Joint inversion of tectonic stress and magma pressures using dyke trajectories

Frantz Maerten\textsuperscript{1}, Laurent Maerten\textsuperscript{1}, Romain Plateaux\textsuperscript{2}, and Pauline Cornard\textsuperscript{3}

\textsuperscript{1}YouWol, France
\textsuperscript{2}YouWol, Taiwan
\textsuperscript{3}Institute of Geology, University of Innsbruck, Austria

In volcano-tectonic regions, dyke propagation from shallow magmatic chambers are often controlled by ambient perturbed stress field. The variations of the stress field result from combining factors including, but not exclusively, the regional tectonic stress and the pressurized 3D magma chambers. In this contribution, we describe and apply a new multiparametric inversion technique based on geomechanics that can invert for both the far field stress attributes and the pressure of magma intrusions, such as stocks and magma chambers, constrained by observed dyke orientations. This technique is based on a 3D boundary element method (BEM) for homogeneous elastic half-space where magma chambers are modelled as pressurized cavities. To verify this approach, the BEM solution has been validated against the known 3D analytical solution of a pressurized cylindrical cavity. Then, the effectiveness of this technique and its practical use, in terms of mechanical simulation, is demonstrated through natural examples of dyke network development affected by magma intrusions of two different volcanic systems, the Spanish Peaks (USA) and the Galapagos Islands (Ecuador). Results demonstrate that regional stress characteristics as well as pressure of magma chambers can be recovered from observed radial and circumferential dyke patterns.