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Data Article

Porosity, bulk density and $CaCO_3$ content of travertines. A new dataset from Rapolano, Canino and Tivoli travertines (Italy)

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ABSTRACT

The dataset presented in this article is used in the Quaternary Science Review research article "Evaluating the geogenic CO_2 flux from geothermal areas by analysing Quaternary travertine masses. New data from western Central Italy and review of previous CO_2 flux data" [1]. The present data article reports the physical properties and new compositional data of 86 travertine samples from Rapolano, Canino and Tivoli travertine deposits (Italy). The dataset include the following parameters: mass, volume, porosity, bulk density, $CaCO_3$ content and insoluble fraction. The dataset is integrated with the photographic documentation of the sampling areas, the location and the stratigraphic position of each sample.

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Specifications table

Subject area	*Earth Science*
More specific subject area	*Surface processes*
Type of data	*Table, Figure*
How data was acquired	*Collecting of samples in stratigraphic sections measured in Rapolano, Canino and Tivoli. Dissolution experiments*
Data format	*Raw and analyzed*
Experimental factors	*Sampling, cutting sampled rocks to 10–20 cm^3 specimens, rinsing and drying specimens.*
Experimental features	*Weighting the specimens with a high precision balance; measurement of their volume by water displacement; computation of bulk density and porosity; dissolution experiments for the determination of the $CaCO_3$ content and the insoluble fraction.*
Data source location	*Department of Physics and Geology, Perugia University. Via Pascoli sn.c. 06123 Perugia, Italy.*
Data accessibility	*Data is included with this article*
Related research article	*Mancini, A., Frondini, F., Capezzuoli, E., Galvez Mejia, E., Lezzi, G., Matarazzi, D., Brogi, A., Swennen, R., 2019. Evaluating the geogenic CO_2 flux from geothermal areas by analysing Quaternary travertine masses. New data from western Central Italy and review of previous CO_2 flux data. Quaternary Science Review "in press"* [1].

Value of the data

- The data available from this document include new compositional ($CaCO_3$ fraction and insoluble residue), porosity and density data of 86 travertine samples from three large travertine deposits (Rapolano, Canino and Tivoli) located in the geothermal region of western central Italy.
- The data, together with radiometric data, can be used for the evaluation of the geogenic CO_2 flux from geothermal areas [1].
- The porosity and compositional data can be used for comparative studies on continental carbonates.
- The dataset is useful to infer the tectonic-sedimentary evolution of the Rapolano, Canino and Tivoli geothermal basins in the last 250.000 years.

1. Data

The dataset contains compositional, porosity and bulk density data of Quaternary travertines from Rapolano, Canino and Tivoli (Italy). Travertines were sampled during spring 2016 (Canino), spring 2017 (Tivoli) and winter 2018 (Rapolano). The location of the three travertine basins is shown in Fig. 1.

In order to sample the largest possible time intervals, samples weighing a few kilograms each were collected from 8 sections: five sections in Rapolano, with ages from 157 ± 15 Ka to present [2]; two sections in Canino (ages from 209 ± 28 Ka to present [3]) and one section in Tivoli (ages from 115 ± 8 Ka to 28 ± 16 Ka [4]).

Fig. 2 show the location of the sampled sections and the stratigraphic positon of each sample. Geographic coordinates and elevation data of the sampled sections are reported in Table 1.

The results obtained by the dissolution experiments and characterizing the 86 travertine samples analyzed (ID) in the different study area (System and Section) are reported in Table 2.

2. Experimental design, materials, and methods

In the laboratory, the samples were cut to specimens of about 10–20 cm^3, rinsed with ultrapure water, dried at 120 °C and weighted with a high precision balance (precision 0.001 g). The bulk volume of each specimen was determined by water displacement after coating the rock surface with paraffin. The bulk density was computed from the weight/volume (W/V) ratio and the sample porosity has been computed from

$$p = 1 - (\rho_b/\rho_p) \quad (1)$$

Fig. 1. Location of the sampled travertine outcrops.

Where ρ_b is the bulk density and ρ_p is the particle density (assumed to be 2.7 g cm^{-3}, that is the density of calcite).

In order to compute the $CaCO_3$ fraction a known amount (some grams) of each sample was dissolved in a 5 M HCl solution. Each solution was filtered with a cellulose acetate 0.45 μm membrane filters and the insoluble residue dried and weighted. The carbonate fraction of each travertine was calculated as follows:

$$f\ CaCO_3 = (W_i - W_r)/W_i \quad (2)$$

Where W_i is the initial weight and W_r the weight of the insoluble fraction, after subtraction of the cellulose acetate filter weight (0.073 ± 0.002 g).

