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Multimicrofossil biostratigraphy and paleoenvironment of Yanam offshore wells, Krishna – Godavari Basin, India

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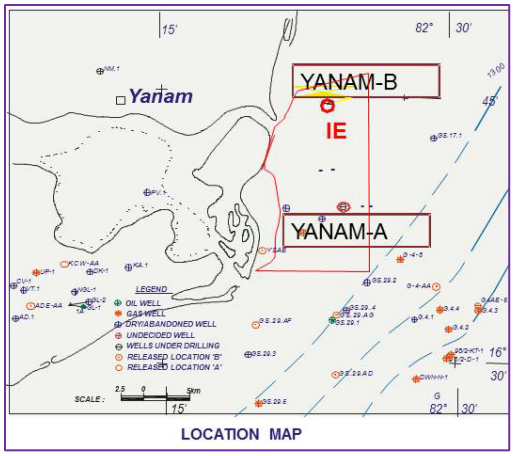
ABSTRACT

Multimicrofossil biostratigraphy and paleoenvironment using foraminifera, nannofossils and dinoflagellate cysts and biostratigraphic correlation with earlier studied wells is attempted in two wells of Yanam offshore. K/T boundary is marked at 2790 m and 2335 m, respectively in wells Yanam A and B. Well Yanam A, drilled to 5005m, has oldest sediments dated Kimmeridgian - Tithonian and youngest as Late Pliocene. Dinoflagellate cysts indicate shallow inner shelf environment for Kimmeridgian **-** Tithonian. Foraminifera suggests fluctuating outer shelf to upper bathyal environment for Hauterivian - Pliocene sediments. Well Yanam B drilled to 4155m, has oldest sediments of Hauterivian - Barremian age and youngest of Pliocene age. Foraminifera and dinoflagellate cysts suggest fluctuating inner to outer shelf environment for Early Cretaceous and middle shelf to bathyal environment for the Late Cretaceous to Early Pliocene section. Albian - Cenomanian sediments in Yanam A are thicker as compared to Yanam B. The study refines existing geological model and understanding of age and paleodepositional setup in Yanam shallow shelf.

WELL A: MULTIMICROFOSSIL STUDY

Data generated on Foraminiferal, nannofossils, dinoflagellate and spore pollen was integrated to arrive at precise age boundaries between Jurassic, Early Cretaceous and Neogene sections penetrated in the studied wells. In well A, the basement was encountered at 5005 m. The oldest sediments at 4650m yielded Dinoflagellate cyst. The overlying sediments between 4080 and 4650 were dated Hauterivian – Berriasian based on nannofossils. Dinoflagellate cysts in this interval suggest probable inner shelf environment. Albian top is marked at 3220m , Cenomanian top at 3100m, Santonian top at 2940m and Campanian top at 2840m based on nannofossils. The K/T boundary is demarcated at 2840m based on index nannofossil along with a rich foraminiferal assemblage comprising several species of *Globotruncana, Rugoglobigerina,* indicating an outer shelf to upper Bathyal environment. Paleocene top is marked based on nannofossils at 2460m. Characteristic foraminifera includes *G.velascoensis* and *G.inconstans* and an outer shelf to upper Bathyal environment is inferred. Top of middle and late Eocene are marked at 2020m and 1800m respectively on the basis of *Truncarotaloides rohri* and *T. centralis.* Foraminiferal yield indicates an upper Bathyal environment. Early to middle Oligocene section contains *Globigerina ampliapertura* and *G. tripartita.* Top of this section is marked at 1450m indicating middle to outer shelf marine conditions.



Multimicrofossil Biostratigraphic summary of well Yanam-A is as follows:

Depth	Age	Criteria
735m	Late Pliocene and younger	Foraminifera, nannofossils
1180m	Early Pliocene top	Foraminifera
1200m	Middle-Late Miocene top	Nannofossils
1300m	Early Miocene top	Foraminifera
1400m	Late Oligocene top	Foraminifera
1450m	Early to Middle Oligocene top	Foraminifera
1800m	Late Eocene top	Foraminifera
2020m	Early- Middle Eocene top	Foraminifera
2460m	Late Paleocene top	Nannofossils
2700	Early-Middle Paleocene	Nannofossils
2840m	Campanian-Maastrichtian top	Nannofossils
2940m	Santonian-Turonian top	Nannofossils
3100	Cenomanian top	Nannofossils
3220m	Albian-Aptian top	Nannofossils
3680m	Barremian	Nannofossils
4080	Hauterivian-Berriasian	Nannofossils
4650m-5005m	? Kimmeridgian -Tithonian	Dinoflagellate cysts

