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Zircon characteristics controlled by magma type and shearing: SHRIMP data from Ordovician metavolcanic rocks of the Kaczawa Mountains (Polish Sudetes)

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Observations based on optical microscopy and CL studies of zircons from Early Ordovician metarhyodacite and metatrachyte of the Kaczawa Complex (West Sudetes) indicate that zircon abundance and morphology strongly depend on the chemical type of magma. The zircons in the calc-alkaline rock (metarhyodacite) are larger and abundant; typically, they are euhedral, short- to medium-prismatic, with dominant (100) prism and (101) pyramid. Most crystals have a clear central domain, and moderately pronounced growth zoning in their outer parts. A few crystals have less regular habits: isometric, subrounded or ellipsoidal, occasionally broken; the latter are usually very bright in CL images and appear to represent inherited grains. In contrast, the zircons in the alkaline rock (metatrachyte) are smaller and less frequent. They are also euhedral, short-prismatic, with strongly dominating (100) prism and (110) pyramid. Most of them are clean and homogeneous, with only a very few displaying indistinct cores and zoning; the latter grains are usually brighter in CL images with very rare inheritance.

The zircon abundance in both the rock types is in contrast to their zirconium contents: 68-219 ppm in the metarhyodacites, and 650-1186 ppm in the metatrachytes. The low quantity of zircon crystals in the metatrachytes, their small size and scarcity of inherited cores, seem to be controlled by the strong alkalinity of the magma, zirconium undersaturation and resultant high solubility of Zr in such melts. It might well be that zirconium was consumed by other early growing minerals (e.g. pyroxene), so there was not enough that element to form abundant independent mineral phase. All these features are in line with the mantle provenance of the alkaline magmas in that area. In contrast, the metarhyodacites derived from continental crustal calc-alkaline melts

contain large amounts of fairly big crystals, with many enclosing inherited cores from the magma precursor.

There is also a strong contrast between the two rocks, as far as the degree of tectonic deformation is concerned. The metarhyodacites are extremely sheared, with common mylonitic fabric. The zircon grains in these rocks are very often cracked and this physical damage has caused local disturbance in their chemistry. It was notified that the SHRIMP data from analytical spots close to cracks show high common Pb and wide (c. 270 to 500 Ma) dispersion of ages. In contrast, again, the metatrachytes are very massive, often with no traces of deformation, and their zircons display much less chemical and isotopic disturbance, and define a much more distinct age cluster at around 485 Ma.

Summing up, our investigations have shown that zircon abundance and morphology strongly depend on chemical type of magma (alkaline vs. calc-alkaline). Furthermore, deformation, e.g. intense shearing, may disturb their chemical and even isotopic characteristics, and consequently, influence the measured isotopic ages.

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