Kagoshima University Research Center for the Pacific Islands, Occasional Papers No.34, 69-76, 2001 Part 1, Section 2, Report 1. The Progress Report of the 1999 Survey of the Research Project "Social Homeostasis of Small Islands in an Island-zone"

GEOLOGICAL ENVIRONMENTS OF YAP ISLANDS, MICRONESIA

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Abstract

The Yap islands are characterized by the occurrence of metamorphic rocks of greenschist to amphibolite facies from oceanic tholeiite, and by the lack of raised coral reef. These geological features might be related to the slow ascending history of Yap island arc system. The lack of limestone might make Yapian people recognize the economic value on the stone money of stalactite. Also, strong hydrothermal alteration, associated with the eruption of the Tomil volcanics, plays a role in producing poor soils over a wide area of the Yap islands, where vegetation does not develop. However kaolinite is a predominant clay mineral in the alteration zone, which could be a useful resources for ceramics.

Sulfur isotopic ratios near the coast are generally low, and especially the samples from the channel close to the populated area show extremely low values. The ratio might be useful in the evaluation of the natural environment, as well as in the assessment of destructive impact on the environment by human activities.

Key words: amphibolite, greenschist, hydrothermal alteration, lagoon environment, raised coral reef, sulfur isotope, oceanic tholeiite

Introduction

Yap Islands are located in the western zone of Federated States of Micronesia, and comprise four main islands: Yap, Map, Tomil, and Rumong. Yap Islands are composed mainly of accretional metamorphic rocks and volcanic rocks, accompanied by coral sand and mangrove mud.

Yap Islands comprise an island arc system on the eastern convergent margin of Philippine Plate, connecting to the Palau island arc southward, and to Izu-Mariana arc northward.

There are many Micronesia islands in the east of Yap islands, such as Ulithi, Woleai, Satawal and Ifalik, which are located in the Pacific Ocean plate region, and are oceanic volcanics or atolls developed on the descending volcano.

The geology and its difference between each island might have played an important role in the development of culture and history of each island or region. In this study, the social homeostasis of small islands is considered from geological aspects, especially from the aspects of evolution of the Yap island arc, rock and mineral resources, and sediments on the lagoon floor.

Basement Rocks in the Yap Islands

The geological map in Fig. 1 is cited from JOHNSON et al. (1960). The pre-Quaternary rocks are divided into Yap formation, Map formation, and Tomil volcanics in order of formation age (TAYAMA, 1935). The Yap formation constitutes the basement and is exposed all over the four islands. The Yap formation is composed mainly of greenschist and amphibolite of basalt origin.



Fig. 1. Geological map of Yap Islands, indicating the location of sampling points of rocks (after Johnson et al., 1960).

The metamorphic grade increases eastward from greenschist facies (western coast of Yap island) to amphibolite facies (eastern coast of Tomil island). Among three island arcs; Izu-Mariana, Yap and Palau, the metamorphic rocks occur only on the Yap arc. Both tholeite and calc-alkaline rock series common in island arc region are observed in the Palau arc, but no metamorphic rocks (NEDACHI et al., 1996). The Yap formation is derived from melange trapped in the Yap trench. Ultramafic rocks intrude into the amphibolite. The rock is clinopyroxinite to olivine websterite, and the main rock-forming mineral is clinopyroxene, associated with olivine, orthopyroxene, plagioclase and magnetite. The rocks are not metamorphosed and the serpentinization is so weak.