PS Lithospheric Flexure Maps for the Paradox Basin Using Graphic Correlation Data

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Abstract

The Paradox Basin (PB) was a flexural basin during Late Paleozoic Ancestral Rocky Mountains compressional tectonics. Previous studies resulted in two-dimensional profiles showing the flexural subsidence in front of the rising Uncompahgre Uplift. This study involves a novel method using high-resolution stratigraphic data from hundreds of wells bundled into six Pennsylvanian-Permian chronostratigraphic stages to estimate the foredeep, forebulge, backbulge basin and backbulge areas. By using graphic correlation (GC), where the total thickness of the study interval for wells was set at 100 percent and each stage or partial stage is an incremental thickness percent of the total starting with strata in the oldest stage (Atokan Lower Hermosa), the resulting data for the study wells could then be mapped. A "hinge well" was chosen on the backbulge to correlate percentages with the remaining study wells. Maps of the calculated GC differences with the "hinge well" are independent of measured thickness (isochore) maps, and some study maps were found to be sensitive to the paleotopography of the underlying Mississippian erosional surface and its "paleostructures" and the buried flexural tectonic features. The influence of those features decreases with continued deposition and eventually disappears.

Results for the Atokan Lower Hermosa interval were mixed because those strata onlapped and buried the Mississippian topography; better information is through maps of the onlapping Lower Hermosa cycles that reveal drainage patterns on the eroded Mississippian Leadville Fm. Results for the Atokan Alkali Gulch interval were "hazy" because of widespread deposition of thick halite beds during the early stages of tectonic flexure of the PB and the sparsity of data in the Deep Fold and Fault Belt (DFFB) with subsequent massive salt flowage. Results for the Desmoinesian Hatch, Ismay, Desert Creek, Akah and Barker Creek intervals were outstanding and provided considerable detail. The foredeep can now be better defined for the previously mapped DFFB and shows a prominent forebulge that follows much of the outer outline of the DFFB. Importantly, several hydrocarbon-bearing traps are now identified to occur on the flanks of or directly on the forebulge trend. The backbulge basin is large and complex and contains the Blanding Subbasin in the southern PB. More rapid subsidence of the Blanding Subbasin part of the backbulge basin likely preserved porosity in the hydrocarbon-bearing bioherms and carbonate buildups in the Desmoinesian Ismay and Desert Creek strata. The backbulge is gradationally outward from the outer backbulge basin marked by limits of PB halite deposition and

