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HERPETOFAUNA OF LATE MIOCENE SAPPA CREEK FAUNA, NORTHWESTERN KANSAS

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ABSTRACT

A diverse herpetofauna from the Clarendonian to Hemphillian Sappa Creek local fauna, Kansas, is described. The occurrence of biostratigraphically diagnostic amphibians and reptiles from the Clarendonian part of the sequence support the earlier age determination based on mammalian species. The earliest occurrence of the rattlesnake *Crotalus* is reported from the lower part of the Clarendonian section. Composition of the herpetofauna suggests a paleoenvironment with a warm, dry climate with at least seasonal surface water available.

INTRODUCTION

The rocks exposed along Sappa Creek in northwestern Kansas have yielded numerous fossil mammals (Korth, 2004; Korth and Baskin, 2009). The stratigraphic section spans the boundary between the Clarendonian and Hemphillian land mammal ages, ranging from approximately 9.5 to 9.0 mya (Korth, 2004). Although much less common, several specimens of amphibians and reptiles have been collected from the same quarries. Screenwashing of microvertebrates has yielded very few micromammals, but has produced all of the elements of the herpetofauna except the large land tortoises. The specimens described below have been collected from the previously reported fossil quarries in Decatur and Rawlins counties, Kansas (Korth, 2004). The early Hemphillian quarries that have yielded the reptile and amphibian specimens described below are Anderson Quarries #1 and #2, and the late Clarendonian quarries are Katy's Quarry, Mumm Quarry and Yoos Quarry (see Korth, 2004).

Sappa Creek specimens described herein reside at the Carnegie Museum of Natural History (CM), Pittsburgh. Taxonomy for extant genera and species follows Crother (2008), and general geographic ranges of extant taxa follow Conant and Collins (1998). Measurements (in millimeters) were made with an optical micrometer calibrated in a binocular microscope at 9X magnification.

SYSTEMATIC PALEONTOLOGY

Class Amphibia Linneaus, 1758
Order Caudata Oppel, 1811
Family Ambystomatidae Hallowell, 1856
Ambystoma Tschudi, 1838
Ambystoma maculatum (Shaw, 1802)
(Figure 1A, B)

Specimens—CM 76280 - trunk vertebra; CM 76281- trunk vertebra.

Locality—Mumm Quarry

Comments—Tihen (1958) devised ratios of linear vertebral measurements to distinguish among morphological groups within *Ambystoma.* As the ranges of ratios overlap between groups, large sample sizes and corroboration with additional morphologic features are prudent in assigning fossil specimens. The Mumm vertebral ratios are 2.0/1.5 (CM76280) and 2.2/1.4 (CM76281). The former plots within the published *A. opacum* and *A. tigrinum* ranges, the latter just within the *A. maculatum* range, but also within *A. opacum* and *A. tigrinum*. Holman (2006:142) considered the combination of upswept posterior neural arch and large to very large size of trunk vertebrae "essential" for assignment to the *A. tigrinum*-group. *Ambystoma opacum*-group trunk vertebrae also exhibit somewhat upswept posterior arches, but are smaller than *A. tigrinum* (Holman, 2006). The Mumm specimens are relatively large (4.4, 4.9 mm centrum length), but do not exhibit pronounced upsweep of the

