



Initial Results from a 200-year Soil Monitoring Study

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Project Goals:

1. Establish five 50 x 50 m relatively uniform plots in sites associated with the VMC.
2. Sample plots at 0, 5, 10, 20, 50, 100, 150 and 200 years.
3. Archive initial samples for later comparisons.
4. Obtain a large reference sample of two horizons for laboratory quality control.
5. Analyze initial samples at three different laboratories to determine baseline values.
6. Protect the plots for future monitoring.

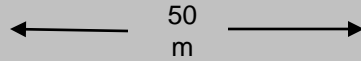
Sites:

- Mt. Mansfield Ranch Brook
 - northern hardwood
- Mt. Mansfield Forehead
 - high elevation spruce/fir
- Mt. Mansfield Underhill State Forest
 - transitional
 - SCAN site; reference sample site
- Lye Brook “Road”
 - northern hardwood
 - SCAN site
- Lye Brook “Trail”
 - transitional



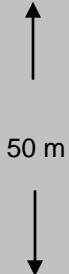
Mansfield Forehead

NW



←5m→ NE

91	92	93	94	95	96	97	98	99	100
81	82	83	84	85	86	87	88	89	90
71	72	73	74	75	76	77	78	79	80
61	62	63	64	65	66	67	68	69	70
51	52	53	54	55	56	57	58	59	60
41	42	43	44	45	46	47	48	49	50
31	32	33	34	35	36	37	38	39	40
21	22	23	24	25	26	27	28	29	30
11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10



SW

SE

A typical plot plan.

Plots with red numbers were sampled in 2002.

Mansfield forehead plot











Underhill State Park Plot





A photograph of a forest plot. The ground is covered in brown leaves and twigs. There are several trees, some with orange flags attached to their trunks. A large, dark, mossy log lies on the ground. The background is a dense forest of thin trees. A semi-transparent grey box with black text is overlaid on the right side of the image.

Ranch Brook
plot





Lye Brook "Road"

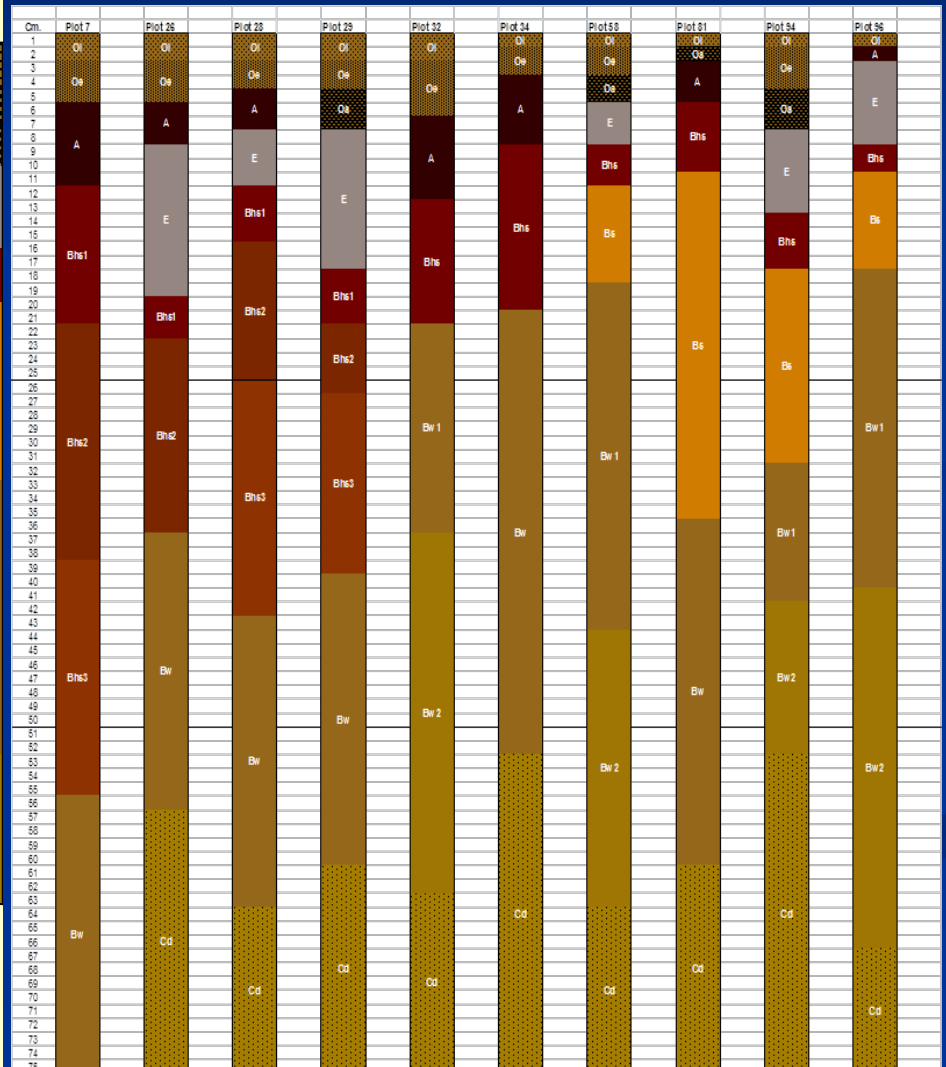
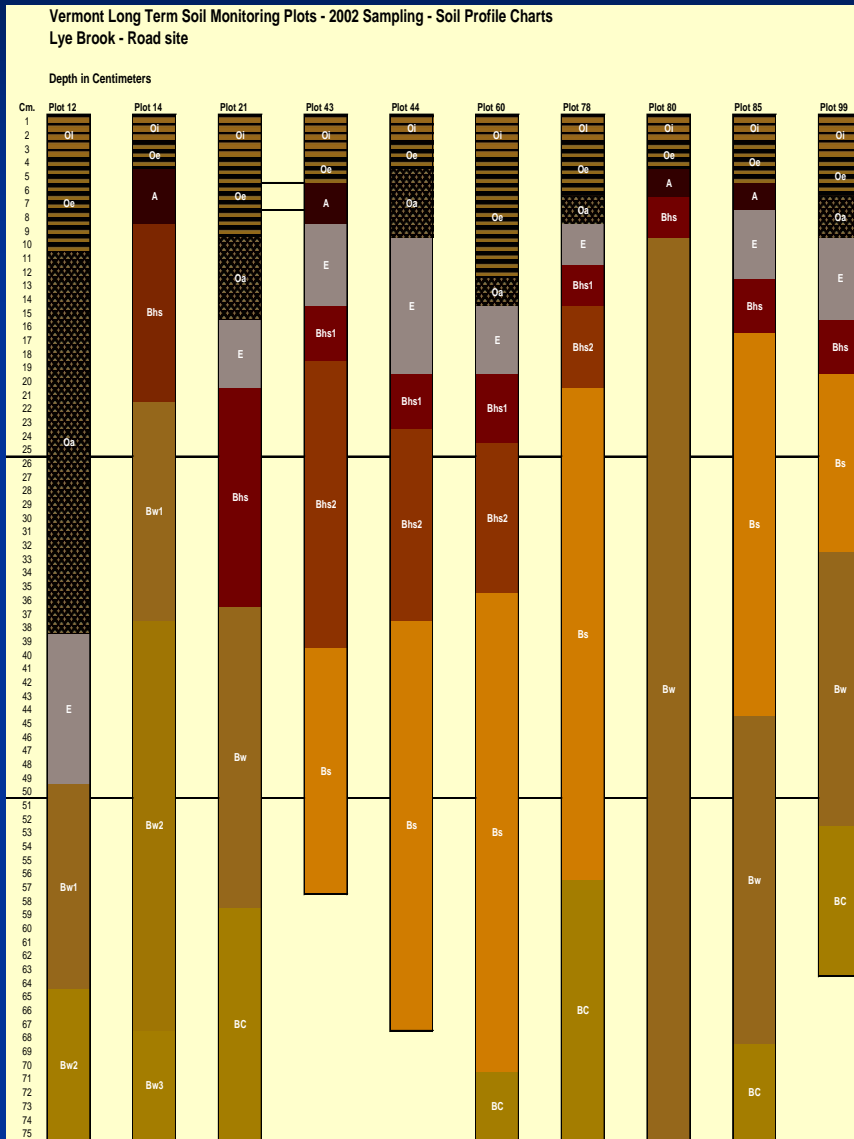


Lye Brook “Trail” plot

Sampling plan

- 2002 by horizon (no Oi, Oe or Cd)
 - 204 samples: 49 Oa, 22 A, 30 E, 91 B, 12 BC
- 2007 'large samples'
 - Oi/Oe, Oa or A, top 10 cm of B, 60-70 cm,
 - 192 samples: 50 Oi/Oe, 50 Oa or A, 44 B, 40 C, 8 E (FH)
- 2007 by horizon, all sampled
 - 340 samples: 39 Oi, 9 Oi/Oe, 36 Oe, 48 Oa, 30 E, 21 A, 129 B, 28 C

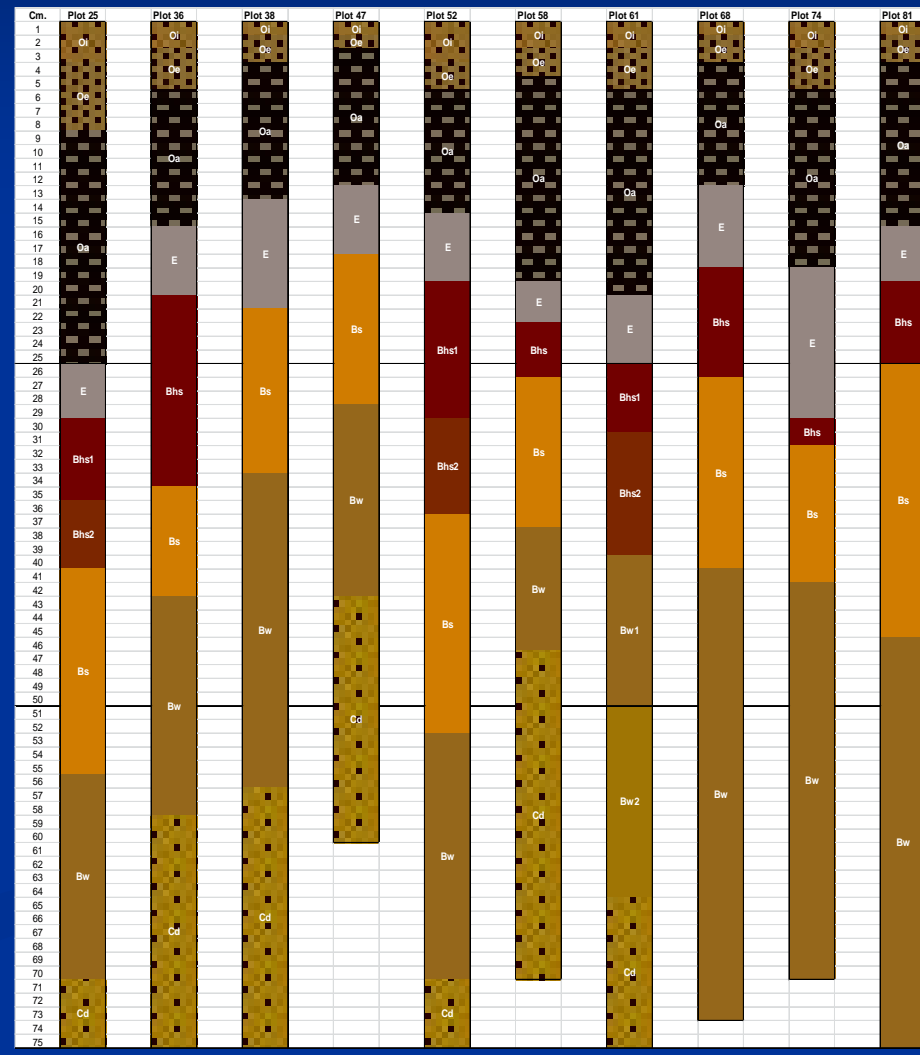
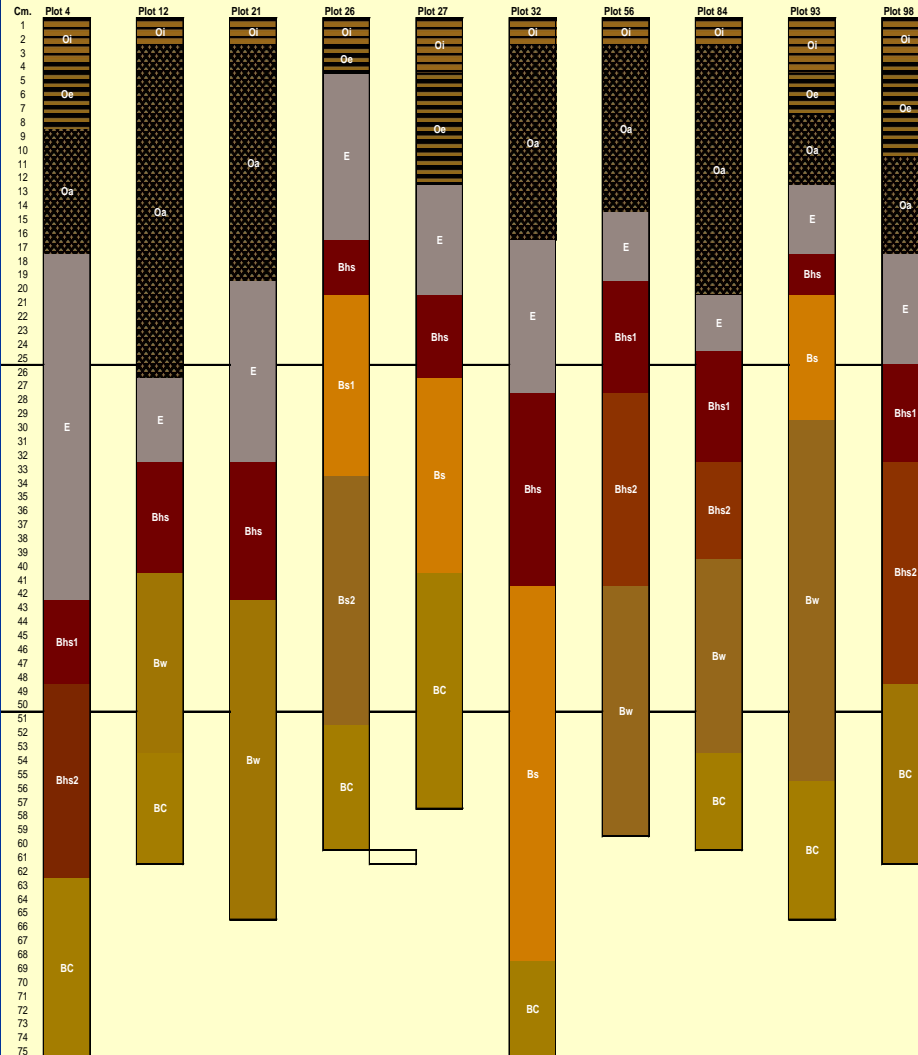
2002 Lye Brook – Road site 2007



