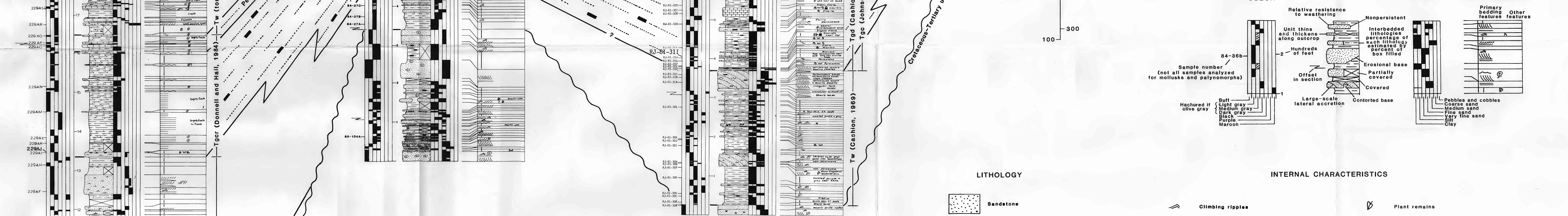
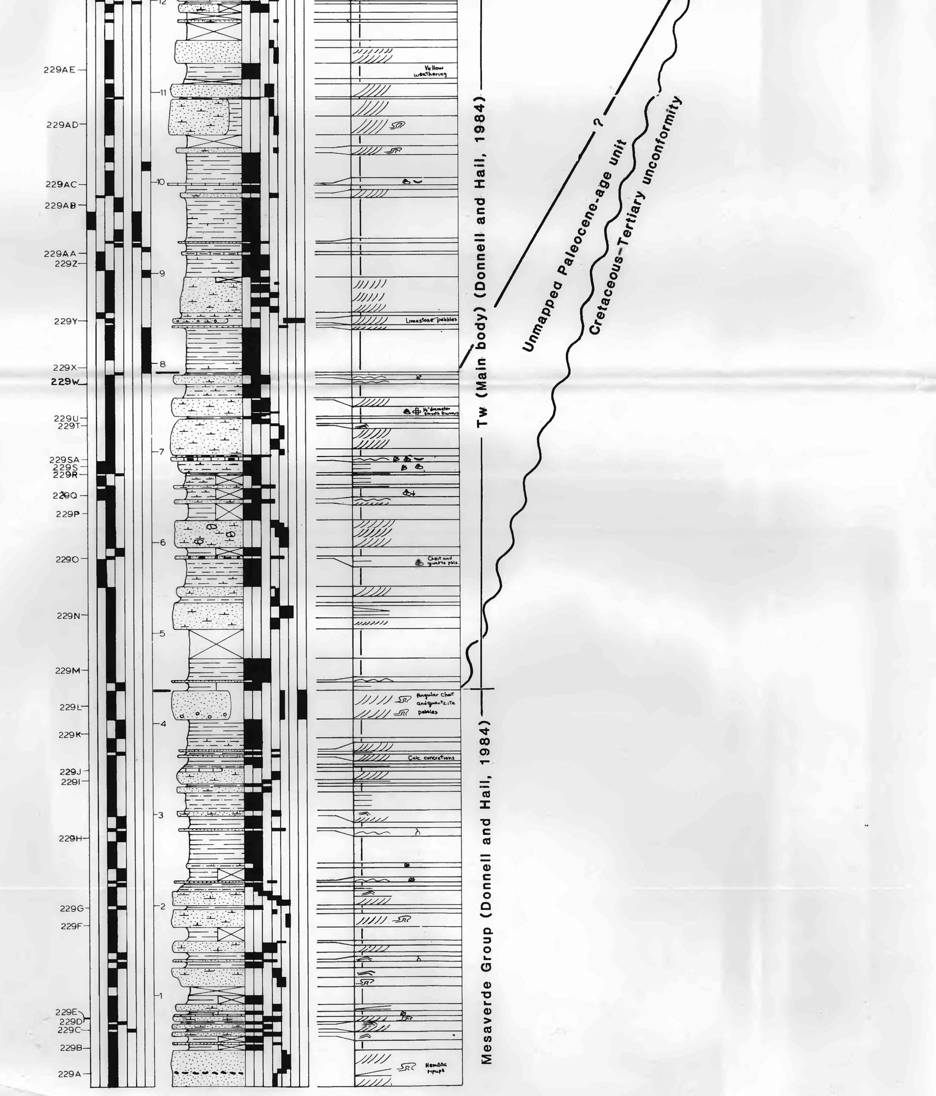




