

The Geomorphological Map of The Northeastern Part of Thailand

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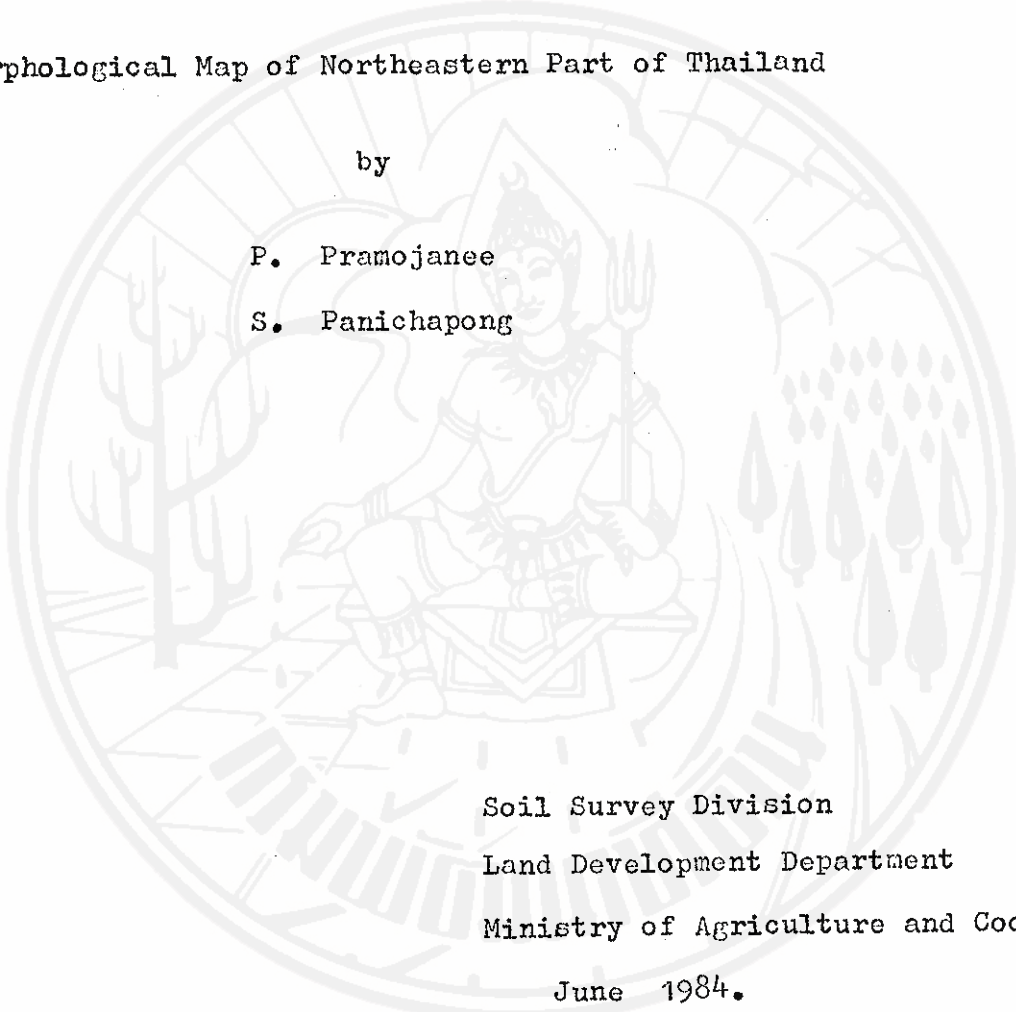
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GEOMORPHOLOGICAL MAP OF NORTHEASTERN PART OF THAILAND

Introduction

This geomorphological map was prepared based on information obtained by visual interpretation of LANDSAT imagery together with existing topographical maps of 1 : 250,000 scale, geological map of 1 : 500,000 scale, soil map at Great Group level (Soil Taxonomy USDA system) of 1 : 1,000,000 scale and other available relevant documentation.

