CHAPTER - 7

SEDIMENTARY CYCLES

The detailed study of microfacies, biofacies, amount of clastic supply and environments of deposition in vertical sequences in four sections has led to very interesting conclusions regarding cyclicity of sedimentation. Einsele (1982), has also worked out sedimentary cycles on similar parametres. Transgressive/regressive phenomenon which has been identified from the environments, ultimately suggests the on-lap and off-lap conditions. The changing characteristics of the depth of burial, energy of depositing medium, clarity/turbidity of aqueous zone could be well infer from the bio and lithofacies. Carbonate rocks particularly, have helped in identifying such sequences. Generally, coarsening upward/negative or fining upward/postivie sequences are identified as suggested by Reckmann et.al (1982).

7.1 SEDIMENTARY SEQUENCES

Several repetitive sequences have been identified in all the sections studied. Detailed results with respect of sections studied are described below.

7.1.1 Ratipal Section

Figure 7.1 shows microfacies, biofacies, amount of clastic supply and the resultant transgressive regressive fluctuations in

terms of paleobathymetry of Ratipal section. Three major transgressions and corresponding regressions are observed during the deposition of entire Bermoti series sequence. Both, top and base of Bermoti are marked by distinct shallowing of the sea and in turn represent unconformities. Two subsequent diastems are also observed at the base of upper Ramania stage and Waior stage.

The maximum bathymetry of about 35 metres was reached during the deposition of Waior sediments. The minimum bathymetry was less than 5 metres. Such changes could be related to wider eustatic changes as suggested by Abul Nasar et. al. (1987). The carbonate sediments close to the unconformity/diastem indicate much higher percentage of insoluble residue of clastic supply.

7.1.2 Bermoti Section

As compared to Ratipal section, the Bermoti section shows several transgressive-regressive fluctuations within Ramania stage (Figure 7.2). The Waior stage, however, indicates only one sedimentary cycle. The greater number of fluctuations are attributed to general shallowness of the sea and minor changes could very well affect the resulted facies, both litho and biofacies. However, Waior stage experienced greater depth of deposition, the maximum being about 30 metres.

The shallowing of the sea broadly matches with the maxima of the amount of clastic supply. In spite of several

fluctuations, the major sea level changes are correlatable with the global stratigraphic breaks and records as suggested by Veli, et.al. (1977).

7.1.3 Bernani Section

The bio and microfacies of the Ramania stage of Bernani section show far more fluctuations as compared to other sections (Figure 7.3). Most of the changes, however, are not complete and do show only minor shallowing of the sea. In contrast to Ramania stage, the Waior stage shows only one sedimentary cycle and gradual regression at the top.

The amount of clastic supply matches fairly well with majority of the regressive tendencies. The data shows that the depth of burial during the Ramania deposition was relatively higher and the regression could not be completely effected.

7.1.4 Waior Section

Though the Ramania stage indicates only two to three sedimentary cycles, three prominent sea level fluctuations are observed during the deposition of Waior stage in Waior section (Figure 7.4). This is in contrast to the other area, where the Waior stage shows only one sedimentary cycle. This obviously marks a general shallowness in the Waior area and is further supported by several highly bioturbated carbonate bands and abundance of ichnofossils in late Oligocene strata.

The position of general maxima of the clastic supply matches well with the shallowing of sea levels.

7.2 CYCLE CORRELATION AND LATERAL CHANGES OF UNCONFORMITIES

The detailed cyclicity documented in various sections and their exact stratigraphic positioning could be use to decipher the corresponding positions of unconformities, as well as, the correlation of sedimentary cycles. Vail et.al. (1977) followed such principles to correlate different sedimentary basins, of the world.

Figure 7.5 shows the sedimentary cycles observed in all the four sections in relation to geological time scale. The Oligocene sequence is supposed to range from 36.6 Ma to 23.7 Ma. Minor variations in the transgressive/regressive fluctuations have resulted in crossing over such time restrictions in designating the sedimentary cycles.

Broadly, the lower Ramania stage which shows only one sedimentary cycle in Ratipal, indicates several fluctuations in other areas. This possibly shows the seaward and relatively deeper basinal position of Ratipal. Excepting Bernani, the upper Ramania stage indicates only one cycle in all the area. Likewise Waior stage has experienced only one sedimentary cycle in Ratipal, Bermoti and Bernani, but in Waior proper three cycles are identified.