2002 Lye Brook – Trail site 2007

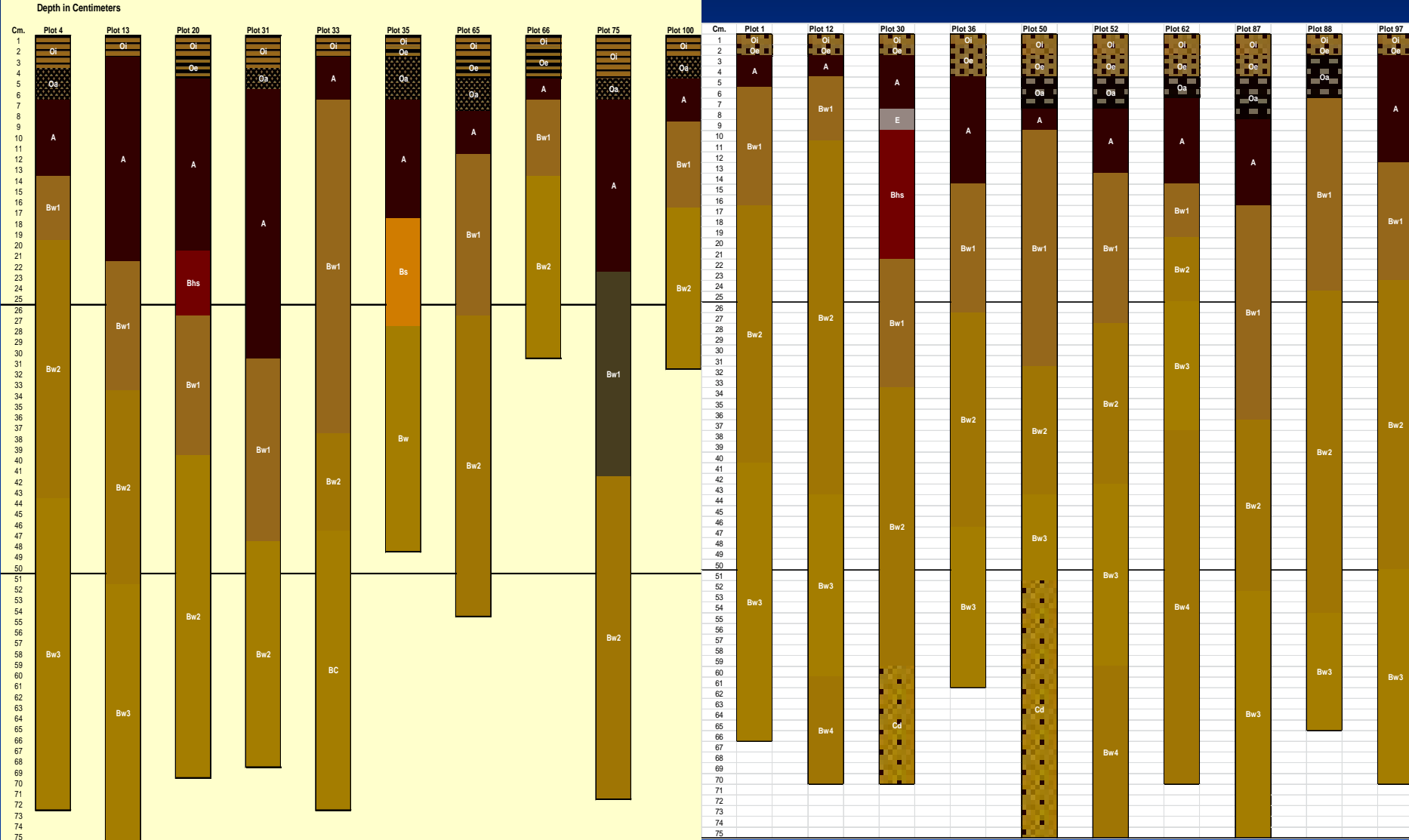
Vermont Long Term Soil Monitoring Plots - 2002 Sampling - Soil Profile Charts
Lye Brook - Trail site

Depth in Centimeters



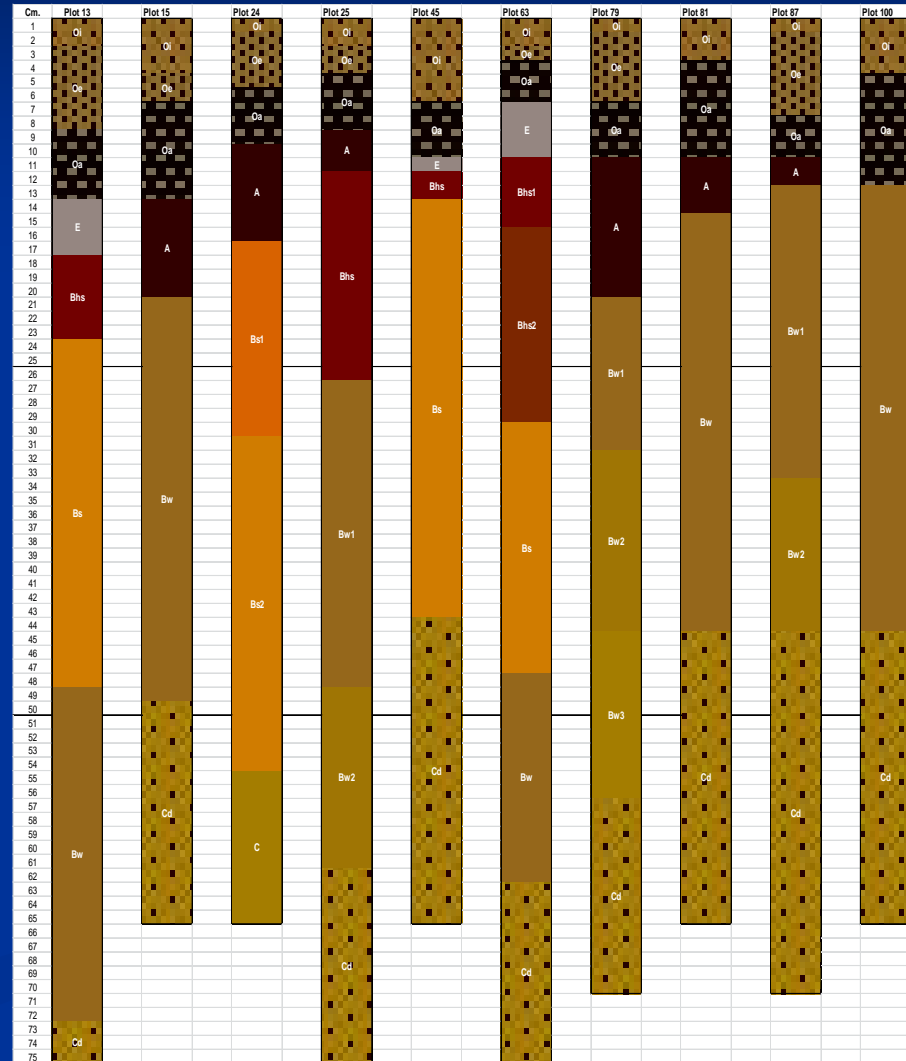
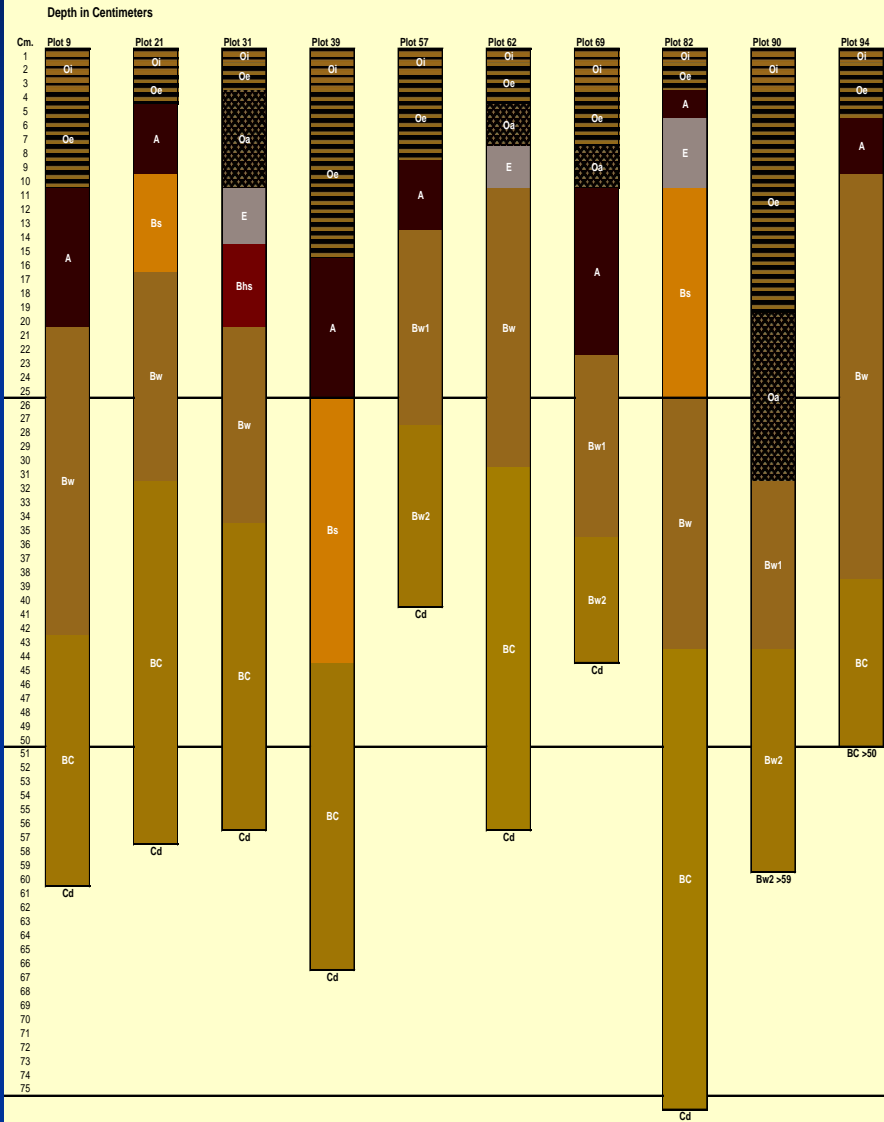
2002 Mt. Mansfield – Ranch Brook 2007

Vermont Long Term Soil Monitoring Plots - 2002 Sampling - Soil Profile Charts
Mount Mansfield - Ranch Brook site



