

Formation of Pulau Batu Hairan and other islands around Pulau Banggi, Northern Sabah

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Abstract : An island 100 m in diameter, emerged from the sea east of Pulau Banggi in northern Sabah on the 14th April 1988. The appearance was accompanied by rumbling sounds but there were no outbursts of natural gas or water. The material forming the island consists of grey mud, grey and red mudstone, blocks of sandstone, igneous rocks and life corals. The rock fragments are similar to those of the Chert-Spilite, Kudat and Crocker Formations. Radial fractures are the prominent features on the dome-shaped island.

Diapiric action was the likely mechanism for the formation of the island. Many of the more than forty small islands on the east and southeast of Pulau Banggi were probably also similarly formed along major fracture zones of shallow depths.

INTRODUCTION

In the morning of 14th April, 1988, three fishermen from Kudat witnessed the birth of an island about 4 miles northeast of Pulau Lotoan, east of Pulau Banggi (Fig. 1). The emergence of the island from the shallow sea was accompanied by rumbling sounds, but no explosion nor gas or water discharges were seen. Two earlier sightings of islands emerging from the same spot were witnessed by villagers from Pulau Banggi.

PULAU BATU HAIRAN

The new island named by villagers as "Pulau Batu Hairan" is circular in plan and 100 m in diameter (Plate 1). It is nearly flat at the central portion, and slopes gently toward the sea. An isolated 5-m diameter rock island probably a remnant of a once bigger island, occur just 30 m to the north of Pulau Batu Hairan.

Pulau Batu Hairan is made up of dark grey clay, marine mud, and mudstone with exotic blocks of hard rocks (Plate 2). The clay appears to be from an old sedimentary formation, possibly the Crocker Formation. It appears to have been "melted" and has turned into a mass of mobile mud. Some blocks of unaffected, layered grey and red mudstone can be seen. The exotic hard blocks and fragments range from a few centimetres to a few metres across. They consists of grey sandstone, which appear to be of the Crocker Formation type, calcareous sandstone, chert, calcarinite, and rare blocks of ultrabasic rocks. These rocks

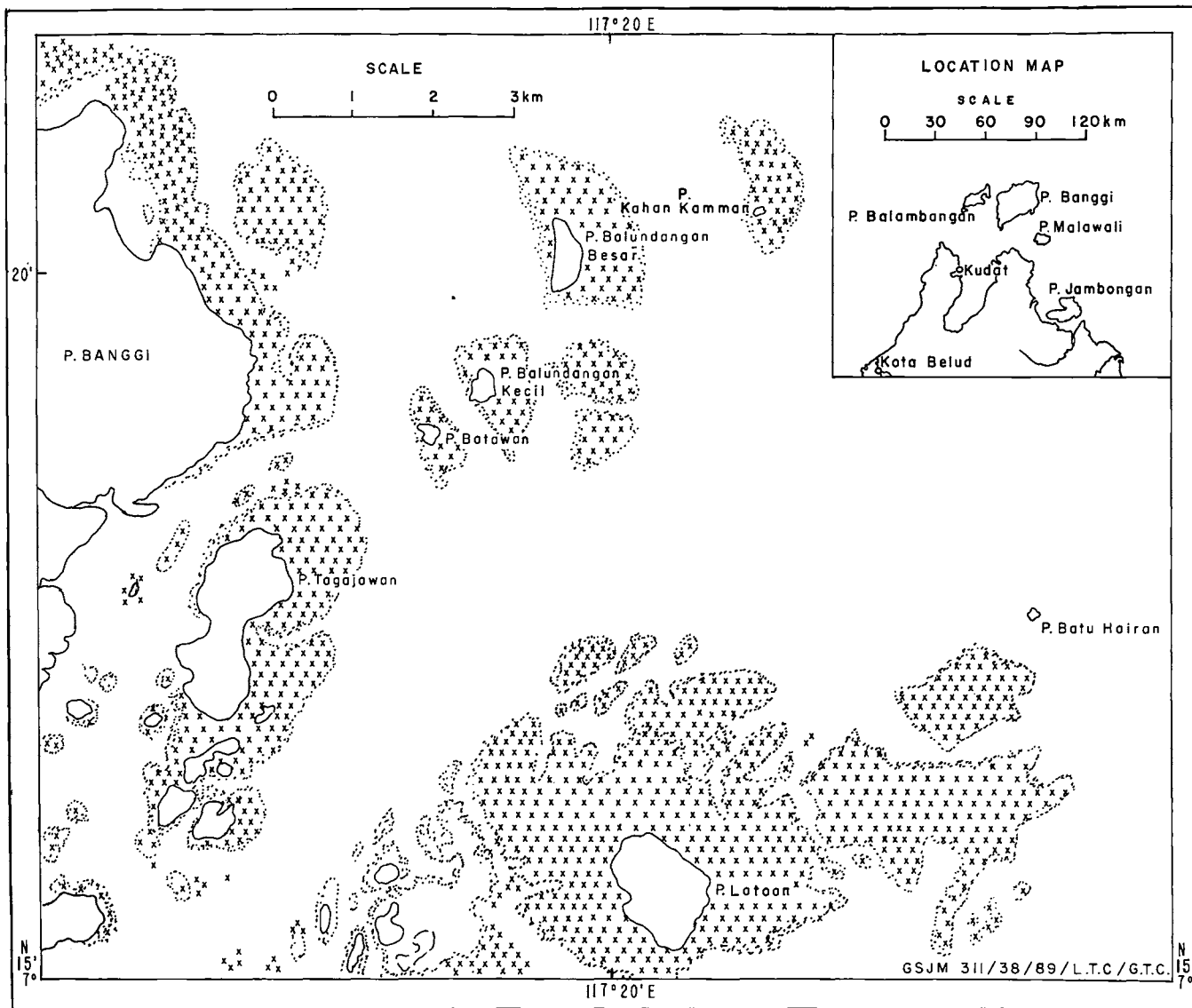


Figure 1: Location of Pulau Batu Harian and surrounding islands



Plate 1 : A general view of Pulau Batu Hairan.

