SEQUENCE STRATIGRAPHY IN CAMPOS BASIN UPPER CRETACEOUS DEEP WATER DEPOSITS

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SUMMARY

The Upper Cretaceous deep water turbidites in Campos Basin are predominantly characterized by sandy retrogradational depositional systems filling structural lows formed by halocinesis. According to the foraminifera content the depositional environment was in medium batial depths. Tectonism, eustasy and sediment supply have influenced, in several scales, the faciologic features (textures), and geometry of the deep water sandy reservoirs.

The evolutive stratigraphy of the depositional sequence is made up, from base to top, of the following architectural elements: 1) basal conglomerate systems; 2) confined coarse grain turbidite lobes (Bruhn, 1998); 3) channel-overbank association (Walker, 1992) interlobe / interchannel (fringe facies); 5) unconfined fine grain turbidite lobes and, 6) unconfined medium grain turbidite lobes, herein named as depositional domains D1 to D6, respectively.

The D1 to D6 depostional domains could be splited into two third order depositional sequences and four fourth order depositional sequences superimposed (Fig. 1). The depositional sequences and systems tracts have been individualized based mostly on bioestratigraphy and paleobatimetric analysis, along with stratigraphic and sedimentological criteria, and well log patterns. The sequence stratigraphy concepts were applied to assemble the architectural elements, in systems tracts; and to stablish the sedimentary evolution in high frequency fourth order depositional sequences.

INTRODUCTION

Local seismisms, halocinesis and volcanic activities were the main contributing agents to form the Upper Cretaceous sedimentary framework of the Campos Basin deep water deposits. These agents associated with relative sea level variations are key factors in the history of the basin, mostly on provenance, sediment composition, bottom features, internal and external geometry of sandstone bodies.

A case hystory of halocinetic lows filled by Upper Cretaceous sediments in the batial enviroment is present here. The sequence stratigraphy concepts (Posamentier, 1988) have been used, in spite of the tectonic influence, mainly in the basal sedimentary deposits (D1).

The identification of the depositional elements, systems tracts (Brown & Fisher, 1977) and, the genetic correlation of each fourth order depositional sequences (Vail et alii,1991), have been done through integration and interpretation of the geological data. The methodology used in this work was to group facies into facies association, depositional elements, and architectural elements (Miall,1985).

The architectural elements were informally named sedimentary domains (D1 to D6), bearing chronoestratigraphic concepts (Figs. 1 and 2). The architectural elements are also identifiable in 3D seimic sections (Fig. 3).

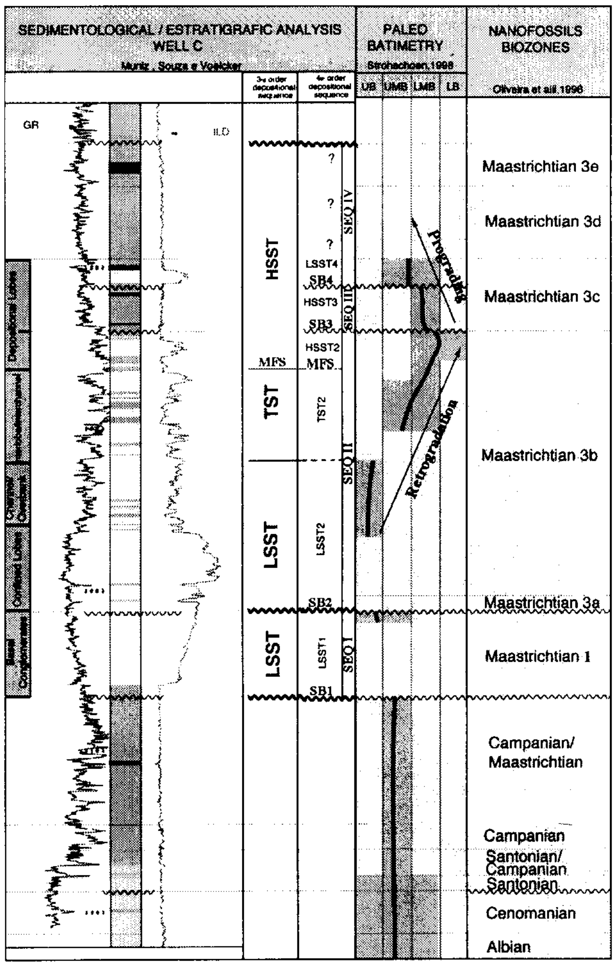

Fig.1 – Sedimentologic / Stratigraphic data with Paleobatimetry and Calcareous Nanofossil Zones (Petrobras).