All the data are reported in Table 2.

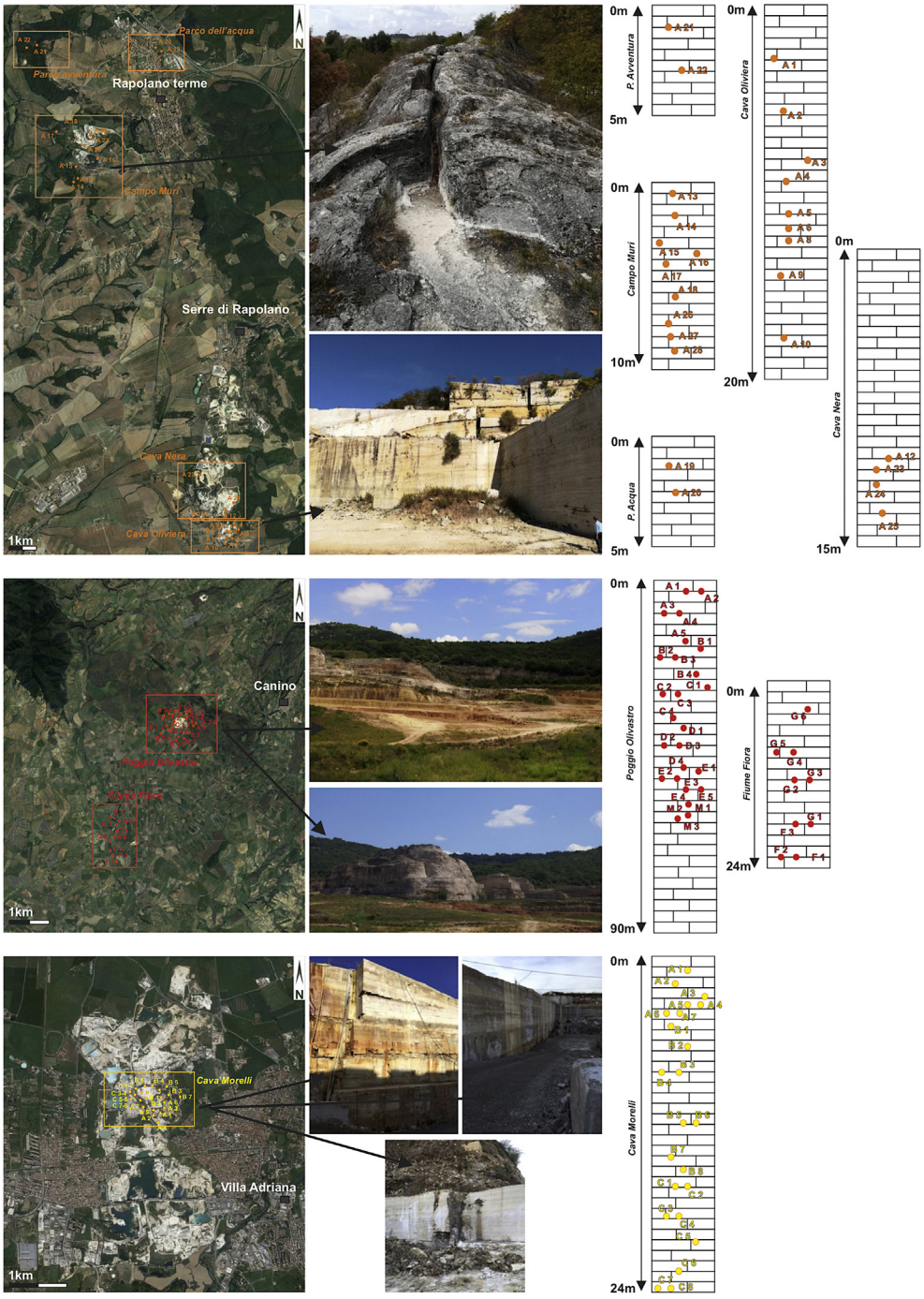

Fig. 2. Aerial views [5], photographic documentation and stratigraphic columns of sampled sections.

Table 1
Geographic coordinates and elevation of sampled section. Elevation data refer to the bottom of each section.

