

RV-2023-01

Final Proficiency Test Report for cement

FLX-1004



Bedburg-Hau, May 4th, 2023

Coordinator of PT

Charlotte Winkels-Herding

Statistics and Report

Susan Aschenbrenner

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	Al2O3	CaO	Fe2O3	K2O	MgO	Mn2O3	Na2O
Unit	%	%	%	%	%	%	%
No. of laboratories	28	28	28	26	28	26	26
Mean m	6,479	58,201	2,606	0,689	2,951	0,317	0,166
Reproducibility standard deviation s_R	0,058	0,371	0,053	0,099	0,071	0,015	0,029
Repeatability standard deviation s_r	0,025	0,078	0,008	0,009	0,010	0,002	0,010
Robust standard deviation s^*	0,055	0,354	0,006	0,062	0,098	0,092	0,072
Uncertainty U (s^*)	0,026	0,167	0,030	0,048	0,034	0,006	0,014
Uncertainty U (s_R)	0,027	0,175	0,025	0,049	0,034	0,007	0,014
Mean - 2* s_R	6,364	57,460	2,500	0,490	2,810	0,287	0,107
Mean + 2* s_R	6,594	58,942	2,712	0,888	3,092	0,347	0,224

	P2O5	SiO2	SO3	TiO2	LOI	Cl
Unit	%	%	%	%	%	%
No. of laboratories	26	28	26	28	29	13
Mean m	0,162	24,700	3,359	0,412	2,015	0,071
Reproducibility standard deviation s_R	0,005	0,243	0,159	0,013	0,096	0,006
Repeatability standard deviation s_r	0,002	0,024	0,025	0,004	0,012	0,001
Robust standard deviation s^*	0,013	0,028	0,005	0,240	0,150	0,012
Uncertainty U (s^*)	0,003	0,113	0,074	0,006	0,043	0,004
Uncertainty U (s_R)	0,002	0,115	0,078	0,006	0,045	0,004
Mean - 2* s_R	0,151	24,215	3,040	0,386	1,822	0,058
Mean + 2* s_R	0,172	25,185	3,678	0,438	2,207	0,083

All values are in mass % and are based on ignited sample material, except for Cl values based on dried sample material.

Mean	calculated from laboratory means using traceable methods only
s_R	Reproducibility standard deviation
s_r	Repeatability standard deviation
s^*	Robust standard deviation
U (s^*)	uncertainty calculated for a confidence interval of P= 95% (k=2)
U (s_R)	uncertainty calculated for a confidence interval of P= 95% (k=2)
Range of tolerance	Mean \pm 2 x s_R ; all labs within this range show satisfactory performance

Introduction

FLUXANA GmbH & Co. KG is a company providing services in the field of X-ray fluorescence analysis (XRF).

In 2011, FLUXANA introduced its own quality management.

In 2020 the accreditation of the FLUXANA Laboratory in Bedburg-Hau, Germany, was updated to DIN EN ISO/IEC 17025:2018 and FLUXANA received accreditation as Producer of Reference materials according to DIN EN ISO 17034:2017, as well.

The performance of proficiency tests is not yet accredited. However, the proficiency tests are conducted following the corresponding norms.

Outliers

Outliers in the statistical sense are typically not detected when using robust statistical methods because the robust A+S algorithms were found to work better than the classical approach (which is outlier detection plus arithmetic mean and classical s.d. formula). Obvious blunders are taken out before calculation and will be marked as 'information only'.

Further Information

All laboratory data is listed in the following evaluation report. Additional information about laboratory accreditation and analytical methods used is also provided. Calculation was done only on traceable methods.

Other methods, e.g., XRF using "pressed pellets" as the sample preparation method or XRF with the "standardless analysis" method, which are not traceable can also be used. These values will not be included in the evaluation. They will, however, be shown as 'information only' in the report and laboratory comparison.

The laboratory performance is shown based on z-scores. The diagrams show the laboratory data in comparison with the calculated mean values.

Participants

RHI Magnesita	Austria
CBR Antoing (Groupe Heidelberg Materials)	Belgium
Rio Tinto Aluminium/ARDC	Canada
Neste Oyj Corporation	Finland
Imerys	France
Lafarge Ciments Martres-Tolosane	France
SFC (Societe Francaise de Ceramique)	France
BASF SE	Germany
BMI - BRAAS GmbH	Germany
Chemische Fabrik Budenheim KG	Germany
Daimler AG	Germany
DAW SE (Dr. Robert-Murjahn-Institut GmbH)	Germany
Dorfner Analysezentrum und Anlagenplanungsgesellschaft mbH (Anzaplan)	Germany
Dyckerhoff GmbH	Germany
FLUXANA GmbH & Co. KG	Germany
Gebr. Pfeiffer SE	Germany
Horn & Co. Analytics GmbH (HUK)	Germany
IAB Weimar gGmbH	Germany
OPTERRA Wössingen GmbH	Germany
Rigaku Europe SE	Germany
SGS Institut Fresenius GmbH	Germany
Technische Universität Berlin	Germany
THYSENKRUPP STEEL EUROPE AG	Germany
Sharrcem Sh. P. K. - Titan Group	Kosovo
CRH Lab SP z o o	Poland
FERROCARBO Sp. z o.o.	Poland
Institute of Ceramic and Building Materials	Poland
Moravacem d.o.o	Serbia
Gfe-MIR	South Africa
D-LAB Degerfors Laboratorium AB	Sweden
LKAB	Sweden
Jura-Cement-Fabriken AG	Switzerland

Statistical Evaluation used for this PT

Calculation of Mean m

The mean m for all laboratories is calculated using the Hampel estimator (ISO/TS 20612:2007 9.2.3) based on the laboratory means μ using traceable methods only.

Calculation of reproducibility standard deviation s_R

The reproducibility standard deviation s_R is calculated using the Q-method (ISO/TS 20612:2007 9.2.3).

Calculation of repeatability standard deviation s_r

The repeatability standard deviation s_r is also calculated using the Q-method.

Calculation of robust standard deviation s^*

The robust standard deviation s^* is calculated from the laboratory means μ using the Q-method.

Calculation of uncertainty U_{s_R} (according to Nordtest TR 537 ed 3.1.)

