

Using zircon to decode the timing and source of Au mineralization

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The Porcupine gold camp, located in the Abitibi Subprovince, is host to numerous quartz-carbonate vein gold deposits purportedly generated during late to post-Kenoran (2750-2670 Ma) orogenesis. We attempt to constrain the timing of mineralization and determine hydrothermal fluid sources through depth-profiling techniques on unpolished zircon using SIMS $\delta^{18}\text{O}$ and U-Pb isotopic and LA-ICPMS trace element analyses. Depth-profiling allowed the crystal face, and potential thin rims, of the zircon to be analyzed. Zircons from three separate mineralized syn-tectonic $\text{qtz} \pm \text{ab} \pm \text{ms}$ porphyritic intrusions yielded $^{207}\text{Pb}/^{206}\text{Pb}$ ages of 2658 to 2632 Ma, ca. 25 to 55 m. y. younger than abraded zircons from the same suite of rocks dated with TIMS geochronology (2688 to 2684 Ma; Ayer *et al.* 2005). Similarly, zircons from five mineralized metagreywacke and polymictic metaconglomerate beds have bimodal age distributions with populations separated by 30 to 35 m. y. The older population (2687 to 2669 Ma) coincides with documented synorogenic sedimentation, whereas the younger population (2658 to 2635 Ma) is correlative to SIMS ages on the porphyritic intrusions. In many dated zircons, two distinct chemical zones have been distinguished based on REE depth-profiles. Zircons hosted in metasediments tend to have a relatively enriched LREE zone near the crystal face. In contrast, zircons from the porphyritic sills that intrude basalt tend to have a relatively depleted LREE zone near the crystal surface. Zircon oxygen isotopic data ($\delta^{18}\text{O}$) range from 2.3 to $8.5 \pm 0.3\text{‰}$. In general, average $\delta^{18}\text{O}$ values suggest primitive magmas and agree with other Abitibi intrusive suites, (zircon $\delta^{18}\text{O}$ value: $\sim 5.8\text{‰}$; King *et al.* 1998); the variability suggests magmatic fluid heterogeneously mixed with surface-derived and/or metamorphic fluids. The younger zircon ages and distinct trace element zones, coupled with $\delta^{18}\text{O}$ data is likely indicative of magmatically-derived hydrothermal fluids interacting with preexisting zircons in the country rock. The depth-profiling techniques used in this study reveal that zircons from this region of the Abitibi retain the isotopic and trace element signatures of a hydrothermal event ca. 30 to 40 m. y. after orogenesis that is likely linked to the main stages of mineralization in the Porcupine gold camp. Furthermore, the orogenic nature of gold genesis is now more tenuous, and appears to be more clearly related to a post-orogenic magmatic episode.

Influence of oxygen depletion on noble gas partial pressures in soil air

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Dissolved noble gases in groundwater are an established temperature proxy. However, the basic assumption of equilibration with air of atmospheric composition during groundwater recharge has recently been questioned by Hall *et al.* [1]. In order to account for too low apparent noble gas temperatures, they suggested that oxygen depletion combined with partial removal of the produced CO_2 leads to a relative noble gas enrichment in soil air.

To study this process, measurements of the gases O_2 , CO_2 , CH_4 and H_2S involved in oxygen depletion were performed at soil air sampling sites in southwestern Germany (two permanent sites in Stuttgart and Freiburg, five self-drilled sites in the Heidelberg area). Furthermore samples for mass spectrometric noble gas analysis were taken using a packer probe.

While at four sampling sites a significant drop of the sum of O_2 and CO_2 concentrations was observed, which in theory accounts for a measureable increase of the concentrations of the other gas components, increased noble gas partial pressures could not be verified by the mass spectrometric measurements.

[1] Hall *et al.* (2005) *Geophys. Res. Lett.* **32**, S. L18404, doi, 10.1029/2005GL023582