The growth of plutons: how precisely and accurately can we date incremental melt emplacement with zircon U-Pb (Adamello intrusion, Northern Italy)?

U. SCHALTEGGER[1], P. BRACK[2], M. OVTCHAROVA[1], I. PEYTCHEVA[1,2], B. SCHOENE[1], A. STRACKE[2], G.M. BARGOSSI[3]

[1]Earth Sciences, University of Geneva, Switzerland urs.schaltegger@terre.unige.ch
[2]Earth Sciences, ETH Zürich, Switzerland
[3]Earth Sciences, University of Bologna, Italy

Understanding the timescales and mechanisms relating to the injection, emplacement, and solidification of melts at upper crustal levels is important for generating models for the growth of continental crust. High-precision U-Pb geochronology can date zircon crystallization to better than 0.1% uncertainty of the age, and can therefore be used to deduce the timescales of melt crystallization of the whole melt batch. However, important for reconstructing the emplacement of single magma pulses is resolving post-crystallization lead loss in zircon from the effects of prolonged growth and inheritance of older grains. Thus, the lifetime of one magma batch can only be constrained by the dispersion of zircon ages using grains crystallized from one single melt.

We present the first results from an attempt to accurately quantify the timescales of magma emplacement and related processes in the Adamello batholith, a 43-33 Ma old intrusive body in northern Italy. Four of the southernmost intrusions (distinguished based on field relations) of the Re di Castello unit were emplaced over a time span of less than 2 m.y., between 42.6 Ma and 40.9 Ma. The youngest age clusters of each individual sample agree with the emplacement sequence deduced from field relationships. Age dispersion of up to several 100 kyrs in two intrusions may record prolonged zircon growth in the same magma whereas larger crystallization ranges of 700 kyr could be due to the incorporation of antecrystic zircon from the same magma system. Hf isotope analyses of dated zircons evidence coexistence of juvenile liquids with epsilon Hf of + 6 to + 8 with melts deduced from various sources at different degrees of hybridization, with epsilon Hf of -3 to +3.

These results provide a tight framework for future attempts to further refine the chronology and quantification of magmatic processes in the southern Adamello. These data also suggest that zircon ages combined with their geochemistry may be necessary to disentangle the complex interaction of melt transport, emplacement and crystallization.

Abstract Goldschmidt Conference 2008, Vancouver