1.1 INTRODUCTION TO THE PROJECT:

Stratigraphic correlation in Ransi Member in the Tatau-Bintulu area of Sarawak, East Malaysia has always been difficult, due to the lack of large continuous exposures, limitations of road access and lack of detailed studies. This has made the correlation of outcrops within the formation difficult leading to difficulties in interpreting the depositional setting, origin of sediments and relationship with other sequences of adjacent formations in the area.

This study is needed to clarify the stratigraphic relationships of the Ransi Member with the adjacent formations and give a clearer picture of the palaeoenvironment and geological setting during its deposition to work out the geological evolution of the study area during Miocene-Eocene time.

Previous workers have mostly focused on general stratigraphic description and mapping. This research project will focus more on detailed geological mapping and sedimentological studies.

1.2 OBJECTIVE:

The aim of this study is to interpret the depositional setting and geologic history of the Tertiary formations in the Tunggal-Ransi area between Tatau and Bintulu with emphasis on the relationship between the Ransi Member and sedimentary formations adjacent to it. The objectives are as follows:

(I) To establish the age of the Ransi Member which had been dated as Upper Miocene to Lower Pliocene (Liechti, et al., 1960), Late Eocene to Oligocene (Barbeito, 2008) and Late Miocene (Ismail, 1996) by previous workers.

(II) To establish if the Ransi Member is the basal member of the Tatau Formation or is a distinct formation by itself.

(III) To determine the source of the angular volcanic clasts which is commonly found in the Ransi Member

(IV) Establishing the relationships with other formations such as the Arip Limestone and Piring Igneous intrusion in the study area.

1.3 STUDY AREA:

The study area in Tatau is located in the central part of Sarawak (Fig. 1.1); that is between the Sibu and Bintulu Divisions. The study area is bounded by latitudes 02°30'N and 03°15'N and longitudes 112°30'E to 113°00'E. A regional NE-SW trending Anak-Nyalau Fault is present in the study area.

The area is composed of various types of rock, including the Piring Hill igneous intrusion, low-grade metamorphosed Belaga Formation and limestone bodies in the Arip area but the bulk consists of fluvial to shallow marine sedimentary rocks that range from Lower Eocene to Quaternary in age.

Outcrops in the study area are located along the main Trans-Borneo Highway and its branch roads as road-cuttings and in several quarries. Fig. 1.2 shows these localities in the study area.

