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"Satellite monazites" in polymetamorphic basement rocks of the Alps: Their origin and petrological significance

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Abstract

Allanite-fluorapatite reaction coronas around monazite are abundant in metamorphic rocks. We report here special cases where a new generation of "satellite" monazite grains formed within these coronas. Using examples from different *P-T* regions in the eastern Alps, we examine the origin and the petrological significance of this complex mineralogical association by means of the electron microprobe utilizing Th-U-Pb monazite dating and high-resolution BSE imaging. Satellite monazite grains form when a monazite-bearing rock is metamorphosed in the allanite stability field (partial breakdown of first generation monazite to fluorapatite plus allanite), and is then heated to temperatures that permit a back reaction of fluorapatite plus allanite to secondary satellite monazite grains surrounding the remaining original first generation monazite. Depending on the whole-rock geochemistry satellite monazites can form under upper greenschist- as well as amphibolite-facies conditions. In each of the three examples focused on here, the inherited core monazite was resistant to recrystallization and isotopic resetting, even though in one of the samples the metamorphic temperatures reached 720 °C. This shows that in greenschist- and amphibolite-facies polymetamorphic rocks, individual grains of inherited and newly formed monazite can and often will occur side by side. The original, inherited monazite will preferentially be preserved in low-Ca, high-Al lithologies, where its breakdown to allanite plus fluorapatite is suppressed. Conversely, a medium- or high-Ca, monazite-bearing rock will become particularly fertile for secondary monazite regrowth after passing through a phase of strong retrogression in the allanite stability field. Based on this knowledge, specific sampling strategies for monazite dating campaigns in polymetamorphic basement can be developed.

Keywords: Monazite, fluorapatite, allanite, metamorphic rocks, geochronology