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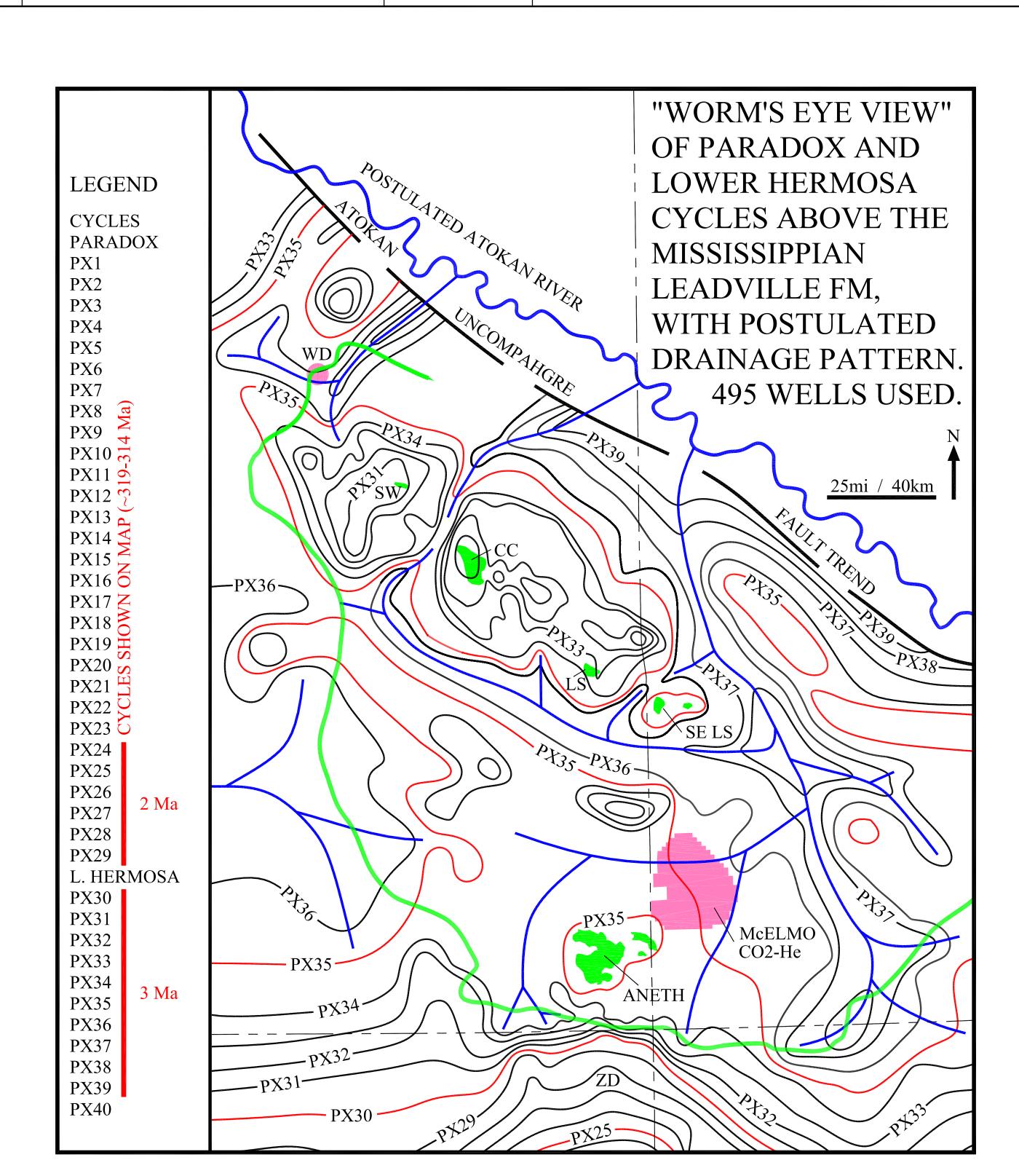
includes the "hinge" trend. Results for the Missourian, Virgilian, Wolfcampian, and Leonardian intervals were muted by massive siliciclastic deposition that masked underlying features. This study suggests a new method for the analysis of flexural basins.				

