RELATIONSHIP BETWEEN EROSION AND ACCUMULATION OF SEDIMENTS IN COASTAL ZONE OF BINH THUAN PROVINCE - SOUTH CENTRAL OF VIETNAM

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ABSTRACT

Binh Thuan coastal zone was composed of detrital sediments and effusive rocks of Nha Trang formation and effected by some sectors: marine current, tidal, wave... so that the hydro-lithodynamic of this area was quite complex. For solving this problem, we use two model: the first is Cerc model what was established by Civil Engineering Research Center of America applied for 0-10m water deep zone and solved. The second is Mc Laren what a Canadian sedimentologist built. Base on these results from 2 models; this area can be divided into 2 zones:

- In 0-10 water deep zone: Binh Thuan coastal zone can be divided into 3 erosive areas and 4 accumulative areas from North to South.
- In 10-30 water deep zone: strong abrasion in South of Mui Gio-Mui Yen, Hon Rom, Phan Thiet (10-25m irater deep), average abrasion in coral reef islands in Southeast of Mui Yen (18-35m water deep), East and Southeast Mui Ne (20-27m water in deep) and Southeast of Phan Thiet (18-27m water in deep), weakly abrasion in Tombolo facies where is in south of Phan Ri river mouth.

INTRODUCTION

Nowadays, erosion and accumulation of sediments in Vietnamese coastal zone are strongly happening in global modern transgression phase settings. Especially, Binh Thuan coastal zone is one of many littoral provinces has been strongly happening coastal erosion and accumulation. Therefore, the knowledge of correlative regulations not only have full meaning in arguments but also in finding the reasons, trends and quantitative of accumulation - erosion process. Base on these results we can find diminished solutions erosive and accumulative hazards in coastal zone. Binh Thuan coastal zone extended from North to South and protruding coastal sections were composed by effusive rocks of Nha Trang formation and the flat composed by red sand of Phan Thiet formation and others composed by marine and alluvial - marine sediment mixed by red sand.

METHODS

Hydro - litho dynamic problems aim solutions at erosive - accumulative sediment in shallow sea are combined fieldwork with laboratory methods.

Fieldwork methods

In process of fieldwork research Binh Thuan onshore were taken over 1000 sedimentary samples and described geological offshore outcrops and results of hydrodymamics measured.

Laboratory methods

Results of analysis and sample processing were applied to interpret lithofacies and lithodynamic features. These results were based on: grain size parameters like: Md (average grain size), So (Sorting), Sk (Skewness), Sf (Sphere) and Ro (Roundness), detrital minerals, clay minerals, geo-environment coefficients: Eh, pH, Kt, carbonate components and high solution shallow seismic....

Hydro - Lithodynamic model

Binh Thuan onshore was divided into two Hydro - Lithodynamic zones: wave dominated zone (0-10m water deep) and marine current dominated (10-30m water deep).

a. Cerc model

Cerc (Civil Engineering Research Center) formula was applied to quite straight shorelines and isobaths were nearly parallel and bottom sediment is sand.
Based on bottom sedimentary data of Binh Thuan onshore: average grain size in 10% on accumulative curved line were d10=1.41mm, d50=0.26mm and d90=0.14mm we can absolutely use Cerc formula to calculated model the 0-10m water deep zone.

b. Mc Laren model

Changes in average grain size, sorting and skewness were describing grain size distributions have been used to interprete the direction of sediment transport. This method present model whereby the distributions of sediment in transport are related to their source by a sediment transfer function which defines the relative probability that a grain within each particular class interval will be eroded and transported. When a sediment is being eroded, the probability of any grain going into transport to be finer and more negatively skewed than its source and the remaining sediment must be relatively coarser and more positively skewed. The distributions of transfer functions change from having a highly negative skewness to being nearly symmetrical as the energy of the transporting process increases. These phenomenons were called low energy and high energy transfer functions. If energy is decreasing and the transfer functions have low energy distributions, successive deposits will be finer and more negatively skewed. If energy is decreasing the initial transfer function has a high energy distribution, successive deposits will become coarser and more positively skewed. This model describing changes in sediment distribution was tested in a variety of environments where the transport direction was known. The results indicate that the model has real world validity and can provide a method to predict the direction of sediment transport. This model was conformity with Binh Thuan onshore.

