

Table S1: Abridged unit descriptions in the San Luis Caldera Complex\*

Abbreviation	Description
<u>Nelson Mountain Tuff</u>	
<i>Tndn</i>	Nonwelded to partly-welded dacite: yellow-tan to gray, porous, grades down into more welded dacitic NMT ( <i>Tnd</i> ). Crystal rich with phenocrysts similar to welded dacite ( <i>Tnde</i> ). 10-50 m thickness.
<i>Tnde</i>	Welded mafic dacite (Equity facies): Dacite and mafic dacite in a welded zone with dense dark-gray devitrified tuff comprising most of the intracaldera NMT (63-66% SiO <sub>2</sub> ; 25-45% pl, incl. bi, cpx, sn, hbl, qz <sup>1</sup> ). Grades downward into silicic dacite tuff ( <i>Tnd</i> ). Thickness 20-50 m in outflow; within caldera, thickness varies from <200 m in the south to >1,200 m in the north with no base exposed.
<i>Tnd</i>	Welded silicic dacite and transitional rhyolite-dacite: Brownish-gray main cliff-forming welded caprock of the outflow NMT (67-72% SiO <sub>2</sub> , 15-25 % pl, incl. sn, bi, cpx, qz), commonly with a blank vitrophyre (3-5 m) near the base. Grades downward into rhyolite ( <i>Tnr</i> ). Thickness 20-50 m in outflow, not mapped separately within caldera.
<i>Tnr</i>	Welded to partly welded rhyolite: light gray and tan to light reddish-brown welded tuff (71-74% SiO <sub>2</sub> , 5-15% pl incl. sn, bi, cpx). Includes dark-gray pumice fiamme with <10:1 flattening ratio are commonly set in orange-brown devitrified matrix. Grades into less welded tuff ( <i>Tnn</i> ). Thickness 0-200 m.
<i>Tnn</i>	Nonwelded to partly welded rhyolite and silicic dacite: gray porous pumiceous tuff containing common small angular fragments of andesitic lava. Mostly argilized or zeolitized. Contains 5-10% pl incl. sn and bi. Thickness 10-250 m.
<u>Cebolla Creek Tuff</u>	
<i>Tcc</i>	Partly-welded mafic dacite: dark gray massive intracaldera tuff (62-66% SiO <sub>2</sub> , 25-40% pl, incl. bi, hbl). Contains orange-brown to blank pumice fragments (2-5 cm across) and 1-3 cm andesitic lithics. Blank vitrophyre near base of most welded sections; total thickness 25-50 m.
<u>Rat Creek Tuff</u>	
<i>Trd</i>	Welded dacite tuff: light brown devitrified upper part of the proximal RCT (65-70% SiO <sub>2</sub> , 20-35% pl, incl. bi, sn, cpx). Grades downward into rhyolitic tuff ( <i>Trr</i> ).
<i>Trr</i>	Nonwelded to partly welded rhyolite tuff: poorly exposed light gray to yellow glassy pumiceous tuff (70-73% SiO <sub>2</sub> , 5-20% pl, incl. sn, bi, cpx) commonly containing small andesitic fragments. Typically glassy or argilized/zeolitized.
<i>Trrf</i>	Light-colored, crystal-poor rhyolitic pumice of the Rat Creek Tuff from Los Pinos Pass
<i>Trrm</i>	Dark-colored, crystal-poor rhyolitic pumice of the Rat Creek Tuff from Los Pinos Pass
<i>Trrg</i>	Mingled, crystal-poor rhyolitic pumice of the Rat Creek Tuff from Los Pinos Pass

\*for complete list of San Luis units and descriptions, see Lipman (2006) *Geologic map of the central San Juan caldera cluster, southwestern Colorado*. US Department of the Interior, US Geological Survey.

<sup>1</sup>pl = plagioclase; bi = biotite; cpx = clinopyroxene; sn = sanidine; hbl = hornblende; qz = quartz

