VERTEBRATES OF THE TURTLE BASIN LOCAL FAUNA, MIDDLE EOCENE, SEVIER PLATEAU, SOUTH-CENTRAL UTAH

Jeffrey G. Eaton
Department of Geosciences, Weber State University, Ogden, UT 84408-2507

J. Howard Hutchison and Patricia A. Holroyd
Museum of Paleontology, University of California, Berkeley, CA 94720

William W. Korth
Rochester Institute of Vertebrate Paleontology, 928 Whalen Road, Penfield NY 14526

Patrick M. Goldstrand
Midas Joint Venture, HC66, Box 125, Midas, NV 89414

ABSTRACT

The Turtle Basin local fauna, assignable to the Duchesnean North American Land Mammal Age, is here described from the Sevier Plateau of southern Utah. The Turtle Basin local fauna is dominated by aquatic faunal elements, especially chelonians, with rarer records of artiodactyls, a diverse rodent fauna, perissodactyls, and various fish taxa. The combined occurrence of the Uintan to Duchesnean rodents *Griphomys* and *Metanoiamys*, a heliscomyid and a new species of *Litoyoderimys* more primitive than Chadronian forms, and the Duchesnean and later anthracotheriids *Aepinacodon* and *Heptacodon* are the basis for a Duchesnean age for the Turtle Basin local fauna. The fauna is distinctive among Duchesnean faunas in including latest records of North American freshwater rays (Dasyatidae), and several turtles (*Plastomenus* sp., *Baptemys* n. sp., *Echmatemys* n. sp., and a new genus of derived chelydrid).

INTRODUCTION

The Sevier Plateau (figure 1) of Garfield and Kane Counties, southern Utah, is bounded on the east by the Paunsaugunt fault system, separating it from the Aquarius Plateau; to the south by the topographically lower Paunsaugunt Plateau; and to the west by the Sevier fault system, separating it from the Markagunt Plateau. The stratigraphic sequence on the plateau consists primarily of early Tertiary carbonates grading upward into volcanics, although faulted Cretaceous sequences are present at the southern margin of the plateau. The lowest Tertiary unit on the Sevier Plateau is the Claron Formation, which forms the picturesque pink and white cliffs of the region, including Bryce Canyon National Park. The Claron Formation consists predominantly of carbonates, mudstones, sandstones, and conglomerates. Only rare invertebrates and palynomorphs have been recovered. These fossils suggest an Late Paleocene to early Eocene age for the lower part of the formation (Goldstrand and others, 1993; Goldstrand, 1994).

Overlying the Claron Formation is a thick (approximately 250 m) sequence of volcaniclastic rocks (figure 2) with a complex nomenclatural history. Gregory (1944, 1945, 1949, 1950) applied the name "Brian Head Formation" to those rocks he considered equivalent to ones exposed in the type area on the Markagunt Plateau to the west. The formation was poorly defined and included several rock units that were subsequently recognized as distinct and removed from the "Brian Head Formation." Problems were noted by Threet (1952a, 1952b), Anderson (1971) and Judy (1974). The name was formally abandoned by Anderson and Rowley (1975).

This sequence of volcaniclastic rocks has been given informal names such as the "variegated sandstone member" and the "white tuffaceous sandstone" by Bowers (1972) in the Aquarius Plateau area or included within the Claron Formation on the Sevier Plateau (Rowley and others, 1987). Sable and Maldonado (1997) reinstate and redefine the Brian Head Formation based on a type section exposed on the Markagunt Plateau and refer the sequence of rocks on the Sevier Plateau to that formation. The term Brian Head Formation will be used in quotes here due to uncertainties in the correlation of this unit from the type area.