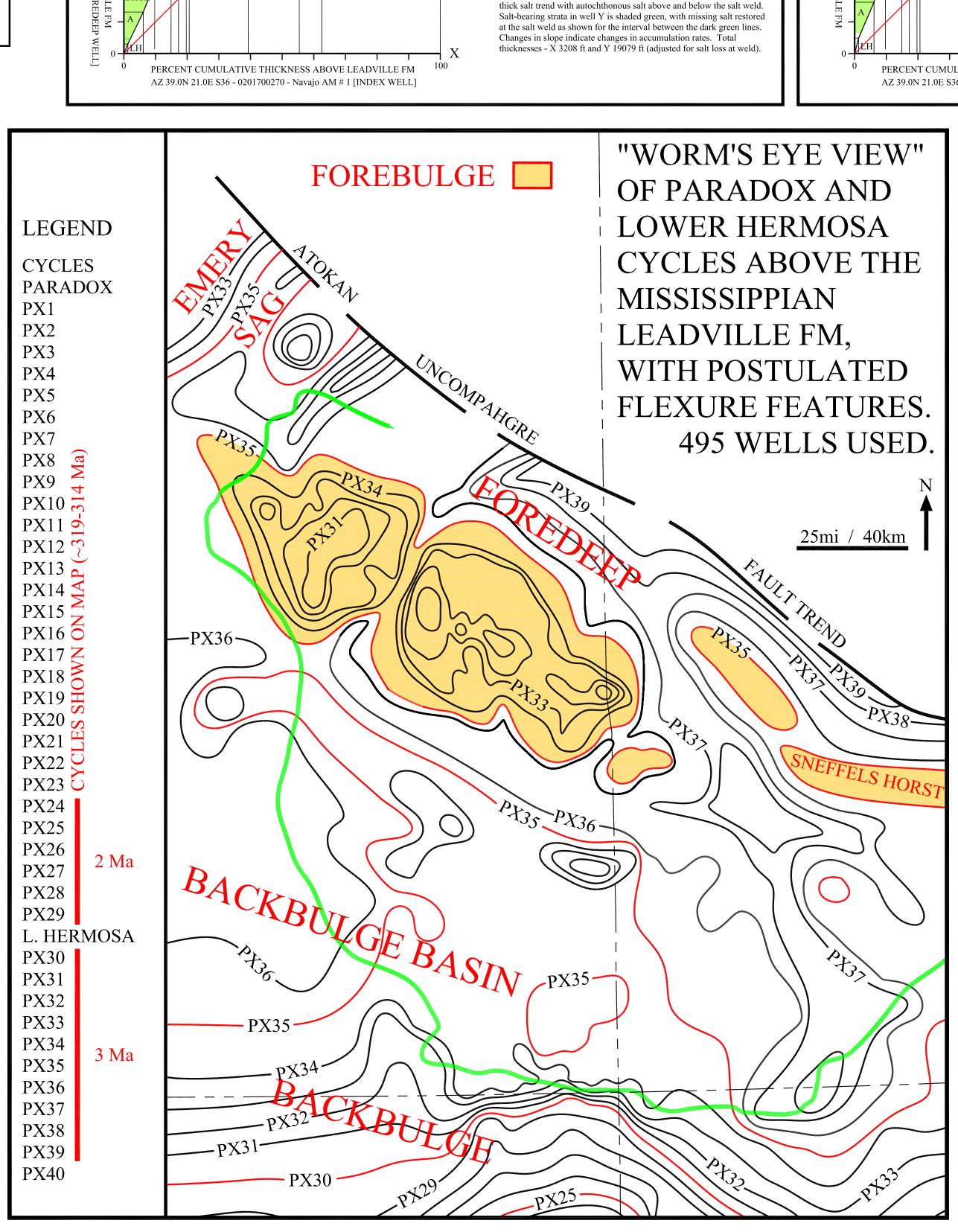
LITHOSPHERIC FLEXURE MAPS FOR THE PARADOX BASIN USING GRAPHIC CORRELATION DATA

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STRATIGRAPHIC CHART - PARADOX BASIN

AGE	STAGE / Ma	GROUP	HORIZON
Perm.	Leonardian / 286.00-272.95		White Rim SS, Organ Rock Fm & Cutler Fm
	Wolfcampian / 298.90-286.00		Elephant Canyon Fm (CY-W01-CY-W10)
Pennsylvanian	Virgilian / 303.70-298.90	Hermosa	Elephant Canyon Fm (CY-V01-CY-V08)
	Missourian / 306.00-303.70		Honaker Trail Fm (CY-M01-CY-M11)
	Desmoinesian / 306.24-306.00		Paradox Fm - Hatch Mbr (PX1)
	Desmoinesian / 306.73-306.24		Paradox Fm - Ismay Mbr (PX2-PX3)
	Desmoinesian / 307.21-306.73		Paradox Fm - Desert Cr Mbr (PX4-PX5)
	Desmoinesian / 308.90-307.21		Paradox Fm - Akah Mbr (PX6A-PX10)
	Desmoinesian / 311.80-308.90		Paradox Fm - Barker Cr Mbr (PX11-PX19)
	Atokan / 316.04-311.80		Paradox Fm - Alkali Gulch Mbr (PX20A-PX29)
	Atokan / 318.70-316.04		Lower Hermosa & Belden Fms (PX30-PX40)
	Morrowan / 323.20-318.70		Round Valley Fm (Emery Sag/Uplift)
Mississippian	Chesterian / 335.00-323.20		Doughnut Fm (Emery Sag/Uplift)
	Meramecian / 343.50-335.00		Humbug Fm (Emery Sag/Uplift)
	Late Osagean / 347.40-343.50		Deseret Fm (Emery Sag/Uplift)
	Osagean & Kinderhookian /		Leadville Fm (Paradox Basin/Emery Sag/Uplift)
	358.90-347.40		Leadvine I'm (Laradox Basin/Emery Sag/Opint)