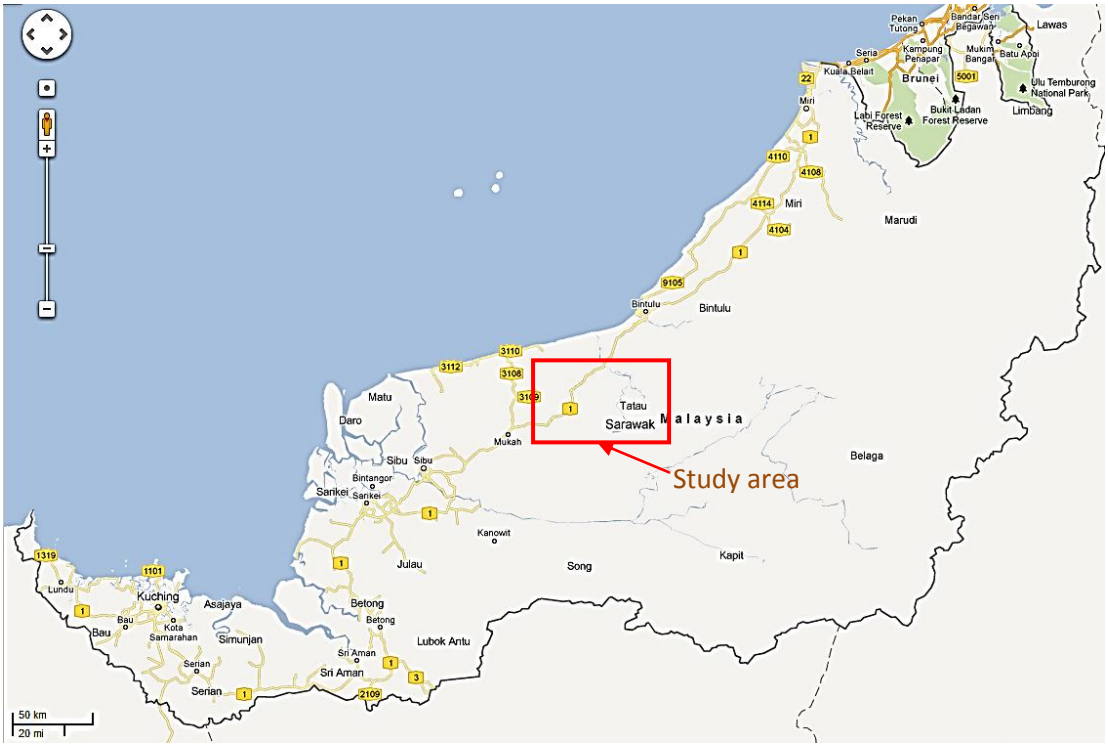
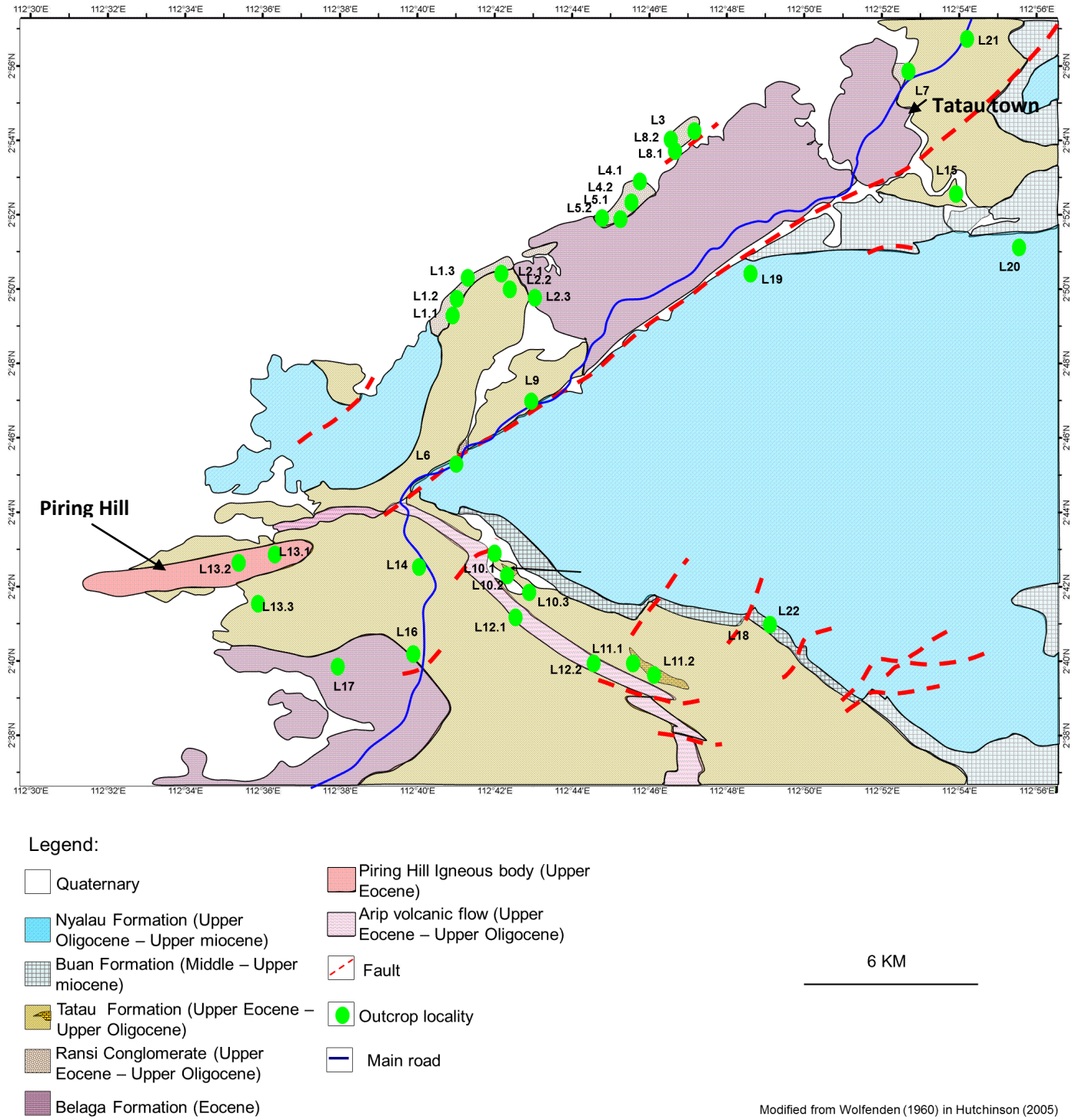


