Supplemental Material

Salge, T., Tagle, R., Schmitt, R.T., and Hecht, L., 2021, Petrographic and chemical studies of the Cretaceous-Paleogene boundary sequence at El Guayal, Tabasco, Mexico: Implications for ejecta plume evolution from the Chicxulub impact crater, *in* Reimold, W.U., and Koeberl, C., eds., Large Meteorite Impacts and Planetary Evolution VI: Geological Society of America Special Paper 550. [https://doi.org/10.1130/2021.2550\(08\)](https://doi.org/10.1130/2021.2550(08)).

(A) Light microscopy and SEM-EDS micrographs

Figure S1. Paired micrographs of a silicate melt coated calcite aggregate from the middle subunit 2. (A, B) Altered silicate melt (black at XPL) is located around the fossil-bearing calcite particle. (C, D) Close up showing replacement of calcite by altered silicate melt. Recrystallized calcite within altered silicate melt is present at the transition zone. Pore space in altered silicate melt (arrows) is pronounced near the calcite contact. (A, C) Plane polarized light, PPL. (B, D) Cross polarized light, XPL.

Figure S2. Paired micrographs of the rim of a silicate melt coated calcite aggregate (1 x 2 cm) from the lowermost subunit 3. The aggregate consists of recrystallized calcite at the center and is progressively replaced by altered silicate melt towards the rim. The altered silicate melt contains microcrystalline calcite, and pseudomorph pore space. At the outermost rim, only pseudomorph pore space and no microcrystalline calcite is present. These microstructures resemble those of melt particles type 2a (MP2a, Figs. 4A, 4B, and S3). Note the different textured melt particle type 1 (MP1) in upper left corner at (A–C). Dark bubble shapes in (A, B) are artefacts from preparation. (A, D) Plane polarized light. (B, E) Cross polarized light. (C, F): Back-scattered electron micrograph. (D–F) is the close up of the rectangle shown in (A).

Figure S3. Paired micrographs of three melt particles type 2a (MP2a) from the lower subunit 3. (A, B) Overview showing the varying abundance of altered silicate melt (black at cross polarized light, XPL), microcrystalline calcite (bright at XPL), and pore space (dark at plane polarized light, PPL) at three different MP2a (white outlines). Left particle has a low content of microcrystalline calcite, upper right an intermediate content and lower right a high content. (C, D) Close up of the lower right particle showing a low content of altered silicate melt, a high content of microcrystalline calcite, and an intermediate content of pore space. (E, F) Close up of the upper right particle, showing an intermediate content of both altered silicate melt and microcrystalline calcite and a high content of pore space. Compare these microstructures with silicate melt coated calcite aggregates shown at Figs. S1 and S2. (A, C, E): PPL. (B, D, F): XPL.

Figure S4. (A) High resolution EDS composite elemental map (10 kV, 3048x4096 pixel, 410 nm pixel size, Si: blue, Ca: green, Mg: red, Fig. 5) overlaid with BSE micrograph of the lower subunit 3. Rectangles show detail areas of melt particle type 2a (MP2a) with varying contents of microcrystalline calcite, altered silicate melt and pseudomorph pore space. (B) MP2a with a high content of recrystallized calcite. Near the thin layer of altered silicate melt at the rim, calcite is replaced by silica. (C) MP2a showing a replacement of recrystallized calcite by altered silicate melt which is associated with pore space. (D) MP2a with low content of recrystallized calcite and dominating pseudomorph pore space in altered silicate melt. The enlargements shown in (B) and (D) are rotated by 90° in comparison to the overview (A).

Figure S5. High resolution back-scattered electron mosaic of accretionary lapillus (6149 x 7243 pixel). Within the core, the accreted particles are more randomly distributed than towards the edges, where elongated particles are aligned tangential to the lapilli rim. The continuous concentric zones correspond to a decrease in the size of accreted particles.

(B) XRF analyses

Table S1. XRF analyses of El Guayal bulk rock and accretionary lapilli.