Comparing cycles in all the areas, it appears that the diastems between lower and upper Ramania, as well as, between

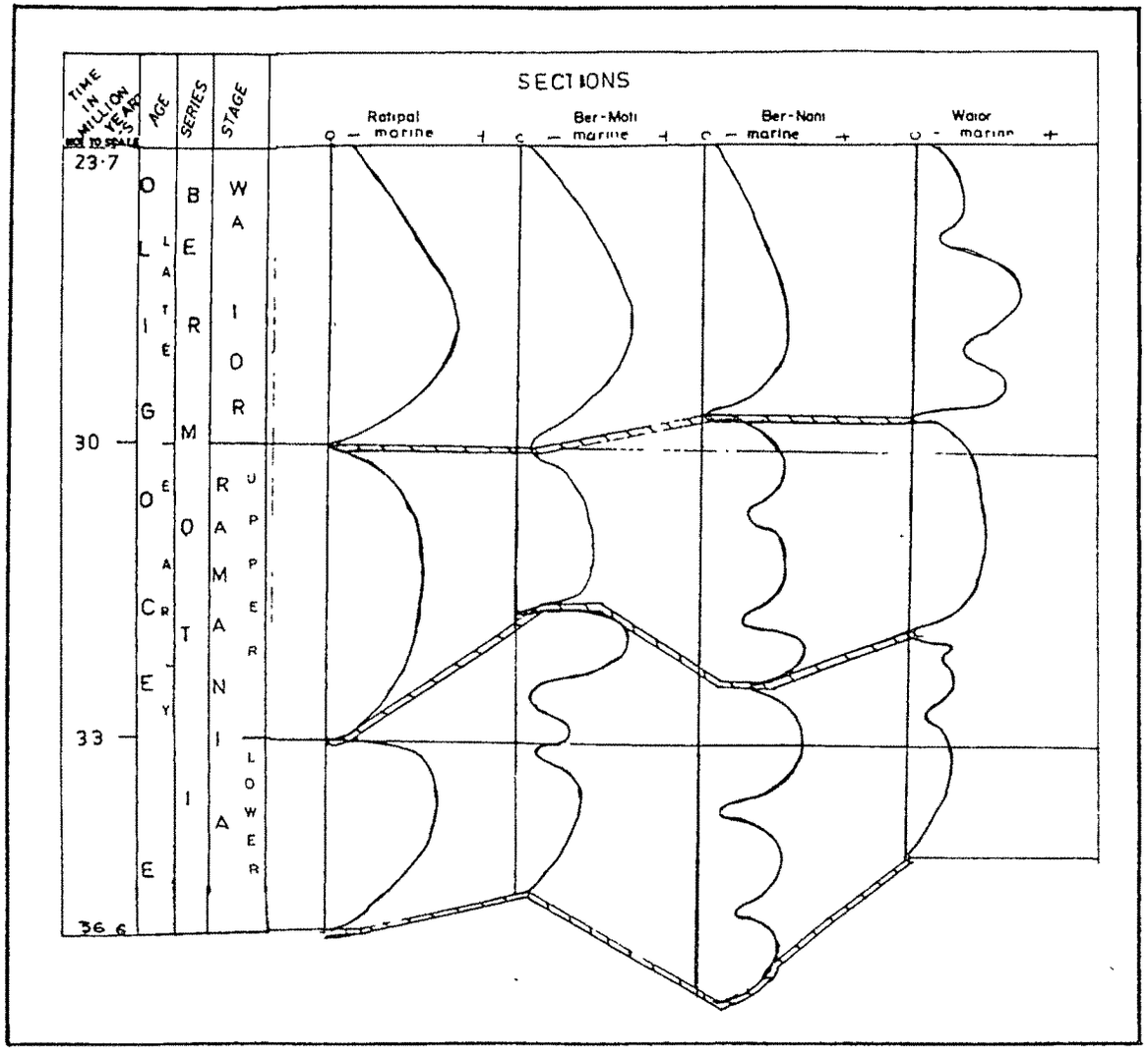

FIG 7 5 , SEDIMENTARY CYCLES , CORRELATION AND LATERAL CHANGES OF UN CONFORMITIES.

Ramania and Waior shows some shift in timing relative to each other. Broadly it appears that all diastems/unconformities indicate certain microlevel changes in the exact timings with respect to locations. The diastems between lower and upper Ramania and also between Ramania and Waior possibly commenced earlier in Waior area as compared to Ratipal where regression reached at a later date, indicating more basinward position of the latter. Similar shifting of the strandline and unconformities are also been studied by Van Siclen, (1972).

7.3 UNCONFORMITIES AND GLOBAL ONLAP-OFFLAP SEQUENCES

In addition to the base and top of Bermoti series, two distinct diastems/unconformities are identified which coincide with the lower and upper Ramania and upper Ramania-Waior boundaries.

Three units, thus identified correspond to the Adam's larger foraminifera Letter stages, Tc, Td and Te (1-4) from base to top respectively (Figure 7.6). The unconformities also correspond well with the facies which normally show red beds and a high amount of clastic supply . The effective changes of coastal onlap as identified by Haq et.al, (1986), broadly match well with the similar situation in the present area. The major off-lap sequences. do fairly well correspond with the identified unconformities of the study area. However, minor changes as envisaged by Haq et.al, (op. cit) during late Oligocene are at slight variance in the present area. The two main diastems identified at the base of upper Ramania and Waior occur roughly at 33 Ma and 30 Ma respectively.

