STRATIGRAPHIC EVIDENCE FOR THE RELATIVE CHANGE OF SEA LEVEL IN THE UPPER MIOCENE STRATA OF THE FORTUNA BASIN, SOUTHEASTERN SPAIN

Cynthia S. Knight
Department of Geology
Amherst College
Amherst, MA 01002

La Loma is a 1-km-long east/west ridge of knolls that lies in southeastern Spain's Fortuna Basin (Fig. 1). The middle segment of the La Loma ridge was the region of my study where stratigraphic sections of Miocene strata were measured and lithogenetic units were defined and correlated. A model for the area was formulated to determine the series of depositional events represented by the various lithologic units. A generalized reconstructed cross-section was made that tied in the work of Amy Steele (see this volume) with my work. It was not possible to correlate Craig Hart's data (see this volume) with mine because his units were probably stratigraphically older.

The lower 6 meters of a composite section (Fig. 2) through my area consists of fine-grained, yellow marls interbedded with thinner beds of sand. These units contain small bivalve and gastropod shells and represent moderately deep-shelf conditions. Beginning at 6.25 meters above the base of the section, there is an increasing thickness of sandy units, signifying a change from the marl's quiet, deep-water, marine environment to a sandier, near-shore beach environment. This is a coarsening-up sequence and represents a movement of the shore line to the south.

At about 12 meters above the base, pebbly and cobbly units are seen. These conglomerates were episodically brought in by rivers from an intermontane, continental drainage system. The source of these conglomerates were the Betic Mountains, which lie to the North of the study area. Three discrete horizons of gravel are found in my section. Petrographic studies show that each have the same composition of pebbles and cobbles. The clasts comprise rounded shale, sandstone, and limestone; the sand-sized matrix contains quartz, feldspar, and metamorphic rock fragments. Hence the sorting of the conglomerates is poor.

The next stage of deposition consists of in situ *Tarbellastraea* coral bioherms. These developed on top of the conglomerates and denote that there was a fairly rapid relative rise in the level of the sea. The terrigenous conglomerates were rapidly covered by marine waters. The bioherms consist of *Tarbellastraea* corals, echinoids, gastropods, bivalves, and a small number of red-coralline algae. Limonite staining on some corals signify subaerial exposure where the corals were next to a paleovalley cut by a channel. Some units of strata contain *Heterostegina*, a large, shallow-water foraminifer common to Miocene reefal sediments of southeastern Spain (Mankiewicz, personal communication).

Figure 3, a schematic cross-section, shows the cyclical repetition of facies. The sequence of coarsening-up units, conglomerate deposition after paleovalley channel cutting, and reef growth above the conglomerate is repeated three times in the sequence of my study area. The deepest channel cut is HG-2 (estimated at more than 25 meters deep) from Amy's area. This channel cut is capped by conglomerate at the top and contains cycles of conglomerates that fine up to sand. The three horizons of conglomerates were determined to be deposited by fresh-water channels because of the lenticular geometry above an erosive surface, and the lack of fossils, except at the very top. Here at the top, oysters were found to be encrusting pebbles. They attached themselves to the pebbles after the cessation of channel flow when the gravel acted as a hardground for the *Tarbellastraea* mounds. The downcutting event that was accompanied by conglomerate deposition must have been from allocyclic causes, i.e. not normal lobe switching or other autocyclic mechanisms. Two types of allocyclic mechanisms are considered: tectonic and eustatic. Only further work in Spain and surrounding regions such as southern France and northern Africa would establish the relative effectiveness of either one or both of these mechanisms.

The model developed from my research proposes that there were many fluctuations of the relative level of the sea in the Fortuna Basin. The lower, coarsening-up units of each cycle suggest offshore marine to beach deposition followed by fluvial conglomerates at the top. This indicates a slow then rapid drop in the relative position of the sea. Rivers then cut paleovalleys which filled with conglomerate. The level of the sea must have then quickly risen to cover the conglomerates which became hardgrounds for the corals to

