KECK GEOLOGY CONSORTIUM

PROCEEDINGS OF THE TWENTY-SECOND ANNUAL KECK RESEARCH SYMPOSIUM IN GEOLOGY

April 2009
Franklin & Marshall College, Lancaster PA.

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2008-2009 PROJECTS

THE BLACK LAKE SHEAR ZONE: A POSSIBLE TERRANE BOUNDARY IN THE ADIRONDACK LOWLANDS (GRENVILLE PROVINCE, NEW YORK)
Faculty: *WILLIAM H. PECK*, *BRUCE W. SELLECK* and *MARTIN S. WONG*: Colgate University
Students: *JOE CATALANO*: Union College; *ISIS FUKAI*: Oberlin College; *STEVEN HOCHMAN*: Pomona College; *JOSHUA T. MAURER*: Mt Union College; *ROBERT NOWAK*: The College of Wooster; *SEAN REGAN*: St. Lawrence University; *ASHLEY RUSSELL*: University of North Dakota; *ANDREW G. STOCKER*: Claremont McKenna College; *CELINA N. WILL*: Mount Holyoke College

PALEOECOLOGY & PALEOENVIRONMENT OF EARLY TERTIARY ALASKAN FORESTS, MATANUSKA VALLEY, AL.
Faculty: *DAVID SUNDERLIN*: Lafayette College, *CHRISTOPHER J. WILLIAMS*: Franklin & Marshall College
Students: *GARRISON LOOPE*: Oberlin College; *DOUGLAS MERKERT*: Union College; *JOHN LINDEN NEFF*: Amherst College; *NANCY PARKER*: Lafayette College; *KYLE TROSTLE*: Franklin & Marshall College; *BEVERLY WALKER*: Colgate University

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Students: *LAUREN D. ANDERSON*: Lehigh University; *STEFANIE GUGOLZ*: Beloit College; *HENRY E. KERNAN*: Williams College; *ADRIENNE LOVE*: Trinity University; *KAREN TEKVERK*: Haverford College

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Students: *AVERY R. COTA*: Minnesota State University Moorhead; *JANE DIDALEUSKY*: Smith College; *ROWAN HILL*: Colorado College; *ANNA PENDLEY*: Washington and Lee University; *MAIJA SIPOLA*: Carleton College; *STACEY SOSENKO*: Franklin and Marshall College

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BLOCK ISLAND, RI: A MICROCOSM FOR THE STUDY OF ANTHROPOGENIC & NATURAL ENVIRONMENTAL CHANGE
Faculty: *JOHAN C. VAREKAMP*: Wesleyan University and *ELLEN THOMAS*: Yale University & Wesleyan University
Students: *ALANA BARTOLAI*: Macalester College; *EMMA KRAVET and CONOR VEENEMAN*: Wesleyan University; *RACHEL NEURATH*: Smith College; *JESSICA SCHEICK*: Bryn Mawr College; *DAVID JAKIM*: SUNY.

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Keck Geology Consortium: Projects 2008-2009
Short Contributions – Alaska

PALEOECOLOGY AND PALEOENVIRONMENT OF EARLY TERTIARY ALASKAN FORESTS, MATANUSKA VALLEY, ALASKA

Project Faculty: ***DAVID SUNDERLIN***: Lafayette College
Project Faculty: ***CHRISTOPHER J. WILLIAMS***: Franklin & Marshall College

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GARRISON LOOPE**:** Oberlin College
Research Advisor: Dennis Hubbard

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Research Advisor: J.I. Garver

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NANCY PARKER**:** Lafayette College
Research Advisor: David Sunderlin

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KYLE TROSTLE: Franklin and Marshall College
Research Advisor: Christopher J. Williams

GASTROPOD ASSEMBLAGES FROM THE TERTIARY CHICKALOON FORMATION IN SOUTHERN ALASKA

BEVERLY WALKER**:** Colgate University
Research Advisor: Connie Soja

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GASTROPOD ASSEMBLAGES FROM THE TERTIARY CHICKALOON FORMATION IN SOUTHERN ALASKA