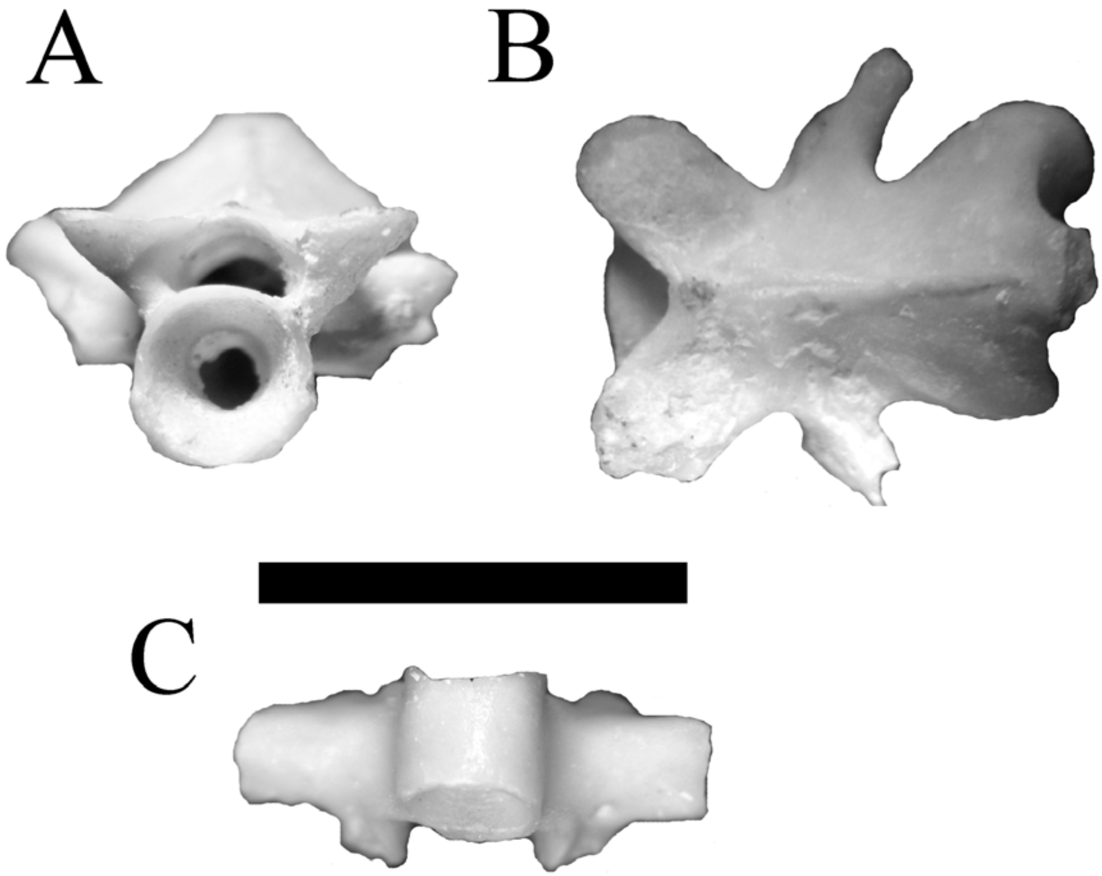

FIGURE 1. Vertebrae of *Ambystoma maculatum* and indeterminate Pelobatid. A, B, *A. maculatum*, CM 76280, trunk vertebra. A, anterior view. B, dorsal view. C, ?Pelobatidae, genus and species indeterminate, CM 83047, vertebral centrum (ventral view). Bar scale = 5 mm.

neural arch, aligning them with the *A. maculatum*-group. As the two vertebrae are much larger than other members of *A. maculatum*-group, including the Clarendonian-Hemphillian species *A. minshalli* Tihen and Chantell, we assign them to *A. maculatum*. This extant species has also been recorded from the Clarendonian WaKeeney local fauna of nearby Trego County, Kansas (Holman, 1975). *A. priscum* Holman, of the medial Barstovian of Nebraska (Holman, 1987), is larger than *A. maculatum* from Sappa Creek, but does not compare favorably in Tihen's ratios. Present western range limit of *A. maculatum* is approximately 500 km east of the fossil locality.

Ambystoma sp. indet.

Specimens—CM 76284 - R humerus, distal fragment; CM 76289 – vertebral centrum.

Locality—Mumm quarry

Comments—These two specimens are not sufficiently complete for specific assignment.