The LANDSAT imageries used were black and white of band 5 and 7 with 1 : 1,000,000 scale taken at different months (mainly in the dry season) and years. The geomorphological units and symbols are classified in accordance to ITC System (Verstappen and Van Zuidam : 1976

Physiography and Drainage

The northeast portion of Thailand is an elevated portion of the country, covering approximately 155,000 km². It is bordered on the west and south by marginal escarpments which rise as high as 900 meters above sea level. The interior of the region is structurally divided into two large basins, namely the Sakhon Nakhon and Khorat Basin, by Phu Phan uplifted mountain range. The general surface of the region is slightly tilted from the western and northern boundaries to the southeast and, except the Phu Phan range, is characterized by a monotonous undulating

to nearly flat plain dotted with monadnock, cuesta and swamps. The average height of the interior of the region is about 170 meters above sea level. The term "Plateau" is used for naming this region but technically the term has no meaning relevant to the structure of the region. It was apparently adopted because of the aforementioned western and southern escarpments that bordered the region which makes the region resemble to plateau.

In general, the region is drained by three main rivers, one for Sakon Nakhon Basin in the north, and the other two for Khorat Basin in the south. For Sakon Nakhon Basin Mae Nam Songkhram and its tributaries constitute a major drainage system whilst Mae Nam Chi and Mae Nam Mun are responsible for draining of the Khorat basin. Roughly most of the river flows across the region from the west marginal escarpment to the east or southeast and enters the Mae Khong River at the border of Thailand.

Climate

According to climatic classification of Koppen this region is in the "Aw" or Tropical Savana Climate with distinct wet and dry season. The rainy season starts from May to October when the southwest monsoon is prevail. The dry season starts from November to May. The average annual precipitation is about 1,400 mm. Evapotranspiration exceeds precipitation during the period of October to April. From March till the end of rainy season the temperatures generally range from 28° C to 32° C whilst from November till the end of February it ranges from 18° C to 26° C.

Geology

Lithologically the Northeastern part of Thailand is inferred to be underlain by a westward extension of the Khorat Precambrian mass which outcrops in the southern part of Viet Nam (Workman 1972). This massif is consequently covered by sediments of Devonian Carboniferous and Permian age which are overlain unconformably by redbeds of so-called Khorat Group. The Precambrian rocks, though no outcrop can be observed in the region, are composed of crystalline metamorphic and igneous rocks. The Paleozoic rocks (Devonian, Carboniferous and Permian age) are composed of slate and quartzite at the lower beds (Ward 1964) and limestone, sandstone and conglomerate in the upper (Borax 1966). The lower beds of this Paleozoic rocks crop out along the west of escarpments that border the region while the upper, which is dominated by limestone, crops out along the northwestern side of the region. (Lamoreaux et. al 1959).

In general the most extensive outcrops of the region are the rocks of the Khorat group. The lower members of the group (Triassic-Jurassic) which are dominated by sandstone and conglomerate respectively crop out as the escarpments that border the region and as isolated outcrops and ranges within the region. The Phu Phan range is also an outcrop of this member. The upper members, the Cretaceous rocks which consist of sandstone, siltstone and shale with some calcareous conglomerate, crop out as a hilly and rolling topography at the outer rim of the Khorat an

Sakon Nakhon basins. As continuous and/or isolated low hills and mountains, the uppermost member of this group, namely the salt formation which consists of siltstone, shale, mudstone (mostly calcareous or intercalated, impregnated with salt) and rock salt, crop out in the central plain of the basins. In the northwest corner of the region a few narrow mountain ranges contain Permo-triassic igneous rocks, mostly granitic, intermingled with folded beds of Paleozoic sedimentary rocks are cropped out.

The Late igneous activities occurred in the region during the Tertiary age. As a result basalt dikes and flows occur in isolated outcrops along the southern edge of the region.

Geomorphology

In fact, no systematic or quantitative investigations concerning geomorphology of the region have been attempted previously. Basic data and information of a relatively shallow regolith, general geology, topography of the area, some scientists, however, have attempted to set up the general hypothesis about evolution of the landforms of the region. In respect to the synchronizing of the distribution, structure, and lithology of the bedrocks with the types and patterns of the soil, Pendeton et. al (1963) and Michael (1981) give a synonymous conclusion about the interior upland other than the distinct structural landforms. Most of them are denudational surfaces and in situ alteration landforms of sedimentary bedrocks which are abundantly present in the region. Alternatively, with respect to the general soils properties and their occurrence

Moormann et. al (1964) proposed the "terrace concept" for the region. claimed that, except in minor places where the relevant bedrocks are present at a shallow depth, most of landforms in the region are alluvial plains comprising of various terrace levels and flood plains, created by Mekong River and their tributaries in the region.

