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## **Expedition to Valdes: Miocene stratigraphy and Recent silled basins**

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A two-phase program of stratigraphic and oceanographic study around Peninsula Valdes (Patagonia, Argentina) was carried out between 4 and 24 September 1981. Use of the R/V *Hero* (cruise 81-4) allowed ready access to isolated coastal outcrops and to submarine deposits from Golfos San Matias, San José, and Nuevo (see figure, inset).

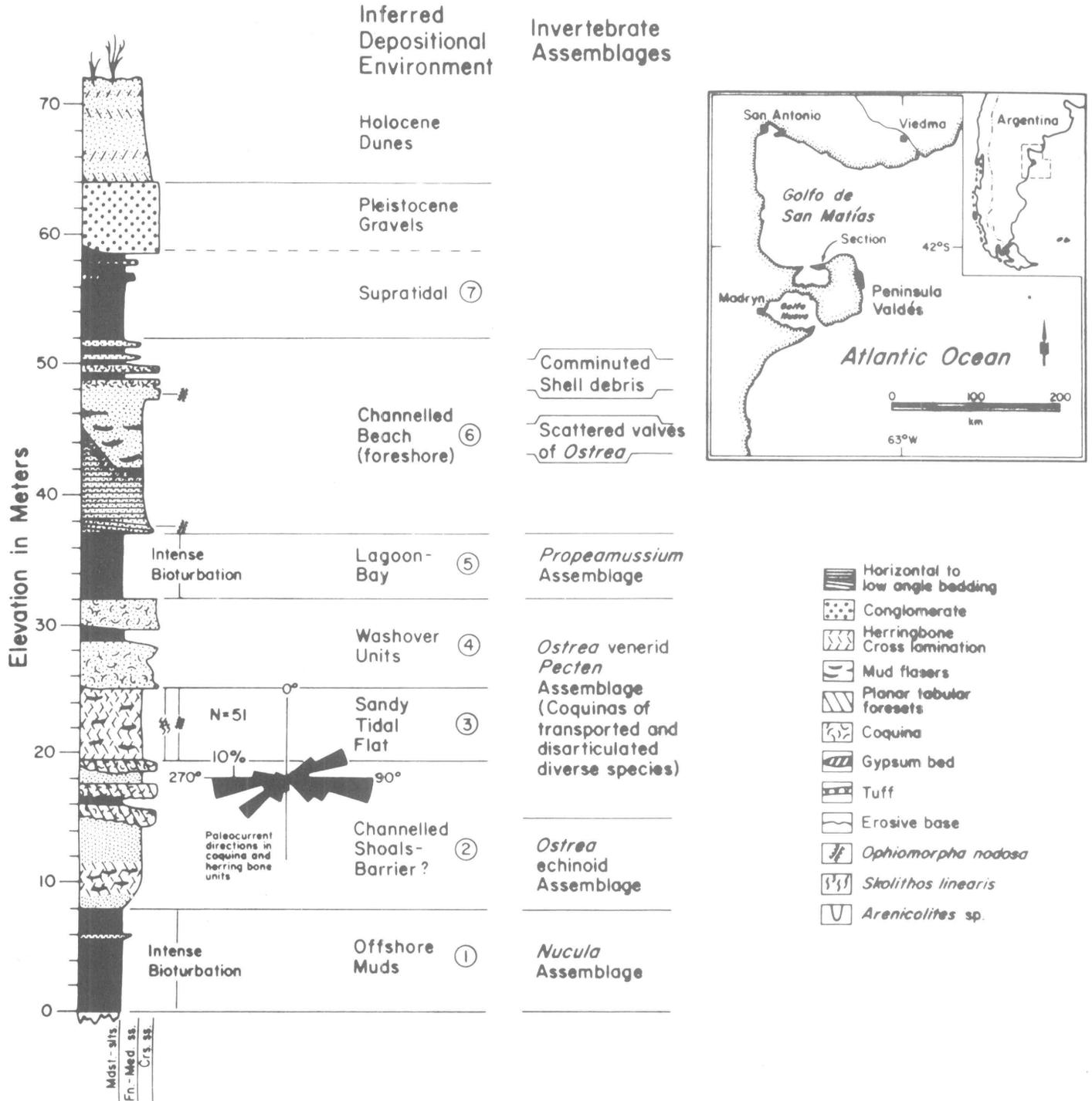
*Miocene stratigraphy.* Our stratigraphic study of the middle to late Miocene Entrerío and Rionegro Formations expands upon that of Zinsmeister and others (1981). They concluded that the two formations were conformable and laterally equivalent, recording the progradation of mudflat, beach, and supratidal

facies into shallow, offshore, marine environments. Our measurements of 17 sections confirm the applicability of this model across the entire Peninsula Valdes region.

