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Monospecific Pliocene oyster buildups, Murray Basin, South Australia: Brackish water end member of the reef spectrum

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Abstract

Paleoestuarine, monospecific oyster bioherms and biostromes formed by the extant, soft-bottom oyster, *Ostrea angasi*, are prolific in the Pliocene Norwest Bend Formation, Murray Basin, South Australia. These buildups are pioneer communities that record "arrested ecological succession", comprising only the Stabilization and Colonization Stages of reef development. Each of these stages is directly linked to a different phase of marine inundation.

Stabilization is restricted to the early transgressive systems tract when pre-existing topographic highs were flooded and populated by dense aggregations of oyster clusters. Colonization is manifest throughout the transgressive and highstand systems tracts when increased accommodation allowed the vertical and lateral accretion of juvenile oyster communities into large buildups. Bioherms formed in areas of low terrigenous clastic sedimentation and seafloor disturbance, both of which encouraged rapid community growth. Biostromes in contrast, record buildup development on an unstable seafloor where episodic, catastrophic community burial by storm sedimentation created repeated conditions of seafloor stabilization and colonization. Subaqueous dunes formed as part of the falling stage systems tract when river and tidal currents reworked shell material from bioherms and biostromes into large-scale, subaqueous bedforms.

Brackish water conditions in the palaeoestuary, a turbid water column, mesotrophic nutrient levels, and high spatial homogeneity of oyster buildups are interpreted to have prevented recruitment of specialized, stenohaline organisms that typify the Diversification Stage of other metazoan reefs. Comparison with modern, low diversity oyster communities imply that high fecundity and growth rates as well as exogenic nutrient cycling also made oysters in the Norwest Bend Formation highly adapted competitors capable of thriving in this nutrient-rich setting.

Keywords: Australia; Pliocene; Oysters; Reefs; Sedimentology; Palaeoecology

1. Introduction

Bioherms and biostromes, the geological manifestation of living reefs, are the most diverse, complicated and contentious of all sedimentary deposits (James, 1983; James and Bourque, 1992; Wood, 1999; Stanley, 2001). Their complexity is because, although they are biological structures, they also have important sedimentological and physiochemical processes involved in their growth. Because reefs are constructed by plants, animals, and microbes, their diversity reflects the biosphere at the time in which they grew and the character of the ocean that surrounded them. They range from buildups that are largely mud with few macrofossils, to monospecific skeletal mounds, to intricate and diverse inter-

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growths of calcareous benthic organisms with growth cavities and synsedimentary precipitates (James and Bourque, 1992). This spectrum of reef types reflects development in an array of environments that extend from the strandline across the shelf to the deep sea (cf. Wood, 1999).

The purpose of this paper is to document fossil, monospecific oyster buildups, a kind of brackish-water reef that has received considerably less attention than other biogenic structures in the reef spectrum. Their abundance in low-salinity settings (Grinnell, 1974; Bahr and Lanier, 1981; Britton and Morton, 1989; Bartol et al., 1999) makes them potentially useful for the interpretation of ancient shallow marine strata (e.g., Wiedemann, 1972; Feldman and Palubniak, 1975; Frey et al., 1987; Puckett, 1994; Hong et al., 1995; Goodbred et al., 1998) as old as the Middle Jurassic, when a major diversification resulted in the population of brackish palaeoenvironments by oysters (Hudson and Palmer, 1976).

Specifically, this study documents and interprets Late Pliocene oyster reefs in the Murray Basin, South Australia (Fig. 1). These bioherms and biostromes are composed of the same benthic organisms that inhabit southern Australian coasts today (Rainer and Fitzhardinge, 1981; Poore, 1982; Ludbrook, 1984; Hutchings, 1999) and act as a bridge into the older fossil record. While much is known about the relationship between modern oysters and their environment, spurred mainly by the oyster's economic importance (e.g., Stenzel,

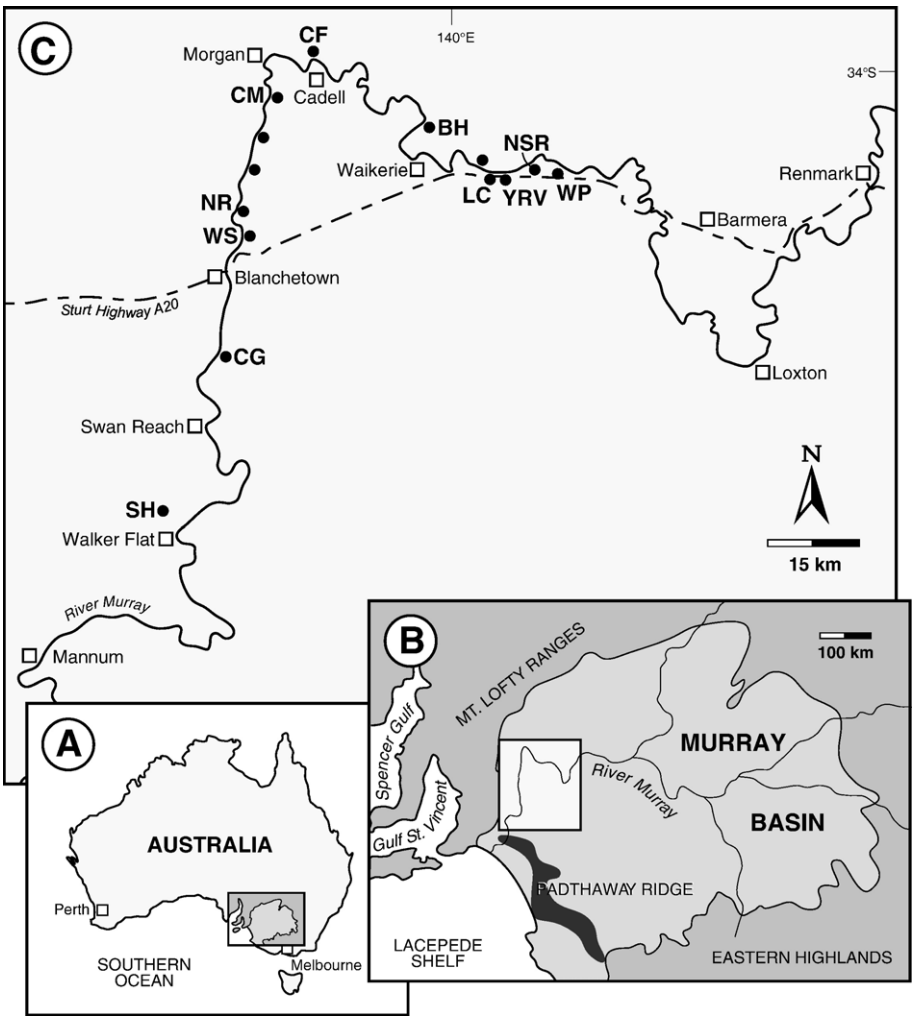

Fig. 1. (A) Map of Australia with location of the Murray Basin. (B) Map of the Murray Basin showing the study area (box) and tectonic elements. (C) The study area with locations of stratigraphic sections (black circles) containing oyster buildups. Labeled sections are where oyster height and length data were collected. SH=Shell Hill; CG=Cudgee; WS=Water Ski Association; NR=Noll Road; CM=Cadell Marl; CF=Cadell Ferry; BH=Broken Hill; LC=Lutheran Church; YV=Yarrow Reach Vineyard; NSR=Nishke Road; WP=Woolpunda Pump Station.