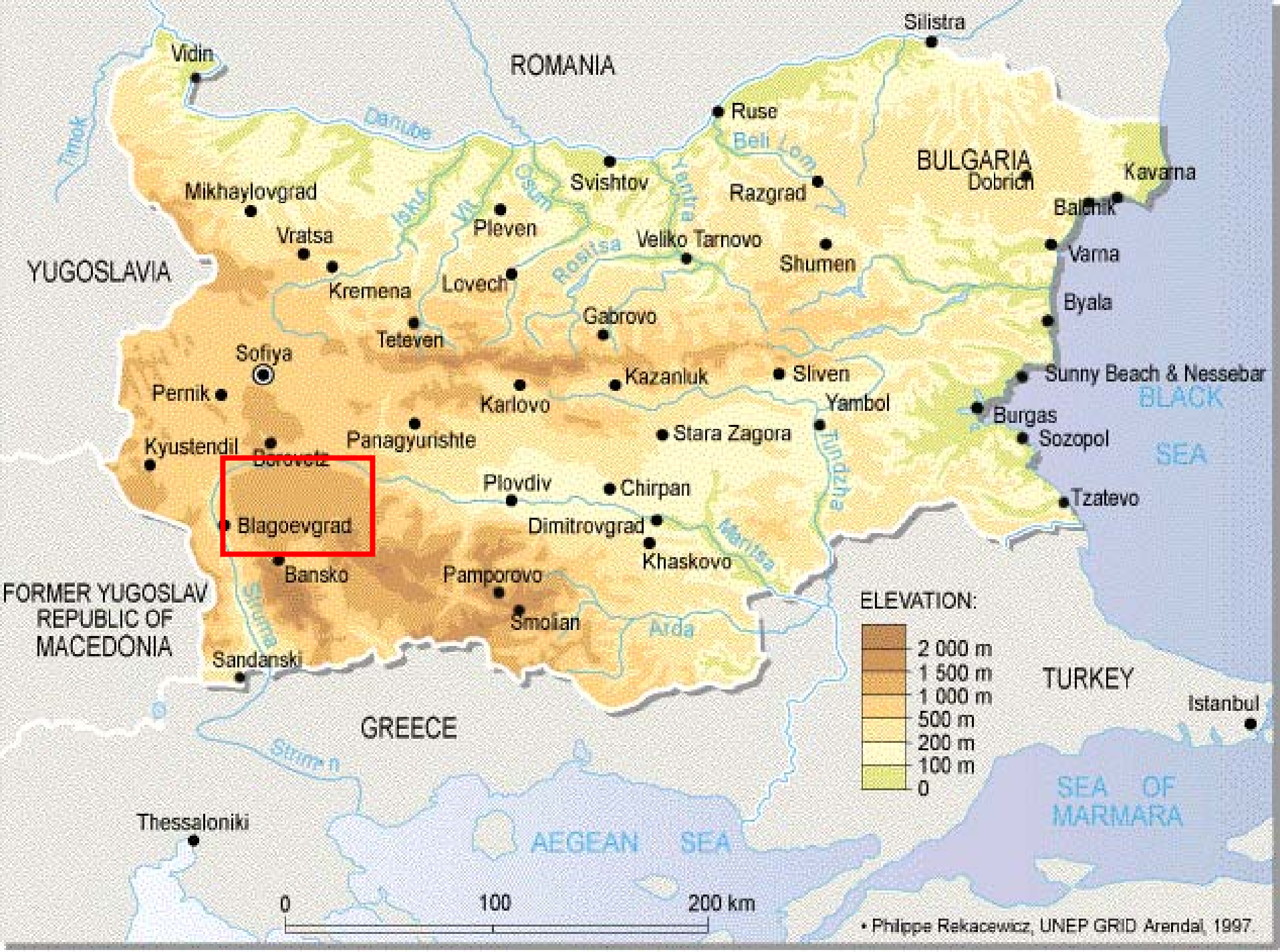
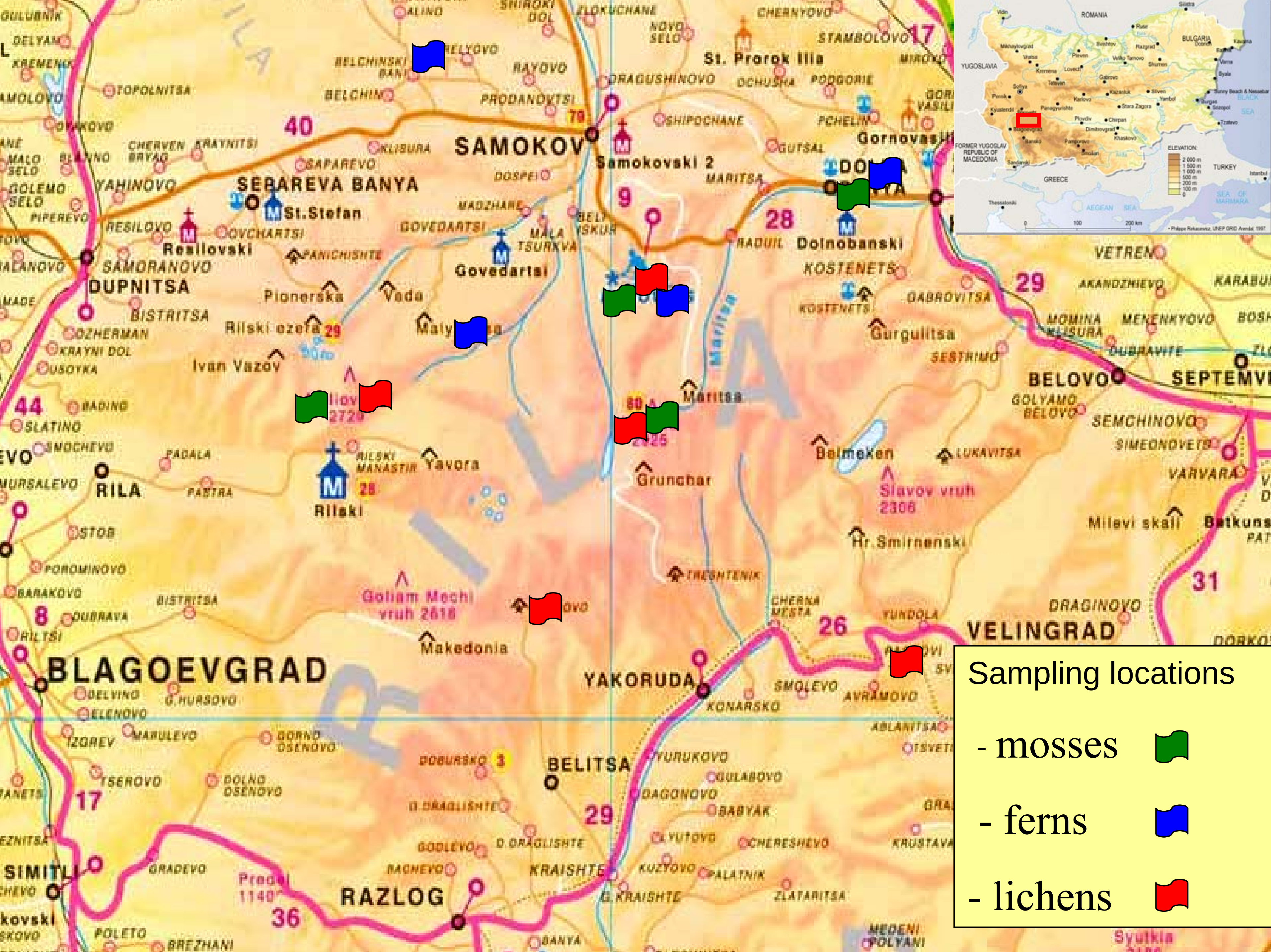
Element quantities in plants from alpine meadows. Comparison between plants from areas with similar characteristics in Rila (Bulgaria) and Alps (Italy)