A section from the south shore of Golfo San Matias depicts a typical transition from offshore to littoral depositional environments (see figure). Unit 1 consists of thin-bedded bioturbated mudstone with scattered valves of *Nucula*. Unit 2 includes massive and well-winnowed sandstones with small-scale her-

ringbone interbeds and mudstone flasers below, and bimodal, planar-tabular, stratified coquinas above. Echinoids and *Ostrea* dominate the sandstones; fragments of diverse pelecypods abound in the coquinas.

Unit 3 contains dark gray medium-grained sandstone with small-scale herringbone crossbeds and mudstone flasers. *Ophiomorpha nodosa* is abundant throughout. *Skolithos linearis* becomes increasingly dense upsection. Thick coquinas and



Lithologic section of Miocene rocks exposed on sea cliffs facing Golfo San Matias. Also shown are invertebrate assemblages collected from these strata and our interpretation of depositional environments represented within the section. (Inset: Peninsula Valdes and location of section described in the text.)

poorly sorted massive sandstones of unit 4 abruptly truncate unit 3. The coquinas consist of large disarticulated *Pecten*, *Ostrea*, broken echinoids, and whale bones.

The fine-grained sandstone and mudstone of unit 5 entomb fragile articulated valves of *Propeamussium* and occasional mytilids. Unit 6 is characterized by low-angle plan bedding with rare *O. nodosa*, truncated above by a channel-form body of medium-grained sandstone with mudstone flasers and scattered *Ostrea* valves. *Arenicolites* and *S. linearis* are developed just below the erosive contact. *Ophiomorpha* shafts in the channel-form body are truncated above by coarse sandstone and coquina.

Unit 7 is composed of afossiliferous, thin-bedded, laminated and contorted mudstone, siltstone, and evaporites. A tuff in the upper part is probably correlative with one dated by Zinsmeister and others (1981) on the south shore of Golfo Nuevo.

The Tertiary sequence is unconformably overlain by Quaternary terrace deposits and by Patagonian gravels.

To summarize our interpretation: Offshore muds with *Nucula* (unit 1) were gradually replaced by a tidally influenced sandy environment of channeled shoals inhabited by echinoids and oysters (unit 2). These subtidal environments were succeeded by sandy tidal flats populated by numerous crustaceans and polychaetes (unit 3). Unit 4 may include washover deposits. A shallow lagoon or bay (unit 5) and its inshore beach (unit 6) prograded across the shoals. The progradation was complete with the appearance of supratidal flats and salt pans (unit 7).

*Oceanography.* The oceanographic program included bathymetric surveys and bottom sampling of the gulfs surrounding Peninsula Valdes. Each gulf is bound seaward by a shallow bedrock sill rising some 80–120 meters above a bowl-

shaped floor. At those times when the Pleistocene sea level stood much lower, these basins must have been brackish lakes or evaporitic depressions, not unlike much smaller emergent depressions nearby. Previously published hydrographic maps (often in error, we discovered), indicated former beaches within these drowned depressions. It was hoped that evaporites or intertidal deposits could be recovered by coring, but our efforts were stymied by a 2-meter (or more) blanket of windblown Recent silt and sand covering most of every basin.

Apart from suggesting an unusual Pleistocene history, the Valdes gulfs pose a dilemma: how to explain small, often nearly landlocked, coastal depressions whose centers are significantly deeper than the continental shelf in which they are impressed. We saw no structural evidence of a tectonic origin for the gulfs. Certain coastal and submarine features may coincide with west-northwest east-southeast regional structural trends, but as yet, these coincidences have not explained the gulfs' origin.

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## Reference

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