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Magma-driven surface uplift of 60+ m spanning the Holocene, Laguna del Maule Volcanic Field, Chilean Andes

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The Laguna del Maule Volcanic Field includes an unusually large and recent concentration of silicic eruptions across a 23x17 km lake basin atop the southern Andes. Since 2007 the crust has been inflating at >20 cm/y. Geological, petrological, and geophysical findings suggest that the silicic vents have tapped an extensive, but ephemeral, layer of crystal-poor rhyolitic melt that began to form atop a mush zone by ~20 ka, with a renewed phase of rhyolite eruptions concentrated around the southern flank of the basin during the Holocene. One of the earliest rhyolites, the Espejos coulée, 40Ar/39Ar-dated at 19.0±0.2 ka, dammed the northern outlet of Laguna del Maule raising its level ~200 m to form a prominent basin-wide shoreline. 36Cl dating of wave-cut bedrock indicates that this shoreline was abandoned during an outbreak flood at 9.5±0.1 ka. This 36Cl date is consistent with younger 40Ar/39Ar and 36Cl dates of lavas that erupted onto the paleo-shoreline. Using 67 static GPS measurements around the basin, referenced to a set of 5 continuous GPS receivers, the elevation of this paleo-shoreline was determined to be 67 m higher at the southern end of the lake compared to the north. Interpretations of current surface deformation, earthquake distribution, and gravity changes suggest that magma is currently intruding at 0.05 km3/yr at ~5 km depth. The amount of magma required to raise the surface 2 m during 9 years is ~0.45 km3. If similar episodes of intrusion raised the roof of the magma reservoir by >60 m since 9.5 ka, it implies: (1) rapid accumulation of >12 km3 of magma within the shallow crust, and (2) the locus of intrusion has shifted northward several km during the last 9.5 ky. We are extending numerical models of magma intrusion developed to explain the current deformation, to this Holocene intrusive scenario.