INCIPIENT PANGEAN RIFTING RESPONSIBLE FOR THE INITIATION OF CHINLE-DOCKUM SEDIMENTATION: INSIGHTS FROM THE NEWARK SUPERGROUP AND SHARED LATE TRIASSIC PLATE-SCALE TECTONIC EVENTS AND GEOCHRONOLOGIES

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THE NEWARK SUPERGROUP AND RELATED SUBSURFACE BASINS

Withjack et al., 2013
TS II CONTAINS THE ONLY KNOWN SUBSTANTIAL RECORDS OF NONMARINE CARNIAN STRATA IN NORTH AMERICA, BEST ILLUSTRATED BY THE RICHMOND AND TAYLORSVILLE BASINS
SUMMARY OF RICHMOND BASIN STRATIGRAPHY, MAJOR FACIES AND SEQUENCE BOUNDARY

Tuckahoe Group
- Vinita Formation
  - Swift Creek Member (170-500 m)
  - Manakin Member (500 m)
  - Boscow Formation (0-100 m)
  - Winterpock Formation (0-160 m)

Chesterfield Group
- Turkey Branch Formation (420+ m)
  - Otterdale Formation (280-380 m)

Fluvio-Mudflat-Paludal
Tectono-stratigraphic Sequence 2

Fluvial

Fluvio-Mudflat-Deltaic-Lacustrine
Tectono-stratigraphic Sequence 1

Deltaic Shallow-Deep Water Lacustrine/Alluvial Fan

Deltaic-Paludal-Alluvial Fan

Fluvio-Deltaic-Lacustrine
TIMING AND GROWTH OF SOUTHEASTERN NEWARK RIFTS

INITIAL TS II
LATE CARNIAN
~232 mya

LATE TS II
CARINIAN-NORIAN
BOUNDARY ~229 mya

EARLY TS III
EARLY NORIAN
~225 mya
SOMETHING BIG HAPPENED APPROXIMATING THE CARNIAN-NORIAN BOUNDARY!

1. EXISTING NEWARK SUPERGROUP BASINS EXPERIENCED ACCELERATED GROWTH.

2. NEW RIFT BASINS DEVELOPED, INCLUDING EAGLE MILLS RIFTS PARALLEL TO THE PRESENT GULF COAST.

3. POSSIBLE CHANGE IN REGIONAL STRESS REGIME.

4. INITIAL SEDIMENTATION COMMENCED IN THE DOCKUM-CHINLE BASIN.
CONCURRENT WITH THE TS II – TS III BOUNDARY, THE DOCKUM-CHINLE BASIN BEGAN TO DEVELOP.
MAJOR TECTONIC FEATURES AND TRIASSIC BASINS, SOUTHWEST U. S. AND MEXICO (after Dickenson et al., 2010)
PREVIOUS REGIONAL LOWER CHINLE-DOCKUM CORRELATIONS ARE IN FLUX AND NOT RELIABLE

<table>
<thead>
<tr>
<th>Chronology &amp; Sequences</th>
<th>southern Colorado Plateau</th>
<th>Rio Grande Rift</th>
<th>New Mexican High Plains</th>
<th>Texas Panhandle</th>
<th>Southwest Texas</th>
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<tr>
<td>Late Triassic</td>
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<td>Carnian</td>
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<td>Shinarump-Blue Mesa seq.</td>
<td>DG 3764</td>
<td>Sonseka Mbr (PF Fm)</td>
<td>Poleo Formation</td>
<td>Trujillo Formation</td>
<td>Trujillo Mbr Dockum Fm.</td>
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<td>Blue Mesa Mbr (PF Fm)</td>
<td>Salitrut Formation</td>
<td>Garita Creek Formation</td>
<td>Tecovas Mbr Dockum Fm.</td>
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<td>1430</td>
<td>Bluewater Creek Fm</td>
<td>Salitrut Formation</td>
<td>Tres Lagunas &amp; Los Esteros mbrs Santa Rosa Fm</td>
<td>Tecovas Mbr Dockum Fm</td>
<td>Tecovas Mbr Dockum Fm</td>
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<td>1312</td>
<td>Shinarump Fm/&quot;mottled strata&quot;</td>
<td>Agua Zarca Formation</td>
<td>Tecolotito Mbr Santa Rosa Fm</td>
<td>Camp Springs Mbr Dockum Fm</td>
<td>Colorado City &amp; Camp Springs mbrs</td>
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From Heckert, 2004.
RECENT U-PB ZIRCON DATING OF NUMEROUS CHINLE ASH BEDS TIED TO GLOBAL TRIASSIC TIMESCALES INDICATE STRATA OF CARNIAN AGE ARE ABSENT

From Ramezani et al. (2014)
LOWER CHINLE – DOCKUM IS DESCRIBED AS CHARACTERIZED BY BROAD PALEOVALLEYS INCISED INTO UNDERLYING PERMIAN TO MIDDLE TRIASSIC STRATA
IN THIS INTERPRETATION THESE BROAD VALLEYS CONTAIN THE CLASSIC LOWER CHINLE SEQUENCES SUCH AS THAT AT THE PETRIFIED FOREST NATIONAL PARK
SEDIMENTATION IN MANY AREAS WAS RESTRICTED TO THIN SEQUENCES WITH PALEOSOLS OR IN LOCAL BASINS FORMED BY SALT MOBILIZATION. ONE SUCH BASIN IS LOCATED AT FORT WINGATE, NM.

