The Minor Structure Analysis of the Akka Limestone, Iwate Prefecture, Northeast Japan

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Summary

In this paper we have used the statistical analysis as a tool for identifying the geological parameters controlling cavern-passageways orientation of Jurassic Akka Limestone, in Northern Kitakami massif, Northeast Japan.

The geological parameters, such as bedding plane, joint, fault and fold axis, were measured in the field, and plotted on equal-area, lower hemisphere stereographic diagrams.

The results of this study were based on the analysis a total of over 7200 data indicate that the geologic parameters will involved in the creation and the development of the caves in the Akka Limestone.

Introduction

The study area is one of the most interesting karst massif in Japan, because here is situated more than 100 caves, including the longest cave(Akka-do Cave ; more than 10km long) in Japan.

As is well-known, cavern passageways show more or less the same orientation as that of the geological minorstructure in the host limestone. The geological minor structure analysis of the Akka Limestone and associated rocks will help to understand the structural control involved in the creation and the development of the Akka Belt caves. Previously, several studies(MORI *et al*., 1966; KASHIMA, 1969) have been conducted throughout the Akka Limestone testing the geological minor structure controlling cavern passageways orientation.

It has been pointed out that Akka Limestone has been subject to intensive tectonic activity and recognized two excellent tectonic directions of nearly trending NW-SE and NE-SW of the Northeast area(SUGIMOTO *et al.,* 1973).

Since 1993, the authors have been doing the field investigation and the statistical analysis of a great many data of bedding plain, joint, fault and fold axis of the nine areas in the Akka Limestone(KASHIMA *et al*., 1994; KUWAHARA *et al.,* 1995:1996:1997:1998:1999 & 2000).

Geological Setting

The study area is located in the Akka Belt and is bounded by the Taro fault to the east and the Seki fault to the west, in the Northern Kitakami Massif, Northeast Honshu, Japan(Fig.1).

The Akka Belt is occupied by Mesozoic strata consisting of Late Triassic Kayamori Group and Trias-Jurassic Iwaizumi Group. The Iwaizumi Group is subdivided into three formations; named the Sawayamagawa Formation, the Akka Formation and the Takayashiki Formation.

Fig.1 Location and geological sketch of the study area(simplified from HASE G.S.O., 1981).
Abbreviation ; A:Cretaceous Granite, B:Akka Limestone & C:Akka Belt. 1:North-East area, 2:North-West area, 3:Yamane area, 4:Uchimagi area, 5:East area, 6:Shigawatari area, 7:Central area, 8:Ryusendo area & 9:South area.

The Akka Formation, which is exposed in about 4km miximum-wide and approximately 60km long trending in a northwest-southeast direction, made up largely of limestone(named Akka Limestone) and contains much intercalated basaltic rocks and chert. The Akka Formation is overlain by mainly of the alternation sandstone and slate of the Takayashiki Formation..

The Early Cretaceous(120-110 m.y.) granites occur as concordant intrusive masses to the Akka Belt and the limestone have been locally metamophosed to the marble.

The major caves of the study area are located in the Akka Limestone which varies in thickness from 500m in the North-East part to more than 1,000m in the Central part(SUGIMOTO, 1974).

Methods and Results

Geological minor structures; bedding plain, joint, fault and fold axis, were measured in the subdivided into nine areas on the basis regional categories of study area(1.North-East, 2.North-West, 3.Yamane, 4.Uchimagi, 5.East, 6.Shigawatari, 7.Central, 8.Ryusendo & 9.South) and the obtained data were plotted on each equal-area stereographic diagram(Schmidt's net) in serch for orientation of the major trend. The results were compared with limestone, clastic rocks and granite of the each areas in the Akka Belt as given Table 1. Fig.2 showing the relashionship of the major trends of bedding and joint in Akka Limestone in the each areas.

Table 1 Major trend data for bedding, joint and fault in the Akka Limestone of studied nine areas.

Fig.2 Equal-area stereographic plots of major trend of bedding(the left side) and joint(the right side) of the each areas in the Akka Limestone.

Conclusive Remarks

Accumulated data indicate that the NW trend corresponds to bedding plane whereas the NE trend represents joint and fault of the Akka Limestone. These trends are consistent with the cavern passageways, for examples; Uchimagi-do Cave cavern passageways in Uchimagi area are to show same orientation as that of joint(the main way) and bedding plane(the branch way), Shigawatari-do Cave cavern passageways in Shigawatari area are oriented along joint and fault.

An analysis of the geological minor structures for the Akka Limestone and associated rocks(clastic rocks and granite) shows the nearly same orientation. It can be explained as the result of genetical relation that these rocks have undergone the same stress environment.

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