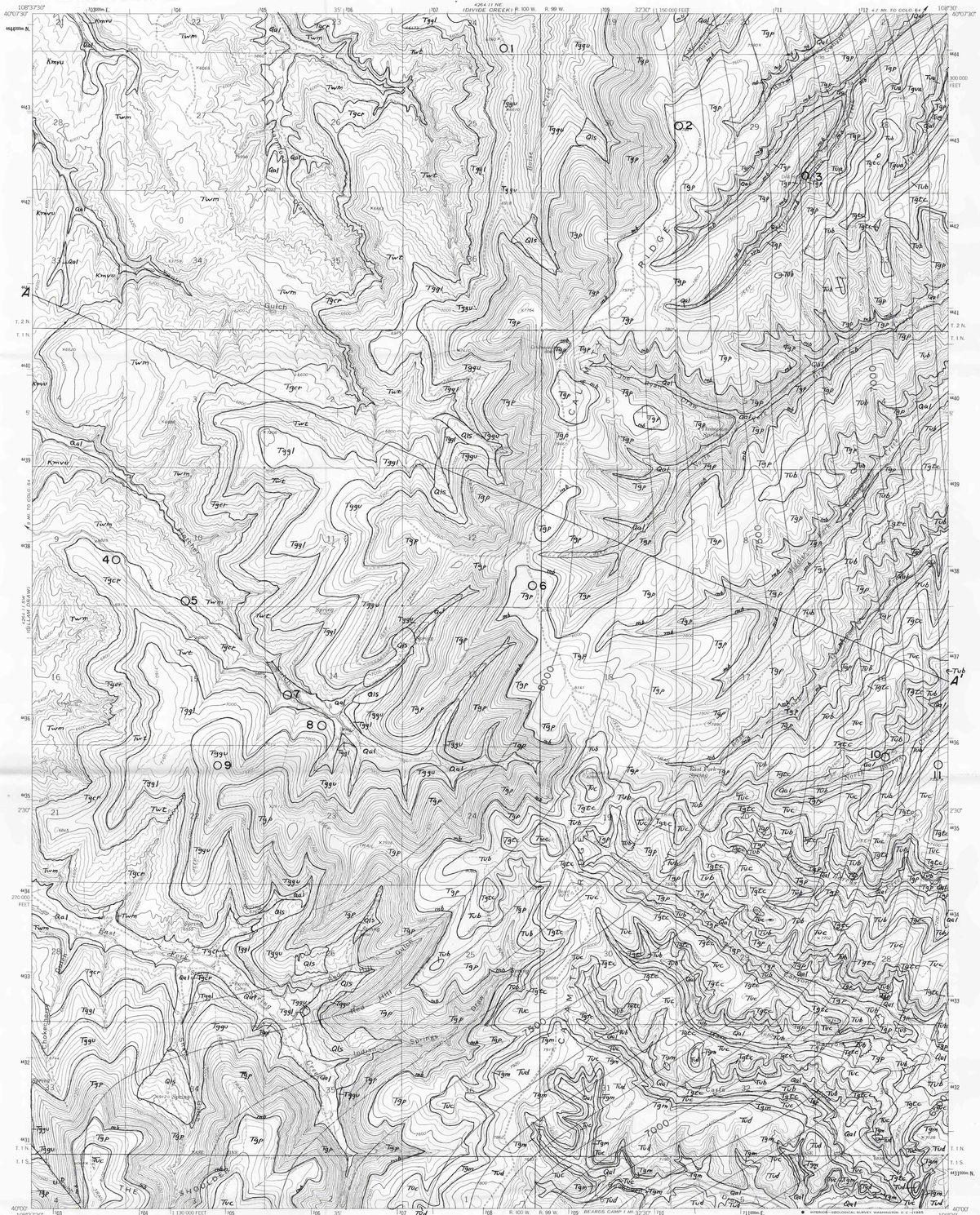
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1690



PRELIMINARY GEOLOGIC MAP OF THE CALAMITY RIDGE QUADRANGLE, RIO BLANCO COUNTY, COLORADO

By
John R. Donnell and William J. Hail, Jr.