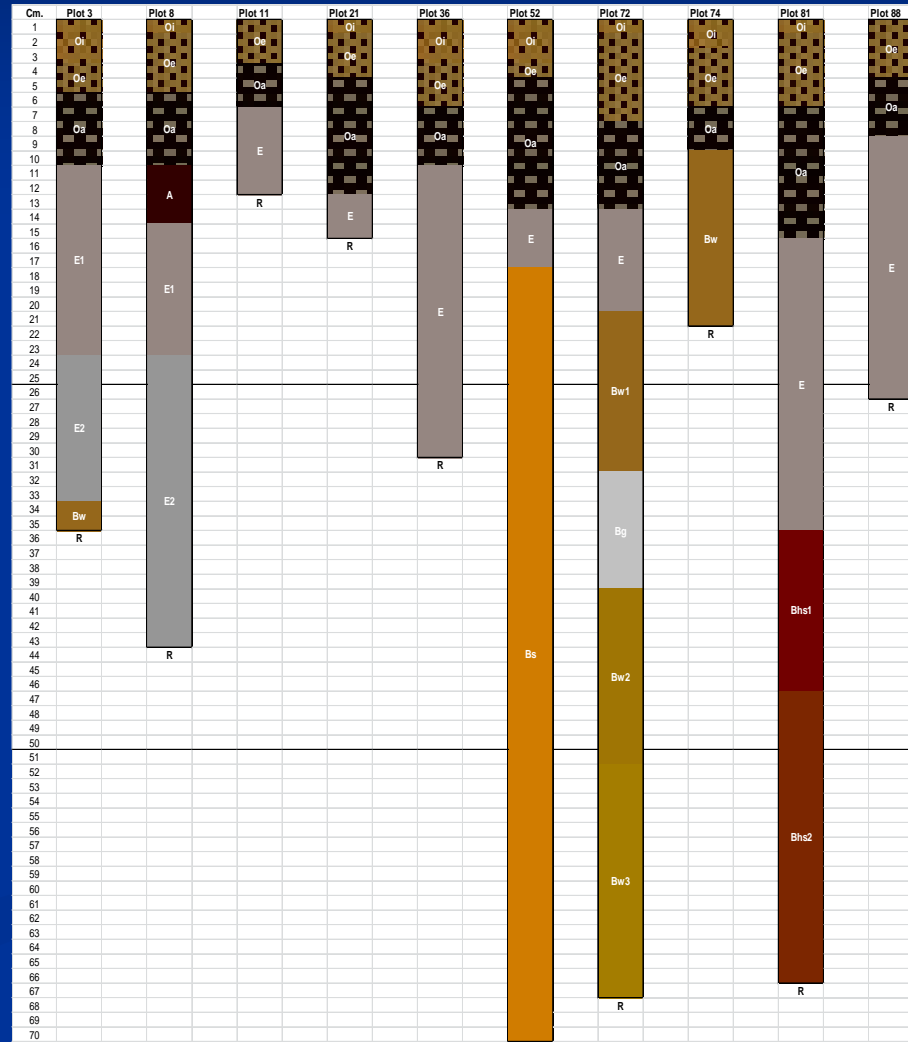
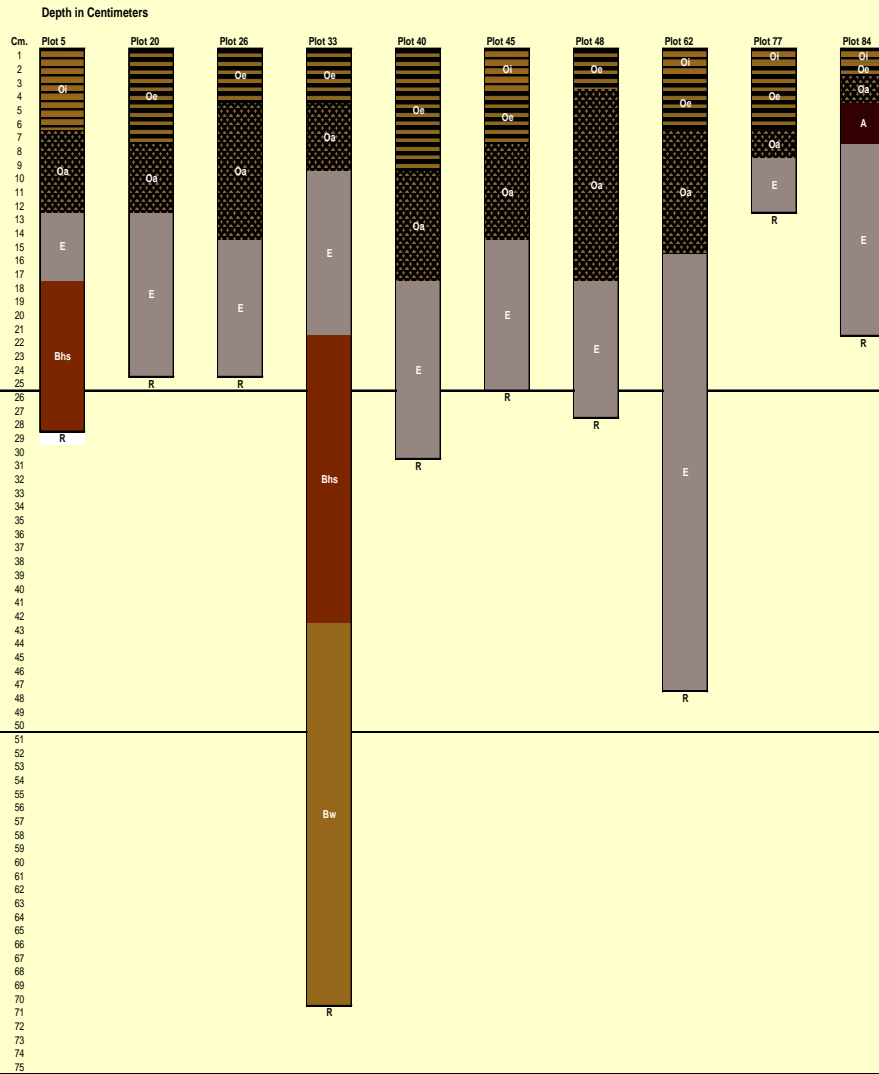
2002 Mt. Mansfield – Polka Dot site 2007

Vermont Long Term Soil Monitoring Plots - 2002 Sampling - Soil Profile Charts
Mount Mansfield - Polka Dot site



2002 Mt. Mansfield – Forehead Site 2007

Vermont Long Term Soil Monitoring Plots - 2002 Sampling - Soil Profile Charts
Mount Mansfield - Forehead site



Storage

- 2002 by horizon
 - 2-8 8-oz polyethylene cups
 - 1 complete set stored at HBEF
 - Remainder in Jeffords Hall basement
- 2007 'large samples'
 - 2-9 8- or 16-oz cups, Jeffords Hall basement
 - 1 complete set to be stored at HBEF?
- 2007 by horizon
 - Still in plastic bags

Analysis

- 2002 by horizon **B horizons only**
 - 20 mL sent to NRCS Lincoln Lab
 - Cations 'batch' extracted at UVM, pH
 - Cations by mechanical vacuum extraction (MVE) at UVM, ICP at FS lab in Durham
- 2007 'large samples' **all except Oi/Oe**
 - 20 mL sent to NRCS Lincoln Lab
 - Cations by MVE at UVM, ICP at FS lab
- 2007 by horizon **B horizons only**
 - Total C,N and cations by MVE at UVM

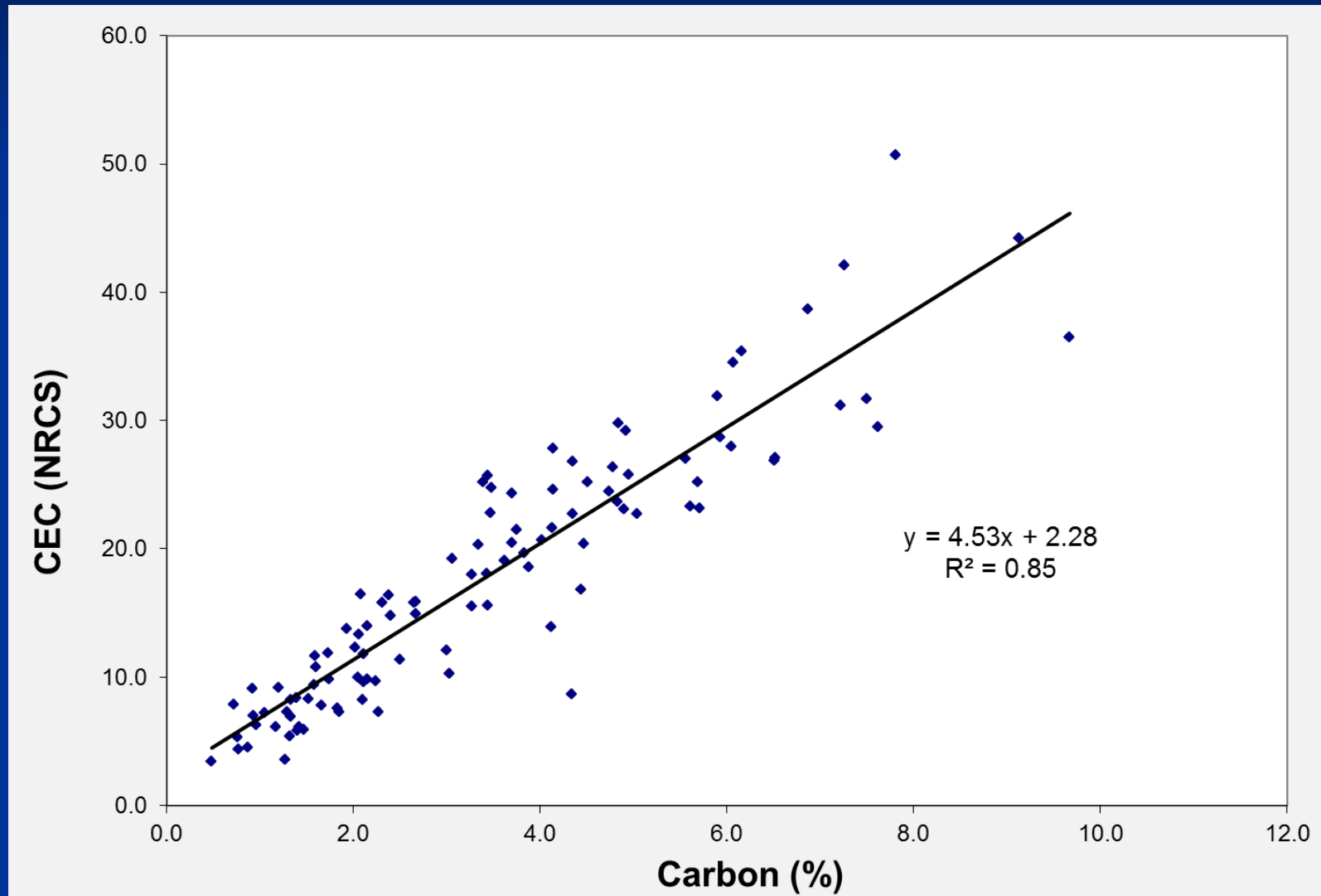
Analyses run by NRCS

- 2002 by horizon **B horizons only**
 - Total C, N and S
 - Oxalate extractable Al, Fe, Mn, Si and P
 - Pyrophosphate Al, Fe and Mn
 - CEC
 - Exchangeable cations (detection limit too high)
- 2007 'large samples'
 - All of the above except CEC and cations

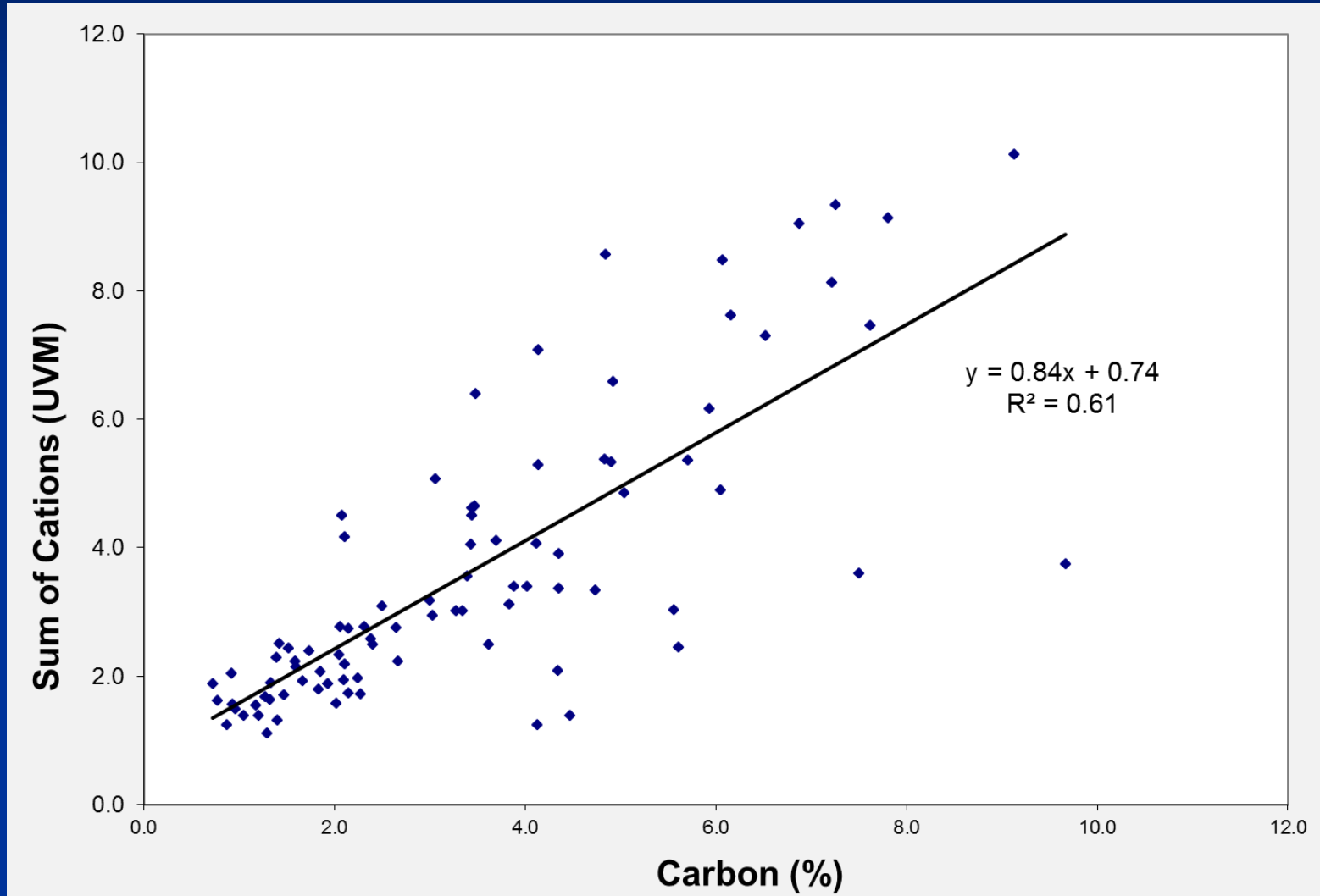
2007 C, N and S from NRCS lab

Site			<u>FREQ</u>	C	N	C/N	S
				%	%		%
1 LR	Oa/A	10	10	18.23	0.87	20.72	0.11
2 LT	Oa/A	10	10	41.68	1.83	23.47	0.22
3 RB	Oa/A	10	10	9.22	0.64	14.60	0.03
4 PD	Oa/A	10	10	24.66	1.33	18.49	0.13
5 FH	Oa/A	10	10	23.49	1.48	16.19	0.08
1 LR	B	10	10	5.63	0.25	23.92	0.04
2 LT	B	10	10	5.09	0.17	33.63	0.03
3 RB	B	10	10	2.30	0.18	13.12	0.03
4 PD	B	10	10	4.59	0.24	20.23	0.04
5 FH	B	4	4	2.33	0.18	13.10	.
1 LR	C	10	10	0.79	0.05	20.12	0.02
2 LT	C	10	10	0.76	0.02	42.74	0.01
3 RB	C	10	10	0.79	0.08	10.73	0.04
4 PD	C	10	10	0.42	0.03	17.09	0.02
5 FH	E	8	8	2.21	0.19	14.79	0.03