Order Anura Rafinesque, 1815
Family Pelobatidae Bonaparte, 1850
?Pelobatidae, genus and species indeterminate
(Figure 1C)

Specimen—CM 83047—vertebral centrum [centrum width = 1.8mm, centrum length = 2.0 mm], missing neural arch, right prezygopophysis, postzygopophyses, and distal transverse processes.

Locality—Mumm quarry

Comments—The vertebra is biconcave, characteristic of the third presacral of North American adult microhylids (Holman, 2006:184). However, this specimen is much larger than modern *Gastrophryne*, and the transverse processes leave the centrum laterally, not with a dorsally angled orientation. It most closely matches *Scaphiopus* or *Spea* and may represent a late-juvenile individual based on size.

Anura, indeterminate

Specimen—CM 76291—right tibiofibula fragment, central shaft with distal portion.

Locality—Mumm quarry.

Comments—This bone is not sufficiently complete for further identification. Additional collecting from the Sappa Creek localities may produce anuran material identifiable to genus or species level. All extant frog families of the Great Plains are known to have occurred in the region during the Clarendonian/Hemphillian interval (Holman 2006; Parmley et al., 2010).

Class Reptilia Laurenti, 1768
Order Testudines Batsch, 1788
Family Testudinidae Gray, 1825
Hesperotestudo sp. indet. (large)

Specimens—CM 76171 – medial pleural fragment; CM 76207 – limb element fragment; CM 73521 – limb element fragment.

Locality—Anderson #1 quarry.

Specimens—CM 76163 – 2nd right costal fragment, CM76164 – 3rd neural, CM 76165 – posterior costal fragment, CM 76166 – left peripheral medial fragment, CM 76167 – costal fragment, 76168 - left peripheral medial fragment, CM 76169 - costal fragment, CM 76218 – left scapula with both articular ends missing, CM 70378 - small indeterminate shell fragment.

Locality—Mumm Quarry

Hesperotestudo sp. indet. (small)

Specimen—CM 76170 – pleural fragment.

Locality—Katy's quarry

Comments—Holman (1975:59) reported *Geochelone* (=*Hesperotestudo*) *orthopygia* (Cope), a large-shelled land tortoise, and a second, smaller testudinid species represented by indeterminate material, from the WaKeeney local fauna. Wild Horse Creek #1, a Clarendonian-Hemphillian local fauna from Oklahoma, has also yielded large and small testudinid morphs (Czaplewski et al., 2001). Although none of the Sappa Creek quarries have yet produced sufficient material for specific identifications, the Anderson #1 and Mumm animals (large morph) were much larger than the Katy's tortoise.

Testudinidae, gen. et sp. indet.
(Figure 2C)

Specimens—CM 76172 – entoplastron; CM 83048 – L ulna.

Locality—Mumm Quarry.

Comments—Relatively small size and particularly the scute pattern make assignment of the entoplastron equivocal between *Gopherus* and *Hesperotestudo* respectively, based on comparisons with modern and fossil material. A small individual of the former or juvenile of the latter could be represented. The ulna is also equivocal based on size, but is morphologically distinct from non-testudinid turtles. Tortoise material is almost ubiquitous among Great Plains Tertiary local faunas.

Testudines indet.

Specimen—CM 70379 - plastral fragment.

Locality—Yoos quarry

Comments—This bone is not sufficiently complete for further identification, but likely is a testudinid or emydid turtle.

Order Sauria McCartney, 1802
Family Teiidae Cope, 1871
Aspidoscelis Fitzinger, 1843
Aspidoscelis sp. indet.
(Figure 2A, B)

Specimens—CM 76273 – trunk vertebra, CM 76275 – trunk vertebra, CM 76278 – right dentary, CM 76279 – left dentary, CM 76282 – trunk vertebra, CM 76285 – left tibia, CM 76286 – left humerus, CM 76287 – left femur.

Locality—Mumm Quarry

Comments—The material compares favorably with modern *Aspidoscelis*, but we are unable to assign it confidently to any one of the many species of *Aspidoscelis* including *A. bilobatus* (Taylor). Holman (1975) reports *Aspidoscelis* (as *Cnemidophorus*) cf. *A. sexlineatus* (Linneaus) from the WaKeeney local fauna.