1984

CORRELATION OF MAP UNITS

Qls	Holocene	QUATERNARY	
Qal	Pleisto-cene (?)		
Unconformity			
Tud	Eocene	TERTIARY	
Tgm			
Tuc			
Tgtc			
Tub / Tub			
Tgp / Tua			
Tua / Tua			
mb			
Tgp			
Tggu			
Tggl			
Tgcr / Twt			
Tgcr			
Twm	Paleocene		
Unconformity			
Kmvu	Upper Cretaceous	CRETACEOUS	

DESCRIPTION OF MAP UNITS

Qls LANDSLIDE DEPOSITS (HOLOCENE)--Detached masses and slumped ground, mostly lying at the foot of steep cliffs. Most slides are derived from the lower part of the Parachute Creek Member or upper part of the Garden Gulch Member of the Green River Formation. Slide masses lying northeast of the East Fork of Spring Creek include much oxidized material; it is presumed that this landsliding resulted from clinkering or oxidation of oil-shale beds in the Parachute Creek Member

Qal ALLUVIUM (HOLOCENE AND PLEISTOCENE(?))--Locally derived material confined to stream valleys; also includes some slope wash along valley walls; includes alluvial fans at mouths of branch streams. Most drainages contain at least some alluvial deposits, but only the thickest, most persistent, or most extensive deposits are shown

UINTA FORMATION (EOCENE)--Mostly clastic sediments of a prograding deltaic complex that ultimately filled the Eocene lake in which the sediments of the Green River Formation were deposited. Generally southward-thinning wedges composed chiefly of sandstone and siltstone that interfinger with marlstones of the Green River Formation

Tud Tongue D--Brown to brownish-gray sandstone and siltstone; minor marlstone. Sandstone is very fine to coarse grained, locally conglomeratic; massive or evenbedded, to crossbedded. Abundant channel units. Locally concretionary. Includes a locally persistent bed of light-gray marlstone containing a very thin bed (less than 0.5 ft (0.2 m)) of rich oil shale. Basal contact gradational to sharply scoured. Top eroded. Maximum remaining thickness about 220 ft (66 m)

Tuc Tongue C--Mostly light gray to brown sandstone and siltstone; some gray silty marlstone. Sandstone is very fine to medium grained; locally coarse grained to conglomeratic. Resistant beds form cliffs along some valley walls. Basal contact gradational to sharply scoured. Thickness ranges from about 60 to 200 ft (18-60 m)

Tub Tongue B--Mostly brown to brownish gray sandstone and siltstone; minor variably silty marlstone. Contains abundant channel sandstone and siltstone units. Sandstone is very fine to medium grained, crossbedded or evenbedded, locally conglomeratic, locally concretionary. Penecontemporaneous slump blocks common. Resistant beds form cliffs along some valley walls. Locally discontinuous in the southeastern part of the quadrangle; tongues out on outcrop near the head of Indian Springs Draw in the south-central part of quadrangle. Basal contact gradational to sharply scoured. Maximum thickness is about 270 ft (80 m)

Tua Tongue A--Mostly brown to gray sandstone and siltstone; lesser marly siltstone and silty marlstone. Contains channel sandstone units. Present only in the extreme northeastern corner of quadrangle, although unmapped isolated lenses are present farther south in drainages of the North Fork and Middle Fork of Greasewood Creek, where they are included with the main body of the Parachute Creek Member of the Green River Formation. May be represented elsewhere by a brown-weathering silty zone in the main body of the Parachute Creek. Maximum thickness is about 120 ft (36 m)

GREEN RIVER FORMATION (EOCENE)--Sediments deposited in a variety of lacustrine environments