I. Penev[1], B. Damyanov[1], N. Uzunov[2], N. Arhangelova[2], N. Ivanov[3], G. Moschini[4], P. Buso[4], A. Nadali[5]

[1] INRNE, BAS, Bulgaria, [2] Department of Natural Sciences, Shumen University, Bulgaria, [3] AEZ-Kozloduy, EP-2, s-r RFT, Bulgaria, [4] Department of Physics, University of Padua and Nat. Laboratories of Legnaro, INFN, Italy, [5] Department of Pharmaceutical Sciences, University of Padua, Italy


Silistra
Vidin
ROMANIA
Ruse
Beli Lom
Danube
Svishtov
Razgrad
BULGARIA
Dobrich
Kavarna
Balchik
Mikhaylovgrad
Vratsa
Pleven
Veliko Tarnovo
Shumen
Varna
YUGOSLAVIA
Kremena
Lovech
Gabrovo
Byala
Teteven
Sofiya
Kazanluk
Sliven
Sunny Beach & Nessebar
Pernik
Karlovo
Yambol
BLACK
Burgas
Kyustendil
Panagyurishte
Stara Zagora
Sozopol
SEA
Blagoevgrad
Plovdiv
Chirpan
Tzatevo
Dimitrovgrad
Khaskovo
Bansko
Pamporovo
FORMER YUGOSLAV
REPUBLIC OF
MACEDONIA
Smolian
Arda
Sandanski
ELEVATION:
2 000 m
1 500 m
1 000 m
500 m
200 m
100 m
0
TURKEY
Istanbul
GREECE
SEA OF
MARMARA
Thessaloniki
AEGEAN SEA
0
100
200 km
• Philippe Rekacewicz, UNEP GRID Arendal, 1997


SAMOKOV
SAPAREVA BANYA
DUPNITSA
RILA
BLAGOEVGRAD
YAKORUDA
BELITSA
RAZLOG
VELINGRAD
BELOVO
SIMITLI
St. Prorok Ilia
Samokovski 2
Dolnobanski
Reslilovski
Govedartsi
St.Stefan
Rilski
Pionerska
Vada
Rilski ezera
Ivan Vazov
Yavora
Grunchar
Maritsa
Belmeken
Slavov vruh 2306
Goliam Mechi vruh 2618
Makedonia
Hr.Smirnenski
Milevi skali
Gurgulitsa
Sampling locations
- mosses
- ferns
- lichens

№	Type of plant samples	Sampling location
1	lichens	Yundola
2	ferns	Dolna Banya
3	mosses	
4	lichens	Karaalanica
5	mosses	
6	ferns	Maliovitza
7	mosses	
8	lichens	
6	mosses	Mussala
10	lichens	Semkovo
11	ferns	Alino
12	ferns	Borovetz
13	mosses	

The Alps are a mountain system located in south-central Europe, to the immediate north of the Mediterranean Sea. They extend for almost 1200 km in a crescent shape from the coastline of southern France into Switzerland, then through northern Italy into Austria, and down through Slovenia, Croatia, Bosnia and Herzegovina, Serbia and Montenegro - then ending in Albania on the rugged coastline of the Adriatic Sea.

Sampling locations

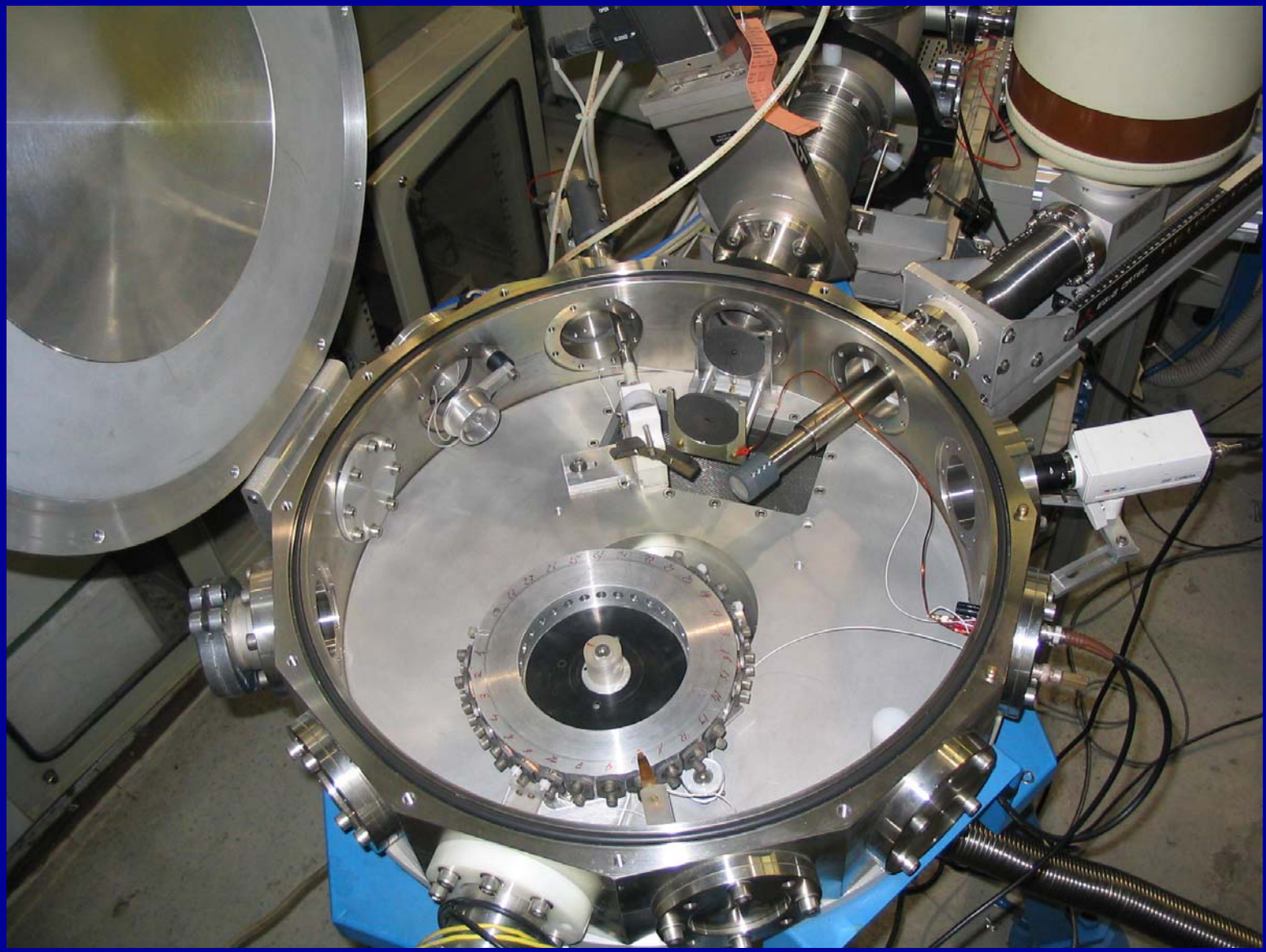
- Pra di Bosco (1200m asl)
- Adamello-Brenta (1400m asl)