Order Serpentes Linneaus, 1758
Family Colubridae Oppel, 1811
Subfamily Xenodontinae Cope, 1893
Heterodon Latreille *in* Sonnini and Latreille, 1801
or *Paleoheterodon* Holman, 1964
(Figure 3)

Specimen—CM 76274 – trunk vertebra.

Locality—Mumm Quarry

Comments—"The fact that subtle vertebral differences between genera of snakes such as

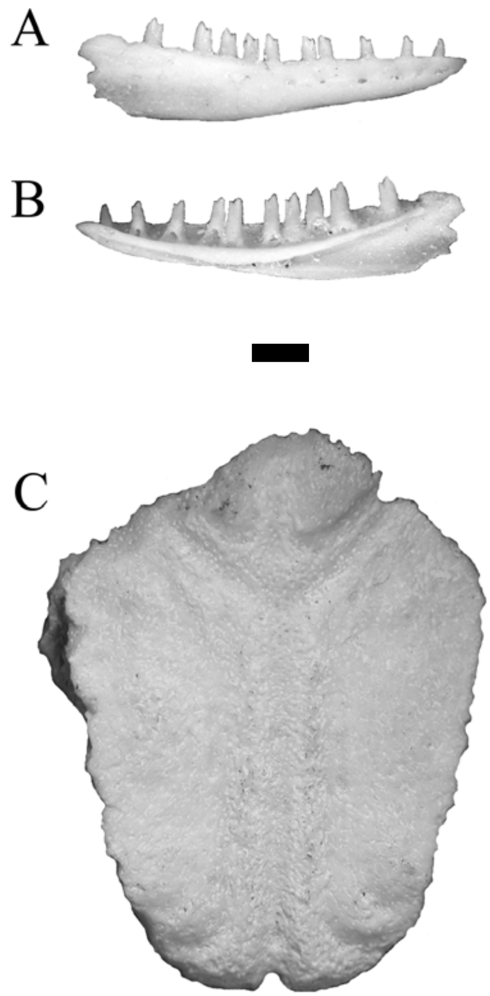

FIGURE 2. *Aspidoscelis* and undetermined testudinid. A, B, *Aspidoscelis* sp. indet., CM 76278, right dentary. A, lateral view. B, medial view. C, Testudinidae, gen. and sp. undet. CM 76172 , entoplastron (ventral view). Bar scale = 1 mm.

Paleoheterodon and *Heterodon* may be accompanied by very marked differences in their individual skull bones is provocative" (Holman, 2000:133). This single vertebra is an insufficient sample to attempt generic identity. A larger sample from Sappa Creek may offer insight into the *Heterodon/Paleoheterodon* lineage, as there is a temporal, but not spatial, overlap between the two genera in the Hemphillian record. Parmley and Hunter (2010) noted that there was no morphological difference between the trunk vertebrae of *Paleoheterodon* and *Heterodon,* thus making a generic distinction on the Kansas material impossible.

Xenodontinae, gen. et sp. indet.

Specimen—CM 76276 – trunk vertebra.
Locality—Mumm Quarry
Comments—A very small xenodontine featuring low neural arch and a (damaged) neural spine that was apparently very long and low. It does not compare favorably with known North American Late Miocene diminutive xenodontines, such as *Diadophis*, or with other Neogene or modern xenodontines from the Great Plains. It may represent a previously unknown genus.

Colubridae, gen. and sp. indet.
(Figure 4)

Specimen—CM 73519 – trunk vertebra.
Locality—Katy's Quarry
Comments—This specimen is from a juvenile individual, suggestive of a lampropeltine.

Colubridae, genus and species indeterminate

Specimen—CM 76277 – trunk vertebra in three fragments.
Locality—Anderson Quarry #2
Comments—Representing a very small snake, the specimen is not sufficiently complete for further identification.

