Nonmarine Ostracoda from the Eocene Florissant Formation, Colorado, USA

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Introduction

The upper Eocene Florissant Formation at Florissant Fossil Beds National Monument has yielded many fossils of plants, insects, mammals, and fish (Evanoff et al. 2001). A description of ostracodes was first documented without illustration by Cockerell (1910). This study aims to illustrate the taxa present, report their stratigraphic ranges, and discuss the paleoecological implications as it relates to the geologic history of this historically significant fossil site.

Geologic Setting and Material

The lacustrine deposits of the Florissant Formation originated from the periodic eruption of the Guffey stratovolcano, located in the Thirtynine Mile volcanic field 30 km southwest of the formation (Figure 2). Lahars dammed the former stream valley to form the lake. The deposition of ash and weathered smectite clay in the lake triggered a cycle of diatom blooms, resulting in the deposition of paper shale. The formation includes the following informal units: lower shale, lower mudstone, middle shale, caprock conglomerate, upper shale, and upper pumice conglomerate (Figure 3). Pumice sediments were radiometrically dated to an age of 34.07 ± 0.10 MYA, placing the formation at the cusp of the Eocene-Oligocene boundary (Evanoff et al. 2001). The specimens reported here were collected from the upper shale unit of the formation. Samples show early diagenetic silicification, with little to none of the original calcite remaining. Ostracodes comprise internal and external molds and casts recovered from bedding planes.

Figure 1: Caddisfly larval case comprised of ostracodes. *Cypris florissantensis* (Ostracoda) and *Indusia cypridis* (Trichoptera) holotype described by Cockerell (1910).

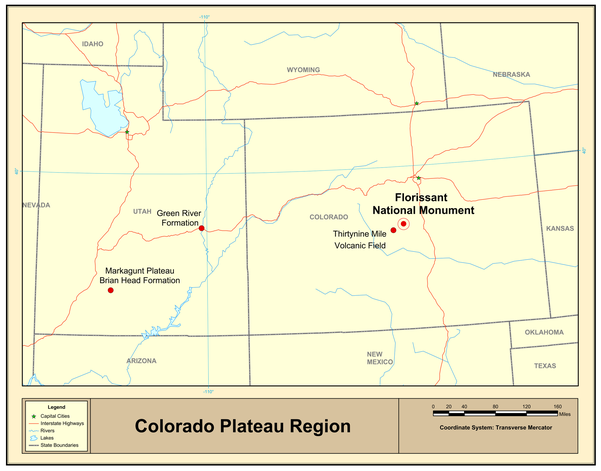

Figure 2: Map of the Florissant Formation in relation to surrounding coeval Green River and Brian Head Formations, and the nearby Thirtynine Mile Volcanic Field.

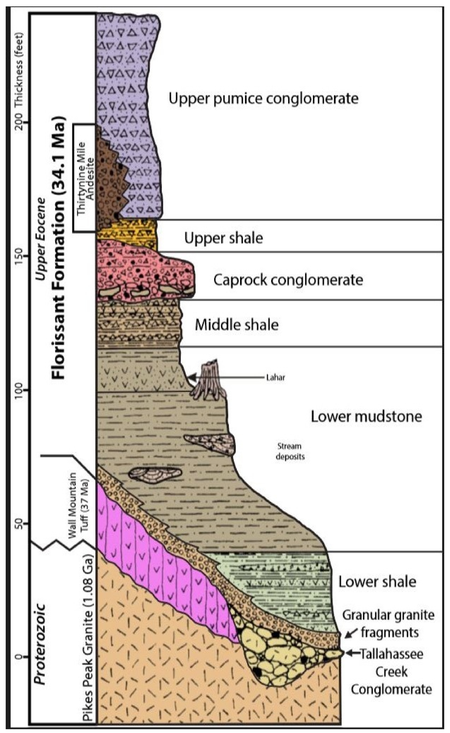

Figure 3: Stratigraphy of the Florissant Formation (modified from Evanoff et al. 2001). Ostracodes have been reported from both the lower and upper shale units.