Sample	G4	G5	G5	G5	G6	G6	G6	G7	G7	G7	G8	G8	G8
No.	1	1	2a	2b	1	2a	2b	1	2a	2b	1	2a	2b
Subunit ¹	1u	1u	1u	1u	2l	2l	2l	2m	2m	2m	2u	2u	2u
(wt.%)													
SiO ₂	3.6	5.1	4.5	4.8	11.6	11.6	11.7	13.9	14.2	14.0	20.3	20.2	20.4
TiO ₂	0.05	0.07	0.06	0.07	0.13	0.13	0.12	0.13	0.14	0.14	0.19	0.18	0.18
Al ₂ O ₃	1.1	1.7	1.4	1.5	2.9	2.8	2.9	3.1	3.4	3.4	4.7	4.4	4.5
Fe ₂ O ₃ ²	0.31	0.45	0.45	0.50	0.99	0.98	0.99	1.21	1.31	1.28	2.02	1.97	1.99
MnO	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.05	0.05	0.08	0.06	0.06
MgO	4.93	4.56	4.02	3.99	4.33	4.73	4.73	4.67	4.85	4.82	5.48	5.52	5.58
CaO	47.3	46.5	47.5	47.0	43.2	42.7	42.2	41.2	40.5	40.7	35.7	35.8	36.0
Na ₂ O	0.03	<0.02	0.04	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
K ₂ O	0.12	0.25	0.22	0.23	0.3	0.28	0.28	0.24	0.28	0.27	0.39	0.35	0.35
P ₂ O ₅	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02
SO ₃ ²	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
LOI ²	42.3	41.0	41.6	41.6	36.4	36.7	36.7	35.2	35.1	35.1	30.7	30.9	30.8
Total	100.0	99.8	99.9	99.8	100.0	100.1	99.8	99.8	100.0	99.9	99.7	99.5	100.1
CO ₂	42.3	40.9	n.d.	n.d.	35.2	n.d.	n.d.	33.3	n.d.	n.d.	27.9	n.d.	n.d.
(µg/g)													
Ba	<30	31	<30	<30	<30	43	51	<30	35	36	<30	36	51
Ce	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Co	<15	<15	<15	<15	<15	15	15	<15	<15	<15	18	16	<15
Cr	15	15	<15	15	19	18	17	22	21	22	26	21	22
Cu	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Mo	<10	<10	10	11	<10	<10	<10	<10	<10	<10	<10	<10	<10
Nb	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Ni	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
Pb	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
Rb	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
Sr	347	334	331	331	318	314	318	312	308	310	271	263	265
Th	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
U	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
V	30	35	33	32	34	39	42	38	42	45	47	53	50
Y	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Zn	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Zr	30	31	31	31	38	37	38	38	40	40	45	43	44

¹Suffix shows the stratigraphic level, l: lower; m: middle; u: upper; ²Total Fe calculated as Fe₂O₃, total S calculated as SO₃, LOI = loss on ignition; No. 1 corresponds to samples grinded in a steel mortar and No. 2 in a corundum mortar; n.d.: not determined.

Table S1. continued.

Sample	G9	G9	G9	G10	G10	G10	G11	G11	G11	G12	G12	G12
No.	1	2a	2b	1	2a	2b	1	2a	2b	1	2a	2b
Subunit ¹	3l	3l	3l	3l	3l	3l	3m	3m	3m	3m	3m	3m
(wt.%)												
SiO ₂	19.0	22.6	22.7	20.6	24.1	23.8	23.5	24.1	24.3	30.0	31.7	31.2
TiO ₂	0.19	0.27	0.27	0.21	0.29	0.29	0.20	0.21	0.21	0.30	0.32	0.31
Al ₂ O ₃	4.7	6.4	6.5	5.3	6.9	6.9	5.3	5.4	5.5	7.9	8.4	8.3
Fe ₂ O ₃ ²	1.93	2.56	2.63	2.14	2.81	2.83	2.49	2.63	2.51	3.15	3.33	3.27
MnO	0.06	0.06	0.06	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
MgO	4.82	6.20	6.24	5.63	7.05	7.12	5.14	5.07	5.06	5.42	5.53	5.48
CaO	36.5	32.1	31.6	35.1	30.1	29.7	33.7	32.7	32.5	27.6	25.2	25.2
Na ₂ O	<0.02	<0.02	0.03	0.02	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03
K ₂ O	0.49	0.65	0.66	0.51	0.66	0.66	0.39	0.41	0.43	0.73	0.81	0.80
P ₂ O ₅	0.03	0.04	0.04	0.01	0.02	0.03	0.03	0.03	0.04	0.07	0.07	0.06
SO ₃ ²	0.1	<0.10	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	<0.10	<0.10
LOI	31.6	28.8	28.9	30.1	27.6	28	28.8	28.9	28.8	24.4	24.4	25.0
Total	99.4	99.7	99.7	99.8	99.7	99.6	99.7	99.6	99.5	99.8	99.8	99.7
CO ₂ ²	28.4	n.d.	n.d.	26.3	n.d.	n.d.	25.7	n.d.	n.d.	20.1	n.d.	n.d.
(µg/g)												
Ba	133	157	146	128	190	179	100	135	115	118	174	168
Ce	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Co	<15	18	18	17	18	17	<15	<15	15	17	20	17
Cr	23	32	30	26	42	42	24	29	31	28	46	46
Cu	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Mo	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Nb	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Ni	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
Pb	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
Rb	19	<15	<15	<15	<15	<15	<15	<15	<15	17	26	17
Sr	283	241	239	287	226	230	210	209	213	165	153	157
Th	<10	<10	<10	<10	12	11	<10	<10	<10	<10	<10	<10
U	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
V	47	58	58	48	63	60	50	51	54	62	78	74
Y	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Zn	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	32	33
Zr	45	55	55	49	62	60	47	49	50	58	65	65

¹Suffix shows the stratigraphic level, l: lower; m: middle; u: upper; ²Total Fe calculated as Fe₂O₃, total S calculated as SO₃, LOI = loss on ignition; No. 1 corresponds to samples grinded in a steel mortar and No. 2 in a corundum mortar; n.d.: not determined.

