GSA DATA REPOSITORY 2010119

Appendix: Methods and raw data

1. Sampling

We collected, from the best exposed proximal section in the "Pacte del Quesito" quarry on the northeastern flank of the Croscat Complex Scoria Cone (lat. 42°09'14''N, long. 2°32'09''E), a total of 14 samples of the order of few kg each, representative of all tephra units (Fig.DR1 and Fig. 1 in the text).

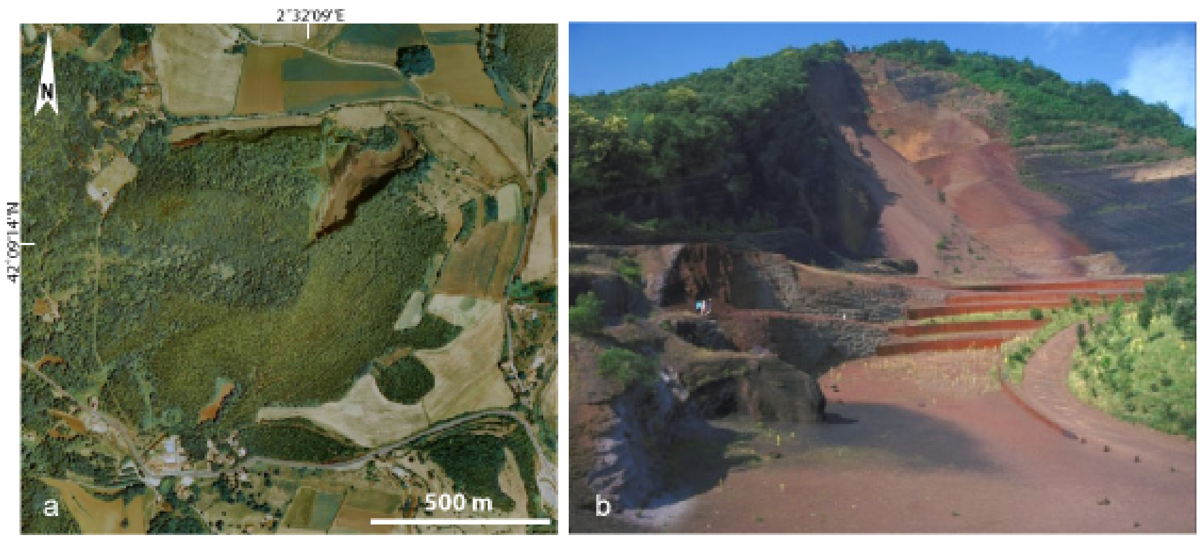

Fig. DR1 Aerial photo (a) of the Croscat Complex Scoria Cone showing the Pacte del Quesito quarry (b) on the NE flank of the cone.

2. Analytical procedures

2.1. Chemical analyses

Spot chemical analyses on microlite poor (MPD) and microlite rich domains (MRD) interstitial glasses (Table DR1) from all samples (at least 5 scoriae per sample) have been performed using mainly Electron Microprobe (EMP, Jeol JXA 8200, beam 15 kV and 10^{-8} Amp.). Interstitial glass too small for EMP was analyzed by using Field Emission Scanning Electron Microscope (FE-SEM, Jeol JSM-6500F) Energy Dispersion System (EDS, beam 10 kV and 8.5 x 10^{-10} Amp., error lower than 1% on duplicated EMP analyses). Bulk analyses of MRDs were performed by raster FE-SEM EDS, allowing averaged chemical analyses to be performed over areas of variable dimension. Mass balance calculations derived from the chemical analyses of crystals and glasses were used to estimate the crystal content of both MPD and MRD.

2.2 Textural analyses

Textural analyses have been performed on thin sections of 4-16 mm-sized scoriae under petrographic and FE-SEM. Gray tone FE-SEM back scattered electron images (BSE) of selected thin section were also used to estimate the crystal content of both microlite poor (MPD) and microlite rich domains (MRD) in order to check results derived from mass balance calculations.

Table DR1. Selected, clast-averaged glass EMP analyses of scoriae from the Croscat Complex Scoria Cone, divided in microlite-poor (MPD) and microlite-rich (MRD) domains. n: number of analyses. In brackets, the standard deviation. Data are plotted in Fig 2 of the paper.

