# Complex Relationships Between 'Fall' and 'Flow' Processes in a Large 'Wet' Eruption

C J N Wilson (Institute of Geological & Nuclear Sciences, Private Bag 2000, Taupo 2730, New Zealand; ph.+64 7 374 8211; fax +64 7 374 8199; e- mail:c.wilson@gns.cri.nz)

The interplay between different eruption and transport mechanisms in explosive eruptions creates diversity in pyroclastic products and hazards. A first distinction can be made between material that is deposited from a high buoyant plume ('fall') and that deposited from some kind of laterally moving pyroclastic density current ('flow'). In the great majority of 'dry' eruptions the distinction between these two fundamental transport mechanisms is clear cut; 'fall' deposits drape the landscape and are relatively well-sorted, while 'flow' deposits are more poorly sorted and show evidence for lateral emplacement. However, in 'wet' eruptions involving interaction between the magma and external water, fall deposits are often as poorly sorted as most flow deposits and, if exposure is limited, evidence for or against lateral transport may be subtle. It is important to be able to recognise and characterise the different 'fall' and 'flow' components that go to make up 'wet' deposits in order to reconstruct the dynamics of the eruption plumes.

The 26.5 ka Oruanui eruption from Taupo volcano represents a case study for large-scale 'wet' volcanism that is extreme in both size and complexity (Self, 1983, JVGR 17, 433-469; Wilson, 2001, JVGR (in press)). About 530 km3 of magma generated ~ 430 km3 of 'fall' deposits that pre-date, are coeval with and post-date ~ 320 km3 of 'flow' deposits (mostly typical ignimbrite), with another ~ 420 km3 of intra- caldera material now concealed beneath Lake Taupo. I divide the 'fall' deposits into 10 units, and present data from Unit 3. Field observations and isopach data are used to divide Unit 3 into proximal and distal facies. The proximal facies is 0.5->8 m thick, and covers an asymmetric area of ~ 3000 km2 around (and excluding) modern Lake Taupo. Individual beds can be traced for up to 10's of metres at favourable exposures but almost none can be correlated between exposures kilometres apart. Individual beds show a complete spectrum from (i) pure accreted accretionary lapilli bands, through (ii) cm-dm-scale turbidite-like normally graded beds with sharp locally scoured bases and tops that are rich in accretionary lapilli, to (iii) less-common massive beds with sharply defined bases and tops, and similar textures and grain sizes to the ignimbrite generated in succeeding eruptive phases 4 and 6. The distal facies is a bedded deposit up to several dm thick, with a characteristic internal stratigraphy that can be traced over >10,000 km2. Individual beds in the distal facies have plane parallel, non-erosive contacts, variable but poor sorting and high <63 mm ash contents and are interpreted as conventional 'fall' deposits.

Field and grain size data imply that the proximal Unit 3 deposits are the products of 3 distinctive but overlapping transport systems. 1. Fall-out from a high plume, dominated by very fine ash and by deposition as accretionary lapilli or mud pellets, that probably acted continuously through this phase of the eruption. 2. Laterally emplaced dilute turbulent density currents that generated the turbidite-like beds. The sharp bases of these beds represent the sudden influx of the current, and the accretionary-lapilli-rich tops the 'fading out' of the current and a gradual return to background fall deposition. 3. Laterally emplaced concentrated currents that generated the massive sandy beds; the currents both started and finished rapidly, reflecting their concentrated natures. In both proximal and distal Unit 3, the overall combination of these transport systems is that the mean grain size of the whole Unit 3 deposit coarsens away from vent to a maximum about 140 km downwind.