

A NEW SPECIES OF THE CLYPEASTEROID ECHINOID *ASTRODAPSIS* FROM THE MIOCENE ISIDRO FORMATION, BAJA CALIFORNIA SUR, MEXICO

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ABSTRACT—The clypeasteroid echinoid *Astrodapsis bajasurensis* n. sp. is described from upper middle Miocene beds of the Isidro Formation near the mouth of Arroyo Mezquital on the Pacific coast of north-central Baja California Sur, Mexico. The new species is the first occurrence of *Astrodapsis* outside of California and extends the southern limit of the genus by 1,100 km.

INTRODUCTION

SPECIMENS OF the clypeasteroid echinoid *Astrodapsis bajasurensis* n. sp. were found in the Isidro Formation at California State University, Northridge (CSUN) locality 1495 on the south side of Arroyo Mezquital about 13.5 km south of the village of San Juanico on the Pacific Coast (Figure 1). The locality is near the mouth of Arroyo Mezquital and is approximately at 112°21'15"W and 26°13'11"N on the San Isidro, Baja California Sur, Mexico, 1:250,000 quadrangle map (number NG 12-4), issued in 1973 under the authority of the Instituto Panamericano de Geografía e Historia. At this locality, which is just south of the dirt road leading to the village of San Juanico, the Isidro Formation is about 15 m thick and crops out in north-facing, vertical to near vertical cliffs that are 40 m high. Pictures of the cliffs in the vicinity of the locality are shown in Beal (1948, Pl. 7, fig. 1) and in McLean et al. (1987, fig. 4). The Isidro Formation in this area unconformably overlies middle Eocene exposures of the Bateque Formation (Squires and Demetron, 1990, 1992). The cliffs are usually too steep to allow direct sampling of the Isidro Formation, but in a few places macrofossils can be collected directly from the outcrops, which consist of several shell-hash layers separated by grayish-green mudstone and sandstone nearly barren of macrofossils.

McLean et al. (1987) reported that shell-hash beds in the Isidro Formation vary widely in fossil content and each tends to contain a different dominant genus. Similarly, at locality 1495 some of the shell-hash beds consist dominantly of large barnacles or large oysters, whereas others consist dominantly of pectinids or the new species of clypeasteroid echinoid. Specimens of *Astrodapsis bajasurensis* n. sp. are present in all the shell-hash beds throughout the 15-m-thick section of Isidro Formation at locality 1495. Some specimens of *A. bajasurensis* n. sp. are encrusted by bryozoans, serpulids, or small barnacles.

Although the macrofossils in the shell-hash beds have obviously been transported, the distance of post-mortem transport was not far, because most specimens do not show any significant signs of abrasion or selective sorting. Other indications that the distance of post-mortem transport was not far include some closed-valved specimens of the pectinid bivalve *Oppenheimopecten vogdesi* (Arnold, 1906) [= *O. heimi* Hertlein, 1925], some closed-valved specimens of the large-sized oysterid bivalve *Crassostrea? eucorrugata* Hertlein, 1934, and a partial growth series of *Astrodapsis bajasurensis* n. sp. with specimens ranging in length from 7.0 to 38.5 mm.

Collecting at locality 1495 is best done by walking along the steep cliffs and examining the numerous fallen blocks that are easily correlated with the outcrop. Specimens of the new species of clypeasteroid can be extracted from these fallen blocks. Easier collecting can be done where the blocks have fallen apart due

to weathering, and specimens lie loose on the ground. Most of these specimens do have some rock matrix adhering to the test, but some specimens are free of any rock matrix. Internally, the specimens of the new species are filled with fine sand that is usually well cemented. In exceptional specimens, such as the one shown in Figure 2.6, the internal matrix can be removed by careful cleaning. Magnetite particles were not found in the fine sand within these specimens. Locality 1495 represents collections made from a ground distance of about 350 m along the base of the cliffs. Two hundred specimens were found in about five hours of collecting.

The Isidro Formation was named by Heim (1922). The type section is at the village of San Isidro about 20 km south of locality CSUN 1495 (Figure 1). Among the various names used for the formation are the "yellow beds" of Darton (1921), Ysidro Formation (Hertlein and Jordan, 1927; Beal, 1948), and Monterrey and San Raymundo Formations (Mina, 1957). Beal (1948, Pl. 7, fig. 1) referred to the outcrops that contain the new species as the Ysidro Formation, and McLean et al. (1985) mapped them as the Isidro Formation.