Experimental set up

Quantitative element analysis have been conducted using PIXE (Particle Induced X-ray Emission) setup at the National Laboratory of Legnaro, INFN, Italy. Proton beams with energy of 1.8MeV from the 2.5 MV Van de Graaff accelerator have been used to excite characteristic X-ray emission of the plant samples. A high-purity germanium X-ray detector (ORTEC Iglet X-series) with a resolution of 150 eV at 5.89 keV was used to acquire the X-ray spectra.

Sample preparation

Samples have been washed, dried, grinded and pressed in pellets using a 5 ton press and subsequently covered with a thin carbon layer in order to ensure their electroconductivity.



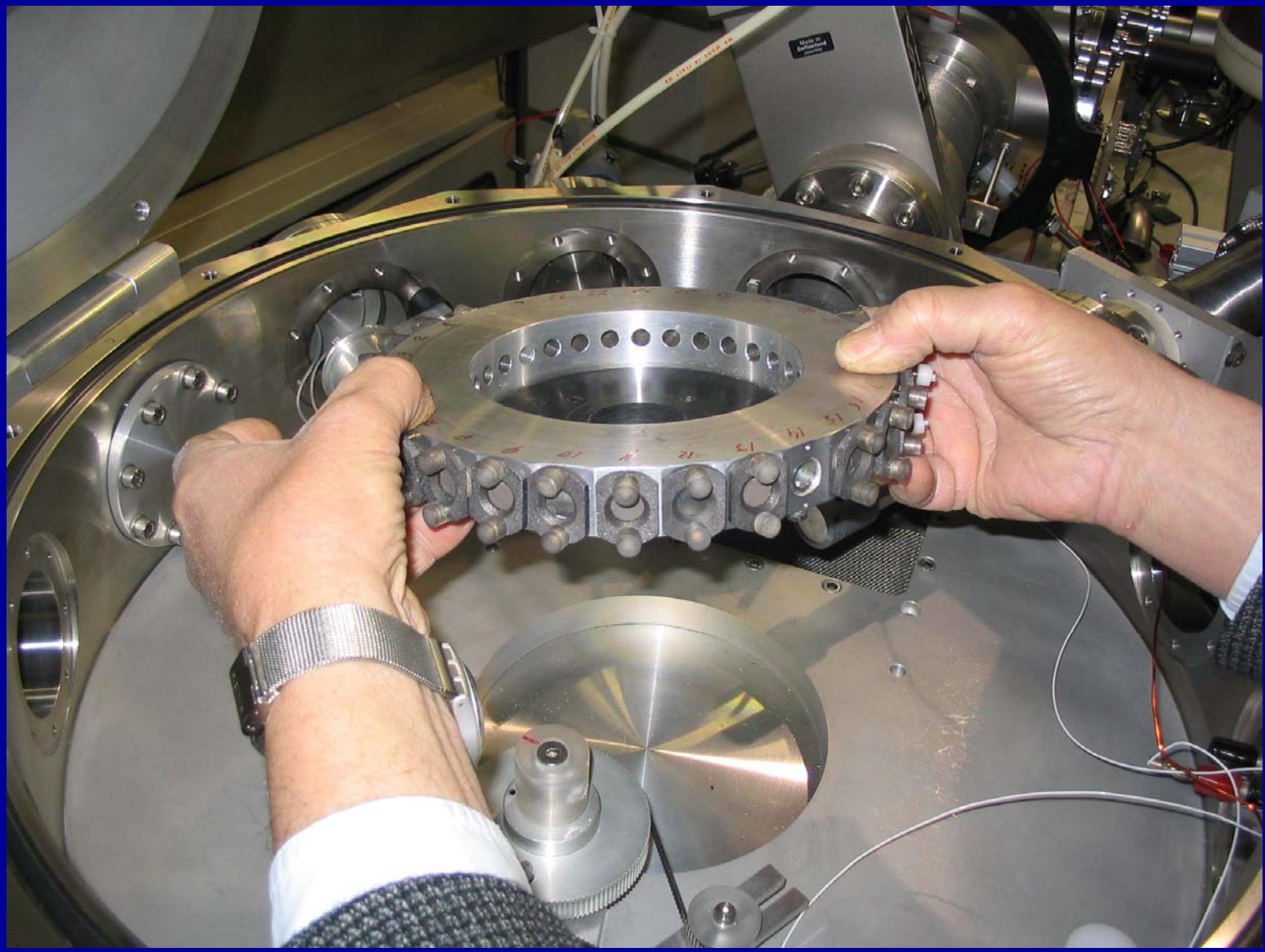


Table 1. Comparison of the element quantities in fern leaves

Sampling location	Element quantity (ppm)										
	Cl	K	Ca	Ti	Mn	Fe	Ni	Cu	Zn	Rb	Sr
Borovetz	6668	28594	14187	19.7	52.3	116.8	1.6	8.13	71.1	84.2	7.1
Maliovitza	6596	29769	15424	12.2	58.2	121.4	2.0	9.6	79.4	94.0	7.8
Alino	3747	46724	12898	49.8	282.6	195.3	2.3	11.5	136.1	12.3	24.3
Dolna Bania	4469	46052	13083	50.6	280.5	245.5	4.0	7.8	126.6	27.0	25.4
Pra di Bosco	7947	42487	13498	14.9	116.1	195.3	3.2	7.9	34.8	6.2	13.4
