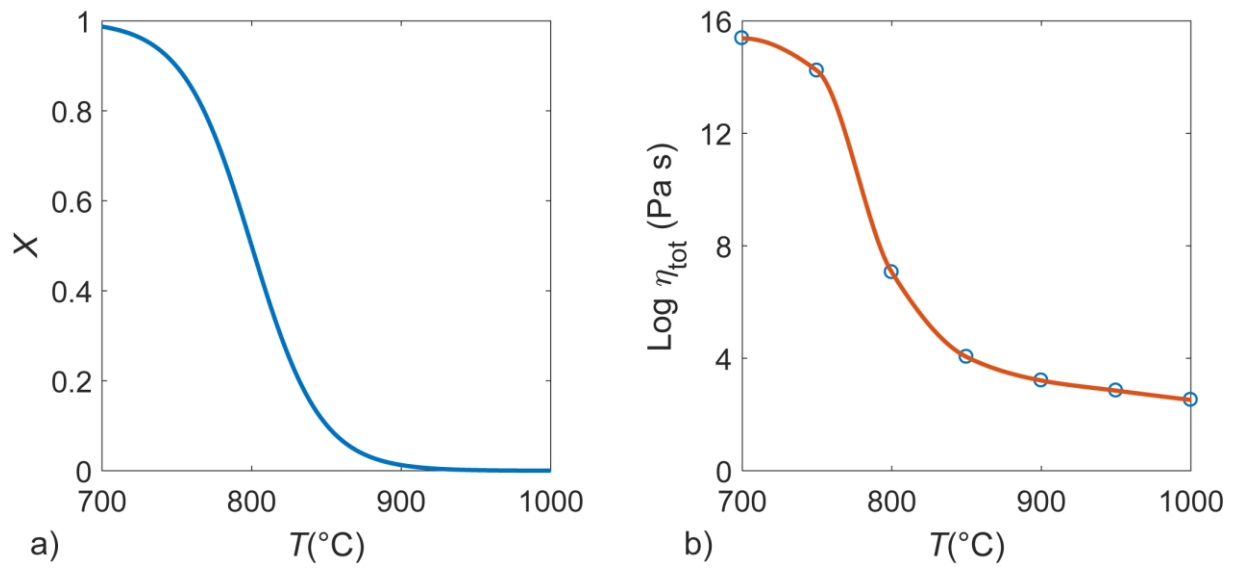


Caldera	CO₂ (ton yr⁻¹)x10⁴
Yellowstone (U.S.A.)²	985.50
Campi Flegrei (Italy)³	54.75
Ischia (Italy)⁴	45
Rotorua (New Zeland) ⁵	36.5
Pantelleria (Italy)⁶	32
Siwi (Tanna Island)⁷	30.66
Fournas (Portugal, Azzorre) ⁸	26.79
Sierra Negra (Ecuador, Galapagos)⁹	22.08
Iwojima (Japan)¹⁰	16.43
Latera (Italy) ¹¹	12.78
Pululahua (Ecuador) ^{*12}	9.86
Miyakeijima, (Japan) ¹³	4.73
Usu (Japan) ¹⁴	4.38
Cuicocha (Ecuador) ^{*12}	3.87
Nisyros (Greece) ^{*15}	3.07
Hakkoda (Japan) ^{*16}	2.70
Satsuma-Iwojima (Japan) ¹⁷	0.73

Supplementary Table 1 – Magmatic contribution of CO₂ soil degassing at several semi-plugged (or degassing¹) calderas (resurgent calderas in bold); * = no distinction between magmatic and biogenic contribution of CO₂. In all the cited studies the magmatic component of the diffused CO₂ has been related to the crystallization of new magma input.

Model	<i>p</i> (m)	<i>D</i> (m)	<i>d</i> (m)	η_{sil} (Pa s)	ρ_s (kg m⁻³)	<i>T</i> (°C)	$\rho_{o.v.}$ (kg m⁻³)	$\eta_{o.v.}$ (Pa s)	<i>v</i> (m s⁻¹)	<i>t</i> (s)
RIS 0	0.04	-	-	-	1400	50	907.8	1.87×10 ⁻²	1.5	290
RIS 1	0.03	-	-	-	1400	50	907.8	1.87×10 ⁻²	1.5	60
RIS 2	0.03	0.17	0.015	10 ⁴	1400	50	907.8	1.87×10 ⁻²	1.19	180
RIS 4	0.03	0.12	0.015	10 ⁴	1400	50	907.8	1.87×10 ⁻²	1.19	225
RIS 5	0.03	0.06	0.015	10 ⁴	1400	50	907.8	1.87×10 ⁻²	1.19	50
RIS 7	0.03	0.06	0.015	10 ⁴	1400	36.4	936.8	3.08×10 ⁻²	1.19	65
RIS 9	0.07	0.08	0.06	10 ⁴	1400	38	931	2.90×10 ⁻²	0.88	248

Supplementary Table 2 – Analogue experiments and related tested parameters. *P* = depth of the nozzle; *D* = diameter of silicone layer; *d* = depth of silicone level; η_{sil} = viscosity of silicone; ρ_s = density of silicone; *T* = temperature of vegetable oil; $\rho_{o.v.}$ = density of vegetable oil; $\eta_{o.v.}$ = viscosity of vegetable oil; *v* = injection velocity of vegetable oil; *t* = duration of experiment.



Supplementary Figure 1 – Thermal models. a) Crystal fraction (X) as a function of temperature (T). b) Variation of the total viscosity (η_{tot}) with temperature (T).

