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INFORMATION FOR FIELD TRIP 3

by

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AAPG RMS Field Trip #3 - E.A. Merewether (U.S. Geological Survey, Denver) and B.L. Mieras (University of Colorado, Boulder)

On the first day of this trip, we will examine the mid-Cretaceous Frontier Formation at stops on the Casper Arch and along the flanks of the Shirley Basin and the Rawlins Uplift. The Frontier Formation is composed mainly of complexly-related sandstones and shales that were deposited primarily in marine and marginal-marine environments. Most of the formation in south-central Wyoming was deposited during Cenomanian through Turonian time, but locally the uppermost beds are early Coniacian.

Regionally, the Frontier Formation consists of three members named, in ascending order, the Belle Fourche Member, the member of Emigrant Gap, and the Wall Creek Member. Disconformities separate the three members, and the member of Emigrant Gap is absent where the upper and lower disconformities coalesce. The unconformity at the base of the Wall Creek Member corresponds to a surface that is widely recognized in the Western Interior Basin as the major sequence boundary between the underlying Cenomanian-Turonian Greenhorn cycle and the overlying Turonian-Coniacian Niobrara cycle.

The character and distribution of the unconformities and the lithologies associated with the member of Emigrant Gap and the Wall Creek Member record local tectonism in late early Turonian or early middle Turonian time and a eustatic sea-level fall during middle Turonian and perhaps earliest late Turonian time. The internal architecture of the Frontier demonstrates that: 1) local tectonism and eustatic events controlled the stratigraphic distribution of lithofacies, and 2) the dominance of tectonism and eustasy varied both regionally and temporally during mid-Cretaceous deposition in south-central Wyoming.

STOP 1. EMIGRANT GAP RIDGE - Sec. 4, T. 33 N., R. 81 W:

At this stop, the outcropping Frontier Formation is about 905 ft thick and consists of sandstone, siltstone, shale, and bentonite that were deposited mainly in shallow-marine environments during a succession of marine transgressions and regressions. The Frontier in this area is composed of the Belle Fourche Member, 653 ft thick and of Cenomanian age (molluscan zones 6-14); the member of Emigrant Gap, 120 ft thick and of middle Turonian age (molluscan zones 23-25); and the Wall Creek Member, 187 ft thick and of latest Turonian age (molluscan zone 29). Separating the three members are two significant disconformities; the older represents part of late Cenomanian time and early Turonian time (molluscan zones 15-22), and the younger represents most of the late Turonian (molluscan zones 26-28). The Belle Fourche Member contains coarsening-upward, shale-to-sandstone parasequences. The basal units of both the member of Emigrant Gap and the Wall Creek Member overlie and/or contain pebble lags developed on erosional surfaces. The basal part of the Wall Creek Member is poorly exposed and dominated by shale; the upper part of the Wall Creek Member is mostly sandstone.

STOP 2. COAL CREEK - Sec. 27 and 28. T. 32 N., R. 81 W:

The mid-Cretaceous Frontier Formation at Coal Creek is about 940 ft thick and consists of shallow-marine sandstone, siltstone, shale, and bentonite. In this area, the Frontier is composed of two members: the Belle Fourche Member, 710 ft thick and of Cenomanian age (molluscan zone 6-15); and the overlying Wall Creek Member, 230 ft thick and of late Turonian age (molluscan zone 29). The member of Emigrant Gap, which is 120 ft thick about ten miles to the north at Emigrant Gap Ridge, is absent here and presumably was deposited and removed during the time represented by the disconformity between the Belle Fourche and Wall Creek Members. The hiatus at this disconformity extends from the middle late Cenomanian (molluscan zone 16) to the late late Turonian (molluscan zone 28). Both the Belle Fourche and Wall Creek Members contain parasequences that coarsen upward from shale to sandstone. The basal sandstone units of the Wall Creek Member appear to be tidally influenced and upper sandstone units of the member are capped by channel-filling sandstone (fig. A). Although the Wall Creek Member at Coal Creek is the same age as the Wall Creek Member at Stops 1 and 3, it is distinguished by more sandstone units and less shale than at Emigrant Gap Ridge, ten miles to the north, and it is five times thicker than at Cheney Ranch, about eight miles to the southeast.

