What happens when a pyroclastic flow enters the water - numerical modelling of an offshore pyroclastic turbidite

Pete Rowley[1], Dave Waltham[2], Andrew J Hogg[3], Fukashi Maeno[4], Stuart McLean[5], R. Stephen J. Sparks[6], Peter J. Talling[7], Jessica Trofimovs[8], Sebastian F. L. Watt[7]

[1]Laboratoire Magmas et Volcans, Université Blaise Pascal / CNRS / IRD, Clermont Ferrand, 63000, France, [2]Department of Earth Sciences, Royal Holloway, University of London, TW20 0EX, UK, [3]School of Mathematics, University of Bristol, University Walk, Bristol BS8 1TW, UK, [4]Volcano Research Center, Earthquake Research Institute, The University of Tokyo, Japan, [5]Midland Valley Exploration Ltd, 144 West George Street, Glasgow, G2 2HG, UK, [6]School of Earth Sciences, University of Bristol, Wills Memorial Building, Clifton BS8 1RJ, UK, [7]National Oceanography Centre Southampton, University of Southampton Waterfront Campus, SO14 3ZH, UK, [8]Earth and Environmental Sciences, Queensland University of Technology, Brisbane, QLD 4001, Australia

E-mail: pete.rowley@gmail.com

When pyroclastic flows encounter water they are understood to deposit a proximal course unit, as well as generate a highly mobile turbidity current comprising an unknown fraction of the particulate fines. There is little information regarding how this secondary current forms, where it forms, how it flows, or what fraction of the original material is included within it. This work attempts to address these shortfalls through applying the Move sediment tool (a depth averaged turbidity current numerical model) to high resolution bathymetry and vibrocore data from a single pyroclastic-derived turbidite unit from the 2003 dome collapse event from Soufrière Hills Volcano, Montserrat.

We model tens of thousands of individual flows, each with initial conditions selected randomly from within a parameter space defined by known physical and measured constraints. Each flow is compared to the measured core data, and a root mean square error (RMSE) is calculated as a measure of quality of fit. It is subsequently possible to observe where the lowest RMSE (best fitting) flows exist within the parameter space, such that the initial conditions can be refined and further runs in this smaller parameter space are performed in an iterative process until an appropriate range of parameter values has been isolated. These analyses reveal the grainsize parameters for the load which is transported, as well as a wealth of information on flow concentration, thickness, velocity and form. Forward modeling of these input parameters assists in understand the behavior of the flow after its initiation, and help to interpret grading patterns and structures seen in the sediment cores obtained from the sea floor.