2002 C vs CEC, B horizons

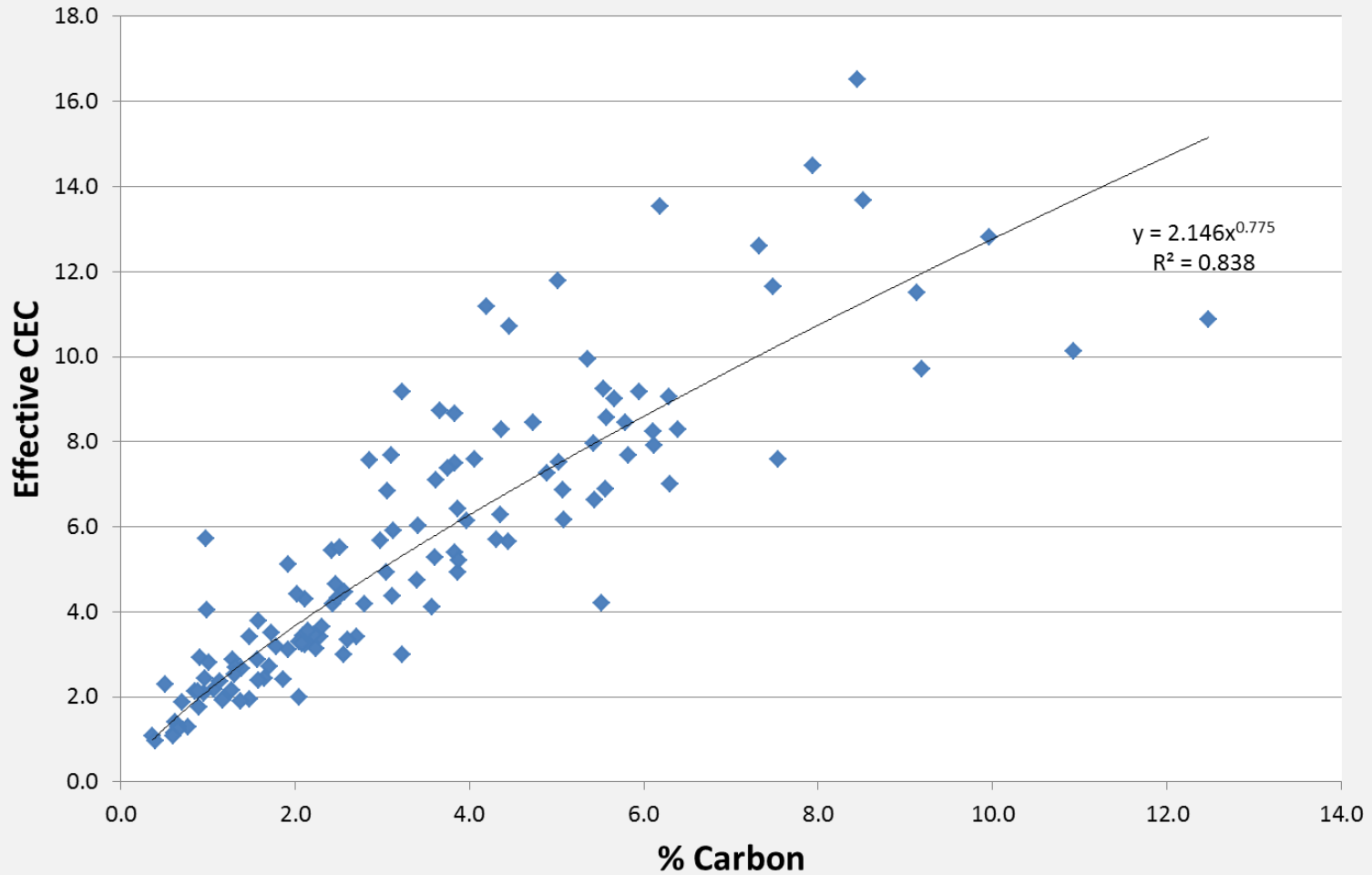


2002 C vs CECe, B horizons



2007 C vs CECe, B horizons

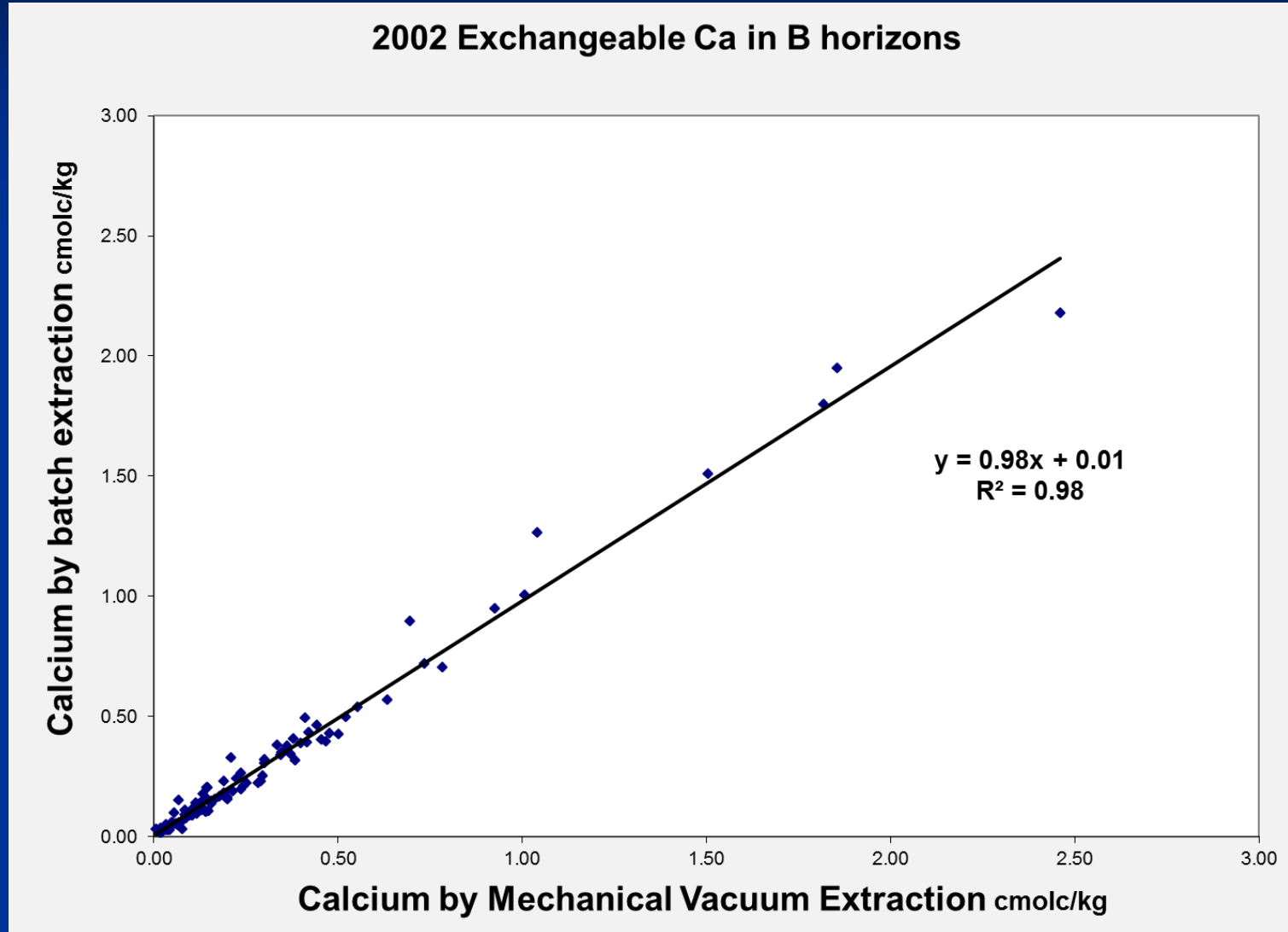
Carbon vs. CECe for all B horizons
(sampled by horizon not depth)



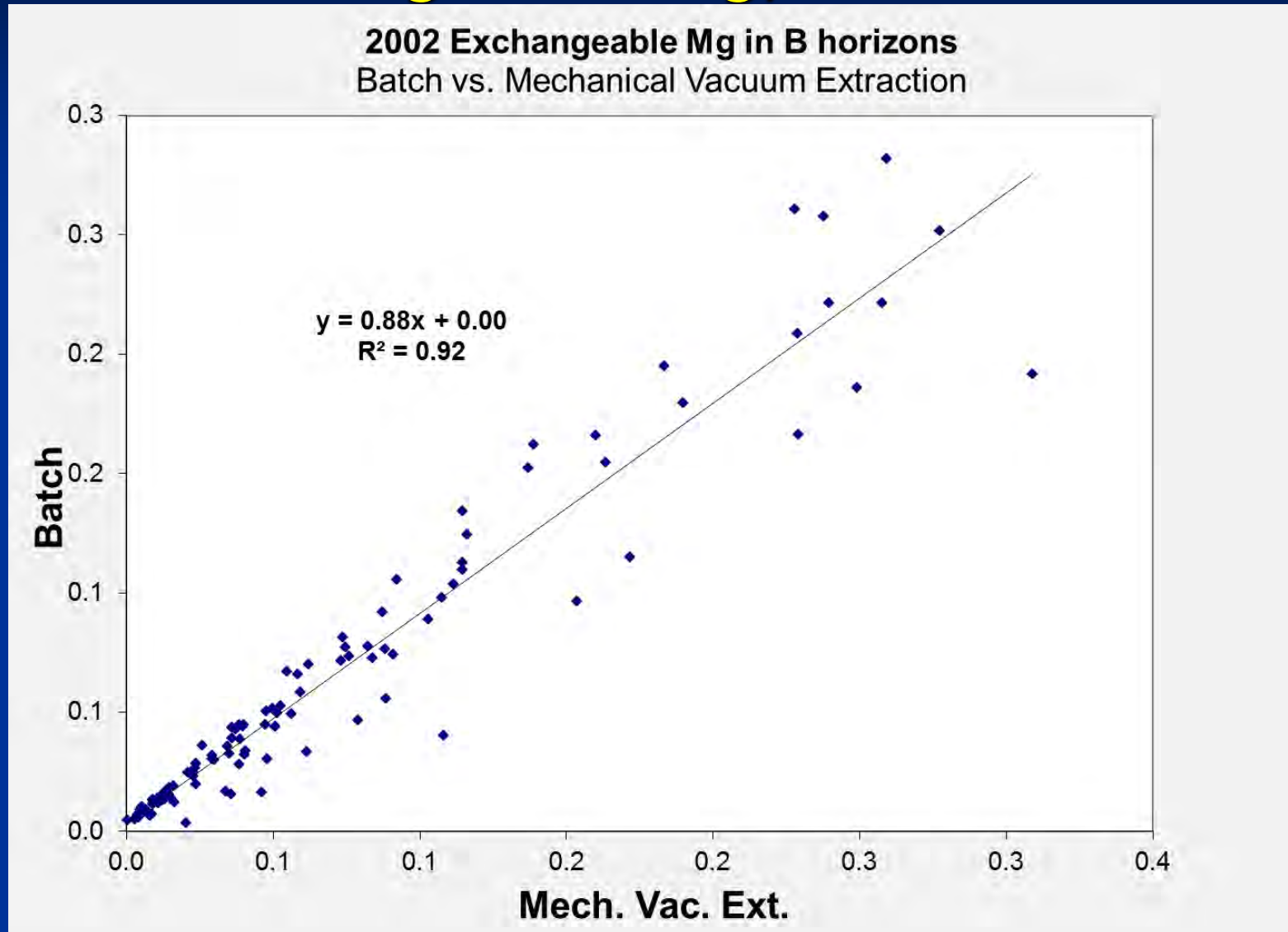
Comparisons

1. 2002 B horizon exchangeable cations
UVM batch vs. UVM/FS MVE
NRCS data not used
2. 2007 depth samples vs. 2007 horizons
Horizons 'prorated' to 10 cm
If: 7 cm Bhs1, 16 cm Bhs 2
 $10\text{-cm Ca} = 0.7 \times \text{Ca1} + 0.3 \times \text{Ca2}$
3. 2002 vs. 2007
 - Average of all B horizons