Basin	section	LAT	LONG	elevation m.as.l.
Rapolano	Cava Oliviera	43°14′23.3″N	11°36′34.3″E	280
Rapolano	Cava Nera	43°14′02.9″N	11°36′43.2″E	272
Rapolano	Campo Muri	43°16′58.7″N	11°35′28.6″E	230
Rapolano	Parco dell'Acqua	43°17′36.8″N	11°34′55.8″E	234
Rapolano	Parco Avventura	43°17′36.0″N	11°36′16.2″E	300
Canino	Poggio Olivastro	42°27′34.0″N	11°40′58.1″	147
Canino	Fiume Fiora	42°25′41.8″N	11°37′56.2″	60
Tivoli	Cava Morelli	41°58′00.4″N	12°44′26.6″	41

Table 2
Mass, volume of travertine specimens and results of dissolution experiments.

System	Section	ID	W_i g	V cm^3	ρ_b g/cm^3	W_r g	$CaCO_3$ g	Porosity fraction	Porosity %	$CaCO_3$ %	$CaCO_3$ fraction
Canino	Poggio Olivastro A	A-1	16.260	8.00	2.03	0.08	16.18	0.25	24.72	99.53	0.995
Canino	Poggio Olivastro A	A-2	26.870	12.80	2.10	0.25	26.62	0.22	22.25	99.08	0.991
Canino	Poggio Olivastro A	A-3	15.930	7.50	2.12	0.06	15.87	0.21	21.33	99.64	0.996
Canino	Poggio Olivastro A	A-4	18.920	9.00	2.10	0.04	18.88	0.22	22.14	99.80	0.998
Canino	Poggio Olivastro A	A-5	19.250	9.00	2.14	0.02	19.23	0.21	20.78	99.91	0.999
Canino	Poggio Olivastro B	B-1	13.240	7.00	1.89	0.11	13.13	0.30	29.95	99.19	0.992
Canino	Poggio Olivastro B	B-2	18.020	8.00	2.25	0.29	17.73	0.17	16.57	98.41	0.984
Canino	Poggio Olivastro B	B-3	21.940	10.00	2.19	0.34	21.60	0.19	18.74	98.46	0.985
Canino	Poggio Olivastro B	B-4	15.690	7.00	2.24	0.10	15.59	0.17	16.98	99.38	0.994
Canino	Poggio Olivastro M	M-1	20.110	8.00	2.51	2.57	17.54	0.07	6.90	87.24	0.872
Canino	Poggio Olivastro M	M-2	18.480	7.00	2.64	0.17	18.31	0.02	2.22	99.10	0.991
Canino	Poggio Olivastro M	M-3	18.070	8.00	2.26	0.43	17.64	0.16	16.34	97.64	0.976
Canino	Poggio Olivastro C	C-1	18.820	9.00	2.09	0.04	18.78	0.23	22.55	99.80	0.998
Canino	Poggio Olivastro C	C-2	25.010	11.00	2.27	0.08	24.93	0.16	15.79	99.69	0.997
Canino	Poggio Olivastro C	C-3	25.500	11.00	2.32	0.54	24.96	0.14	14.14	97.89	0.979
Canino	Poggio Olivastro C	C-4	19.100	9.00	2.12	0.09	19.01	0.21	21.40	99.54	0.995
Canino	Poggio Olivastro D	D-1	33.180	13.50	2.46	0.23	32.95	0.09	8.97	99.32	0.993
