LA METEORITE CAVEZZO:

ANALISI E CLASSIFICAZIONE

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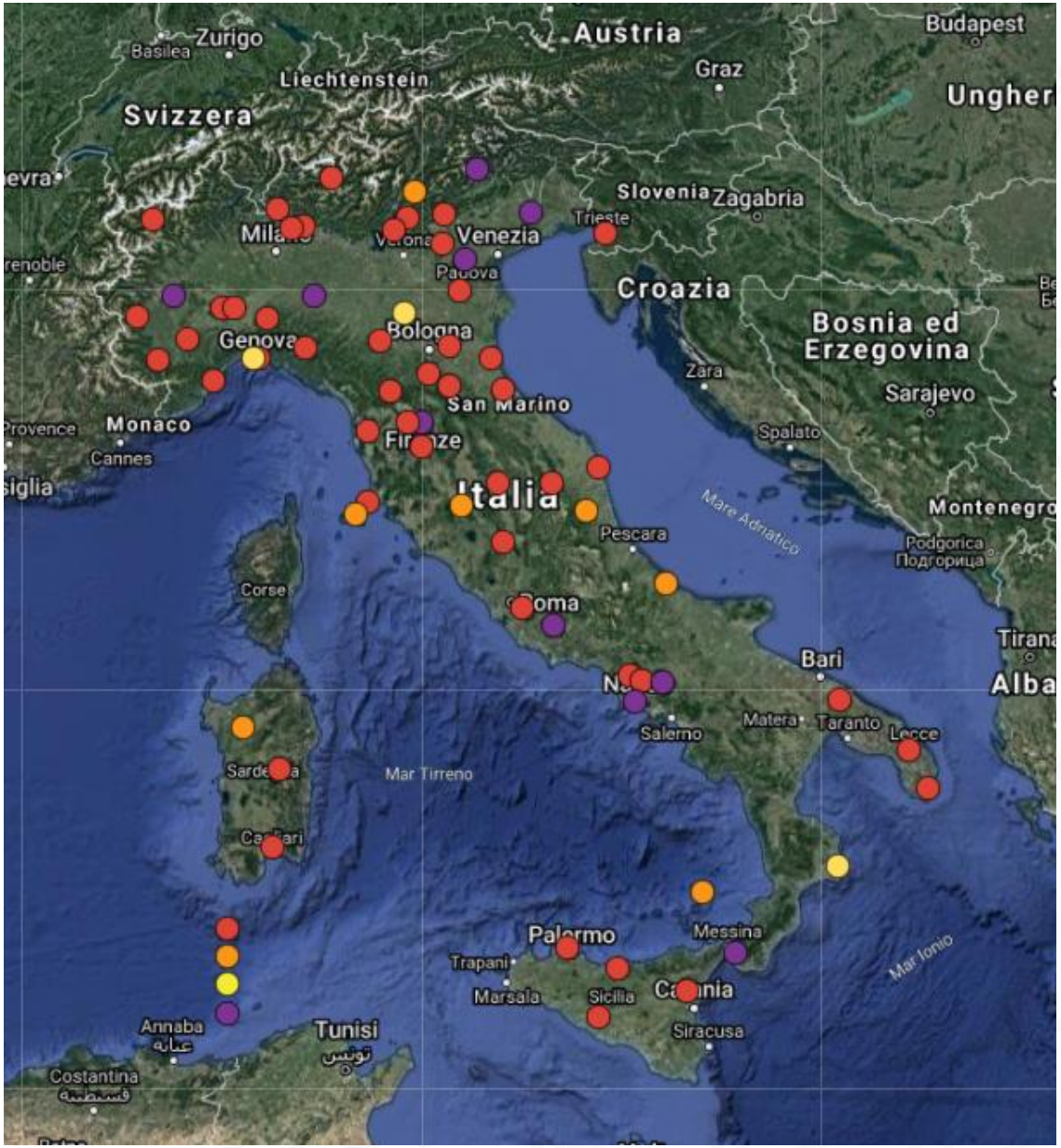
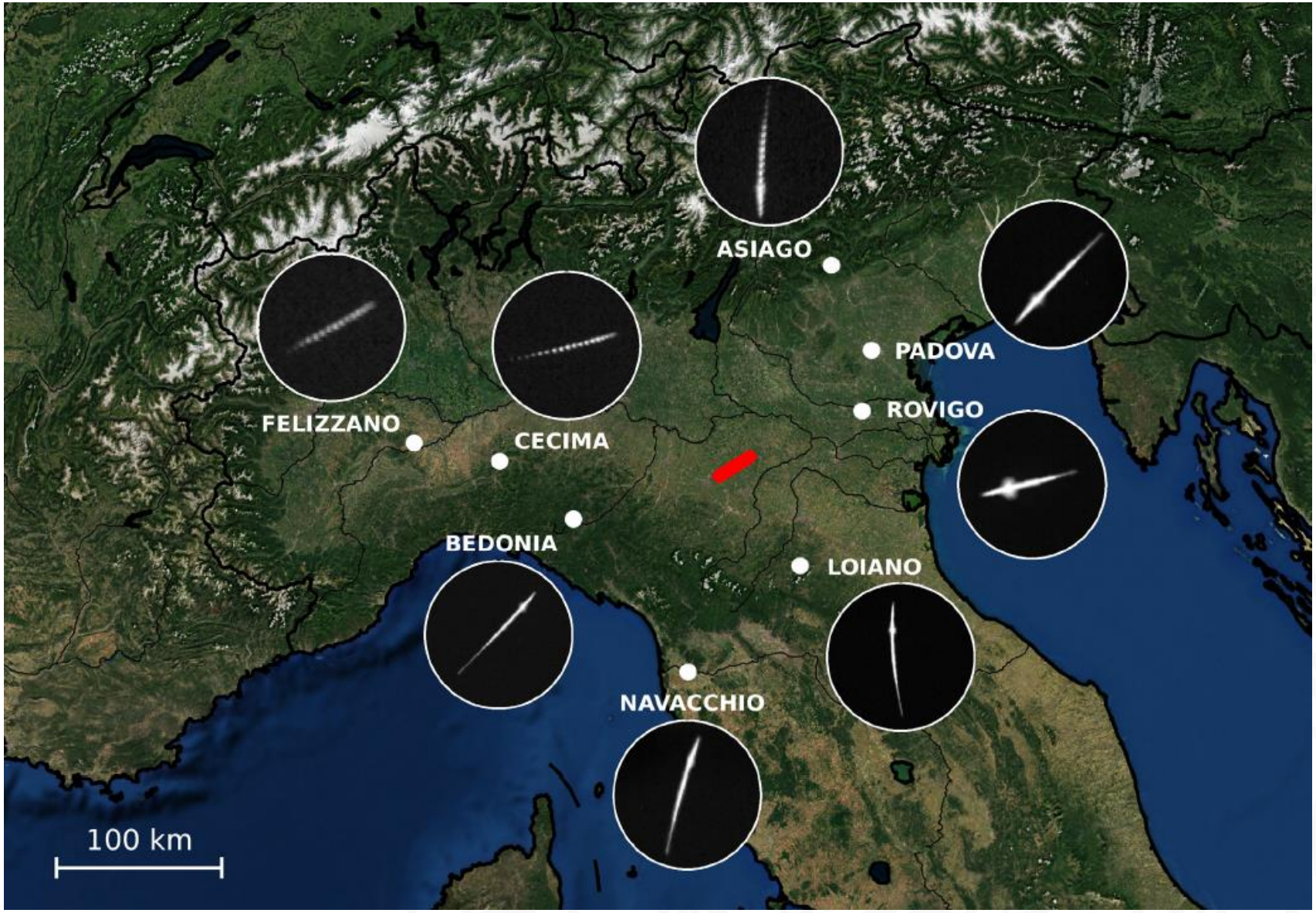
PRISMA network configuration