Late Oligocene top is marked at 1400m on the basis of *Globigerina ciperoensis ciperoensis* and *G. ciperoensis angulisuturalis.* An outer shelf environment is inferred for this section. Early

Miocene top is marked at 1300m on the basis of *Gt. mayeri, Cassigerinella chipolensis*. An Outer shelf to Upper Bathyal environment is inferred in this section. Middle to Late Miocene top is marked at 1200m based on Nannofossil, foraminifera in this section suggests outer shelf to Bathyal environment. Early Pliocene top is marked at 1180m on the basis of Foraminifera indicating outer shelf to upper Bathyal environment. Middle to late Pliocene top is marked at 735m.

WELL B: MULTIMICROFOSSIL STUDY

Multimicrofossil Biostratigraphic summary of well Yanam-B is as follows:

Depth	Age	Criteria
2130	Campanian top	Nannofossil, Dinoflagellate cysts
2230	Santonian top	Foraminifera, Nannofossil & Dino.Cysts
2410	Coniacian top	Foraminifera & Nannofossil
2730	Turonian top	Dinoflagellate cysts
3120	Cenomanian top	Dinoflagellate cysts
3800	Albian top	Dinoflagellate cysts
4140	Aptian top	Dinoflagellate cysts
4440-	Barremian	Dinoflagellate cysts
5310	and older	

Multimicrofossils data was also integrated in well B to arrive at fine time slicing in Cretaceous section. Barremian top is marked based on the LAD of *Cassiculosphaeridia magna* (125.0 Ma) at 4440m. Inner- outer shelf (20-200m) environment is inferred on the basis of palynoflora. Aptian top is marked based on the LAD of *Achomosphaera neptunii* (112.0 Ma) at 4140m. The section from 4300-4140m is mainly deposited under middle shelf environmental conditions with two pulses of deeper (Outer shelf) environments at 4280-4300m and 4200-4220m.

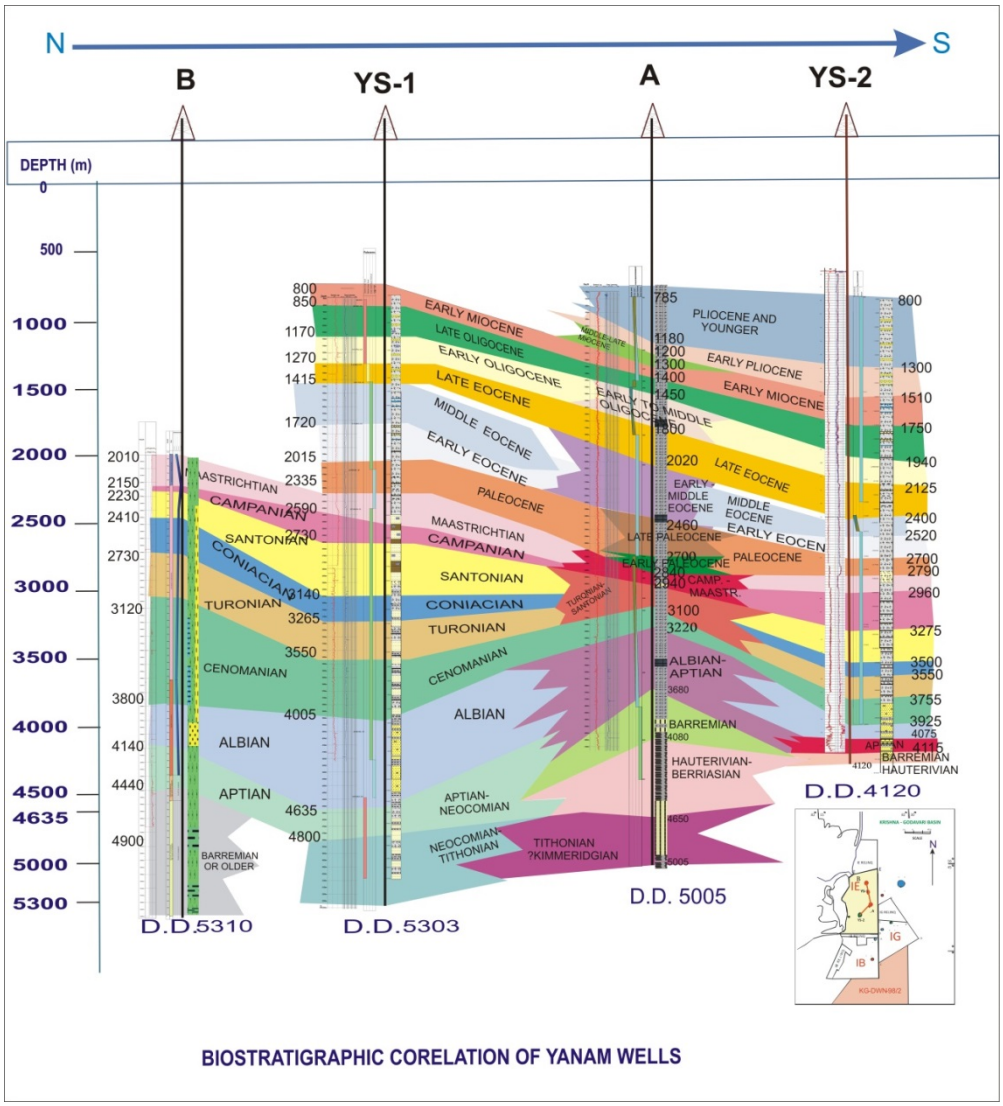
Presence of dinoflagellate cysts represented by *Litosphaeridium arundum*, *Batioladinium micropodum, Kiokansium williamsii* and *Hystrichosphaerina schindewolfii* and Nannofossil taxa *A. albianus* and *G. meddii* were recorded in the interval from 3800-4140m indicating an Albian age**.** The section was deposited under outer shelf environment.
Dinoflagellate cysts and spore-pollen represented by *Cribroperidinium edwardsii, Apteodinium granulatum, Kiokansium williamsii, Florentinia mantellii* suggest a Cenomanian age and also supported by foraminifera and nannofossils. Section from 2930-3680m was deposited in fluctuating middle to outer shelf environments. Turonian age is suggested by Dinoflagellate cysts and spore-pollen and also supported by foraminifera and nannofossils.
Middle to Outer shelf environment (50-200m) with intermittent shallowing (at 3030-3080m) is inferred.
Based on LAD of nannofossil txa *R. achlyostaurion* and *Thierstenia ecclesiastica* Coniacian top is marked at 2410m. Section was mainly deposited in middle shelf with deepening at three intervals; at 2430-2450m, 2490-2530m and 2630-2650m showing outer shelf environment. LAD of nannofossil taxa *Zeugrhabdotus scutula* is marked at 2230m indicating top of Santonian. Foraminiferal taxa *Dicarinella asymmetrica* and dinoflagellate cysts species *Xiphophoridium*