The **uncertainty** U_{s_R} for a confidence interval of P=95% (k=2) can be calculated from the **reproducibility standard deviation** s_R (factor 1.25 for average median, robust statistics) and the number of participating laboratories p :

$$U_{s_R} = 2 * 1.25 * \frac{s_R}{\sqrt{p}}$$

Calculation of uncertainty U_{s^*} (according to ISO 13528:2022)

The **uncertainty** U_{s^*} for a confidence interval of P=95% (k=2) can be calculated from the **robust standard deviation** s^* (factor 1.25 for average median, robust statistics)) and the number of participating laboratories p :

$$U_{s^*} = 2 * 1.25 * \frac{s^*}{\sqrt{p}}$$

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The **uncertainty** U_{S^*} only takes the between laboratories uncertainty into account while the **uncertainty** U_{S_R} also includes the within laboratories uncertainty. Therefore U_{S_R} is recommended for use in accredited laboratories.

Laboratory performance

Laboratory proficiency assessment is based on z-scores.

The **z-score** z is calculated from all laboratory means μ :

$$z = \frac{m - \mu}{S_R}$$

m	Mean value for all laboratories (assigned value)
μ	Mean value of individual laboratory
S_R	Reproducibility standard deviation

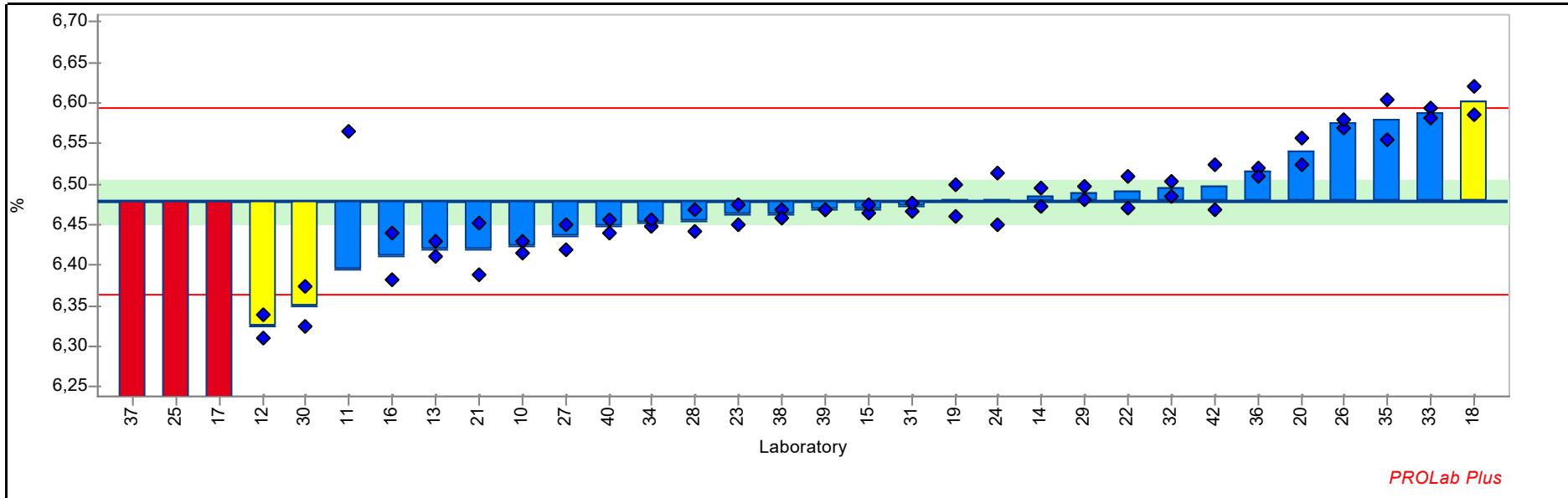
Assessment on z-scores:

$ z \leq 2.0$	indicates “satisfactory” performance = generates no signal
$2.0 < z < 3.0$	indicates “questionable” performance = generates a warning signal
$ z \geq 3.0$	indicates “unsatisfactory” performance = generates an action signal

Z-scores with $3 \geq |z| \geq 2$ are highlighted with a yellow color, z-scores with $|z| \geq 3$ are highlighted with a red color.

Summary results

Sample: FLX-1004 **Reprod. s.d.:** 0,058 %
Measurand: Al2O3 **Repeat. s.d:** 0,025 %
Mean ± U(Mean): 6,479 ± 0,026 % **Range of tolerance:** 6,364 - 6,594 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 28 **Statistical method:** Q/Hampel