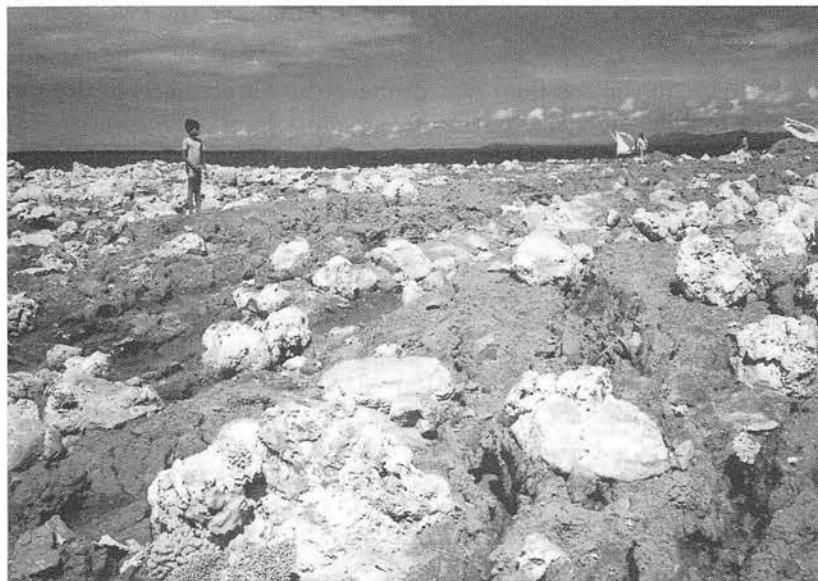


Plate 2 : Exotic blocks of hard rocks in mud. Some of the blocks are encrusted with coral. Long radiating tensional cracks can be seen.

can be found in formations that underly Pulau Banggi and the Kudat Peninsula described by Stephens (1956) and Wilson (1961). The blocks and fragments are mostly angular, some are subrounded and appear to have been weathered. Many of the larger blocks which were obviously brought up from depth from earlier episodes, have coral grown on them. Large patches of life corals are seen on the edges of the island (Plate 3).

The surface of the island is marked by a series of radiating tensional cracks (Plate 4). These cracks are up to 10 m long, 0.3 m wide and 0.3 m deep. They are quite straight and taper away towards the edge of the island. Towards the centre mini graben features are seen. Some groove marks are preserved on the mud surface where large blocks had slid over during the emergence of the island.

POSSIBLE MODE OF FORMATION

Pulau Batu Hairan cannot be classified as a mud volcano in the true sense of the word. Rastall (1911) stated that "*mud volcanoes necessitate outbursts of natural gas through shale or clay formation.....they are due to natural gas under pressure finding its way up along faults*". AGI Glossary of Geology (1960) has a similar description of mud volcanoes. The formation of Pulau Batu Hairan was not accompanied by any outbursts of gas, nor was there any gas emitting from the cracks. No mud cones, so typical of mud volcanoes were formed. The rumbling sound heard was caused by the movement of the sea floor as it was lifted up about 20 m.

The uplifting of the sea floor was probably accomplished by the upwelling of a mass of mobile mud originating from some depth. Due to pressure and difference in specific gravity a bed of mudstone had become fluidized, expanded, and escaped upwards along fractures. The rising force of the fluidized mudstone was able to carry solid blocks in the fracture zone upward and to the surface.

FORMATION OF SURROUNDING ISLANDS

Pulau Batu Hairan is not an isolated phenomenon. In fact, old folks who have lived in Pulau Banggi for a long time of two other islands have observed the emergence near the present island in the last 70 years. Each times the island remained for several months and then disappeared. The small rock island just north of Pulau Batu Hairan is most likely the remains of one of the earlier emergence. As the material forming the island consists mostly of soft mud with hard stone blocks it is easy to get eroded by ocean waves and currents, hence the disappearance of earlier formed islands.

It is believed that such upward movement of mud along fractures occur quite frequently in this area, and that the many small islands and reefs east and



Plate 3 : Life coral on the island uplifted from sea-floor.



Plate 4 : Tensional cracks developed on the surface of the island.

southeast of Pulau Banggi were formed in the similar manner over the past few million years. These islands are also low-lying, 10-15 m high and are made up of assorted rock blocks. Some islands are circular, others are elongated. They are more or less aligned either northeast or northwest, indicating that they were formed along major fracture zones trending in these directions.

The formation of an island probably took several hundreds of years after many episodes of appearances and disappearances, until sufficient hard stone blocks were brought up to form a broad base to withstand the waves. The many isolated coral reefs just a few metres beneath the surface of the sea may also be sites of former islands formed in the same manner, but had since been demolished by waves. Some day these too may once again be pushed up above the water surface and form islands.

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