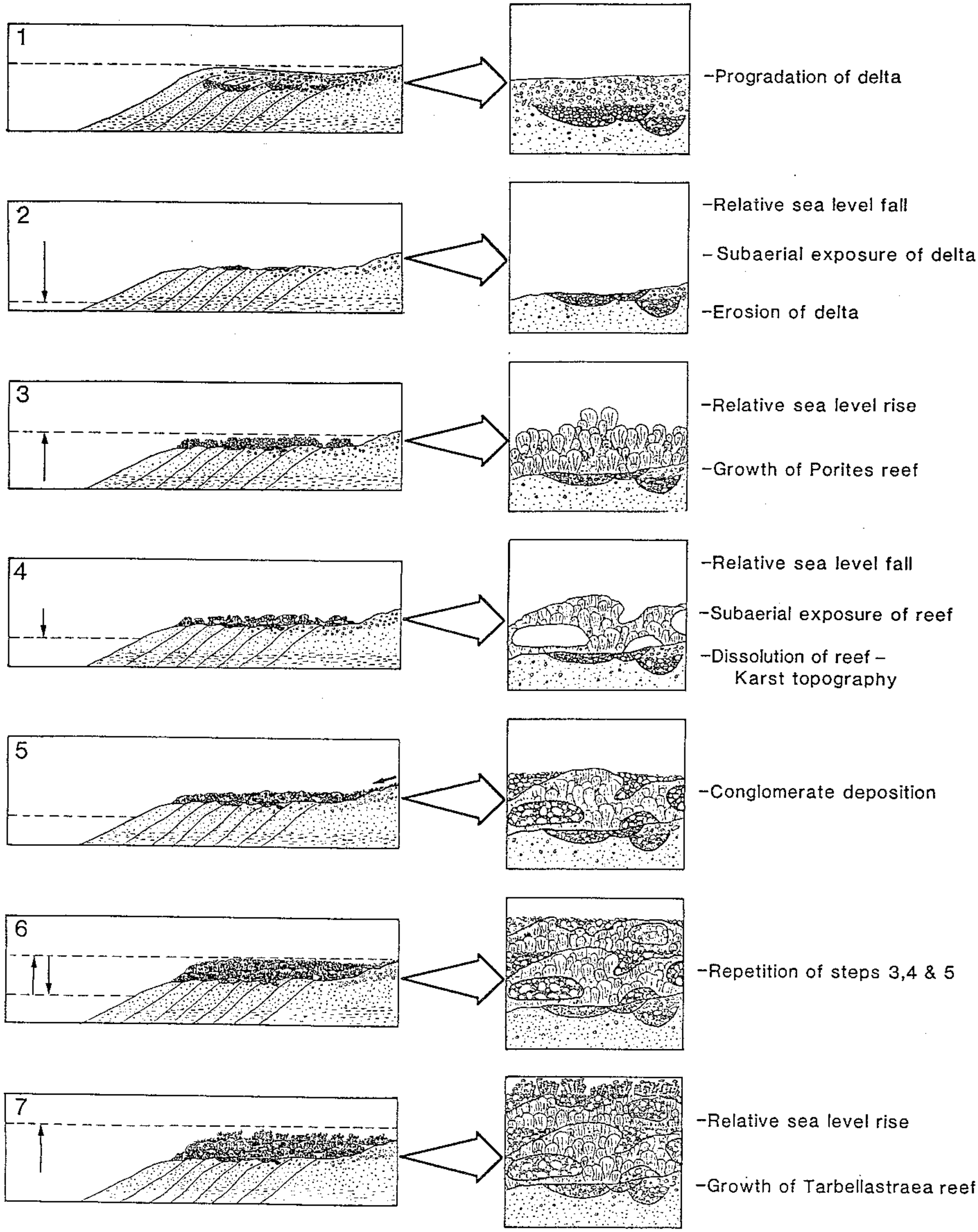
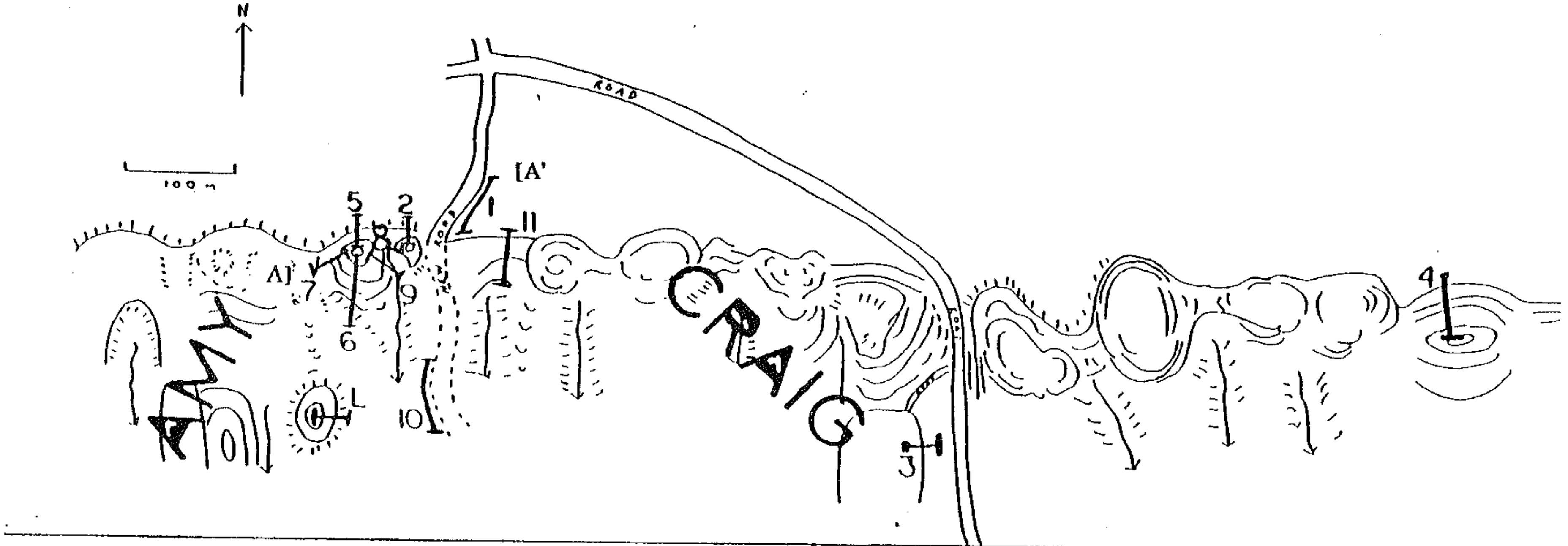