MPD

sample	PQ1		PQ3		PQ6		PQ5		PQ7		PQ10	
n	*7*		*15*		*9*		*18*		*19*		*27*	
SiO2	**46.87**	*(0.69)*	**47.01**	*(0.37)*	**45.86**	*(0.89)*	**48.16**	*(0.71)*	**46.18**	*(0.44)*	**46.34**	*(0.66)*
TiO2	**2.95**	*(0.19)*	**2.91**	*(0.13)*	**2.91**	*(0.14)*	**2.91**	*(0.20)*	**2.91**	*(0.13)*	**2.94**	*(0.12)*
Al2O3	**16.89**	*(0.23)*	**17.09**	*(0.11)*	**16.80**	*(0.14)*	**17.09**	*(0.29)*	**16.63**	*(0.14)*	**17.14**	*(0.15)*
FeO	**8.90**	*(0.32)*	**9.75**	*(0.27)*	**9.26**	*(0.19)*	**9.39**	*(0.41)*	**9.48**	*(0.26)*	**9.74**	*(0.30)*
MnO	**0.17**	*(0.03)*	**0.17**	*(0.04)*	**0.14**	*(0.02)*	**0.19**	*(0.04)*	**0.19**	*(0.04)*	**0.17**	*(0.04)*
MgO	**4.58**	*(0.13)*	**4.40**	*(0.20)*	**4.25**	*(0.05)*	**3.88**	*(0.19)*	**4.46**	*(0.19)*	**4.22**	*(0.20)*
CaO	**10.24**	*(0.68)*	**10.63**	*(0.23)*	**10.55**	*(0.14)*	**9.35**	*(0.34)*	**10.47**	*(0.35)*	**9.90**	*(0.42)*
Na2O	**3.15**	*(1.09)*	**1.94**	*(0.21)*	**4.01**	*(0.16)*	**2.85**	*(0.31)*	**4.16**	*(0.12)*	**4.25**	*(0.11)*
K2O	**2.72**	*(0.44)*	**2.97**	*(0.16)*	**3.06**	*(0.06)*	**3.77**	*(0.26)*	**3.04**	*(0.15)*	**3.09**	*(0.20)*
P2O5	**0.82**	*(0.08)*	**0.87**	*(0.06)*	**0.86**	*(0.05)*	**0.97**	*(0.06)*	**0.86**	*(0.06)*	**0.96**	*(0.08)*
SrO	**0.11**	*(0.04)*	**0.11**	*(0.04)*	**0.12**	*(0.05)*	**0.10**	*(0.05)*	**0.12**	*(0.05)*	**0.10**	*(0.04)*
BaO	**0.07**	*(0.04)*	**0.11**	*(0.05)*	**0.11**	*(0.09)*	**0.14**	*(0.08)*	**0.10**	*(0.08)*	**0.09**	*(0.06)*
ZrO2	**0.04**	*(0.03)*	**0.05**	*(0.03)*	**0.05**	*(0.04)*	**0.05**	*(0.04)*	**0.04**	*(0.03)*	**0.05**	*(0.04)*
Total	**97.52**	*(0.46)*	**98.01**	*(0.40)*	**97.96**	*(0.80)*	**98.85**	*(0.70)*	**98.64**	*(0.64)*	**98.99**	*(0.93)*

