Geomorphic constraints on the Pleistocene growth of Uturuncu Volcano, Bolivia

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The Altiplano-Puna Volcanic Complex (APVC) in southern Bolivia repeatedly sourced large-volume ignimbrite eruptions over the last 11 myr. Though eruption rates have waned since 3ma, given the cyclic nature of eruptions in this region it is uncertain whether or not future eruptions of similar scale (VEI 8 and above) will occur. Moreover, InSAR studies at Uturuncu Volcano, Bolivia reveal surface inflation over a 70 km area, with a central uplift rate of 1-2 cm/yr and a corresponding magma chamber growth rate of 1m3/s sustained over the 14 years of available data. A key question still remains for Uturuncu Volcano: what does this modern unrest mean in terms of the volcano's magmatic evolution, and consequently its eruptive stability? As silicic magma chamber evolution is a subject of much debate, real-time observations of this system's evolution may help constrain future modeling efforts. Here we investigate the evolution of Uturuncu Volcano using geomorphology. Geomorphic processes operate on timescales similar to those of magma chamber growth (10 ˆ4-10 ˆ5 yrs), and the APVC has had a rich history of Pleistocene lakes whose shorelines can be used as markers to measure surface deformation. Lakes near Uturuncu are experiencing uplift gradients from the modern deformation field, which drives shoreline tilting away from the volcano. If this deformation is sustained on timescales greater than 10 ˆ3 yrs, then we expect to observe Pleistocene shorelines to be tilted on the order of 1-10's of meters. Alternatively, if we observe no measurable tilting then the modern defomration must either be a recent or perhaps periodic phenomenon. We focused our field efforts on two lakes adjacent to Uturuncu: Laguna Mama Khumu and Laguna Loromayu. Here we surveyed shorelines and deltas using differential GPS, characterized the stratigraphy of multiple shoreline fatures, and collected samples for OSL dating. OSL ages for the Loromayu shoreline sequence show highstands of Tauca age (e.g., Placzeck et al., 2006), suggesting a regional basinal response to climate. Differential GPS surveys of Mama Khumu shoreline features show no discernable tilting of lake shorelines, which suggests no sustained long term surface deformation associated with magma intrusion. Additionally, river longitudinal profiles from a photogrammetry-derived 5m digital elevation model yield no easily-interpretable evidence for sustained surface uplift. Together, these observations imply a relatively stable topography at Uturuncu over the late Pleistocene. The recent decadal uplift here thus likely reflects a transient inflational pulse rather than a snapshot of long term tumescence.