

Influence of surface condition on data quality of U-Pb zircon geochronology: an example from AS3 zircon, the Duluth Complex, U.S.A.

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U-Pb zircon geochronology by using microbeam analysis such as SIMS and LA-ICP-MS has played a pivotal role in geochronology because one of the advantages of microbeam analysis in U-Pb geochronology is to select the appropriate analytical spot for U-Pb dating. Many analysts empirically believe that accuracy and precision of microbeam analysis strongly depend on the surface condition of analytical spots. Especially, existence of fractures within the analytical spots is considered to decrease the data quality, but there is no quantitative evidence that the fractures result in some negative effect on the data quality. In this study, we quantitatively discuss influence on the data quality from the surface condition of the analytical spots. AS3 zircons collected from gabbroic anorthosites of the Duluth Complex, Minnesota, U.S.A., were used in this study. Previous work reported that some grains in AS3 zircons yield discordant data due to Pb loss caused by thermal diffusion (Schmitz et al., 2003).

Observation of thin sections by optical microscope and electron microprobe reveals chloritization of amphibole in AS3, which suggests hydrothermal alteration. U-Pb analyses of some AS3 zircon grains yielded discordant data. The analytical spots that yield discordant data can be classified into (1) altered domains characterized by high contents of LREE and non-formula elements, such as Ca, Al, and Fe, and (2) domains containing undersurface fractures. In the case that analytical depth is close to the undersurface fractures, the second domains also show high LREE contents. When the fractures in zircon worked as channels of hydrothermal fluid (Carson et al., 2002), there are possibilities that areas around the fractures was altered like a clad by the fluid. Therefore, selection of the analytical spots for U-Pb zircon dating should be based on observation of fractures not only on the surface but also under the surface. When AS3 zircon is used as U-Pb reference material, it is important to carefully choose analytical spots on the basis of the backscattered electron and optical microscope images for achieving more precise analysis.

Reference

Schmitz, M.D., Bowring, S.A., & Ireland, T.R. (2003) *Geochimica et Cosmochimica Acta* **67**, 3665-3672.
Carson, C.J., Ague, J.J., Grove, M., Coath, C.D., & Harrison, T.M. (2002) *Earth and Planetary Science Letters* **199**, 287-310.