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Neogene syn-tectonic sedimentation in the eastern margin of Arakan–Bengal basins, and its implications on for the Indian–Asian collision in western Myanmar

Kyi Khin [a,*], Takashi Sakai [b], Khin Zaw [c]

[a] SK Engineering and Construction, Singapore
[b] Dept. of Earth and Planetary Sciences, Faculty of Science, Kyushu University, Fukuoka, Japan
[c] CODES ARC Centre of Excellence in Ore Deposits, University of Tasmania, Hobart, Tasmania, Australia

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ABSTRACT

The Arakan Basin is one of the major sedimentary basins formed in the frontal part of the Himalayan orogenic belt since the Late Cenozoic. Defining one of the four major sedimentary basins of Myanmar, it is geomorphologically and tectonically differentiated from the others. The study area along the westernmost edge of Myanmar is separated from the Arakan Yoma (Indo–Burman Ranges) by a narrow coastal strip and is bordered by the Bay of Bengal to the west.

Regional stratigraphic correlation and the geological age of the siliciclastic sequences were established based on planktonic foraminiferal zonation. Deep marine slope and shelf environments during Early- to Middle Miocene (ca. 21.5–11 Ma), and a southward prograded shelf–delta environment during Late Miocene to Pliocene time were determined.

The Early Miocene underthrusting along the Himalayan front is well documented by the forced-regressive sedimentation patterns in the slope and shelf systems, sediments of which derived from the paleo-Ganges–Brahmaputra river systems in the Bengal–Arakan basins. Sequential evolution of the Miocene successions manifests in forced regressive wedged systems tracts. These evolved through slope by-passing and slumping and, following deep-marine channel in-filling, began to accumulate an increasing sediment load due to the rapid fall of sea level by the uplift in the hinterlands during the Early- to early-Middle-Miocene.

The formation of a shelf–delta systems marks a dramatic shift in the evolution of the southward prograding delta systems following a eustatic sea-level low. In the foreland areas, erosional off-loading with foreland uplifting caused a wide active fluvial systems and formed transverse rivers distally in the late-Middle- to Late-Miocene.

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1. Introduction

In recent years, there have been an increasing number of studies aiming to interpret the link between tectonic events and sedimentary responses (Curray, 1991; Harrison et al., 1993; Beck et al., 1995; Harris, 1995; Burbank et al., 1996; France-Lanord and Derry, 1997; Uddin and Lundberg, 1998a,b, 2004; Curray, 2005; Zahid and Uddin, 2005; Searle et al., 2007). In this context, substantial effort has been devoted to subdividing syn-tectonic successions into genetic sequences, which reflect changes in parameters such as provenance, tectonically induced subsidence and uplift in sedimentary basins.

The Miocene Arakan Basin is located in the Arakan Coastal Ranges, situated at the junction between the Indian and Asian Plates (Fig. 1). The collision of these plates produced the Himalayan orogenic belts, the most profound tectonic event of the past 100 million years (Searle et al., 2007). The northern Himalayan domain began to experience extensional tectonics after the Eocene–Oligocene transition while the Himalayan orogeny was still in progress (Zhang et al., 2012).

The collision history of the Himalayas is recorded in sediments deposited in subsiding foreland basins to the south (Burbank et al., 1996), including the Bengal Basin of Bangladesh and the western part of the Indo–Burman Ranges (Uddin and Lundberg, 1998a) and the Bengal Fan (Curray, 1991, 2005; Searle et al., 2007). The collision and arc–trench systems of northwestern Myanmar contain sedimentary basins developed since the Late Cenozoic. Various models have been proposed for the tectonic evolution of the Himalayas and Tibetan Plateau relating to this Neogene foreland and foredeep sedimentation (e.g. Dewey and Burke, 1973; Powell and Conaghan, 1973; Powell, 1986; Copeland and Harrison, 1990; Burbank et al., 1993; Harrison et al., 1993; Beck et al., 1995; Harris, 1995; France-Lanord and Derry, 1997; Yin et al., 1999).

Many papers have been published from neighboring regions, using geological evidence to constrain the timing of the India–Asia

* Corresponding author at: BLK.402#05-16, Admiralty Link, Singapore 750402. Tel.: +65 8183 3041.
E-mail address: kyikyaw2@yahoo.com (K. Khin).