Fig. 1.1 Location of Tatau-Bintulu study area, in google map of Sarawak.



Legend:

- Quaternary
- Nyalau Formation (Upper Oligocene – Upper miocene)
- Buan Formation (Middle – Upper miocene)
- Tatau Formation (Upper Eocene – Upper Oligocene)
- Ransi Conglomerate (Upper Eocene – Upper Oligocene)
- Belaga Formation (Eocene)
- Piring Hill Igneous body (Upper Eocene)
- Arip volcanic flow (Upper Eocene – Upper Oligocene)
- Fault
- Outcrop locality
- Main road

6 KM

Modified from Wolfenden (1960) in Hutchinson (2005)

Fig. 1.2 Localities (L) of outcrops in the study area

1.4 PREVIOUS WORK

Sarawak was divided into 3 major geological zones that include Miri Zone, Sibu Zone and Kuching Zone. Miri Zone and Sibu Zone is separated by Tatau-Mersing Line, whereas Sibu Zone and Kuching Zone is separated by Lupar Line (Fig. 2.1).

The Upper Eocene to recent sedimentary basins of Sarawak overlies the Upper Cretaceous to Upper Eocene highly deformed, low-grade metamorphosed deep marine shales and turbidites of the Rajang Group together with some radiolarian chert, spilite and dolerite unconformably (Mazlan, 1999).

Although the basins resemble in general many continental terranes in cross section, a variety of structures occur in different parts of the basins. These are related to basement-involved extensional tectonics, strike-slip and wrench tectonics and gravity-driven basement-detached tectonics (Mazlan, 1999).

Northern Tatau is characterized by Oligocene to Early Miocene wrench deformation with intense folding. As a result, the Oligocene to Early Miocene structural axes trend NW-SE (Swinburn, 1994). The basement rocks of the Belaga Formation are located at relatively shallow depths where; large basement highs are expressed as high-amplitude reflections on seismic (Agostinelli et al., 1990).

Tatau is located in the northern part of the Tatau-Mersing Line (Fig. 2.1) which is a structurally complex zone consisting of Paleocene to Eocene ophiolitic rocks, including spilite, basalt, tuff and radiolarian chert (Hutchison, 2007). This Tatau-Mersing Line also represents a major unconformity between the Belaga Formation and the overlying Upper Eocene to Recent sediments of the Miri Zone that include the Tatau Formation, Nyalau Formation and younger Tertiary formations (Mazlan, 1999).

The deposition of Eocene sediments in Central Sarawak was brought to an end by a Late Eocene Orogeny accompanied by the extrusion of andesite and rhyolite lavas and pyroclastics and hypabyssal basalt and andesite intrusions at in the Lupar Valley (Leong, 1971).

