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Palynostratigraphy and depositional setup of Early Cretaceous sediments of Bantumilli Graben and adjoining area, Krishna Godavary Basin, India

B. S. Pundeer and Bijai Prasad
Palynology Division, Geology Group, KDMIPE, ONGC, Kaulagarh Road, Dehradun-248195, Uttrakhand, India
Presenting author, E-mail: pundirbs@yahoo.com

Abstract

Integrated palynological studies have been carried out on the Early Cretaceous and older Mesozoic sediments encountered in wells BTS-A, MS-A, C & D, SRM-A, KND-A, GJ-A, SU-D and SU-F from Bantumilli Graben and adjoining areas in West Godavari Subbasin. The studies are undertaken with objective to determine precise age, depositional environments, recognition of hiatuses and correlation of Early Cretaceous synrift sequence, occurring below the Albian-Cenomanian boundary unconformity (MI60 level unconformity). Eighteen dinoflagellate cyst bioevents, ranging from Tithonian to Albian-Cenomanian are recognized, and corroborated with associated spore-pollen data that précised the age of different Late Jurassic - Early Cretaceous lithounits encountered in the studied wells.

Palynostratigraphic studies in the above wells reveal the occurrence oldest synrift sediments of Tithonian age at the drilled depth level in KND-A and GJ-A wells suggesting the initiation of rift in K.G. Basin during Tithonian. Jurassic sediments older than Tithonian are not recorded in the studied wells. The absence of major part of Jurassic and older Permo-Triassic Gondwanic sediments suggest that above time span is represented by a major hiatus. Another important hiatus is also recognized across the Albian-Cenomanian boundary spanning ca 3 to 5 My which marks the shift of basin from rift to passive margin setup. The succeeding Early Cenomanian is marked by emergence of major transgressive phase in the KG Basin as spiked by the maximum diversity of marine phytoplanktons.

Dinoflagellate cyst diversity and associated spore-pollen occurrences in the studied wells suggest fluctuating marginal marine to inner neritic depositional environment for Late Jurassic (Tithonian) - Early Cretaceous (Neocomian-Albian) sediments.

The precise dating and interpretation of depositional environment of latest Jurassic- Early Cretaceous sediments in Bantumilli Graben and adjoining areas, and recognition of unconformities will help in intra and interbasinal correlation. Present studies will also help in precise mapping of Early Cretaceous reservoirs in the above areas of KG Basin for refining the geological model.

INTRODUCTION

The initiation of K.G. Basin rift along the Indian East Coast is well understood to be during the Late Jurassic (Tithonian) corrosponding to the break-up of the Indian Plate from the East Gondwanaland (Powell *et al.,* 1988; Prasad *et al.,* 1996; Prasad, 1999). The basin consists of thick, shallow to deep marine successions ranging from Upper Mesozoic (latest Jurassic-Early Cretaceous) to Holocene. Recent discoveries of commercial oil & gas from Cretaceous and the older sediments have necessitated for detailed geoscientific studies with special reference to the biostratigraphic inputs that could provide lead in hydrocarbon exploration activities of the K. G. Basin.

The geological age and depositional environment of different formations/lithounits occurring in outcrops as wells subsurface of K. G. Basin, especially the Cretaceous and Pre-Cretaceous sequence, are well established through various fossil parameters by the ONGC geoscientists (for details Venkatarengan *et al.,* 1993; Prasad *et al.,* 1995; Raju *et al.,* 1996; Prasad, 1999; Prasad & Phor 2009, Pundeer et.al 2011). However, in recent years problems are being faced by the geoscientists in dating and correlation of some of the Cretaceous and Pre-Cretaceous sections in the newly drilled wells in Bantumilli Graben and adjoining areas that led to intra and interbasinal correlation problem. Keeping in view of above problems, attempts have been made to precisely date the Early Cretaceous sequences of Bantumilli Graben and adjoining areas of KG-PG Basin (Fig. 1) to establish a logical intrabasinal correlation.