Canino	Poggio Olivastro D	D-2	17.230	7.50	2.30	0.11	17.12	0.15	14.91	99.38	0.994
Canino	Poggio Olivastro D	D-3	22.200	10.00	2.22	0.20	22.00	0.18	17.78	99.11	0.991
Canino	Poggio Olivastro D	D-4	20.590	8.00	2.57	0.11	20.48	0.05	4.68	99.48	0.995
Canino	Poggio Olivastro E	E-1	25.150	10.00	2.52	0.10	25.05	0.07	6.85	99.61	0.996
Canino	Poggio Olivastro E	E-2	20.490	9.00	2.28	0.45	20.04	0.16	15.68	97.82	0.978
Canino	Poggio Olivastro E	E-3	26.500	12.00	2.21	0.26	26.24	0.18	18.21	99.03	0.990
Canino	Poggio Olivastro E	E-4	18.420	8.00	2.30	0.05	18.37	0.15	14.72	99.74	0.997
Canino	Poggio Olivastro E	E-5	20.110	9.00	2.23	0.02	20.09	0.17	17.24	99.92	0.999
Canino	Fiume Fiora F	F-1	16.610	7.50	2.21	0.89	15.72	0.18	17.98	94.66	0.947
Canino	Fiume Fiora F	F-2	21.920	10.00	2.19	1.68	20.24	0.19	18.81	92.35	0.923
Canino	Fiume Fiora F	F-3	20.840	9.00	2.32	2.68	18.16	0.14	14.24	87.15	0.872
Canino	Fiume Fiora G	G-1	17.880	8.00	2.24	2.05	15.83	0.17	17.22	88.55	0.886
Canino	Fiume Fiora G	G-2	20.420	8.50	2.40	0.70	19.72	0.11	11.02	96.59	0.966
Canino	Fiume Fiora G	G-3	34.320	14.00	2.45	1.28	33.04	0.09	9.21	96.28	0.963
Canino	Fiume Fiora G	G-4	26.580	12.00	2.22	3.27	23.31	0.18	17.96	87.71	0.877
Canino	Fiume Fiora G	G-5	21.680	9.00	2.41	2.03	19.65	0.11	10.78	90.65	0.907
Canino	Fiume Fiora G	G-6	28.230	12.00	2.35	1.98	26.25	0.13	12.87	93.00	0.930
Rapolano	Cava Oliviera	A1	34.266	13.50	2.54	0.63	33.64	0.06	5.99	98.17	0.982
Rapolano	Cava Oliviera	A2	28.911	15.00	1.93	0.80	28.11	0.29	28.61	97.23	0.972
Rapolano	Cava Oliviera	A3	26.749	10.50	2.55	0.16	26.59	0.06	5.65	99.42	0.994
Rapolano	Cava Oliviera	A4	31.028	12.50	2.48	0.09	30.94	0.08	8.07	99.72	0.997
Rapolano	Cava Oliviera	A5	29.538	11.50	2.57	0.09	29.45	0.05	4.87	99.71	0.997
Rapolano	Cava Oliviera	A6	23.396	9.50	2.46	2.25	21.15	0.09	8.79	90.39	0.904
Rapolano	Cava Oliviera	A8	36.459	15.50	2.35	2.07	34.39	0.13	12.88	94.33	0.943
Rapolano	Cava Oliviera	A9	31.731	12.50	2.54	0.58	31.15	0.06	5.98	98.16	0.982
Rapolano	Cava Oliviera	A10	33.103	16.50	2.01	0.43	32.68	0.26	25.69	98.71	0.987
Rapolano	Cava Nera	A12	24.665	9.50	2.60	0.63	24.04	0.04	3.84	97.45	0.974