Map of the PRISMA stations (white dots) involved in the detection of the IT20200101 fireball



(Gardiol et al. 2021 MNRAS 501, 1215–1227)

The IT20200101 fireball

List and relevant data of ‘pedigree’ meteorites, i.e. for which recovery was accompanied by a sufficient set of sporadic or systematic observations

Name	Date UT	v_∞ (km s^{-1})	m_∞ (kg)	m_{fin} (kg)	TKW (kg)	M[a]	E (T)[b]	Fireball Network[c]	References
Příbram	07/04/1959	20.9	1300	80	5.6	−19	70	CFN	1, 2
Lost City	04/01/1970	14.1	165	25	17	−12	4	PFN	3, 4, 5
Innisfree	06/02/1977	14.7	42	4.9	4.58	−12.1	1	MORP	5, 6
Benešov	07/05/1991	21.3	4100	300[d]	0.0116	−19.5	200	EFN	5, 7, 8, 9
Peekskill	09/10/1992	14.7	5000	–	12.4	−16	130	–	2, 10
Tagish Lake	18/01/2000	15.8	56000	1300	10	−22	1700	–	11, 12, 13
Morávka	06/05/2000	22.5	1500	100	1.4	−20	90	–	14, 15, 2
Neuschwanstein	06/04/2002	20.9	300	20	6.22	−17.2	16	EFN	16, 17, 18
Park Forest	27/03/2003	19.5	11000	–	30	−21.7	500	–	19, 20
Villalbeto de la Peña	04/01/2004	16.9	600	13	5.2	−18	20	–	21, 22, 23
Bunburra Rockhole	20/07/2007	13.4	22	1.1	0.339	−9.6	0.5	DFN	24, 25
Almahata Sitta	07/10/2008	12.4	40000	39	10.7	−19.7	730	–	26, 27, 28, 29
Buzzard Coulee	21/11/2008	18.0	10000	–	>200	−20	390	–	30, 31, 32
Maribo	17/01/2009	28.3	2000	<20	0.0258	−20	190	–	33, 34
Jesenice	09/04/2009	13.8	170	20	3.611	−15	4	SFN	35, 36
Grimsby	26/09/2009	20.9	30	5	0.215	−14.8	2	SOMN	37
Košice	28/02/2010	15.0	3500	500	11.3	−18	100	–	38, 39
Mason Gully	13/04/2010	14.5	40	–	0.0245	−9.4	1	DFN	40, 41
Križevci	04/02/2011	18.2	50	<5[e]	0.291	−13.7	2	CMN	42
Sutter’s Mill	22/04/2012	28.6	40000	–	0.943	−19	4000	–	43
Novato	18/10/2012	13.7	80	–	0.363	−13.8	3	CAMS	44
Chelyabinsk	15/02/2013	19.0	$1.2\cdot 10^7$	10000	730	−27.3	$5\cdot 10^5$	–	45, 46, 47
Annama	18/04/2014	24.2	470	12.5	0.1679	−18.3	30	FFN	48, 49, 50
Žďár nad Sázavou	09/12/2014	21.9	150	>1.3[f]	0.087	−15.3	9	EFN	51
Porangaba	09/01/2015	–	–	–	0.970	–	–	–	52
Sariçiçek	02/09/2015	17.3	1700	–	24.78	−16.8	60	–	53
Creston	23/10/2015	16.0	50	–	0.8523	−12	2	CAMS, SACN	54
Murrili	27/11/2015	13.7	38	2	1.68	–	0.9	DFN	55, 56
Ejby	06/02/2016	14.5	120	–	8.982	−14.0	3	–	57, 58
Stubenberg	06/03/2016	14	600	–	1.473	−15.5	14	EFN	59, 60
Hradec Králové	17/05/2016	–	–	–	0.134	−11.5	–	EFN	61, 62
Dishchii’bikoh	02/06/2016	16.6	1000[g]	–	0.07957	−16	30	CAMS, SACN	63, 64
Dingle Dell	31/10/2016	15.4	40	1.4	1.150	–	1	DFN	65
Hamburg	17/01/2018	15.8	140	>1	~1	−16.3	5.5	–	66, 67
Renchen	10/07/2018	20	50[h]	–	1.227	−13.4	2	EFN	61, 68
Cavezzo	01/01/2020	12.8	3.5	1.5	0.0553	−9.5	0.07	PRISMA	This work

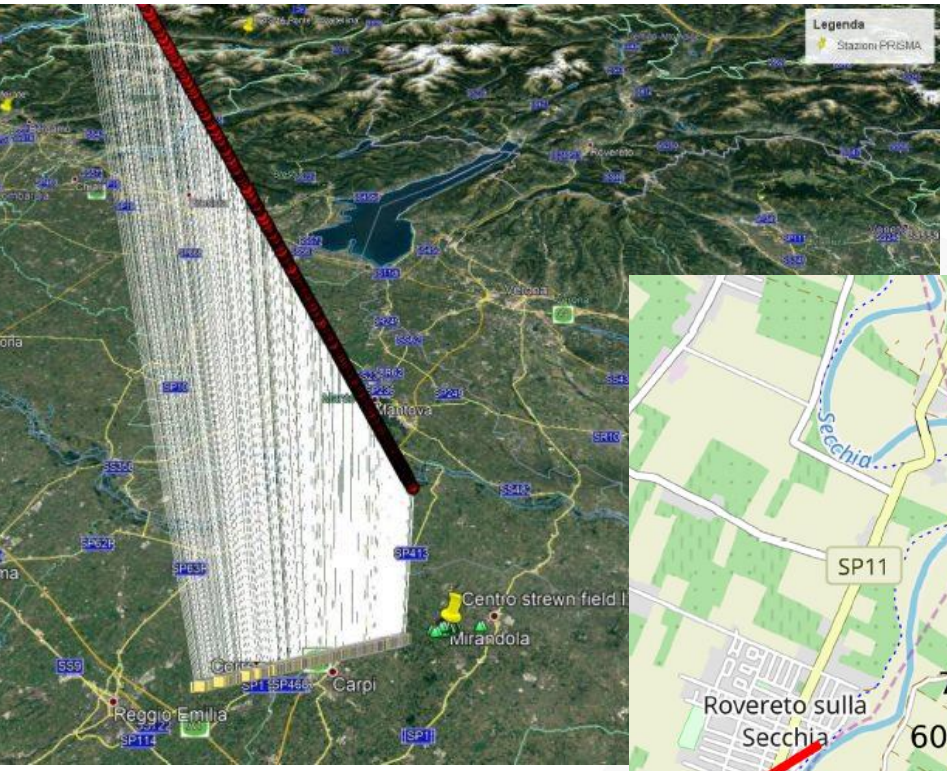
(Gardiol et al. 2021 MNRAS 501, 1215–1227)

