Tonoshiki breccia recording the signature of the closure of Maizuru back-arc basin during Permian-Triassic boundary

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Tonoshiki Formation, a breccia-dominated unit which is made up of different sized extremely angular clasts occurred in Maizuru back-arc basin that closed during Late Permian. One of the dominant types is a breccia dominated by mafic rock clasts derived from the Yakuno ophiolites. Recently, clasts with different features, mostly felsic shallow crustal rocks fragments, have been found in the breccia. These two types of breccia might not only differ in terms of their petrology, but they are likely to also present different geochronological and microstructural characteristics. In this study, we report the depositional timing and some microstructural features for Tonoshiki breccia. The detrital zircon LA-ICP-MS dating of Tonoshiki breccia provide Latest Permian maximum depositional ages of 259 and 251 Ma for the mafic-rock clast-rich type and the felsic-rock block-dominated unit, respectively. These characteristics of Tonoshiki breccia suggest its formation as a result of two phases of tectonic activity-induced debris flow occurring during Late Permian. The optical microscopic observation of 2 specimens of Tonoshiki breccia reveal several microstructural features for both types. The two types of Tonoshiki breccia commonly display internal fracturing within several single clasts (e.g., tonalitic, rhyolitic rock fragments). Moreover, evidence of hydraulic fracturing has been found in both types of the breccia. In contrast, following two different types of veins are prominent for both types. Prehnite-pumpellyite and quartz-filled veins are found in the mafic rock-clast rich unit whereas a network of multi-directional calcite-filled fractures are present in some felsic rock fragments. The examination of a Triassic sandstone sample of the Fukumoto Formation under optical microscope does not reveal any evidence of hydraulic fracturing. This provides a possible constraint for the timing of veins formation in Tonoshiki breccia. The development of veins was triggered by fluid overpressure that possibly occurred during the last evolutional stage of Maizuru back-arc basin represented by the collision with the eastern margin of the East Asian continent, which marks the present Maizuru terrane. The Permo-Triassic transition in Maizuru-back-arc basin is characterized by the deposition of Tonoshiki breccia during two pulses of tectonic activity and is accompanied by hydraulic fractures affecting the breccia. Hydraulic fracturing might represent the tectonic signature related to the closure of the basin.

Keywords: Basin closure, Hydraulic fracturing, Late Permian, Maizuru back-arc basin, Tonoshiki breccia.

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