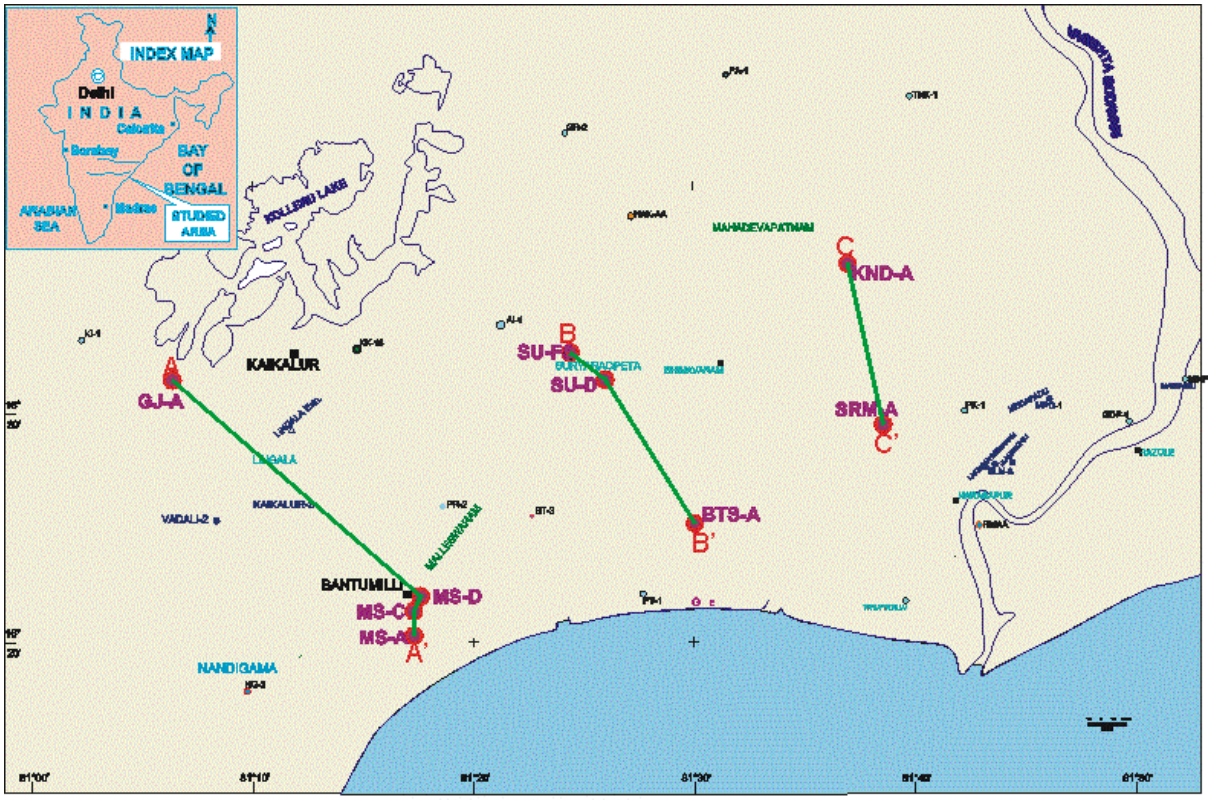

Fig. 1. LOCATION MAP

OBJECTIVES

Integrated high resolution biostra-tigraphic studies on the Early Cretaceous and older sediments in BTS-A, MS-A, C & D, SRM-A, KND-A, GJ-A, SU-D and SU-F wells of Bantumilli Graben and adjoining area undertaken to ascertain precise age, recognition of unconformities, interpretation of depositional environment and intra & interbasnal correlation for basin modeling.

OBSERVATION

Eighteen globally established Early Cretaceous dinocyst bioevents from Tithonian to Albian are recognized and corroborated with associated foraminifera, nannoplankton & spore-pollen. Oldest sediments of Tithonian are precisely identified in KND-A and GJ-A only. Barremian top is marked in all the nine wells, viz. MS-A, MS-C, MS-D, BTS-A, SRM-A, KND-A, SU-F, SU-D and GJ-1 at 3750m, 3805m,3780m, 4000m,3650m,3800m, 3400m, 2875m and 2025m respectively. However, Hauterivian sediments are precisely identified in MS-A, SU-D, SU-F,GJ-A, SRM-A and KND-A. The well KND-A and GJ-A recorded Tithonian (Latest Jurassic) sediments over the basement, whereas in SRM-A, MS-D, MS-C and BTS-A Neocomian sediments are identified in the lowermost drilled depth level.

DISCUSSIONS AND INTERPRETATION

The biostratigraphic studies carried out on the wells KND-A and GJ-A have revealed the presence of Tithonian (Latest Jurassic) sediments above the basement, whereas, in well MS - A, C, D, SU-D, F, BTS-A and SRM-A Lower Cretaceous sediments recognized at the drilled depth level. All the wells recorded characteristic Albian-Aptian palynofossil assemblages including age marker dinoflagellate cysts, suggesting the presence of sediments of similar age below the MI60 (Albian-Cenomanian Unconformity) level. Palynoflora older than Late Jurassic are not recorded in the studied wells suggesting the absence of major part of Jurassic or older Permo-Triassic Gondwanic sediments. A correlation of above identified Early Cretaceous sediments are shown in Fig. 2.

HG-HR Barremian-Aptian to Early Albian shale occurring below the MI60 Unconformity, and resting over Kanukollu/Gollapalli Formation, represents the sensu-stricto Raghavapuram Shale that biostratigraphically correlates with its outcropping type section near Raghavapuram Village in West Godavari District. Succeeding LG-LR Cenomanian -Turonian to Santonian shale above MI60 Unconformity, till now grouped into “Upper Raghavapuram Shale”, is a quite separate lithounit, representing basal unit of the passive margin sequence.

Recovered flora suggest intertidal environment during latest Jurassic-Neocomian that shifted to subtidal during Aptian-Albian.

