様式６

平成 21 年度共同利用実施報告書（研究実績報告書）

１．　共同利用種目（該当種目にチェック）

□特定共同研究(A)　□特定共同研究(B)　□特定共同研究(C)　■一般共同研究

□地震・火山噴火予知研究　□施設・実験装置・観測機器等の利用

□データ・資料等の利用　□研究集会

２．課題番号または共同利用コード　２０10－Ｇ　－　26

３．プロジェクト名、研究課題、集会名、または利用施設・装置・機器・データ等の名称

和文：　変成岩に現れる褶曲構造の成因と応力解析

英文：　Origin of folding in metamorphic rocks

４．研究代表者所属・氏名　東京工業大学・岩森光

（地震研究所担当教員名）　折橋裕二・中井俊一

５．利用者・参加者の詳細（研究代表者を含む。必要に応じ行を追加すること）

氏名	所属・職名	利用・参加内容または施設,装置,機器,データ	利用・参加期間	日数	旅費支給
岩森光	東京工業大学・教授	XRF、LAICPMS 分析装置	2009 年 4 月～2010 年 3 月	10	なし
佐々木潤	東京大学・大学院生	XRF、LAICPMS 分析装置	2009 年 4 月～2010 年 3 月	10	なし
飯田和也	東京大学・大学院生	XRF、LAICPMS 分析装置	2009 年 4 月～2010 年 3 月	10	なし

６．研究内容（コンマ区切りで 3 つ以上のキーワードおよび 400 字程度の成果概要を記入）

キーワード：変成岩、縞状構造、褶曲

変成岩帯に頻繁に見られる褶曲構造とその応力・変形履歴を解明する目的で、褶曲を呈する縞状構造そのものの成因を XRF 分析による全岩化学組成から制約を試みた。典型的にはｍｍからｃｍスケールの縞状構造の単位でサンプリング・分析を行った結果、（１）複数の縞にまたがる basic rock 全体としての原岩は MORB 起源と考えて差し支えがないこと、（２）それらは、複数の鉱物からなり、縞に応じてそれらのモードが変化すること、（３）それらのモードは、物質移動（おそらくは流体が関与した化学反応と物質輸送）によって不均質性が生じた可能性があることが分かった。

７．研究実績報告（公表された成果のリスト*1または 2000～3000 字の報告書）

（*1論文タイトル、雑誌・学会・セミナー等の名称、謝辞への記載の有無、ポイント数、電子ファイル添付のこと）

Banding structure is a ubiquitous texture in metamorphic rocks formed by regional metamorphism, which is observed regardless of its protolith, metamorphic grade and region. It is very important to clarify the origin, because it may include information concerning kinetics of metamorphic reaction and initial condition of folding process (i.e., deformation process) which originates from banding structure. The origin has been frequently discussed since Eskola(1932), but remain largely controversial due to lack of detailed comparison between theory and natural analysis.

The problem is the origin of anisotropy in structure and mechanism of differentiation. The followings are regarded as the major factors that may cause banding structure formation: (1) initial structure of its protolith, (2) mechanical effect (e.g., shear crack, flow differentiation), (3) chemical effect (e.g., coupling of diffusion and reaction).

In this study, we examine the origin of banding structure using basic rocks from Sambagawa belt in Shikoku, southwest Japan. Sampling points are distributed from central to western part of Shikoku, corresponding to high grade to low grade metamorphism. In western part (i.e., lower grade), basic rocks are composed of albite-actinolite layer and epidote-actinolite layer with small amounts of pumpellyite-rich layer and chlorite-rich layer, which are characterized by unclear boundary and larger mean width (1cm). In central part (i.e., high grade), major minerals are hornblende, epidote and albite spot (or garnet). Banding structure is usually not developed so much, but albite spot (or garnet) is localized to be like layers in some rocks. In the area where rocks show intermediate grade, basic rocks are composed of albite-actinolite layer, epidote-chlorite layer and epidote-actinolite layer with small amounts of quartz layer, which are characterized by clear boundary and smaller mean width (1mm). Some outcrops in this area are considered to originate in pillow lava, initial structure of which is closely homogeneous, and these rocks show similar mineral assemblage and banding pattern to basic schists parallel to bedding plane. This indicates that the origin of banding structure is same in both occurrence. Therefore, banding structure can be formed during deformation and/or metamorphism. As a result of XRF analysis, elements which are immobile to fluid system (e.g., Ti, V, Zr, Y, Nb) show a meaningful trend beyond the variation from heterogeneity, and many samples belong to non-alkaline basalts and tholeiitic series. Furthermore, discrimination diagrams for tectonic settings (e.g., Zr-Y-Nb, Ti-V, Ti-Fe/Mg) show that almost all samples originate in MORB, independent of its metamorphic grade and occurrence. This also supports that banding structure is formed during deformation and/or metamorphism, because of homogeneity in MORB texture. Mineral compositions are measured by EPMA over the tens of centimeters in a direction perpendicular to layers to compute one-dimensional spatial profile for elements. Auto correlation function for each element behaves periodically and its amplitude damps gradually; the correlation length is roughly ten times as long as mean layer. Especially, function for mobile elements (e.g., Si, Na, K) show strong correlation. Furthermore, cross correlation function show weak correlation between different elements. These results mean that some mechanism to localize element distribution is needed during metamorphism and/or deformation. We thus may conclude that initial structure of these rocks are homogeneous, and elements differentiate during metamorphism and/or deformation related to fluid. The mechanism to produce anisotropy may be related to rock flow because some samples have textures like lens, not like layer. The model which can explain these results is discussed, compared with existing models.