Table S1 continued.

Sample	G14	G14	14	G13	G13	G13	G15	G15	G15	G9L	G10L
No.	1	2a	2b	1	2a	2b	1	2a	2b	1	1
Subunit ¹	3u	3u	3u	3u	3u	3u	4	4	4	AcL	AcL
(wt.%)											
SiO ₂	41.7	42.8	42.7	36.5	39.8	39.3	55.1	51.5	52.1	71.3	70.4
TiO ₂	0.35	0.34	0.33	0.33	0.29	0.28	0.34	0.31	0.31	0.18	0.20
Al ₂ O ₃	11.4	11.7	11.7	9.5	10.5	10.4	10.1	10.3	10.3	3.3	3.5
Fe ₂ O ₃ ²	4.58	4.98	4.90	3.89	5.16	5.20	4.62	4.92	4.99	1.18	1.10
MnO	0.07	0.08	0.07	0.03	0.05	0.05	0.14	0.1	0.1	0.03	0.03
MgO	7.22	7.57	7.48	6.42	6.54	6.54	5.84	5.76	5.78	4.63	4.94
CaO	17.0	14.4	14.3	21.8	17.9	17.9	11.5	12.9	12.4	8.4	8.4
Na ₂ O	0.04	0.03	<0.02	<0.02	0.03	0.06	0.05	0.11	0.11	<0.01	<0.01
K ₂ O	0.96	0.97	0.95	0.91	1.01	1.02	1.07	1.33	1.35	0.28	0.31
P ₂ O ₅	0.06	0.06	0.06	0.04	0.05	0.05	0.06	0.08	0.08	0.07	0.05
SO ₃ ²	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
LOI	16.3	16.2	17.0	20.0	18.4	18.8	10.6	12.2	12.1	10.1	10.5
Total	99.7	99.1	99.5	99.4	99.7	99.6	99.4	99.5	99.6	99.5	99.4
CO ₂ ²	10.5	n.d.	n.d.	14.9	n.d.	n.d.	5.5	n.d.	n.d.	7.8	7.5
(µg/g)											
Ba	165	167	168	119	171	173	197	203	230	141	134
Ce	<30	<30	<30	<30	<30	<30	<30	<30	37	34	31
Co	18	23	23	19	26	24	33	23	22	<15	<15
Cr	50	46	50	41	45	45	61	58	63	27	30
Cu	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Mo	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Nb	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	10
Ni	<15	16	16	<15	19	17	40	16	47	<15	<15
Pb	<15	<15	<15	<15	<15	<15	<15	<15	<15	17	<15
Rb	22	22	21	18	21	22	33	22	42	<15	<15
Sr	120	125	102	151	126	125	111	119	131	70	74
Th	<10	14	<10	<10	11	10	<10	14	<10	<10	14
U	<10	<10	<10	<10	<10	<10	<10	<10	<10	15	16
V	95	95	100	72	81	79	100	95	93	44	47
Y	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Zn	45	54	50	43	<30	52	73	54	71	<30	<30
Zr	76	87	83	70	76	76	77	84	75	59	62

¹Suffix shows the stratigraphic level, l: lower; m: middle; u: upper, AcL: Accretionary lapilli; ²Total Fe calculated as Fe₂O₃, total S calculated as SO₃, LOI = loss on ignition; No. 1 corresponds to samples grinded in a steel mortar and No. 2 in a corundum mortar; n.d.: not determined.

(C) Electron microprobe phase analyses

Detection limits and reference compositions

Following reference samples were used to determine the detection limit and to control the stability of the EMP calibration:

United States National Museum (Jarosewich et al., 1980, 1987):

- Glass, basaltic, Juan de Fuca Ridge, USNM 111240/52 VG-2
- Glass, tektite, synthetic, USNM 2213, Microcline, location unknown, USNM 143966
- Microcline, location unknown, USNM 143966
- Plagioclase (Labradorite), Lake Country, OR, USNM 115900
- Anorthoclase, Kakanui, New Zealand, USNM 133868

Astimex Scientific Limited MINM25-53:

- Chlorite

Table S2 Detection limits of chemical elements for EMP analyses. Values in brackets are discarded values due too low element concentration in given references. The highest value for each element is the assumed detection limit (bold values).

	Glass, basaltic	Glass, Tektite	Microcline	Plagioclase	Anorthoclase
(wt.%)					
SiO ₂	0.09	0.09	0.12	0.11	0.12
TiO ₂	0.09	(0.13)	-	-	-
Al ₂ O ₃	0.07	0.07	0.06	0.07	0.06
FeO	0.11	0.09	(0.26)	(0.08)	(0.08)
MgO	0.05	0.06	-	-	-
MnO	0.08	(0.10)	-	-	-
CaO	0.05	0.04	(0.04)	0.05	0.05
Na ₂ O	0.05	0.04	0.04	0.04	0.06
K ₂ O	0.03	0.03	0.03	0.03	0.03
(µg/g)					
Si	561	517	580	525	569
Ti	438	623	-	-	-
Al	361	356	315	382	298
Fe	844	730	(2092)	642	640
Mg	323	366	-	307	-
Mn	619	740	-	-	-
Ca	387	304	(312)	335	325
Na	352	276	267	293	413
K	286	260	237	238	242

Table S3. Comparison of the chemical composition of references used for EMP analyses.