LIST OF ABBREVIATIONS USED IN COLUMN FOR INTERNAL CHARACTERISTICS

abnt	abundant
ang	angle
biot	bioturbated
brn	brown
calc	calcareous
carb	carbonaceous
cht	chert
cly	claystone
clyst	claystone
cntrt	contorted
conc	concretion
dia	diameter
disc	discontinuous
discon	discontinuous
dol	dolomite, dolomitic
dk	dark
ft	foot, feet
gast	gastropod, gastropods
gonio	goniobasis
grad	gradational
gyp	gypsum
in	inch
irreg	irregular
intb	interbedded
intbd	interbedded
lam	laminated
l.s.	limestone
lyr	layers
o.s.	oil shale
ost	ostracode, ostracodes
pbls	pebbles
pers	persistent
poss	possible
ptgs	partings
qtzt	quartzite
quartzt	quartzite
ripp	ripple
sat	saturated
sev	several
sh	shale
siltst	siltstone
sli	slightly
strom	stromatolites
ss	sandstone
sur	surface
syn	syneresis
thk	thick
vf	very fine
vivip	viviparus
w/	with
wt	white
wthr	weathered

LIST OF SYMBOLS USED FOR ROCK NOMENCLATURE

Tg	Green River Formation
Tgp	Parachute Creek Member of Green River Formation
Tgg	Garden Gulch Member of Green River Formation
Tgd	Douglas Creek Member of Green River Formation
Tgi	Intertonguing unit of Green River Formation
Tgu	Unnamed member of Green River Formation
Tgc	Cow Ridge Member of Green River Formation
Tgcr	Cow Ridge Member of Green River Formation
Tw	Wasatch Formation
Twr	Renegade Tongue of Wasatch Formation
Tws	Shire Member of Wasatch Formation
Twm	Molina Member of Wasatch Formation
Twa	Atwell Gulch Member of Wasatch Formation
R-1 through R-6	Rich oil-shale zones of Cashion and Donnell (1972)
L-1 through L-5	Lean oil-shale zones of Cashion and Donnell (1972)

ENVIRONMENT	LITHOLOGY
Offshore lacustrine	Laminated and brecciated dolomitic oil shale, laminated silty and clayey carbonate, and some laminated and nonlaminated siltstone
Offshore lacustrine	Laminated and nonlaminated illitic oil shale and illitic clay shale
Offshore lacustrine to marginal lacustrine transition	Laminated and nonlaminated carbonate-rich claystone and siltstone, and fine-grained sandstone, commonly with contorted laminae
Offshore lacustrine to marginal lacustrine transition	Laminated and nonlaminated silty and clayey carbonate and some laminated to nonlaminated siltstone and dolomitic oil shale
Marginal saline lacustrine	Stromatolitic, ostracodal, and oolitic limestone, laminated and nonlaminated carbonate-rich claystone and siltstone, and fine-grained, commonly ripple-laminated sandstone
Marginal freshwater lacustrine	Mollusk-rich ripple-laminated sandstone, ostracodal limestone, shale, and carbonaceous shale containing thin coal beds
Fluvial and alluvial	Varicolored mudstone and lenticular sandstone units

LITHOLOGY

- Sandstone
- Siltstone
- Claystone, clay shale, or mudstone
- Oil shale
- Limestone
- Coal
- Calcareous or dolomitic rock
- Stromatolites
- Rip-up clasts
- Carbonaceous or woody material
- Concretions; H-hematitic, L-calcareous or dolomitic
- Thin beds of dolomite
- Conglomeratic
- Tuff

INTERNAL CHARACTERISTICS

- Climbing ripples
- Symmetrical ripples
- Crossbeds, less than 1 ft high
- Crossbeds, from 1 to 3 ft high
- Cross laminae, less than 15°
- Parallel horizontal laminae
- Indistinct parallel horizontal laminae
- Indistinct laminae
- Irregular laminae
- Contorted laminae
- Ripples, nonspecific
- Feature near top of bed
- Feature near base of bed
- F Flaser bedding
- Ostracodes
- Gastropods
- Oncolites
- Oolites
- Plant remains
- Bivalves
- Fish bones or fish scales
- Root casts
- Crocodile parts
- Turtle parts
- Fossil bones
- T Tuff (shown on left side of lithologic column)
- Fly larvae
- Mudcracks
- LLH Laterally linked hemispheroids (stromatolites)
- SLH Space-linked hemispheroids
- LLH→SLH Laterally linked hemispheroids grading up into space-linked hemispheroids
- LLH/LLH Laterally linked hemispheroids that internally have small-scale laterally linked hemispheroids
- Horizontal burrows
- Vertical burrows
- Oblique burrows
- Burrows nondescriptive
- Veinlets
- SH-V Vertically stacked hemispheroids