DEPOSITIONAL ENVIRONMENTS

All the sedimentation occurred in the upper to medium/low batial environments filling halocinetic structural lows. The base of the sequences are characterized by confined coarse grain sandy deposits (D1 and D2). The D1 and D2 are thick and laterally restricted deposits. Upwards, the sandy deposits become fine to medium grain (D6), as well as thin and widespread.

The complete evolution shows a retrogradational behavior from the D1 to D4 and progradation of muddy section D5 and D6 (Fig. 2).

SEQUENCE STRATIGRAPHY

The sequence stratigraphy concepts used in this area were based on rock data and biostratigraphic analysis (nanofossils and paleobathimetric foraminifera data). Two deposicional sequences of third order and four of forth order were defined (Fig. 1). The depositional sequences identified are limited by erosive discordances (Vaill *et alli*, 1991).

The sedimentary record herein studied has beeen dated as Upper Cretaceous based on calcareos nanofossils data. All of the section is filling a low of halocinesis origin.

Four depositional sequences (Seq.I,II,III and IV) of fourth order were identified (Fig, 1).

Seq.I- Positioned between the discontinuity (sequence boundary 1-SB1) in the base of Mastrichtian 1 and the base of the Maastrichtian 3a (SB2). It is a basal sequence of low filling with polimitic conglomerates in a low stand system tract 1 (LST1). A well defined discontinuity (SB2) is observed between this lower sequence and the upper one.

Seq.II- between the discontinuity SB2 (bottom) and SB3 (top). Three system tracts were distinguished using paleobathimetric and lithologic data, and the continuous increasing of gamma ray values upward (Fig. 1). The three system tracts are: low stand system tract 2 (LST2), transgressive system tract 2 (TST2) and high stand system tract 2 (HST2). The LST2 is made up of confined sandstones (basin floor fan-bff), and channel overbank deposits (channel-levee complex-clc). A relative sea level rise allowed the deposition of a shale-rich facies association. This is represented by interchannel \ interlobes deposits (fringe facies deposits-thin bedded turbidities) of TST2 ranging from upper/middle batial to lower/middle batial environment. The end of TST2 is the maximum flooding surface (MFS), defined by the paleobathimetric data, with a high content of radiolarians. The HST2 is composed of fine grain deposicional lobes at the end of the fourth order sequence. This may indicate the begining of a progradacional sandstone in a still stand sea level.

Seq.III- A discontinuity has been identified between sequences II and III based on paleobathimetric data. Even with the continuous high stand sea level (HST3) it was possible to determine environment change based on biofacies shift above sequence II.

Seq.IV- A discontinuity at the base of the low stand system tract 4 (LST4) was also described by the paleobathimetry as a fall of sea level with the increasing grain size to medium sandstones, interpreted as basin floor lobes.

SEDIMENTARY CONTROLS

The stratal patterns and the facies distribution are the result of the acomodation and the rate of the new space added in specific sedimentation phase, directly reflecting on the textural and geometrics caracteristics of the reservoir, Posamentier *et alli*, 1988.

The first sendimentary control was the halocinetic tectonis creating depositional lows, where basal conglomerates (D1), and confined lobes (D2), were deposited. These deposits are thick, narrow and laterally restrict lenticular sandy bodies.

The deposition of the domains D3 and D4 took place during a relative sea level rise. Both intervals are shale-rich and laterally continous.

In a stand still sea level and large sedimentary supply the sedimentation was dominated by progradation. The D5 domain was deposited in a high stand system tract (HST2), composed of fine grain sandstones with large lateral continuity.

The D6 domain was deposited during a sea level fall. It is composed of fine to medium grain sandstones in a tabular geometry.

