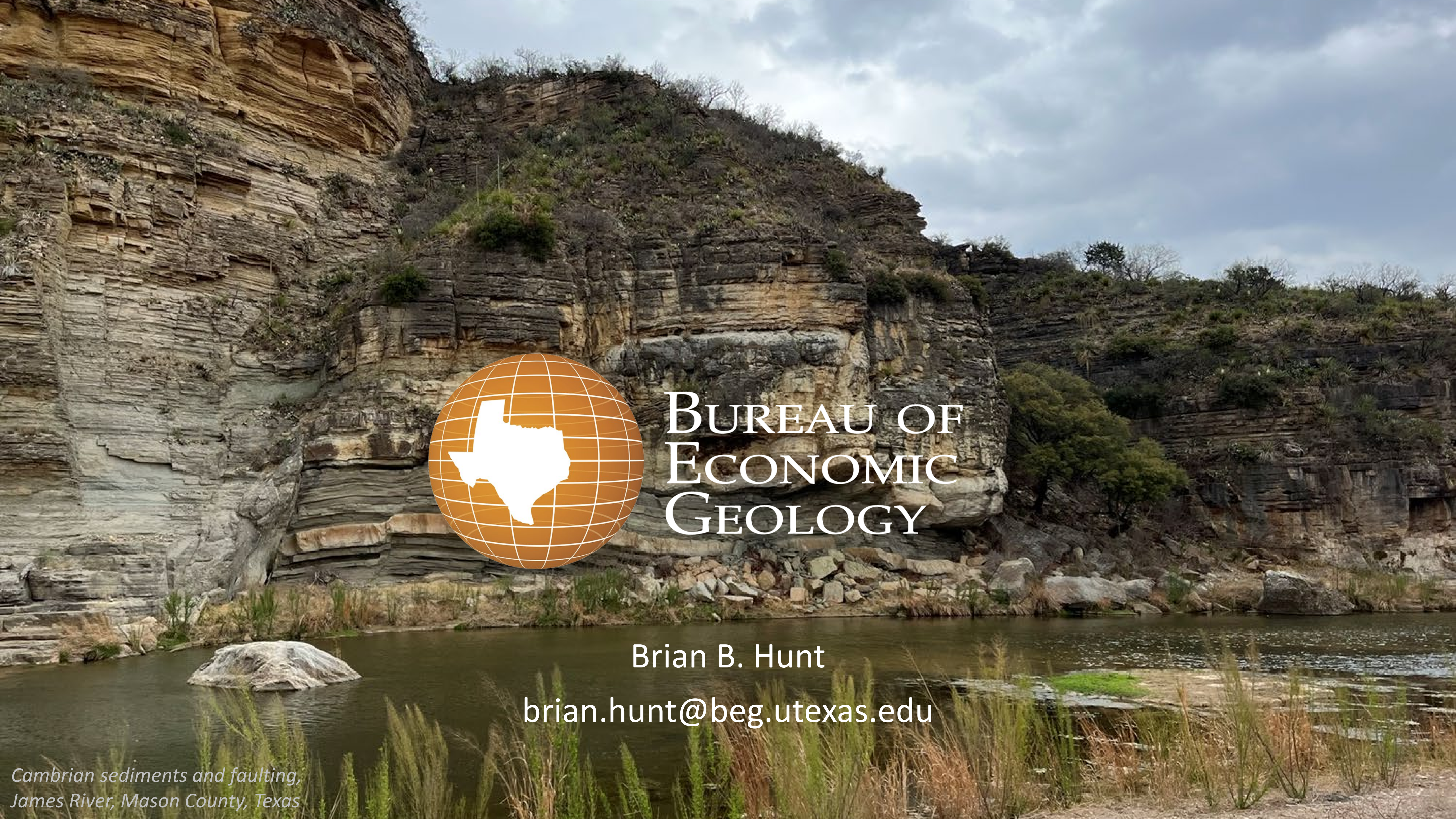
Acknowledgements

- Co-authors: André W. Droxler, Daniel J. Lehrmann, and Pankaj Khanna
- UT-BEG Mapping PI: Jeffrey G. Paine
- U.S. Geological Survey (USGS) National Cooperative Geologic Mapping Program STATEMAP cooperative agreement (awards G20AC00313, G21AC10838, and G22AC00495).
- Bureau of Economic Geology State of Texas Advanced Resource Recovery (STARR) funds for geologic mapping.
- Mark Helper (UT-JSG), Robert Loucks (UT-BEG), Charles Kerans (UT-BEG), and Nancy R. Stamm (USGS) for their peer review of this manuscript.
- USGS staff: Dave Soller, Kathryn Pauls, Randall C. Orndorff, Nancy R. Stamm, and Robert G. Stamm.



Bureau of Economic Geology

Brian B. Hunt

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Cambrian sediments and faulting, James River, Mason County, Texas