FLEXURAL BACKBULGE

10 mi / 16 km

Vertical Exaggeration X10

01 Guadalupian (Kaibab Fm) [Eroded]

Virgilian (Elephant Canyon Fm)

Chesterian (Doughnut Fm) [Erodec

6 Meramecian (Humbug Fm) [Erode

5 Missourian (Honaker Trail Fm)

Wolfcampian (Elephant Canyon Fm)

Desmoinesian (Paradox Fm - Hatch Mbr)

Desmoinesian (Paradox Fm - Ismay Mbr)

Desmoinesian (Paradox Fm - Desert Creek Mbr) [DS

Desmoinesian (Paradox Fm - Akah Mbr) [AKA]

Desmoinesian (Paradox Fm - Barker Creek Mbr) [I

Leonardian (White Rim SS & Organ Rock Fm / Cutler Fm)

Red 100 % slope line indicates well X and well Y would have the sar

accumulation rate. Here, the accumulation rate is greater for all hor

t well Y. Well X is on the Flexural Backbulge trend and is the Index

Well for the Graphic Correlation calculations. Well Y is in a Foredee

GRAPHIC CORRELATION - PARADOX BASIN

CONTRAST BETWEEN BACKBULGE INDEX WELL AND FOREDEEP WELL (143 MILES APAR

NEOGENE STRATA

PALEOGENE VOLCANICS

LATE CRETACEOUS STRATA

EARLY CRETACEOUS STRATA

Wolfcampian Elephant Canyon Fm

Virgilian Elephant Canyon Fm

PALEOGENE STRATA

LATE JURASSIC STRATA