T ($^{\circ}\text{C}$)	X	$\text{Log } \eta_m$ (GRD) (Pa s)	$\text{Log } \eta_r$ (Pa s)	$\text{Log } \eta_{\text{tot}}$ (Pa s)
1000	0	2.52	0	2.52
950	0	2.85	0	2.85
900	0.01	3.20	0.01	3.21
850	0.10	3.92	0.13	4.05
800	0.50	4.71	2.35	7.06
750	0.90	5.43	8.80	14.23
700	0.99	5.96	9.42	15.38

Supplementary Table 3 - Thermal models. T = temperature of the melt (in $^{\circ}\text{C}$); X = crystal fraction of the magma; η_m = viscosity of the melt obtained with the GRD model³¹; η_r = relative viscosity obtained with a previous model²⁹; η_{tot} = total viscosity.

	Experiments	Nature
$\Pi_1 = (\rho_s gD)/c$	7.8-2.7	13- 4
$\Pi_2 = d/D$	$(1.3-7.5) \times 10^{-1}$	$(1.9-3.8) \times 10^{-1}$
$\Pi_3 = d/p$	$(5-8.6) \times 10^{-1}$	5×10^{-1}
$\Pi_4 = p/D$	$(2.5-8.8) \times 10^{-1}$	$(3.8-8.8) \times 10^{-1}$
$\Pi_5 = \rho_{o.v.}/\rho_s$	$(6.3-6.7) \times 10^{-1}$	8.5×10^{-1}
$\Pi_6 = \eta_{o.v.}/\eta_{sil}$	$(1.87-3.08) \times 10^{-6}$	$(1-3) \times 10^{-6}$
$\Pi_7 = (vt)/D$	$(1.3-3.5) \times 10^3$	$(5.6-9.2) \times 10^3$
$\Pi_8 = (\rho_{o.v.} p^2)/(\eta_{o.v} t)$	$(1.9-6.7) \times 10^{-1}$	$(1.5-4.5) \times 10^{-3}$

Supplementary Table 4 – Analogue experiments. The eight dimensionless parameters in experiments and nature

Supplementary References

1. Acocella, V., Di Lorenzo, R., Newhall, C. & Scandone, R. An overview of recent (1988 to 2014) caldera unrest: Knowledge and perspectives. *Rev. Geophys.* **53**, doi:10.1002/ 2015RG000492. (2015)
2. Werner, C. & Brantley, S. CO₂ Emissions from the Yellowstone volcanic system. *Geochem. Geophys. Geosyst.* **4**, 1061 doi:10.1029/2002GC000473 (2003)
3. Chiodini, G. *et al.* Evidence of thermal-driven processes triggering the 2005–2014 unrest at Campi Flegrei caldera. *Earth Planet. Sci. Lett.* **414**, 58-67 (2015)
4. Di Napoli, R. *et al.* A model for Ischia hydrothermal system: evidences from the chemistry of thermal groundwaters. *J. Volcanol. Geotherm. Res.* **186**, 133-159 (2009).
5. Werner, C. & Cardellini, C. Comparison of carbon dioxide emissions with fluid upflow, chemistry, and geologic structures at the Rotorua geothermal system, New Zealand. *Geothermics* **35**, 221-238 (2006).
6. Favara, R., Giammanco, S., Inguaggiato, S. & Pecoraino, G. Preliminary estimate of CO₂ Output from Pantelleria Island volcano (Sicily, Italy): evidence of active mantle degassing. *Appl. Geochem.* **16**, 883 – 894 (2001)
7. Métrich, N. *et al.* Magma and volatile supply to post-collapse volcanism and block resurgence in Siwi Caldera (Tanna Island, Vanuatu arc). *J. Petrol.* **52**, 1077-1105 (2011)
8. Viveiros, F. *et al.* CO₂ Emissions at Furnas volcano, São Miguel Island, Azores archipelago: Volcano monitoring perspectives, geomorphologic studies, and land use planning application. *J. Geophys. Res.* **115**, B12208, doi:10.1029/2010JB007555 (2010)
9. Padrón, E. *et al.* Fumarole/plume and diffuse CO₂ emission from Sierra Negra caldera, Galapagos archipelago. *Bull. Volcanol.* **74**, 1509–1519 (2012)
10. Notsu, K., *et al.* Diffuse CO₂ efflux from Iwojima volcano, Izu-Ogasawara arc, Japan. *J. Volcanol. Geotherm. Res.* **139**, 147–161 (2005)
11. Chiodini, G. *et al.* Carbon dioxide degassing at Lateral caldera (Italy): evidence of geothermal reservoir and evaluation of its potential energy. *J. Geophys. Res.* **112**, B12204 doi:10.1029/2006JB004896 (2007)

12. Padrón, E. *et al.* Diffuse CO₂ emission rate from Pululahua and the lake-filled Cuicocha calderas, Ecuador. *J. Volcanol. Geotherm. Res.* **176**, 163-169 (2008)
13. Hernández, P.A., *et al.* Diffuse emission of CO₂ from Miyakejima volcano, Japan. *Chem. Geol.* **177**, 175-185 (2001)
14. Hernández, P.A. *et al.* Carbon dioxide degassing by advective flow from Usu volcano, Japan. *Science* **292**, 83-86 (2001)
15. Cardellini, C., Chiodini, G. & Frondini, F. Application of stochastic simulation to CO₂ flux from soil: mapping and quantification of gas release. *J. Geophys. Res.: Solid Earth* **108**, 2425 doi:10.1029/2002JB002165 (2003)
16. Hernandez, P.A. *et al.* Carbon dioxide emissions from soils at Hakkoda, north Japan. *J. Geophys. Res.* **108**, 2210, doi:10.1029/2002JB001847 (2003)
17. Shimoike, Y., Kazahaya, K. & Shinohara, H. Soil gas emission of volcanic CO₂ at Satsuma-Iwojima volcano, Japan. *Earth Planets Space* **54**, 239-247 (2002)