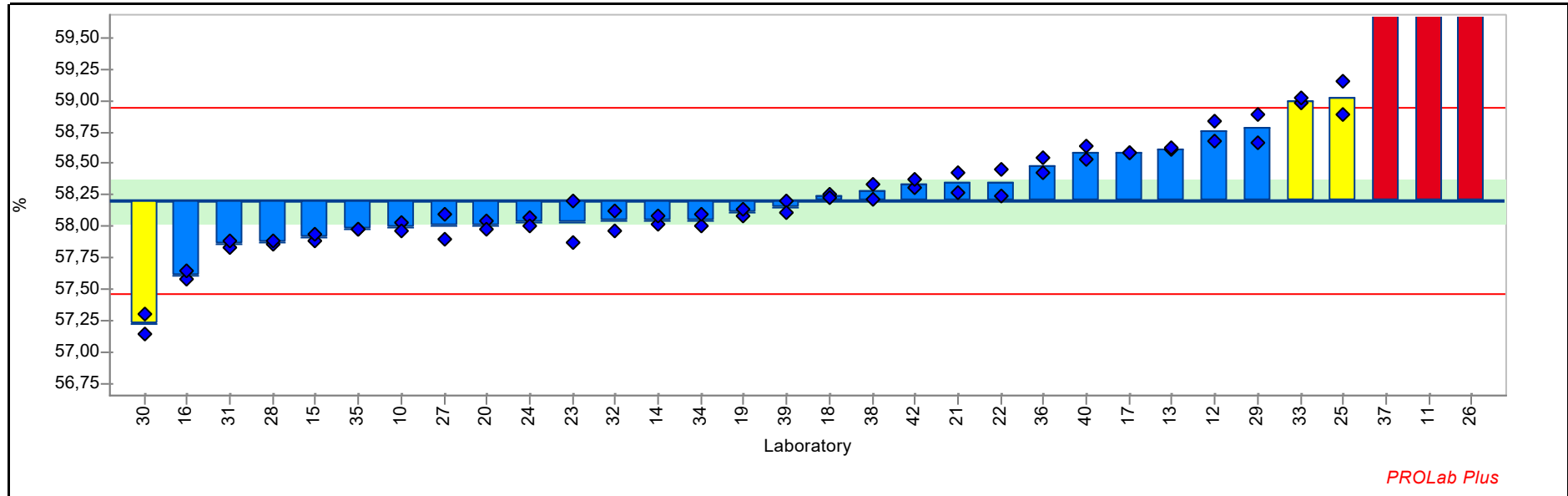


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	6,429	6,416	6,423	0,009	-1,0	XRF (fusion)	no accreditation	
11	6,564	6,225	6,394	0,240	-1,5	XRF (fusion)	no accreditation	
12	6,310	6,340	6,325	0,021	-2,7	XRF (pressed pellet)	no accreditation	Info only
13	6,410	6,430	6,420	0,014	-1,0	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	6,495	6,473	6,484	0,016	0,1	XRF (fusion)	no accreditation	
15	6,464	6,474	6,469	0,007	-0,2	XRF (fusion)	ISO 17025	PN-EN ISO 12677:2011

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
16	6,439	6,382	6,410	0,040	-1,2	XRF (fusion)	no accreditation	DIN EN 196-2
17	6,140	6,210	6,175	0,049	-5,3	XRF (fusion)	no accreditation	DIN EN 196-2; Info only
18	6,585	6,620	6,603	0,025	2,2	XRF (fusion)	ISO 17025	ISO 29581-2 2010
19	6,460	6,500	6,480	0,028	0,0	XRF (fusion)	no accreditation	
20	6,556	6,524	6,540	0,023	1,1	XRF (fusion)	no accreditation	ISO 29581-2
21	6,389	6,451	6,420	0,044	-1,0	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	6,510	6,470	6,490	0,028	0,2	XRF (fusion)	no accreditation	
23	6,475	6,450	6,463	0,018	-0,3	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	6,450	6,513	6,482	0,045	0,0	XRF (fusion)	no accreditation	DIN EN 196-2
25	6,184	6,107	6,146	0,054	-5,8	XRF (fusion)	no accreditation	
26	6,570	6,580	6,575	0,007	1,7	XRF (fusion)	no accreditation	
27	6,420	6,450	6,435	0,021	-0,8	Other Method	no accreditation	
28	6,468	6,442	6,455	0,018	-0,4	XRF (fusion)	no accreditation	
29	6,481	6,498	6,489	0,012	0,2	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	6,373	6,325	6,349	0,034	-2,3	XRF (fusion)	no accreditation	Info only
31	6,467	6,477	6,472	0,007	-0,1	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	6,504	6,485	6,495	0,013	0,3	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	6,594	6,582	6,588	0,008	1,9	XRF (fusion)	no accreditation	DIN EN 196-2
34	6,448	6,457	6,453	0,006	-0,5	XRF (fusion)	no accreditation	ISO 12677
35	6,555	6,603	6,579	0,034	1,7	XRF (fusion)	ISO 17025	DIN EN 196-2
36	6,520	6,510	6,515	0,007	0,6	XRF (fusion)	no accreditation	DIN EN 196-2
37	5,863	5,865	5,864	0,001	-10,7	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	6,468	6,458	6,463	0,007	-0,3	Other Method	ISO 17025	
39	6,469	6,468	6,469	0,001	-0,2	XRF (fusion)	ISO 17025	DIN EN 196-2
40	6,440	6,457	6,449	0,012	-0,5	XRF (fusion)		
42	6,524	6,469	6,497	0,039	0,3	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,371 %
Measurand: CaO **Repeat. s.d.:** 0,078 %
Mean ± U(Mean): 58,201 ± 0,167 % **Range of tolerance:** 57,460 - 58,942 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 28 **Statistical method:** Q/Hampel

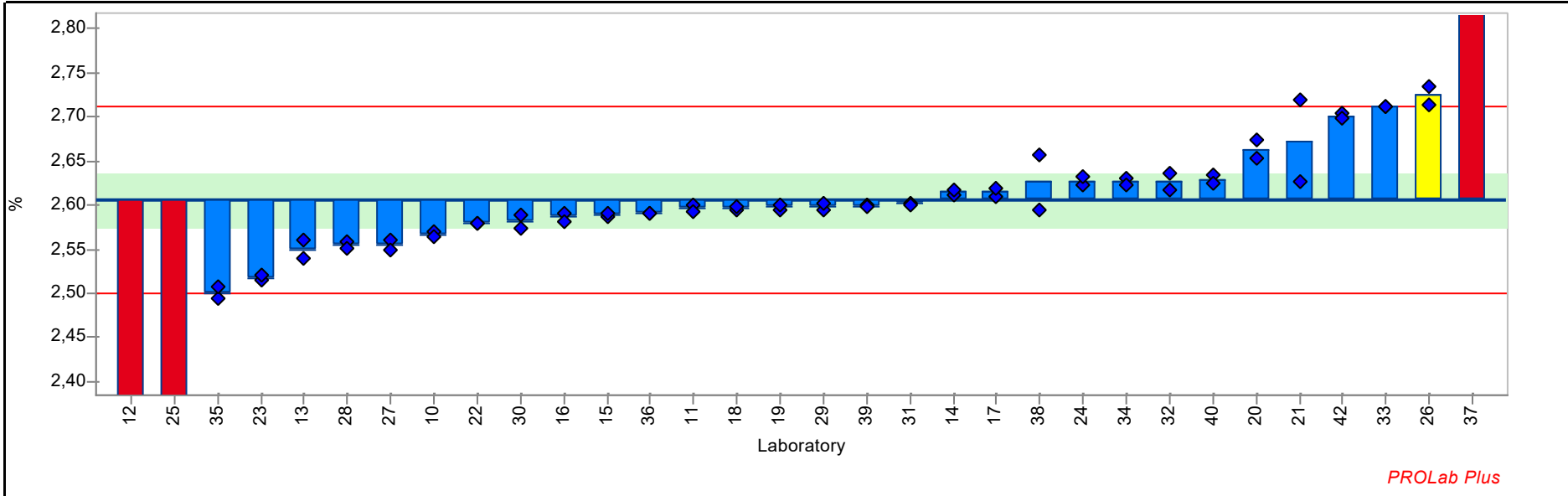


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	58,024	57,966	57,995	0,041	-0,6	XRF (fusion)	no accreditation	
11	61,584	61,511	61,547	0,052	9,0	XRF (fusion)	no accreditation	
12	58,830	58,680	58,755	0,106	1,5	XRF (pressed pellet)	no accreditation	Info only
13	58,610	58,620	58,615	0,007	1,1	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	58,011	58,077	58,044	0,047	-0,4	XRF (fusion)	no accreditation	
15	57,889	57,936	57,913	0,033	-0,8	XRF (fusion)	ISO 17025	PN-EN ISO 12677:2011
16	57,573	57,647	57,610	0,052	-1,6	XRF (fusion)	no accreditation	DIN EN 196-2
17	58,590	58,580	58,585	0,007	1,0	XRF (fusion)	no accreditation	DIN EN 196-2; Info only

