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A Physiographic Classification of Rice Land in the Mekong Delta

by

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Abstract

The Mekong delta is divided into seven divisions in terms of physiographic character relating to rice culture. They are Trans-Bassac Horst, Floodplain, Modern Delta, Coastal Complex, Broad Depression, Plain of Reeds and Western Coastal Zone, and some of them are further subdivided. Trans-Bassac Horst is a slightly uplifted geologic block with flat ground surface. Floodplain is a graven filled up by the Bassac and the Mekong's fluviation. Modern Delta is the downward extension of Floodplain and has deltaic network of rivers of great tidal range. Broad Depression is a blocked-in swamp behind Coastal Complex. These five divisions are important rice growing area of the delta. The last two, Plain of Reeds and Western Coastal Zone, are swampy areas on the margin of the delta and still waiting reclamation. The distributions of the divisions and their subdivisions are given in Fig. 3.

Introduction

Three papers, which appear in series in the same volume of this journal, deal with the physical environment and rice culture of the Mekong delta. The first paper, which is by the present author, analyzes the virgin environment of the delta from physiographic view point. The second one, by Kaida, describes the changing phase of the environment by engineering works. And the third one, by Fukui, discusses the current rice culture in relation to the environment.

1. Geohistory of Mekong Delta

The geohistory of the Mekong delta is briefly summarized into three stages, each of which is characterized by a particular geological agency. They are the stages of horst-graven type tectonism, of fluviation within the graven and of coastal process.

1-i Horst-graven type tectonism

The author imagines that a horst-graven type tectonism has been and probably is till going on and controls the fundamental framework of the Mekong delta. There are two evidences indicative of this supposition. One is the peculiarly straight course of the Bassac river and the other is a slightly elevated land block with monadnocks which is located west of the Bassac river. Both the straight Bassac river course and the elevated land block extend in NW-SE direction which is the direction of the biggest geologic fructure of continental Southeast Asia. The elevated land block is Horst, and a trough in

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which the Bassac and Mekong rivers flow coincides to Graven.

1-ii Fluviation within the graven

Once the graven is formed, this topographical trough becomes a good channel for the water of continental Southeast Asia to drain to the sea, then naturally the fluvial process begins within this channel. When silt load is high, series of levee and backswamp develop in and along the channel. Thus in the course of time, this trough of graven origin transforms to a depositional terrain which must be called Floodplain.

At the lower reach of the trough, where the contrast between Horst and Graven is less pronounced, fluviation occurs in the style of delta making rather than the simple combination of levee and backswamp confined in a valley. Major rivers shoot off many distributaries resulting in the so-called bird-foot type river system. Geologically this portion may be called Modern Delta.

Roughly speaking the upper reach than the city of Sadec where the Bassac and the Mekong run parallel each other is Floodplain portion, while a triangular defined by the provincial cities of Vinh Long, Can Tho and My Tho is Modern Delta.

1-iii Coastal process

The fluvial and deltaic processes, however, do not cover the entire geohistory of the Mekong delta. These must be followed by the final geologic event of delta making, a coastal process. Long shore currents which are generated by winds of South China Sea behave to carry the sediments which come to the sea-facing edge of Modern Delta out of the spot further to the west. This coastal process characterized by the reworking of the sediments leads the formation of beach and lagoon complex which extends parallel to the sea coast. The geological body formed by this sea energy is called Coastal Complex in this paper.

1-iv Marginal adjustment

Once the main framework is thus prepared, marginal adjustments start. When the

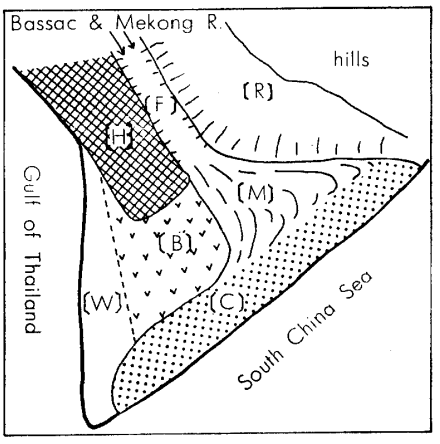

Fig. 1 A schematic illustration of the Mekong Delta's geohistory: [H]: Trans-Bassac Horst, [F]: Floodplain, [M]: Modern delta, [C]: Coastal Complex, [B]: Broad Depression, [R]: Plain of Reeds, and [W]: Western Coastal Zone

stretch of Coastal Complex develops and happens to engulf a large water body in between Coastal Complex itself and Trans-Bassac Horst, the engulfed water begins to change itself to a broad swampy depression helped by the meager supply of sediments from the two sandwitching geological bodies. Broad Depression is, thus, one of the most typical cases of the marginal adjustment.

