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A long-lived mid-crustal magma chamber beneath a ring intrusion

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The Åva ring intrusion is one of four post-collisional shoshonitic ring intrusions situated in the archipelago of SW Finland. The Åva ring intrusion is about 7 km in diameter, and contains hundreds of ring dykes varying in width between 10 cm and 5 meters. These consist principally of coarse K-feldspar-phenocrystic granite, mingled in places with even-grained monzonite, although some of the rings consist of even-grained granites. The whole ring structure is cut by lamprophyric and granitic radial dykes. One of these phenocrystic granite radial dykes is found more than 8 km from the ring center. The ring rocks form a shoshonitic rock series with SiO_2 contents between 45 and 78 wt-%. All rocks have elevated concentrations of Ba, Sr and LILE, while the even-grained granite has the highest Rb content of all rocks. Brittle emplacement structures in the country rocks can be traced around the whole ring intrusion, in places filled with granitic melts. The country rock also forms a dome structure into which the ring dykes intruded, consisting of reactivated gneisses and palingenic granites with ages overlapping those of the ring rocks.

Texturally controlled PT and age determinations from the phenocrystic granite, the monzonite and the lamprophyres have shown that a mineral assemblage, including the K-feldspar phenocrysts, formed in a differentiating mid-crustal magma chamber (4 – 7 kbar) some 30-35 m.y. before emplacement in the upper crust. The deep mineral assemblages started to crystallise at $\sim$1800 Ma, while emplacement in the upper crust occurred at $\sim$1766 Ma (Eklund & Shebanov, 2005).

Zircons from the even grained granite have bright CL-cores, either sharply or gradually grading to CL-dark rims. Some grains contain textural evidence of partial resorption on some crystal faces, however oscillatory zoning patterns consistently indicate (semi-)continuous crystallisation under evolving conditions. A new laser-ICP-MS survey of these zircons shows a spread of $^{207}Pb/^{206}Pb$ ages from 1808 Ma to as little as 1717 Ma. Results indicate a continuous period of crystallisation within a differentiating mid-crustal magma chamber for a period of at least 40 m.y. Crystal growth continued (semi-)continuously until magma emplacement in the upper crust. The youngest of these ages deviate slightly from discordia, which likely is a result of post-emplacement lead loss from zircon rims.

New structural and age data and re-interpretation of the geometry of the ring-intrusion give a complementary version of the history of the Åva ring intrusion. The plastic structures with palingenic melts in the country rock surrounding Åva were formed by doming of the country rock above a slowly ascending, fractionating magma chamber containing a large amount of volatiles. When the volatile saturation was reached, due to cooling and decompression, the fluid pressure in the magma chamber caused a forceful emplacement in the upper crust forming the ring structure and the brittle deformation in the pre-existing dome.