Timescales and processes involved in the construction of crustal-scale magmatic systems

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Volcanic edifices, as large as they may be, are likely only the tip of gigantic magmatic icebergs; they cap plumbing systems that grow and mature over time, potentially extending over the whole crust. What happens in these crustal-scale magmatic systems controls: (a) the volcanic record at the surface, (b) the formation of key ore deposits in and around the magma bodies, and (c) the rate at which new crust is formed. Here, we present new high-precision U/Pb zircon ages on crustal cross-sections in a post-collisional rifting environment (Ivrea zone, Italy), and in an arc (Famatian region, Argentina), as well as in an Archean block (Barberton, South Africa) to determine the minimum duration of peak magmatism at each location, and the relationship between volcanic and plutonic lithologies. We couple those field and geochronological informations with thermo-mechanical modeling to gain insights into the potential feedbacks between recharge, eruption and storage of magmas in these crustal columns, focusing on the subvolcanic environment. Modeling results suggest that, in mature systems, reservoirs that both grow and erupt will preferentially cluster in a narrow pressure range between 1.5 and 2.5 kb, at least for post-Archean thermal gradients. Such depths of storage are compatible with geobarometry results in many magmatic environments, and with geophysical imaging of upper crustal magma reservoirs.