BEVERLY WALKER: Colgate University
Research Advisor: Connie Soja

INTRODUCTION

Gastropod (snail) specimens were collected from the 55-million-year-old Chickaloon Formation in southern Alaska. The Chickaloon has a great abundance of well preserved fossils (Wolfe, et al., 1966), but no in-depth analysis of the floral and faunal paleoecology. This portion of the project focused on determining paleoecological conditions associated with the assemblage of fossilized snail shells. The assemblage I studied contains members of the genera *Campeloma* and *Bellamya* as well as a group of unidentifiable snails. The modern relatives of these fossilized genera are detritivores and bacterial feeders (Dillon and Jokinen, 1992). Together with the abundance of tree, plant, and flower fossils it was determined that the area was heavily vegetated. The fossilized opercula preserved in localized concentrations suggest that the freshwater environment had moving water. Thin sections show evidence of burrowing organisms and fine sediments that could have been found in a fluvi-lacustrine system.

METHODS

Fossiliferous beds of the Chickaloon were located by the presence of fossils in the float below the actual bed. The specimens were collected from shale beds surrounded by sandstones. There were three primary beds that contained fossilized gastropods and assumed opercula. The stratigraphically lowest bed had three localities that contained the greatest abundance of specimens.

All gastropod specimens found at the outcrop were brought back to Colgate University for analysis. At Colgate all specimens were catalogued and labeled. Each specimen was prepared, to reveal the morphological details. A combination of dental tools, a micro-abrasion drill and a hydraulic press were used in the preparation of the specimens. The specimens were divided into three snail groupings based on similar morphological features, size and shape. A fourth group of small orange ovals was determined to be possible snail opercula. A review of the literature was used to identify the shells and opercula (Hanna and Hertlein, 1938; Moore et al., 1960; Shimer and Shrock, 1980; Boardman, et al., 1987; Dillon; Jokinen, 1992; Kipp and Benson, 1992; Pierce and Constenius, 2001; Thorp and Covich, 2001; Trop et al., 2003).

RESULTS

More than 250 samples were examined and characterized, but only 156 specimens contained identifiable material. The morphologies of these Tertiary snail specimens, including size dimensions (Table1), were compared to modern and fossil taxa. Important distinguishing features include the type of spiral ornamentation, number and shape of whorls, growth lines, sutures, handedness, and aperture if visible. The snails are members of the Viviparidae family and belong to the genus *Campeloma* (Figure 1A), genus *Bellamya* (Figure 1B) and an indeterminate taxon. Images of fossil opercula described in the literature were used to positively identify the orange ovals as opercula. Thin sections were examined to analyze the matrix in which the snails were imbedded.

DISCUSSION

Taxonomy

Previous expeditions to the Chickaloon Formation found *Bellamya westoni* (Tozer)?; *Campeloma ed-*

Genus	Height (mm)	Width (mm)	Number of Whorls
Campeloma	8	5	2
	11	9	3
	16	12	3+
	18	10	1+
	18	10	5
	20	12	4
	23	11.5	4
Bellamya	10	15	2
	16	15	3
	13	16	2
	14	16	2
	23	18.5	3
	11	20	2
	10	21	3

Table 1: Summary of snail shell sizes for two most prominent genera.