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
18	58,257	58,225	58,241	0,023	0,1	XRF (fusion)	ISO 17025	ISO 29581-2 2010
19	58,080	58,133	58,106	0,037	-0,3	XRF (fusion)	no accreditation	
20	58,045	57,970	58,008	0,053	-0,5	XRF (fusion)	no accreditation	ISO 29581-2
21	58,267	58,423	58,345	0,110	0,4	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	58,240	58,450	58,345	0,148	0,4	XRF (fusion)	no accreditation	
23	57,865	58,205	58,035	0,240	-0,4	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	58,064	58,000	58,032	0,045	-0,5	XRF (fusion)	no accreditation	DIN EN 196-2
25	58,884	59,150	59,017	0,188	2,2	XRF (fusion)	no accreditation	
26	62,620	62,740	62,680	0,085	12,1	XRF (fusion)	no accreditation	
27	57,900	58,100	58,000	0,141	-0,5	Other Method	no accreditation	
28	57,855	57,890	57,873	0,025	-0,9	XRF (fusion)	no accreditation	
29	58,670	58,885	58,778	0,152	1,6	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	57,295	57,140	57,218	0,110	-2,7	XRF (fusion)	no accreditation	Info only
31	57,834	57,880	57,857	0,033	-0,9	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	58,123	57,958	58,040	0,117	-0,4	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	58,986	59,017	59,002	0,022	2,2	XRF (fusion)	no accreditation	DIN EN 196-2
34	58,003	58,092	58,047	0,063	-0,4	XRF (fusion)	no accreditation	ISO 12677
35	57,975	57,982	57,978	0,005	-0,6	XRF (fusion)	ISO 17025	DIN EN 196-2
36	58,430	58,540	58,485	0,078	0,8	XRF (fusion)	no accreditation	DIN EN 196-2
37	61,500	61,411	61,456	0,063	8,8	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	58,335	58,220	58,278	0,081	0,2	Other Method	ISO 17025	
39	58,196	58,110	58,153	0,061	-0,1	XRF (fusion)	ISO 17025	DIN EN 196-2
40	58,531	58,635	58,583	0,074	1,0	XRF (fusion)		
42	58,311	58,369	58,340	0,041	0,4	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,053 %
Measurand: Fe2O3 **Repeat. s.d:** 0,008 %
Mean ± U(Mean): 2,606 ± 0,030 % **Range of tolerance:** 2,500 - 2,712 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 28 **Statistical method:** Q/Hampel

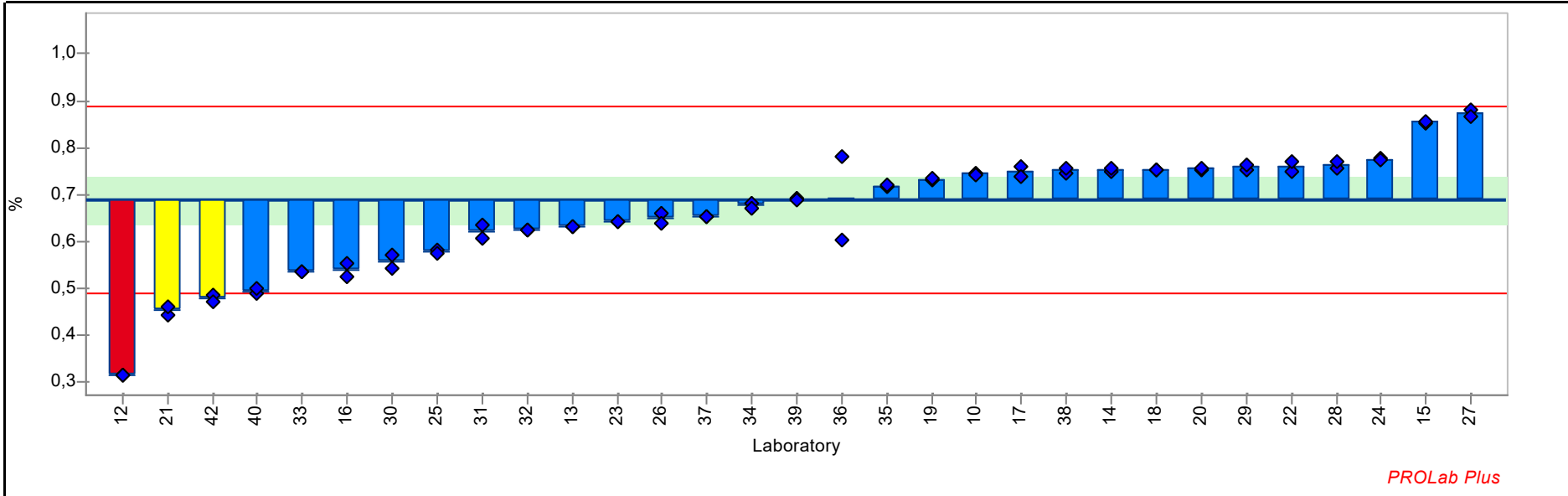


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	2,569	2,565	2,567	0,003	-0,7	XRF (fusion)	no accreditation	
11	2,601	2,593	2,597	0,006	-0,2	XRF (fusion)	no accreditation	
12	2,275	2,290	2,282	0,011	-6,1	XRF (pressed pellet)	no accreditation	Info only
13	2,560	2,540	2,550	0,014	-1,1	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	2,612	2,618	2,615	0,004	0,2	XRF (fusion)	no accreditation	
15	2,587	2,590	2,588	0,002	-0,3	XRF (fusion)	ISO 17025	PN-EN ISO 12677:2011
16	2,591	2,582	2,587	0,006	-0,4	XRF (fusion)	no accreditation	DIN EN 196-2
17	2,610	2,620	2,615	0,007	0,2	XRF (fusion)	no accreditation	DIN EN 196-2; Info only

