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GEOLOGY AND GEOCHEMISTRY OF THE LIMESTONE IN SARAWAK**Richard Mani Banda, Rengga Gendang and Alex Unya Ambun**

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ABSTRACT

In Sarawak, limestone outcrops cover about 520 km² or 0.4% of Sarawak (total area: 124,000 km²); mainly located in southwestern Sarawak. However, they do occur as few isolated formations in central and northern Sarawak.

The geology of Sarawak is recognized as belonging to three distinct provinces, namely West Sarawak, Central and North Sarawak. West Sarawak is that part of the state south and west of Lupar River, mainly underlain by the older formation of Mesozoic age; however in some places there are some localities of the Paleogene sediments and carbonates. The sediments in this region were intensely deformed compared to northern region. Central and North Sarawak are mainly underlain by the late Cretaceous sediments, but younger towards the northern region where they are being underlain by the Miocene-Pliocene sediments. Most parts of Sarawak were intruded by the igneous rocks during Miocene time.

Keywords: Bau, geology, geochemistry, limestone, Mulu

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The distribution of the limestone formation is greatly influenced by the underlying geology of the region; the older limestone formations are located in the southwestern region, whereas the younger formations are located in the central and northern region of Sarawak. In the southwestern region, most of the limestone formation are located in Bau-Serian area. However in central and north Sarawak the limestone formation occurs as isolated hills, such as Sarang Limestone in Bintulu and the Melinau and Subis limestone formations in the northern region. The limestone formation forms extensive caves in the northern region compared to the smaller caves in southwestern Sarawak, where the formations are more faulted and fractured. The oldest limestone formation is Gunung Selabor, in the Serian area which is Permian in age (280 million years); in the Bau and northern Serian area, the limestone formation is Jurassic (170 million years). The Mulu and Subis Limestones are Paleogene (50 million years) in age.

The limestone in the Bau-Serian was studied for its geochemical contents such as SiO₂, Al₂O₃, Fe₂O₃, MgO, MgCO₃, CaO, and P₂O₃. A total of 95 limestone hills in West Sarawak was sampled. Based on this study, most of the limestones in West Sarawak are classified as high calcium limestone.

The limestone caves such as Mulu Caves and Niah Caves in the northern region, and Wind Cave in West Sarawak are great caves which are being developed for geotourism with emphasis on the development of the natural

beauty of the cave without destruction in order to attract more visitors to the cave area. In the year 2002, Niah and Mulu caves received a total of 30,000 visitors which contributed an annual revenue of RM300,000. Therefore, geotourism which emphasized the sustainable development by preserving the nature or biodiversity of the limestone area should be placed on a better platform for the country's future development plans.

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INTRODUCTION

Background

Limestone is a sedimentary rock, consisting mainly of consolidated calcium carbonate sediments. In hand specimen, limestone appears pale to dark grey, depending on the composition. Algal limestone is usually grey, whereas the rudist limestone is usually light grey such as the Bau Limestone in the Penrissen area of West Sarawak. Limestone, besides being the host rock for the formation of the great cave and beautiful karst landscape, is also fundamentally important as materials for the economic development of the country.

This paper highlights the geology, geochemistry and current development of the limestone resource in Sarawak.

Definition of Limestone

Limestone is defined as rock, consisting mainly of consolidated calcium carbonate sediments. Chemically pure limestone consists of 100% calcite (CaCO_3); however in practice, virtually all limestones contain impurities such as clay, quartz, dolomite as well as numerous other components. Examples of impure limestone are sandy limestone, marly limestone and dolomitic limestone. Marble is a metamorphosed limestone or dolomite, fine grained and will take a polish. A chalk is a very fine grained, white limestone, formed as the result of the consolidation of the calcareous tests of floating marine organisms.

Limestone is a well known building material, such as block stone, aggregate and powder for the lime and paint fillers. Famous building such as Lincoln Memorial, Washington D.C. is made of Colorado Yule Marble. This marble is widely acclaimed for its quality and purity.