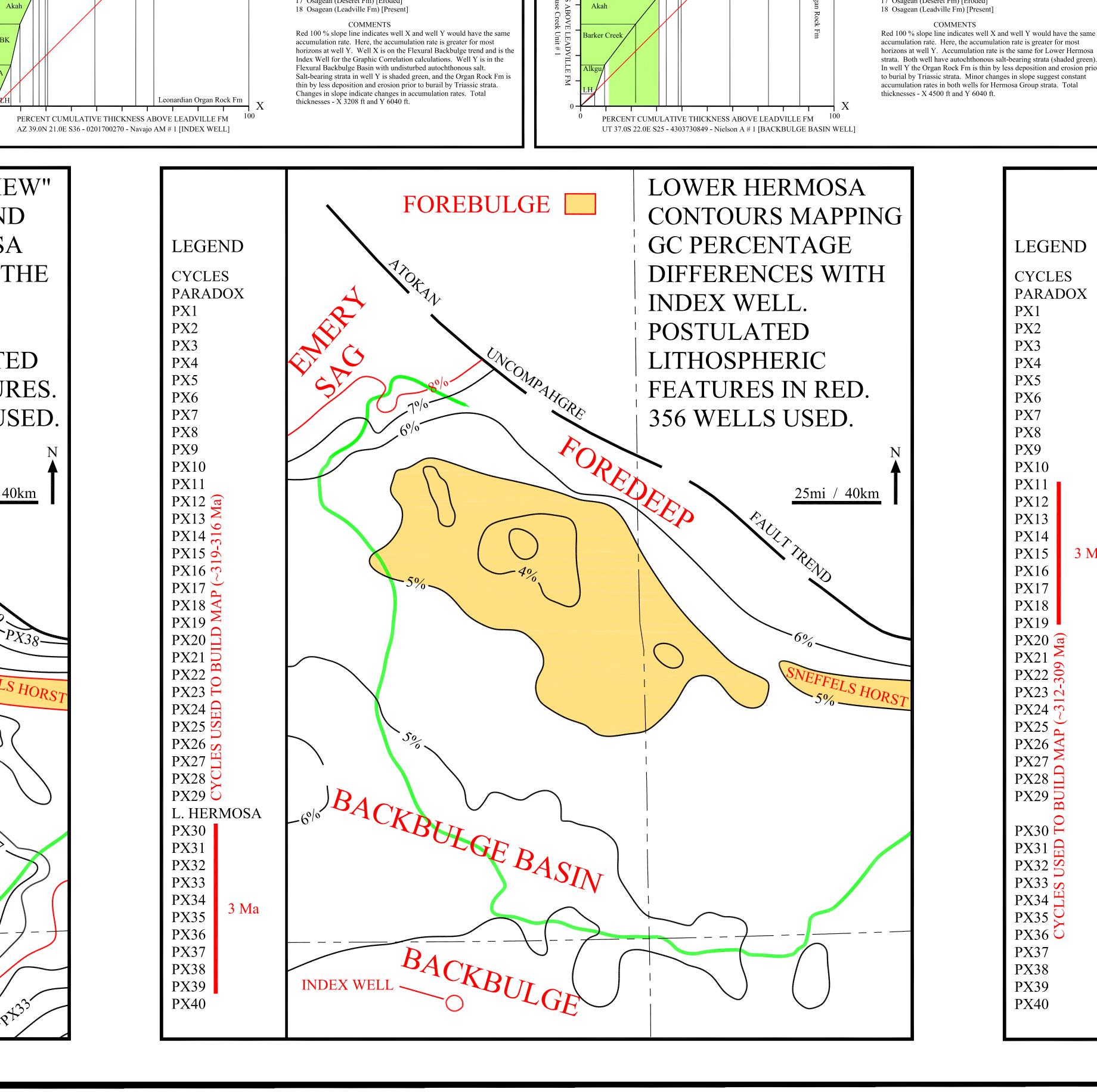
EARLY JURASSIC STRATA

DENNEHOTSO PALEOSTRUCTURE

Leonardian White Rim SS & Organ Rock Fm

Wolfcampian Elephant Canyon Fi

Virgilian Elephant Canyon Fm



PARADOX BASIN

FLEXURAL BACKBULGE BASIN

GROSS STRATIGRAPHIC HORIZONS

1 Guadalupian (Kaibab Fm) [Eroded]

3 Wolfcampian (Elephant Canyon Fm)

Desmoinesian (Paradox Fm - Hatch Mb

Desmoinesian (Paradox Fm - Ismay Mbr) [Isma

Desmoinesian (Paradox Fm - Akah Mbr) [Akah]

Desmoinesian (Paradox Fm - Barker Creek Mbr) [I

Desmoinesian (Paradox Fm - Desert Creek Mbr) [Prese

4 Virgilian (Elephant Canyon Fm)

Missourian (Honaker Trail Fm)

Chesterian (Doughnut Fm) [Erode Meramecian (Humbug Fm) [Erod

2 Leonardian (White Rim SS & Organ Rock Fm / Cutler Fm)

DESMOINESIAN POST-SALT ST

LATE ATOKAN PRE-SALT STRA

MISSISSIPPIAN CHESTERIAN STRATA

SALT-BEARING STRATA

EARLY ATOKAN STRATA

MORROWAN STRATA

LATE TRIASSIC STRATA

EARLY TRIASSIC STRATA

LATE LEONARDIAN STRATA

WOLFCAMPIAN STRATA

GRAPHIC CORRELATION - PARADOX BASIN

CONTRAST BETWEEN BACKBULGE INDEX WELL AND BACKBULGE BASIN WELL (106 MILES APART)