(*continued on next page*)

Table 2 (*continued*)

System	Section	ID	W_i g	V cm^3	ρ_b g/cm^3	W_r g	$CaCO_3$ g	Porosity fraction	Porosity %	$CaCO_3$ %	$CaCO_3$ fraction
Rapolano	Campo Muri	A13	20.355	8.50	2.39	0.19	20.17	0.11	11.31	99.09	0.991
Rapolano	Campo Muri	A14	36.914	15.50	2.38	1.08	35.84	0.12	11.79	97.09	0.971
Rapolano	Campo Muri	A15	22.336	10.00	2.23	0.26	22.08	0.17	17.27	98.86	0.989
Rapolano	Campo Muri	A16	20.474	9.00	2.27	0.15	20.33	0.16	15.74	99.29	0.993
Rapolano	Campo Muri	A17	14.037	7.50	1.87	0.12	13.92	0.31	30.68	99.16	0.992
Rapolano	Campo Muri	A18	22.044	10.50	2.10	0.92	21.13	0.22	22.24	95.85	0.958
Rapolano	Parco dell'Acqua	A19	23.482	9.50	2.47	1.23	22.25	0.08	8.45	94.76	0.948
Rapolano	Parco dell'Acqua	A20	36.606	14.50	2.52	0.56	36.05	0.06	6.50	98.48	0.985
Rapolano	Parco Avventura	A21	32.006	12.50	2.56	0.20	31.81	0.05	5.17	99.39	0.994
Rapolano	Parco Avventura	A22	30.273	12.50	2.42	1.59	28.68	0.10	10.30	94.75	0.948
Rapolano	Cava Dei	A23	28.426	11.50	2.47	0.95	27.48	0.08	8.45	96.68	0.967
Rapolano	Cava Nera	A24	31.896	12.50	2.55	0.17	31.73	0.05	5.49	99.48	0.995
Rapolano	Cava Nera	A25	29.407	11.50	2.56	0.49	28.92	0.05	5.29	98.34	0.983
Rapolano	Campo Muri	A26a	43.385	17.50	2.48	1.78	41.61	0.08	8.18	95.91	0.959
Rapolano	Campo Muri	A26b	27.226	11.00	2.48	0.76	26.46	0.08	8.33	97.20	0.972
Rapolano	Campo Muri	A27a	19.947	8.00	2.49	0.06	19.89	0.08	7.65	99.71	0.997
Rapolano	Campo Muri	A27b	16.581	7.00	2.37	0.55	16.04	0.12	12.27	96.71	0.967
Rapolano	Campo Muri	A28a	29.378	12.00	2.45	0.06	29.32	0.09	9.33	99.79	0.998
Rapolano	Campo Muri	A28b	31.950	14.00	2.28	0.08	31.87	0.15	15.48	99.75	0.997
Tivoli	Cava Morelli 3° banco	A1	23.196	9.50	2.44	0.16	23.03	0.10	9.57	99.29	0.993
Tivoli	Cava Morelli 3° banco	A2	23.170	9.50	2.44	0.14	23.03	0.10	9.67	99.40	0.994
Tivoli	Cava Morelli 3° banco	A3	19.637	8.00	2.45	0.01	19.63	0.09	9.09	99.94	0.999
Tivoli	Cava Morelli 3° banco	A4	22.424	8.50	2.64	0.23	22.19	0.02	2.29	98.96	0.990
Tivoli	Cava Morelli 3° banco	A5	31.384	12.50	2.51	0.03	31.36	0.07	7.01	99.91	0.999
Tivoli	Cava Morelli 3° banco	A6	25.324	10.50	2.41	0.05	25.28	0.11	10.67	99.81	0.998
Tivoli	Cava Morelli 3° banco	A7	25.515	10.50	2.43	0.02	25.49	0.10	10.00	99.91	0.999
Tivoli	Cava Morelli 2° banco	B1	24.749	10.50	2.36	2.40	22.35	0.13	12.70	90.30	0.903
Tivoli	Cava Morelli 2° banco	B2	24.326	9.50	2.56	0.03	24.30	0.05	5.16	99.88	0.999
Tivoli	Cava Morelli 2° banco	B3	27.541	10.50	2.62	3.96	23.59	0.03	2.85	85.64	0.856
Tivoli	Cava Morelli 2° banco	B4	26.924	10.50	2.56	0.37	26.55	0.05	5.03	98.61	0.986
Tivoli	Cava Morelli 2° banco	B5	24.490	9.50	2.58	0.60	23.89	0.05	4.52	97.56	0.976
Tivoli	Cava Morelli 2° banco	B6	21.375	9.50	2.25	0.04	21.33	0.17	16.67	99.80	0.998
Tivoli	Cava Morelli 2° banco	B7	31.068	13.00	2.39	1.52	29.55	0.11	11.49	95.10	0.951
Tivoli	Cava Morelli 2° banco	B8	25.447	10.50	2.42	0.17	25.28	0.10	10.24	99.32	0.993
Tivoli	Cava Morelli 1° banco	C1	26.529	11.00	2.41	0.24	26.29	0.11	10.68	99.11	0.991
Tivoli	Cava Morelli 1° banco	C2	23.329	9.50	2.46	0.09	23.24	0.09	9.05	99.60	0.996
Tivoli	Cava Morelli 1° banco	C3	27.397	11.00	2.49	0.11	27.29	0.08	7.75	99.60	0.996
Tivoli	Cava Morelli 1° banco	C4	29.619	11.00	2.69	1.06	28.56	0.00	0.27	96.43	0.964
Tivoli	Cava Morelli 1° banco	C5	26.962	11.00	2.45	0.08	26.88	0.09	9.22	99.71	0.997
Tivoli	Cava Morelli 1° banco	C6	24.698	9.50	2.60	0.18	24.52	0.04	3.71	99.28	0.993
Tivoli	Cava Morelli 1° banco	C7	26.357	10.00	2.64	0.24	26.11	0.02	2.38	99.07	0.991
Tivoli	Cava Morelli 1° banco	C8	26.403	10.00	2.64	0.22	26.18	0.02	2.21	99.15	0.992

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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