Figure 2: Cartoon diagram showing the depositional history of La Loma. The boxes on the right show enlarged sections of the corresponding events shown in the left column.

FIG. 1 La Loma (from Curran's field map)



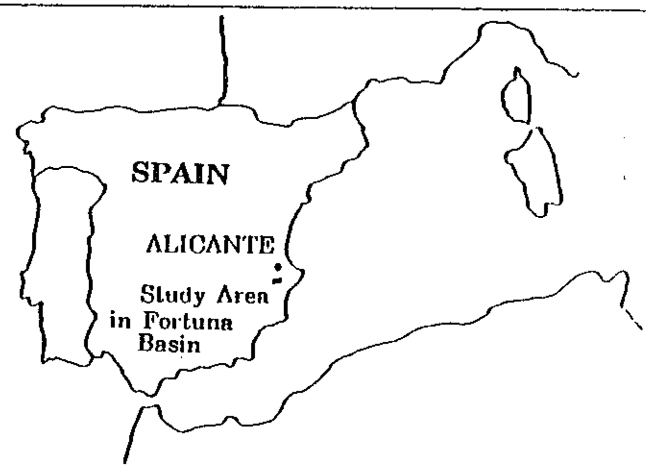
KEY

- 1 - The Trench
- 2 - North Pipe Knoll
- 3 - Open Bowl East
- 4 - North Hole Knoll
- 5 - North Rabbit Knoll
- 6 - South Rabbit Knoll
- 7 - West Rabbit Knoll
- 8 - West Pipe Knoll
- 9 - East Rabbit Knoll
- 10 - Road Cut
- 11 - North Trench Knoll
- L - East Little Knoll