EARLY LEONARDIAN STRATRA

PENNSYLVANIAN VIRGILIAN STRATA

PERMIAN GUADALUPIAN STRATA

LITHOSPHERIC FORELAND BASIN SYSTEM

MERAMECIAN STRATA

OSAGEAN STRATA

DEVONIAN STRATA

CAMBRIAN STRATA

PRECAMBRIAN STRATA

IGNEOUS INTRUSIONS

Virgilian Elephant Canyon Fm

Missourian Honaker Trail Fm

PRECAMBRIAN BASEMENT

GRAPHIC CORRELATION - PARADOX BASIN

CONTRAST BETWEEN TWO WELLS IN THE BACKBULGE BASIN (56 MILES APART

1 Guadalupian (Kaibab Fm) [Eroded]

4 Virgilian (Elephant Canyon Fm)

4 Morrowan (Round Valley Fm) [Eroc

6 Desmoinesian (Paradox Fm - Hatch Mbr)

7 Desmoinesian (Paradox Fm - Ismay Mbr) [Isma

9 Desmoinesian (Paradox Fm - Akah Mbr) [Aka

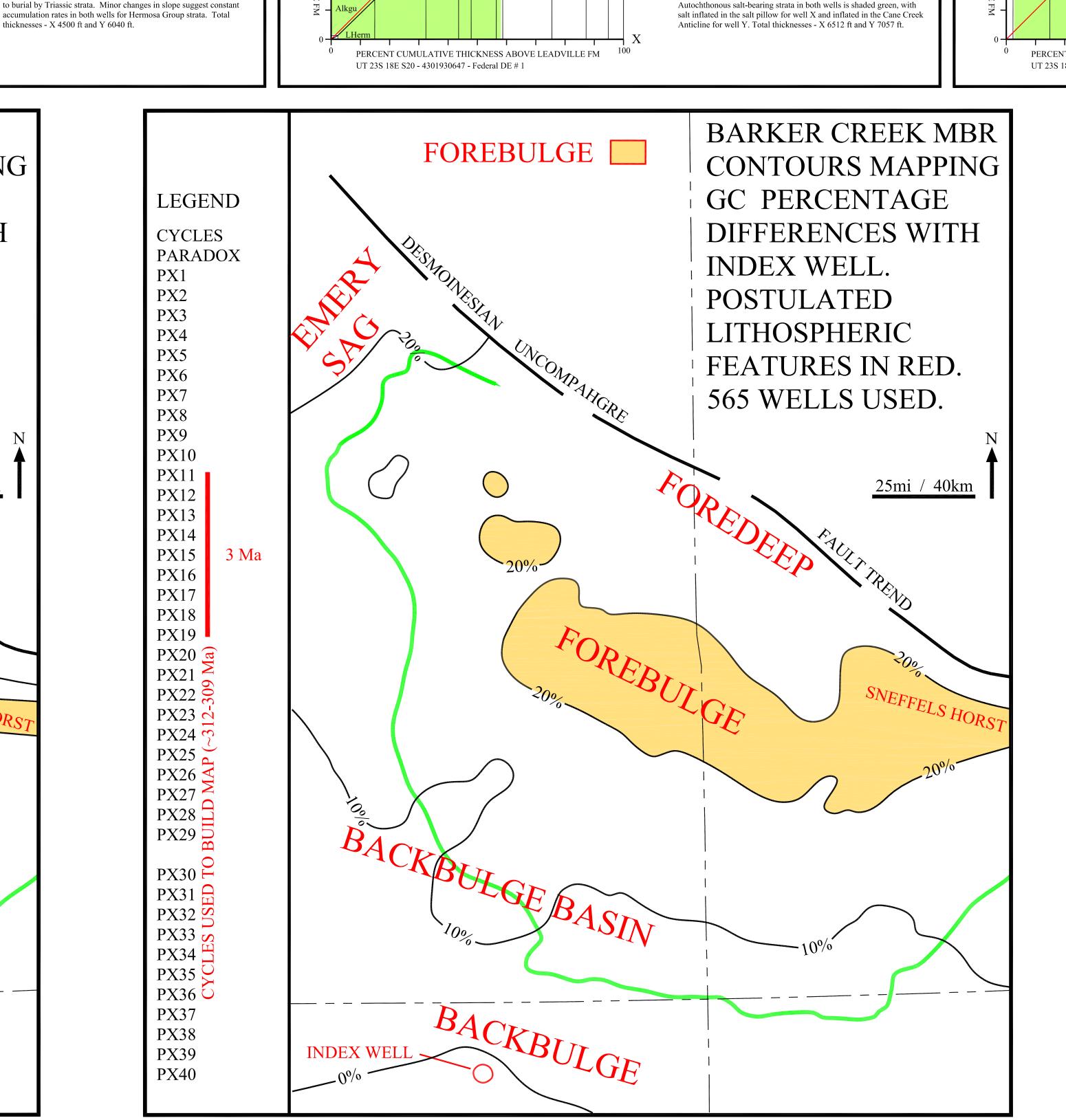
0 Desmoinesian (Paradox Fm - Barker Creek Mt