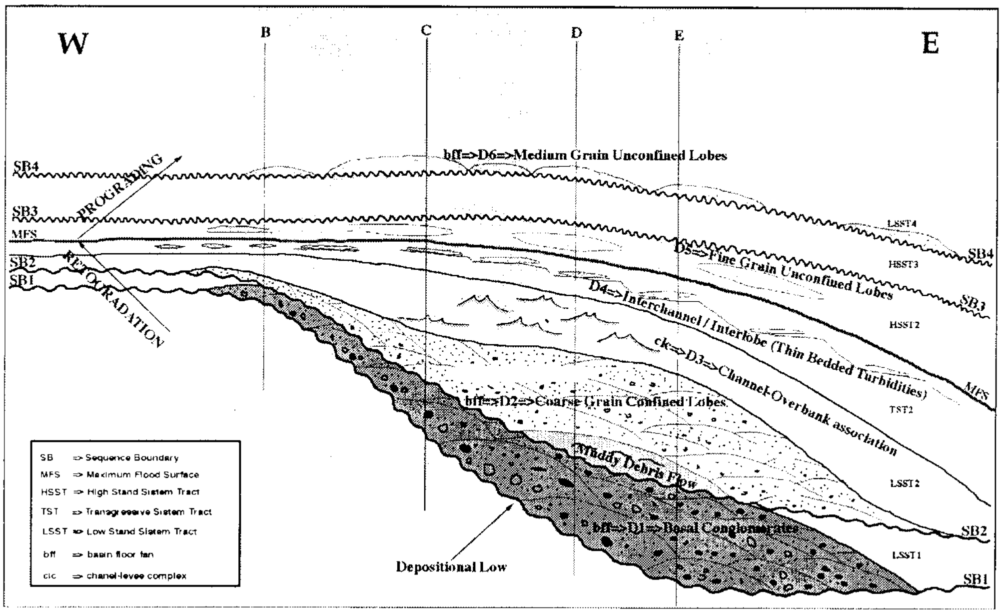

Fig.2 - Schemathic stratigraphic cross-section showing the Systems Tracts and their respective Architectural Elements

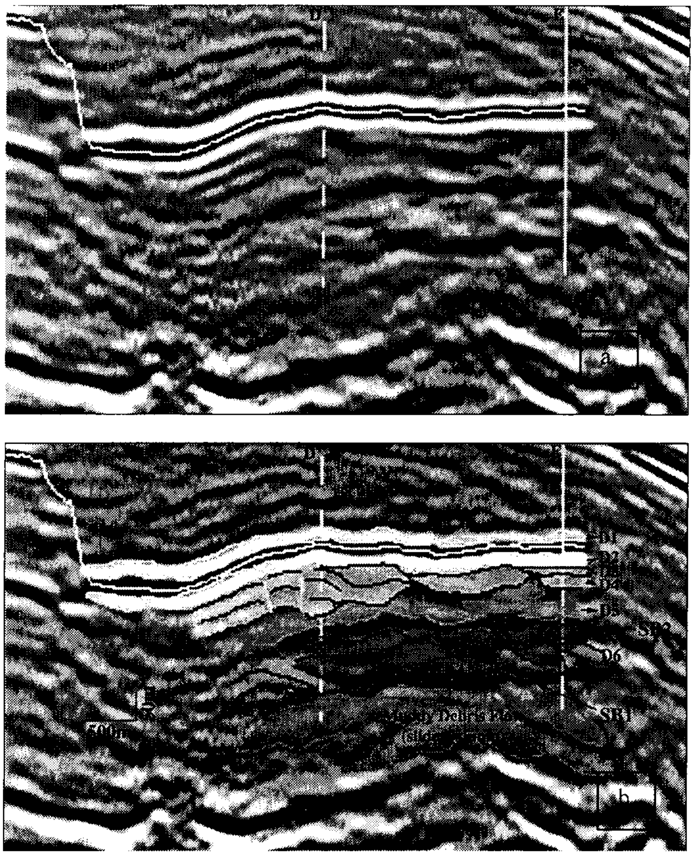

Fig. 3 – 3D Seismic Section (a) Interpreted (b) with the related arquitetural elements: D1- basal conglomerate systems; D2) confined coarse grain turbidite lobes; D3) channel-overbank association; D4) interlobe / interchannel (fringe facies); D5) unconfined fine grain turbidite lobes and. D6) unconfined medium grain turbidite lobes. Also sequence boundaries SB1 and SB2.

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