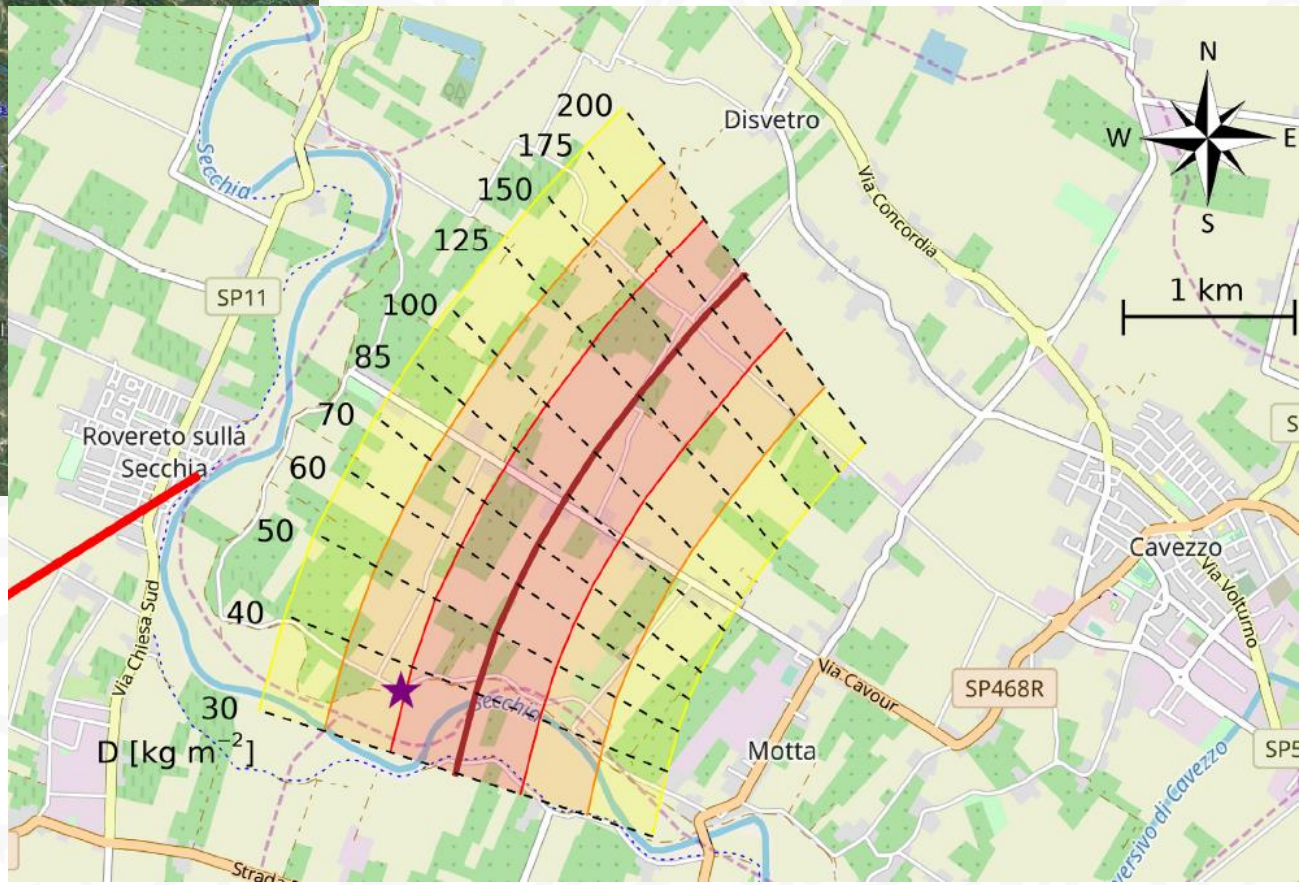
IT20200101 fireball (Cavezzo meteorite) parameters obtained from triangulation and dynamical model.

		Beginning	Terminal
Time (UT)	t	18:26:52.9	18:26:58.5
Height (km)	h	75.9 ± 0.2	21.5 ± 0.1
Latitude (N)	ϕ	$44°44'03'' \pm 7''$	$44°50'24'' \pm 7''$
Longitude (E)	λ	$10°43'09'' \pm 7''$	$10°57'25'' \pm 7''$
Velocity (km s^{-1})	v	12.2 ± 0.2	4.0 ± 0.2
Mass–section ratio (kg m^{-2})	D	280 ± 20	210 ± 20
Mass (kg)	m	3.5 ± 0.8	1.5 ± 0.4
Diameter (m)	d	0.13 ± 0.01	0.09 ± 0.01
Luminous path-length (km)	L	59	
Duration (s)	T	5.6	
Trajectory inclination (°)	T_i	68.4 ± 0.3	
Trajectory azimuth (°)	az	238.1 ± 0.2	
Min. absolute magnitude	M	-9.5 ± 0.5 @ 32.6 km	
Pre-atmospheric velocity (km s^{-1})	v_∞	12.8 ± 0.2	
Ablation coefficient (s^2 km^{-2})	σ	0.012 ± 0.003	
Max. dynamic pressure (MPa)	P_{max}	1.0 ± 0.3 @ 28.2 km	
Impact Energy (T TNT)	E	0.07 ± 0.02	

(Gardiol et al. 2021 MNRAS 501, 1215–1227)

Strewn-field for the Cavezzo meteorite fragments





(Gardiol et al. 2021 MNRAS 501, 1215–1227)

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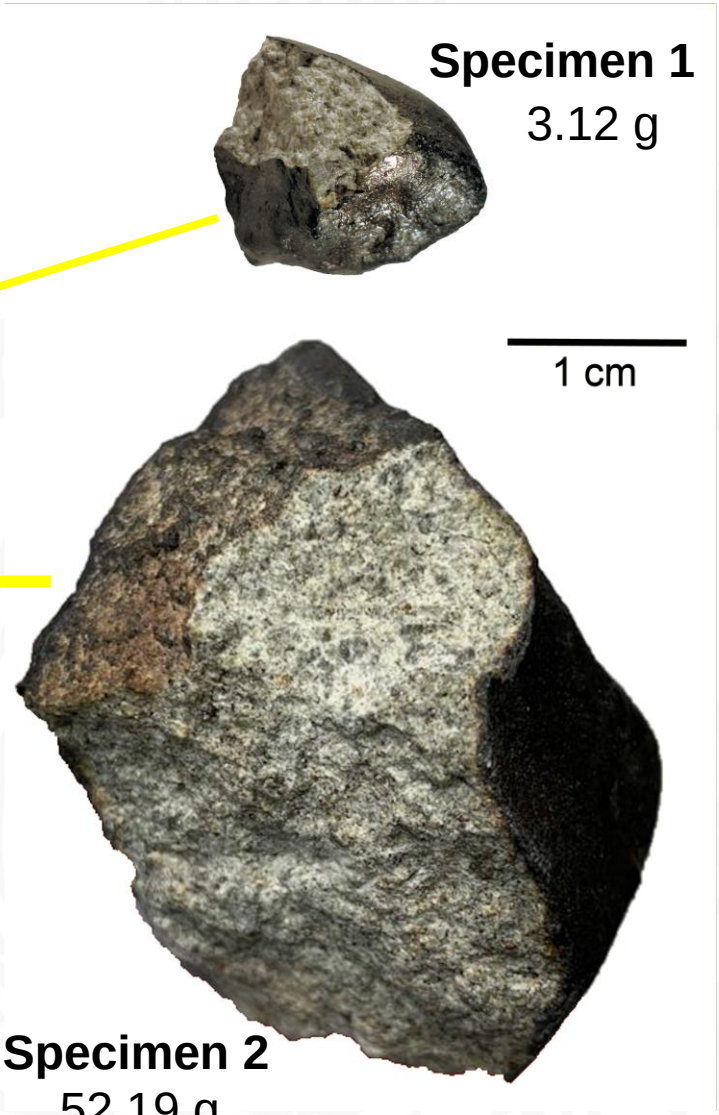
Locations where the two Cavezzo meteorite specimens were found



