Marine and Petroleum Geology 58 (2014) 425–437

Contents lists available at ScienceDirect

Marine and Petroleum Geology

journal homepage: www.elsevier.com/locate/marpetgeo

Sedimentation rates from calcareous nannofossil and planktonic foraminifera biostratigraphy in the Andaman Sea, northern Bay of Bengal, and eastern Arabian Sea

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ARTICLE INFO

Article history:
Received 2 March 2014
Received in revised form
13 August 2014
Accepted 14 August 2014
Available online 24 August 2014

Keywords:
Indian Ocean
Calcareous plankton biochronology
NGHP-01
Age model
Hiatuses

ABSTRACT

In this study we determined calcareous nannofossil and planktonic foraminifera events in sediments recovered during the 2006 Indian National Gas Hydrate Program (NGHP) Expedition-01. Selected bioevents permitted the assignment of orbitally calibrated ages, derivative sedimentation rate estimates, and identification of sedimentary discontinuities. In the Andaman Sea at Hole NGHP-01-17A, a late Miocene to recent record was recovered, but with a significant hiatus during the latest Miocene and Pliocene. Sedimentation rates here vary from 50 m/Myr during the Pleistocene to 130 m/Myr for the late Miocene. In the northern Bay of Bengal at Hole NGHP-01-19A the base of the cored record also reaches the late Miocene and extends to recent, but the same hiatus, missing the Pliocene, is present at this hole. a. The Early Pleistocene at Hole NGHP-1-19A shows sensible variation in sedimentation rates ranging between 130 m/Myr and 10 m/Myr during the last 0.5 Ma. For the late Miocene the sedimentation rate was ca. 50 m/Myr. In the western Bay of Bengal at Hole NGHP-01-10B/D, calcareous nannofossils were sparse and only foraminifera datums are available. The base of the section is latest Early Pliocene to Late Pliocene, and the majority of the record is considered younger than Late Pliocene. Due to the scarcity of calcareous nannofossils and the few foraminifera datums, sedimentation rates were not determined here. However, Hole NGHP-01-16A, in the same region, recorded the highest occurrence of *Pseudoemiliania lacunosa*, an event that confirms a Pleistocene age, allowing us to estimate a sedimentation rate between 110 m/Myr and 450 m/Myr. Along the western peninsular Indian margin at Hole NGHP-01-01A a continuous record from the Holocene to the early Oligocene indicates sedimentation rates of ca. 25 m/Myr until the middle Miocene, and a sensible reduction downward, reaching 4 m/Myr in the early Miocene to the early Oligocene. No hiatuses were observed. The large changes in sedimentation rates observed in these cores reflect long timescale changes in the environment likely induced by changes in the strength of the Indian monsoon system.

1. Introduction

The slope environments in the Andaman Sea, northern Bay of Bengal, and eastern Arabian Sea margins are located in oceanic regions where continental margin sediments accumulate in response to tectonic and climate forcing. There are few scientific ocean drilling expeditions (DSDP, ODP, IODP) in these regions (Fig. 1), however, limiting our understanding of sediment accumulation patterns on million year timescales in these environments. In 2006 the Indian National Gas Hydrate Program (NGHP) carried out its first drilling and coring expedition in Indian territorial waters (Collett et al., 2008), recovering cores in the Bay of Bengal from 17 sites in the offshore Krishna–Godavari Basin, 2 sites in the offshore Mahanadi Basin, and 1 site in the accretionary wedge of the Sunda subduction zone in the Andaman Sea (Fig. 1). In addition, one site was cored in the Kerala–Konkan basin on the western peninsular Indian margin in the Arabian Sea (Fig. 1). The

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http://dx.doi.org/10.1016/j.marpetgeo.2014.08.011
0264-8172/