This study illustrated that both concepts are applicable in the Northeastern Thailand. The concept of in situ weathering and local alteration of bedrock of Pendleton and Michael can be applied for the evolution of landforms on comparatively highland, whilst the terrace concept of Moormann et.al. can also be applied for the landform in relative lowland. For the description of the mapping unit, the information concerning with landforms, their genesis (although some are still doubtful), and the involved geomorphological processes is provided in as much as relevant data is available. By the ITC system, landform units were divided into 4 main groups according to structural, volcanic, denudational and fluvial origin. Subdivision of the groups is based on amplitude, relief, lithology and form. The details of the mapping unit are as followed :-

Unit of Structural Origin

Structural Mountain (diversified lithology)

This unit is the tracts of high land other than the distinct hogback, cuesta and mesa in which its amplitude is higher than 500 meters

above sea level. The escarpment that bordered the region on the west the south, the Phu Phan range, and some granitic outcrops at the north corner of the region are included. At the northwest corner, this unit consists of granitic and meta-sediment outcrops. The escarpment and Phu Phan range are folded and uplifted beds of Mesozoic Sedimentary rocks which are dominated by sandstone and conglomerate.

Structural hill (diversified lithology)

Hilly relief surfaces other than the distinct hogback, cuestas and mesa which have amplitude between 300 and 500 meters above mean sea level are grouped in this unit. It occurs mostly in the northwest corner of the area and along both sides of Phu Phan range. The same as in the structural mountains, the northwest corner of the same as in the structural mountains, the northwest corner of the area are mainly granitic and meta-sedimentary rocks whilst along the Phu Phan range are the upper and middle members of the Mesozoic sedimentary formation.

Structural Valley

Parallel to the trend of strongly folding Mesozoic sedimentary bedrock, i.e. Phu Phan range and hogback scarps that run roughly from the W - SW corner to the N - NW corner of the area, many structural valleys are present. They are both anticlinal and synclinal valleys. Most of valley bottoms have flat to nearly undulating relief and relative shall. At a certain depth of not more than 2 - 3 meter the bedrock or hard lateritic layer which is believed to form directly from the rotten bed beneath is usually reached.

Hogbacks

Strongly folded lower and middle members of Mesozoic sedimentary bedrock forming a sinuous trend of hogbacks from, roughly, middle west to northwest in the region. Frontslopes which are the steep scarp face westwardly and the moderately steep back slopes occur as intervals along the trend. Gullies and ravines are abundant along the slopes and vegetation cover is sparse or thinned out. Elevation of hogbacks range from 400 - 800 meters a.s.l

Cuestas and Mesas

As the isolated small to large sized flat top table lands with steep scarps, the mesas occur along the front slopes of the aforementioned hogback trend. Most of them are the nearly horizontal uplifted beds of the middle and lower Mesozoic sedimentary rock which composes mostly of sandstone. The shape of these mesas are approximately rounded. Two cuestas are observed in the area. One at the end of Phu Phan range and the other at the southwest corner of the region. Most of it is the bedrock of the middle and upper Mesozoic sedimentary bed rock which compose mostly of sandstones and conglomerates.

Unit of volcanic origin

Effusive lava flow plains and volcanic cones

This unit represents an effusive lava flow areas. They are basaltic flow that isolately distributed as the shield plains along

the southern edge of the region. Usually at the middle of the plain, distinct cones, clearly observed from LANDSAT, are present. Some alignments, probably dikes, are also clearly observed in the plain. These plains have high agricultural potential. Most of the soils in the plain is the in situ weathering products of basaltic rock. They are reddish clayey texture soils that have comparatively high fertility. In the low lying areas where the drainage are poor the soils became blackish color.

Unit of denudational Origin. This unit divides into two groups

1. Denudational hills, hillocks in areas of various rock type.

The group consists of relatively low hills or hillocks, of which the height is usually between 200 - 300 meters a.s.l and the covering soils are relatively shallow. It is subdivided according to the lithology of the bedrocks into denudational hill, hillock in areas of mainly clastic sedimentary rocks, mixed bedrocks and igneous rocks respectively. The first one occurs along the Phu Phan range, the aforementioned hogback trend, and at the northwest corner of the area. The ones that occur along the range and trend are mostly sandstone of various grades. The ones that occupy the northwest corner are mostly underlain by upper Paleozoic sedimentary rocks, which mostly consists of shale and low grade metamorphic equivalent. Limestone, however is present as a isolated low hill.