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PRISMA

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Cavezzo: a genuine fall

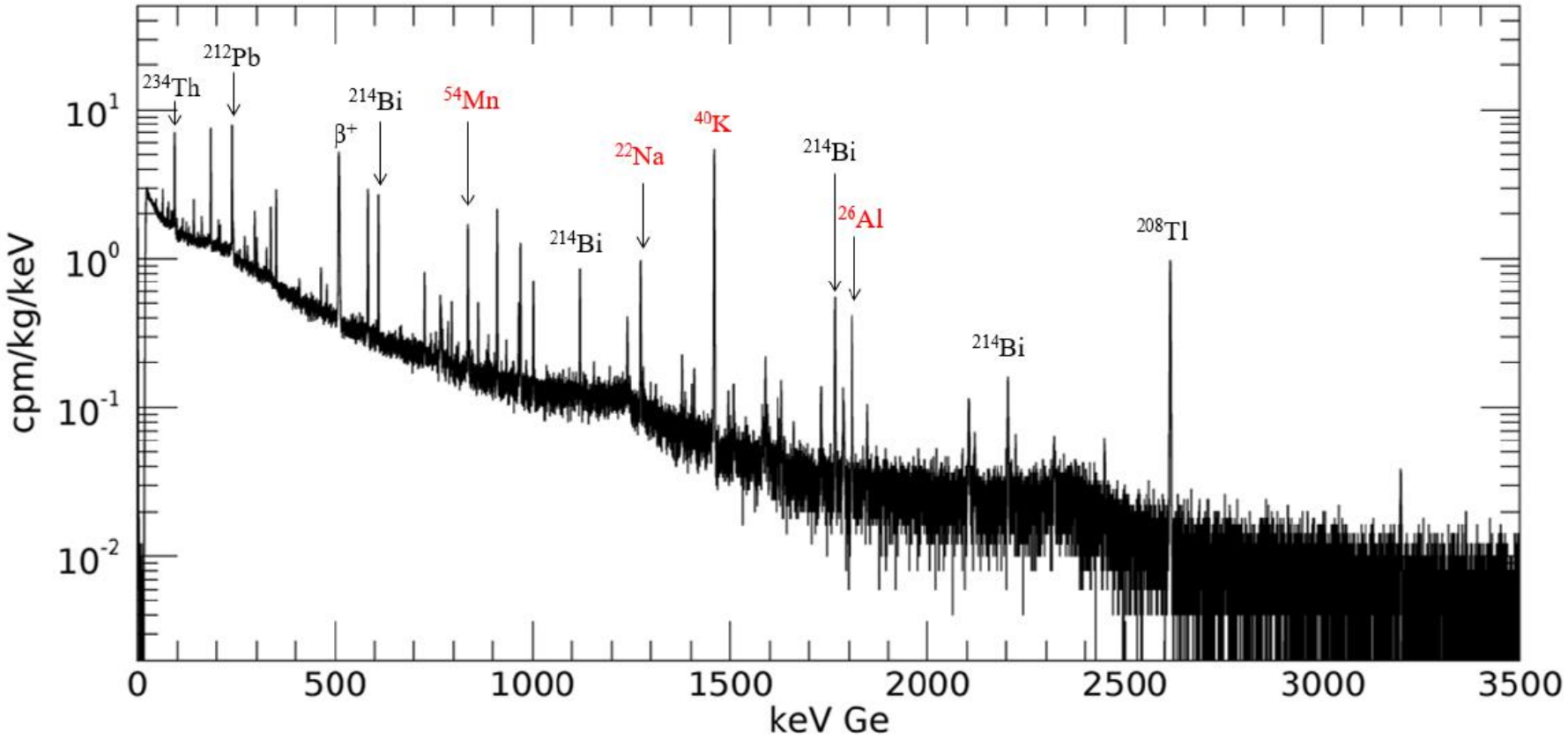


Figure 3: The Cavezzo meteorite gamma-ray spectrum in normal mode (HPGe alone, ~ 45 days counting time). Some peaks are highlighted and associated with the related cosmogenic (red) or natural occurring (black) radionuclide.

(Bizzarri et al. 2022, Applied radiation and isotopes. Preprint)

Cavezzo: a genuine fall

Nuclide	Decay mode	Half-life	E_γ [keV]
^{47}Ca	β^-(100%)	4.5 d	1297.09
^{52}Mn	ϵ(68.9%) - β^+(31.1%)	5.6 d	1434.06
^{48}V	ϵ(50.1%) - β^+(49.9%)	16.0 d	983.52
			1312.10
^{51}Cr	ϵ(100%)	27.7 d	320.08
^{7}Be	ϵ(100%)	53.2 d	477.60
^{58}Co	ϵ(85.1%) - β^+(14.9%)	70.9 d	810.76
^{56}Co	ϵ(80.4%) - β^+(19.6%)	77.2 d	846.76
			1238.27
^{46}Sc	β^-(100%)	83.8 d	889.28
			1120.55
^{57}Co	ϵ(100%)	271.8 d	122.06
^{54}Mn	ϵ(100%)	312.2 d	834.85
^{22}Na	ϵ(9.6%) - β^+(90.4%)	2.6 y	1274.54
^{60}Co*	β^-(100%)	5.3 y	1173.23
			1332.49
^{44}Ti*	ϵ(100%)	60 y	1157.02*
^{26}Al	ϵ(18.3%) - β^-(81.7%)	717 ky	1129.67
			1808.65
^{40}K	ϵ(10.7%) - β^-(89.3%)	1250 My	1460.82

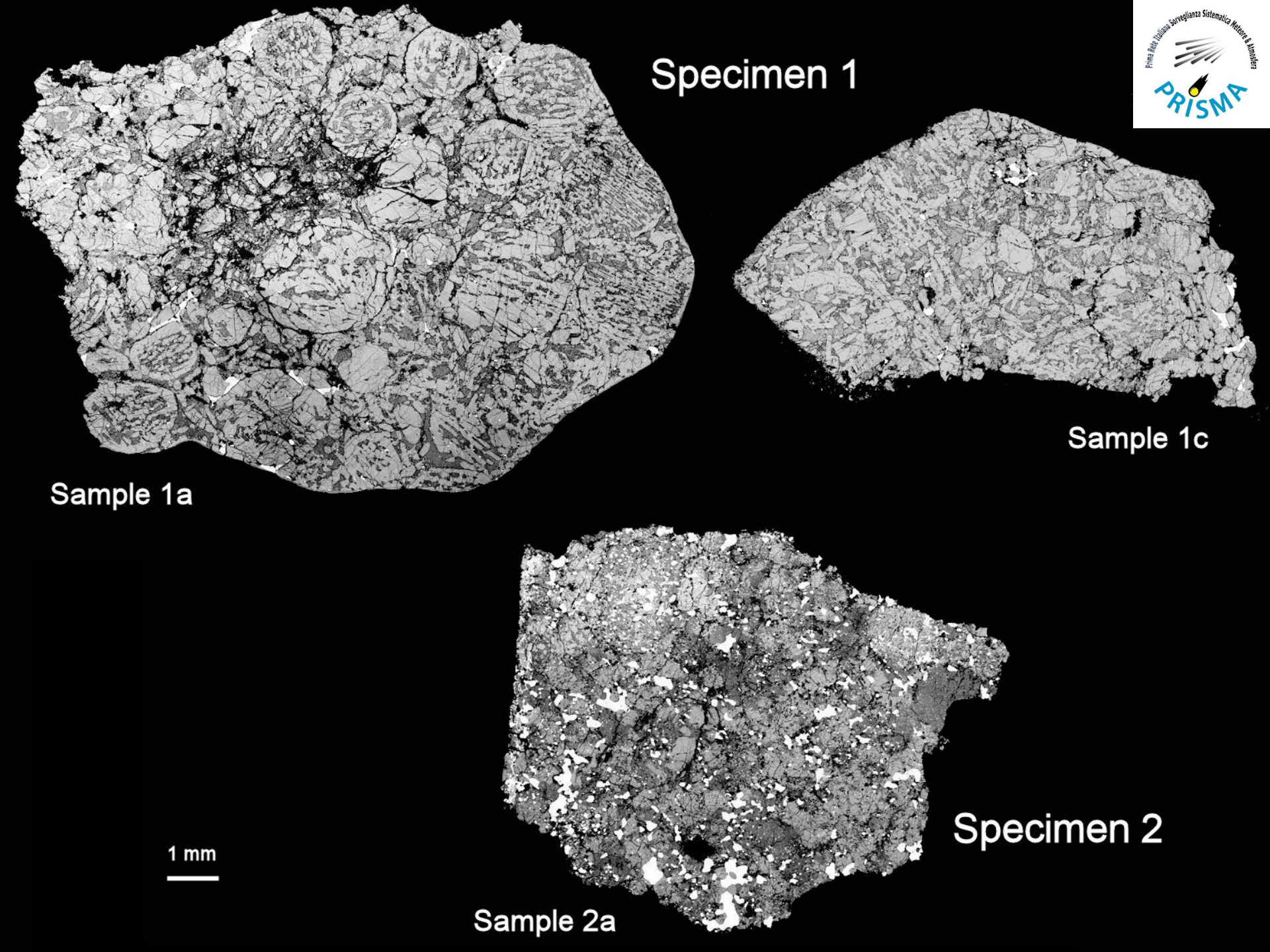
(Bizzarri et al. 2022, Applied radiation and isotopes. Preprint)

