

TABLE 1—Dimensions (in mm) of the type specimens of *Haimea bajasurensis* n. sp.

IGM specimen	Length	Width	Height
5918	*	17.5	10.9
5934	18.0	15.7	11.6
5935	19.7	16.8	13.8
5936	13.7	12.0	9.5
5937	19.5	15.6	13.6

\* Incomplete specimen.

single series of closely spaced, pores alongside each adradial suture; area between adradial sutures widest in vicinity of maximum curvature of ambitus and converging near peristome.

Peristome central, pentagonal, slightly wider than long, slightly depressed; perignathic girdle with five sets of paired small ridges, posterior support (apophyses) the most elevated; periproct inframarginal, opening circular, located approximately 75 percent of distance from center of peristome to posterior margin.

Test covered with small, irregularly arranged tubercles; scrobicules deep with vertical sides; boss large, extending upward as high as surrounding surface of test.

Dimensions of type specimens in Table 1.

*Remarks.*—Out of 137 collected specimens, 49 are totally complete, show no indications of crushing, and are free of matrix. The length-width and length-height relationships of these 49 specimens, which are from the Tepetate Formation at locality 1492, are plotted in Figure 3. There is little variation in the length-width ratio, but there is a fairly wide scatter of points in the length-height ratio. These same patterns have been noted by Kier (1967) for other species of *Haimea*.

In the ambulacral areas beyond the petaloids, the sutures of the primary plates and demiplates are obscured in all the specimens of *Haimea bajasurensis*, and the demiplates cannot be discerned. A single series of pores along the adradial sutures, however, can be readily seen, as on the specimen shown in Figure 2.4 and 2.5. The plate arrangement and sutures of the structures that form the lantern supports also are not discernible.

Approximately half of the specimens of *Haimea bajasurensis* have holes in them like the specimen shown in Figure 2.2 and 2.4. The holes are on the dorsal surface or on the ambitus, but they are never on the ventral surface. These holes were probably drilled by predatory naticid gastropods. Several specimens of unidentifiable naticid gastropods were found at locality 1492.

The new species was compared to all previously known and adequately defined species of *Haimea*. There are 13 of these species, and they are monographed in Kier (1967). The new species is most like *Haimea parvipetala* (Arnold and Clark, 1927, p. 38, Pl. 5, figs. 13–15) from the middle Eocene Yellow Limestone in Jamaica. The new species differs from *H. parvipetala* in the following features: test higher, greatest height and greatest width at apical system rather than anterior to it, petaloids much narrower, petaloid III with two to three (rather than four to seven) more pore-pairs than petaloids II and I, and periproct inframarginal rather than submarginal.

*Haimea bajasurensis* n. sp. is the westernmost and northernmost *Haimea* in the world. Previously, the western limit of this genus was in Cuba and Peru along the 80th parallel west of Greenwich, and its northern limit was in Cuba (Kier, 1967). The presence of *Haimea* in Baja California Sur, Mexico, extends its western limit by 925 km and the northern limit by 100 km. *Haimea bajasurensis* is also the westernmost oligopygoid anywhere in the world. Previously, the only other oligopygoid genus, *Oligopygus*, was reported as far west as southeastern Mexico (Kier, 1967).