alatum, Odontochitina porifera also suggest Santonian age. Based on foraminiferal yield an Outer shelf to Upper Bathyal environment is inferred. LAD of *B. parcus constrictus* has been marked at 2150m indicating top of Campanian. Occurrence of dinoflagellate cysts species *Coronifera oceanica* and *Hystrichodiniun* spp. indicates a Campanian age.

Section from 2130-2230m is deposited under Outer shelf to Upper bathyal marine environment. Presence of Foraminifera taxa *Globotruncana lapparenti*, *G. arca, G. linneiana, G. ventricosa,* Nannofossil taxa *Cribrocorona echinus, A. maastrichtiana, Micula spp.* and Dinoflagellate cysts species *Cannosphaeropsis utinensis*, *Xenascus asperatus* indicate Maastrichtian age. The foraminiferal and dinocysts assemblage in the upper section (2010-2070m) indicates a fluctuating Middle to Outer shelf environment; while the lower section (2070-2130m) is deposited under Outer shelf - upper bathyal marine environment.

CONCLUSIONS:

1) Campanian, Santonian, Coniacian tops are marked using foraminifera and nannofossils in well B.
2) Turonian, Cenomanian, Albian and Aptian tops are marked on the basis of dinoflagellate cysts at 2730m, 3120m, 3800m and 4140m respectively.
3) Section from 4440m to 5310m has been referred to Barremian and older based on the dinoflagellate cysts.
4) The oldest sediments in well A (4650-5005m) are dated Late Jurassic (?Kimmeridgian - Tithonian) on the basis of palynofossils: Dinoflagellate cysts and spore pollen studies indicating a shallow inner shelf environment.
5) K/T boundary is recognized in A at 2840m based on foraminiferal studies.
6) Biostratigraphic correlation between recently drilled wells in Yanam offshore indicate that Albian in well B is thinner as compared to well YS-1, whereas, it is thicker and appear to be higher in A as compared to wells YS-1 and YS-2.Sediments referred to Cenomanian stage are thicker in well B as compared to wells YS-1, A and YS-2.
7) The oldest sediments in well B are referred to Barremian and older whereas in well A they are dated ?Kimmeridgian - Tithonian on the basis of dinoflagellate cysts.



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