Cavezzo: a genuine fall

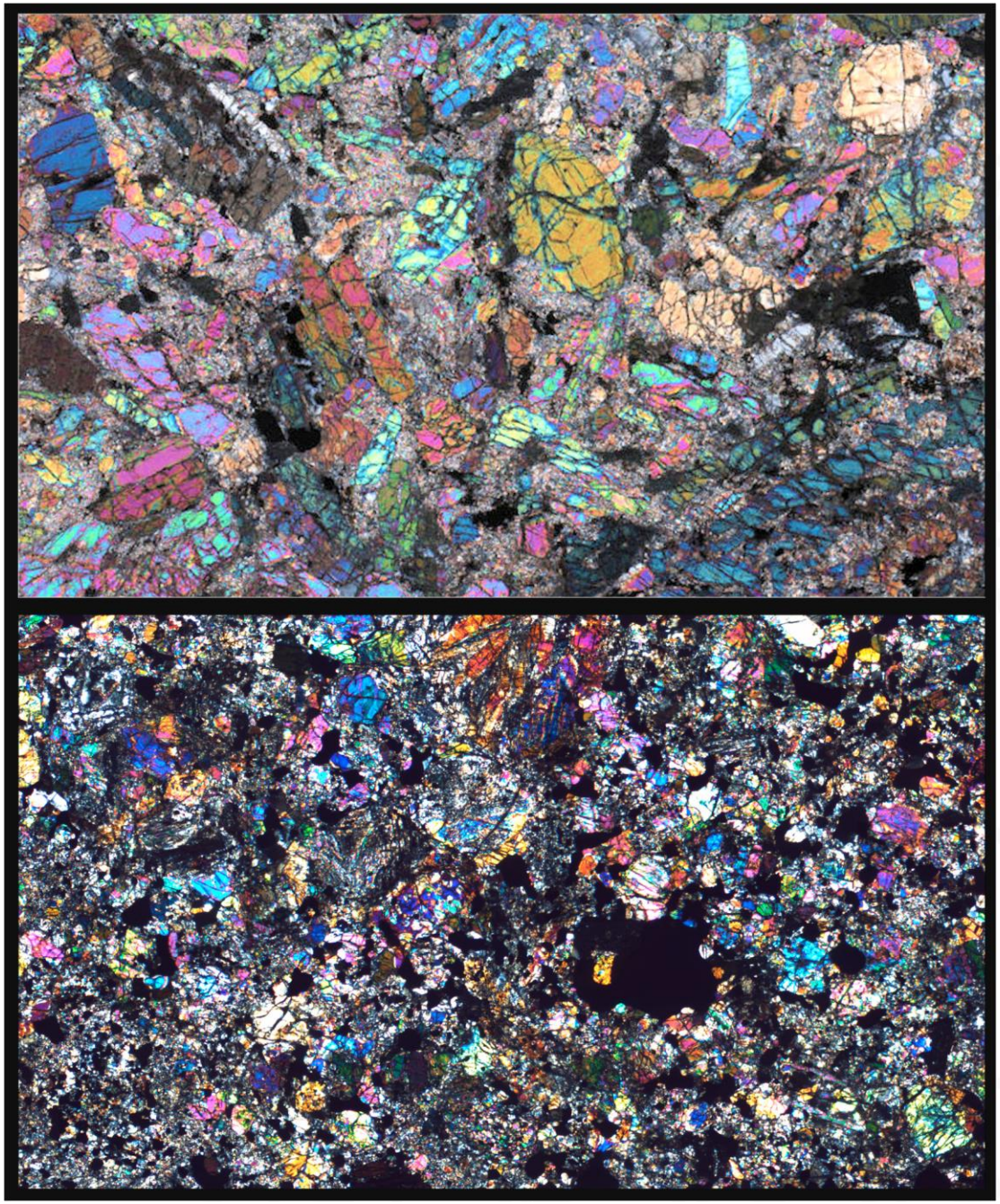
Thanks to the high efficiency and selectivity of gamma-ray spectrometer at the Monte dei Cappuccini underground Research Station, we were able to reveal the presence of cosmogenic radionuclides with half-lives down to few days, thus confirming the recent fall of the sample.

Great care must be taken in attributing a fall since the literature has already recorded conclusive cases of fraud (see the forensic studies for Castenaso and Hocheppan).

(Bizzarri et al. 2022, Applied radiation and isotopes. Preprint)


Specimen 1
Sample 1a
Sample 1c
Specimen 2
Sample 2a
1 mm

Texture of the achondritic area in specimen 1



Texture of the specimen 2

Field width 6.3 mm. (Pratesi et al. 2021 MAPS 56, 1125-1150).

