

Petrological characteristics of the mantle section of the northern Oman and Lizard ophiolites : An approach from in-situ rocks and detrital chromian spinel

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学 位 論 文 要 旨

The petrological characteristics in the northern Oman ophiolite and Lizard ophiolite, which were, respectively, of the fast-spreading ridge origin and of the slow-spreading ridge origin, were investigated to determine and compare the deep magma processes related with the origin of MORB and formation of late intrusives. In this study, the conventional petrological investigation is accompanied by a new approach using detrital chromian spinels (DCS). One of the advantages of this method is to survey the complex in terms of chromian spinel relatively evenly as far as water and other eroding agents can reach. Its methodology and implications are shown.

The DCS were extensively examined from 10 localities in the northern Oman ophiolite. The Cr# in the Oman DCS are high, ranging from 0.3 to 0.9 (mostly from 0.4 to 0.8). Examinations on in-situ rocks exposed at the mantle section of the Oman ophiolite indicate that the high-Cr# DCS were derived from discordant, that is, post-deformational dunite. In-situ harzburgite usually has spinels with lower Cr# (<0.6). This relation combined with the general mineral chemistry indicates that the dunite-harzburgite with high-Cr# spinel was formed by a sort of reaction between melt and a less depleted peridotite with lower-Cr# spinel. This process is possibly equivalent to the deep-seated

magmatism which converts the ocean-floor peridotite to the arc-type mantle at the very early stage of arc development onto the ocean floor. These chemical variations of the detrital chromian spinel and in spinel from in-situ rocks strongly indicate that the upper mantle section of the Oman ophiolite has a substantial amount of supra-subduction zone "component".

In the Lizard ophiolite, DCS were examined from 9 localities in modern beach, although one of them is omitted because of the lack of chromian spinel. We can identify three groups of DCS suite which are consistent with the lithological characteristics of each localities. DCS suggests that the initial variation of spinel remained in lherzolite/harzburgite suite of Central area ($\text{Cr\# } 0.1-0.5$; $\text{TiO}_2 < 1\text{wt\%}$), whereas the subsolidus reaction and the formation of dunite-troctolite-gabbro associations respectively modified the chemistry of spinel from the lherzolite/harzburgite suites in Western and Eastern areas. These processes deduced from detailed analysis of DCS are consistent with our preliminary observations on in-situ rocks and with descriptions in the literature.

The dunite feature in the northern Oman ophiolite and Lizard ophiolite is discussed in terms of the differences between concordant and discordant dunites, which are, respectively, parallel to and subparallel to the foliation of surrounding harzburgite. The chemical variation of dunites and surrounding rocks indicated that the formation of discordant dunite has, extensively and severely, modified the chemistry of the related rocks, although the modification feature is quite different between at the Moho transition zone and at the mantle section. At the Moho transition zone, discordant dunite forms the association with feldspathic rocks, and their clinopyroxenes make chemical trends similar to those of Hess Deep, EPR, of which rocks are interpreted to be due to melt/peridotite interaction. On the other hand, at the mantle section, discordant dunite tends to be high-Cr# (up to 0.8) in spinel and low-Fo in olivine, and modified surrounding harzburgite and concordant dunite. This relationship implies some arc magma was responsible for the formation of discordant dunites at an arc-related geological setting.

Similar characteristics were also found in the Lizard ophiolite, although the discordant dunite in the mantle section is quite different from the Omani one both in shape on the outcrops and in spinel chemistry. The discordant dunite in the Lizard ophiolite has high-Ti

(up to 6 wt% of TiO_2) spinel which is similar to that in dunite xenoliths derived from the oceanic hot spots. The surrounding lherzolite/harzburgite suite and concordant dunite of the Lizard ophiolite were, therefore, possibly affected by the formation of discordant dunite related with an intra-plate magmatism.

In conclusion, the petrological characteristics of the mantle section are similar to each other in the both ophiolites in terms of the modification process, although the primary feature before the modification, is quite different and imply the processes of MORB formation at different conditions, namely at a fast-spreading ridge for the Oman ophiolite and at a slow-spreading ridge for the Lizard ophiolite.

学位論文審査結果の要旨

角島和之君の提出論文について、第1回審査委員会に引き続き、2月1日に公開発表会、第2回審査委員会を行い以下の結論を得た。

本論文はイギリスのリザード、およびアラビア半島のオマーンの2つの有名なオフィオライトのマントル部分の生成過程を岩石学的に明らかにしたものである。オフィオライトは昔の海洋底の断片とされているがその実体は未だ不詳である。角島君は精力的な調査と綿密な室内解析により、両オフィオライトが、それぞれ低速、高速拡大軸の海嶺で形成された後、他のマグマ活動の産物が非調和性ダナイトなどとして付加したものであることを明らかにした。また、この新たなマグマの性質はオマーンでは島孤的、リザードではプレート内的であることを指摘した。特筆すべきは、通常のような露頭の岩石からの情報のみでなく、両オフィオライト周辺の現世の堆積物中の重鉱物として普遍的に見い出されるクロムスピネルの重要性を認め、その解析を最大限に利用したことであろう。この手法は従来、堆積学では行われていたが岩石成因的に用いて成功した例は余りない。この手法は膨大な露出を示すかんらん岩類の研究には極めて有効であることが実証された。角島君は、世界的に有名な両オフィオライトにおいて、新たな手法を用いて重要な新知見をもたらし、オフィオライトや海洋底の成因の研究史に新たなページを加えることに成功した。これらの業績は、角島和之君に博士（理学）の学位を与えるのに十分値するものである。