Table S2: Brief Sample Descriptions

Sample	Mapped Unit	Latitude	Longitude	Locality, notes	Description
<u>Nelson Mountain Dacite</u>					
17SJ02	<i>Tndn</i>	37°51'01"	107°08'58"	North Clear Creek Falls	Welded dark to tan bulk tuff; very crystal-rich with plag, bt, cpx
17SJ18	<i>Tnde</i>	37°55'59"	106°57'33"	Equity Mine	Welded intracaldera bulk tuff; crystal-rich with abundant plag
17SJ03	<i>Tnd</i>	37°51'01"	107°08'58"	North Clear Creek Falls	Slightly welded white to gray bulk tuff; very crystal rich with plag, bt, cpx, similar to CCT
NMT14-1	<i>Tnd</i>	37°50'55"	106°08'50"	North Clear Creek Falls	Slightly welded white to gray bulk tuff; very crystal rich with plag, bt, cpx
17SJ09	<i>Tnd</i>	37°54'52"	106°56'06"	Nelson Mountain	Welded dark burgundy bulk tuff; crystal rich
NMT08-2	<i>Tnd</i>	37°52'49"	106°46'01"	Wheeler Monument	Slightly welded white to gray bulk tuff; very crystal rich with plag, bt, cpx
<u>Nelson Mountain Rhyolite</u>					
17SJ17	<i>Tnr</i>	37°54'28"	106°57'21"	Equity Mine	Welded intracaldera bulk tuff; crystal-rich
17SJ04	<i>Tnn</i>	37°49'01"	107°08'04"	Bristol Head	White pumiceous tuff, crystal-poor
NMT14-2	<i>Tnn</i>	37°49'01"	107°08'04"	Bristol Head	White pumiceous tuff, crystal-poor
17SJ16	<i>Tnn</i>	38°04'35"	107°00'24"	Powderhorn Park	White non-welded slightly altered bulk tuff, crystal-poor
17SJ19	<i>Tnn</i>	38°04'53"	107°05'02"	Powderhorn Park	White to gray non-welded bulk tuff, crystal-poor
NMT08-1	<i>Tnn</i>	37°52'49"	106°46'01"	Wheeler Monument	Pumice fragment from bulk <i>Tnn</i>
<u>Cebolla Creek Tuff</u>					
SRM07	<i>Tcc</i>	38°05'47"	106°59'04"	Los Pinos Pass	White to gray slightly welded bulk tuff, very crystal-rich
<u>Rat Creek Dacite</u>					
RCT14-1	<i>Trd</i>	37°54'41"	106°58'58"	Rat Creek	Upper welded RCT dacite, very crystal-rich Highest RCTD sample location in sequence, massive, welded with glassy matrix (even darker than DF12), many small (mm-cm) whitish (peach colored weathered) pumices, also darker bigger pumices, some mm-cm sized lithics, small ~cm-long fiamme present
17DF13	<i>Trd</i>	38°04'55"	107°00'07"	Cathedral Creek	Second highest RCTD sample location in sequence, massive, welded dacite, darker matrix -> glassy; whitish-peach colored weathered pumices, small elongated bigger brownish pumices, some weathered/altered to zeolite, some mm-sized lithics, ~cm-long fiamme
17DF12	<i>Trd</i>	38°04'53"	107°00'08"	Cathedral Creek	Reworked RCTR with dacitic clasts and lithic fragments with various size (up to dm-sized); porous matrix, yellowish pumices (zeolith) dacitic clasts -> purplish color, yellowish matrix -> Rhyolite
17DF09	<i>Trd</i>	38°04'50"	107°00'05"	Cathedral Creek	
<u>Rat Creek Rhyolite</u>					
17DF11	<i>Trr</i>	38°04'51"	107°00'06"	Cathedral Creek	Highest RCTR sample location in sequence, purple/greyish matrix, dense massive rock with some holes (left from pumices maybe)-> welded dacite; white pumices, some weathered with peach color (mm-cm size),

some strongly weathered to zeolite (yellow color), brownish pumices, less than white ones (cm size); maybe "fluidal" structures, aligned elongated pumices = fiamme structures -> elongated, flattened pumices  
 Second highest RCTR sample location in sequence, whitish/pinkish matrix, solid but easy to crumble -> non-welded, white pumices mm-cm size, some lithic fragments in mm-size  
 Porous, fine-grained grey-whitish matrix with white pumices mm-cm size, some lithics mm size  
 Very porous and weathered, small white pumices present, lots of ~mm-sized lithic fragments, fine-grained whitish matrix; small scale: no layering, homogeneous distribution, large scale: kind of layers visible by color variations  
 Second highest RCTR sample location in Cathedral sequence; for bulk rock, pinkish matrix, slightly friable, ashy matrix, non-welded, cm-sized white pumices & grey-brownish pumices and lithics  
 Slightly weathered bulk tuff, white and black pumices (up to cm size) and peach colored (weathered), nearly no lithic fragments, pinkish ground mass; plag, qtz and bt phenocrysts visible  
 Non-welded bulk tuff, few small (<1 cm) white pumices present