MRD

sample	PQ1		PQ3		PQ6		PQ5		PQ7		PQ10	
n	*9*		*24*		*12*		*18*		*22*		*21*	
SiO2	**47.53**	*(1.01)*	**47.99**	*(1.12)*	**46.92**	*(1.35)*	**49.12**	*(0.79)*	**47.23**	*(0.80)*	**47.53**	*(1.09)*
TiO2	**2.61**	*(0.11)*	**2.54**	*(0.21)*	**2.52**	*(0.23)*	**2.38**	*(0.14)*	**2.70**	*(0.22)*	**2.66**	*(0.16)*
Al2O3	**17.43**	*(0.32)*	**17.71**	*(0.61)*	**17.44**	*(0.39)*	**17.93**	*(0.57)*	**17.01**	*(0.76)*	**17.52**	*(0.34)*
FeO	**8.74**	*(0.42)*	**9.36**	*(0.46)*	**8.95**	*(0.56)*	**8.44**	*(0.38)*	**9.44**	*(0.36)*	**9.51**	*(0.35)*
MnO	**0.19**	*(0.07)*	**0.20**	*(0.06)*	**0.21**	*(0.04)*	**0.20**	*(0.06)*	**0.20**	*(0.04)*	**0.20**	*(0.04)*
MgO	**3.43**	*(0.27)*	**3.28**	*(0.39)*	**3.19**	*(0.43)*	**3.04**	*(0.39)*	**3.66**	*(0.62)*	**3.42**	*(0.30)*
CaO	**7.40**	*(0.65)*	**7.77**	*(1.20)*	**8.07**	*(1.06)*	**7.32**	*(0.90)*	**8.90**	*(1.32)*	**8.08**	*(0.70)*
Na2O	**4.41**	*(0.99)*	**3.22**	*(0.92)*	**4.47**	*(0.47)*	**3.45**	*(0.41)*	**4.24**	*(0.26)*	**4.35**	*(0.21)*
K2O	**4.21**	*(0.17)*	**4.27**	*(0.49)*	**4.26**	*(0.47)*	**4.86**	*(0.49)*	**3.81**	*(0.51)*	**3.97**	*(0.33)*
P2O5	**1.09**	*(0.15)*	**1.09**	*(0.11)*	**1.12**	*(0.12)*	**1.12**	*(0.07)*	**1.06**	*(0.14)*	**1.19**	*(0.14)*
SrO	**0.10**	*(0.04)*	**0.11**	*(0.05)*	**0.11**	*(0.04)*	**0.12**	*(0.04)*	**0.11**	*(0.04)*	**0.13**	*(0.04)*
BaO	**0.18**	*(0.11)*	**0.12**	*(0.08)*	**0.16**	*(0.08)*	**0.14**	*(0.08)*	**0.13**	*(0.06)*	**0.12**	*(0.08)*
ZrO2	**0.06**	*(0.04)*	**0.04**	*(0.04)*	**0.04**	*(0.04)*	**0.05**	*(0.03*	**0.05**	*(0.02)*	**0.06**	*(0.05)*
Total	**97.38**	*(0.77)*	**97.71**	*(0.87)*	**97.45**	*(0.57)*	**98.17**	*(0.52)*	**98.52**	*(0.71)*	**98.75**	*(0.86)*

3. Preparation of the samples and statistical treatment of counting data

With a view to its applicability during volcanic crisis, we developed a rapid procedure to measure the relative abundance of MPDs and MRDs. In order to obtain a fast and accurate measure of the relative abundance of the two domains in the eruption products, we classified individual lapilli from each level as “MR” or “MP” on the base of their prevailing groundmass texture. In order to speed-up the measurement of the proportions of MP and MR domains, we selected the largest lapilli size class where mingled clasts were rare. In our case, the size and spatial distribution of the domains relative to clast size allowed clasts 2-4 mm in size to be small enough to display mostly homogeneous (not mingled) textures at the scale of observation, thus facilitating the counting operation.

Since MR and MP clasts couldn’t be discriminated under binocular microscope, we observed sectioned and polished clasts with the petrographic microscope under reflected light. Sieved clasts from each sample were embedded in a bi-component epoxy resin. We used Mecaprex® epoxy resin in order to dramatically reduce (to 5-10 minutes) the curing and induration phase during samples preparation. From each sample we obtained two polished slabs each including about 100-300 clasts. Clasts counting under microscope was enhanced by dividing each slab surface into 8 squared sectors (1 cm^2 approximately) by using a paint marker. The preparation of the sample and the counting procedure takes a few hours, the cutting and polishing procedures being the most time consuming. An example of the counting results for sample PQ9 is reported in Table DR2.

Table DR2. Example of counting analysis performed on the PQ9 sample. Total number (N) of clasts embedded in each slab is about 200. Total number (n) and relative percentage (%) of MP, MR, and mingled clasts per each sector are displayed.

PQ9 slab 1							
	MR (n)	MP (n)	Mingled (n)	tot (N)	MR (%)	MP (%)	Mingled (%)
Sector_1	26	12	0	38	68	32	0
Sector_2	30	6	0	36	83	17	0
Sector_3	25	7	0	32	78	22	0
Sector_4	19	11	2	32	59	34	3
Sector_5	23	8	1	32	72	25	1
Sector_6	27	7	1	35	77	20	1
Sector_7	18	5	0	23	78	22	0
Sector_8	19	11	0	30	63	37	0
total	**187**	**67**	**4**	**258**	**72**	**26**	**6**

PQ9 slab 2							
	MR (n)	MP (n)	Mingled (n)	tot (N)	MR (%)	MP (%)	Mingled (%)
Sector_1	19	14	1	34	56	41	2

Sector_2	25	12		37	68	32	0
Sector_3	20	7	1	28	71	25	1
Sector_4	26	9	0	35	74	26	0
Sector_5	25	6	0	31	81	19	0
Sector_6	19	8	0	27	70	30	0
Sector_7	32	15	0	47	68	32	0
Sector_8	30	8	1	39	77	21	1
total	**196**	**79**	**3**	**278**	**71**	**28**	**4**

This procedure has been repeated for each sample (Table DR3).