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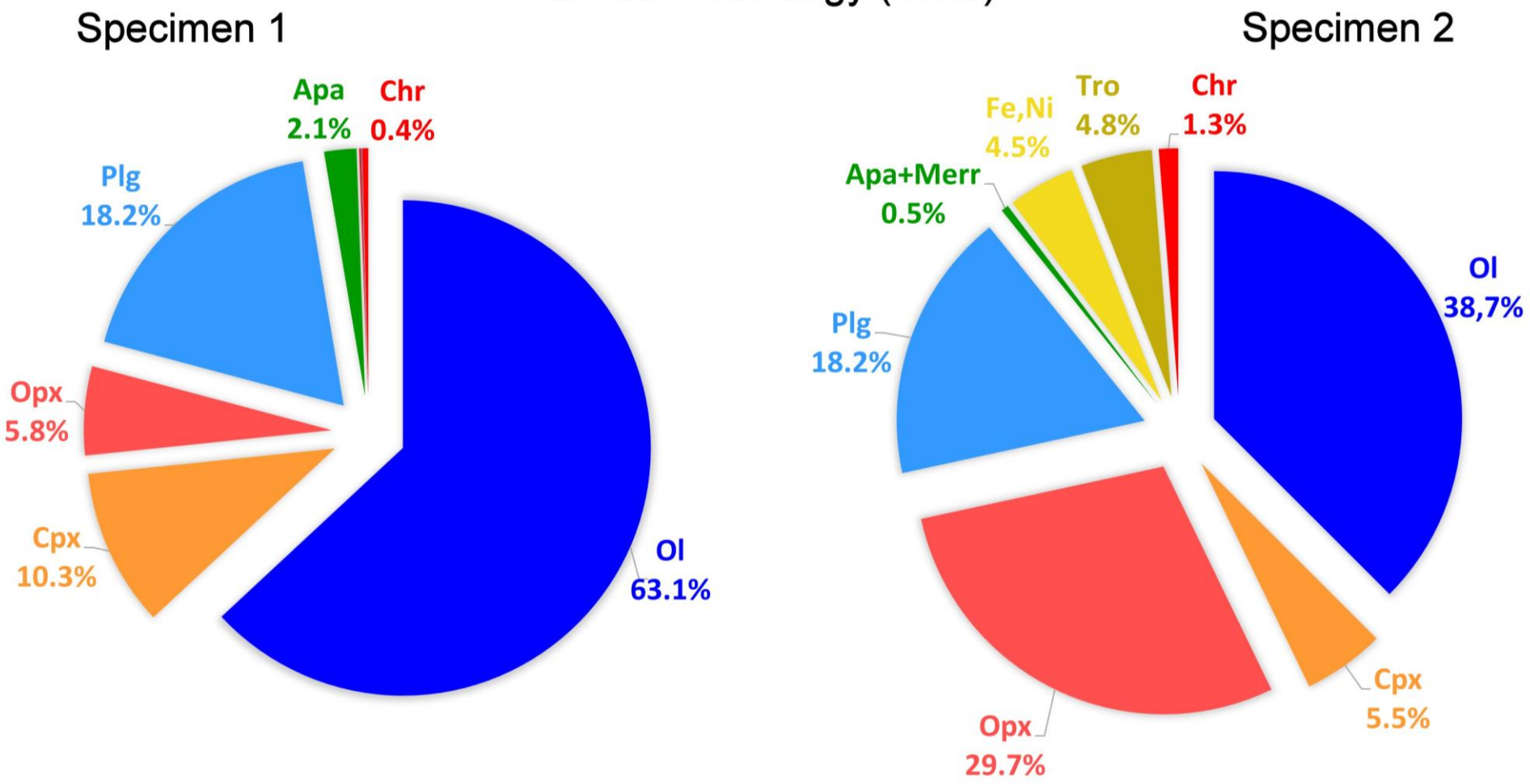
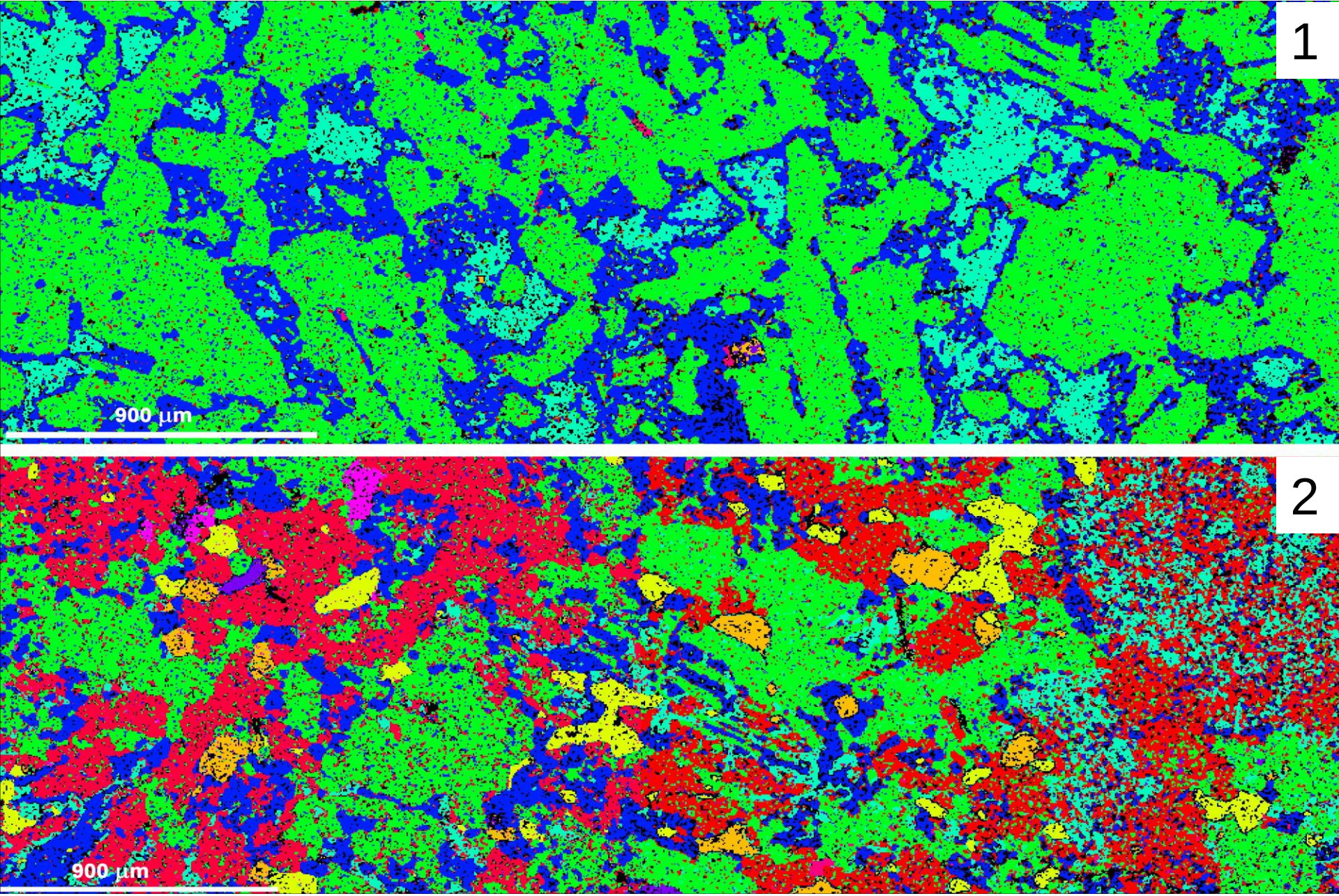
CAVEZZO

Modal mineralogy (Vol%)