INTRODUCTION

Eleven detailed stratigraphic sections of lower Tertiary rocks were measured near the crest of the Douglas Creek arch, a broad north-south-trending structure near the Colorado-Utah border that separates two early Tertiary structural and sedimentary basins, the Uinta basin to the west and the Piceance Creek basin to the east. During the early Tertiary the arch acted as a hinge line between the two adjacent subsiding basins, and thus the lower Tertiary sections in both basins thin toward the crest of the arch (Johnson and Finn, 1986). Throughout most of the Paleocene the arch appears to have stood topographically above the two adjacent basins, and Paleocene sediments lap out on the flanks of the arch. Base level in the two adjacent basins rose during the Eocene, burying the crest of the arch beneath Eocene rocks. Because the Douglas Creek arch was an important connecting area between the adjacent Uinta and Piceance Creek basins, a study of the strata preserved along the crest of the arch will help to better understand early Tertiary sedimentary patterns found in the two adjacent basins. The results of this study are preliminary, and consequently little interpretation is presented.

STRATIGRAPHY

The stratigraphic sections are arranged into two roughly north-south cross sections, one a few miles east of the crest of the arch (section A-A') and one a few miles west (section B-B'). Samples were collected and analyzed for mollusks and palynomorphs. Most of the sections begin at or just below the Cretaceous-Tertiary unconformity, a regional unconformity that separates Upper Cretaceous from lower Cenozoic rock throughout much of the Uinta and Piceance Creek basins, and end in or above the Mahogany Ledge of the Green River Formation, a widespread upper Eocene marker zone. Many of the sections were measured in areas for which detailed geologic mapping is available, and the nomenclature used by each mapper is shown next to the plotted sections. Lithologic units and their interpreted environments of deposition are traced along the two cross sections. The description of these lithologic units are modified from Johnson (1985b). Far more lithologic units are shown on the cross sections than are typically mapped, but mapped contacts, in most cases, correspond to boundaries between lithologic units.

Much of the lower Cenozoic section near the crest of the Douglas Creek arch was deposited during the Eocene when large lakes covered much of the Uinta and Piceance Creek basins. Initially there were two freshwater lakes, one in each basin. Rocks deposited in the freshwater lake in the Piceance Creek basin were recently named the "Cow Ridge Member of the Green River Formation" (Johnson, 1984). These freshwater lacustrine rocks appear to wedge out into the fluvial Wasatch Formation a few miles east and west of the crest of the Douglas Creek arch. South of Rangely, Colo., in an area where lower Cenozoic strata have been removed by post-Eocene erosion, the two freshwater lakes may have briefly connected to form one lake.

During the late early to early middle Eocene, the two lakes expanded rapidly during the Long Point transgression (Johnson, 1984) and connected across the crest of the arch to form one large lake, Lake Uinta. Freshwater mollusks are rarely found above the basal transgressive bed, the Long Point Bed of the Green River Formation, indicating that Lake Uinta became saline shortly after maximum transgression was reached. Marginal lacustrine rocks from Lake Uinta in the Douglas Creek arch area are generally mapped as the Douglas Creek Member of the Green River Formation, and offshore lacustrine oil shales are mapped as Garden Gulch or Parachute Creek Members. The name "Garden Gulch Member" is generally applied to illitic-rich oil shales deposited early in the history of Lake Uinta, and the name "Parachute Creek Member" is applied to the dolomitic oil shales deposited later. The oil shales of the Garden Gulch Member and the Parachute Creek Member below the Mahogany oil-shale zone are subdivided into persistent rich zones designated R-1 through R-6 and lean zones designated L-1 through L-5 (Donnell and Blair, 1970; Cashion and Donnell, 1972; Donnell and Smith, 1980). Many of these zones were traced along the two lines of section, and, where possible, the zones were traced into their marginal lacustrine equivalents. The tracing of offshore oil shales into their approximate marginal lacustrine equivalents follows the paleogeographic reconstructions of Johnson (1985b).