STOP 3. CHENEY RANCH - Sec. 28, T. 31 N., R. 80 W.:

At Cheney Ranch, marine sandstones, shales, and bentonites of the Frontier Formation are about 900 ft thick, although only the upper part of the formation crops out. The Frontier in this area consists of the Belle Fourche Member, about 855 ft thick and of Cenomanian age (molluscan zones 6-13 or 14), disconformably overlain by the Wall Creek Member, about 45 ft thick and of latest Turonian age (molluscan zone 29). The disconformity that truncates the top of the Belle Fourche Member represents part of the late Cenomanian and nearly all of the Turonian (molluscan zones 14 or 15 to 28). About 14 miles to the west at Gray Reef (fig. B), the ages, lithologies, and thicknesses of Frontier units are similar to those at Cheney Ranch, and the disconformity at the base of the Wall Creek Member is overlain by a multigenerational lag, which contains lithic pebbles, smooth phosphate pebbles, bored phosphate pebbles, sharks' teeth in different stages of phosphatization, and rounded, well-cemented, conglomeratic sandstone pebbles. The pebbles are as much as 2 inches long.

STOP 4. (OPTIONAL) WILLIAMS RANCH - Sec. 15, T. 26 N., R. 80 W.:

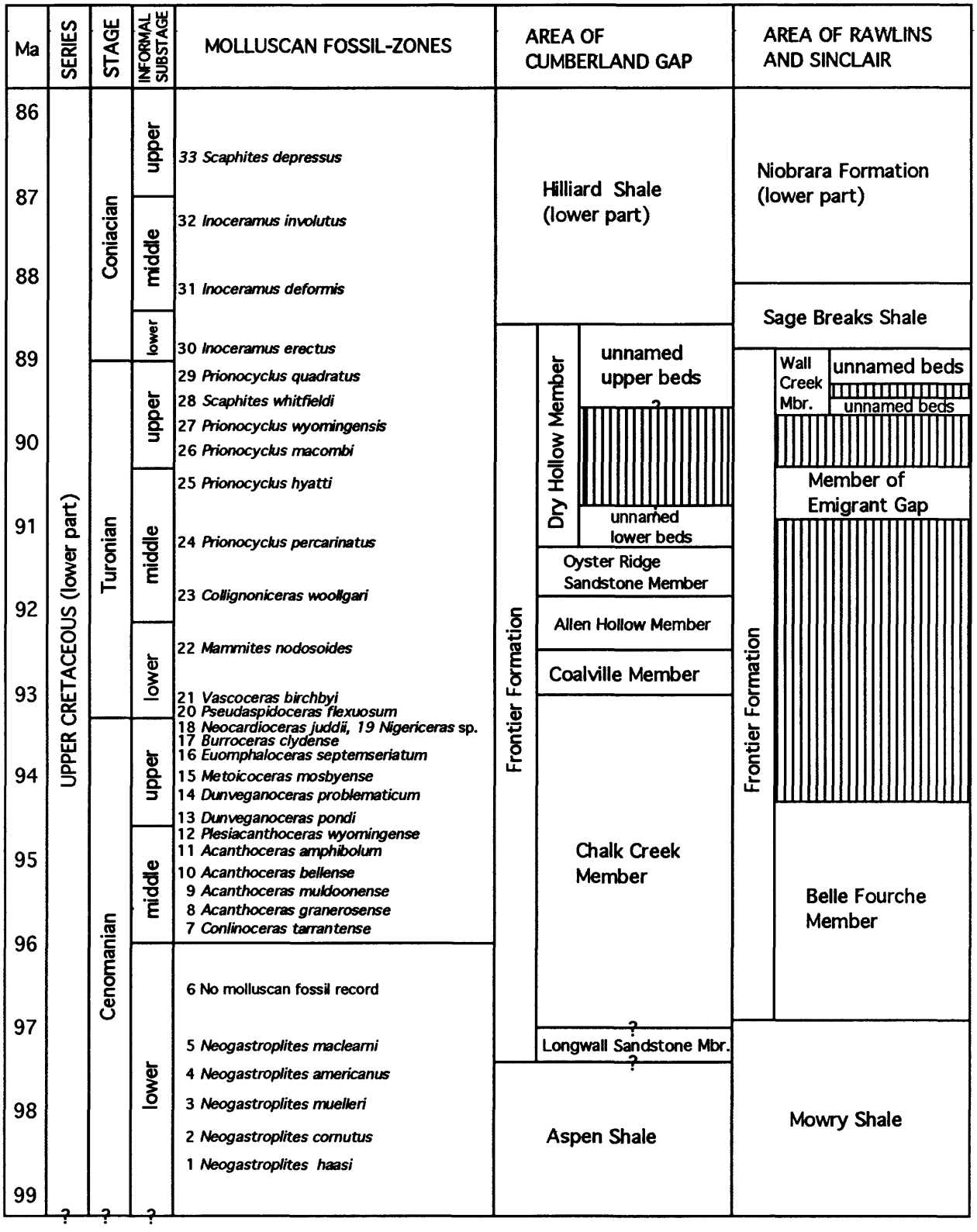
Much of the lower part of the Frontier Formation at Williams Ranch is poorly exposed, but the formation is marine to marginal marine and is about 1,000 ft thick (fig. C). It consists mainly of shale, siltstone, sandstone, and bentonite. The Belle Fourche Member is of Cenomanian age (molluscan zones 6-15?) and is about 910 ft thick; the overlying Wall Creek Member is of late Turonian age (molluscan zone 27 and probably zone 28) and is about 90 ft thick. The Wall Creek Member contains two distinct sandstone units separated by shale; the lower of these units contains evidence of tidal influence, particularly at its top. Compared to beds at the preceding stops to the north, the basal part of the Wall Creek Member in this area is significantly older. The disconformity between the Belle Fourche and Wall Creek Members represents an hiatus that extends from the late Cenomanian to the late Turonian (molluscan zones 16?-26). The member of Emigrant Gap could be represented by a thin sequence of carbonaceous shale and sandstone at the contact between the Belle Fourche and Wall Creek Members, but no fossils have been found in this poorly-exposed, laterally-discontinuous unit.