Tgm Marlstone tongue at Mare Canyon--Mostly light-gray variably silty marlstone; lesser marly siltstone. Contains two thin oil shale beds, usually less than 0.5 ft (0.15 m) thick. The upper bed locally contains an estimated 20-25 gal per ton of oil, and may be as much as 1.5 ft (0.45 m) thick. The unit presumably merges with the Parachute Creek Member south of quadrangle where tongue C of the Uinta Formation pinches out. Thickness ranges from about 30 to 70 ft (9-21 m)

Tgtc Marlstone tongue at Trail Canyon--Light-gray, variably silty marlstone; lesser marly siltstone. In the southeastern part of quadrangle, unit contains three thin, very low grade (4 gal per ton or less) beds of oil shale. North of Middle Barcus Creek, the unit is barren of oil shale. Merges with the Parachute Creek Member in upper Indian Springs Draw in the south-central part of the quadrangle and locally in parts of Trail and Mare Canyons in the southeastern part of quadrangle. Thickness ranges from about 60 to 170 ft (18-50 m)

Tgua Tongue A--Light-gray, variably silty marlstone. Present only in the extreme northeast part of the quadrangle where it merges with the Parachute Creek Member. Maximum thickness is about 150 ft (45 m)

Tgp Parachute Creek Member--Oil shale, dolomitic marlstone, and lesser clay shale. Oil shale is medium to dark brown; weathers light gray. Marlstone is gray to light-grayish brown; weathers light gray. Clay shale is medium to dark brown. Also contains minor siltstone and sandstone, and several very thin beds of altered tuff. In the valley of the North Fork of Greasewood Creek, unit contains discontinuous sandstone beds believed to be outliers of tongue A (Tua) of the Uinta Formation which were not mapped separately. The oil shale and marlstone beds are resistant and form steep slopes and cliffs. Contains most of the oil-shale deposits in the quadrangle and includes rich oil-shale zones R-2, R-3, R-4, R-5, R-6, the Mahogany zone, and rich beds above the Mahogany zone. Contains the Mahogany bed (mb on map), the richest oil-shale bed in the Mahogany zone; thickness about 5-10 ft (1.5-3 m). Base is placed at the base of the R-2 zone; this contact coincides with the blue marker, a resistivity-log marker widely recognized throughout much of the Piceance Creek basin (see fig. 1). Top is equivalent to the top of the R-6 oil-shale zone as mapped in the Sagebrush Hill quadrangle to the south (Donnell, 1982). Thickness varies owing in part to the tonguing out of tongues A and B (Tua and Tub) of the Uinta Formation. Thickness ranges from about 1,050 to 1,600 ft (320-480 m)

Garden Gulch Member

Tggu Upper part--Clay shale, lesser carbonate shale, and shaly marlstone, much of which is low- to moderate-grade oil shale. Clay shale dominates and is fissile to papery, gray to brown, and weathers dark gray. Carbonate shale and shaly marlstone weather light gray. Unit contains a few sparse, thin, and inconspicuous beds of ostracodal limestone in lower part. Soft, nonresistant; forms slopes. Includes the R-1 rich oil-shale zone (see fig. 1). Thickness ranges from about 220 to 450 ft (65-135 m)

Tggl Lower part--Clay shale and ostracodal limestone. Shale is mostly brown to gray, fissile to papery, low-grade oil shale. Nonresistant; forms slopes. Limestone beds are locally silty or sandy; weather light gray to grayish orange; form thin resistant ledges. A thin brown-weathering sandy claystone bed containing broken shells locally lies 5-10 ft (2-3 m) above the base of the unit. The unit may correlate with the upper part of the Douglas Creek Member as mapped in the Black Cabin Gulch quadrangle (Cashion, 1969), 9 mi (15 km) south of the Calamity Ridge quadrangle. Upper contact is drawn on top of the highest conspicuous persistent bed of ostracodal limestone; in the area south of Fletcher Gulch, this contact appears to be at or near the lean oil-shale zone containing the orange marker (see fig. 1). Drill hole 9 (USGS core hole 78-9, Smith and O'Sullivan, 1982, p. 105-126) shows low-grade oil-shale values through a section at least 140 ft (43 m) thick below the orange marker. Thickness ranges from about 180 to 300 ft (55-92 m)