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
18	2,595	2,599	2,597	0,003	-0,2	XRF (fusion)	ISO 17025	ISO 29581-2 2010
19	2,595	2,600	2,598	0,004	-0,2	XRF (fusion)	no accreditation	
20	2,653	2,674	2,663	0,015	1,1	XRF (fusion)	no accreditation	ISO 29581-2
21	2,719	2,626	2,672	0,066	1,3	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	2,580	2,580	2,580	0,000	-0,5	XRF (fusion)	no accreditation	
23	2,515	2,520	2,518	0,004	-1,7	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	2,622	2,632	2,627	0,007	0,4	XRF (fusion)	no accreditation	DIN EN 196-2
25	2,309	2,322	2,316	0,009	-5,5	XRF (fusion)	no accreditation	
26	2,714	2,735	2,724	0,015	2,2	XRF (fusion)	no accreditation	
27	2,560	2,550	2,555	0,007	-1,0	Other Method	no accreditation	
28	2,558	2,551	2,554	0,005	-1,0	XRF (fusion)	no accreditation	
29	2,594	2,602	2,598	0,006	-0,1	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	2,573	2,589	2,581	0,011	-0,5	XRF (fusion)	no accreditation	Info only
31	2,603	2,601	2,602	0,001	-0,1	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	2,618	2,637	2,627	0,013	0,4	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	2,711	2,712	2,712	0,001	2,0	XRF (fusion)	no accreditation	DIN EN 196-2
34	2,631	2,623	2,627	0,006	0,4	XRF (fusion)	no accreditation	ISO 12677
35	2,494	2,507	2,501	0,009	-2,0	XRF (fusion)	ISO 17025	DIN EN 196-2
36	2,590	2,590	2,590	0,000	-0,3	XRF (fusion)	no accreditation	DIN EN 196-2
37	3,054	3,045	3,050	0,006	8,4	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	2,657	2,595	2,626	0,044	0,4	Other Method	ISO 17025	
39	2,600	2,598	2,599	0,001	-0,1	XRF (fusion)	ISO 17025	DIN EN 196-2
40	2,634	2,624	2,629	0,007	0,4	XRF (fusion)		
42	2,704	2,698	2,701	0,004	1,8	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,099 %
Measurand: K2O **Repeat. s.d:** 0,009 %
Mean ± U(Mean): 0,689 ± 0,048 % **Range of tolerance:** 0,490 - 0,888 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 26 **Statistical method:** Q/Hampel

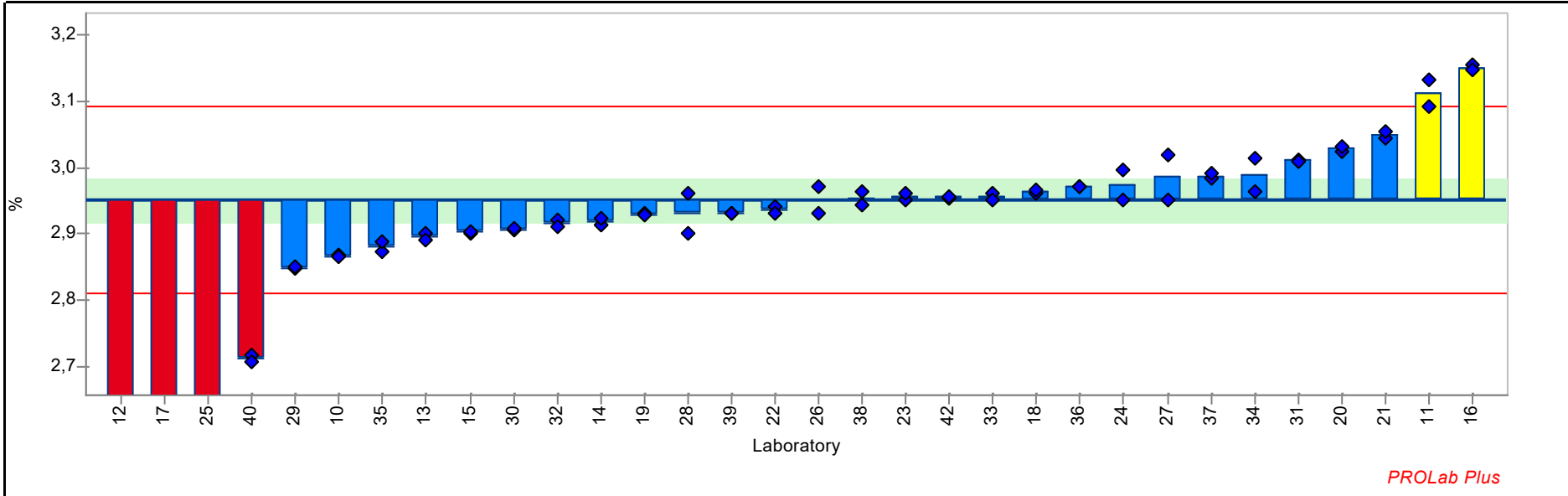


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	0,746	0,742	0,744	0,003	0,6	XRF (fusion)	no accreditation	
12	0,317	0,314	0,316	0,002	-3,8	XRF (pressed pellet)	no accreditation	Info only
13	0,630	0,630	0,630	0,000	-0,6	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	0,750	0,756	0,753	0,004	0,6	XRF (fusion)	no accreditation	
15	0,853	0,856	0,855	0,002	1,7	XRF (fusion)	ISO 17025	PN-EN ISO 12677:2011
16	0,524	0,554	0,539	0,021	-1,5	XRF (fusion)	no accreditation	DIN EN 196-2
17	0,760	0,740	0,750	0,014	0,6	XRF (fusion)	no accreditation	DIN EN 196-2; Info only
18	0,754	0,753	0,754	0,001	0,7	XRF (fusion)	ISO 17025	ISO 29581-2 2010