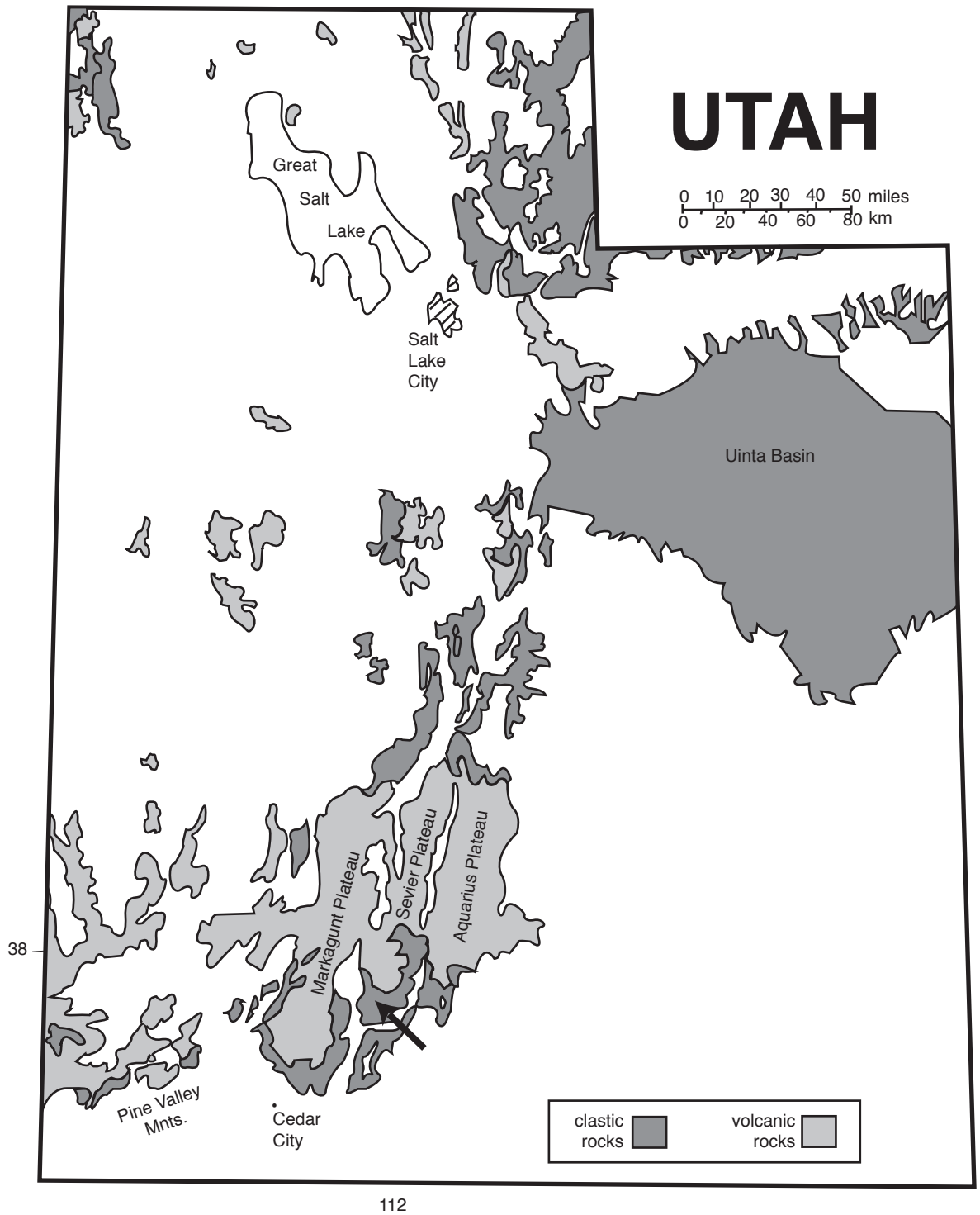

Figure 1. *Tertiary outcrop map of Utah (based on Hintze, 1974) indicating geographic location of the Sevier, Markagunt, and Aquarius plateaus. Arrow indicates location of the Turtle Basin local fauna.*