2002 exchangeable Ca, batch vs. MVE

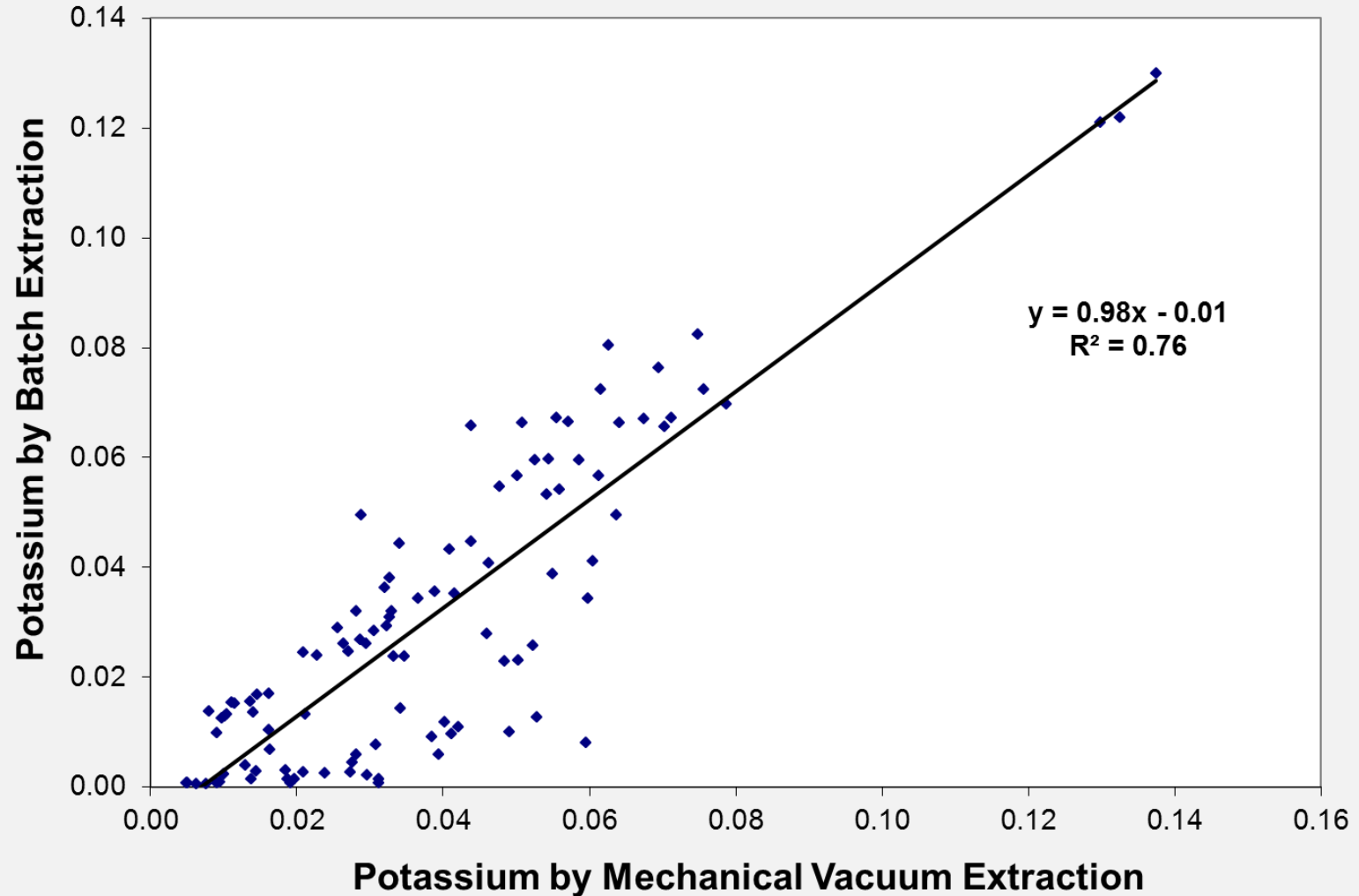


2002 exchangeable Mg, batch vs. MVE

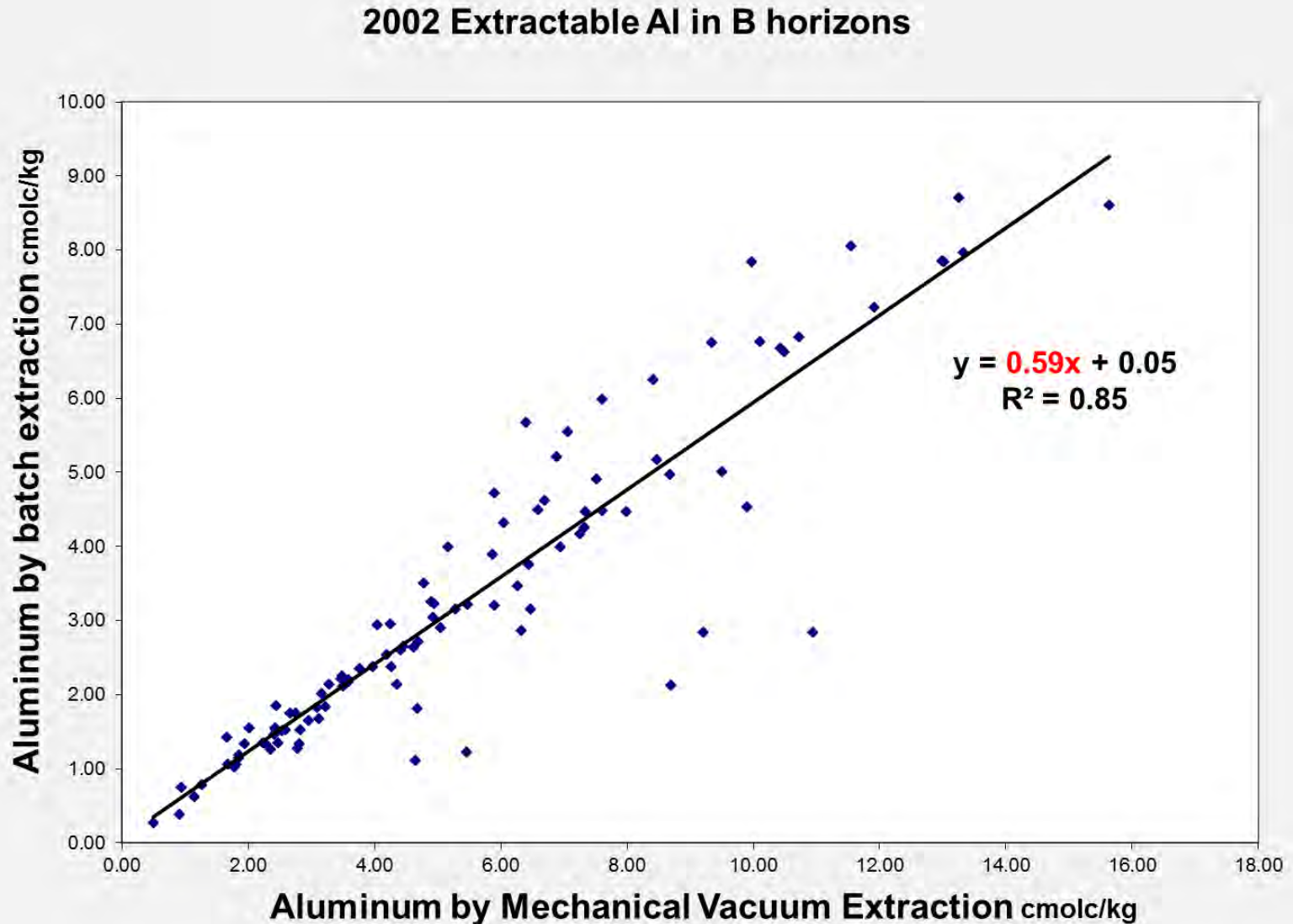


2002 exchangeable K, batch vs. MVE

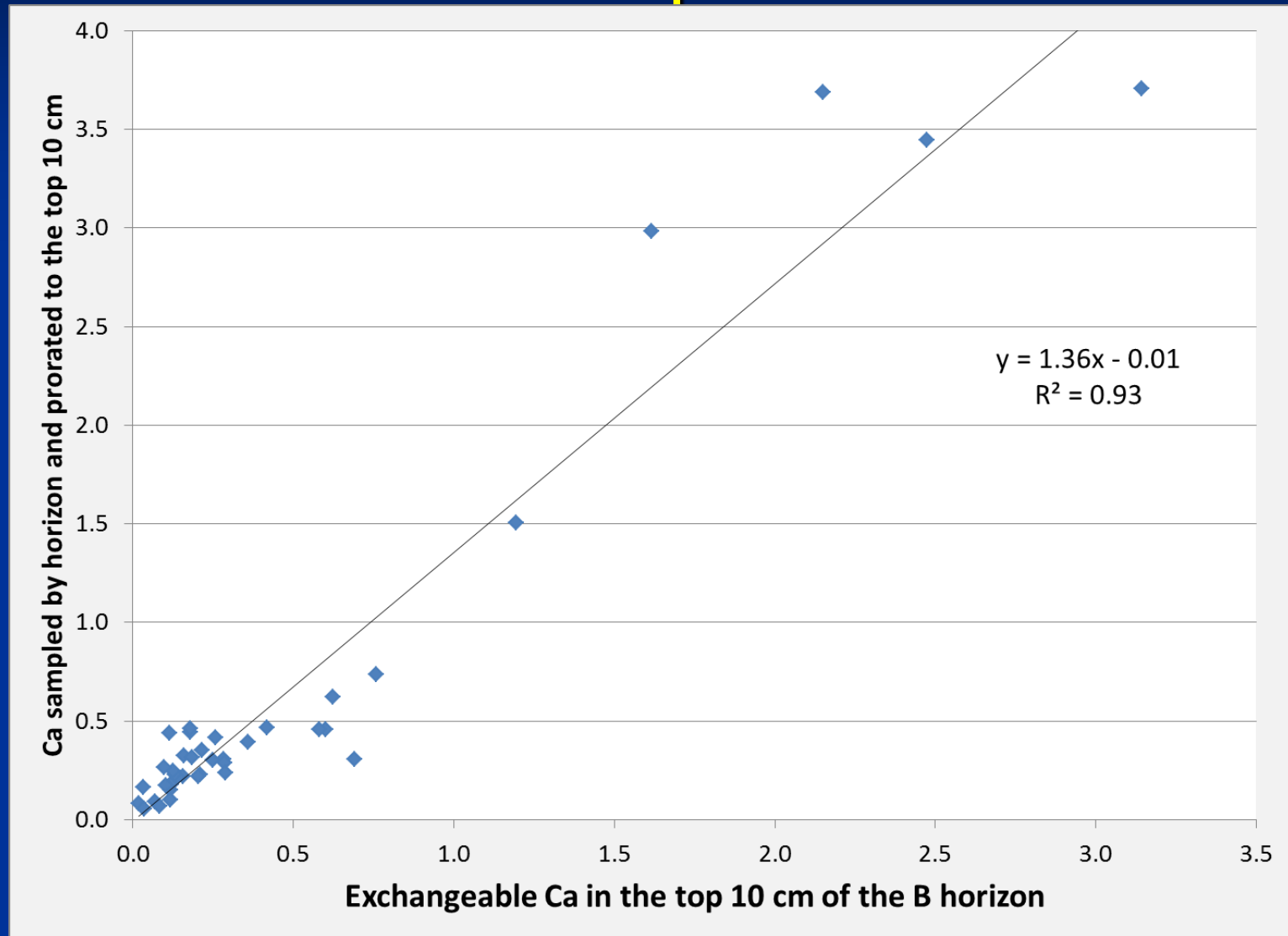
2002 Exchangeable K in B horizons



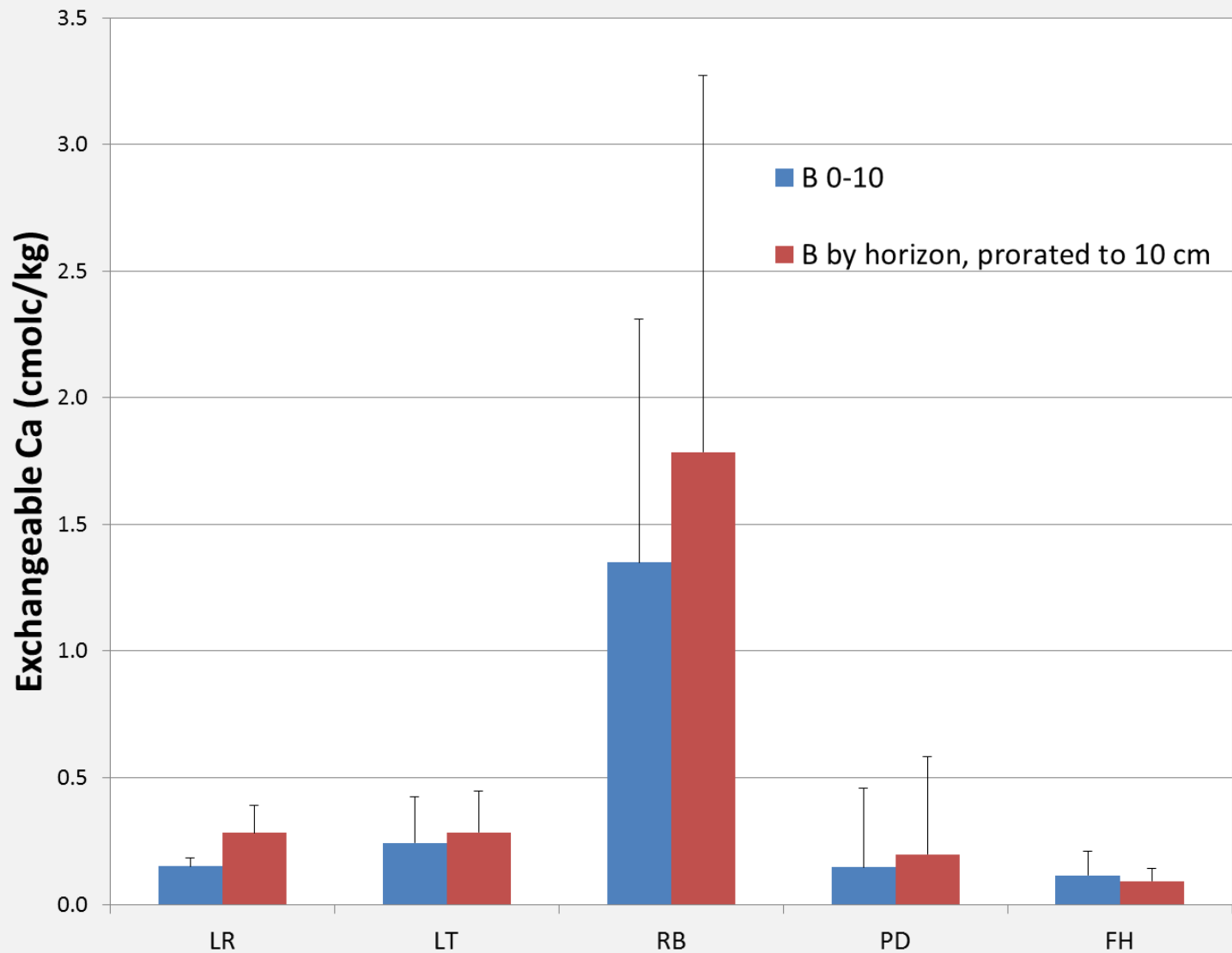
2002 exchangeable Al, batch vs. MVE



2007 exchangeable Ca 0-10 cm sample vs. prorated horizon

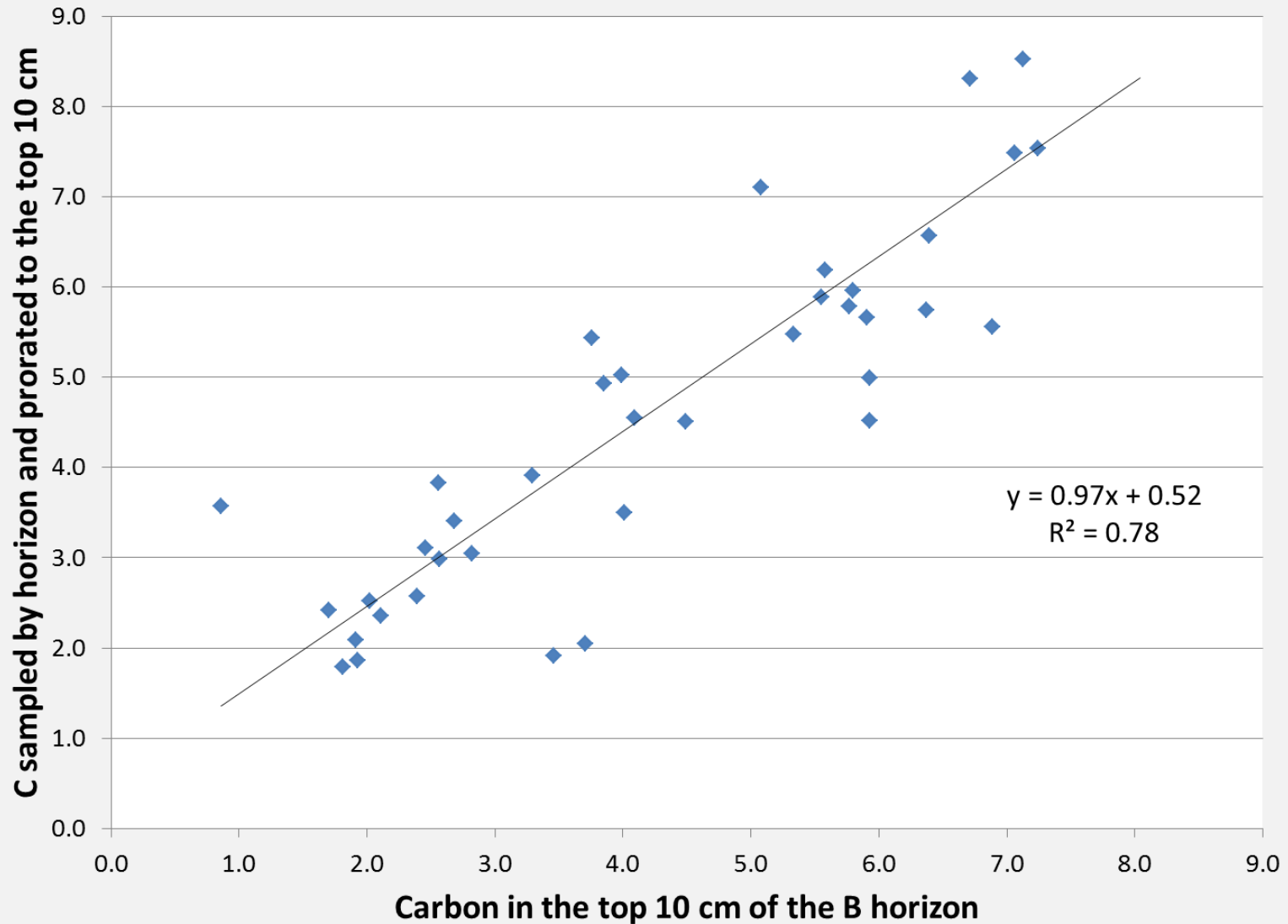


2007 exchangeable Ca 0-10 cm sample vs. prorated horizon