17DF10	<i>Trr</i>	38°04'50"	107°00'05"	Cathedral Creek
17DF08	<i>Trr</i>	38°04'50"	107°00'05"	Cathedral Creek
17DF06	<i>Trr</i>	38°03'47"	107°04'30"	Powderhorn Park
17DF15	<i>Trr</i>	38°07'44"	106°56'22"	Los Pinos Creek
17DF01	<i>Trr</i>	37°52'43"	106°47'07"	Wheeler Monument
17DF21	<i>Trr</i>	37°51'17"	107°05'48"	Point Bennett

*Rat Creek Pumice\**

17DF18	<i>Trrg</i>	38°4'44"	106°56'22"	Los Pinos Creek	Mingled pumice from Los Pinos Creek, brownish and whitish bands
15SJ14	<i>Trrg</i>	38°4'44"	106°56'22"	Los Pinos Creek	Mingled pumice from Los Pinos Creek, mixed brownish and whitish pumices together
17DF20-1	<i>Trrf</i>	38°4'44"	106°56'22"	Los Pinos Creek	White pumices in various size from RCTR; crystal-poor (predominantly plag)
17DF20-2	<i>Trrf</i>	38°4'44"	106°56'22"	Los Pinos Creek	White pumices in various size from RCTR; crystal-poor (predominantly plag)
17DF20-3	<i>Trrf</i>	38°4'44"	106°56'22"	Los Pinos Creek	White pumices in various size from RCTR; crystal-poor (predominantly plag)
17DF19-1	<i>Trrm</i>	38°4'44"	106°56'22"	Los Pinos Creek	Dark pumices in various size from RCTR; crystal-poor (predominantly plag)
17DF19-2	<i>Trrm</i>	38°4'44"	106°56'22"	Los Pinos Creek	Dark pumices in various size from RCTR; crystal-poor (predominantly plag)
17DF19-3	<i>Trrm</i>	38°4'44"	106°56'22"	Los Pinos Creek	Dark pumices in various size from RCTR; crystal-poor (predominantly plag)

Table S3: LA-ICP-MS analytical parameters for trace element and U-Pb dating

<b>Laboratory &amp; Sample Preparation</b>	
Laboratory name	Dept. of Earth Science, ETH Zurich
Sample type/mineral	Zircon; silicate minerals
Sample preparation	Conventional mineral separation, 1-in resin mount, 1 µm polish
<b>Laser ablation system</b>	
Make, model & type	ASI Resolution
Ablation cell & volume	Laurin Technic 155, constant geometry, aerosol dispersion volume < 1 cm <sup>3</sup>
Laser wavelength	193 nm
Pulse width	25 ns
Energy density / Fluence	2.5-3.5 J cm <sup>-2</sup>
Repetition rate	5 Hz
Spot size	29 µm
Ablation rate	~75 nm pulse <sup>-1</sup>
Sampling mode / pattern	Single hole drilling, 3 cleaning pulses
Carrier gas and flow	100% He, 0.7 l/min
Ablation duration	40 s
<b>ICP-MS Instrument</b>	
Make, model & type	Thermo Element XR SF-ICP-MS
Sample introduction	Ablation aerosol only, squid-like aerosol homogenization device
RF power	1550 W
Make-up gas flow	~0.95 L/min Ar (gas mixed to He carrier inside ablation cell funnel)
Detection system	Single detector triple mode SEM, analogue, Faraday
Masses measured (U-Pb)	202, 204, 206, 207, 208, 232, 235, 238 amu
Integration time per peak (mass)	10 ms (202, 204, 208, 232, 235), 20 ms (238), 75 ms (206, 207);
Integration time per reading	0.25 s
Dead time	20 ns
Typical oxide rate (ThO/Th)	0.18%
Typical (++) rate (Ba <sup>++</sup> /Ba <sup>+</sup> )	3.50%
<b>Data Processing</b>	
Gas blank	30 s prior to each ablation spot
Calibration strategy	GJ-1 (U-Pb) and NIST612 (TE) used as calibration ref. materials; bracketing 2 per 20 samples
Reference material information	601.86 ± 0.37 Ma; U = 312 and Th = 10.8 ppm; Horstwood et al., 2016
Data processing package used	Iolite v2.5 using VizualAge
Mass discrimination	Mass bias correction for all ratios normalized to calibration reference material
Uncertainty level & propagation	Ages are quoted at 2s absolute. Propagation is by quadratic addition.
Validation reference materials	GSD-1G (TE); Temora2, 91500, Plesovice, OD-3 (U-Pb)