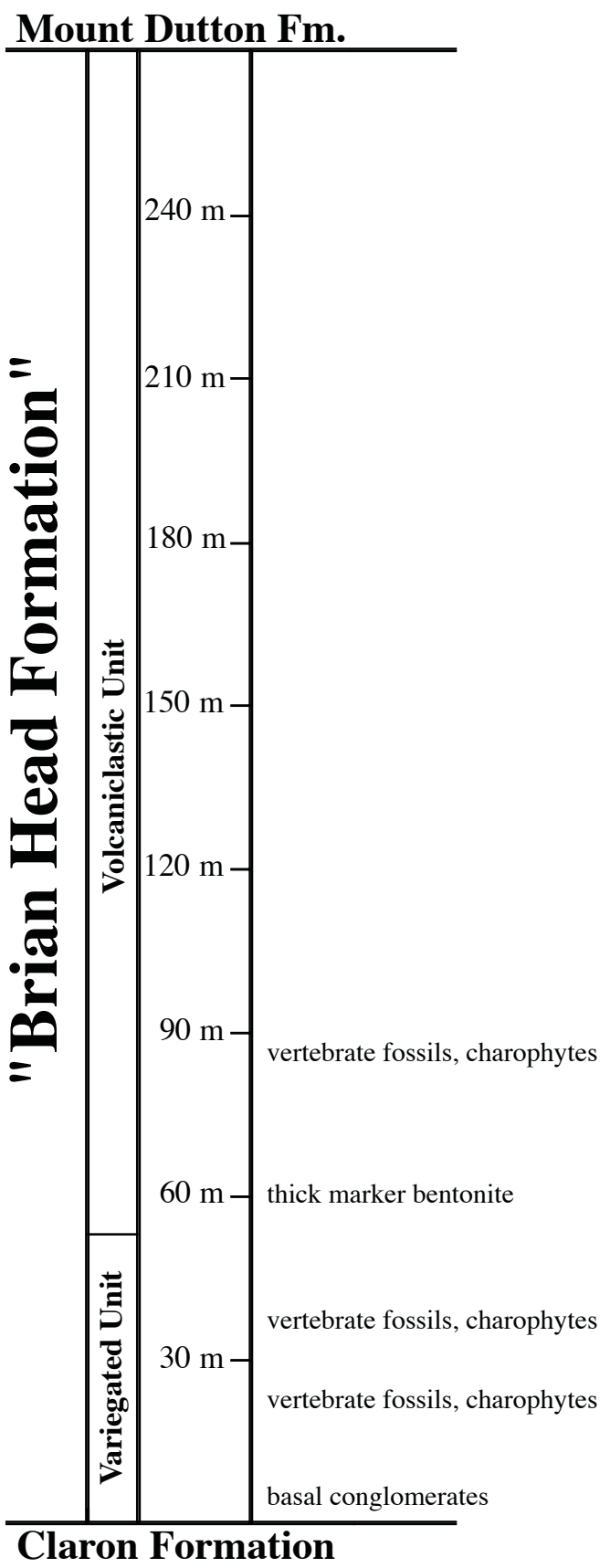

Figure 2. *Generalized stratigraphic section of the "Brian Head Formation" on the Sevier Plateau indicating informal stratigraphic units and approximate stratigraphic position of fossil localities and marker beds.*

Overlying the "Brian Head Formation" is a thick (~1000 m), complex sequence of volcanic flows, tuffs, and lahars of the Mount Dutton Formation. A radiometric date from near the base of the unit indicates an Oligocene age (32 Ma; Rowley and others, 1994).

STRATIGRAPHY

The "Brian Head Formation" on the Sevier Plateau is separated from the underlying Claron Formation by a conglomerate of quartzite and chert pebbles which float in a carbonate mud matrix. This conglomerate is widespread and highly variable in thickness and appears to infill a paleotopographic surface. The conglomerate is overlain by a sequence of variegated mudstones, bentonitic mudstones, fine-grained sandstones, and thin limestone beds. Sandstones from the variegated unit consist primarily of quartz and chert with some feldspar (Goldstrand and Eaton, 1996). Volcanic influence is restricted to bentonitic contributions to the mudstones. This unit, informally referred to as the "variegated unit" (see figure 2), is variable in thickness but averages about 50 meters and represents a series of lake and associated facies deposits laid down over a relatively short interval of time.

Overlying the variegated unit is a thick (200 m) unit dominated by volcaniclastic sandstones and conglomerates informally referred to as the "volcaniclastic unit" (figure 2). The sandstones are compositionally markedly different from those of the variegated unit as they are dominated by felsic and intermediate volcanic fragments suggesting a more proximal relationship to active volcanism than was the case for the variegated unit. Thin mudstones and bentonitic layers are present in the volcaniclastic unit.

Most of the fossils recovered to date have been from the variegated unit. It contains abundant charophytes, and more rarely ostracodes and gastropods. Among the vertebrates, turtle remains are the most abundant. The fossils are recovered from a sequence of lacustrine mudstones probably representing a single lake system. Fossils have also been recovered from lacustrine localities low in the volcaniclastic unit (figure 2). The turtles and rodents recovered from the variegated unit and low in the volcaniclastic unit represent the same taxa and are likely to be approximately of the same age.

VERTEBRATE FAUNA

Fossil vertebrates are common in the variegated unit, and collections are dominated by abundant turtle re-

mains. Other lower vertebrates include bony fishes, a ray, a bird, and an alligator. Mammalian fossils are rare in surface collections, and most mammalian taxa were recovered through screenwashing. A preliminary faunal list is provided in table 1. Large surface-collected vertebrate materials (turtles and ungulates) are housed at the Museum of Paleontology, University of California, Berkeley. Small vertebrate material recovered by screenwashing (rodent and ray teeth) are housed at the Utah Museum of Natural History, Salt Lake City.