RESULTS AND DISCUSSION

Lithofacies features

a. Remnant of ancient tidal flat biloclatic gravelly sand facies (Q_2^{1-2}) distributed broad in 10 m water deep, especially in Southeast of study area.
b. Remnant of ancient tidal flat slightly bioclastic gravelly sand facies (Q_2^{1-2}) appeared at 25-35m water deep in NE and 10-15m in SW.
c. Remnant of tombolo slightly bioclatic gravelly sand facies (Q_2^{1-2}) distributed in South of Phan Ri river mouth and Mui Ne (20-25m water deep)
d. Remnant of ancient bay slightly bioclastic gravelly muddy sand facies (Q_2^{1-2}) distributed in sunken relief in NE.
e. Remnant of ancient coastal shallow gravelly muddy sand facies (Q_2^{1-2}) was formed in the same phase in South of Binh Thuan coastal (15-35m water deep).
f. Remnant of ancient coastal shallow slightly bioclastic gravelly muddy sand facies (Q_2^{1-2}) was results of sedimentary differentiation in Flandrian transgression.
g. Bay slightly bioclastic gravelly muddy sand facies (Q_2) distributed in West of Mui Ne (7-16m water deep)
h. Bay bioclastic gravelly muddy sand facies (Q_2) was formed succession from Fladrian transgression up to now in South of Mui Ne (5-22m water deep)
i. Modern tidal flat bioclastic gravelly sand facies (Q_2^3) was produce of redeposit and redistributed by wave in Tan Phu to Hong Thang and Phan Thiet port to Tien An.
j. Modern tidal flat sand facies (Q_2^3)
k. Modern coastal shallow bioclastic gravelly sand facies (Q_2^3) extend and parallel with the ancient shoreline in 5-15m water deep (Phan Ri river mouth to Mui Ne and Ngoc Hai to Tien Thanh)
l. Modern coastal shallow gravelly muddy sand facies (Q_2^3) appeared at SE of Phan Ri river mouth, East of Mui Gio, SE of Mui Ne and SW of Phan Thiet.

m. Coral reef facies (Q_2) included alive coral and death in SE Phan Thiet (18-27m), E-SE Mui Ne (20-27m) and SE Mui Yen (18-35m).

Lithodynamic features

a. 0 -10m water deep zone

Corresponding to results of Cerc model, Binh Thuan onshore was divided into 8 sections: The first: Phan Ri river mouth to Mui Gio, the second: Mui Gio to Mui Yen, the third: Mui Yen - Mui Ron, the fourth: Mui Ron - Mui Ne, the fifth: Mui Ne - Ham Tien, the sixth: Ham Tien - Mui Da, the seventh: Mui Da - Phan Thiet and the last: Phan Thiet - Tien Thanh. Each of section has amount of sedimentary transportation as follow:

Section	Jan	Feb	Mar	April	May	June	July	Aug	*Sept*	Oct	Nov	Dec	Annual (m^3/year)
D1	+161614.2	+102657.5	+47027.17	+1499.417	+2619.583	+112.5	-1306.58	-13.75	+1593.667	+27245	+105790.8	+188613.3	+637452.8
D2	0	+209.3333	-7471.83	+1385.583	-57449.5	-62712.8	-167900	-151861	-100680	-25395.3	+6783.167	0	-565093
D3	+283043.8	+178983.3	+69212.08	+3364.25	+3988.25	+82.25	-1197.42	-12.1667	+2221.917	+47397.92	+185438.1	+330265.7	+1102788
D4	0	+929.4167	+11123.75	-115.667	-19067.9	-21451.7	-59058.6	-52343.3	-34140.3	-8342.5	+3134.917	0	-179332
D5	-1425.67	+34.33333	-9103.67	+2971.75	-104816	-256307	-378839	-492391	-182819	-49732	+4882.667	0	-1467546
D6	0	+683.0833	+3781.167	+510.5833	-37605	-41488.1	-112231	-100769	-66415.5	-16579.7	+5090.833	0	-365022
D7	0	+90.91667	-9948.42	+1593.25	-60384.4	-65851.8	-176011	-159411	-105760	-26991.5	+6939	0	-595735
D8	+234158.4	+148351.5	+60431.75	+2601.333	+3446.583	+94.5	-1247.17	-13.75	+1970.583	+39392.17	+153384.2	+273055.8	915625.8