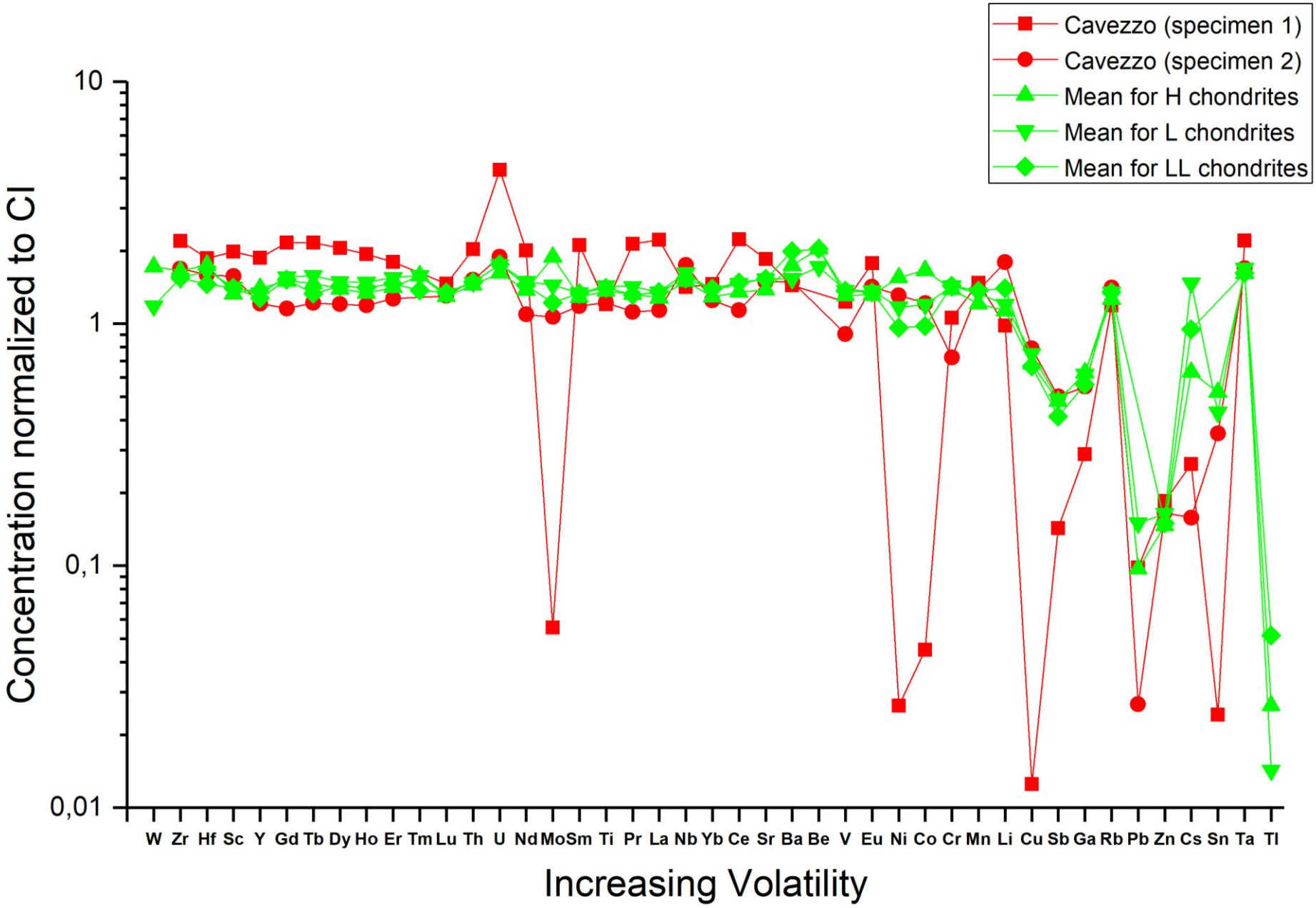


(Pratesi et al. 2021 MAPS 56, 1125-1150)

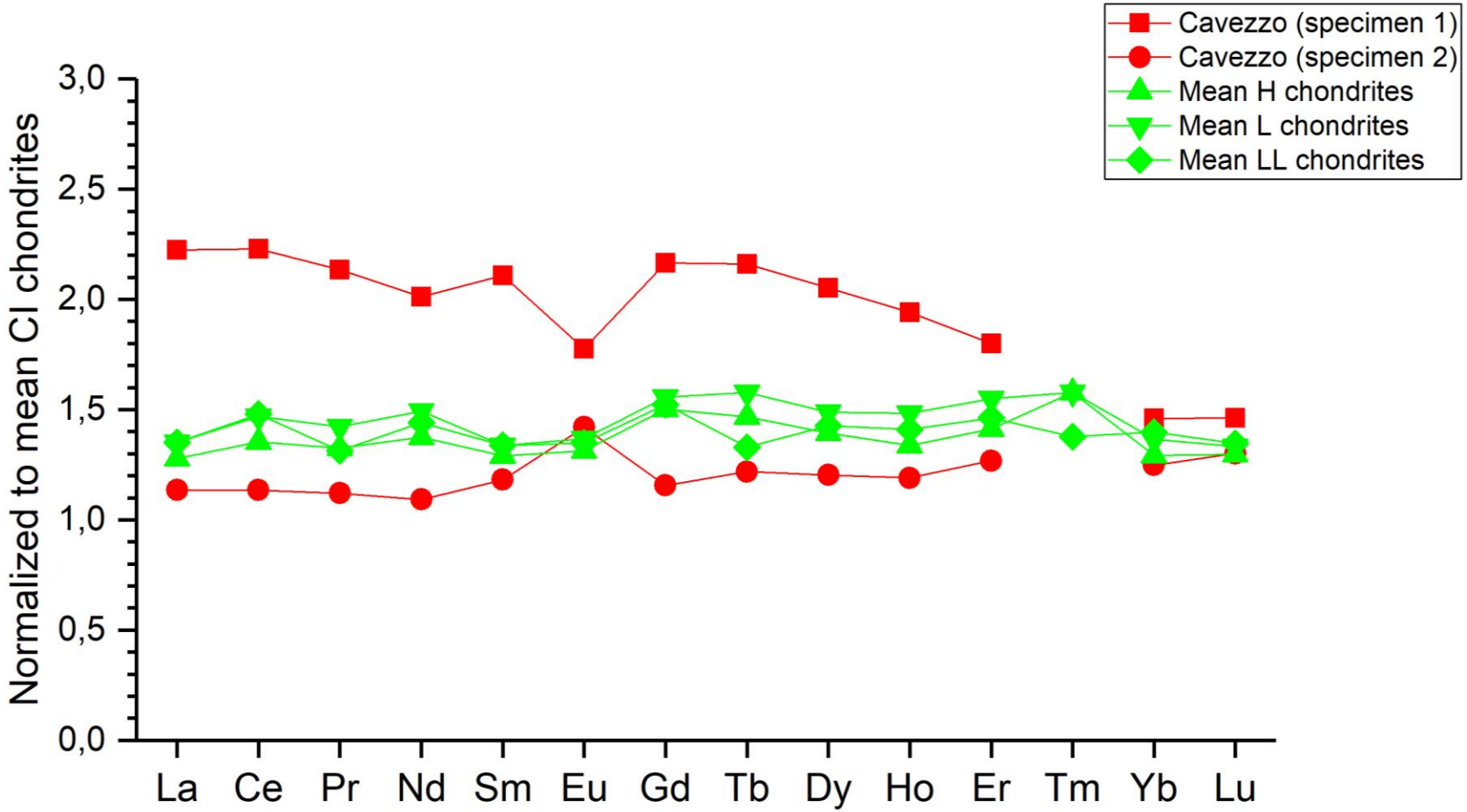


Phase maps: olivine (green), low-Ca pyroxene (red), plagioclase (blue), high-Ca pyroxene (cyan), Ca-phosphates (fuchsia), Fe,Ni metal (orange) and troilite (yellow).

(Pratesi et al. 2021 MAPS 56, 1125-1150)