	Basalt glass				Tektite				Chlorite			
	Prov.	Meas.	s	s	Prov.	Meas.	s	s	Prov.	Meas.	s	s
	(N=131)	($\pm$ mass%)	($\pm$ %)		(N=128)	($\pm$ wt.%)	($\pm$ %)		(N=12)	($\pm$ wt.%)	($\pm$ %)	
(wt.%)												
SiO ₂	50.81	50.4	0.36	0.7	75.75	75.2	0.48	0.6	30.04	30.0	0.17	0.6
TiO ₂	1.85	1.72	0.10	5.9	0.50	0.48	0.04	9.1	-	<0.09	-	-
Al ₂ O ₃	14.06	14.0	0.18	1.3	11.34	11.2	0.16	1.4	18.08	18.8	0.29	1.5
FeO	11.84	11.3	0.55	4.9	4.90	4.74	0.24	5.1	3.31	3.28	0.16	5.0
MgO	6.71	6.73	0.14	2.1	1.51	1.46	0.06	3.9	33.51	31.2	0.33	1.1
MnO	0.22	0.21	0.04	18.0	0.11	0.10	0.04	35.4	-	<0.08	-	-
CaO	11.12	11.1	0.36	3.3	2.66	2.69	0.10	3.7	0.03	<0.05	-	-
Na ₂ O	2.62	2.49	0.09	3.5	1.06	0.83	0.10	12.3	-	<0.04	0.02	94.4
K ₂ O	0.19	0.19	0.02	12.9	1.88	1.75	0.17	10.0	-	<0.03	0.01	114.6
Total	99.42	98.2	0.82	0.8	99.71	98.4	0.61	0.6	84.97	83.3	0.56	0.7

	Plagioclase				Microcline				Anorthoclase			
	Prov.	Meas.	s	s	Prov.	Meas.	s	s	Prov.	Meas.	s	s
	(N=43)	($\pm$ wt.%)	($\pm$ %)		(N=41)	($\pm$ wt.%)	($\pm$ %)		(N=33)	($\pm$ wt.%)	($\pm$ %)	
(wt.%)												
SiO ₂	51.25	51.2	0.57	1.1	64.24	65.0	0.44	0.7	66.44	66.5	0.45	0.7
TiO ₂	0.05	<0.09	-		0.01	<0.09	-	-	-	<0.09	-	-
Al ₂ O ₃	30.91	30.5	0.25	0.8	18.30	18.7	0.17	0.9	20.12	20.0	0.21	1.0
FeO	0.46	0.39	0.06	16.3	0.04	<0.11	-	-	0.20	0.13	0.03	24.6
MgO	0.14	0.12	0.03	21.7	0.03	<0.06	-	-	-	<0.06	-	-
MnO	0.01	<0.09	-	-	0.04	<0.09	-	-	-	<0.09	-	-
CaO	13.64	13.5	0.40	3.0	0.02	<0.05	-	-	0.87	0.57	0.04	6.3
Na ₂ O	3.45	3.41	0.09	2.8	1.30	1.26	0.05	3.9	9.31	8.55	0.17	2.0
K ₂ O	0.18	0.13	0.02	12.6	15.14	15.7	0.44	2.8	2.35	2.54	0.07	2.8
Total	100.09	99.3	0.65	0.7	99.12	100.6	0.67	0.7	99.29	98.3	0.51	0.5

Number of cations on the basis of 24O												
Si	7.032	0.041	0.6		8.950	0.027	0.3		8.920	0.025	0.3	
Ti	-	-	-		0.002	0.002	123.6		-	-	-	
Al	4.939	0.048	1.0		-	-	-		3.153	0.026	0.8	
Fe	0.045	0.007	16.4		0.002	0.003	122.6		0.015	0.004	24.7	
Mg	0.025	0.005	21.6		-	-	-		-	-	-	
Mn	-	-	-		-	-	-		-	-	-	
Ca	1.982	0.058	2.9		-	-	-		0.082	0.005	6.3	
Na	0.908	0.026	2.8		0.337	0.013	3.9		2.222	0.050	2.2	
K	0.023	0.003	12.5		2.749	0.075	2.7		0.435	0.012	2.7	
Total	14.953	0.039	0.3		15.076	0.054	0.4		14.830	0.041	0.3	

N: number of analyses; Prov.: Provided; Meas.: Measured.

Chemical compositions of melt particles (altered to clay minerals) in bulk rock

The analyses of melt particles with compositional heterogeneities were grouped according to their SiO₂ concentration and named with an affix (L: low; M: intermediate; H: high).

Table S4. Average composition (wt.%) of melt particle type 1.

