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Low *P-T* Caledonian resetting of U-rich Paleoproterozoic zircons, central Sweden

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ABSTRACT

Uranium-rich zircons from a Paleoproterozoic, high-grade deformation zone in the Fennoscandian Shield, central Sweden, show an almost complete resetting of the U-Pb system in early Phanerozoic time. A mylonitic gneiss in the deformation zone contains two types of highly discordant (>70%), U-rich zircons: large, brown, cloudy prisms, and small milky-white irregularly shaped grains. The gneiss also contains mostly clear prismatic zircon of lower U content with mildly discordant to concordant U-Pb ages. Laser Raman spectroscopy reveals that the dark cathodoluminescent areas in brown zircons have a highly metamict crystal structure, whereas the structures of both the dark cathodoluminescent milky-white grains and the bright cathodoluminescent clear prisms have higher degrees of crystallinity.

Age dates obtained by U-Pb SIMS analysis of 40 zircons of the three types described above range continuously from concordant at 1871 ± 11 Ma to 98% discordant at 384 ± 15 Ma. The strongly discordant zircons clearly have suffered severe disturbance at about the time of the Caledonian orogeny. However, Caledonian metamorphic temperatures and pressures in this region did not exceed 150–200 °C and 1–3 kbar, too low to strongly disturb the U-Pb systematics in non-metamict zircon by thermal means alone. Independent evidence indicates that saline fluids were circulating in the Paleoproterozoic basement rocks at this time, possibly driven by hydrological gradients generated in front of the encroaching Caledonian orogenic wedge. These low-temperature saline fluids are inferred to be responsible for causing both strong Pb loss in the mostly metamict brown zircons via a diffusive process, and the formation of small milky-white zircon via a low-temperature recrystallization or dissolution/re-precipitation process.