Table DR3. Raw counting data for MP and MR clasts. Values displayed in bold in Table DR2 are here reported for each tephra sample.

		MR (n)	MP (n)	Mingled (n)	tot (N)	MR (%)	MP (%)	Mingled (%)
PQ1	slab1	111	87	2	200	55.50	43.50	3.60
	slab2	137	93	2	232	59.05	40.09	3.39
	total	**248**	**180**	**4**	**432**	**57.41**	**41.67**	**0.93**
PQ2	slab1	136	32	1	169	80.47	18.93	1.24
	slab2	185	57	3	245	75.51	23.27	3.97
	total	**321**	**89**	**4**	**414**	**77.54**	**21.50**	**0.97**
PQ3	slab1	185	30	1	215	86.05	13.95	1.16
	slab2	219	37	2	256	85.55	14.45	2.34
	total	**404**	**67**	**3**	**471**	**85.77**	**14.23**	**0.64**
PQ4	slab1	150	35	3	188	79.79	18.62	3.76
	slab2	165	30	4	199	82.91	15.08	4.82
	total	**315**	**65**	**7**	**387**	**81.40**	**16.80**	**1.81**
PQ5	slab1	32	155	0	187	17.11	82.89	0.00
	slab2	22	112	0	134	16.42	83.58	0.00
	total	**54**	**267**	**0**	**321**	**16.82**	**83.18**	**0.00**
PQ6	slab1	190	45	2	237	80.17	18.99	2.49
	slab2	153	30	2	185	82.70	16.22	2.42
	total	**343**	**75**	**4**	**422**	**81.28**	**17.77**	**0.95**
PQ7	slab1	30	106	4	140	21.43	75.71	2.86
	slab2	55	172	3	230	23.91	74.78	1.30
	total	**85**	**278**	**7**	**370**	**22.97**	**75.14**	**1.89**
PQ8	slab1	177	24	1	202	87.62	11.88	1.14
	slab2	160	31	2	193	82.90	16.06	2.41
	total	**337**	**55**	**3**	**395**	**85.32**	**13.92**	**0.76**
PQ9	slab1	33	87	7	127	25.98	68.50	5.51
	slab2	36	101	0	137	26.28	73.72	0.00
	total	**69**	**188**	**7**	**264**	**26.14**	**71.21**	**2.65**
PQ10	slab1	187	67	4	258	72.48	25.97	5.52
	slab2	196	79	3	278	70.50	28.42	4.26
	total	**383**	**146**	**7**	**536**	**71.46**	**27.24**	**1.31**
PQ11	slab1	123	80	1	204	60.29	39.22	1.66
	slab2	117	50	1	168	69.64	29.76	1.44
	total	**240**	**130**	**2**	**372**	**64.52**	**34.95**	**0.54**
PQ12	slab1	131	72	3	203	64.53	35.47	4.65
	slab2	147	70	4	217	67.74	32.26	5.90
	total	**278**	**142**	**7**	**420**	**66.19**	**33.81**	**1.67**
PQ13	slab1	142	103	1	245	57.96	42.04	1.73
	slab2	130	69	2	199	65.33	34.67	3.06

	total	**272**	**172**	**3**	**444**	**61.26**	**38.74**	**0.68**
	slab1	122	87	2	209	58.37	41.63	3.43
PQ14	slab2	111	74	2	185	60.00	40.00	3.33
	total	**233**	**161**	**4**	**394**	**59.14**	**40.86**	**1.02**

The proportion of mingled clasts always being of the order of 1-2 %, we neglected such clasts in the calculation of the standard deviation values for each sample.

The standard deviation has been calculated applying the formula

$$\sigma_p = \sqrt{\frac{P(1-P)}{N}}$$

where P is the proportion of clasts characterized by the same homogeneous texture (i.e. MP or MR clasts) and N is the total number of clasts of a given population (i.e. total clasts counted for each sample).

The values of σ_p for the MP clasts are reported in Table DR4, including the data used for Fig. 3 of the paper.

Table DR4.

	N	P_{MP}	σ_p
PQ1	428	0.58	0.024
PQ2	410	0.78	0.020
PQ3	471	0.86	0.016
PQ4	380	0.83	0.019
PQ5	321	0.83	0.021
PQ6	418	0.82	0.019
PQ7	363	0.77	0.022
PQ8	389	0.86	0.018
PQ9	257	0.73	0.028
PQ10	529	0.72	0.020
PQ11	370	0.65	0.025
PQ12	420	0.66	0.023
PQ13	444	0.61	0.023
PQ14	395	0.59	0.025