Legend: (+) the direction of sedimentary transportation from North to South, (-) from South to North

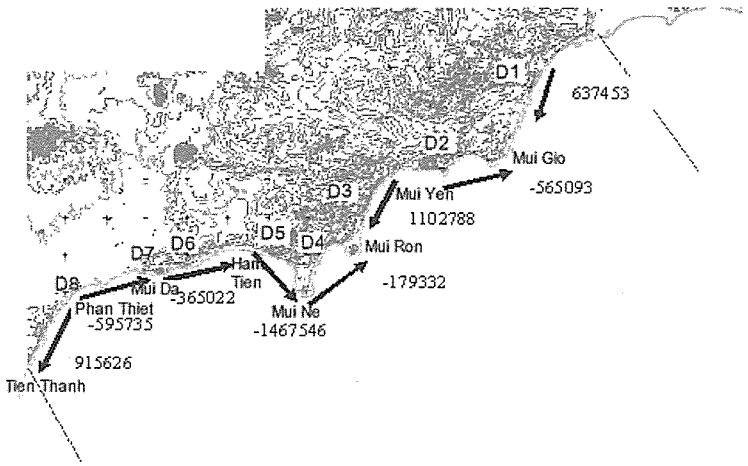

Table 2. Regulations of erosion and accumulation in Binh Thuan onshore

Section	Transported amount (m^3/năm)	Erosion - Accumulation trends
D1-D2	+1202546	Accumulated
D2-D3	-1667881	Eroded
D3-D4	+1282120	Accumulated
D4-D5	+1288214	Accumulated
D5-D6	-1102524	Eroded
D6-D7	+230713	Accumulated
D7-D8	-1511361	Eroded

b. 10-30m water deep zone

Abrasion, aggravating and balanced sedimentary area were established by map of lithofacies - lithodynamic and diagram of vector of sedimentary transportation.

1. Abrasion

- South of Mui Gio - Mui Yen, Hon Rom, Phan Thiet (10-25m water deep) are places where raised to the surface. They are sand dunes and tidal flat grey orange-to-orange gravelly sand facies were formed in late Pleistocene and redeposit in Fladrian transgression. Resedimented process lasted from Flandrian transgression to now. Materials were carried from high relief to low relief where is modern coastal shallow gravelly muddy sand facies. These phenomenons were clearly showed in South of Mui Ne, Phan Thiet on lithofacies map. The trend of sediment was transported from coarse, moderate sorted of remnant of ancient tidal flat biloclatic gravelly sand facies (Md=0.37mm, So=1.68) to finer and well sorting (Md=0.19, So=1.31) of remnant of ancient tidal flat slightly bioclastic gravelly sand facies. After of all others, sediment was deposited in finer and moderate sorted (Md=0.14-0.21mm, So=1.47-1.85) of remnant of ancient coastal shallow gravelly muddy sand and slightly bioclastic gravelly muddy sand facies.
- Coral islands in Southeast of Mui Yen (18-35m water deep), East and Souteast Mui Ne (20-27m water in deep) and Southeast of Phan Thiet (18-27m water in deep) were weakly eroded. These areas can be worn out by flow current, especially wave in storm.
- Tombolo in south of Phan Ri river mouth area was weakly eroded. Erosive process mainly happened in Flandrian transgression where were ancient shoreline zone. Tombolo was composed of coral gravelly sand (Md=0.32mm, So=1.54 (well sorted). Erosive materials were transported from high relief to low relief in West of tombolo where created to tidal flat slightly gravelly sand facies. The sediment of this area was finer grain (Md=0.19) and well sorted (So=1.31). Subsequent to transgression, sediment of tombolo were continuously transported and eroded to low relief where was remnant of ancient bay slightly bioclastic gravelly muddy sand of (Md=0.14, So=1.77).

2. Agradating

In 10-30m water deep zones, agradating areas were in low relief where were bay and ancient shallow sea slightly gravelly muddy sand facies. Specifics of them were moderate grain size (Md=0.08-0.4mm), poorly sorted (1.77-1.85) and high mud content. Their resource is another. Tombolos and adjacent ancient tidal flat in Fladrian transgression mainly supplied ancient bay facies. Ancient shallow sea facies supplied by ancient and modern coastal current flew from Southeast. So that, in area the first facies exposed in smaller scale than the second facies.