Family Viperidae Oppel, 1811
Subfamily Crotalinae Oppel, 1811
Crotalus Linneaus, 1758
Crotalus sp. indet.
(Figure 5)

Specimen—CM 76272 – trunk vertebra.
Locality—Yoos Quarry
Comments—This vertebra has multiple paracotylar foramina, characteristic of *Crotalus*, but not *Agkistrodon* or *Sistrurus*. Neural spine and zygosphenes are not complete enough to indicate species identity. Holman (2000) and Parmley and Holman (2007) recognized *Crotalus* from the middle and late Hemphillian, and Parmley and Hunter (2010:539) questionably referred two trunk vertebrae to "cf. *Crotalus* sp. indet." from the late Clarendonian. The Yoos Quarry specimen is the oldest definite reported *Crotalus*.

DISCUSSION

Mammalian biostratigraphy indicates that the Clarendonian-Hemphillian transition is represented within the sequence of quarries in the North and Middle Fork of the Sappa Creek sections (Korth,

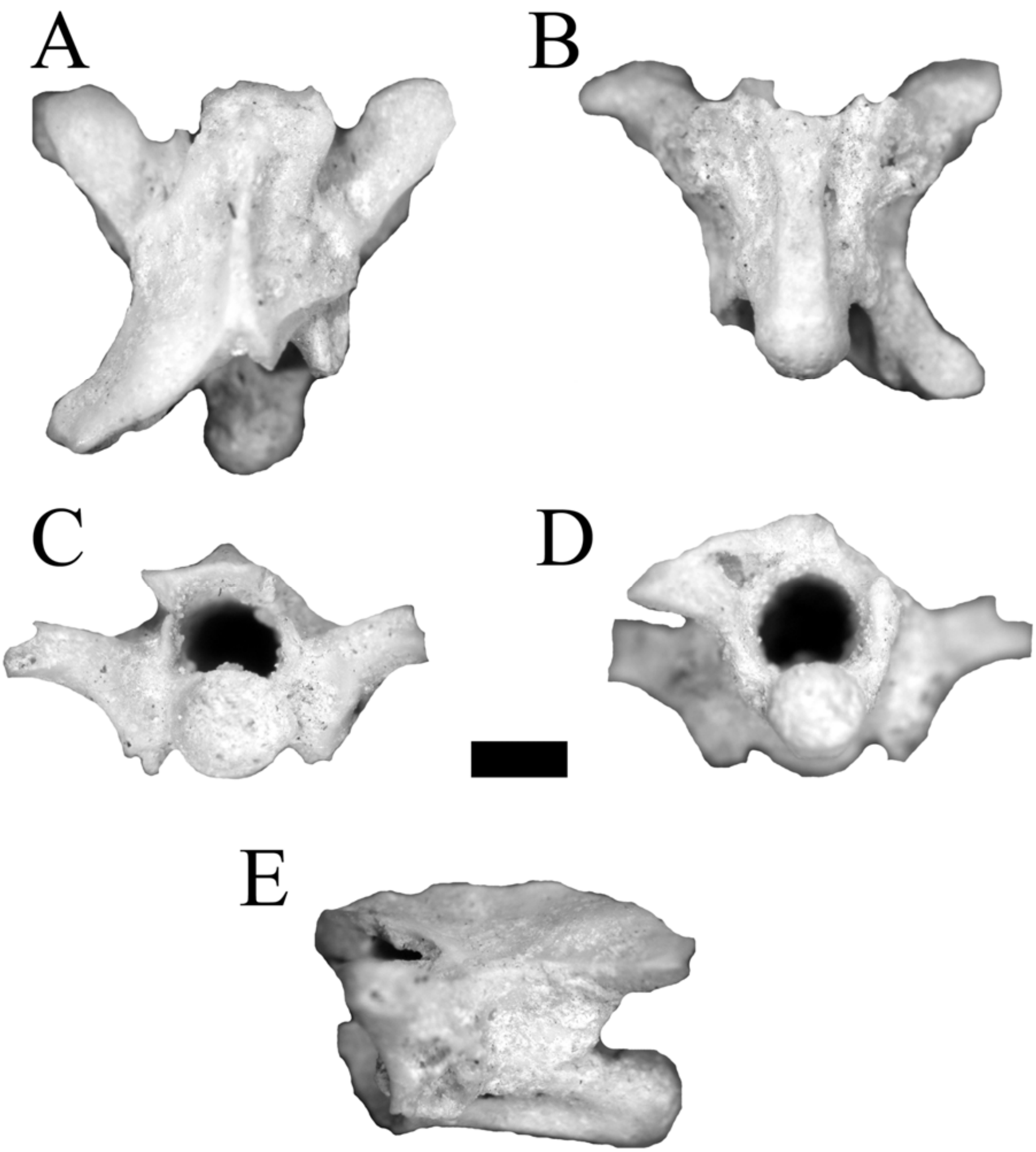

FIGURE 3. *Heterodon* or *Paleoheterodon*, CM 76274, trunk vertebra. A, Dorsal view. B, ventral view. C, anterior view. D, posterior view. E, left lateral view. Bar scale = 1 mm.

2004). Taxonomically and potentially biostratigraphically diagnostic amphibian and reptile fossils have been recovered from the Clarendonian part of the sequence (Mumm and Yoos quarries) and are consistent with this assignment (Table 1). No early Miocene (*sensu* Holman, 2000) faunal elements have been recovered. Larger samples of several known taxa (especially xenodontine snakes and *Hesperotestudo* tortoises) may contribute to understanding of those