The composition of the lower vertebrate fauna reflects a lakeshore paleoenvironment. Fish are present, and the turtle and crocodilian fauna is entirely aquatic. The mix of chelonian taxa is unique and incorporates late members of earlier Eocene lineages and derived members of others. The fauna is also unusual in the absence of terrestrial turtles (testudinids), taxa preferring river channels (baenids), and kinosternids found in other Duchesnean faunas (Hutchison, 1996).

An undescribed genus of chelydrid turtles shares derived features of the shell with the Neogene members of the family. These include inflation of the peripherals, thinning and reduction of the carapace and plastron, serration of the posterior peripherals, and prominent development of carinae and knobs on the carapace, the latter suggesting *Macroclemmys*. The oldest known *Macroclemmys* are Miocene.

Two trionychids are known from this fauna. The plastominine *Plastomenus* sp. represents the latest record of the genus, elsewhere known only as late as Bridgerian. The trionychine lacks a preneural and is probably allied with *Apalone*, the extant North American genus. The dermatemydid *Baptemys* undescribed species is derived by comparison to the previous latest known species, *B. wyomingensis* Leidy, 1870 from the Uintan (Shoshonian) of the Rocky Mountain states. This undescribed species exhibits a broadening of the plastron and development of a xiphiplastral notch continuing the trend seen in the earlier species toward the extant *Dermatemys*.

Three batagurids are present and all represent new species. Two belong to genera known earlier, while one may represent a new genus. *Echmatemys* is the most abundant turtle in the fauna and outnumbers all others combined. The *Echmatemys* from the fauna is comparable to Wasatchian species in size, reversing the general trend for size increase seen from the Wasatchian through Uintan (Hutchison, 1992). This is also the latest confirmed record of the genus *Echmatemys* in North America. The second, small batagurid is related to "*Rhinoclemmys*" *morrisiae* Hay, 1908, a species known only from the Fowkes and Bridger Formations of Wyoming which may be as late as Shoshonian. The third batagurid may represent a new genus and is the largest batagurid in the fauna.

Table 1. *Preliminary vertebrate faunal list, Turtle Basin local fauna.*

- **Chondrichthyes**
  - Myliobatiformes
    - Dasyatidae?, unidentified
- **Osteichthyes**
  - Amiiformes
    - Amiidae
      - *Amia uintensis*
  - Salmoniformes
    - Esocidae, unidentified
  - Lepisosteiformes
    - Lepisosteidae, unidentified
  - Cypriniformes
    - cf. Catostomidae
  - Siluriformes
    - Ictaluridae, unidentified
- **Osteichthyes, unidentified**
- **Reptilia**
  - Chelonia
    - Chelydridae, undescribed genus
    - Bataguridae
      - *Echmatemys* undescribed species
      - "*Rhinoclemys*" undescribed species
      - genus unidentified
    - Dermatemydidae
      - *Baptemys* undescribed species
    - Carettochelyidae
      - *Anosteira* sp. or *Pseudanosteira* sp.
    - Trionychidae
      - *Apalone* sp.
      - *Plastomenus* sp.
  - Crocodylia
    - Alligatoridae
      - *Alligator* sp.
- **Aves**
  - Neornithes, unidentified
- **Mammalia**
  - Marsupialia
    - Peradectidae, unidentified
  - Rodentia
    - Eomyidae
      - *Litoyoderimys* undescribed species
      - *Metanoiamys* sp., cf. *M. lacus*
      - *Protadjidaumo* sp.
      - *Paradjidaumo* sp., cf. *P. alberti*
    - Heteromyidae
      - undescribed genus and species
    - Geomyoidea?
      - *Griphomys alecer*
  - Artiodactyla
    - Anthracotheriidae
      - *Aepinacodon* sp.
      - *Heptacodon* sp.
    - Perissodactyla
      - Brontotheriidae, unidentified
      - Helaletidae?, unidentified
    - Carnivora, unidentified

A large, broad-snouted *Alligator* is the only crocodylian. It approaches the size of the extant North American *Alligator*. Fish remains are present, but not common. The ray is unusual and clearly new, but its relationships are obscure. It could bear some relationship to the only genus of freshwater ray known from the Eocene of the Western Interior, *Heliobatis*; however, the strong, paired prong-like cusps are unlike anything seen in *Heliobatis*.

