

The middle Miocene San Antonio Formation: Acoralline algae and rodolite bearing biostrome built in the La Cruz Fault footwall

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Marine incursion during the latest stages of crustal extension in the Progreso Basin permitted the development and preservation of a shallow water bioclastic limestone sequence known as the San Antonio Formation. This unit has been incorrectly correlate with the Middle Eocene San Eduardo. However, this unit is only found overlying the Cretaceous Cayo Formation along the Chongón-Colonche High and it was deposited contemporaneously with the Ancon Group flysch sequence, while the San Antonio Formation was deposited in a narrow and elongated horse formed synthetically to the La Cruz Fault and was deposited contemporaneously with the Subibaja Formation. Indeed, the age of this unit is Middle Miocene based on the presence of the Calcareous nannofossil *Helicosphaera ampliaperata*, and the planktic foraminifer *Globorotalia mayeri*.

At its type locality, the San Antonio Formation is highly faulted because of the active motion along the La Cruz Fault. However, a partial measured section consist of several thinning and finning upward cycles of thick bedded coralline algae limestones showing well defined medium scale channeling. The limestones are mainly grainstones and subordinate fossiliferous packstones with abundant coralline red algae and fossil fragments including large foraminifera as well as other mollusks. The sequence is separated by two distinctive yellowish brown to tan calcareous and thinly laminated shales with discrete foraminifera lime mudstone that records episodic dip slip motion along the La Cruz Fault.

The limestones are mainly made of coralline red algae and larger foraminifera grainstones and packstones with occasional rhodolite pavements. The coralline algae are dominated by *Lithothamnion*, and *Lithophyllum* that are often micritized. Some limestone beds are made up of coralline algae detritus as well as mollusk fragments and rare unilaminar erect bryozoan growth-forms and often nummulitids and small benthic foraminifera are abundant. When present, the rhodolith facies show a succession to columnar to laminar coralline algae and rarely the green algae *Halimeda* is present. Sporadically, there are well developed oncolites that display some *Cliona* boring.

The neptonic presence of the pelecipod macrofossil *pecten* sp, suggest open marine condition of more than 4 meters water depth.

This mixed carbonate-siliciclastic sequence documented the active role of the La Cruz Fault during deposition of this shallow water carbonates along an elongate and narrow shelf. This setting permitted the development of local hydrodynamic conditions characterized by significant sunlight, high energy and low turbidity accompanied by high carbonate productivity off the shoals. Indeed, while the larger foraminifera mollusks, and bryozoans thrived and flourished in shallower water near fair-weather wave base (FWWB), the coralline algae prevailed in relative deeper water below FWWB. Carbonate deposition was episodically interrupted by an influx of terrigenous siliciclastic supply during motion of this fault and carbonate productivity was rapidly recovered.