↗ = Drainage Directions

I = Measured Sections By Author

A] [A' = Generalized Cross Section



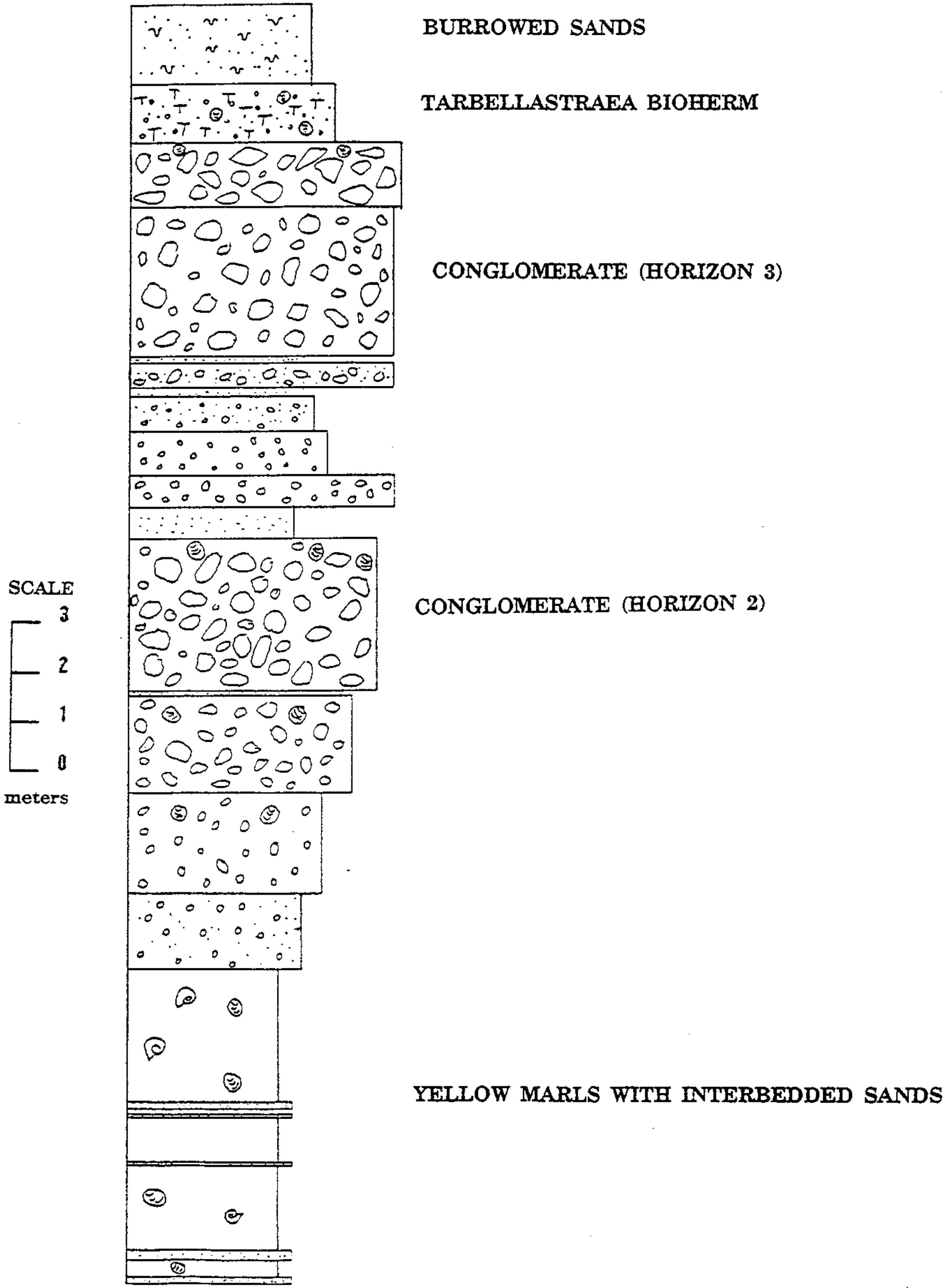
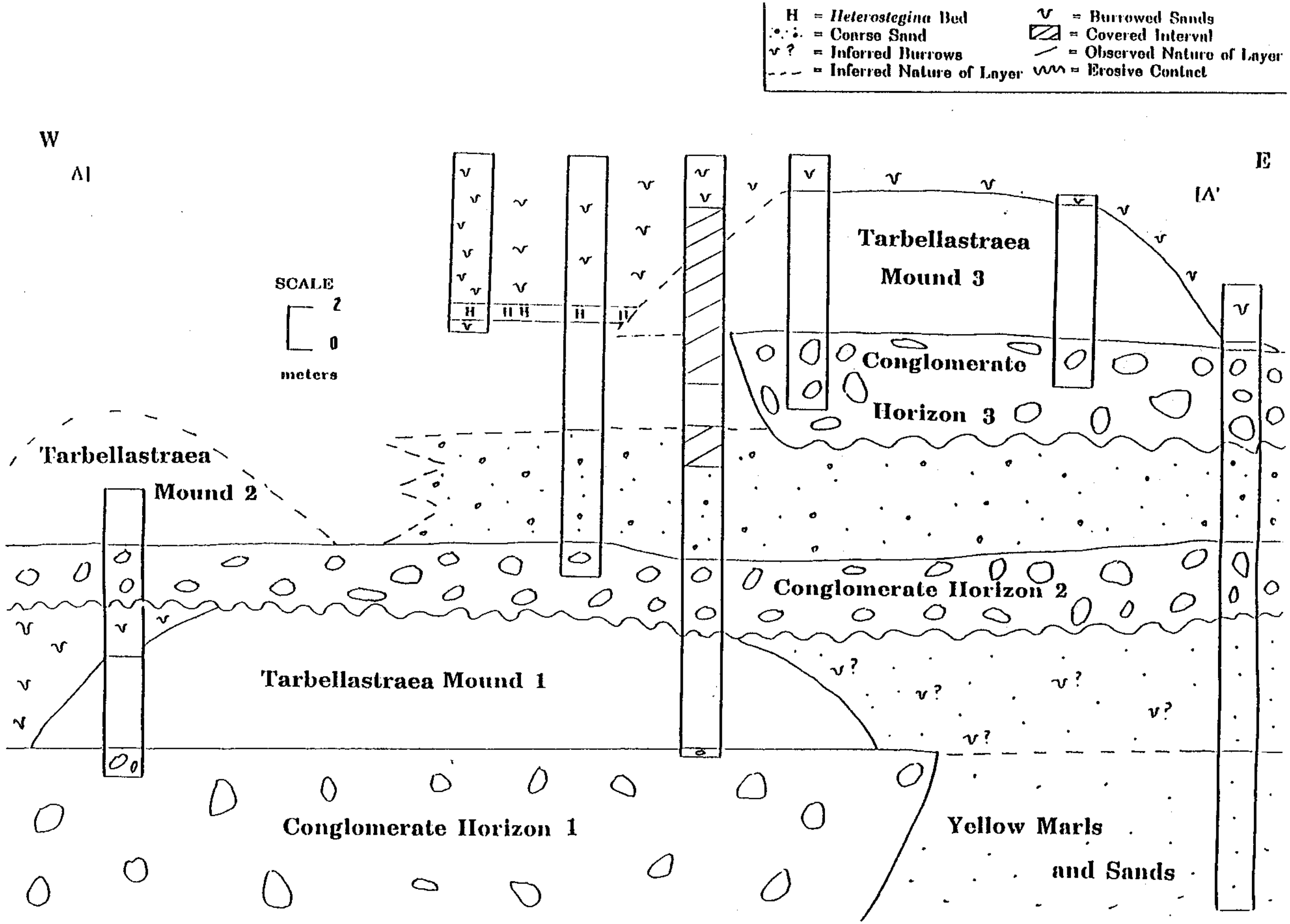