Figure 4: The 2015 excavation trench. Ostracode-bearing samples were recovered from the highlighted shale bed. Mosaics in Science intern D. Desai is shown excavating specimens on the right side of the trench.

Methods

A minor excavation from clay-rich shale and mudstone was conducted near the locality from which the original type material was collected. Exceptional specimens were disaggregated and the preserved ostracodes were sieved following the methods of Medley et al. (2008). A variable-pressure scanning electron microscope (Hitachi S-3400N) was used to capture images of the ostracodes. The size and shape of the carapace, adductor muscle scars, and duplicature were subsequently evaluated.

Taxonomic Notes

Heterocypris florissantensis (Cockerell 1910): This species is a moderate sized, equivalved ostracode with sub-ovate outline, broadly rounded posterior, narrowly rounded anterior, convex ventral margin, and arched dorsal margin (Figure 5A-C). The inner duplicature is narrow throughout. Adductor muscle scars on the internal mold are characterized by a central aggregate of a five stigmata that are obliquely oriented to the lateral extremities.

Candona artesensis (Swain 1964): This is a moderate sized Candonidae with the diagnostic reniform lateral outline, concave ventral margin, prominent slope on the anterior dorsal margin, and an acuminate posterior (Figure 5D-E). The internal molds reveal an impression of the calcified inner lamella that is widest in the position of the posterior and anterior ventral margin.

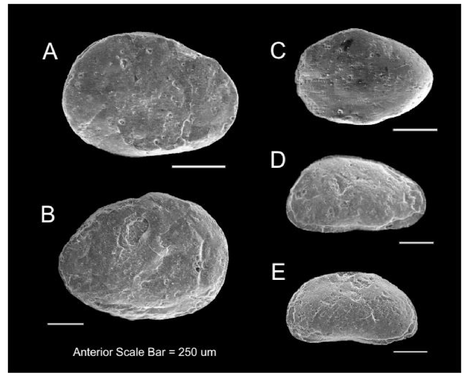

Figure 5: (A-C) *Heterocypris florissantensis*; (C, E) *Candona artesensis.*

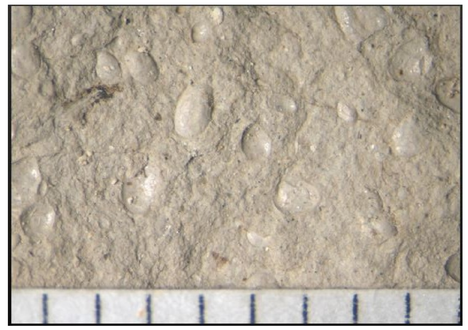

Figure 6: Ostracodes along the bedding plane. The range of instars present, particularly those of the cypridid *Heterocypris,* suggests an *in situ* biocoenosis.

Discussion

Based on the internal and external features of the ostracodes described herein, our study validates the original species designation of Cockerell; however, we recommend it be reassigned to the more fitting genus *Heterocypris* (Tibert et al., in review). This genus as well as *Candona* have been reported from nearby deposits: the early Eocene Colton and Green River formations (Swain 1964) and the middle Eocene Brian Head Formation (Eaton et al. 2011; Tibert et al., in review). Ostracodes have been reported from the Florissant Formation's upper and lower shale units. Their presence in the upper shale implies a period of ecological recovery after the deposition of volcanic lahars in the lake manifested in the formation as the caprock conglomerate. Re-colonization of the lake may have occurred through transport *via* regional birds or other vertebrates, a dispersal mechanism seen in modern ostracodes. The high abundance and low diversity of the ostracodes implies variable water quality, in which only opportunistic taxa could colonize and populate (Tibert and Scott 1999). On the basis of the dominant presence within the upper shale unit and the range of instars, *Heterocypris* is well suited for advanced paleoecological studies.

Acknowledgements

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