Limestone in nature may form precipitous cliff, pinnacles, caves and underground channels; the landscape with these geomorphological features is known as karst topography. The world-class pinnacles and the largest cave are located in Mulu Cave area, northern Sarawak and are recognized as World Heritage of Mulu National Park. Each year this national park attracts about 12,000 visitors.

GEOLOGY OF THE LIMESTONE FORMATION

Overview of Geology of Sarawak

Sarawak has an area of about 124,000 km² which is almost equivalent to the total area of Peninsular Malaysia. It stretches over 700 km along the northeastern coast of the Borneo Island. Inland, the boundary between Kalimantan Borneo is formed by watershed dividing those rivers flowing southerly into Java and Celebes Seas. The big rivers draining Sarawak are the Kayan, Sarawak, Lupar located in the west region and the Rajang, Baram and Limbang, located in the central and north regions. The Rajang River is the longest river both in Sarawak and Malaysia.

The geology of Sarawak is recognized as belonging to three distinct provinces, namely West, Central and North Sarawak (Figure 1). West Sarawak is that part of the state south and west of Lupar River, mainly underlain by the older formation of Mesozoic age; however in some places there are localities of Paleogene sediments and carbonates. The sediments in this region are intensely deformed compared to those in the northern region. Central and North Sarawak are mainly underlain by late Cretaceous sediments, but younger towards the northern region where they are underlain by Miocene-Pliocene sediments. Most parts of Sarawak were intruded by igneous rocks during Miocene time.

The distribution of limestone formation is greatly influenced by the geological evolution of the region. The limestone formations in West Sarawak are much older than those in central and north Sarawak. The age of the Bau-Serian limestone is Mesozoic whereas the limestone in the northern region of Sarawak is Early Paleocene-Neogene. The Subis Limestone is Miocene while the Mulu Limestone is Paleocene-Miocene in age.

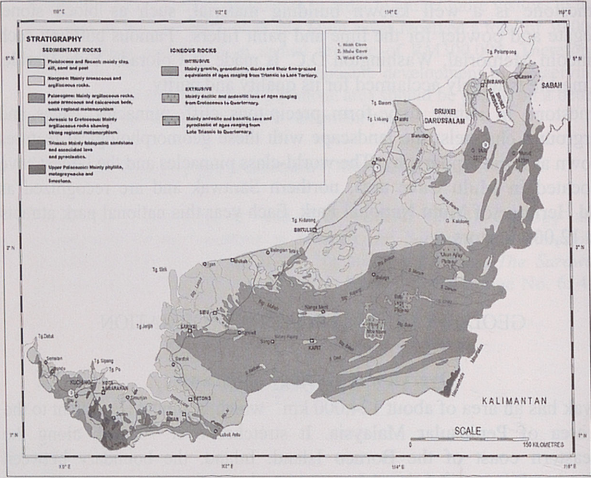


Figure 1: Geological map of Sarawak.

Bau Limestone

The term Bau-Formation describes the limestone formation located in the Bau-Serian area, West Sarawak (Liechti *et al.*, 1960), and is Cretaceous and Jurassic in age (Figure 2). The limestone formation that occur as isolated hills are Bukit Pangga, Gunung Batu, Gunung Lobang Angin, Gunung Kapor, Gunung Jambusan, and Gunung Stulang in the Bau area. In the Penrissen area, the limestone hills are Gunung Bah, Gunung Kom and Gunung Sebayat. In the Serian area, the widespread limestone hills are Gunung Kedadom, Bukit Serambu, Gunung Retoh and Gunung Selabor at the southern end of the area. In the Bau area, the hills are aligned in an ENE-WSW zone about 7 km width, stretching from Batu Kitang to the Serikin area in the WSW. In the Padawan area, the limestone hills are aligned in the NNW-SSE, before they swing to SSW direction in the Serian area. The alignment of the limestone is greatly controlled by the regional deformational structures of Borneo which developed during Late Eocene (ENE-WSW folds) and Late Miocene-Pliocene (NNW-SSE folds) time.

The limestone may be divided into two varieties, the argillaceous and the fossiliferous. The argillaceous limestone is bedded, dark brown to dark grey; the fossiliferous limestone is light grey, and in most places, it is massive.