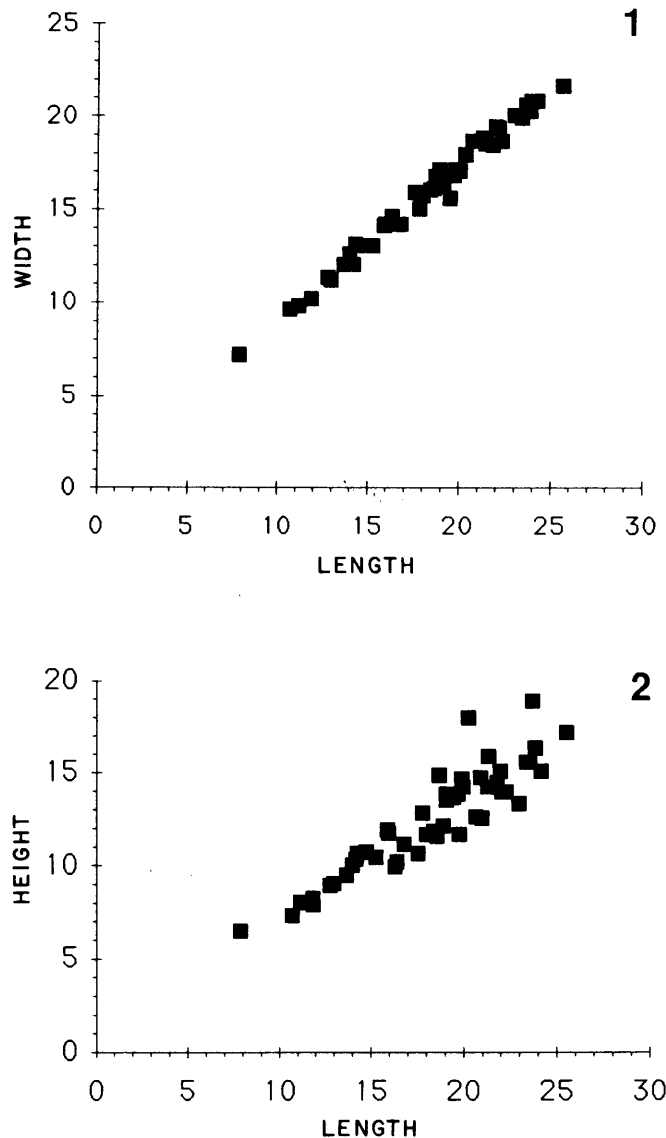


FIGURE 3—Scatter diagrams showing relationships of test dimensions (in mm) of the 49 best preserved specimens of *Haimea bajasurensis* n. sp. from the Tepetate Formation at CSUN loc. 1492. 1, length relative to width; 2, length relative to height.

*Haimea bajasurensis* n. sp. is the earliest known oligopygid species in the world. Previously, the geologic range of *Haimea*, like that of *Oligopygus*, was middle to late Eocene (Kier, 1967).

*Etymology.*—The new species is named for Baja California Sur.

*Material.*—One hundred twenty specimens from the Tepetate Formation; 17 specimens from the Bateque Formation. Paratype, IGM 5918 (formerly hypotype, IGM 5918 in Squires and Demetron, 1992, figs. 135, 136) = plastoparatype, LACMIP 12120; holotype, IGM 5934 = plastoholotype, LACMIP 12121; paratypes, IGM 5935 through 5937 = plastoparatypes, LACMIP 12122 through 12124.

*Occurrence.*—Baja California Sur, Mexico, middle lower Eocene ("Capay Stage"): Bateque Formation, CSUN locs. 1470, 1546, 1547, 1549, and 1550; Tepetate Formation, CSUN loc. 1492 = type locality.

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## APPENDIX

## LOCALITIES

CSUN loc. 1470. 40-m elevation, at base of east-facing canyon wall, southeastern end of Mesa La Azufrera, along west side of Arroyo San Juan de Abajo, about 0.75 km west of dirt road from San José de Gracia to El Datilon, at 112°44'W and 26°29.5'N, coordinates 27.35 and 31.20 of Mexican government topographic quadrangle map (scale 1:50,000), Punta Santo Domingo (number G12A74), Baja California Sur, Mexico, 1982. Bateque Formation. Age: Middle early Eocene ("Capay Stage"). Collectors: R. L. Squires and R. A. Demetron. 1990.

CSUN loc. 1492. Approximately 1.25 km east of Mexico Highway 1 and just north of a dirt road that intersects Mexico Highway 1 at kilometer 74, 140-m elevation on a south-facing cliff face along the north side of a tributary to Arroyo Conejo, at 110°53'50"W and 24°10'N, coordinates 10.75 and 72.55 of Mexican government 1:50,000 topographic quadrangle map, El Conejo (number G12D81), Baja California Sur, Mexico, 1983. Tepetate Formation. Age: Middle early Eocene ("Capay Stage"). Collectors: R. L. Squires and R. A. Demetron, 1991.

CSUN loc. 1546. 120-m elevation, near middle of east-facing cliff along canyon wall, near north end of Mesa La Azufrera, west side of Arroyo La Tortuga in vicinity of abandoned rancho El Cuarenta, 112°53'13"W, 26°38'55"N, coordinates 12.45 and 48.80 of Mexican government 1:50,000 topographic quadrangle map, San José de Gracia (number G12A64), Baja California Sur, Mexico, 1983. Bateque Formation. Age: Middle early Eocene ("Capay Stage"). Collectors: R. L. Squires and R. A. Demetron, 1992.

CSUN loc. 1547. Immediate vicinity of CSUN loc. 1546 and approximately 5 m stratigraphically upsection.

CSUN loc. 1549. 90-m elevation, just west of dirt road, near base of east-facing cliff along canyon wall, northeast side of Mesa La Azufrera, west side of Arroyo La Tortuga, 112°51'45"W, 26°38'30"N, coordinates 14.75 and 48.10 of Mexican government 1:50,000 topographic quadrangle map, San José de Gracia (number G12A64), Baja California Sur,

Mexico, 1983. Bateque Formation. Age: Middle early Eocene ("Capay Stage"). Collectors: R. L. Squires and R. A. Demetrio, 1992.

CSUN loc. 1550. 140-m elevation, just west of dirt road, lower part of east-facing cliff along canyon wall, northeast side of Mesa La Azufra, west side of Arroyo La Tortuga, 112°51'00"W, 26°37'55"N, coordinates

15.95 and 47.05 of Mexican government 1:50,000 topographic quadrangle map, San Jose de Gracia (number G12A64), Baja California Sur, Mexico, 1983. Bateque Formation. Age: Middle early Eocene ("Capay Stage"). Collectors: R. L. Squires and R. A. Demetrio, 1992.