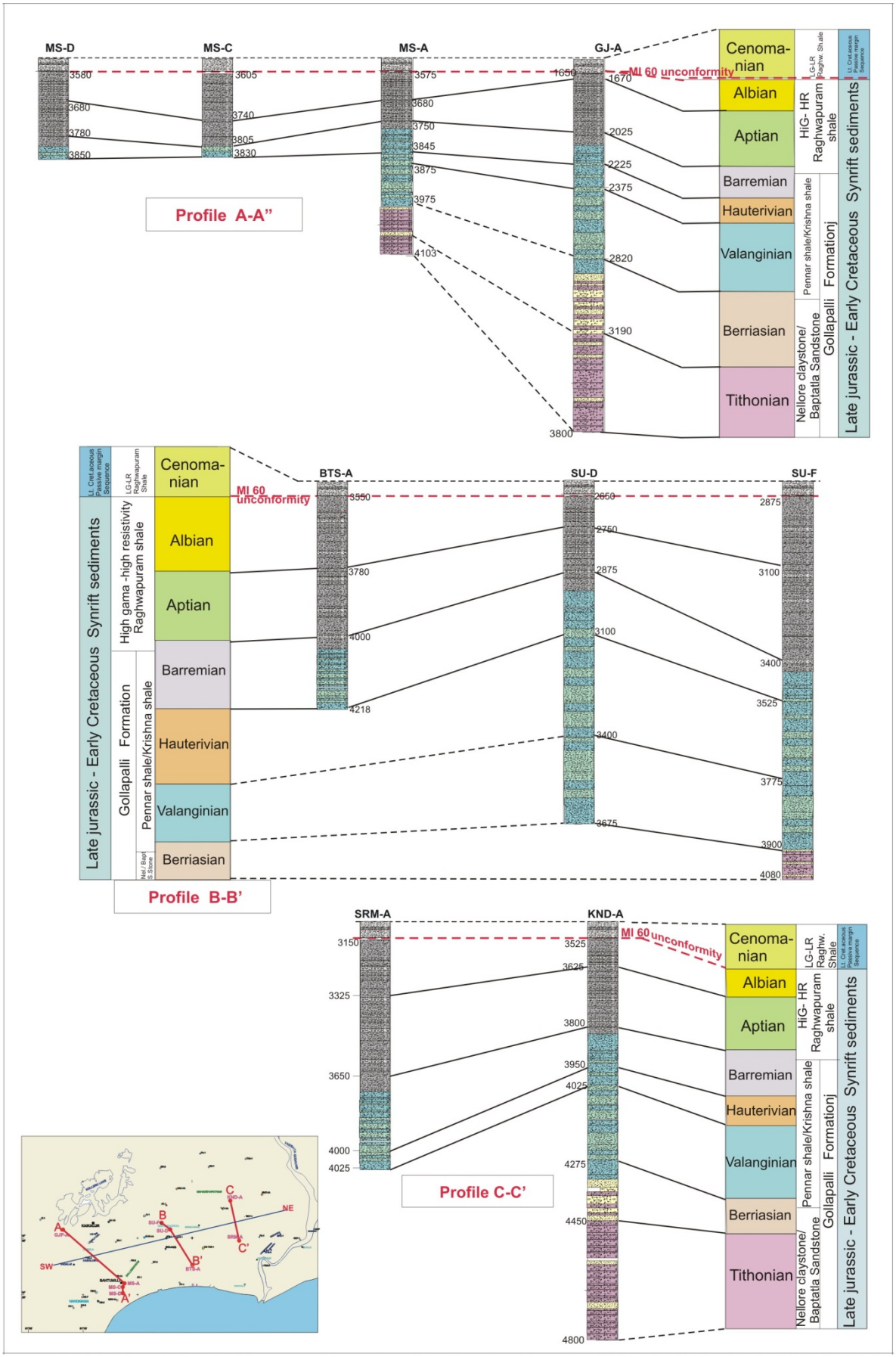

FIG. 2. Biostratigraphic correlation of wells MS-D, MS-C, MS-A, BTS-A, SU-D, SU-F, SRM-A & KND-A across different profiles of Early Cretaceous sequence in Bantumilli Graben, K. G. Basin

CONCLUSIONS

The well KND-A recorded Tithonian (latest Jurassic) sediments over the basement, whereas in SRM-A, MS-D, MS-C and BTS-A Neocomian sediments are identified in the lowermost drilled depth level. Palynoflora older than Late Jurassic (Tithonian) are not recorded in the studied wells suggesting the absence of major part of Jurassic and older Permo-Triassic Gondwanic sediments. Eighteen globally established Late Jurassic-Early Cretaceous dinoflagellate bioevents ranging from Tithonian to Albian are recognized. Aptian and Barremian tops are precisely marked in all the studied wells. The most significant finding of the present work is the recognition of an unconformity across the Albian-Cenomanian boundary in all the studied wells which broadly corresponds to the MI60 Level unconformity of the East Coast Pericratonic basins that correspond with the change of basin from rift to passive margin setup. This unconformity also separates the HG-HR shale from the overlying LG-LR shale of Raghavapuram Formation. The span of hiatus across the Albian-Cenomanian boundary varies from 3-4 Ma.

The palynofloral assemblages recorded in the studied wells suggests that the Tithonian-Barremian sediments were deposited under marginal marine environment, whereas inner neritic condition prevailed during the deposition of Aptian-Albian sediments. An Inner to middle neritic environment is interpreted for Cenomanian sediments.

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