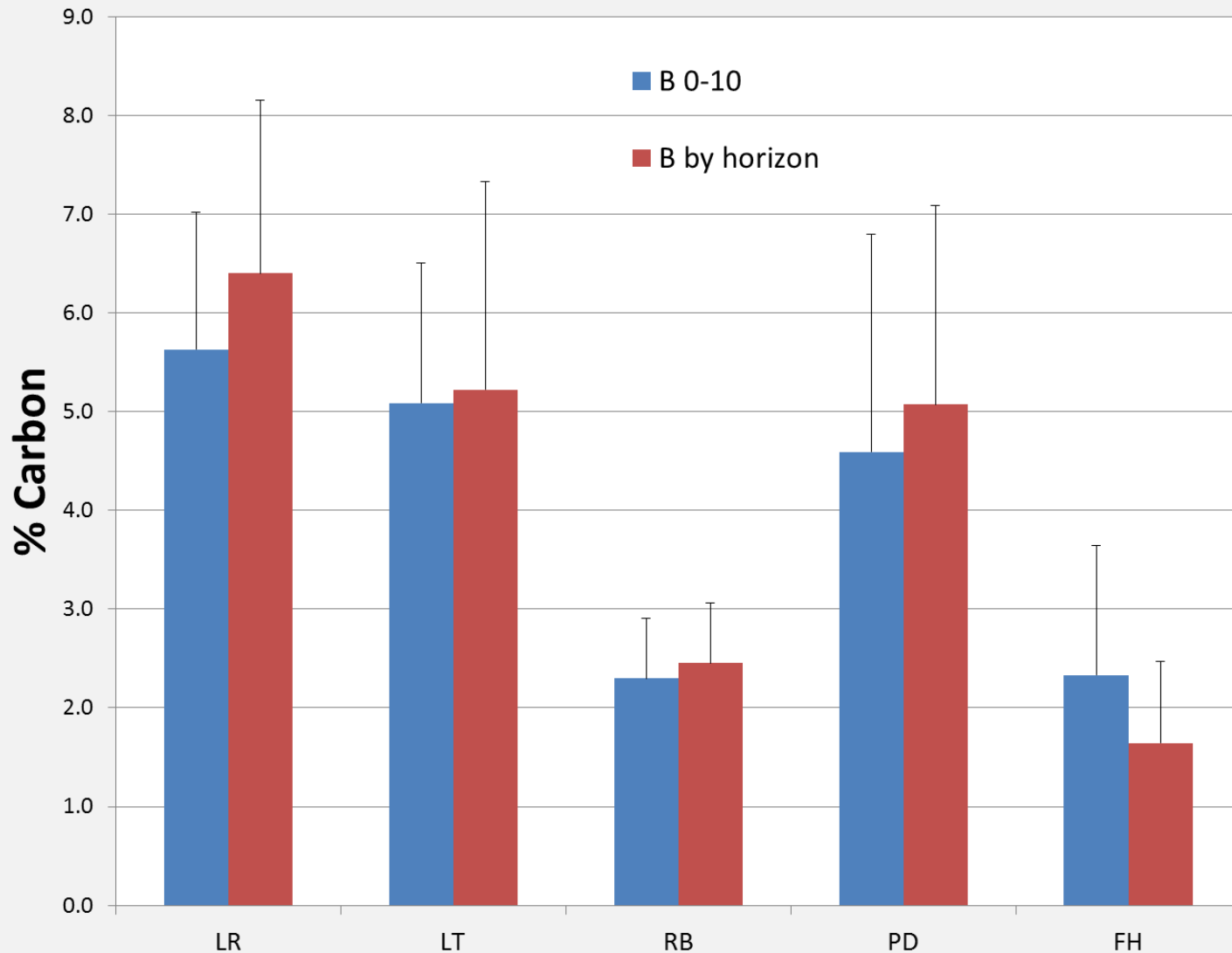
2007 total carbon

0-10 cm sample vs. prorated horizon



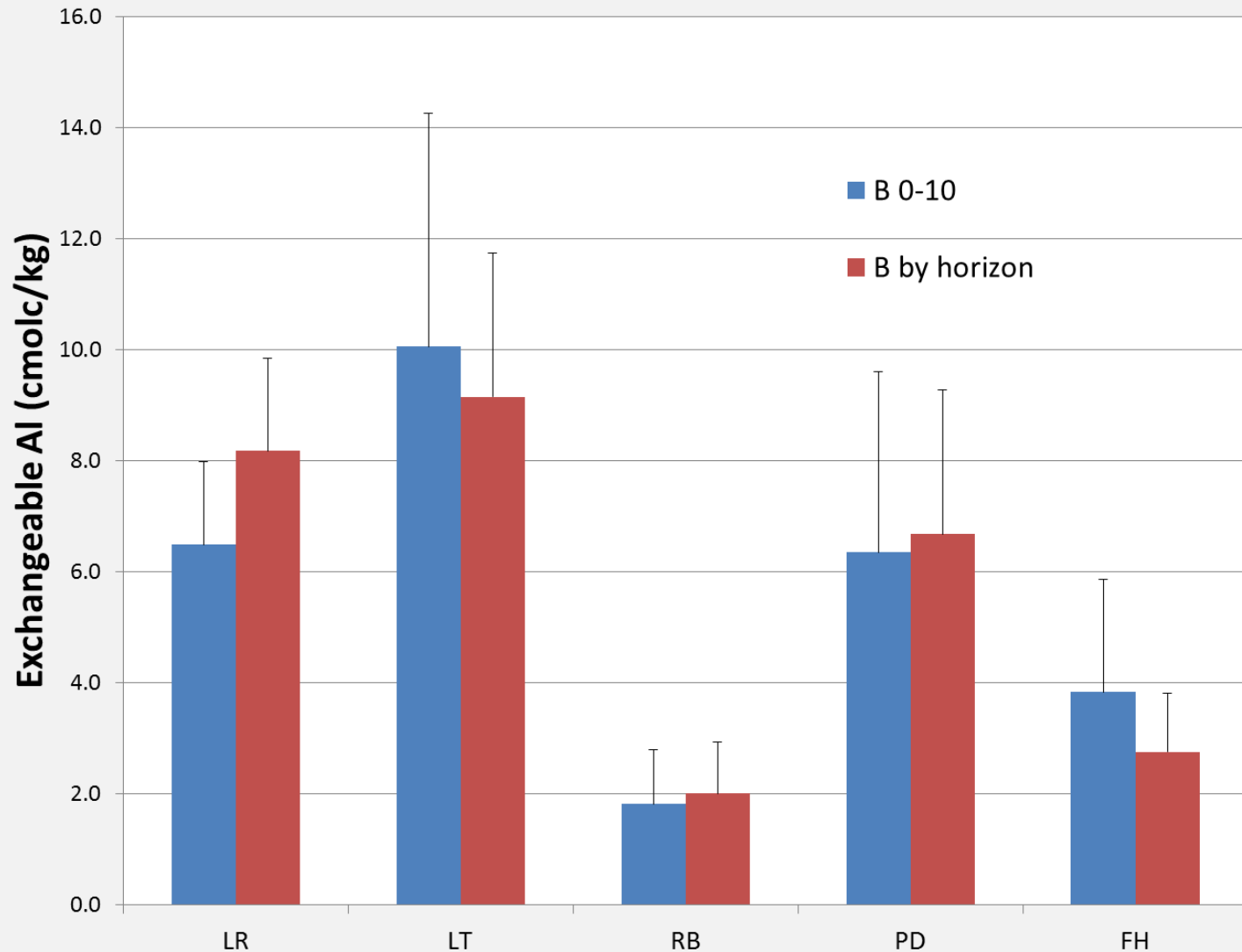
2007 total carbon

0-10 cm sample vs. prorated horizon



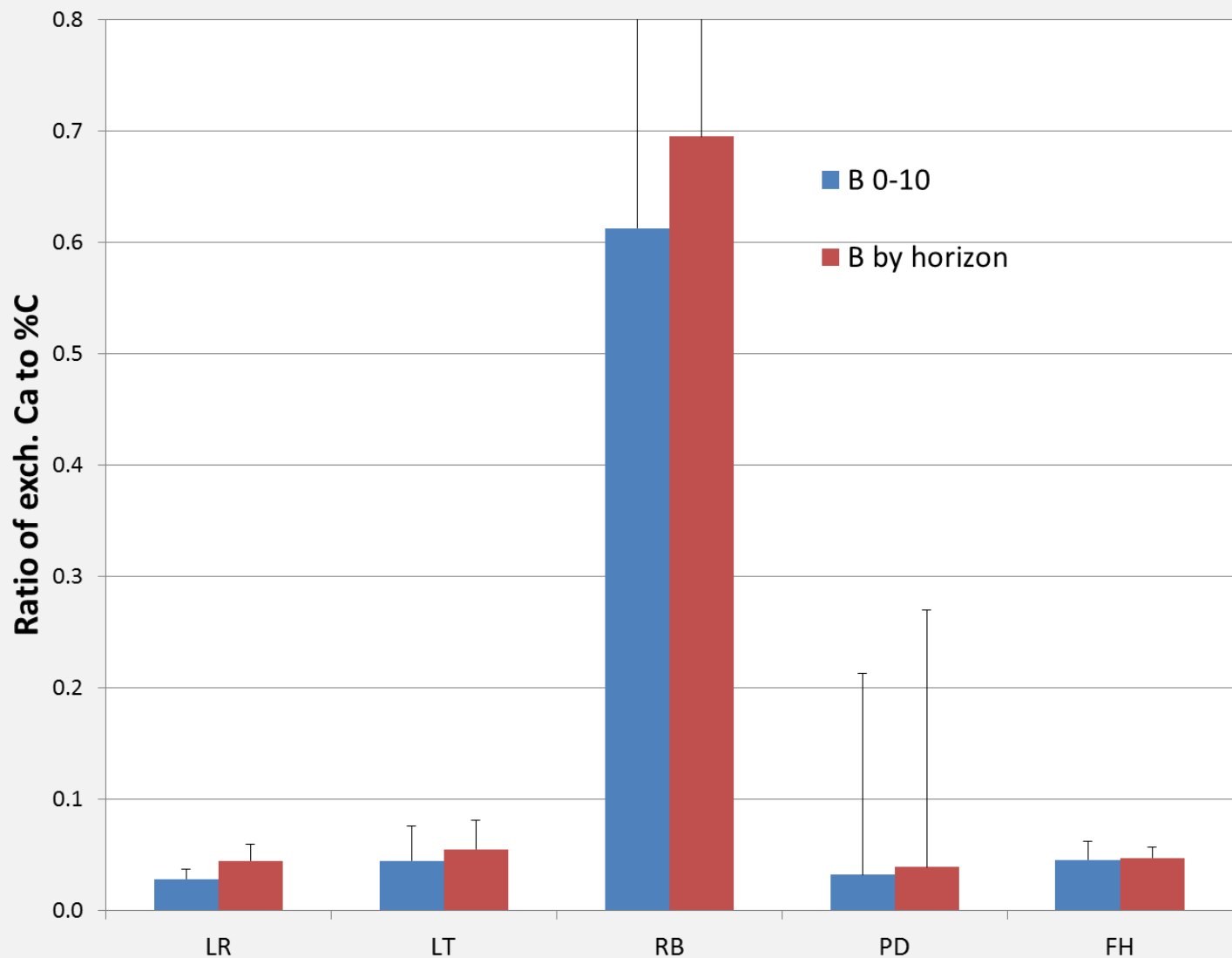
2007 exchangeable Al

0-10 cm sample vs. prorated horizon

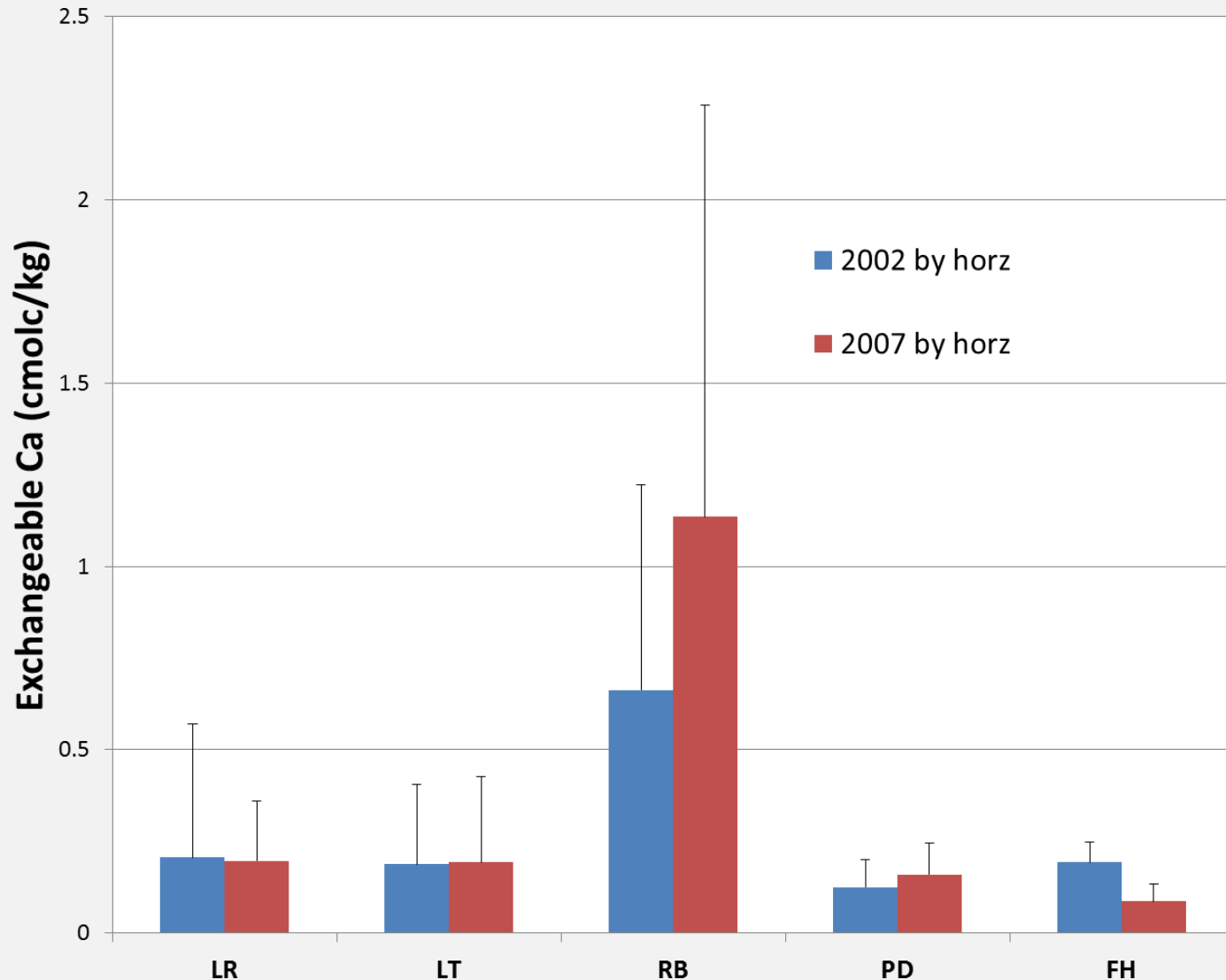


2007 Ca:C ratio

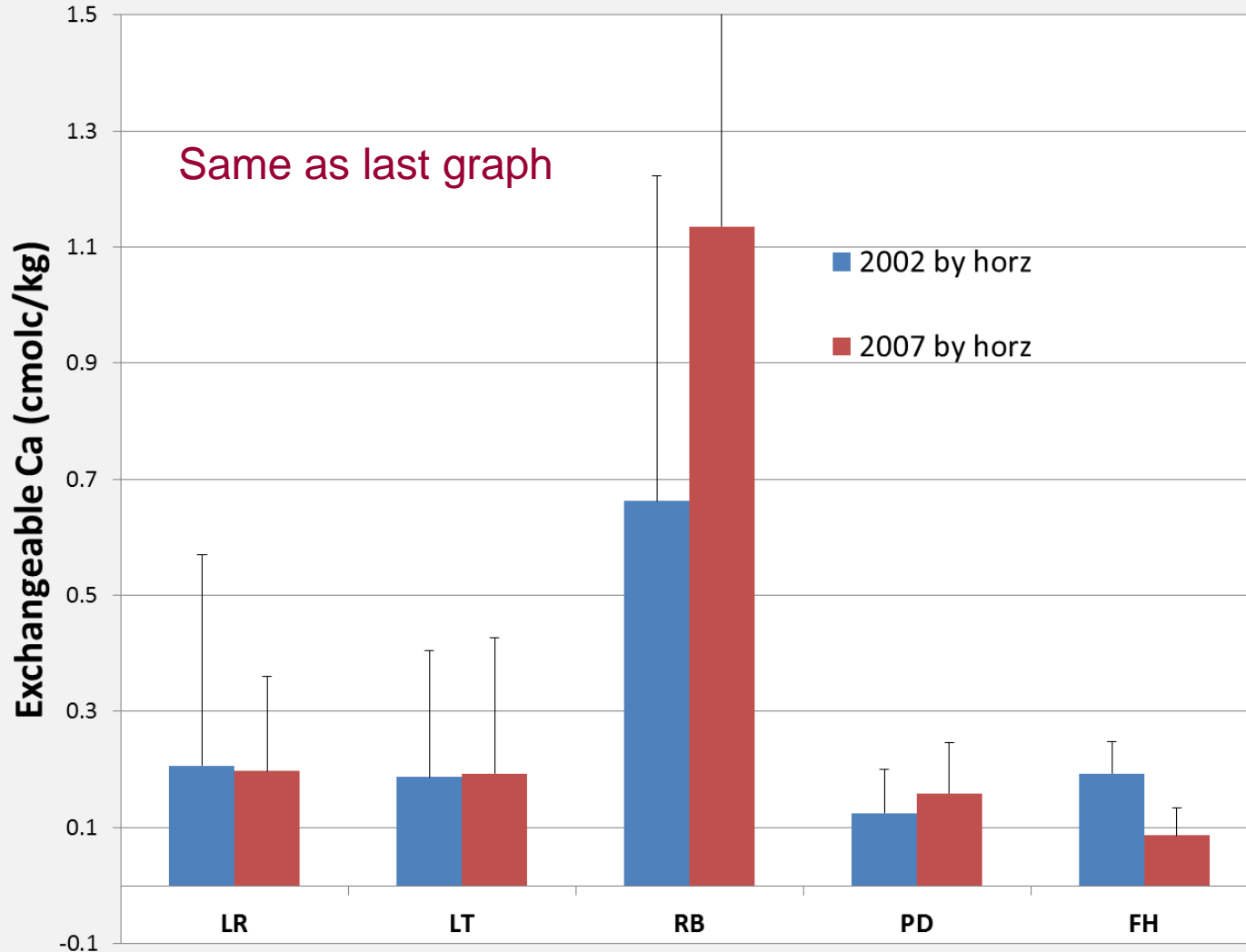
0-10 cm sample vs. prorated horizon



2002 vs. 2007 exchangeable Ca average of all B horizons