1 Atokan (Paradox Fm - Alkali Gulch Mbr) [Alkg

5 Missourian (Honaker Trail Fm)

Leonardian (White Rim SS & Organ Rock Fm / Cutler Fm

Desmoinesian (Paradox Fm - Desert Creek Mbr) [Presen



GRAPHIC CORRELATION - PARADOX BASIN

Wolfcampian Elephant Canyon Fm

Virgilian Elephant Canyon Fm

Missourian Honaker Trail Fm

Desmoinesian Paradox Fm - Hatch Mb

01 Guadalupian (Kaibab Fm) [Eroded]

4 Virgilian (Elephant Canyon Fm)

7 Desmoinesian (Paradox Fm - Ismay Mbr)

9 Desmoinesian (Paradox Fm - Akah Mbr)

Chesterian (Doughnut Fm) [Eroded]

COMMENTS

Red 100 % slope line indicates well X and well Y would have the sa

X is on an autochthonous salt pillow on the deep Forebulge trend

orebulge trend) and the overlying Cane Creek Salt Anticline.

accumulation rate. Here, accumulation rate is equal for both wells.

nd well Y is on the crest of the Long Canyon deep paleostructure (de

Meramecian (Humbug Fm) [Erode

0 Desmoinesian (Paradox Fm - Barker Creek Mbr

Atokan (Paradox Fm - Alkali Gulch Mbr) [Alkgu

2 Leonardian (White Rim SS & Organ Rock Fm / Cutler Fm)

UNCOMPAHGRE UPLIFT

Regional South-North Structural Cross Section Northern Black Mesa Basin to Eagle Basin Arizona, Utah and Colorado

Leonardian White Rim SS & Organ Rock Fm

Wolfcampian Elephant Canyon Fm

Desmoinesian Paradox Fm - Hatch Mb

Missourian Honaker Trail Fm

Paradox Fm - Ismay Mbr

Desert Creek Mbr

Akah Mbr

GRAPHIC CORRELATION - PARADOX BASIN

ONTRAST BETWEEN WELLS IN FOREBULGE WITH SALT AND FOREDEEP W/O SALT (35 MILES APART

Guadalupian (Kaibab Fm)

5 Missourian (Honaker Trail Fm)

Chesterian (Doughnut Fm) [Erodec

Meramecian (Humbug Fm) [Erode

Wolfcampian (Elephant Canyon Fm)

Desmoinesian (Paradox Fm - Hatch Mbr)

Desmoinesian (Paradox Fm - Ismay Mbr)

Desmoinesian (Paradox Fm - Akah Mbr)