Very small rodent teeth are the most common mammalian element produced by screenwashing. The recov-

ered eomyids include *Protadjidaumo* sp. which is only known from the Uintan or Duchesnean; *Metanoiamys* sp., cf. *M. lacus*, a taxon known from the Duchesnean of Saskatchewan, Canada; *Paradjidaumo* sp., cf. *P. alberti* known from near the Duchesnean-Chadronian boundary of British Columbia; and an undescribed species of *Litoyoderimys* more primitive than known Chadronian species. An undescribed genus of heliscomyid is present that is more primitive than the Chadronian genus *Heliscomys*. The possible geomyid *Griphomys alecer* is known from the Uintan and Duchesnean of California (Chiment and Korth, 1996).

Two anthracotheriid artiodactyls are present. The more common is a large, medium-crowned species that is probably best assigned to *Aepinacodon*. Until further preparation is completed, it is not possible to determine whether these fossils represent a new species of the genus. A second genus, *Heptacodon*, is represented by a single poorly preserved maxilla.

AGE AND BIOSTRATIGRAPHIC RELATIONSHIPS

The age of the vertebrate fauna can be constrained from several lines of evidence. Charophytes from the variegated unit (based on comparisons with European charophyte zonations) suggest a lower Paleocene to middle Eocene age (Feist and others, 1997). A lower limit for the age of the vertebrate fauna can be obtained from the late Paleocene to early Eocene age for the underlying Claron Formation. An upper limit can be derived based on K/Ar dates from the overlying volcaniclastics. These dates, from presumably coeval rocks to the west, range from 32 to 34 million years ago (Sable and Maldonado, 1997) and those from the top of the type section of the Brian Head Formation range from 29 to 32 million years ago (Rowley and others, 1994). Based on a revised age for the Eocene-Oligocene boundary of approximately 33.5 million years ago (Berggren and others, 1995), the volcaniclastic unit of the upper part of the "Brian Head Formation" is latest Eocene to earliest Oligocene in age. Although the K/Ar dates provide a broad upper boundary for the age of the vertebrate fauna, their utility for dating the fauna itself is limited. The variegated unit does not occur in either of the sections for which K/Ar dates are available, nor is the stratigraphic correlation between the volcaniclastic rocks of the Markagunt and Sevier Plateaus clear. However, these varying lines of evidence (age range of underlying rocks and overlying rocks, age range of charophytes) are consistent with a middle to late Eocene age for the vertebrate fauna of the variegated unit.

The vertebrate fauna itself provides several biostratigraphic clues. Many of the chelonian taxa (for example, *Echmatemys, Plastomenus, Baptemys*) range throughout most of the Eocene, but are not definitely known in the Chadronian. Morphologically, most of the species found in the Turtle Basin local fauna are derived with respect to Uintan members of these genera. None of the distinctive Chadronian emydids are present (Hutchison, 1996). Another, *Apalone*, is more typically known from the Chadronian, and the chelydrid is more derived than other known members in the Eocene. The chelonians strongly suggest a post-Uintan, pre-Chadronian age, that is, the Duchesnean Land Mammal Age

The combination of mammalian taxa also indicates a Duchesnean age. The anthracotheriids, *Heptacodon* and *Aepinacodon*, first appear in North America in the Duchesnean (Storer, 1983; Hanson, 1996) and persist through the early Oligocene (MacDonald, 1956). Unfortunately, anthracotheriid material is rare in the Duchesnean and Chadronian, so adequate comparisons among species cannot be made.

The rodents also strongly support a Duchesnean age. *Metanoiamys* sp., cf. *M. lacus* is known from the Chadronian; *Griphomys acer* and *Ptotadjidaumo* sp. range from the Uintan through the Duchesnean; *Paradjidaumo* sp., cf. *P. alberti* is close to a taxon known from the Duchesnean-Chadronian boundary; and the new species of *Litoyoderimys* and new genus and species of heliscomid are more primitive than Chadronian forms.

Recently, the entire Duchesnean North American Land Mammal Age was shifted into the middle Eocene subepoch and the Chadronian/Duchesnean boundary to be approximately coincident with the middle/late Eocene boundary, based on new data on the magnetostratigraphy and radiometric ages of critical vertebrate-bearing stratigraphic sections (Prothero, 1995). An assignment of the Turtle Basin local fauna to the Duchesnean would thus be consistent with the limited charophyte data as well as the morphology and ranges of the vertebrate taxa.

SUMMARY

The vertebrate fauna recovered from low in the "Brian Head Formation" on the Sevier Plateau, south-central Utah, the Turtle Basin local fauna, suggests lacustrine paleoenvironments developed locally during the Duchesnean (end of the middle Eocene). The fauna is dominated by aquatic taxa such as turtles, alligatorids, and fish in association with charophytes, ostracodes, and gastropods. The Turtle Basin local fauna represents an unusual association of taxa both from chronologic, geographic, and paleoecologic perspectives.

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