STOP 5. (OPTIONAL) MARSHALL ROAD - Secs. 25 and 26, T. 23 N., R. 78 W.:

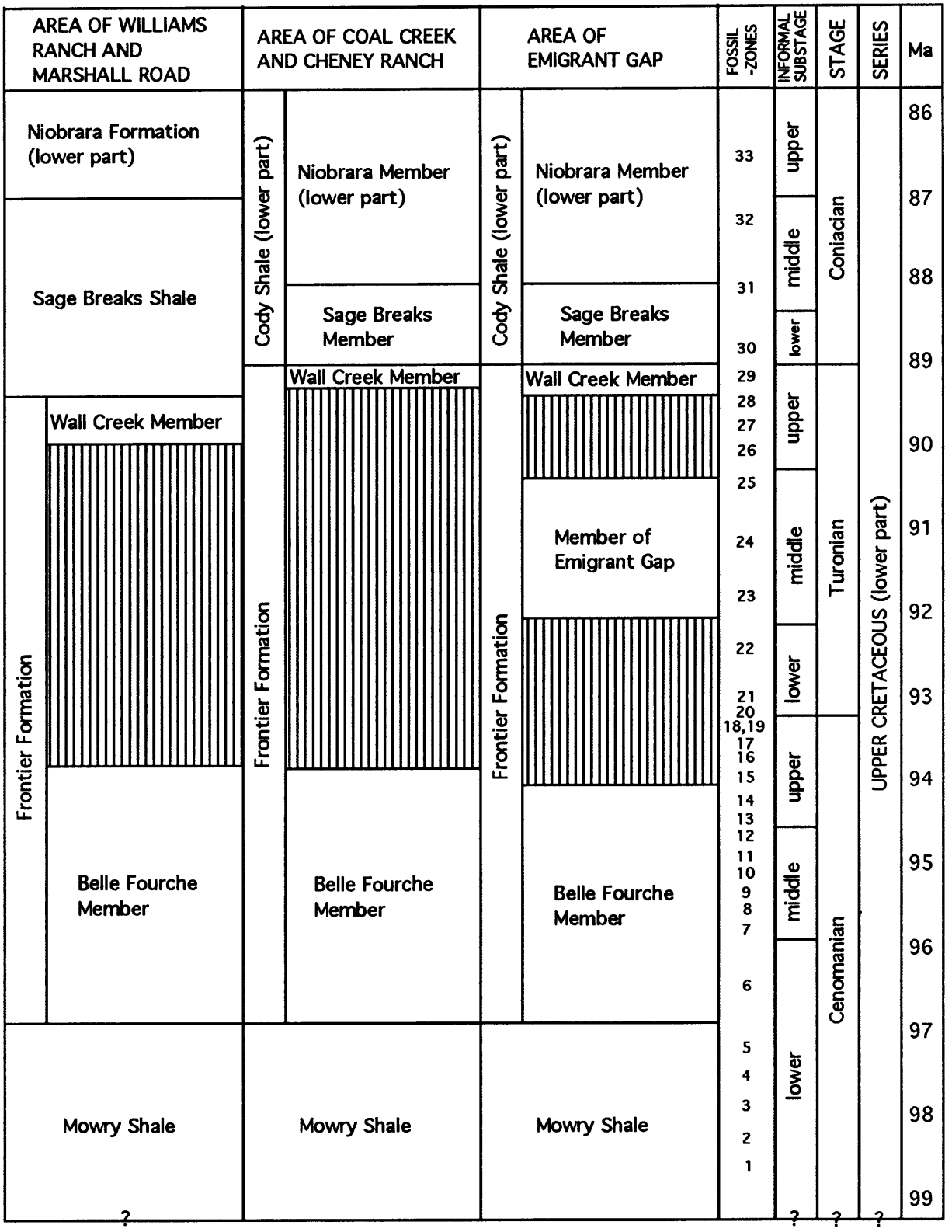
Well-exposed outcrops of the Frontier Formation along Marshall Road display assorted marine siliciclastic rocks and bentonites. The Frontier is 753 ft thick and is composed of the Belle Fourche Member, about 600 ft thick, and the overlying Wall Creek Member, about 153 ft thick. A unit of shale in the basal part of the Wall Creek Member along Marshall Road contains chert and phosphatic pebbles as much as 2 inches long. The member of Emigrant Gap is absent in the Marshall Road outcrops and at Como Bluff (fig. D), 4.5 miles to the southeast, but along the southern flank of the Freezeout Mountains about twelve miles northwest of this stop, a thin member of Emigrant Gap composed of shale and sandstone lies between the Belle Fourche and Wall Creek Members. Both the Belle Fourche and Wall Creek Members at Marshall Road contain coarsening-upward shale-to-sandstone parasequences. Fossil mollusks from nearby areas indicate that the Belle Fourche Member is of Cenomanian age; fossils from the Marshall Road area indicate that the Wall Creek Member is middle late Turonian in age (molluscan zones 27 and 28).