Tgcr Cow Ridge Member--Mostly clay shale and ostracodal limestone; minor marlstone and thin sandstone beds. Shale is mostly gray to brown, fissile to papery, ostracodal. Gray, nonfissile shale or claystone is present in the upper part of the unit. Nonresistant; forms slopes. Limestone is light gray. Lacustrine shale and thin sandstone beds in upper part of unit intertongue with alluvial sandstone and claystone of a tongue of the Wasatch Formation and are included with the tongue of the Wasatch (Twt) in the area south of Fletcher Gulch. The top of a thin probably lacustrine sandstone bed extending southward from the top of the tongue of the Wasatch (Twt), is designated as the boundary between the Cow Ridge Member and the lower part of the Garden Gulch Member; south of the East Fork of Spring Creek, this contact is drawn by projection of structure contours. Lower part continues beyond the north boundary of the quadrangle into adjacent Divide Creek quadrangle. Exposed rocks of the unit tongue out entirely into the Wasatch Formation in the eastern part of the Divide Creek quadrangle (B. E. Barnum, oral commun., 1982). The Cow Ridge has been recently named by R. C. Johnson (1984) for exposures on Cow Ridge about 42 mi (68 km) southeast of the Calamity Ridge quadrangle. The unit is correlative in part with the Douglas Creek Member of the Green River Formation as mapped in the Black Cabin Gulch quadrangle (Cashion, 1969) 9 mi (15 km) south of the Calamity Ridge quadrangle. Thickness ranges from about 60 ft (18 m) near the northern quadrangle boundary, to about 420 ft (128 m) near the southern boundary

WASATCH FORMATION

Twt Tongue of Wasatch (Eocene)--Sandstone, claystone, and shale. Sandstone is light to dark gray and brown, fine to coarse grained, locally conglomeratic, massive to crossbedded. Claystone and shale are mostly light to medium gray; a few claystone beds are red. Consists almost entirely of alluvial rocks near the north boundary of the quadrangle, but contains an increasing proportion of lacustrine beds southward, i.e. lacustrine shale and thin sandstone beds intertongue with nonlacustrine beds in the area south of Fletcher Gulch. Prominent sandstones in the unit tongue out within a short distance north of the East Fork of Spring Creek where the unit is arbitrarily terminated. Exposed rocks of the unit merge with the main body of the Wasatch Formation northeast of the Calamity Ridge quadrangle. Thickness ranges from about 140 to 600 ft (40-180 m)

Twm Main body (Eocene and Paleocene)--Sandstone, claystone, and mudstone; minor siltstone and limestone. Sandstone beds are light gray to light brown, very fine to medium grained, crossbedded to massive, discontinuous; locally form cliffs and ledges. Some sandstone beds contain sparse gastropods. Claystone and mudstone beds are brown, gray, grayish-green, purple, and red. The lower 330-400 ft (100-120 m) lacks any red or purple claystone and contains some brown carbonaceous shale beds. Upper part is Eocene in age; lower part is Paleocene. Lower part is correlative in part with the lower member of the Wasatch as mapped in the Cactus Reservoir quadrangle (Barnum and Garrigues, 1980) to the northwest, and with the Fort Union Formation as mapped in the Rough Gulch quadrangle (Hail, 1974) to the northeast. Lower part is not mapped separately in the Calamity Ridge quadrangle. Thickness ranges from about 650 to 1,100 ft (200-335 m)