Sample	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MgO	MnO	CaO	Na ₂ O	K ₂ O	Total
Ir07A-15	10	35.7	0.52	14.7	7.80	18.1	<0.08	0.81	0.08	0.22	77.9
s		2.3	0.49	0.8	1.69	1.5	-	0.19	0.02	0.15	2.5
Ir11-17	2	43.5	2.27	17.2	4.05	14.7	<0.08	1.33	0.15	2.07	85.2
s		0.7	0.77	0.1	0.85	1.8	-	0.59	0.02	0.03	3.4
Ir11-245	3	43.4	1.16	16.6	4.74	17.9	<0.08	1.33	0.16	1.21	86.5
s		4.0	0.93	1.4	1.08	4.8	-	0.25	0.04	0.76	1.7
Ir11-24b	3	36.4	<0.09	15.8	6.43	26.9	<0.08	0.51	0.15	0.10	86.3
s		0.3		0.1	0.18	0.2	-	0.04	0.00	0.02	0.7
Ir15aB	2	43.1	<0.09	17.0	5.80	19.0	<0.08	1.33	0.10	1.05	87.5
s		3.7		0.6	0.55	3.8	-	0.19	0.03	1.03	0.8
Ir18-3bA	5	50.6	0.95	16.3	3.78	12.0	<0.08	2.20	0.51	1.29	87.4
s		2.3	0.90	1.0	1.09	1.3	-	0.22	0.05	0.27	1.2
Ir18-4	3	47.6	0.11	16.3	3.42	11.3	<0.08	2.35	0.34	1.14	82.5
s		0.8	0.02	0.8	0.99	2.1	-	0.28	0.08	0.16	3.2
Ir22-1-1-10	4	54.0	0.28	18.3	4.04	9.22	<0.08	2.66	0.35	2.97	91.7
s		0.5	0.02	0.2	0.66	0.50	-	0.11	0.06	0.88	1.5
Ir22-3-0-3	3	52.8	0.13	17.7	3.38	9.84	<0.08	3.10	0.38	1.03	88.4
s		1.4	0.03	1.4	0.28	1.14	-	0.11	0.05	0.19	1.7

N: Number of analyses.

Table S5. Average composition (wt.%) of melt particle type 1 with compositional heterogeneities.

Sample	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MgO	MnO	CaO	Na ₂ O	K ₂ O	Total
Ir07-01M	4	40.9	0.58	16.3	5.85	17.4	<0.08	1.38	0.06	0.47	82.9
s		1.3	0.41	0.3	0.88	1.3	-	0.02	0.01	0.11	2.4
Ir07-01L	9	35.0	0.33	14.4	8.12	19.8	<0.08	1.12	0.07	0.18	79.1
s		1.0	0.10	0.4	0.61	1.0	-	0.26	0.01	0.06	2.0
Ir11-12H	2	49.1	0.14	18.3	3.52	10.8	<0.08	1.03	0.16	3.03	86.1
s		0.8	0.06	0.3	0.24	0.1	-	0.22	0.04	0.32	1.8
Ir11-12M	3	43.6	0.22	17.2	5.45	16.3	<0.08	1.37	0.17	1.28	85.5
s		1.6	0.15	0.6	0.64	1.2	-	0.24	0.02	0.50	2.6
Ir11-12L	4	37.9	0.23	15.0	7.10	20.5	<0.08	1.02	0.18	0.33	82.3
s		1.0	0.18	0.6	0.60	1.4	-	0.22	0.05	0.09	1.9
Ir11-17H	2	46.2	<0.09	18.1	4.04	13.8	<0.08	0.97	0.15	1.88	85.1
s		1.0	-	0.3	0.33	0.5	-	0.03	0.03	0.20	0.6
Ir11-17L	3	40.3	<0.09	15.5	5.95	21.0	<0.08	1.17	0.21	0.51	84.6
s		0.5		0.5	0.29	0.6	-	0.22	0.04	0.14	1.1
Ir11-24bH	2	45.4	1.44	17.0	5.18	14.7	<0.08	1.36	0.22	2.06	87.4
s		1.7	1.10	0.8	0.82	2.5		0.08	0.00	0.90	1.0
Ir11-24bL	2	39.2	0.57	15.3	5.78	20.1	<0.08	1.25	0.14	0.46	82.9
s		1.1	0.62	0.2	0.78	0.5	-	0.69	0.04	0.17	2.5
Ir15aK	5	52.0	<0.09	18.7	3.08	4.90	<0.08	0.68	<0.06	5.16	84.6
s		1.2	-	0.6	0.05	0.13	-	0.10	-	0.43	1.8
Ir15aH	7	51.5	<0.09	17.0	3.11	5.99	<0.08	1.30	0.08	1.82	80.8
s		1.2	-	0.5	0.29	0.89	-	0.15	0.01	0.31	2.1
Ir15aL	8	39.9	0.22	15.4	7.13	22.9	<0.08	1.35	0.09	0.20	87.1
s		1.3	0.12	0.8	0.90	1.0		0.13	0.02	0.06	1.2
Ir18-6H	4	51.8	0.11	17.7	3.25	10.9	<0.08	1.97	0.49	1.29	87.5
s		2.1	0.02	0.5	0.16	0.7	-	0.28	0.11	0.13	2.1
Ir18-6L	2	40.7	0.37	14.3	8.02	18.4	<0.08	2.05	0.32	0.28	84.5
s		0.0	0.10	0.1	0.09	1.8	-	0.03	0.00	0.04	1.7

N: Number of analyses.