STOP 6. SINCLAIR/RAWLINS - Sec. 18, T. 21 N., R. 86 W.:

In the Sinclair/Rawlins highway cut and at nearby outcrops, the Frontier Formation is about 800 feet thick and consists mainly of marine to marginal marine siliciclastic rocks and bentonites. In this area, the three members of the Frontier, in ascending order, are: the Belle Fourche Member, 435 ft thick and of Cenomanian age (molluscan zones 6-13); the member of Emigrant Gap, about 25 ft thick and of middle Turonian age (molluscan zone 25); and the Wall Creek Member, about 340 ft thick and of late late Turonian and earliest Coniacian age (molluscan zones 28-30). Significant disconformities have been recognized between the three members. The hiatus between the Belle Fourche Member and the member of Emigrant Gap reflects much of the late Cenomanian, the early Turonian, and possibly part of the middle Turonian (molluscan zone 14-24). The hiatus between the member of Emigrant Gap and the Wall Creek Member (fig. E) spans the early late Turonian (molluscan zones 26-27). At these outcrops, all members of the Frontier contain coarsening-upward parasequences. Significant sequence boundaries, developed at approximately one-million to three-million-year intervals, can be recognized within the Frontier in this region.



AGES, FOSSIL ZONES, AND STRATIGRAPHIC NOMENCLATURE FOR SOME MID-CRETACEOUS SEDIMENTARY ROCKS AT LOCALITIES IN SOUTH-CENTRAL AND SOUTHWESTERN WYOMING. Radiometric ages and fossil zones from Obradovich and Cobban (1975), Obradovich (1988), Obradovich (in press), and W.A. Cobban (1992, written commun.).


AREA OF WILLIAMS RANCH AND MARSHALL ROAD
AREA OF COAL CREEK AND CHENEY RANCH
AREA OF EMIGRANT GAP
FOSSIL -ZONES
INFORMAL SUBSTAGE
STAGE
SERIES
Ma
Niobrara Formation (lower part)
Sage Breaks Shale
Wall Creek Member
Frontier Formation
Belle Fourche Member
Mowry Shale
Cody Shale (lower part)
Niobrara Member (lower part)
Sage Breaks Member
Wall Creek Member
Frontier Formation
Belle Fourche Member
Mowry Shale
Cody Shale (lower part)
Niobrara Member (lower part)
Sage Breaks Member
Wall Creek Member
Member of Emigrant Gap
Frontier Formation
Belle Fourche Member
Mowry Shale
33
32
31
30
29
28
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26
25
24
23
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18,19
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
upper
middle
lower
upper
middle
lower
upper
middle
lower
Coniacian
Turonian
Cenomanian
UPPER CRETACEOUS (lower part)
86
87
88
89
90
91
92
93
94
95
96
97
98
99
?
?
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REFERENCES CITED

Obradovich, J.D., 1988, A different perspective on glauconite as a chronometer for geologic time scale studies: Paleoceanography, v. 3, no. 6, p. 757-770.

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