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
19	0,730	0,735	0,732	0,004	0,4	XRF (fusion)	no accreditation	
20	0,753	0,756	0,754	0,002	0,7	XRF (fusion)	no accreditation	ISO 29581-2
21	0,445	0,460	0,453	0,011	-2,4	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	0,750	0,770	0,760	0,014	0,7	XRF (fusion)	no accreditation	
23	0,644	0,641	0,643	0,002	-0,5	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	0,776	0,775	0,776	0,001	0,9	XRF (fusion)	no accreditation	DIN EN 196-2
25	0,581	0,576	0,579	0,004	-1,1	XRF (fusion)	no accreditation	
26	0,660	0,640	0,650	0,014	-0,4	XRF (fusion)	no accreditation	
27	0,880	0,866	0,873	0,010	1,9	Other Method	no accreditation	
28	0,755	0,771	0,763	0,011	0,7	XRF (fusion)	no accreditation	
29	0,754	0,763	0,758	0,006	0,7	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	0,542	0,572	0,557	0,021	-1,3	XRF (fusion)	no accreditation	Info only
31	0,637	0,608	0,623	0,021	-0,7	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	0,623	0,623	0,623	0,000	-0,7	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	0,536	0,535	0,536	0,001	-1,5	XRF (pressed pellet)	no accreditation	DIN EN 196-2, Info only
34	0,683	0,671	0,677	0,008	-0,1	XRF (fusion)	no accreditation	ISO 12677
35	0,718	0,719	0,718	0,001	0,3	XRF (fusion)	ISO 17025	DIN EN 196-2
36	0,782	0,605	0,694	0,125	0,0	XRF (fusion)	no accreditation	DIN EN 196-2
37	0,653	0,654	0,653	0,001	-0,4	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	0,746	0,756	0,751	0,007	0,6	Other Method	ISO 17025	
39	0,691	0,689	0,690	0,001	0,0	XRF (fusion)	ISO 17025	DIN EN 196-2
40	0,489	0,500	0,494	0,008	-2,0	XRF (fusion)		
42	0,486	0,472	0,479	0,010	-2,1	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,071 %
Measurand: MgO **Repeat. s.d.:** 0,010 %
Mean ± U(Mean): 2,951 ± 0,034 % **Range of tolerance:** 2,810 - 3,092 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 28 **Statistical method:** Q/Hampel

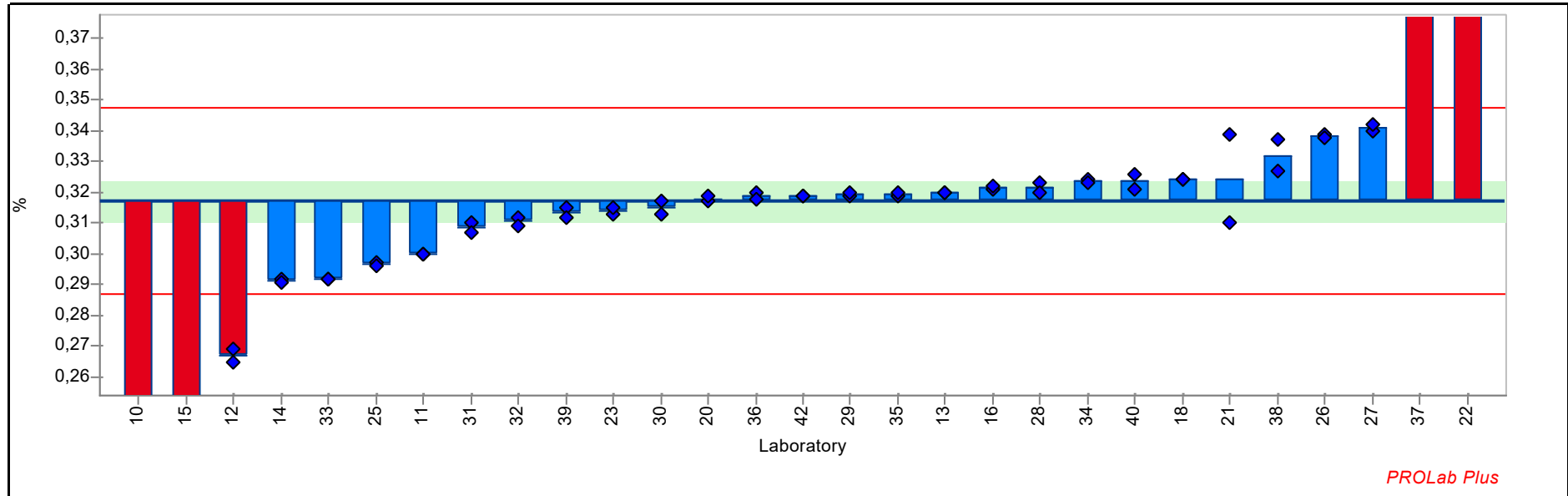


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	2,868	2,865	2,867	0,002	-1,2	XRF (fusion)	no accreditation	
11	3,091	3,132	3,112	0,029	2,3	XRF (fusion)	no accreditation	
12	1,800	1,700	1,750	0,071	-17,0	XRF (pressed pellet)	no accreditation	Info only
13	2,900	2,890	2,895	0,007	-0,8	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	2,912	2,923	2,917	0,008	-0,5	XRF (fusion)	no accreditation	
15	2,900	2,904	2,902	0,003	-0,7	XRF (fusion)	ISO 17025	PN-EN ISO 12677:2011
16	3,155	3,147	3,151	0,006	2,8	XRF (fusion)	no accreditation	DIN EN 196-2
17	2,310	2,310	2,310	0,000	-9,1	XRF (fusion)	no accreditation	DIN EN 196-2; Info only