The second group which is underlain by mixed bedrock, is found in the northwest corner of the area. The underlain bedrock is mostly Paleozoic sediments and few isolated intrusive igneous rocks.

The last group of this unit that is underlain by intrusive igneous rock, is also found in northwest corner. Most of this intrusive igneous rock, is granite.

Glacis

Glacis refers to gently slope surface at the foot of the hills ranges of hill, mountains, ranges of mountain. The materials of such land scapes were transported from their adjacent highland.

Based on slope and erosion status (actual and potential), this unit is subdivided into two major types; erosion and accumulation glacis. The accumulation glacis is subdivided according to the relief, moderate or low. For erosion glacis, the covering soils are comparative shallow to the bedrocks and coarse in texture whilst the accumulation zone the soils are comparatively thick and fine textured. This unit occurs in the area along the back slopes of escarpments that border the region and as sloping surfaces in the mountain ranges and hogback trends. In general the surface of this unit slopes gently from the highlands, mountain and hills toward the local fluvial basin.

Planation surface

Undulating or rolling terrains of the region where, in so far as the data available, their genesis are still doubtful or debatable, are grouped in this unit. In general; they are the undulating to rolling surfaces at the altitude of 150 - 200 meters a.s.l. Its covering regolith is in general, a coarse stratified profile of sandy or loamy material with lateritic crust or horizons and conglomeratic material (rounded or sub-rounded gravel boulder etc.). Whilst Moormann et. al (1964) referred to it as a middle and high terrace, Michael (1981) believed that it is an *in situ* alteration surface formed under various climatic conditions. Inferred from grain size analysis and some certain physical properties of the covering soil, Boonsaner (1977) claimed that most of this surface is the colluvial deposit.

Since the genesis of such landforms is still doubtful, with respect to the geomorphological processes that currently operate upon them, the dessectional and erosional processes range from severe to mild. therefore, in this context "The Planation surface" is applied to them.

Based on its relative site and altitude this unit is divided into 3 sub units; Unit level 1 is a rolling, moderately dissected surface along eastern sides of the Hogback formed trend. Sheet and gully erosion are abundant on the surface especially where vegetation cover is sparse. With, generally, rolling to undulating topography, Unit level 2 occurs

mainly in Sakon Nakhorn Basin and at the central portion of Khorat basin. Sheet and gully erosion is also present on its surface. Unit level 3 occurs mainly in Khorat basin. With slightly undulating to undulating Topography, this unit is mostly used for upland crops. Erosion features could be observed where conservation practises are improper.

Unit of Fluvial Origin

Terrace

Low terraces occur along two main rivers in the Khorat basin. In general they are flat to nearly flat surfaces with hydromorphic sandy or loamy soils on which the transplanted rice are grown. The area adjacent to local elevated lands are often effected by salinity.

Associated unit of levee, splay and abandoned channel

With the activities of former and present rivers and their tributaries, this unit is abundantly present in the region. Along the east - northeast border of the region landforms of this unit have been developed by the Mekong river. In Sakon Nakhon and Khorat basins this unit occurs along the main rivers and their tributaries. There is many evidences pointing out that most of the rivers in the region have been subjected to a number of depositional and erosional cycles. As a result landforms of this unit are quite distinct. Because water is available throughout the year and the soil fertility is comparatively high, this unit is high agricultural potential.

Associated Units of river basins or back swamps and low terraces

This unit is distinctly present only along the Mun river and its tributaries in the Khorat basin. This is probably, because the general topography of the Khorat basin, especially at the central part is comparatively flat. On the contrary the Sakon Nakhon basin that rugged topography the formation of basin is less distinct. Due to the continuous down cutting activity of the rivers, terraces are formed. These undistinct terraces were named by Moormann as a "semi-recent terraces". With Vertic properties, neutral to slightly acid reaction clayey texture, and flat topography, soils in the basin especially in the so-called semi-recent terrace, have high potential for paddy field cultivation.

Unspecified alluvial plains

These landforms were developed by the dissection of small rivers and/or streams through the other upland units. It occurs along small rivers and streams throughout of the area. In fact, it's formed by both accumulation and dissection processes. In general, it is characterized by long, narrow surface with flat to nearly flat topography. Where the gradient of slopes are more gentle, floodplain with undistinct levees and splay are noticeable. Most of this unit is eventually flooded by impounded water in the rainy season. With hydromorphic characteristics the soils of the plain have been mostly used for transplanted rice.

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