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## UPPERMOST WENLOCK AND LOWER LUDLOW PLECTOGRAPTINE GRAPTOLITES, ARCTIC ISLANDS, CANADA: NEW ISOLATED MATERIAL

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**ABSTRACT**—Beautifully preserved, isolated and uncompressed plectograptine graptolites from the uppermost Wenlock "*Pristiograptus*" *ludensis* Biozone and the lower Ludlow *Lobograptus progenitor* Biozone are described from the Arctic Islands. Described species comprise *Agastograptus robustus* Obut and Zaslavskaya from the *ludensis* and *progenitor* zones; *Agastograptus* sp., *Gothograptus chainos* Lenz, and *Plectograptus* (*Sokolovograptus*?) sp., from the *ludensis* Zone; and *Holoretiolites* (*Balticograptus*) *erraticus* (Eisenack) from the *progenitor* Zone. The dozens of specimens of *A. robustus* from one locality are covered with almost continuous periderm and interthecal tissue, a feature rarely seen in plectograptines.

### INTRODUCTION

**P**LECTOGRAPTINE AND retiolitine (retiolitid) graptolites are particularly well represented and uncommonly well preserved in uncompressed form in graptolite-bearing nodules that occur throughout the Cape Phillips Formation of the central part of the Canadian Arctic Islands (Lenz and Melchin, 1987a, 1987b; Lenz, 1993), and isolated specimens are readily recovered following acid digestion of the nodules. The superb preservation of the retiolitid graptolites, in conjunction with very good stratigraphic control, presents an unparalleled opportunity to better understand these graptolites. A recently completed study of upper Wenlock (Homerian) and lower Ludlow (Gorstian) plectograptines (Lenz, 1993) was a first step in monographing these rich and superbly preserved faunas. Collections subsequently made during the summer of 1991 yielded four species of plectograptines not recovered in the earlier study (Lenz, 1993) and one previously illustrated species that was better preserved. The description of these five species is the purpose of this paper.

The recovery of isolated, uncompressed graptolites is a relatively rare event, but such material contributes much to the understanding of their ontogenetic development and morphology. This is especially true in the case of retiolitid graptolites, which can be morphologically very complex. The relationships between the sicula (if present) and thecal development, the relationship of inner and outer rhabdosomal lists, the nature of the thecae, the distribution of primary and secondary skeletal lists, and whether or not the virgula is part of the skeletal anatomy or is free or attached distally can only be determined in isolated specimens. The great advantage of isolated, uncompressed specimens is that they may be readily viewed and studied in three dimensions, and hence the need for the production and use of scanning electron micrograph stereopairs.

### LOCATION

Two localities were sampled; these are a southern tributary of Abbott River, northwestern Cornwallis Island, and southernmost Baillie Hamilton Island (localities 1 and 2, respectively,

of index map, Figure 1). Locality 1 (75°13.6'N, 95°43'W) comprises two sections, the stratigraphically lower section on the east side of the creek and the higher on the west side, the two being separated by an estimated 2–3-m covered interval. At locality 2 rocks are well exposed along a single, continuous shore section (75°46'N, 94°22'W), only the upper half of which yielded uncompressed graptolites.

### STRATIGRAPHY, BIOSTRATIGRAPHY, AND FAUNAL DISTRIBUTION

The Cape Phillips Formation (Thorsteinsson, 1958) is a graptolite-bearing, basinal-facies unit that is widespread throughout the Arctic Islands. It is well known for the presence of calcareous nodules that yield isolated, uncompressed graptolites, particularly retiolitids (retiolitines and plectograptines) (Lenz and Melchin, 1987a, 1987b; Lenz, 1993). The plectograptines occur in strata ranging in age from late Llandovery through to about mid Ludlow.

Wenlock and Ludlow graptolite biostratigraphy for the Arctic Islands has recently been discussed in Lenz and Melchin (1990, 1991) and Lenz (1990), respectively. Zones relevant to this study are the *Monograptus testis*–*Cyrtograptus lundgreni* Biozone of late Wenlock (early Homerian), the "*Pristiograptus*" *ludensis* Biozone of latest Wenlock (late Homerian), and the *Lobograptus progenitor* Biozone of early Ludlow (Gorstian) age.

Two sections, section 1 (stratigraphically underlying section 2 by about a 2–3-m interval) and section 2, both from locality 1, Abbott River tributary, expose a nearly complete sequence of upper Wenlock to lower Ludlow rocks, only the Wenlock portion of which has yielded uncompressed graptolites.

The faunas of the two localities and their zonal assignments, from younger to older, are as follows (species with asterisks are those described in this study):

Locality 1, section 2 (Abbott River, south tributary)

30 m—"*Pristiograptus*" *ludensis* (Murchison), "*Pr.*" *sherrardae* (Sherwin) (both species flattened and common)