The genesis of Plain of Reeds is similar to that of Broad Depression, but in this case the blocking body is Modern Delta. Another marginal adjustment is seen along the western margin of the Mekong delta where the coastal energy comes from the Gulf of Thailand.

The above mentioned geohistory of the delta is schematically illustrated in Fig. 1.

2. Physiographic Division of Mekong Delta

With the afore-mentioned geohistory in mind, the following physiographic divisions and subdivisions are proposed.

- Trans-Bassac Horst (1)
  - Monadnock (1.1)
  - Plate (1.2)
- Floodplain (2)
  - Levee (2.1)
  - Sand Bar (2.2)
  - Back Swamp (2.3)
- Modern Delta (3)
  - Levee (3.1)
  - Back Swamp (3.2)
- Coastal Complex (4)
  - Raised Beach Ridge (4.1)
  - Coastal Flat (4.2)
    - Non-toxic portion (4.2.1)
    - Salt-affected portion (4.2.2)
  - Lagoonal Swale (4.3)
    - Non-toxic portion (4.3.1)
    - Acid sulphate-affected portion (4.3.2)
- Broad Depression (5)
- Plain of Reeds (6)
- Western Coastal Zone (7)

2-i Description of Division

Monadnock (1.1)

Large and small separate hills are scattered on Trans-Bassac Horst. Large ones are about 500 m high and 10 km in circumstance and have sandy colluvium at their foots, part of which are utilized for growing rice and other crops. Small ones are as low as several meter high and as small as several tens meter in circumstance, having no colluvium. All of these hills are composed of granitic rocks and are in fact the extension of large

granitic mass in West Cambodia.

Plate (1.2)

This is the main constituent of Trans-Bassac Horst. The ground surface is vast and flat lying. The relative ground height measured based on the water level of the Canal Rach Bassac (a canal along the national highway LTL 8) reveals that Plate is serveal tens centimeter higher than the adjoining Floodplain.

Since this is genetically separated from the main courses of the Bassac and the Mekong, there are no major water courses which receive water from the main rivers like the Bassac. Natural streams are mostly small and seasonal and even during flood season do not carry big flood.

Acid sulphate soil occasionally occures because of the poor drainability of the area. This occures more often in the western half of Plate. The texture of soils is, in many places, not as heavy as expected from its flat topography.

Levee (2.1) and Sand Bar (2.2)

Levee and Sand Bar are elevated portions of Floodplain. Both of them do not suffer from flood even during flood season and are utilized as living compounds.

Levee and Sand Bar, however, differ from each other in the following ways. Levee is formed by over-bank flow of a relatively stable river course. Naturally a levee occurs along a stable river occurs showing a monoclinal slope with the crest next to river bank, and it has usually fine grained deposits. On the other hand, Sand Bar is formed under violent flood turbulence in an unstable river channel. In such rough river, water channel shifts quite often, naturally the position of sand bar deposition also shifts often. This results in a series of ridge of sand bar. The composition is far coarser than that of Levee.

Levee and Sand Bar are different in their mode of river side slope. Levee has usually vertical cliff; in the case of Chao Doc the cliff of a levee on the Bassac averages 5 m during low flow of the river. While Sand Bar never shows such sharp cliff like the levee. Sand Bar

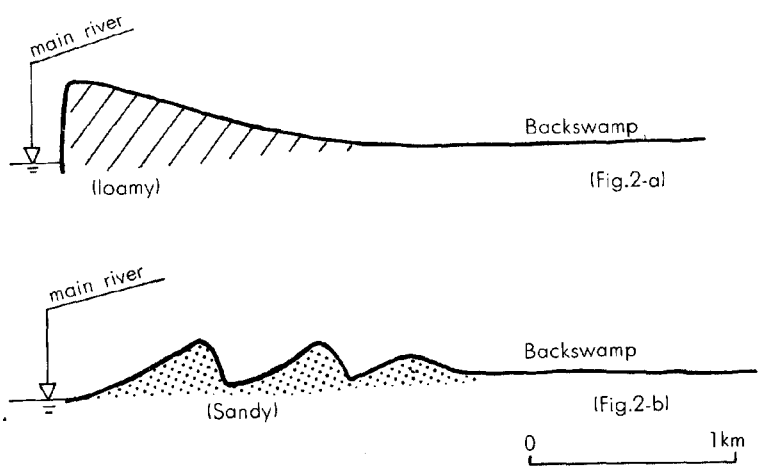

Fig. 2 Cross sections of two types of Floodplain, Levee type and Sand Bar type. The former has a monoclinal slope with loamy material, while the latter has a web of ridges and scars with sandy material.

raises its surface gradually from the river bottom and forms its crest a few hundreds meter away from river. The comparison of Levee and Sand Bar is seen in Figs. 2-a and 2-b.