The Late Eocene unconformity represents a major phase of tectonism that deformed the deep marine rocks of the Rajang Fold-Thrust Belt which form most of the Central Sarawak, Sibu Zone (Wolfenden, 1960). Overlying these deformed rocks are Oligocene-Miocene, mainly shallow marine sediments that crop out in Central Sarawak, these successions include the Tatau Formation, Nyalau Formation, Setap Shale and younger Tertiary formations. Rocks in the Miri Zone represent the lower part of the Sarawak basin succession which extends offshore beyond the continental margin (Mazlan, 1999).

The Ransi Member and other post-Upper Eocene formations were deposited above the Upper Eocene unconformity and underlain by the Belaga Formation and other Rajang Group rocks in the area (Barbeito, 2008).

1.5 GEOGRAPHY

The area of study covers about 962km^2 of the Tatau area. It is bounded on the east by longitude 112°56'E and on the north of Sibu Division border as far west as 112°30'E; the boundary then runs due north from 2°37'N to 2°57'N. The area includes a large part of southern Bintulu Division and a small part of the northern Sibu Division (See Fig. 1.3).

Tatau is a small town located mid-way between Sibu to Bintulu along the Trans Borneo Highway. It has a small population of about 30,000 and is a developing town in the area. It is situated about 23km from the South China Sea. Tarred roads and rivers are the main lines of communication in the area. Earthen roads provide access some of the rural schools and long-houses. Some rural areas can only be reached by boat. During the dry season, the river is too shallow for boat transportation and people have to travel along narrow cycle tracks or on foot to the town. The major oil palm estates and quarry sites in the area are accessible by gravel roads.

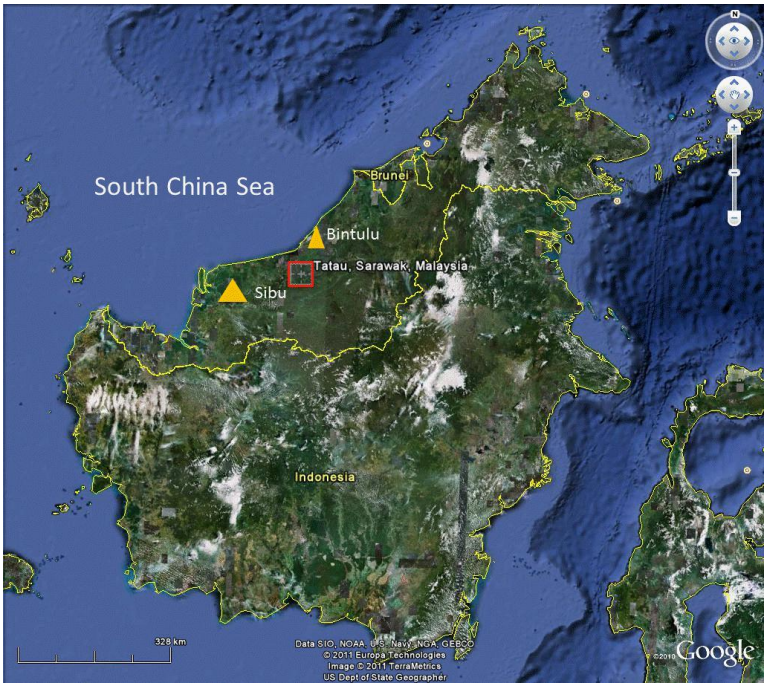


Fig.1.3 Satellite image of Borneo Island and location of Tatau town.

Population

Ibans, Chinese, Malays, Melanaus and some other minor ethnic groups inhabit the area. The population according to the 2010 census (Jabatan Perangkaan, 2010) is about 28,900. This includes one ethnic group named “Tatau” which is unique to the Tatau District. In the lowlands the population is concentrated in and near the towns and villages and in the hinterland people live along the bigger rivers.