FIG. 2-A composite section (Sections 1 and 2)


H = Heterostegina Bed
= Coarse Sand
v ? = Inferred Burrows
= Inferred Nature of Layer
= Burrowed Sands
= Covered Interval
= Observed Nature of Layer
= Erosive Contact
W
A
E
A'
SCALE
2
0
meters
Tarbellastraea Mound 3
Conglomerate Horizon 3
Tarbellastraea Mound 2
Conglomerate Horizon 2
Tarbellastraea Mound 1
Conglomerate Horizon 1
Yellow Marls and Sands

build upon. Esteban (1979), Santisteban and Taberner (1983) noted that Miocene *Tarbellastraea* complexes commonly show this relationship with coastal terrigenous conglomerates.

The cycles of relative sea level changes represented by my research are very characteristic of the Mediterranean area during the Miocene (Stanley and Wezel, 1985). Regional tectonics caused by the collision of the plates containing Africa and Spain, global climatic changes causing glaciation, and local episodes have all been considered to play a part in the dramatic geologic events that eventually led to the puzzling Messinian salinity crisis.

REFERENCES CITED

Esteban, M., 1979, Significance of the upper Miocene coral reefs of the Western Mediterranean: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 29, p. 169-188.

Santisteban, C., and Taberner, C., 1983, Shallow marine and continental conglomerates derived from coral reef complexes after desiccation of a deep marine basin: The Tortonian-Messinian deposits of the Fortuna Basin, SE Spain: Journal of the Geological Society of London, v. 140, p. 401-411.

Stanley, D.J., and Wezel, F.C., eds., 1985, Geological Evolution of the Mediterranean Basin, Springer-Verlag Inc., New York.