Magma chambers function both as transient repositories for melt rising through the crust and reservoirs that feed individual volcanic eruptions. During large volume silicic caldera forming eruptions, these functions occur on vastly different timescales, as many hundred cubic km of magma assembled and distilled in upper crustal reservoirs over 10^4-10^6 yr are likely erupted in hours to days. These “super-eruptions” leave behind calderas 10-100 km in lateral dimension as evidence of contiguous magma chambers at shallow depths. Many of the largest volume erupted rhyolitic lavas contain high (30-45%) crystal volume fractions, sufficiently high that the magma will exhibit yielding behavior. Here we present a model of coupled conduit flow and magma chamber evacuation during super--eruptions that includes the progressive mobilization of stored yield strength magma. Eruptable, mobile magma occupies a dynamic chamber that expands laterally throughout the course of eruption as surrounding crystal-rich magma yields. Progressive yielding buffers chamber pressure until stored, rheologically locked magma is fully mobilized. Our model provides a mechanism for the generation of large calderas at shallow depths, by inhibiting decompression and surface stress concentration that might cause premature caldera collapse until the chamber is fully mobile. This model represents a novel rheological perspective on magma chambers, in which reservoirs dynamically feeding eruptions are conceptually separate in general from reservoirs of magma storage and differentiation.