HALOKENETIC BED DEFORMATION NEAR FORT WINGATE, NEW MEXICO, BASAL CHINLE FORMATION.

(Google Earth image)
TR-3 UNCONFORMITY- MOTTLED STRATA AND SHINARUMP CONGLOMERATE, FORT WINGATE, NM
INTERSEQUENCE PALEOSOLS, FT. WINGATE, NM
RECUMBENT FOLD IN MONITOR BUTTE-LIKE FACIES, FORT WINGATE, NEW MEXICO
LACUSTRINE MONITOR BUTTE-LIKE FACIES, FORT WINGATE, NEW MEXICO
PROFOUND INTER-CHINLE ANGULAR UNCONFORMITY, FORT WINGATE, NM: PROBABALE SALT WITHDRAWL BASIN
INTERPRETATION OF HALOKINETIC DEFORMATION AT FORT WINGATE

The fault mapped by Anderson and Lucas (1998) is probably the edge of a salt wall basin in which the Monitor Butte-like facies accumulated.
By ~222 MYA, most of the broad valley lowlands were infilled with regional deposition marked by laterally-persistent lithosome associations and uniform subsidence.
CORRELATION OF NEWARK SUPERGROUP TS III AND THE LOWER CHINLE FORMATION (U-Pb dates from Ramezani et al., 2011; 2014; Atchley et al., 2013)
Published U-Pb CA-TIMS Outcrop Dates
(Ramezani et al., 2011; Atchely et al., 2013)

\[ \leq 207.8 \]

\[ 209.926 \pm 0.072 \text{ Ma} \]

\[ 213.124 \pm 0.069; 213.870 \pm 0.78 \]

\[ 214.36 \pm 0.16 \text{ (CA-TIMS)} \]

\[ 218.017 \pm 0.017 \]

\[ 219.317 \pm 0.080 \]

\[ 220.124 \pm 0.068 \]

\[ 223.036 \pm 0.059 \]

\[ 225.185 \pm 0.072 \]

\[ 227.604 \pm 0.082 \]
MAJOR TECTONIC FEATURES AND TRIASSIC BASINS, SOUTHWEST U. S. AND MEXICO (after Dickenson et al., 2010)
CONCLUSIONS

1. Revised geochronologies, including U-Pb dating of zircons, lithostratigraphy, magnetostratigraphy, tectono-stratigraphy, cyclostratigraphy and biostratigraphy indicate Late Carnian strata are entirely restricted to Newark Supergroup TS II.

2. The Carnian-Norian boundary coincides with a major extensional pulse along the central and southern rifted margin of North America that generated opening of the Dan River, Culpeper, and possibly segments of the Deep River and Gettysburg basins. Existing basins experienced a dramatic shift in sedimentation and hydrologic regimes, and increased tilting and subsidence which generated the TS II- TS III unconformity across multiple synrift basins.
3. This extensional pulse propagated the rifting margin along the southern flank of the Appalachian-Ouachita front, resulting in formation of numerous, poorly known rift basins that extend in the subsurface from Alabama into northern Mexico. The fill of these rifts are collectively called the “Eagles Mills Formation”, and are paralleled seaward by other deeply buried rifts throughout the Gulf Coast region.

4. Synchronous uplift of the Ouachita-Marathon trend with this extension event generated initial sedimentation in the Chinle-Dockum basin. Note that “Eagle Mills” basins are only 260 miles distant from the preserved Dockum margin.
5. The Chinle-Dockum is underlain by large areas of evaporates and carbonates as shallow depths (10s-100s of m). While early sedimentation was largely confined to broad, Mississippi River scale (or larger) valleys, salt mobilization created numerous, localized depositional basins on broad interfluve uplands that are filled by lacustrine-paludal strata and paleosols. Past workers have concluded these strata were deformed by Laramide tectonics or syndepositional slumping. We suggest they are the product of halokenesis as illustrated by our example of the lower Chinle at Fort Wingate, New Mexico.
CONCLUSIONS (FINALE!)

6. Correlation of the lower Chinle-Dockum with the Newark Supergroup suggests that early sedimentation patterns in the later region were dictated by synrift, rather than by cordilleran arc tectonics.

7. The stratigraphic interval of halokentic basins in the lower Chinle-Dockum correlate with a ~1.2 my duration wet phase in the Newark, which produced coal bearing strata in the Deep River, Dan River, Richmond and Taylorsville basins.