Table S6. Average composition (wt.%) of melt particle type 2a.

Sample	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MgO	MnO	CaO	Na ₂ O	K ₂ O	Total
Ir07A-15	11	39.3	<0.09	17.1	4.30	14.9	<0.08	0.96	0.08	0.79	77.7
s		3.1	-	0.6	1.00	2.5	-	0.25	0.02	0.38	2.6
Ir11-24	5	39.4	<0.09	16.4	5.23	22.3	<0.08	1.35	0.07	0.46	85.4
s		0.7	-	0.4	0.24	0.5	-	0.17	0.00	0.13	1.6
Ir11-06	6	38.7	0.18	16.1	5.60	22.1	<0.08	2.45	0.08	0.36	85.5
s		1.7	0.09	1.2	0.24	1.1		1.37	0.03	0.24	2.4
Ir11-21	5	39.5	<0.09	16.3	5.45	22.4	<0.08	0.95	0.15	0.64	85.4
s		2.6	-	0.7	0.79	3.5	-	0.08	0.03	0.61	1.2
Ir11-24b	3	40.8	0.51	16.7	4.97	20.3	<0.08	2.15	0.16	0.78	86.3
s		1.9	0.16	0.2	0.22	1.3	-	0.77	0.05	0.32	1.3
Ir18-2-1	7	49.4	<0.09	14.4	3.18	13.6	<0.08	2.49	0.20	0.60	83.9
s		2.6	-	1.8	0.70	2.2	-	0.49	0.04	0.27	1.8
Ir18-3a	6	50.3	0.16	16.1	4.46	13.2	<0.08	2.55	0.46	1.03	88.3
s		2.6	0.06	0.8	1.63	2.1	-	0.36	0.15	0.33	1.4
Ir18-3b	3	47.9	0.12	16.0	4.65	15.5	<0.08	2.45	0.48	1.03	88.0
s		4.8	0.04	1.4	1.65	4.2	-	0.13	0.05	0.41	1.2
Ir18-3cA	5	51.4	<0.09	16.3	3.18	11.9	<0.08	2.34	0.47	1.03	86.7
s		3.0	-	0.8	0.64	1.6	-	0.21	0.06	0.31	2.2
Ir18-4a	3	48.7	<0.09	15.7	3.58	12.4	<0.08	2.83	0.22	1.00	84.4
s		6.2	-	1.3	1.36	2.6	-	0.39	0.11	0.17	4.2
Ir22-1-2	5	46.6	<0.09	14.3	6.18	14.6	<0.08	3.49	0.35	0.46	86.1
s		2.7	-	1.9	1.12	1.9	-	0.12	0.12	0.36	2.4

N: Number of analyses.

Table S7. Average composition (wt.%) of melt particle type 2a with compositional heterogeneities.

Sample	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MgO	MnO	CaO	Na ₂ O	K ₂ O	Total
Ir07A-01H	5	52.3	<0.09	17.9	1.77	9.24	<0.08	2.36	0.14	1.11	84.8
s		2.0	-	0.6	0.26	0.77	-	0.35	0.09	0.18	2.3
Ir07A-01M	4	41.8	0.11	17.0	3.82	14.9	<0.08	1.31	<0.06	0.76	79.8
s		2.4	0.01	0.4	0.82	3.0	-	0.11	-	0.31	3.6
Ir07A-01L	28	35.5	<0.09	15.3	7.03	26.1	<0.08	0.63	0.06	<0.03	84.6
s		0.5	-	0.7	0.49	1.0	-	0.12	0.00	-	1.2
Ir15a1H	4	45.1	0.13	16.0	5.59	18.9	<0.08	1.55	0.11	0.63	87.9
s		5.6	0.05	1.9	1.09	2.9	-	0.16	0.02	0.59	2.4
Ir15a1L	4	54.1	0.11	18.7	3.21	6.1	<0.08	1.23	0.09	3.57	87.0
s		1.4	0.02	0.4	0.16	1.1	-	0.20	0.01	0.31	2.0
Ir18-2-2H	3	51.3	0.11	16.8	2.62	10.2	<0.08	2.33	0.21	1.08	84.7
s		0.9	0.02	0.4	0.22	0.4		0.12	0.06	0.11	0.9
Ir18-2-2L	4	46.4	0.17	16.4	4.46	15.7	<0.08	2.27	0.20	0.67	86.2
s		2.4	0.05	0.6	0.79	1.7	-	0.16	0.05	0.15	2.2
Ir18-2-3H	5	52.0	0.10	17.2	2.76	10.7	<0.08	2.29	0.26	1.07	86.4
s		1.0	0.00	0.1	0.15	0.7	-	0.18	0.01	0.06	0.8
Ir18-2-3L	2	45.7	<0.09	16.1	5.12	16.3	<0.08	2.69	0.23	0.49	86.8
s		0.2	-	0.1	0.10	0.5	-	0.76	0.03	0.03	1.0
Ir22-2H	4	54.1	0.11	17.9	3.37	8.80	<0.08	2.82	0.36	1.43	88.9
s		1.2	0.01	0.4	0.27	0.55	-	0.26	0.02	0.26	0.9
Ir22-2L	2	46.0	<0.09	15.0	7.33	16.3	<0.08	4.01	0.19	0.22	89.0
s		0.0	-	0.0	0.04	0.0	-	0.15	0.02	0.04	0.2