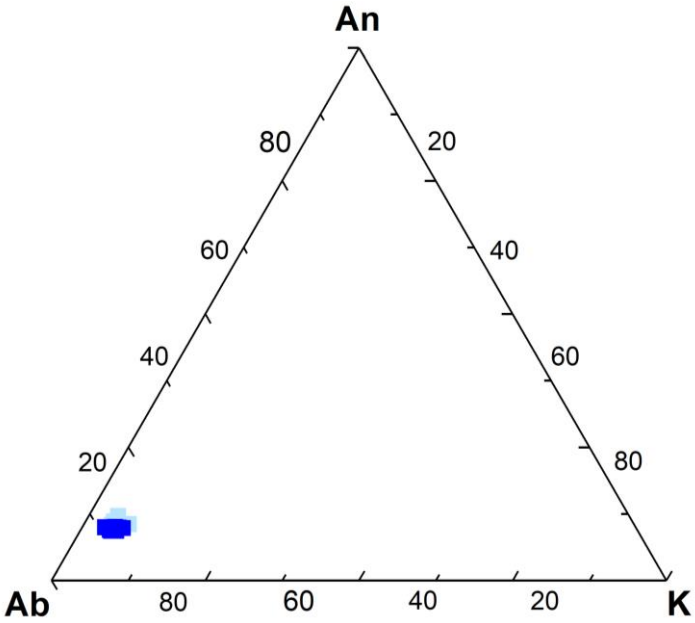


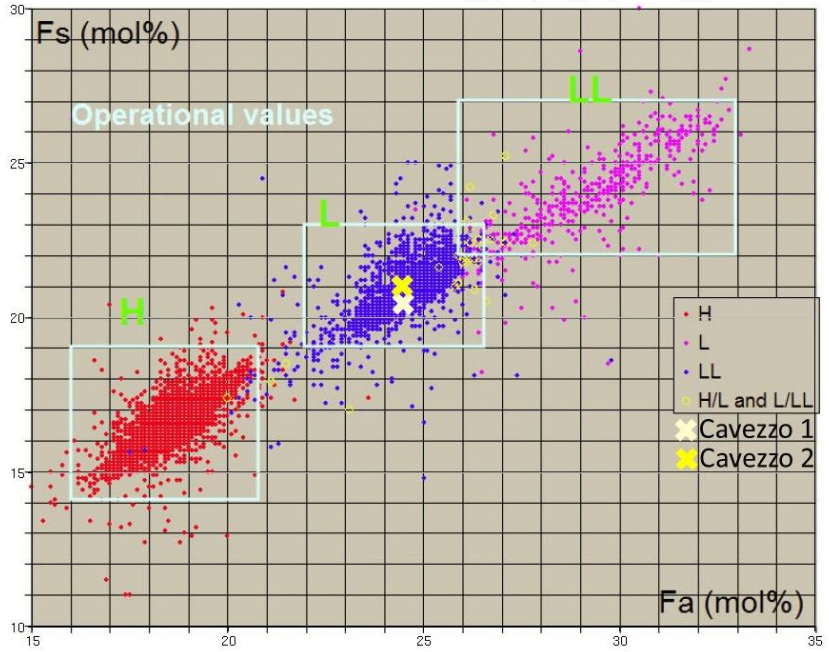
(Pratesi et al. 2021 MAPS 56, 1125-1150)

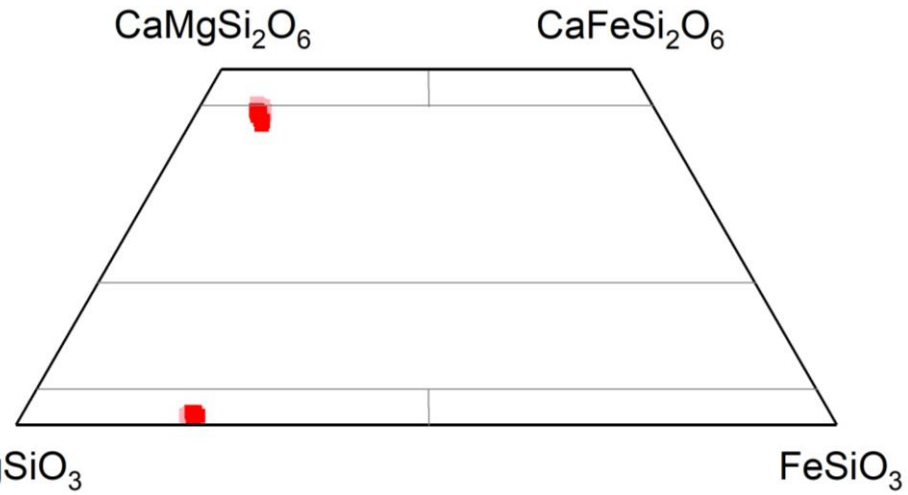


(Pratesi et al. 2021 MAPS 56, 1125-1150)

Cavezzo: an L5 anomalous chondrite

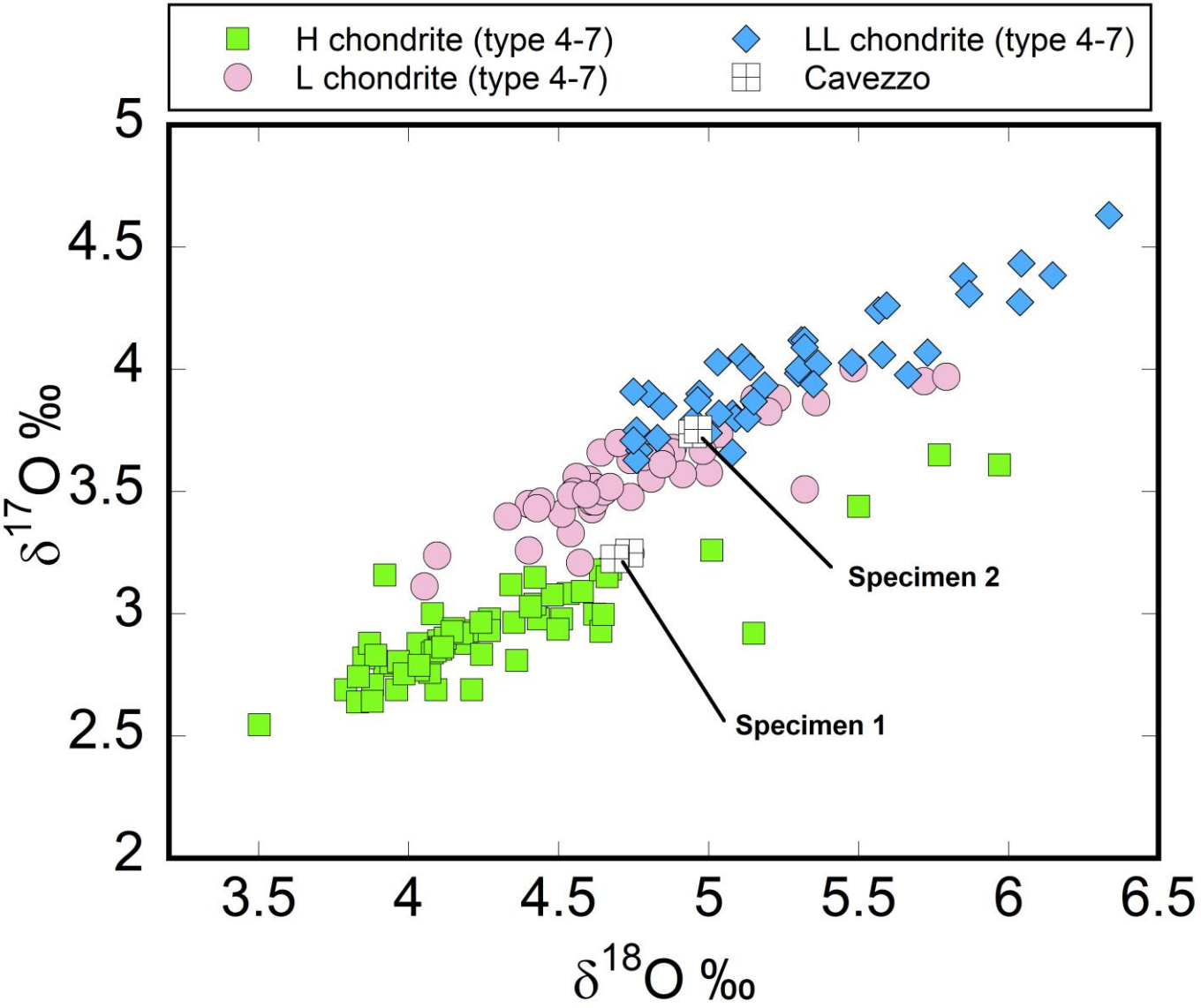






(Pratesi et al. 2021 MAPS 56, 1125-1150)

Oxygen isotopes data from Cavezzo specimens



(Pratesi et al. 2021 MAPS 56, 1125-1150)

Museums where the specimens were deposited

Natural History Museum
Mineralogical collection
University of Firenze (Italy)

Museum of Planetary Sciences
Prato (Italy)

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Cavezzo, the first Italian meteorite recovered by the PRISMA fireball network. Orbit, trajectory, and strewn-field

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Cavezzo—The double face of a meteorite: Mineralogy, petrography, and geochemistry of a very unusual chondrite

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Cover

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Cavezzo—a very unusual chondrite

Cosmogenic radionuclides in the Cavezzo meteorite: gamma-ray measurement and detection efficiency simulations

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(Bizzarri et al. 2022, Applied radiation and isotopes. Preprint)

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