The Isidro Formation has been reported as lower to middle Miocene based on macrofossils, stratigraphic position, and radiometric age-date constraints of underlying and overlying formations (Smith, 1984, 1986). Smith (1984), on the basis of preliminary molluscan studies, assigned the outcrops in the vicinity of locality 1495 to the lower Miocene.

During the present study, mudstones at locality 1495 were sampled and analyzed for calcareous nannofossils, benthic and planktic foraminifera, and radiolarians. The samples proved to be siliceous and barren, except for some rare fragments of radiolarians and sponge spicules (M. V. Filewicz and R. Ahrens, personal commun.). The locality 1495 mollusks that were identified during the present study proved to have geologic ranges too long to be useful for more than a Miocene or Neogene determination.

The presence of genus *Astrodapsis* at locality 1495 is significant in determining the geologic age of the outcrops. *Astrodapsis* occurs throughout the California Neogene provincial invertebrate "Margaritan" and "Jacalitos" "Stages" (Addicott, 1972), and it appears to be restricted to these two units. Modern correlations (e.g., Poore et al., 1984; Armentrout et al., 1984) indicate that the "Margaritan Stage" represents the upper middle to lower upper Miocene; the "Jacalitos Stage" represents the upper upper Miocene. Therefore, the stratigraphic range of *Astrodapsis* is upper middle Miocene to uppermost Miocene. Using this range, along with the early to middle Miocene age of the Isidro Formation, indicates that the age of the outcrops at locality 1495 is probably late middle Miocene. This age determination is also supported by the primitive morphology of *As-*

trodapsis bajasurensis n. sp. As will be discussed later in this report, the morphologic features of the new species show that it is an early form of the genus *Astrodapsis*.

Astrodapsis was confined to warm-temperate or tropical seas and apparently lived in nearshore environments (Hall, 1962). A nearshore environment for the deposits at locality 1495 is also supported by the presence of such genera as the barnacle *Balanus* and the oyster *Crassostrea*.

Abbreviations are as follows: IGM = Instituto de Geología, Universidad Nacional Autónoma de México, Mexico City; LACMIP = Natural History Museum of Los Angeles County, Invertebrate Paleontology Section.

SYSTEMATIC PALEONTOLOGY

Order CLYPEASTEROIDA A. Agassiz, 1872

Family ECHINARACHNIIDAE Lambert, 1914

Genus ASTRODAPSIS Conrad, 1856

Type species.—By monotypy, *Astrodapsis antiselli* Conrad, 1856.

ASTRODAPSIS BAJASURENSIS n. sp.

Figure 2

Diagnosis.—An *Astrodapsis* with length slightly greater than width (in most specimens), distinct lobelike posterior region, distinctly indented ambitus (caused by trifurcating food grooves that continue short distance onto aboral side), petaloids narrow and bisected by prominent food groove, ambulacra wider than interambulacra at ambitus, petaloids of equal length and slightly elevated with double row of respiratory pores noticeably converging about 75 percent of distance to ambitus, and periproct usually on curvature of lower margin.

Description.—Small to medium sized, reaching maximum length of 38.5 mm, slightly longer than wide, length/width about 1.06; maximum width just posterior of center, about 93 percent of total length; ambital outline slightly oval with posterior ambulacral marginal indentations prominent and producing lobelike appearance of posterior interambulacral area; interambulacra 80 percent of width of ambulacra at ambitus; apex very slightly depressed and slightly anterior of center; anterior and posterior surfaces of test about equally declined; apical system confluent with apex and not elevated; madreporite large and subpentagonal in outline; four gonopores present in specimens greater than 10.5 mm in length, one at base of each interambulacral area except interambulacrum 5; petaloids slightly elevated, open, approximately equal in length and width, and extending to ambitus; 150° angle between food grooves on anterior lateral petals, 65° angle between food grooves on posterior petals (bivium); respiratory pore areas narrow, one-half width of interporiferous areas and noticeably constricted about 75 percent of distance to ambitus; pores on inner row small and suboval; pores in outer row slitlike, becoming smaller and suboval distally; pore-pairs aligned parallel to petaloid-plate sutures near apex, but inclined about 20° toward ambitus where respiratory pore areas converge; outer pores do not cross petaloid sutures; interporiferous areas twice as wide as poriferous areas and bisected by narrow ambulacral food groove that extends to ambitus, onto oral surface and to peristome; margin indented at each ambulacral food groove with indentations most prominent on posteriormost two ambulacral areas.

