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Electron-microprobe age mapping of monazite

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Abstract

High resolution X-ray maps of Th, U, Pb, and Y in monazite can be used to construct age maps, which reveal the continuous spatial distribution of ages in a single grain of monazite. The age mapping algorithm and three examples are presented to illustrate the capabilities and applications of this mapping technique, the insights it can provide into monazite geochronology in general, and its limitations compared to electron microprobe (EMP) quantitative dating and other in-situ geochronologic techniques.

Age maps offer critical information for unraveling metamorphic and tectonic histories and for interpreting results from other geochronologic techniques, and they are a valuable aid for rigorously locating in-situ analytical points. Age mapping also can be used to better understand the behavior of the U-Th-Pb system in monazite during metamorphism, deformation, and fluid-circulation events. Age maps presented in this paper reveal unsuspected age heterogeneities on the micrometer scale, like a now-healed fracture not visible in back-scattered electron (BSE) images or young domains less than 5 μm in width located inside an older core. In both cases, using age maps as a template for locating in-situ analysis points will minimize the peril of age mixing and erroneous geological interpretations. In addition to providing critical information for illustrating and interpreting the history of complex polygenetic monazite, age mapping may ultimately lead to a better understanding of the processes involved with monazite growth and recrystallization, and thus, even more powerful applications of the monazite geochronometer.

The *AgeMap* program is available in a Windows version and can be downloaded from the internet at the following address: http://www.geo.umass.edu/probe/agemap.