N: Number of analyses.

Table S8. Average composition (wt.%) of melt particle type 2b.

Sample	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MgO	MnO	CaO	Na ₂ O	K ₂ O	Total
Ir07A-07	10	35.8	<0.09	15.4	7.13	26.5	<0.08	0.72	<0.06	0.03	85.6
s		1.2	-	0.9	0.86	3.6	-	0.24	-	0.11	3.9
Ir18-1	9	43.3	<0.09	10.6	5.14	21.2	<0.08	2.21	0.23	0.28	83.0
s		1.5	-	2.2	0.77	2.6	-	0.47	0.04	0.15	2.6
Ir07A-17H	5	43.9	<0.09	16.3	2.84	12.4	<0.08	1.34	0.13	0.57	77.4
s		3.0	-	0.4	0.61	1.9	-	0.51	0.05	0.23	2.1
Ir07A-17L	14	35.8	<0.09	15.0	7.12	26.3	<0.08	0.67	<0.06	0.02	84.9
s		0.4	-	0.3	0.30	0.9	-	0.08	-	0.01	1.3
Ir18-1bH	3	44.7	<0.09	10.5	4.45	17.3	<0.08	2.06	0.27	0.49	79.8
s		0.5	-	0.8	0.25	1.4	-	0.17	0.04	0.12	1.1
Ir18-1aL	3	39.6	<0.09	12.0	6.61	25.5	<0.08	1.77	0.28	0.11	85.8
s		0.8	-	0.8	0.89	1.1	-	0.42	0.05	0.04	1.8

N: Number of analyses.

Chemical composition of silicate melt (altered to clay minerals) within accretionary lapilli

Table S9. Average composition (wt.%) of melt particles within accretionary lapilli

Sample	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MgO	MnO	CaO	Na ₂ O	K ₂ O	Total
L11NT	12	51.4	0.34	19.0	3.22	12.7	<0.08	0.96	0.22	3.29	91.1
s		2.7	0.24	0.6	0.96	2.3	-	0.16	0.08	1.18	1.2
L9a11.1A	3	49.2	<0.09	14.5	1.57	15.5	<0.08	1.94	0.25	0.94	83.9
s		1.5	-	1.0	0.24	1.5	-	0.27	0.02	0.22	0.6
L9a11.1B	3	55.1	<0.09	19.4	0.82	7.87	<0.08	1.00	0.31	4.21	88.7
s		1.0	-	0.4	0.10	0.29	-	0.02	0.03	0.54	1.6
L9a11.1C	3	48.3	<0.09	12.3	1.80	18.0	<0.08	2.26	0.27	0.53	83.5
s		0.9	-	0.8	0.09	0.6	-	0.04	0.01	0.12	1.1

N: Number of analyses.

Table S10. Average composition (wt.%) of melt particles within accretionary lapilli with compositional heterogeneities.

Sample	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MgO	MnO	CaO	Na ₂ O	K ₂ O	Total
L4NT2H	13	52.3	0.30	17.3	2.99	13.4	<0.08	1.51	0.24	2.69	90.8
s		1.4	0.21	0.8	0.49	1.2	-	0.45	0.13	0.51	1.7
L4NT2L	4	37.8	0.13	15.1	7.70	24.2	<0.08	0.80	0.05	0.29	86.0
s		2.2	0.02	0.9	0.83	1.5	-	0.12	0.04	0.17	1.4
L9a2b10-1AH	4	52.7	<0.09	16.7	1.92	10.6	<0.08	1.68	0.40	1.48	85.4
s		0.8	-	0.4	0.04	0.1	-	0.07	0.06	0.08	0.7
L9a2b10-1BL	2	38.7	0.15	13.9	8.41	21.8	<0.08	1.22	0.20	0.32	84.7
s		3.1	0.05	0.4	1.20	2.7	-	0.12	0.11	0.18	1.0
L9a2b1-1bH	2	52.8	<0.09	16.3	1.91	9.94	<0.08	1.49	0.42	1.71	84.6
s		0.5	-	0.5	0.05	0.16	-	0.16	0.06	0.17	0.0
L9a2b1-15L	4	38.7	0.22	14.0	7.62	21.1	<0.08	1.34	0.16	0.23	83.3
s		1.4	0.12	1.0	0.73	0.8	-	0.07	0.03	0.16	1.0
L9a2b8-5B	4	52.7	<0.09	16.5	1.47	9.9	<0.08	1.64	0.26	1.76	84.4
s		1.6	-	0.6	0.06	0.2	-	0.05	0.03	0.08	2.1
L9a2b8-5Na	3	50.2	<0.09	16.0	1.59	10.2	<0.08	1.08	2.07	1.59	82.8
s		0.6	-	0.2	0.06	0.0	-	0.28	0.23	0.14	0.6

(D) Modal composition calculations

Several calculations with different phase combinations were performed for each sample.