3. Balance areas

Sedimentary balance area is not area where sediment transported from this place to another but it means that amount of supplied sedimentary equivalent to move sediment or differential is not worth and these have agradating and abrasion in small rates. The typical characters of trending transportation vector have chaotic direction and not stable movements.

Sedimentary balances areas have been generally transiting from abrasion to agradating where distributed ancient shallow sea slightly muddy bioclastic sand facies and tidal flat gravelly bioclastic sand facies.

In South of Mui Gio, sediment transported from shallow sea bioloclastic gravelly sand facies to slightly muddy sand facies where have smaller area distribution. In South of Mui Ne area sedimentary transportation in contrary direction. Abrasion areas have been happening in remnant of tidal flat bioclastic gravelly sand transiting to slightly bioclastic gravelly sandy mud in surrounding.

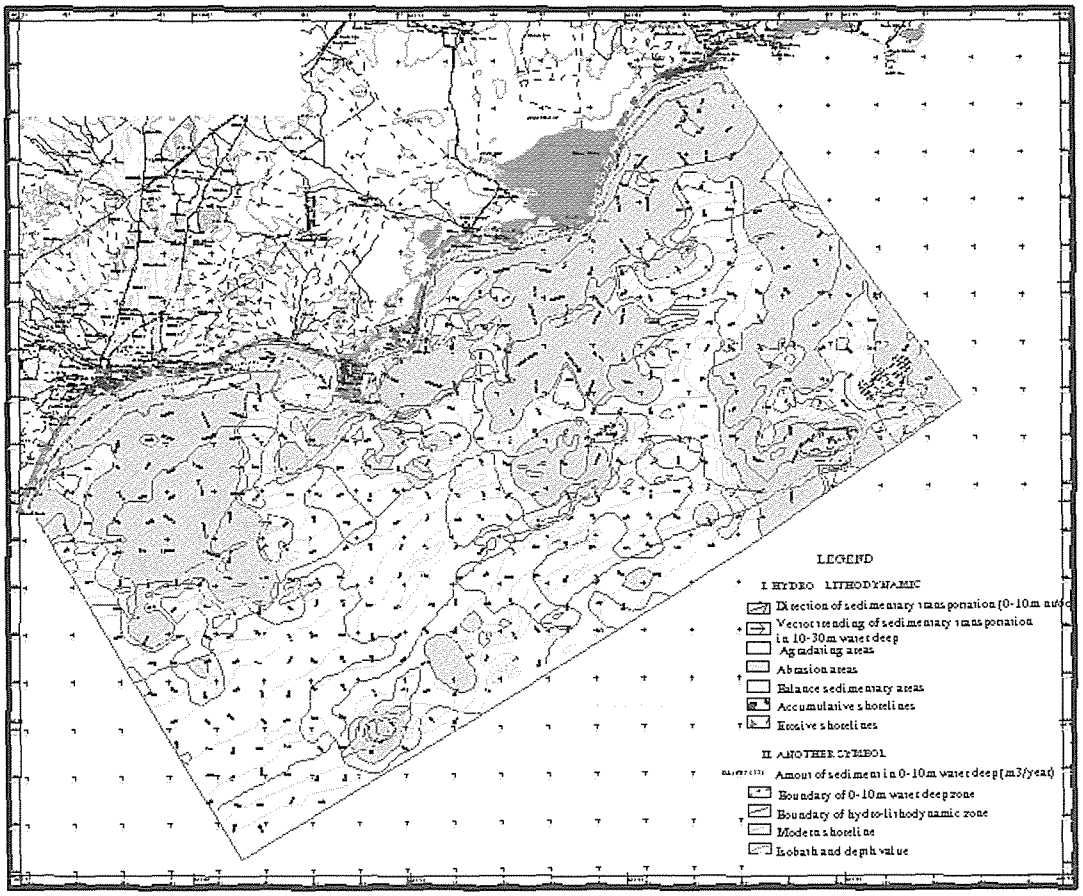

Figure1. Map of lithodynamic in Binh Thuan area

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