Back Swamp (2.3)

The ground height of Back Swamp is 2 to 4 m lower than its corresponding levee crest. During the dry season Back Swamp dries up leaving only very small portions as swamps. During the flood season, this submerges under water entirely. Soil is usually composed of clay.

Modern Delta (3)

The constituent of Modern Delta is also levee and back swamp. But levee and back swamp of Modern Delta have smaller dimension and far more crowded distribution than those of Floodplain.

As the river courses of Bassac and the Mekong enter into Modern Delta, they split into many distributaries and consequently their levee forming forces are dispersed. The height and breadth of distributary levees usually have only about 2 m high and about 500 m wide; this is far smaller when compared to the dimension of Floodplain's levee. The interval of two adjoining levees is, on the other hand, so close because of high stream density. For instance, between Cay Lay and the Mekong ferry along the national highway LTL 4, we can count more than 16 sets of levee of creeks over 20 m wide. The average density of levee is one set in every 1 km in this case.

One thing more to be noticed is the fact that this minutely ramified distributaries are all strongly tide-affected. As far as a creak has width more than 10 m, it has tidal range more than 0.5 m. This means that Modern Delta is well suppled by swift moving water by tidal action throughout the year. Modern Delta may be described to be a mosaic of small scale levee and back swamp with network of tidal creeks.

Raised Beach Ridge (4.1)

This comprises the highest portion of Coastal Complex and is composed almost hundred persent of pure sand. Raised Beach Ridge is too high and too dry to be cultivated to rice and mostly wooded by big trees. The highest elevation may attain 5 m or more above the mean sea level but most places are 2 to 3 m high. One Raised Beach Ridge has width of 200 to 400 m but it may be combined with its neighbours and shows a wider appearance. The longest one continues for more than 40 km, but many have far shorter stretches and marge into Coastal Flat.

Coastal Flat (4.2)

This comprises the middle level of Coastal Complex. The ground surface is flat, slightly higher than the mean sea level and has more or less sandy soils. The stream density is low. Because of this high elevation and poor stream density, river and sea waters cannot go into this terrain under normal condition, thus the area tends to be water deficient despite its position near to the sea. Coastal Flat may, in this sense, be described as poorly watered, isolated, flat land near the coast.

Surface water is poor as mentioned above, but the ground water table is as shallow as less than 1 m from the ground surface in many places even during dry season. And this ground water is occasionally salty, contaminated by the fossil salt which was trapped in

the deposits during the sedimentation. Because of such ground condition, the salty ground water often migrates through sandy sediments by capillary force up to the ground surface, evaporates and accumulates salt on the ground surface during dry season. This is a particular mechanism of salt accumulation on Coastal Flat, which is quite different from salinity problem in Lagoonal Swale caused by direct sea water invasion through open channels. Relatively large areas in Go Cong province, some around Phu Vinh, Ba Tri and west of Bac Lieu have this type of salinity problem.

Lagoonal Swale (4.3)

Lagoonal Swale occurs in Coastal Complex as shallow swale elongated parallel to the coast line. The ground surface is lower than the mean sea level. Naturally there is constant threat of sea water invasion during low flow period.

The floor is in most places composed of clay and sometimes with peaty material. One noticable fact is that the area has wide extension of acid sulphate toxicity. The brackish sediments which deposited in lagoonal swale produce acid sulphate soils when they get oxidized. Strong acid sulphate soils are often found in Go Cong, Ben Tre, and Vinh Binh provinces.

Broad Depression (5)

Broad Depression is primarily a swamp of perenial inundation. Since this is blocked in and separated from the sea by Coastal Complex and has no large channels linking itself with the sea, tidal effect does not reach into the area effectively. It is supposed that the tidal range is neglisible, if not nil, at many places of Broad Depression. Only limited portions located near the Bassac and the Mekong's main courses can have as big tidal range as 1 m.

Many parts of Broad Depression suffer from toxicity of acid sulphate. This is indicated by jarosite-bearing soils and acid tolerant plants of the area. But their degree and extent are not known.

The marging zones of Broad Depression to the adjoining divisions like Trans-Bassac Horst, Modern Delta and Coastal Complex is only shallowly inundated and gradual, thus it is difficult to make a clear boundary with them. By contrast, some portions in the middle part of Broad Depression appear as deeply inundated through the year as to be more economically utilized by fishery rather than by rice growing.