The major tribal group is the Ibans who make up 63% of the population. The other ethnic groups are less than 10%. Most of the Ibans are scattered throughout the rural areas. The rest are concentrated in the Tatau and Kuala Tatau area. There is a large influx of foreign workers from Indonesia who work in the timber industry. It was estimated more than 10% of the population of Tatau population are foreign workers.

Climate

The climate is hot and humid, the temperature varies little throughout the year and there are no well defined seasons.

The Tatau area has a tropical monsoonal climate, characterized by a year round daily temperature of about 28°C and nightly temperature of around 23°C. It receives slightly less rainfall compared to the rest of North Borneo with June to August having the least rainfall and is most suitable for fieldwork. December to March (*landas* or rainy season) is the wet season and less suitable for fieldwork. A few low-land parts in the Tatau area are flooded during the rainy season. Strong winds and storms can develop with little warning and the sea is often dangerous for coastal shipping during that season.

Vegetation and Land Use

Less than one third of the area is covered with primary forest. Most of the coastal alluvium is covered with peat swamp forest in the northern Tatau and Kuala Tatau area. The fertile alluvium adjacent to the main rivers is cultivated with wet rice, sago, pepper, corn and vegetables. Most of the flatland is used for oil palm plantations. About one third of the area has been cleared for shifting cultivation by the Iban and much of this is now covered with dense secondary jungle. Part of this secondary jungle has being cleared for the oil palm plantations. Some of the rocky hills are exploited for quarrying and include Piring Hill, Tutong Hill, and Tatau Hill.

Drainage

The drainage pattern of the rivers in the Tatau area is controlled by both the lithology and geological structures (Fig. 1.4). The upstream part of the Arip River at the south of map is controlled by the lithology and runs along the contact between the calcareous and volcanic rocks of the Tatau Formation.

The Kemena River is upstream of the Nyalau Formation in the Lesong area and flows northwestwards into the South China Sea. It is confined by and flow along the Anak-Nyalau Fault aligned NW-SE perpendicular to the major set of faults striking NW-SE.

In the northern part of the Tatau area the major Tatau River flows from the west to the northeast along a fault line. The fault is also tangential to the major Anak-Nyalau Fault trend. The northern tributaries of the Tatau River are dendritic with small streams cutting across the ridges of the country rocks. The Tatau River cuts across the fault which is a zone of low resistance and meanders towards the river mouth in the lowland.

The study area includes the drainage basin of the Balingian River in the southern part and the Tatau River in the northern part. Smaller rivers such as the Arip River flow parallel to the regional strike of the rocks. Some parts of the river are controlled by the faults. The pattern of the Arip River and its tributaries is sub-dendritic.