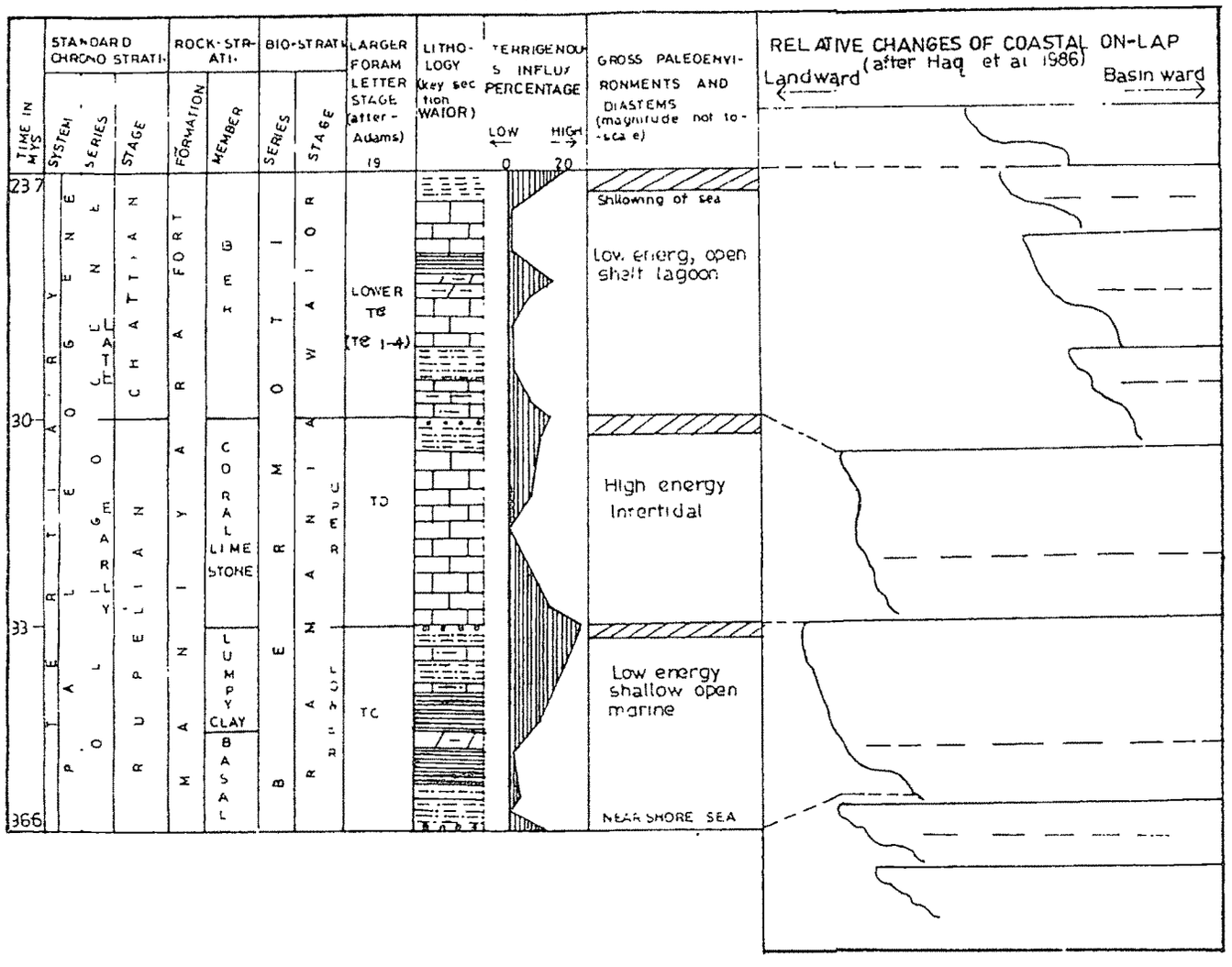

FIG 7-6, STRTIGRAPHIC POSITION OF DIASTEMS RELATIVE TO GLOBAL COASTAL ON LAP RECORD AND LARGER FORAMINIFRA LETTER STAGE

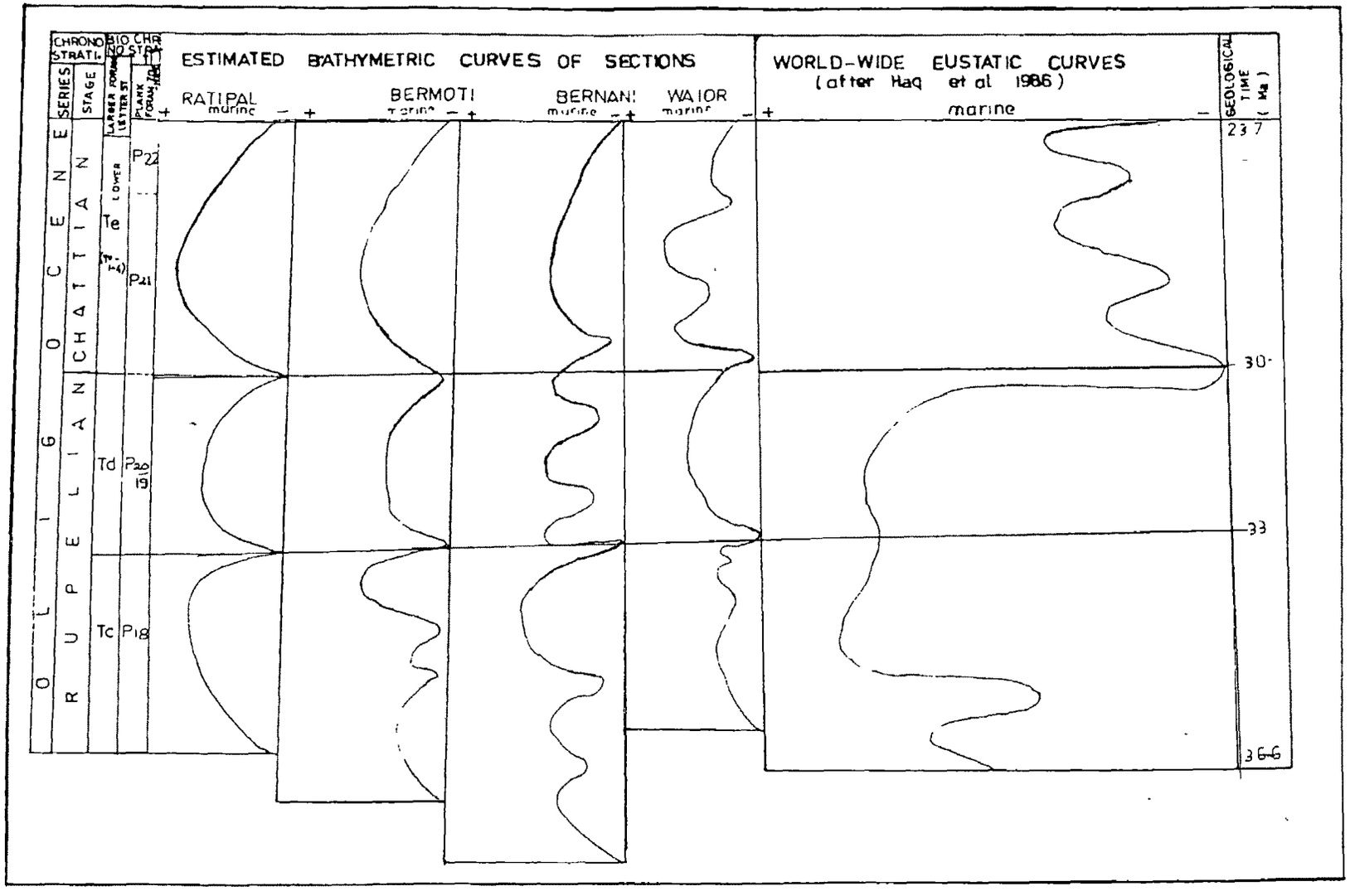

FIG:7.7 BATHYMETRIC CURVES DURING OLIGOCENE OF SOUTH-WEST KUTCH BASIN, COMPARED WITH WORLD-WIDE EUSTATIC CURVES

7.4 CORRELATION WITH GLOBAL SEA-LEVEL CHANGES

Main global regressions as identified by Haq et.al. (1986), during Oligocene, occur at 36.6, 30 and 23.7 Ma (Figure 7.7). The lower off-lap broadly corresponds with boundaries between planktonic foraminiferal zone P17/P18 and larger foraminiferal Letter stage Tb/Tc.

The middle one i.e. around 30 Ma correspond with boundary between plankton foram zones P 19-20 and P-21 and larger foram zones Td and lower Te. Whereas, the topmost off-lap roughly matches with the top of P-22 and top of lower Te.

The record of these worldwide off-lap sequences is well present in the entire studied area (Figure 7.7) though the intensity somewhat varies. Regression, in turn, diastem observed between lower and upper Ramania stage was somewhat subdued in the global record as shown by Haq et.al (op. cit). But the regression record occurring between P-21 and P 19-20 plankton zones matching with Waior and Ramania boundary in the area is less accentuated as compared to global phenominal regression record. The minor fluctuations occurring within the late Oligocene in the global record correspond with the similar fluctuations of the Waior section of the area.