



FIGURE 4—Examples of helicoplacoid taphonomic groups utilized in this study. (A) Photograph of a Group 1 (well-preserved with a slight amount of disarticulation) helicoplacoid specimen. This specimen is not disarticulated in the slightest, but is merely partially overlain by another specimen in its uppermost portion. Portion U.S. one cent coin for scale. (B) Photograph of a Group 2 (partially disarticulated) helicoplacoid specimen. Many interambulacral columns are partially preserved, but this specimen shows signs of decay in the loose plates around its edges. Portion of U.S. one cent coin for scale. (C) Photograph of a Group 3 (almost fully disarticulated) helicoplacoid specimen. Only a few vestiges of interambulacral columns are preserved in this specimen, the rest consisting of a scattering of loose plates. Portion of U.S. one cent coin for scale.

structure. As a result of this collection bias, a disproportionately low number of Group 3 helicoplacoids probably were collected.

To better examine helicoplacoid preservation, any original calcite in these specimens was dissolved in HCl to allow for closer examination of the resulting external molds, and latex casts were made of selected specimens. All specimens also were examined to search for evidence of preservational differences among regions of the helicoplacoid body, to test the hypothesis that the lower end of their body may have been constructed more rigidly because it was adapted for insertion into the substrate (Dornbos and Bottjer, 2000).

Because the limited natural outcrop exposure of the Middle Member of the Poleta Formation at this site did not allow for the measurement of a continuous stratigraphic section, a variety of sedimentological information on the rocks in which helicoplacoids were preserved was acquired by excavating 6 outcrops of the siltstone at this site. From these excavations 81 rock samples were collected for petrographic and X-radiographic studies. These rock samples were slabbed, placed in stratigraphic order, and X-radiographed, thereby creating an X-radiograph core of each sampled outcrop. These "cores" allowed for convenient mm-scale observation of sedimentary structures in 155.8 cm of the stratigraphic section in which helicoplacoids have been found preserved. In addition, all 44 rock samples containing helicoplacoid specimens also were slabbed vertically and X-radiographed to search for any sedimentological correlations between the three taphonomic groups.

The orientations of 33 specimens from three small slabs, totalling approximately 0.1 m² in area, were measured and plotted on rose diagrams to determine, with the aid of circular statistics, the level of alignment of these speci-

mens. In addition to the standard error from the mean vector, the statistical measure used in this study is the Rayleigh test of uniformity, which calculates the probability that the data in the rose diagram are uniformly distributed. Probabilities that are close to, or at, zero therefore indicate that the vectors are preferentially aligned. Fourteen of these 33 specimens are assigned to Group 1, while 19 are assigned to Group 2. No group 3 specimens were preserved on these slabs. Because these three slabs were found in a talus slope, the quadrants on the rose diagrams are meaningless; only the alignment of the specimens on individual slabs, and not their actual orientations, is significant.

HELICOPLACOID TAPHONOMY

Because helicoplacoids were Type 1 echinoderms, their plates probably became disarticulated under post-mortem seafloor exposure in a matter of days (Brett et al., 1997a). Combined with the observation that they commonly are found at the base of graded beds (Durham, 1967, 1993), these facts indicate that all helicoplacoid specimens most likely were preserved in obrution deposits (Dornbos and Bottjer, 2000). The majority of the specimens collected in this study (69%) and at LACMNH (62%) are assigned to Group 2 (partially disarticulated; Table 1).

The physical sedimentary structures visible in the X-radiograph cores from this site provide further insight into helicoplacoid preservation. They typically include: thin (generally <2 cm) beds that are commonly graded in thin section; laminations (generally <1 mm thick); and, more rarely, relatively thick (generally 2–5 cm) graded beds rich in bioclastic material (either echinoderm plates, trilobite fragments, or archaeocyathids). These sedimentary structures are characteristic of a generally low energy outer