2002 vs. 2007 exchangeable Ca average of all B horizons



Ranch exchangeable Ca in the uppermost B horizon

Red is 2002 and blue is 2007

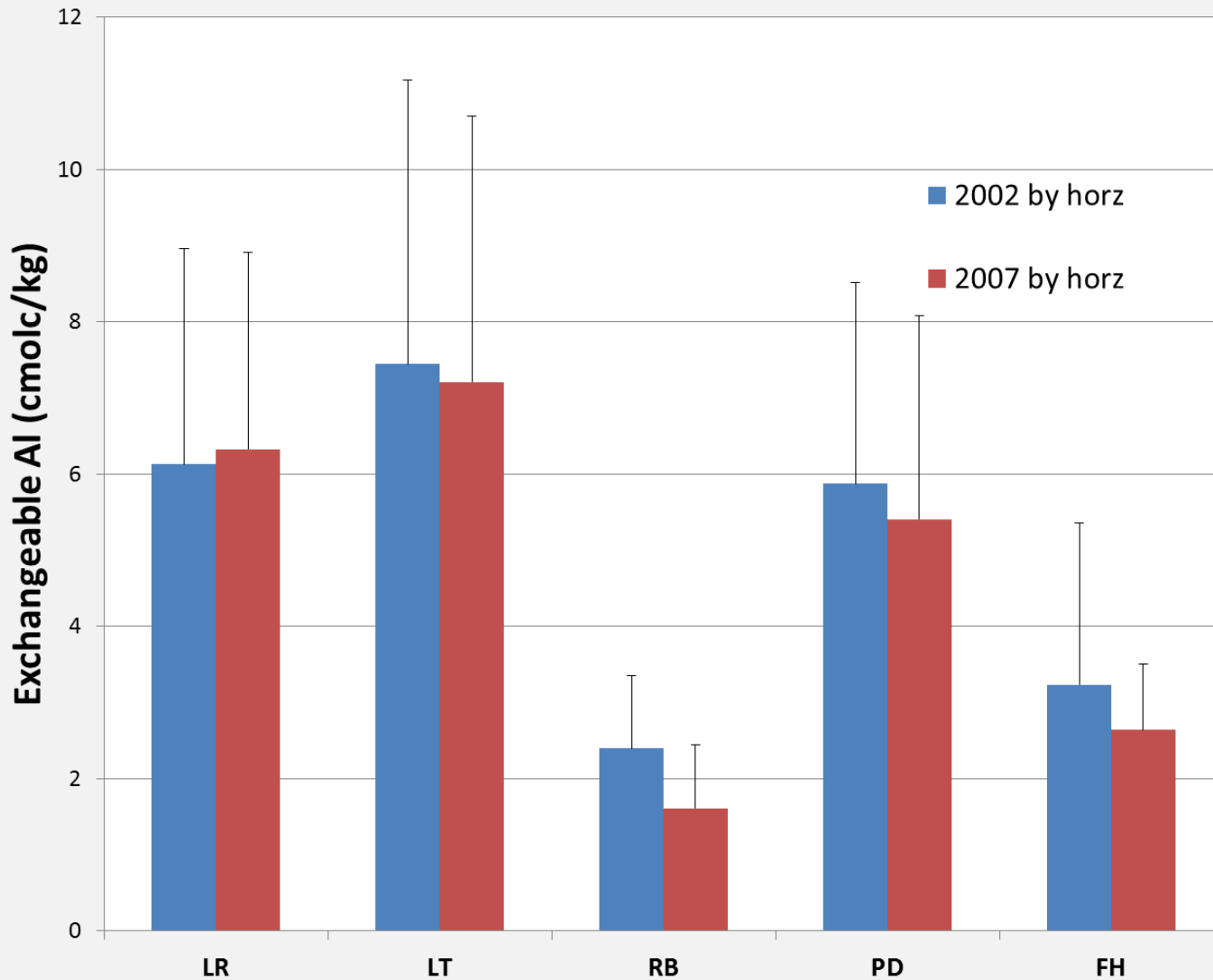
91	92	93	94	95	96	1.50	98	99	1.85
81	82	83	84	85	86	3.71	3.69	89	90
71	72	73	74	0.74	76	77	78	79	80
61	0.31	63	64	0.78	2.46	67	68	69	70
51	0.74	53	54	55	56	57	58	59	60
41	42	43	44	45	46	47	48	49	3.45
0.33	32	0.34	34	0.37	0.31	37	38	39	40
21	22	23	24	25	26	27	28	29	2.98
11	0.55	0.44	14	15	16	17	18	19	0.93
0.46	2	3	0.70	5	6	7	8	9	10