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
18	2,961	2,967	2,964	0,004	0,2	XRF (fusion)	ISO 17025	ISO 29581-2 2010
19	2,930	2,928	2,929	0,001	-0,3	XRF (fusion)	no accreditation	
20	3,025	3,032	3,029	0,005	1,1	XRF (fusion)	no accreditation	ISO 29581-2
21	3,043	3,055	3,049	0,008	1,4	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	2,940	2,930	2,935	0,007	-0,2	XRF (fusion)	no accreditation	
23	2,950	2,960	2,955	0,007	0,1	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	2,997	2,952	2,974	0,032	0,3	XRF (fusion)	no accreditation	DIN EN 196-2
25	2,540	2,550	2,545	0,007	-5,8	XRF (fusion)	no accreditation	
26	2,930	2,970	2,950	0,028	0,0	XRF (fusion)	no accreditation	
27	2,950	3,020	2,985	0,049	0,5	Other Method	no accreditation	
28	2,900	2,960	2,930	0,042	-0,3	XRF (fusion)	no accreditation	
29	2,847	2,850	2,849	0,002	-1,5	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	2,906	2,907	2,907	0,001	-0,6	XRF (fusion)	no accreditation	Info only
31	3,011	3,010	3,010	0,001	0,8	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	2,921	2,911	2,916	0,007	-0,5	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	2,962	2,951	2,957	0,008	0,1	XRF (fusion)	no accreditation	DIN EN 196-2
34	3,013	2,963	2,988	0,035	0,5	XRF (fusion)	no accreditation	ISO 12677
35	2,873	2,887	2,880	0,010	-1,0	XRF (fusion)	ISO 17025	DIN EN 196-2
36	2,970	2,970	2,970	0,000	0,3	XRF (fusion)	no accreditation	DIN EN 196-2
37	2,983	2,991	2,987	0,006	0,5	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	2,943	2,963	2,953	0,014	0,0	Other Method	ISO 17025	
39	2,932	2,931	2,931	0,001	-0,3	XRF (fusion)	ISO 17025	DIN EN 196-2
40	2,717	2,706	2,712	0,008	-3,4	XRF (fusion)		
42	2,953	2,957	2,955	0,003	0,1	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,015 %
Measurand: Mn2O3 **Repeat. s.d:** 0,002 %
Mean ± U(Mean): 0,317 ± 0,006 % **Range of tolerance:** 0,287 - 0,347 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 26 **Statistical method:** Q/Hampel

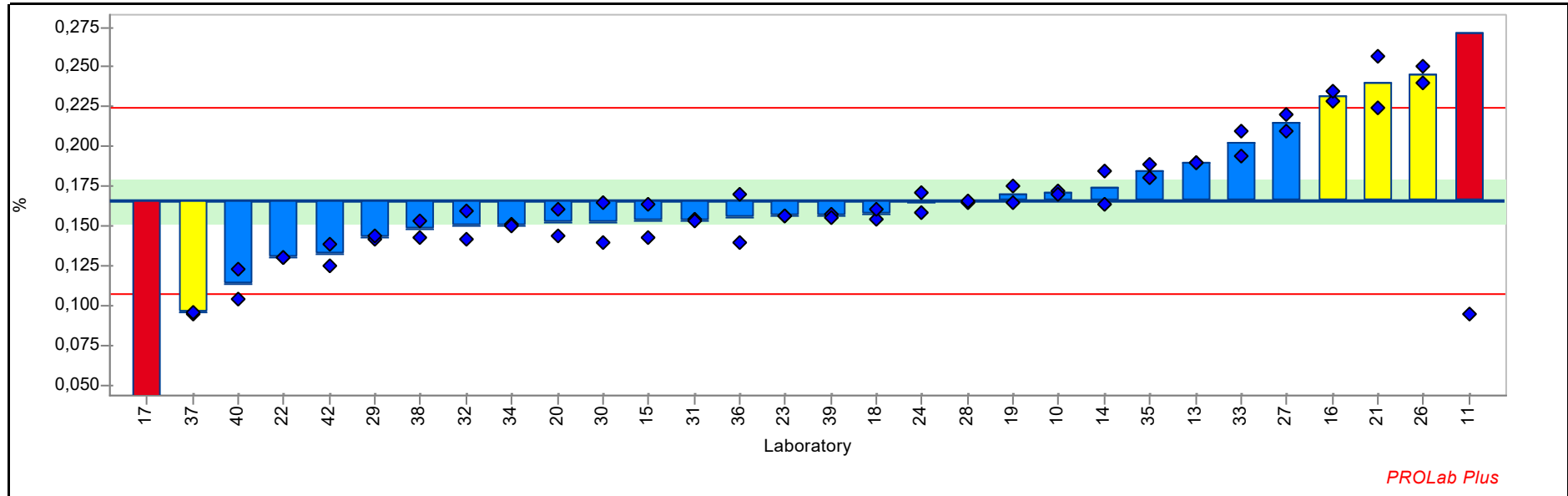


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	0,153	0,156	0,154	0,002	-10,8	XRF (fusion)	no accreditation	
11	0,300	0,300	0,300	0,000	-1,1	XRF (fusion)	no accreditation	
12	0,269	0,265	0,267	0,003	-3,3	XRF (pressed pellet)	no accreditation	Info only
13	0,320	0,320	0,320	0,000	0,2	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	0,292	0,291	0,291	0,001	-1,7	XRF (fusion)	no accreditation	
15	0,225	0,221	0,223	0,003	-6,2	XRF (fusion)	no accreditation	PN-EN ISO 12677:2011
16	0,321	0,322	0,322	0,001	0,3	XRF (fusion)	no accreditation	DIN EN 196-2
18	0,324	0,324	0,324	0,000	0,4	XRF (fusion)	ISO 17025	DIN 51001-2003-08

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
20	0,317	0,319	0,318	0,001	0,1	XRF (fusion)	no accreditation	ISO 29581-2
21	0,339	0,310	0,325	0,021	0,5	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	0,575	0,575	0,575	0,000	17,0	XRF (fusion)	no accreditation	
23	0,313	0,315	0,314	0,001	-0,2	XRF (fusion)	no accreditation	ISO 29581-2 2010
25	0,297	0,296	0,296	0,001	-1,4	Other Method	no accreditation	ICP-OES
26	0,339	0,338	0,339	0,001	1,4	XRF (fusion)	no accreditation	
27	0,340	0,342	0,341	0,001	1,6	Other Method	no accreditation	
28	0,323	0,320	0,322	0,002	0,3	XRF (fusion)	no accreditation	
29	0,319	0,320	0,320	0,001	0,2	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	0,313	0,317	0,315	0,003	-0,1	XRF (fusion)	no accreditation	Info only
31	0,310	0,307	0,308	0,002	-0,6	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	0,312	0,309	0,310	0,002	-0,4	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	0,292	0,292	0,292	0,000	-1,7	XRF (fusion)	no accreditation	DIN EN 196-2
34	0,324	0,323	0,324	0,001	0,4	XRF (fusion)	no accreditation	ISO 12677
35	0,319	0,320	0,320	0,001	0,2	XRF (fusion)	ISO 17025	DIN EN 196-2
36	0,320	0,318	0,319	0,001	0,1	XRF (fusion)	no accreditation	DIN EN 196-2
37	0,392	0,391	0,392	0,001	4,9	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	0,337	0,327	0,332	0,007	1,0	Other Method	ISO 17025	
39	0,315	0,312	0,314	0,002	-0,2	XRF (fusion)	ISO 17025	DIN EN 196-2
40	0,326	0,321	0,324	0,004	0,4	XRF (fusion)		
42	0,319	0,319	0,319	0,000	0,1	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,029 %
Measurand: Na2O **Repeat. s.d:** 0,010 %
Mean ± U(Mean): 0,166 ± 0,014 % **Range of tolerance:** 0,107 - 0,224 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 26 **Statistical method:** Q/Hampel