Adamello-Brenta	7086	40989	14150	20.52	119.5	118.9	2.1	8.2	34.9	14.6	8.2

Table 2. Comparison of the element quantities in mosses

Sampling Location	Element quantity (ppm)									
	K	Ca	Ti	Mn	Fe	Ni	Cu	Zn	Sr	Pb
Dolna Bania	3392	9454	300.4	42.7	2266	8.9	36.0	146.4	8.8	56.1
Borovetz	3643	10322	221.7	42.3	1727	5.6	25.7	111.1	14.1	41.6
Karaalanitza	4737	17263	249.6	86.3	1941	6.4	18.5	108.2	28.1	46.2
Maliovitza	5913	10116	47.3	74.5	279.2		5.9	99.8	20.1	7.2
Mussala	8280	12074	46.0	67.7	270.8	2.4	11.5	86.7	31.7	18.4
Pra di Bosco	10300	16105	462.9	937.4	3950	10.1	24.7	186.5	36.6	44.4
Adamello-Brenta	5764	19390	209.1	51.74	1783	11.9	20.6	240.5	34.9	55.6

Table 3. Comparison of the element quantities in lichens

Sampling location	Element quantity (ppm)										
	Cl	K	Ca	Ti	Mn	Fe	Ni	Cu	Zn	Sr	Pb
Maliovitza	466	1434	20575	5.50	46.78	505.3	3.4	6.2	48.0	37.8	4.2
Karaalanitza	320	1710	17951	13.9	50.79	315.4	4.3	5.3	102.6	28.1	
Semkovo	739	1522	22278	63.3	90.66	761.3	7.2	10.0	106.7	36.9	7.8
Yundola	557	1602	22771	62.8	95.44	1337	9.1	8.3	93.37	42.3	11.9
Pra di Bosco	381	1244	14918	45.7	63.9	892.2	8.6	5.7	218.7	26.5	28.7
Adamello-Brenta	94.54	1768	29617	29.9	60.5	318.5	3.2	5.5	57.5	65.7	24.4

Thank you