A paleoweathered zone extends as much as 500 ft below the Cretaceous-Tertiary unconformity in the Douglas Creek arch area (Johnson and May, 1978, 1980). Sandstone units within this zone are typically white due to kaolinization of feldspars during the time interval represented by the unconformity. The exact position of the unconformity is commonly difficult to locate in the Douglas Creek arch area due to a combination of poor exposure, the lack of a well-developed paleoweathered zone, and the occurrence of similar gray shale both immediately above and immediately below the unconformity in many areas.

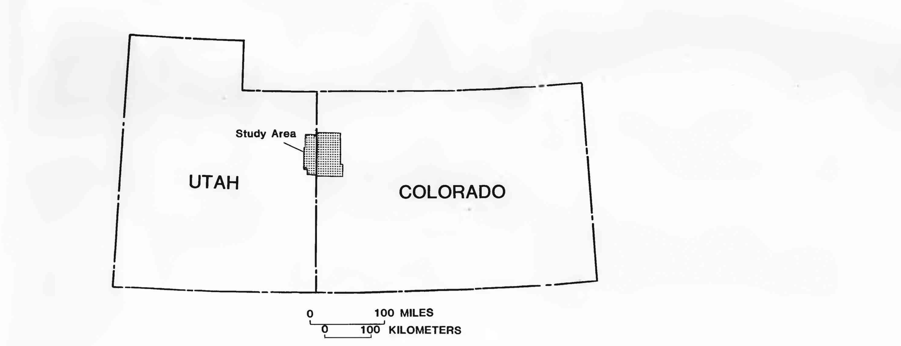
PALYNOMORPH STUDIES

Investigation of palynomorph assemblages has helped to better define the position of the unconformity, but the usefulness of the method was limited due to extensive reworking of Cretaceous and older pollen into the overlying Paleocene and Eocene strata. At Tommy's Draw (section 3 of A-A'), Late Cretaceous pollen was found in sample 81-30C from about 20 ft above the uppermost white sandstone. Early Mississippian through early Tertiary pollen was found in sample 81-30G from about 100 ft above the uppermost white sandstone, and Cretaceous and early Tertiary pollen was found in sample 81-30J from about 160 ft above the uppermost white sandstone. The top of the uppermost white sandstone was mapped as the Cretaceous-Tertiary unconformity in the area (Cashion, 1969). Late Cretacous pollen was also found in samples 81-14A, B, and C in section 9 of B-B', from as much as 20 ft above the top of the uppermost white sandstone. The samples are from a 95-ft-thick sequence of gray carbonaceous shale and light-gray sandstones that overlies the uppermost white sandstone and underlies the lower Eocene Cow Ridge Member of the Green River Formation, and it is possible that some of this sequence is Cretaceous.

Increasingly younger rocks occur just above the Cretaceous-Tertiary unconformity toward the crest of the Douglas Creek arch. Late Paleocene pollen was recovered from samples from just above the Cretaceous-Tertiary unconformity, section 1 on A-A', the section farthest from the crest of the arch, by Johnson and May (1978). In contrast, the lower Eocene Long Point Bed directly overlies weathered Cretaceous sandstone near Texas Mountain, along the crest (Johnson, 1985b). An attempt to better define the nature of this onlap using pollen was hindered by poor recovery as well as by the previously mentioned extensive reworking of older pollen into the lower Cenozoic section. Of the 34 lower Cenozoic samples analyzed for palynomorphs, 25 were barren. Consequently, the age of the Wasatch section below the lower Eocene Cow Ridge Member of the Green River Formation is not well dated along the two cross sections. In particular, it is not known where the Paleocene part of the Wasatch, present at the base of section 1 of A-A', laps out toward the crest of the arch.

MOLLUSK STUDIES

Fossil bivalves and gastropods were collected from the Wasatch Formation, the lower Eocene Cow Ridge Member of the Green River Formation, and the Long Point Bed of the Green River Formation. Gastropods are subdivided into aquatic prosobranchs, aquatic pulmonates, and terrestrial pulmonates. The mollusk identifications help to better define environments of deposition found along the two lines of section. The Cow Ridge Member was deposited during an early freshwater stage of Lake Uinta and may be roughly contemporaneous with freshwater Lake Lumen of the Greater Green River basin to the north (Johnson, 1985b). The study of mollusks found in the Cow Ridge Member may help to clarify the relationship between these two lake systems.



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STRATIGRAPHIC SECTIONS OF LOWER TERTIARY STRATA AND CHARTS SHOWING PALYNOMORPH AND MOLLUSK ASSEMBLAGES, DOUGLAS CREEK ARCH AREA, COLORADO AND UTAH

By
Ronald C. Johnson, Douglas J. Nichols, and John H. Hanley

1988

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1988
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