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授与した学位	博　士		
専攻分野の名称	理　学		
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学位論文の題目	Geochemical Study of the Cameroon Volcanic Line: Implication for the Genesis of Passive Margin Intraplate Magmatism （カメルーン火山列の地球化学的研究：パッシブ・マージンプレート内マグマの成因）		
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学位論文内容の概要

Genesis of hotspot magmatism has generally been explained by the plume hypothesis, namely, melting of upwelling asthenospheric mantle beneath the intraplate lithospheric mantle. The passive continental margin is one of the major hot spot location, which is most widely distributed on and western offshore of the African continent. The plume hypothesis explains the presence of recycled crustal or lithospheric mantle materials in the upwelling mantle plume to generate the large chemical and isotopic variabilities of the west African passive margin intraplate basalt (WAPM-IB). However, absence of time-progressive linear hotspot track and little distribution of high-degree of melt in WAPM-IB make it difficult to explain its genesis by the simple mantle plume hypothesis. In this thesis, I report major and trace elements and Sr, Nd, Hf, and Pb isotopic compositions for 90 mafic samples collected from five volcanic centers (Annobon, Sao Tome, Principe, Bioko, and Etinde) in the Cameroon Volcanic Line (CVL). These chemical and Sr-Nd-Hf-Pb isotopic variations explain that the parental magmas for the CVL can be generated by melting of Group 1 kimberlite source refertilized cratonic subcontinental lithospheric mantle (SCLM), the old asthenospheric mantle-derived low degree of melt that should have metasomatized SCLM during the Mesozoic continental breakup, and the pyroxenite vein or layer in the SCLM. This result demonstrates that no external ‘plume’ components is necessary to form the CVL magmas. The defined source materials can also explain the isotopic variations for other WAPM-IB: Canary Islands, Atlas Mountains, and Capo Verde Islands. Our results combined with the continental rift model deciphers that the tectonically-controlled lateral mantle convection can be a heat source to melt the SCLM widely distributed beneath Africa and Atlantic Ocean to form the parental melt of the WAPM-IB. Edge-driven convection formed by the lateral mantle flow at the continent-oceanic boundary can heat the SCLM beneath the Atlantic Ocean, selectively melting the low solidus material of the SCLM. The coincident distribution of CVL and Canary-Atlas chains at the NW edge of the cratonic lithospheric mantle suggests that the heating of the SCLM by the edge-driven convection can be the most effective where the mantle flow collide near the edge of the SCLM rather than at the front collision. The edge-driven convection can occur more than several tens Mys at the same location, forming the long duration of magmatism without showing the time-progressive linear hot spot track. Consequently, the upwelling mantle plume is not necessary to form the chemical and isotopic characteristics for the passive continental margin hot spot magmatism at the WAPM.

論文審査結果の要旨

The candidate conducted systematic geochemical study of volcanic rocks collected from five volcanic centers of the Cameroon Volcanic Line (CVL). He successfully analyzed the high precision trace element compositions, Sr-Nd-Hf-Pb isotopic compositions, and K-Ar ages for these samples. He logically interpreted the data obtained, and proposed an original model for the magma genesis not only for the CVL but also for the other major West African passive margin (WAPM) intraplate basalts.

Previous studies suggested the necessity of upwelling mantle plume for the genesis of WAPM intraplate basalts because the geochemical signatures of these magma indicate the involvements of recycled crustal or lithospheric materials. On the other hand, a long controversy has continued how to form the non-time progressive volcanic chains which commonly occur in the WAPM volcanic regions based on the plume hypothesis. By the careful discrimination on the data sets obtained, he found three major source components which produced CVL parental magmas. Then, he inferred the possible source materials which are likely to be existed beneath the CVL without considering of external materials such as ‘plume components’. Based on the defined isotopic variations of the current sub-CVL lithospheric mantle compositions, he succeeded to explain the geochemical systematics of the CVL magmas by melting of lithospheric mantle components which were metasomatized by different processes. Considering the tectonic setting and location of the CVL, he revealed the great role of the edge-driven convection of the asthenospheric mantle to create the heat source for the melt generation. He further examined the geochemical variation of the major WAPM intraplate basalts based on the identified source components, and found that most of these magmas were produced by similar source components with the CVL basalts. The prominent conclusion in this study is that the geochemical variations for the CVL and other major WAPM basalts can be explained without considering the upwelling mantle plume.

His proposed model is completely new and could solve the long-time debate for the hot spot magma genesis at the WAPM, one of the major hot spot region on the Earth. This conclusion has a great impact on mantle dynamics in Earth Science. Therefore, we concluded that this research is suitable for the Ph.D. dissertation of Okayama University.