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Evidence for present day magma – fault interaction from microgravity changes at Laguna del Maule volcanic field

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Gravity changes observed at the Laguna del Maule volcanic field, Chile, since 2013 indicate significant on-going mass injection close to the inferred Troncoso fault and adjacent to the Laguna del Maule volcanic field magma reservoir as imaged by Bouguer gravity. Since 2013 we estimate 1.5•1011 kg of new material that has been added. Mass injection is focused along the hypothesized Troncoso normal fault, or other sub parallel structures, at 2-3 km depth and is best modelled by spherical or prismatic source geometries. In contrast, deformation patterns are consistent with the intrusion of a dipping sill, or oblate ellipsoid, at 4.5 to 5 km depth, rather than from the shallower mass source. To account for this discrepancy, we explore a coupled magma–tectonic interaction mechanism that allows for mass injection without associated ground deformation. We propose that the opening of a sill, at ~1 m/y and 5 km depth results in a Coulomb stress drop along the Troncoso fault effectively unclamping it and increasing permeability around the fault. This mechanism allows for magmatic fluids from the nearby reservoir to be injected into the newly created region of higher permeability, resulting in net gravity increase without additional surface deformation. Magnetic data collected on the lake show evidence for previous dyke intrusion sub parallel to the Troncoso fault, suggesting that magma-fault interaction has occurred over a range of time scales. We suggest that gravity changes will continue to be observed as long as the sill intrusion continues to create permeability around the fault, allowing magmatic fluids to fill that space. Observations of that close relationship between ongoing mass intrusion and tectonic structures suggest a focused volcano monitoring.