

## Chapter 9 Supplement 9A

**Table 9.1.** Comparison of eruption parameters obtained using different methods, with supplementary explanation of methods used.

Parameter	Method								
	Observational Data <sup>(1)</sup>	Exponential Method <sup>(2)</sup>	Power Law Method <sup>(3)</sup>	Carey and Sparks (1986) <sup>(4)</sup>	Sparks (1986)	Wilson and Walker (1987)	Inversion: TEPHRA2	OAT: PUFF <sup>(5)</sup>	Numerical solution: FALL3D
Erupted Mass $M$ ( $\times 10^9$ kg)	–	0.9(1seg) 1.1(2seg) 1.8(3seg)	2.0	–	–	–	1.7	–	1.7 <sup>(6)</sup>
Column height $H$ (km a.s.l.)	12	–	–	11	–	–	13	13	12 <sup>(7)</sup>
Mass eruption rate $\dot{M}$ ( $\times 10^6$ kg s <sup>-1</sup> )	–	0.6 (1seg) <sup>(8)</sup> 0.7 (2seg) 1.2 (3seg)	1.3 <sup>(8)</sup>	–	0.6 <sup>(9)</sup>	1.8 <sup>(10)</sup>	1.1 <sup>(8)</sup>	–	2.4 <sup>(7)</sup>
Grainsize distribution <sup>(11)</sup>	Mdφ (0.8) STDV (1.8)	–	–	–	–	–	Mdφ (-0.6) STDV (2.2)	Mdφ (0) STDV (1.5)	–
Duration of sustained phase (min)	25 (total duration)	–	–	–	24 (1seg) <sup>(12)</sup> 30 (2seg) 51 (3seg) 56 (PL) 47 TEPHRA2	8 (1seg) <sup>(12)</sup> 10 (2seg) 17 (3seg) 19 (PL) 16 TEPHRA2	–	20–40	12 <sup>(6)</sup>
<sup>(13)</sup> Maximum/average wind speed (m s <sup>-1</sup> )	11 / 6	–	–	10–30	–	–	6 / 6	–	–
<sup>(14)</sup> $K_H/K_V$ (m <sup>2</sup> s <sup>-1</sup> )	–	–	–	–	–	–	0.5	5000 / 10	5000 / 0.004–600 (mean: 50)

- (1) Observed Data: Plume height was calculated from photographs, using a vent height of 3 km (D. Andronico, unpub. data). Total grainsize distribution was averaged using the Voronoi technique (S. Scollo, unpublished data). Duration is observed from seismic record (Coltelli *et al.*, 2006). Pseudo-sounding wind data were calculated for 37.5°N 15°E at 18:00 LT (see Table 9.2 for details).
- (2) Exponential Method: Total erupted mass was calculated using the exponential method with one, two and three segments to describe the thinning trend (Eqs. 9.2 and 9.4). The 1-segment calculation was done neglecting the very proximal data.
- (3) Power-Law Method: Total erupted mass calculated using the power-law method (Eq. 9.6) with  $\sqrt{A_0} = 1.1$  km and  $\sqrt{A_{dist}} = 500$  km. By varying  $\sqrt{A_{dist}}$  between -80% (100 km) and +300% (2000 km), we obtain a difference in the resulting mass between -11% ( $1.8 \times 10^9$  kg) and +6% ( $2.1 \times 10^9$  kg), respectively. In contrast,  $\sqrt{A_0}$  was taken as the intercept of the proximal exponential segments with the power-law fit. However, if we empirically vary  $\sqrt{A_0}$  between -50% (0.5 km) and +50% (1.6 km) of its value we get a difference of +33% ( $2.7 \times 10^9$  kg) and -13% ( $1.8 \times 10^9$  kg) respectively.
- (4) Carey and Sparks (1986): results from D. Andronico (unpublished data).
- (5) OAT: Best fit obtained from sensitivity tests carried out changing each parameter “One At a Time” (from Aloisi *et al.*, 2002).
- (6) The erupted mass in FALL3D is determined by multiplying  $\dot{M}$  by the eruption duration, which in this case was taken as 12 minutes from the FALL3D OAT analyses.
- (7) Plume height  $H$  and mass eruption rate  $\dot{M}$  are determined in FALL3D using a buoyant plume model derived from Bursik (2001) with a plume temperature at the vent of 1000 °C, a plume exit velocity of 100 m s<sup>-1</sup>, and entrainment coefficients  $\alpha = 0.1$ ,  $\beta = 0.34$ .
- (8) Mass eruption rate was calculated by dividing the erupted mass (derived from the application of both empirical and analytical models) by the observed duration (25 minutes).
- (9) Mass eruption rate was calculated using the method of Sparks (1986) for a plume height of 9 km, a plume temperature of 1000 °C and for a temperate atmosphere.
- (10) Mass eruption rate was calculated using the method of Wilson and Walker (1987) for a plume height of 9 km and  $C = 245 \text{ m kg}^{-1/4} \text{ s}^{1/4}$ .
- (11) Grainsize distributions are defined as the median (Md $\phi$ ) and standard deviation (STDV) of the associated best-fit Gaussian distribution.
- (12) Duration ( $M/\dot{M}$ ) was calculated based on the  $\dot{M}$  determined from the methods of Sparks (1986) and Wilson and Walker (1987), together with the erupted mass  $M$  derived from inversion of TEPHRA2, the integration of the power-law best fit (PL) and the integration of one, two and three exponential segments (1seg, 2seg, 3seg).
- (13) Maximum wind speed is at and altitude of 11 km and average wind speed is calculated below 12 km.
- (14) Horizontal and vertical diffusion coefficients. In FALL3D the vertical diffusion is derived from similarity theory, the horizontal diffusion was set to 5000 m<sup>2</sup> s<sup>-1</sup>, because this value gave better agreement with observations, than did the horizontal diffusion derived from the LES model (2250 m<sup>2</sup> s<sup>-1</sup>; see text for details).