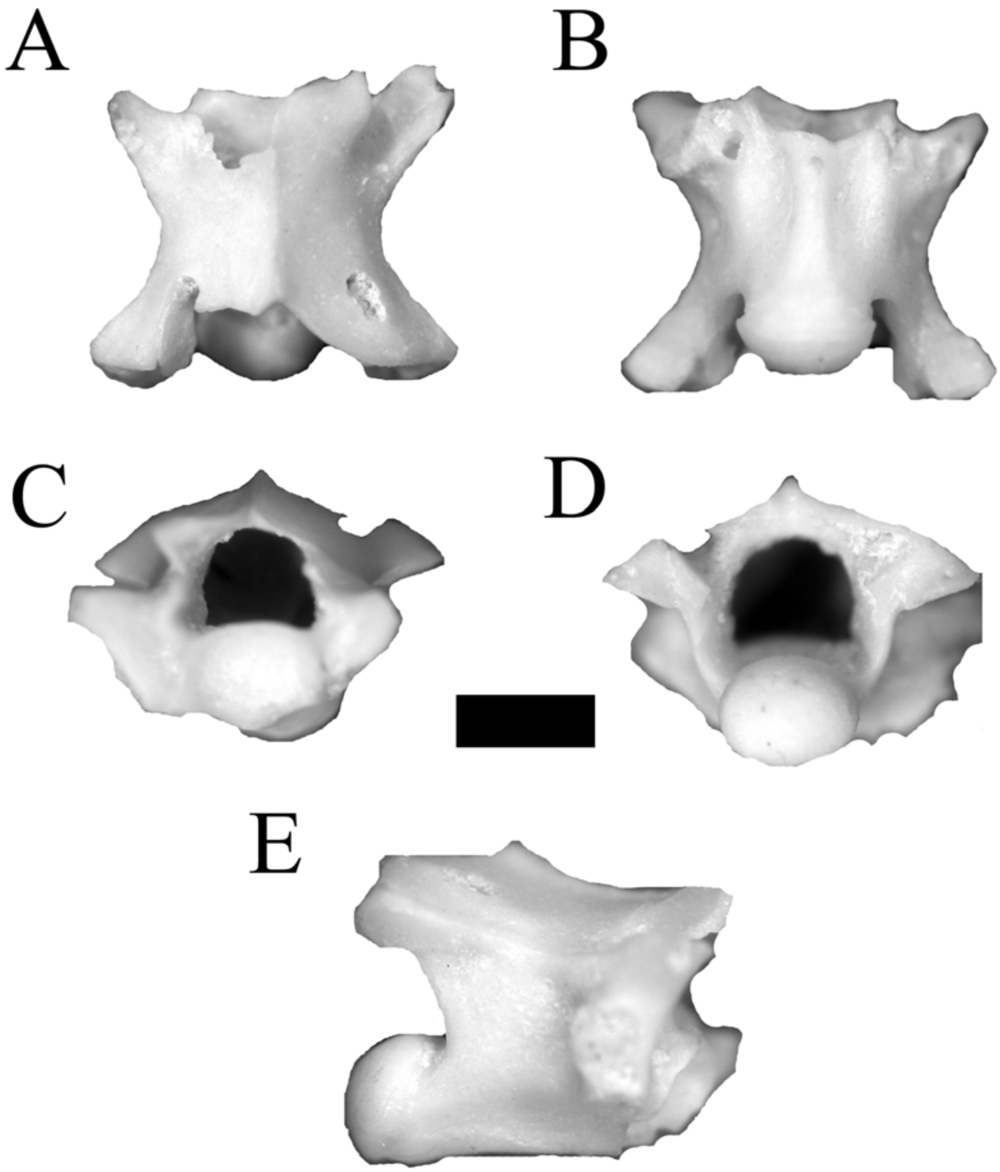

FIGURE 4. Colubridae, gen. and sp. indet., CM 73519, trunk vertebra. A, Dorsal view. B, ventral view. C, anterior view. D, posterior view. E, right lateral view. Bar scale = 1 mm.

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lineages, as well as further refining placement of Sappa Creek localities within the Great Plains Miocene.

Occurrences of *Crotalus* rattlesnakes have not been previously published from localities older than the middle to late Hemphillian of Nebraska (Holman, 2000; Parmley and Holman, 2007), indicating that the Yoos quarry specimen is the oldest known record of the genus.

Although only a few distinctly identifiable forms are represented in the known Sappa Creek samples, some ecological parameters can be suggested. The presence of a large *Hesperotestudo* morph limits paleoenvironmental temperature reconstruction to no lower than 0˚C because, unlike smaller tortoises and turtles, this large tortoise could not burrow to escape adverse conditions (Hibbard, 1960). The modern