0 Desmoinesian (Paradox Fm - Barker Creek Mbr

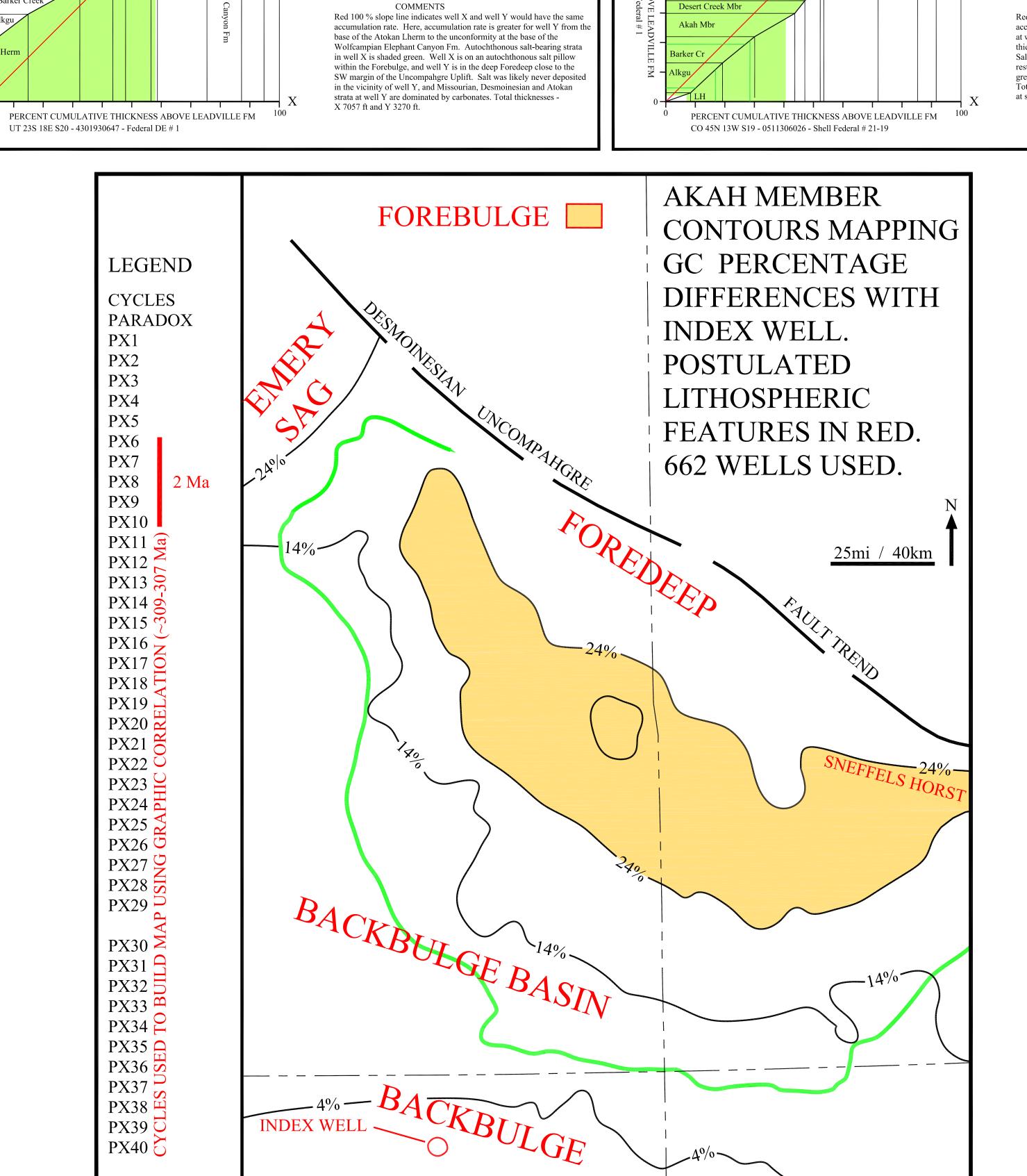
Virgilian (Elephant Canyon Fm) [Eroded in well Y

Desmoinesian (Paradox Fm - Desert Creek Mbr)

Atokan (Paradox Fm - Alkali Gulch Mbr) [Alkgu]

Leonardian (White Rim SS & Organ Rock Fm / Cutler Fm)

ARM THRUST BLOCK



Moenkopi Fm

Desmoinesian strata

= Paradox Akah Mbr

Cambrian strata

Precambrian strata

EAGLE BASIN