Lantern supports single, one on each interambulacral basicoronal plate. Internal buttress system peripheral and fairly well developed, interambulacral areas with two thin, radiating walls, ambulacral areas with thickened calcite elements containing cavities.

Aboral interambulacra slightly sunken; double column of

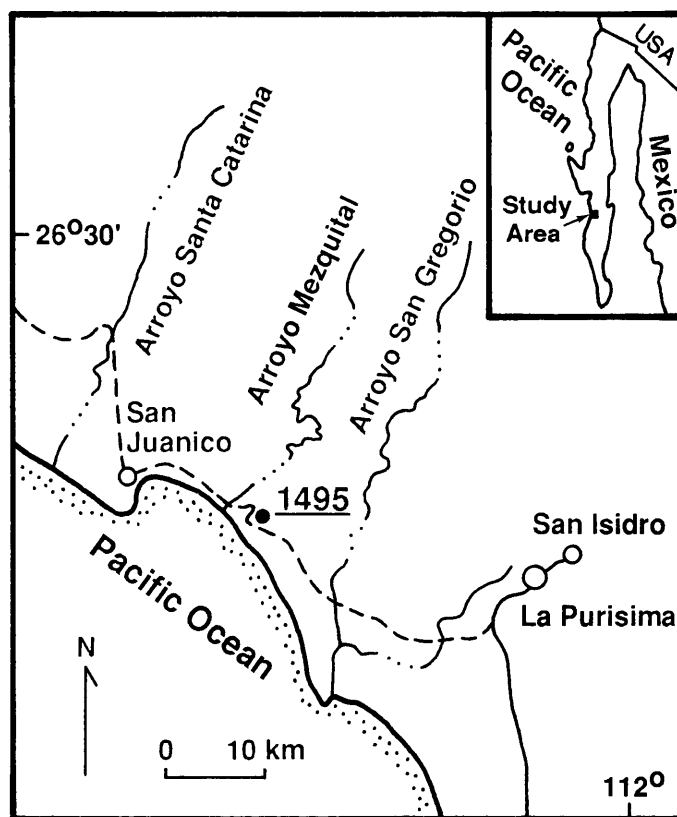


FIGURE 1—Index map to California State University, Northridge collecting locality 1495, Isidro Formation, Baja California Sur, Mexico. = LACMIP loc. 16122 [on 16656]

alternating plates in interambulacra adjacent to apical system; each interambulacral area with food grooves that pass onto aboral surface and ambitus correspondingly indented by trifurcating food grooves, with indentations most prominent on bivium.

Oral surface concave; peristome slightly anterior of center, relatively large and circular in outline; keel in food groove along perradial suture does not extend beyond ambulacral basicoronal plates, keel terminates in peristomial point projecting into peristome; food grooves well developed with straight-line trunk that trifurcates at about 60 percent of distance from center of peristome to ambitus.

Periproct just submarginal on curvature of lower margin, uncommonly on margin, small and oval to pentagonal in outline, in small notch; 15 indentations on ambitus (i.e., 5 ambulacral food grooves and 10 laterally branching interambulacral food grooves), periproct indentation present on some specimens.

Basicoronal plates well developed, in larger specimens (length greater than about 19 mm) ambulacral basicoronal plates become obscured by keel in food groove along perradial suture, interambulacral basicoronal plates project farther than ambulacral basicoronal plates, four to five oral interambulacral coronal plates, seven to eight oral ambulacral coronal plates, oral interambulacra 2 and 3 continuous or discontinuous; oral interambulacra 1, 4, and 5 discontinuous.

Tubercles small to medium sized (0.1–0.2 mm); on aboral surface present everywhere with largest tubercles on interporiferous areas; on oral surface present everywhere except on food grooves, interambulacral tubercles larger than ambulacral ones and in scrobicules wider than those on aboral surface, with smallest tubercles near food grooves.

Dimensions of type specimens in Table 1.