Plain of Reeds (6) and Western Coastal Zone (7)

It is reported that Plain of Reeds is a poorly drained wood and grass land with strong acid sulphate soils and Western Coastal Zone is originally salty swamp with organic soils. These are still left uncultivated to rice at the present moment.

2-ii Physiographic Map

The physiographic division of the Mekong delta is shown in Fig. 3. This map is prepared based on the data collected through the followings;

a) 50 day land traverse by car

b) 2 day survey from air

c) interpretation of topographical map of 1 to 50,000[1)]

In order to draw the borders of Coastal Complex and its subdivision borders, Dutch

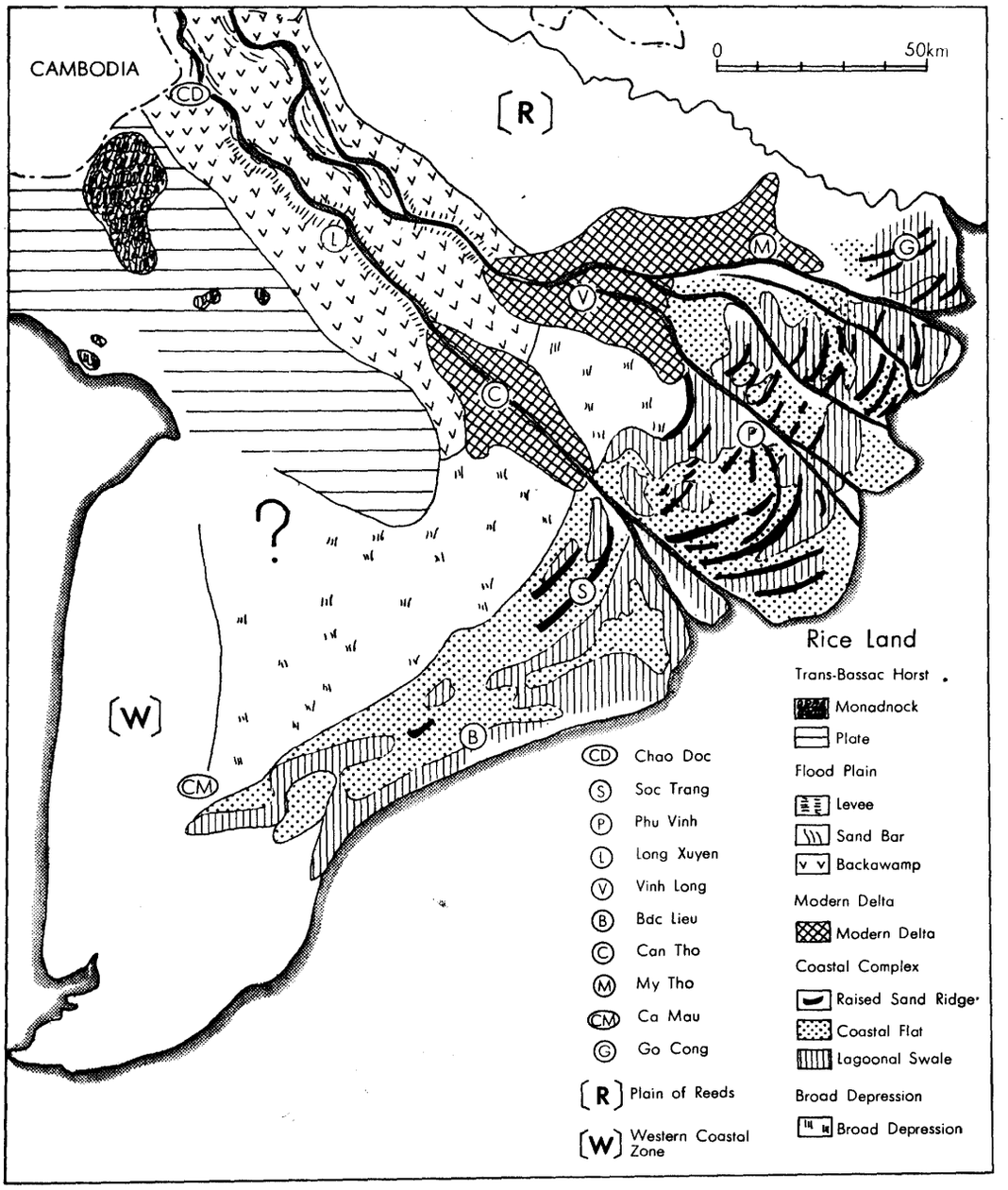

Fig. 3 The Physiographic division of the Mekong delta with respect to rice growing condition.

report[2] is fully relied, though there may exist some gap between the Dutch and author's interpretations on the ecology of the area. The map is subject to minor correction when further examination is made based on areal photograph which was not avairable during the study.

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