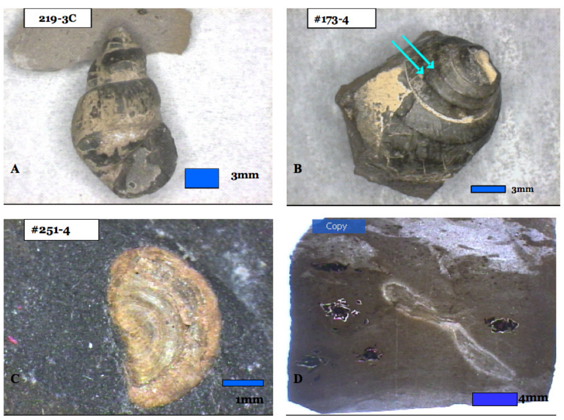

Figure 1. Digital Images showing: A. Genus Campeloma holotype; B. Genus Bellamya holotype; C. Operculum; D. Thin section from most prominent outcrop bed

montonense (Tozer?); and an indeterminate species of snails (Trop et al., 2003). There were few other identifiable specimens found within the formation, but the identified organisms were dated as Cenozoic age. The following sources were used to determine the taxonomy of my snail samples: modern gastropod taxonomic guides, literature on fossilized gastropods, as well as personal communications with Dr. Robert Blodgett, snail specialist at the US Geological Survey in Anchorage, AK, and the Alaska Paleontological Database (www.alaskafossil.org) (Hanna and Hertlein, 1938; Moore et al., 1960; Shimer and Shrock, 1980; Boardman et al., 1987; Jokinen, 1992; Kipp and Benson, 2007; Thorp and Covich, 2001; Trop et al., 2003).

The distinguishing characteristics on the specimens that allowed them to be categorized into the three groups were the type of spiral ornamentation, number and shape of whorls, growth lines, sutures, handedness, and aperture if visible. It was determined that the previously identified genera represent two of the three groups I collected from the Chickaloon Formation.

Systematic Paleontology
Class Gastropoda
Subclass Prosobranchia
Order Mesogastropoda / Architaenioglossa
Family Viviparidae

Genus *Campeloma*

Eighty-nine specimens determined to be the genus *Campeloma*, named by Rasfinesque in 1819, according to Kipp and Benson (2007), have a low to moderate spire, impressed sutures and are dextral (Jokinen, 1992 and Thorp, 2001). The spiral ornamentation intersects the growth lines at right angles creating small raised-protrusions at each intersection (Moore, 1960). These lines and protrusions form cross-hatching that is present across the entire shell. The aperture is a modified oval in shape that tapers towards the apex and has a medial, convex curve on the inner lip. The total height from anterior to posterior ranges approximately from 8 mm to 23 mm (Table1).

Genus *Bellamya (Cipangopaludina)*

Twenty-nine specimens determined to be the genus Bellamya, named by Jousseaume in 1886 according to Robert Dillon, are characterized by a low spire, two keels that are parallel to the sutures and are more distinct on the spire and are less distinct on the body whorl, sutures are impressed or channeled and prosocline growth lines, which intersect the sutures at a 40° angle. These key characteristics distinguish *Bellamya (Cipangopaludina)* from other taxa. This genus is known from the fossil record and has modern species described today in Asian and American literature. Today, *Bellamya* is either unrecognized or considered a sub-genus of *Cipango-*

paludina (Hannibal 1912) in the literature on modern snails in the U.S. (Kipp and Benson, 2007).

Genus Indeterminate

Crushed or incomplete specimens and were unidentifiable. This group is characterized by a large body whorl and distinct growth lines. In the future if more specimens are collected it may be possible to determine their taxonomic identity.

Gastropod Opercula

Twenty-two specimens with small orange and gray calcareous ovals represent fossilized opercula. Only one operculum was found on a gastropod shell but is not in place over the aperture, thus preventing taxonomic identification. Most opercula were found clustered together and were not usually found with gastropods on the same sample.

The opercula and the *Campeloma* aperture have a strikingly similar modified oval shape. According to the fossils described by Boardman et al. (1987), *Viviparus*, a genus also in the *Viviparidae* family, has been found with the operculum covering the aperture. This provides potential evidence that the opercula belonged to *Campeloma*, *Bellamya*, or both, but until an operculum is found over an aperture there is no certainty as to which genus these opercula belong.

