

Quantifying a soil CO₂ flux baseline in an urban monogenetic volcanic field: the Auckland Volcanic Field, New Zealand

Elaine R Smid¹, Agnes Mazot², Luitgard Schwendenmann¹, Hugo Delgado Granados³, Jan M Lindsay¹

¹School of Environment, University of Auckland, New Zealand, ²GNS Science, Wairakei Research Centre, New Zealand, ³Departamento de Vulcanologia, Instituto de Geofisica, Universidad Nacional Autonoma de Mexico Ciudad, Mexico

E-mail: e.smid@auckland.ac.nz

The Auckland Volcanic Field (AVF) is a potentially active monogenetic basaltic field underlying Auckland, New Zealand's major metropolis and economic centre. An eruption could occur with very little warning in anywhere within the city or its harbours. Through the DEtermining VOlcanic Risk in Auckland (DEVORA) project, scientists are attempting to understand the driving forces of monogenetic volcanism, in part to improve Auckland's monitoring networks and refine eruption forecasting models. In polygenetic volcanic settings, soil gas CO₂ flux measurements are routinely used to monitor the volcano's state of unrest. To date, there have been very few published studies determining baseline soil CO₂ flux or soil gas CO₂ concentrations in monogenetic fields, and none within a city centre atop a dormant monogenetic volcanic field, such as in Auckland. From 2010 to 2012, soil gas CO₂ fluxes and soil gas CO₂ concentrations were measured to establish a baseline soil gas CO₂ flux range and to determine the major sources of and controlling influences on Auckland's soil gas CO₂ flux for comparison during potential unrest. Flux measurements varied from 0 to 203 g m⁻²d⁻¹, with an average of 27.1 g m⁻²d⁻¹. Using a graphical statistical approach, two populations of CO₂ fluxes were identified. Both populations may represent the biological CO₂ production background flux in the AVF, with soil permeability, soil temperature and soil moisture acting as the main controls. Higher fluxes were attributed to varying land use properties (e.g., landfill). Isotope analyses of $\delta^{13}\text{C}_{\text{CO}_2}$ confirm that the source of CO₂ in the AVF is biogenic with no volcanic component. This data may be used to assist with eruption forecasting in the event of precursory activity in the AVF and highlights the importance of knowing land use history when assessing soil gas CO₂ flux surveys, particularly in urban environments.