Lifetime and dynamics of large-volume upper crustal magma reservoirs: A zircon perspective

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Large-volume caldera forming eruptions are some of the most remarkable features of continental magmatism. Single eruptive events release hundreds to thousands of cubic kilometres of magma causing collapse of large calderas, formation of extensive pyroclastic flows and continent-wide ash fall deposits. Accessory zircon crystals from these eruptive products record the timescales and mechanisms of reservoir assembly and the pre-eruption thermo-chemical evolution of the magma reservoir. These processes are tracked by integrating a variety of analytical techniques that allow to extract isotopic (O, Hf) and trace element geochemical information from precisely U-Pb dated crystals.

Zircons from high-temperature rhyolites erupted in rift- and hotspot settings record rapid reservoir assembly over 10^3 to 10^4 years [1] [2]. These zircons preserve Hf and O isotopic disequilibria reflecting heterogeneous batch assembly of multiple sub-caldera reservoirs that may merge and mix prior to eruption or produce distinct eruptive units. Inter- and intracrystalline trace element variations are consistent with short upper crustal residence times without extended near-solidus storage. In contrast, zircons from dacitic-rhyolitic subduction-type supervolcanoes record prolonged reservoir assembly and upper-crustal storage over several 10^5 years [3]. During upper-crustal storage, the eruption-feeding magma reservoirs are isotopically homogenized but trace element variations between U-Pb dated zircons as well as intragrain trace element variations document complex pre-eruption thermo-chemical oscillations.

These data document the mechanisms and timescales of reservoir assembly and constrain some of the controlling parameters for the accumulation of large volumes of eruptible magma in the upper crust. We further highlight the range of information that can be extracted from accessory zircons employing creative analytical protocols.

[1] Wotzlaw, J.F. et al., 2014, *Geology*, v. **42**, p. 807-810; [2] Rivera, T. et al., 2014, *Geology*, v. **42**, p. 643-646; [3] Wotzlaw, J.F. et al., 2013, *Geology*, v. **41**, p. 867-870.