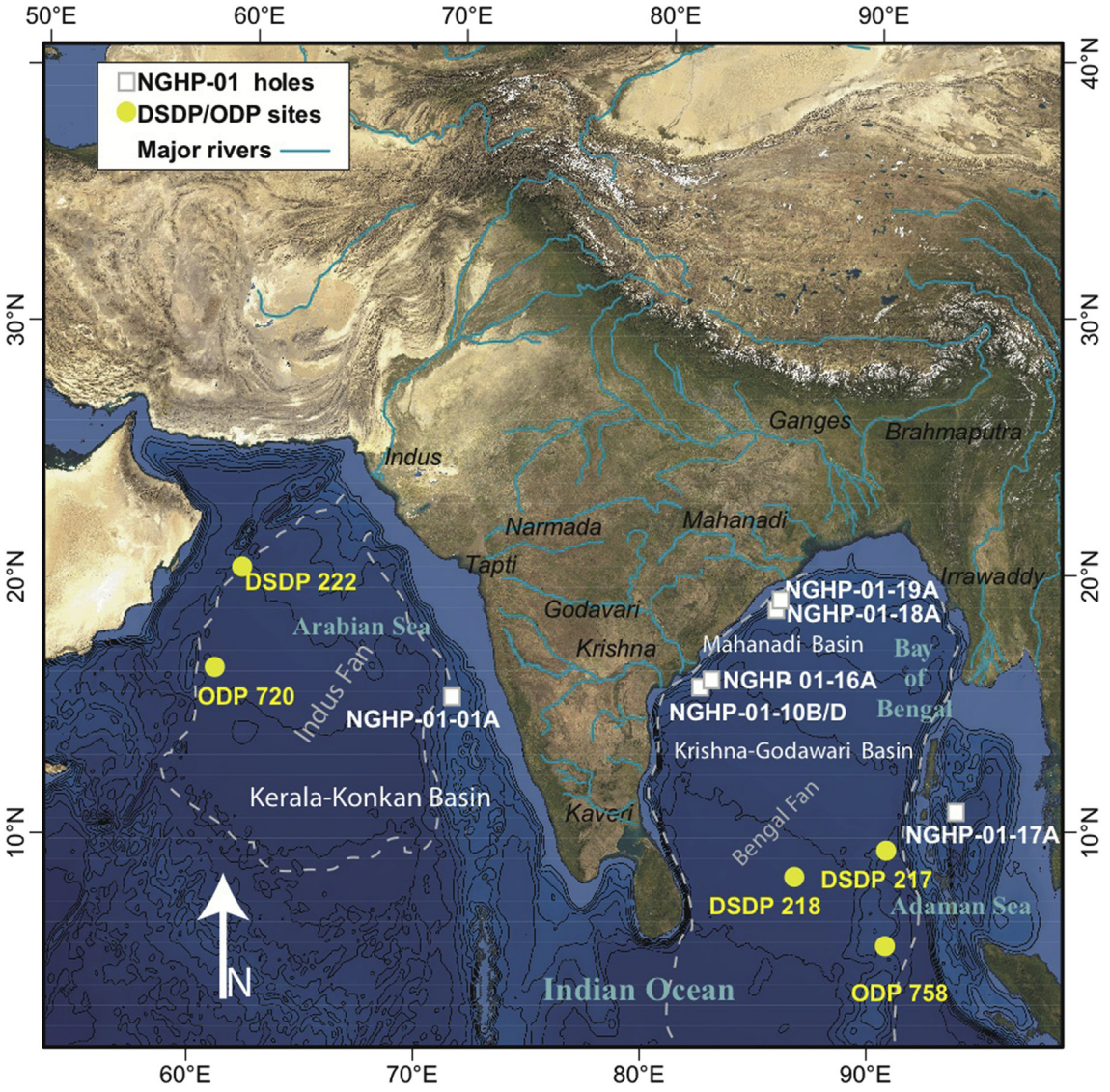

Figure 1. Site location map with the NGHP-01 holes examined in this study plus the existing DSDP and ODP sites in the region. The dotted line marks the Indus and Bengal fans.

sedimentary records on the eastern peninsular margin of India are located in sedimentary basins (Krishna–Godavari and Mahanadi) in the slope environment above the Bengal Fan depositional system (Fig. 1). These sites are also located in close proximity to the peninsular Indian Krishna, Godavari, and Mahanadi Rivers, which deliver significant lithogenic sedimentary materials to these core sites across a narrow continental shelf (Collett et al., 2008; Phillips et al., 2014a,b; Johnson et al., 2014), diluting the biogenic sedimentary constituents. The core site on the western peninsular margin of India is located on the continental slope, above the Indus fan depositional system, and far from the minor rivers that drain western peninsular India (Fig. 1). The record here is dominated by biogenic carbonate oozes (Collett et al., 2008) with less contribution from terrestrial lithogenic or carbon sources (Phillips et al., 2014a; Johnson et al., 2014). The core site in the Andaman accretionary wedge is located above both the Bengal–Nicobar Fan depositional system and the Andaman back-arc basin (Fig. 1). The sedimentary record here is dominated by carbonate oozes and biosiliceous carbonate oozes punctuated by airfall volcanic ashes (Collett et al., 2008; Cawthern et al., 2014; Rose et al., 2014). Clay mineralogy is dominated by smectite throughout the record, and most likely sourced from local volcanic ash sources (Phillips et al., 2014a,b).

In this paper we provide a first attempt at age-models for these records at a resolution significant enough to interpret variations in patterns of sedimentation and the continuity of the records in these regions. Here we present calcareous nannofossil and planktonic foraminifera biostratigraphy from at least one core in each of the four study regions. The identification of calcareous nannofossil and planktonic foraminifer orbitally calibrated events (e.g. Lourens et al., 2004; Raffi et al., 2006; Wade et al., 2011) have been then used to calculate sedimentation rates, which are important for understanding terrigenous and biogenic sedimentary fluxes, linked to regional geological and climatic processes. These age models have been used initially to interpret longer timescale variations in productivity (Cawthern et al., 2014), carbon sources and abundance (Johnson et al., 2014), and lithogenic fluxes (Phillips et al., 2014a,b) in these regions and serve to guide future scientific drilling expeditions and biostratigraphic studies to help constrain the history and evolution of the Indian monsoon.