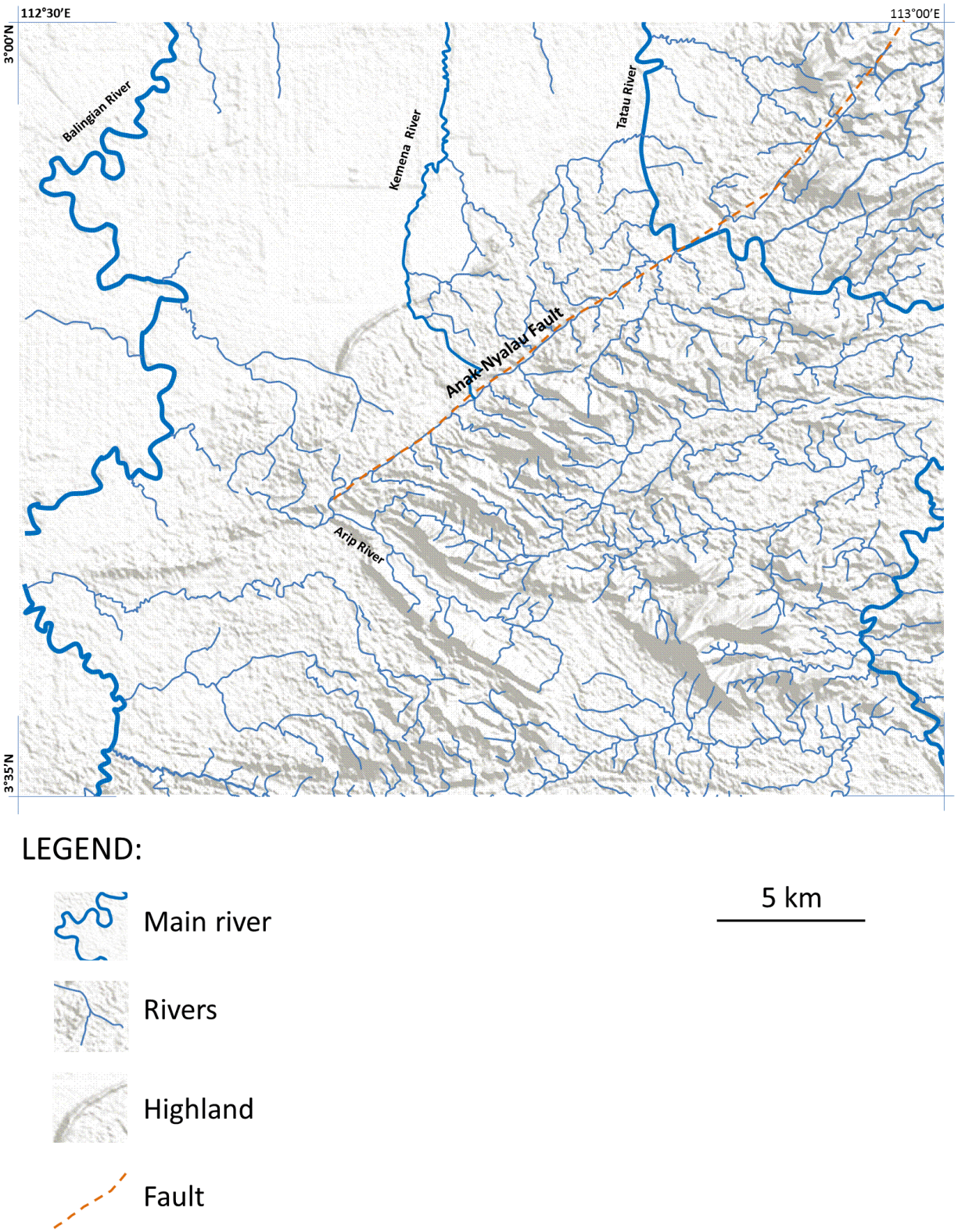


Fig. 1.4 Drainage system of the Tatau area (Modified from SRTM and topographic map (source data from National Mapping Malaysia, 1973)).

1.6 GEOMORPHOLOGY

Topography

The Tatau area is made up mainly of sedimentary rocks comprising about 30% of Middle to Upper Eocene clastics occupying the northern part of the area, 50% Upper Eocene to Miocene clastics which occupy the southern part of the area and 20% Quaternary unconsolidated sediments occupying the northern part along the coast. A small igneous body in the Piring Hill is located in the southern part of the Tatau area.

The Tatau area is composed of several formations each made up of different rocks which differ in resistance to weathering and erosion. The northern half of the Tatau area is generally an open anticline exposing the Belaga Formation in its core and younger formations on both limbs (Fig. 1.2). The Belaga Formation is mainly made up of shale and some sandstone is easily eroded to form generally low land that is frequently flooded during the rainy season at the end of the year.

The southern half of the Tatau area is covered by the younger Nyalau Formation with a gentle syncline with older formations exposed at both of the limbs. The Nyalau Formation is mainly made up of sandstone, some coal beds and a little shale.