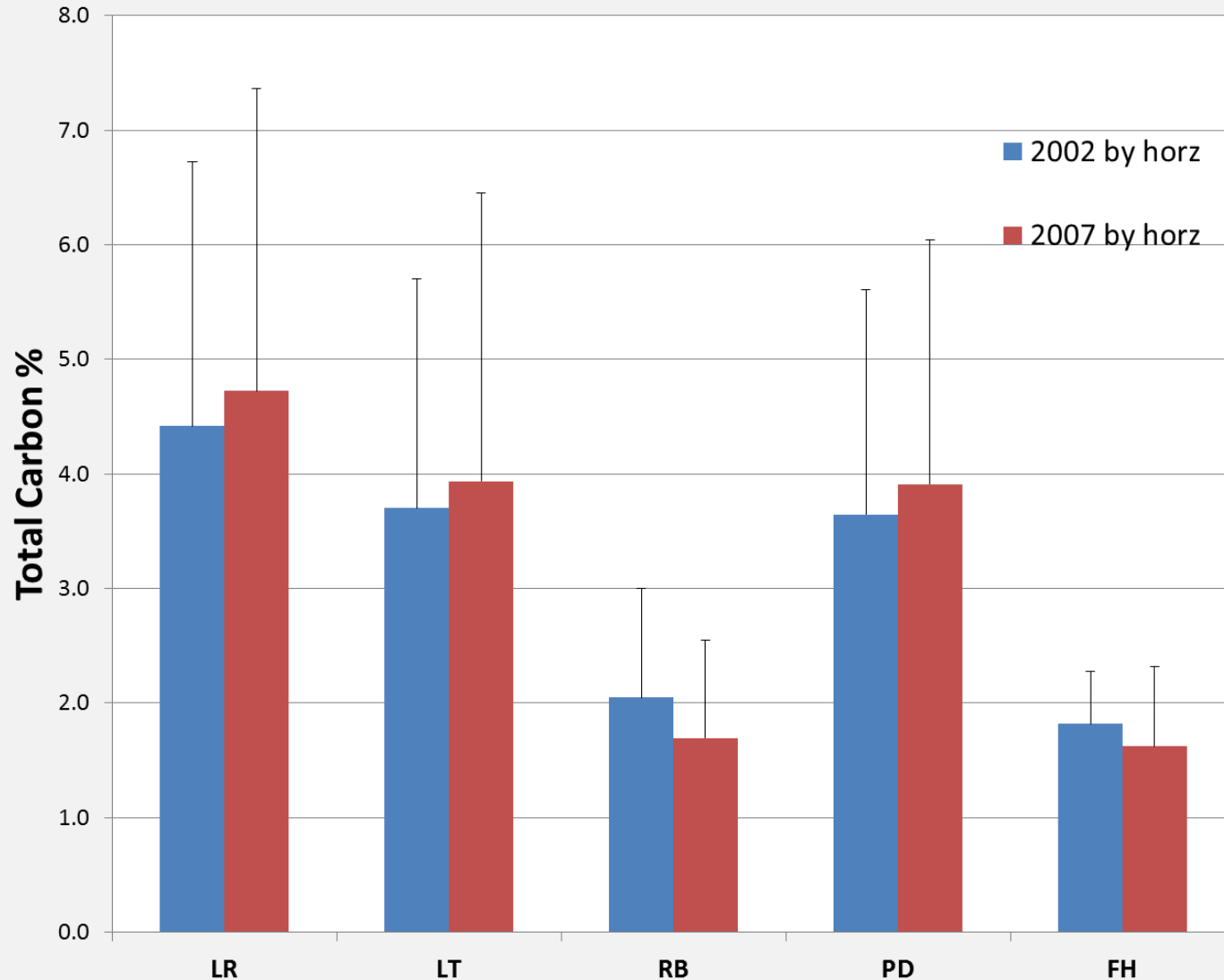
N

3

2002 vs. 2007 exchangeable Al average of all B horizons



2002 vs. 2007 total carbon average of all B horizons

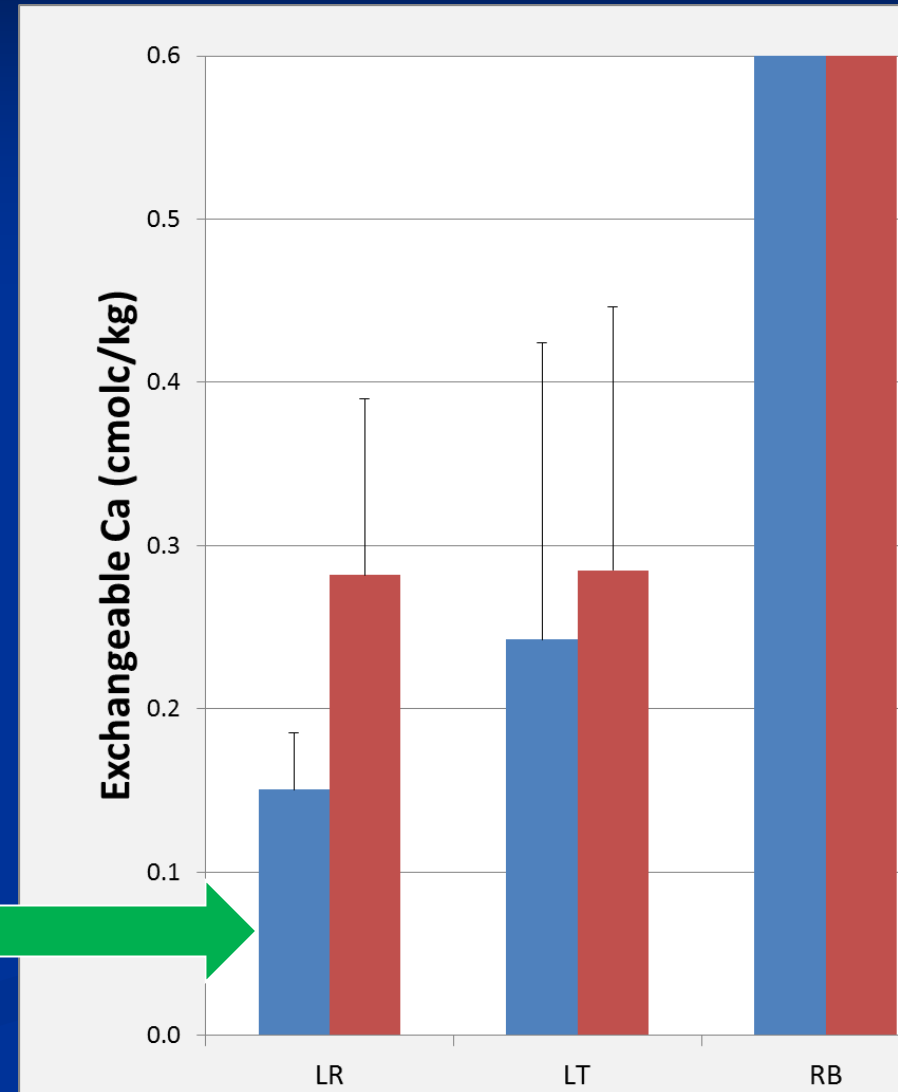


Power analysis

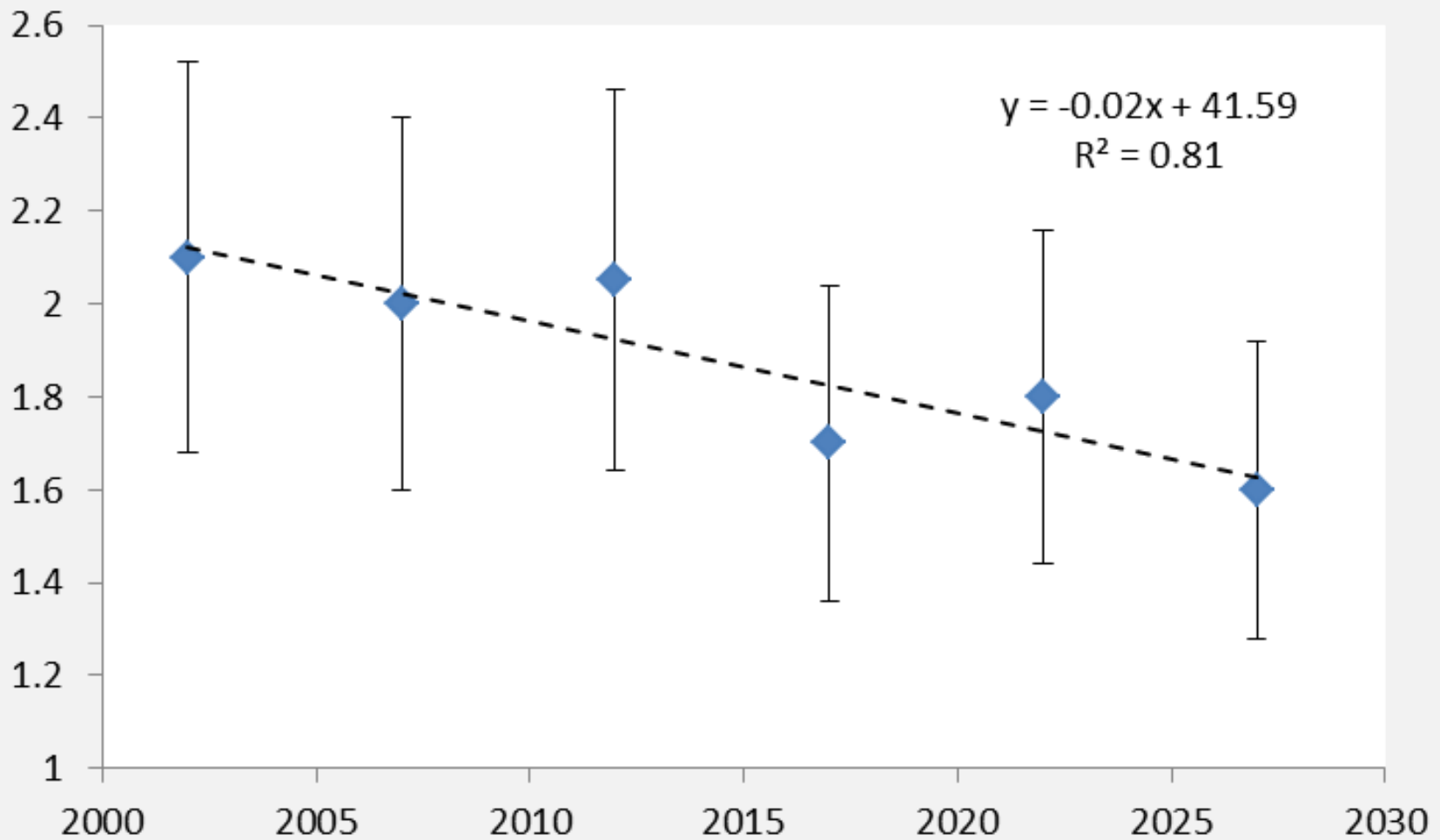
Lye Road B 0-10 cm
Exchangeable Ca
cmolc/kg

0.114
0.118
0.119
0.157
0.140
0.118
0.160
0.179
0.184
0.216

n	10
std dev	0.0348
mean	0.150
difference to detect	
<i>P</i> 0.05	0.071
<i>P</i> 0.10	0.060



Detecting change



Detecting change

Overview and experiences of the
Swiss soil monitoring network
over 25 years

- Focus on forest soils -

André Desaules

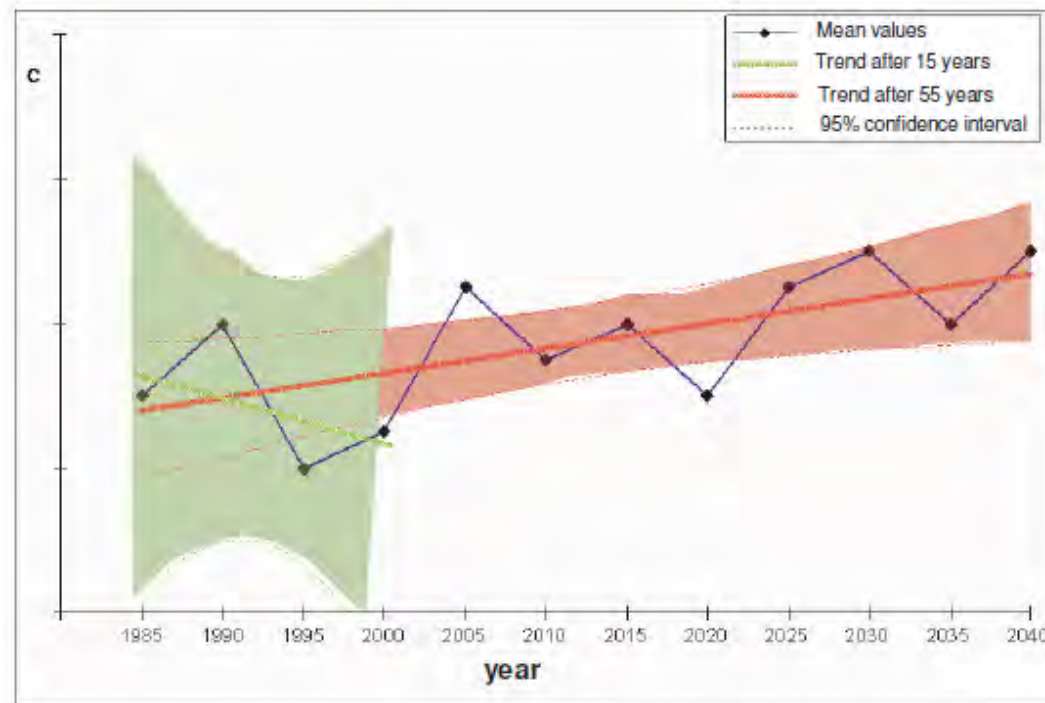
andre.desaules@art.admin.ch

Lesson 2: Trends can be identified and certified only after sufficiently intense and long measurement series. Measurements within the noise cannot be interpreted. With increasing number of measurements and accuracy noise can be reduced and trends earlier detected. This is the foundation of pleading for increasing measurement periodicity in soil monitoring as well.

Detecting change



2) Increasing measuring periodicity





Young volunteers needed!

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Vermont Monitoring
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US Forest Service
Thanks to Ethan Morehouse,
Joel Tilley and ... for lab work.