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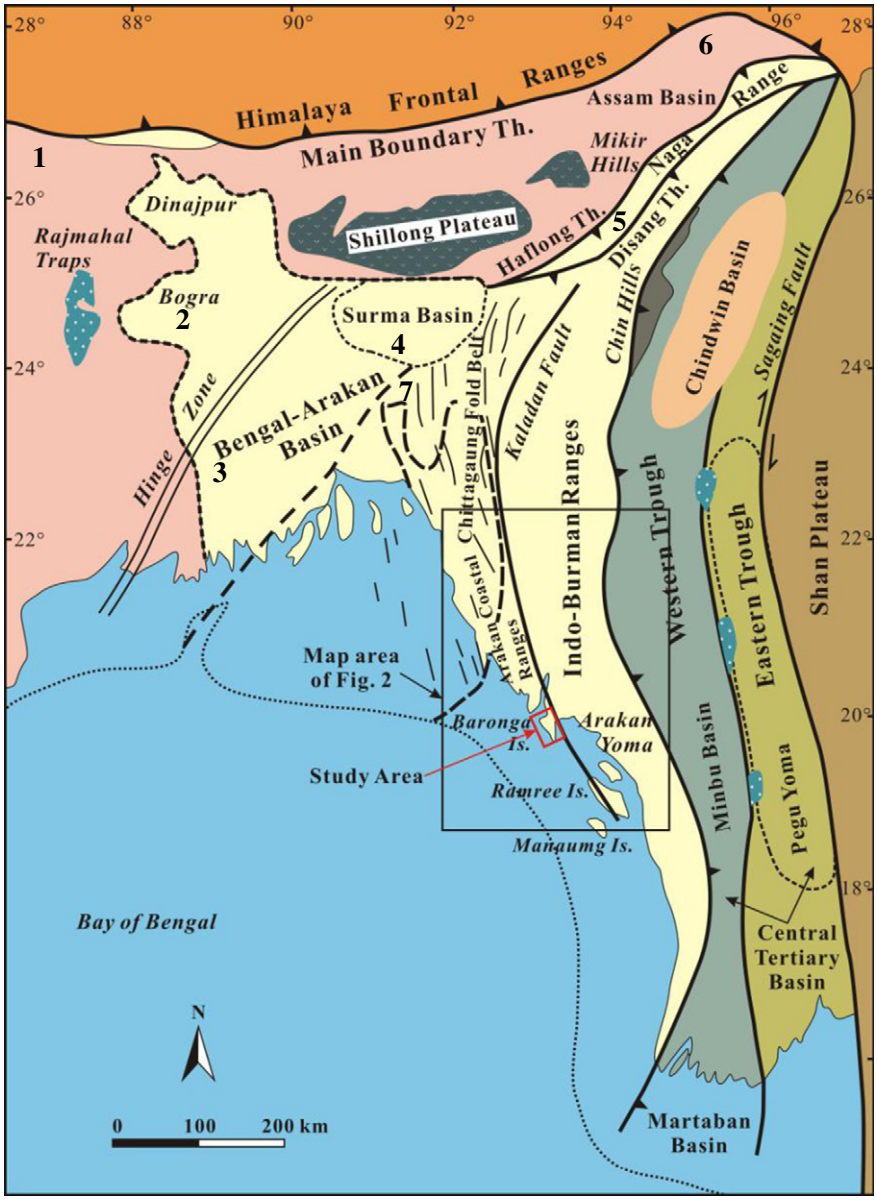

Fig. 1. Tectonic divisions of western Myanmar and associated foreland basins in the eastern India region. Map area of Fig. 2 is shown as bold rectangular box. Dash lines represent paleo-shelf boundaries.

collision; the western and eastern Himalayas (Searle et al., 1987; Beck et al., 1995; Yin et al., 1999; Searle et al., 2007; Seno and Rehman, 2011), Siwalik Ranges and Nepal regions (Harrison et al., 1993; Sakai, 1997; De Celles et al., 1998), Bengal Basin of Bangladesh (Johnson and Alam, 1991; Uddin and Lundberg, 1998a,b, 2004; Zahid and Uddin, 2005), deep-sea Bengal Fan (Curray and Moore, 1974) on two drilling legs DSDP Leg 22 and ODP Leg 116 (e.g., Ingersoll and Suczek, 1979; Cochran and Stow, 1989; Cochran, 1990; Copeland et al., 1990; Amano and Taira, 1992; France-Lanord et al., 1993), and the northern Ninety-East Ridge on ODP Leg 121 (Klootwijk et al., 1992a,b).

On-land geological information from the Arakan Basin, situated between Bengal Basin to the west and Indo–Burman Ranges to the east, however, has not been well documented. The relationship between the sedimentary evolution of the foreland basin that contains both pretectonic and syn-tectonic sequences and the unroofing history of the eastern Himalayas and Indo–Burman Ranges is barely documented. Previous preliminary studies (Aung Khin and Kyaw Win, 1966, 1967; Brunnschweiler, 1974) interpreted that the detrital provenance of the Miocene–Pliocene sequence was from both an ancestral Brahmaputra River systems to the north and the Indo–Burman Ranges to the east. Recent study on provenance of the Miocene sedimentary rocks of the Indo–Burman Ranges (Allen et al., 2008) provided information on Neogene sediments of Indo–Burman Ranges. They interpreted that dominant derivation from the Himalayas and a minor arc-derived component may have been sourced from the Trans-Himalayas, or recycled from the arc-derived Paleogene Indo–Burman Ranges. As such, the Neogene Indo–Burman Ranges most probably represent accretionary prism sediments of the Himalayan-derived paleo-Bengal Fan.

This study is to shed some light on the sedimentation in the distal foreland basin of the Himalayan–Bengal Systems, related to control on timing and distribution of erosional fluxes derived from the uplifted Himalayas since the Early Miocene. The results from the present study constrain two models by providing important information linking syn-tectonic sedimentation in proximal foreland basins and deep marine sediments with periodicity of uplifting and resulting

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