Kmvu MESAVERDE GROUP (UPPER CRETACEOUS)--Upper unit. Mostly sandstone, shale, claystone, and mudstone. Lesser thin carbonaceous and coaly beds; sparse clay-pebble conglomerate. Sandstone is mostly light gray to light brown, fine grained, crossbedded to massive; mostly nonpersistent; locally forms cliffs. Shale, claystone, and mudstone beds are light gray to light greenish gray, and light brown. The unit is entirely nonmarine, and consists of delta-plain alluvial deposits. The name follows that used in the Cactus Reservoir quadrangle by Barnum and Garrigues (1980). The unit is correlative with the upper part of the Upper Cretaceous Williams Fork Formation of the Mesaverde Group in areas to the east. Maximum thickness of exposed rocks is about 400 ft (120 m)

CONTACT--Approximately located where obscured by soil cover or vegetation. Short-dashed line shows arbitrarily drawn name-change boundary between merging units

INTERTONGUING CONTACT

FAULT--U, upthrown side; D, downthrown side

−7500− STRUCTURE CONTOURS--Drawn on Mahogany oil-shale bed in the Mahogany zone. Elevation shown in feet. Dashed where bed is absent owing to erosion

DRILL HOLE AND MAP NUMBER--See table 1

A — A' LINE OF CROSS SECTION

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Barnum, B. E., and Garrigues, R. S., 1980, Geologic map and coal sections of the Cactus Reservoir quadrangle, Rio Blanco and Moffat Counties, Colorado: U.S. Geological Survey Miscellaneous Field Studies Map MF-1179, scale 1:24,000.

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Pitman, J. K., 1979, Isopach, structure contour, and resource maps of the R-6 oil-shale zone, Green River Formation, Piceance Creek basin, Colorado: U.S. Geological Survey Miscellaneous Field Studies Map MF-1069, 2 sheets, scale 1:126,720.

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Smith, M. C., and O'Sullivan, R. B., 1982, Results of core drilling in 1978 for oil shale in the Piceance Green River Formation, Piceance Creek area of western Colorado: U.S. Geological Survey Open-File Report 82-476, 187 p.

OIL SHALE

Oil shale is present in the Parachute Creek and Garden Gulch Members of the Green River Formation, and all the named rich oil-shale zones are exposed. The upper part of the Garden Gulch Member (map unit Tggu) contains rich oil-shale zone R-1, as well as some lower-grade oil shale below R-1. The Parachute Creek Member contains rich oil-shale zones R-2, R-3, R-4, R-5, R-6, and the Mahogany zone, as well as some oil shale above the Mahogany zone. These zones are shown on figure 1. Oil-shale resource evaluation is largely limited to the Mahogany and R-6 zones at the present time and is based mostly on assays from the Barcus Creek 1 drill hole, which is the only core test that penetrated essentially all of the rich oil-shale zones. Four shallow core holes were drilled by the U.S. Geological Survey in 1978 (Smith and O'Sullivan, 1982) but these penetrated only a small part of the oil-shale-bearing section. Hole 1 (USGS 78-7) penetrated only through rich zone R-1; Hole 2 (USGS 78-9) penetrated only part of the Mahogany zone; Hole 6 (USGS 78-9A) penetrated only through the Mahogany zone; Hole 9 (USGS 78-8) penetrated only part of rich zone R-1 and some lower beds.

For the Mahogany zone, Pitman and Johnson (1978) estimated that oil-shale resources range from less than 50,000 barrels per acre (bbl/acre) (20,000 m^3 per hm^2) in the northeastern part of the quadrangle to about 230,000 bbl/acre (90,000 m^3/hm^2) in the southeastern part of the quadrangle. On the basis of these figures, the total oil-shale resource for the Mahogany zone in the quadrangle is about 2.5 billion barrels (0.4 billion m^3). The Mahogany zone ranges in thickness from about 120 ft (36 m) in the southwestern part of the quadrangle, to about 180 ft (54 m) at the eastern boundary of the quadrangle.

