Bayesian statistical evaluation method for detrital zircon geochronology: Applications

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Detrital zircon geochoronology is an essential method for determining the provenance and maximum depositional age of sedimentary and metamorphic strata. The age distribution is conventionally evaluated by using histograms. However the lack of the statistical verification of the histograms can cause misunderstanding of data. In order to overcome the raised statistical issues, we established new statistical evaluation method to evaluate distribution for detrital zircon ages, based on Bayesian Statistics (Furukawa and Tsujimori, 2019 JpGU, session M-GI33). As the application of our new statistical evaluation method, LA-ICPMS U-Pb dating for detrital zircon separates from the Carboniferous lawsonite-bearing metagreywacke of the Osayama serpentinite mélange (OSM) and the Cretaceous arkose sandstone of the Akaiwa Formation (AFS), Tetori Group was conducted.

The OSM of the Renge Belt tectonically overlies the pre-Triassic geotectonic units of the Chugoku Mountains (e.g., Tsujimori 1997 Min. Mag.; Tsujimori and Itaya 1999 IAR). The geological and lithological features are similar to those of late Paleozoic blueschist-bearing serpentinite mélange units of the Kurosegawa Belt in Shikoku, Kyushu and Kii Peninsula. Our new data shows that the OSM zircons show at least bimodal age distributions at ˜500 Ma and ˜1,100 Ma with 95% certainty; the group of the oldest concordant ages reaches 3,300 Ma and the youngest concordant age was 412 Ma.Comparison with existing data in the literatures (e.g. metasediments in the Kii Peninsula: Yoshimoto et al. 2013 JMPS), our Bayesian-based statistical evaluation shows a strong similarity.

We also applied our new evaluation method to the Tetori Group sandstones. The youngest grain yields 187 Ma, and the oldest concordant age was 2,940 Ma. Our evaluation found statistical 'discrepancy' with more than 90% certainty between our AFS data and the existing data of the Itsuki Formation (Kawagoe et al., 2012 Mem. FPDM), which stratigraphically occupy higher portion of the AFS and unconformably overlies the AFS. Throughout the two applications, we introduce how our new statistical evaluation works and its advantages in geological sciences.

Keywords: Bayesian statistics, detrital zircon geochoronology
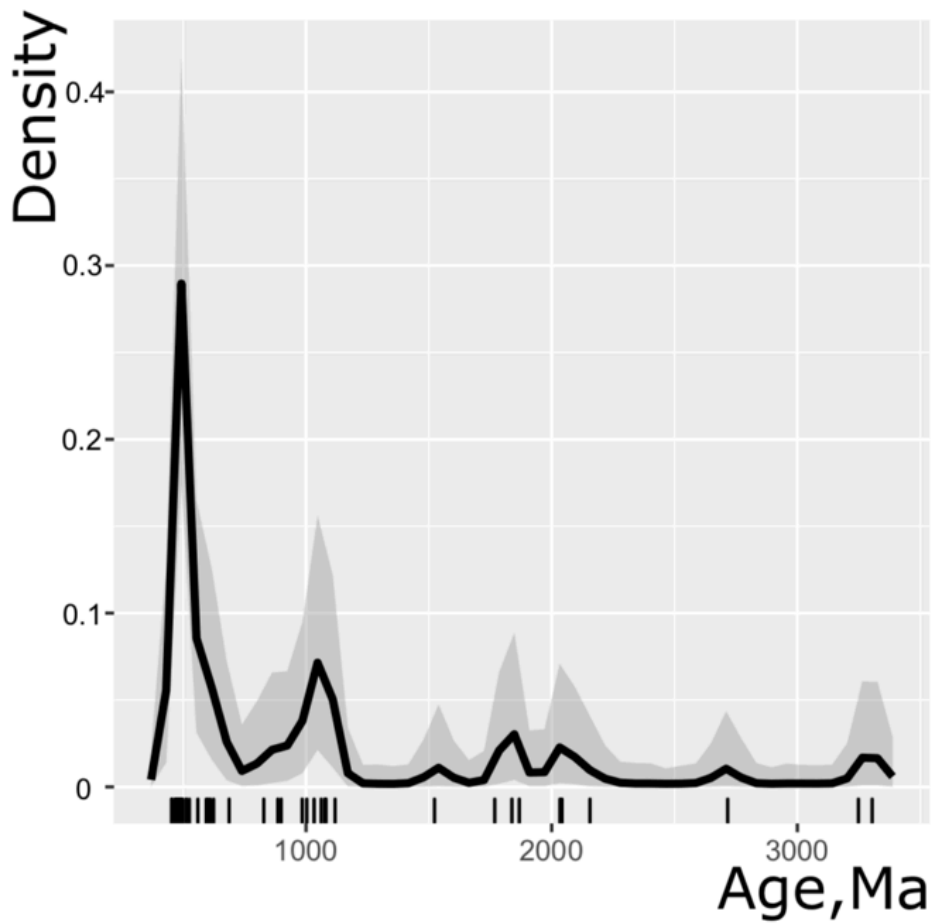
The distribution of OSM detrital zircons and its 95% credible interval