

**論文審査の要旨**  
(Summary of Dissertation Review)

博士の専攻分野の名称 (Degree)	博 士 ( 理 学 )	氏名 (Author)	LARISSA NGOMBI MAVOUNGOU
学位授与の要件	学位規則第 4 条第①・2 項該当		
論文題目 (Title)			
Tectonic processes during Maizuru back-arc basin closure: Geochemical, geochronological, and structural approaches (地球化学・地質年代学・構造地質学的手法に基づく舞鶴背弧海盆閉鎖プロセスの解明)			
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〔論文審査の要旨 (Summary of Dissertation Review)〕			
<p>The Maizuru back-arc basin was a paleo back-arc basin that opened during Early Permian time at the East Asian continental margin with the deposition of a black and massive mudstone-dominated sedimentary cover (the Maizuru Group) and closed possibly during the Permo-Triassic (P-T) boundary with so far unknown tectonic process. The rocks of this paleo back-arc basin are exposed on land, in the Maizuru Terrane, which is subdivided into Northern, Central, and Southern zones. The Northern zone is mostly made up of granitoids, the Southern zone is mainly composed of mafic and ultramafic ophiolitic rocks representing the basement of the Maizuru back-arc basin, and the Central zone, which contains the sediments of the back-arc basin, is dominated by Permian sedimentary rocks with some Triassic rocks. Except for the above-mentioned Maizuru Group, sandstones, and another major lithological unit, the breccia-dominated Tonoshiki Formation, are exposed in the present study area of Mimasaka-Doi, Okayama. The Tonoshiki breccia was initially thought to have been deposited directly on top of the ophiolitic basement rocks, but its stratigraphic position is yet to be clearly understood. Moreover, these rocks have the potential to unravel the exact basin closure-related tectonic processes and that of the East Asian continental margin, which is one of the main aims of this study.</p> <p>To achieve this goal, the determination of the basin closure-related sedimentological and structural rock record is of utmost importance and for this purpose, petrological,</p>			

petrographic, mineralogical, geochemical, geochronological, and structural studies have been carried out in the key localities of the present study area.

The petrographic observations revealed that Tonoshiki breccia rocks are made up of differently-sized extremely angular clasts, which are typical characteristics of debris-flow deposits, and can be subdivided into two major types. The first type (Type I), a major type in this area mainly consists of mafic to intermediate rock clast fragments, and the second type (Type II) is mostly made up of felsic rock clast materials. Both types contain mudstone clasts that also look black and massive and have similar mineralogical and geochemical characteristics as the mudstone of the Maizuru Group. This implies that the mudstone clasts in the Tonoshiki breccia were derived from the underlying Maizuru Group bringing the Tonoshiki Formation stratigraphically on top of the Maizuru Group and representing the rock record during the closure of the basin.

The U-Pb detrital zircon geochronology revealed two pulses of debris flow separated by a more tranquil phase characterized by the deposition of mudstones and sandstones. The first debris flow event occurred at ca. 259 Ma with the deposition of Type I with sources mainly from the Southern Zone and the second debris flow event took place at ca. 251 Ma with the formation of Type II breccia sourced mainly from the Northern zone of the Maizuru Terrane. This switch of provenance suggests that the closure of the Maizuru back-arc basin at the P-T boundary was characterized by intense tectonic activity, which is evident from different fracture patterns in Tonoshiki breccia. Structural studies revealed the presence of calcite and sediment-filled fractures in Tonoshiki breccia, a product of hydraulic fracturing, which possibly triggered the slope failure and the formation of the breccia. The conspicuous lack of similar fractures in the overlying Triassic rocks of the Fukumoto Formation suggests that the fracturing events were limited to the P-T boundary.

Ms. Larissa Mavungou Ngombi generated all the high-precision data in this study and showed that the closure of the Maizuru back-arc basin was related to the subduction of the basement crust of the basin under the East-Asian continent during the P-T boundary and accompanied by the deposition of fractured coarse-grained materials through pulses of debris flow. This in-depth understanding of the tectonic process and precise timing of the closure of the back-arc basin are new and original contribution to the geological evolution of Japanese archipelago and that of the East Asia. Moreover, such in-depth understanding of the back-arc basin closure has its global importance as similar rock record should be targeted to study other closed paleo-backarc basins and also many of the present-day back-arc basins which are in the closing stage.

Finally, it is agreed from the above review result that the author of the present thesis has enough credentials to be awarded the doctoral degree (Science).

公表論文 Published Article

[1] Ngombi, M. L., Das, K., Kawaguchi, K., Hayasaka, Y., and Shibata, T., 2022. Back-arc basin closure at the East Asian margin during Permo-Triassic boundary: Evidence from geochemistry and U-Pb zircon data of sedimentary breccia from Maizuru Terrane, Southwest Japan. *Geosystems and Geoenvironment*, 1(3) (2022) 100080.