Paleoecology

Modern *Campeloma* are known to be detritivores, live under rotting logs and will eat anything animal or vegetable. They are also freshwater burrowers (Jokinen, 1992). Modern *Bellamya (=Cipangopaludina)* are also freshwater snails that live in both rivers and lakes. This genus is known to eat detritus, bacteria, and sludge (Kipp and Benson, 2007). Interestingly, the extant genus *Bellamya (=Cipangopaludina)* is considered native to Japan and an exotic invader in North America (Global Biodiversity Information Facility (GBIF) Data portal which can be found within The Paleobiology Database. My study confirms the fossil record of *Bellamya* in Alaska, which shows that the snails must have died out in North America in the last 55 Myr before their recent reintroduction in the 1890's (Dillon; Wolfe, 1966).

In the Chickaloon Formation strata, *Campeloma* is the dominant species whereas *Bellamya* is present but not in large quantities. Both genera appear to have lived in freshwater, with large amounts of nutrients accessible, as indicated by abundant fossil plant material that co-occurs with these fossil snails. A modern relative of the fossilized genus found in Alaska, *Campeloma decisum*, has a tendency to select upstream areas that are inaccessible by other snails to live and reproduce in (Thorp and Covich, 2001). If the fossil *Campeloma* found in the Chickaloon Formation exhibited the same characteristics, this could be an explanation of why *Campeloma* dominated the snail assemblage that comprised a maximum of three species. However, until future research is conducted the reason for *Campeloma* dominance in the sediments I studied remains speculative.

I found that fossil opercula were often grouped together in what appear to be para-authocthanous assemblages. When placed in a tub of still water, a modern operculum sank directly to the bottom, indicating that opercula do not float. From this information, I hypothesized that if the Chickaloon paleoenvironment was that of a still water area (e.g., lacustrine), the opercula should have been found closer to the snail shells. Because the opercula were found clustered together, it suggests that they were removed from the shells and relocated. Water currents could move the opercula from the snail shell to areas where other opercula were deposited. This suggests that the freshwater area had moving water. An alternative hypothesis is that a predator consumed the snails and deposited the opercula elsewhere. Future research could prove or disprove either hypothesis.

A gastropod specialist, Dr. Robert Blodgett at the U.S. Geological Survey, confirmed that information about Tertiary snails is scarce. One paper on Tertiary freshwater gastropods from Montana describes three snail species from one site and does not state a total number of species or relative diversity (Roth and Emberton, 1994). Another paper stated that there are at least 35 terrestrial and 20 aquatic snail species at one Tertiary site (Pierce and Constenius, 2001). The paucity of literature on Tertiary freshwater gastropods precludes knowing if the Chickaloon site is representative of Tertiary gastropod diversity.

CONCLUSIONS

The overall fossil assemblage of leaves, wood, seeds, cones, flowers, amber, and snails all reinforce the hypothesis that the Chickaloon Formation accumulated in a heavily vegetated environment. The Evan Jones Coal mine is evidence that there was enough fossilized plant material within this formation to turn a profit by mining it. Large coal beds are representative of a great abundance of vegetative material being buried at a faster rate than they can be recycled back into the environment. The carbonized organic material found within the thin sections is evidence that the organic matter was scattered throughout the depositional environment. The high abundance of organic materials suggests the potential for a thriving community that supported detritivores, as well as sludge- and bacteria-eating gastropods. Both *Campeloma* and *Bellamya* are known to live in modern environments where this type of detritus is abundant.

The fossilized opercula were clumped in a way that suggests after detachment from the snail shells the opercula were transported to the same place. This movement could have been caused by moving water or predators. From the thin sections, it is evident the sediments were very fine: *Campeloma*, modern burrower, could have been the one re-working the sediments and creating burrows. Recrystallized snail shells prevented isotopic analysis. Future research or better-preserved specimens may produce information about the paleoclimate of the region.

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