

Combined geophysical constraints on magmatism in the continental crust of volcanic arcs: Focus on the PLUTONS project in the central Andes

Matthew E Pritchard¹, Michael E West², Doug H Christensen², Rodrigo del Potro³, Joachim Gottsmann³, Martyn Unsworth⁴, Estela Minaya⁵, Mayel Sunagua⁶, Stephen McNutt⁷, Jennifer A Jay¹, Scott T Henderson¹, Qingping Yu², Alexandra K Ferrell², Sergio Barrientos⁸, Matthew Comeau⁴

¹Department of Earth and Atmospheric Science, Cornell University, Ithaca, NY, USA, ²Geophysical Institute, Univ Alaska Fairbanks, Fairbanks, AK, USA, ³University of Bristol, UK, ⁴University of Alberta, Canada, ⁵Observatorio San Calixto, Bolivia, ⁶SERGEOTECMIN, Bolivia, ⁷University of South Florida, Tampa, FL, USA, ⁸Chilean Seismological Service, Chile

E-mail: pritchard@cornell.edu

To study the generation, transportation, and emplacement of magma in situ at depths of 10's of km in the continental crust requires geophysics: seismology, gravity, surface deformation, and electro-magnetic methods. While each method provides non-unique constraints on the crustal composition and depth and amount of partial melt, a clearer picture emerges when the techniques are used together at the same location. The ongoing PLUTONS project is just such a joint geophysical and geochemical study focused on the relationship between two current areas of surface uplift in the central Andes of Bolivia, Chile, and Argentina to magma intrusion within the middle to upper crust in the central Andes. This region is home to the world's largest zone of partial melt (the Altiplano-Puna Ultra Low Velocity Zone, or APULVZ), and the most recent ignimbrite flare-up in the world (over the last 10 million years – the Altiplano-Puna Volcanic Complex, or APVC). The primary PLUTONS target is Uturuncu volcano in southwestern Bolivia that is within the APULVZ and APVC and has been undergoing steady uplift over the past 20 years with persistent shallow earthquakes despite not having an eruption in almost 300,000 years. In addition to the 70 km diameter uplift pattern, several studies have shown a 150 km diameter moat of subsidence surrounding the uplift at Uturuncu suggesting large scale movement of materials in the crust. Seismic tomography, gravity and magnetotellurics indicate a complex structure in the upper 20 km consistent with previous evidence for partial melt. In addition to the widespread and throughgoing melt layer, seismic velocities and attenuation indicate prominent shallow features above the melt body extending upward toward the surface. The second PLUTONS target is the Lastarria-Cordon del Azufre (also known as Lazufre) on the Chile-Argentina border that has been uplifting since about 1998 and is also seismically active. While not located within the APULVZ or APVC it also shows evidence for current activity through a significant fraction of the crustal column as sources of ground deformation are located at about 10-15 km and 1 km below local relief. We will discuss the limits of what we can learn about the generation, transportation, and emplacement of magma from geophysics and how these geophysical inferences compare to those from geochemistry.