Calculations with negative phase proportions were rejected. In order to control the accuracy of the result, the bulk rock concentration of each element was back calculated. The deviation of each element from the calculated bulk rock composition with the XRF bulk rock composition is used to calculate the cumulative error (s) for the calculation. Results with lowest cumulative error were assumed to be the most accurate phase combination. In the case of a large deviation for one or more elements, additional proposed phases (hematite and potassium feldspar) were added to minimize the deviation for these elements and the resulting cumulative error.

Table S11. Selected results of modelled modal composition (vol%, mean values of the constrained mixing model of Le Maitre, 1979 and the method of the least square Davis, 1973). The most certain result with the lowest error are in gray rows.

Sample	subunit	No.	Cal	Dol	CM Si	CM Mg	SiO ₂	K-fsp	Hem	Sum	s	Sum carbonate	Sum CM
G4	1u	1	74.5	19.6	5.3	n.m.	0.8	n.m.	n.m.	100.1	0.2	94.1	5.3
G4	1u	2	74.4	19.7	4.9	n.m.	0.6	0.5	n.m.	100.2	0.2	94.1	4.9
G5	1u	1	76.5	14.9	8.2	n.m.	0.4	n.m.	n.m.	100.0	0.2	91.4	8.2
G5	1u	2	76.4	15.0	7.6	n.m.	0.3	0.7	n.m.	100.0	0.2	91.4	7.6
G6	2l	1	76.5	14.9	8.2	n.m.	0.4	n.m.	n.m.	100.0	0.2	91.4	8.2
G6	2l	2	73.4	6.0	6.9	9.2	4.1	0.8	n.m.	100.4	0.3	79.4	16.1
G7	2m	1	76.5	14.9	8.2	n.m.	0.4	n.m.	n.m.	100.0	0.2	91.4	8.2
G7	2m	2	70.9	4.2	7.8	11.4	5.4	0.6	n.m.	100.3	0.3	75.2	19.2
G8	2m	1	58.7	6.5	30.6	n.m.	4.0	n.m.	n.m.	99.8	2.1	65.2	30.6
G8	2m	2	63.8	n.m.	9.5	17.8	8.4	0.7	n.m.	100.3	0.4	63.8	27.3
G9	3l	1	57.5	n.m.	13.6	20.9	6.4	2.6	n.m.	100.9	1.4	57.5	34.5
G9	3l	2	54.8	8.2	26.9	5.7	4.7	0.3	n.m.	100.8	1.1	63.1	32.7
G10	3l	1	57.5	n.m.	13.6	20.9	6.4	2.6	n.m.	100.9	1.4	57.5	34.5
G10	3l	2	53.1	5.6	23.4	12.7	5.3	0.8	n.m.	100.8	0.9	58.7	36.1
G11	3m	1	58.6	n.m.	19.1	13.4	9.0	n.m.	n.m.	100.0	0.8	58.6	32.5
G12	3m	1	45.5	n.m.	39.5	8.0	7.0	n.m.	n.m.	100.0	1.3	45.5	47.6
G14	3u	1	24.6	n.m.	56.6	10.7	8.4	n.m.	n.m.	100.2	2.1	24.6	67.3
G14	3u	2	24.4	n.m.	58.7	7.2	8.5	n.m.	2.1	100.9	0.8	24.4	65.8
G13	3u	1	33.0	n.m.	48.1	10.1	9.2	n.m.	n.m.	100.3	2.4	33.0	58.2
G13	3u	2	32.8	n.m.	50.5	6.2	9.3	n.m.	2.3	98.8	0.9	32.8	56.7
G15	4	1	17.2	n.m.	56.3	5.1	21.1	n.m.	n.m.	99.7	3.7	17.2	61.4
G15	4	2	16.9	n.m.	58.8	0.4	21.3	n.m.	2.7	100.2	2.6	16.9	59.2

Cal: calcite; Dol: dolomite; CM Si: SiO₂-rich, MgO-poor clay minerals (predominantly from altered silicate melt); CM Mg: MgO-rich, SiO₂-poor clay minerals (predominantly from altered silicate melt); SiO₂: quartz and silica; K-fsp: potassium feldspar; Hem: hematite. Suffix at subunit marks the stratigraphic level (l: lower; m: middle; u: upper). n.m.: not modelled.