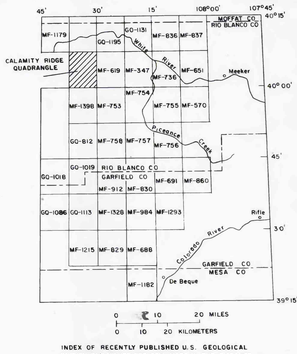
For the R-6 zone, Pitman (1979) estimated that oil-shale resources range from less than 50,000 bbl/acre (20,000 m^3/hm^2) in the northeastern part of the quadrangle to about 250,000 bbl/acre (90,000 m^3/hm^2) in the southeastern part of the quadrangle. Based on these figures, the total oil-shale resource for the R-6 zone in the quadrangle is about 2.1 billion barrels (0.34 billion m^3). North of T. 1 N., the R-6 zone apparently averages less than 5 gallons per ton (Pitman, 1979) and that area is, therefore, not included in the resource estimates.

Figure 1 shows oil yields and rich oil-shale zones for the Barcus Creek 1 drill hole (no. 10 on map). Lean oil-shale zones separating the numbered rich oil-shale zones are designated L-1 through L-5 on the figure. Fischer assays shown on this figure were made by the U.S. Bureau of Mines at Laramie, Wyo.

Figure 1.--Oil yields and oil-shale zones for the Barcus Creek No. 1 drill hole, NE1/4NW1/4 sec. 21, T. 1 N., R. 99 W. Fischer assays by the U.S. Bureau of Mines.

Table 1--Drill holes in Calamity Ridge quadrangle

Map No.	Name	Location	Depth in ft	Stratigraphic Unit At surface	Stratigraphic Unit At total depth
1	USGS 78-7	SW1/4SE1/4 sec. 24, T. 2 N., R. 100 W.	304	Garden Gulch Member of Green River Formation	Garden Gulch Member of Green River Formation
2	USGS 78-9	NW1/4SW1/4 sec.29, T. 2 N., R. 99 W.	205	Parachute Creek Member of Green River Formation	Parachute Creek Member of Green River Formation
3	Skelley Oil Co. 1 Binford	SE1/4SE1/4 sec. 29, T. 2 N., R. 99 W.	5,826	------do-------	Mesaverde Group (Cretaceous)
4	Pacific Transmission Supply Co. 43-9 Fletcher Gulch	NE1/4SE1/4 sec. 9, T. 1 N., R. 100 W.	9,343	Cow Ridge Member of Green River Formation	Mancos Shale (Cretaceous)
5	Baker Well Service 1 Government	SE1/4SW1/4 sec. 10, T. 1 N., R. 100 W.	4,074	Wasatch Formation	Buck Tongue of Mancos Shale (Cretaceous)
6	USGS 78-9A	SE1/4SE1/4 sec. 12, T. 1 N., R. 100 W.	200	Parachute Creek Member of Green River Formation	Parachute Creek Member of Green River Formation
7	Gulf Oil Corp. 1 Cathedral Bluff	NW1/4SW1/4 sec. 14, T. 1 N., R. 100 W.	5,250	Tongue of Wasatch Formation	Mancos Shale (Cretaceous)
8	Chorney Oil Co. 1-14 East Rangely	SE1/4SW1/4 sec. 14, T. 1 N., R. 100 W.	10,300	Garden Gulch Member of Green River Formation	Morrison Formation (Jurassic)
9	USGS 78-8	NW1/4NE1/4 sec. 22, T. 1 N., R. 100 W.	630	------do-------	Cow Ridge Member of Green River Formation
10	USBM 1 Barcus Creek	NW1/4NE1/4 sec. 21, T. 1 N., R. 99 W.	1,801	Tongue B of Uinta Formation	Garden Gulch Member of Green River Formation
11	Marathon Oil Co. D-1X Chevron	NE1/4NE1/4 sec. 21, T. 1 N., R. 99 W.	8,740	Tongue C of Uinta Formation	Mesaverde Group (Cretaceous)



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