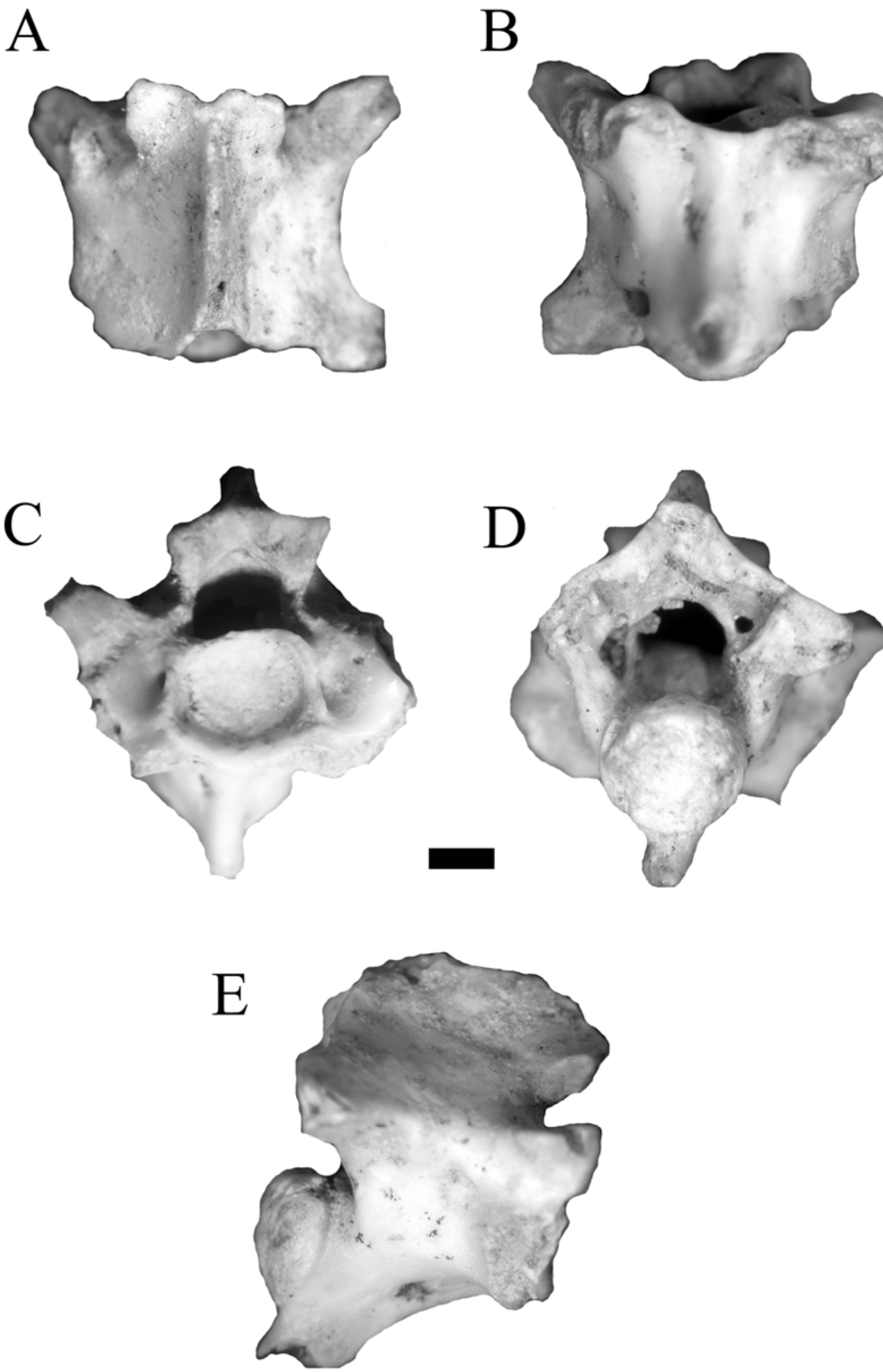

FIGURE 5. *Crotalus* sp. indet., CM 76272, trunk vertebra. A, Dorsal view. B, ventral view. C, anterior view. D, posterior view. E, right lateral view. Bar scale = 1 mm.

representatives of other reptiles identified to genus or species prefer grassy *(?Heterodon)* to semi-xeric habitats. Kansas *Aspidoscelis* have temperature optimums approaching 34˚C (Collins, 1982:160). No obligate aquatic taxa have been recognized, but the amphibians required seasonal surface water for egg-laying.

TABLE 1. Herpetofauna from Sappa Creek local fauna by quarries (arranged in chronological order).

Hemphillian Quarries

Anderson # 2
- Colubridae gen. et. sp. indet.

Anderson #1
- *Hesperotestudo,* sp. indet.

Clarendonian Quarries

Katy's
- *Hesperotestudo,* sp. indet. [small]
- Colubridae gen. et. sp. indet.

Mumm
- *Hesperotestudo,* sp. indet.
  - Testudinidae
  - *Aspidoscelis* sp. indet.
  - ?*Heterodon* or *Paleoheterodon*
  - Xenodontinae, gen. et. sp. indet.
  - *Ambystoma maculatum*
  - *Ambystoma* sp. indet.
  - Anura
  - Anura, ?Pelobatidae

Yoos
- Testudines
- *Crotalus,* sp. indet.

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