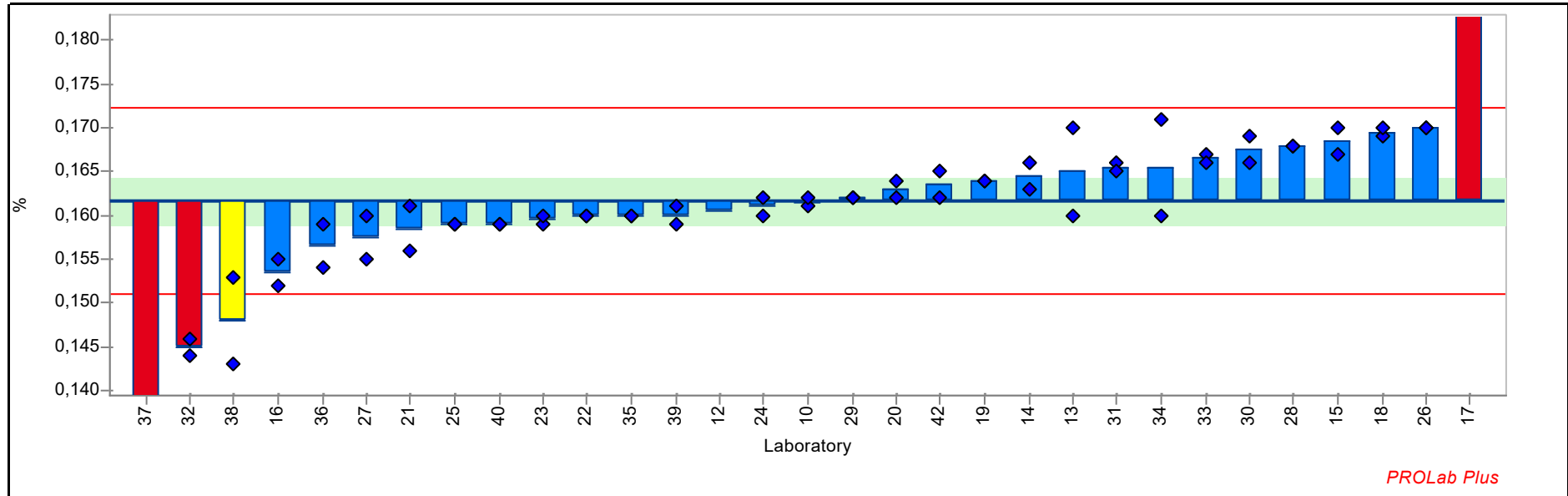


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	0,172	0,170	0,171	0,001	0,2	XRF (fusion)	no accreditation	
11	0,448	0,095	0,272	0,250	3,6	XRF (fusion)	no accreditation	
13	0,190	0,190	0,190	0,000	0,8	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	0,164	0,185	0,174	0,015	0,3	XRF (fusion)	no accreditation	
15	0,143	0,164	0,153	0,015	-0,4	XRF (fusion)	ISO 17025	PN-EN ISO 12677:2011
16	0,229	0,235	0,232	0,004	2,3	XRF (fusion)	no accreditation	DIN EN 196-2
17	0,000	0,000	0,000	0,000	-5,7	XRF (fusion)	no accreditation	DIN EN 196-2; Info only
18	0,154	0,161	0,158	0,005	-0,3	XRF (fusion)	ISO 17025	DIN 51001-2003-08

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
19	0,165	0,175	0,170	0,007	0,1	XRF (fusion)	no accreditation	
20	0,161	0,144	0,152	0,012	-0,5	XRF (fusion)	no accreditation	ISO 29581-2
21	0,257	0,224	0,240	0,023	2,6	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	0,130	0,130	0,130	0,000	-1,2	XRF (fusion)	no accreditation	
23	0,156	0,156	0,156	0,000	-0,3	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	0,171	0,158	0,165	0,009	0,0	XRF (fusion)	no accreditation	DIN 51418-2-2015-03
26	0,240	0,250	0,245	0,007	2,7	XRF (fusion)	no accreditation	
27	0,210	0,220	0,215	0,007	1,7	Other Method	no accreditation	
28	0,165	0,166	0,166	0,001	0,0	XRF (fusion)	no accreditation	
29	0,142	0,144	0,143	0,001	-0,8	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	0,140	0,165	0,153	0,018	-0,5	XRF (fusion)	no accreditation	Info only
31	0,154	0,153	0,153	0,001	-0,4	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	0,142	0,159	0,150	0,012	-0,5	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	0,194	0,210	0,202	0,011	1,2	XRF (pressed pellet)	no accreditation	DIN EN 196-2, Info only
34	0,151	0,150	0,150	0,001	-0,5	XRF (fusion)	no accreditation	ISO 12677
35	0,189	0,180	0,184	0,006	0,6	XRF (fusion)	ISO 17025	DIN EN 196-2
36	0,140	0,170	0,155	0,021	-0,4	XRF (fusion)	no accreditation	DIN EN 196-2
37	0,095	0,096	0,096	0,001	-2,4	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	0,143	0,153	0,148	0,007	-0,6	Other Method	ISO 17025	
39	0,157	0,155	0,156	0,001	-0,3	XRF (fusion)	ISO 17025	DIN EN 196-2
40	0,123	0,104	0,113	0,013	-1,8	XRF (fusion)		
42	0,139	0,125	0,132	0,010	-1,2	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,005 %
Measurand: P2O5 **Repeat. s.d.:** 0,002 %
Mean ± U(Mean): 0,162 ± 0,003 % **Range of tolerance:** 0,151 - 0,172 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 26 **Statistical method:** Q/Hampel

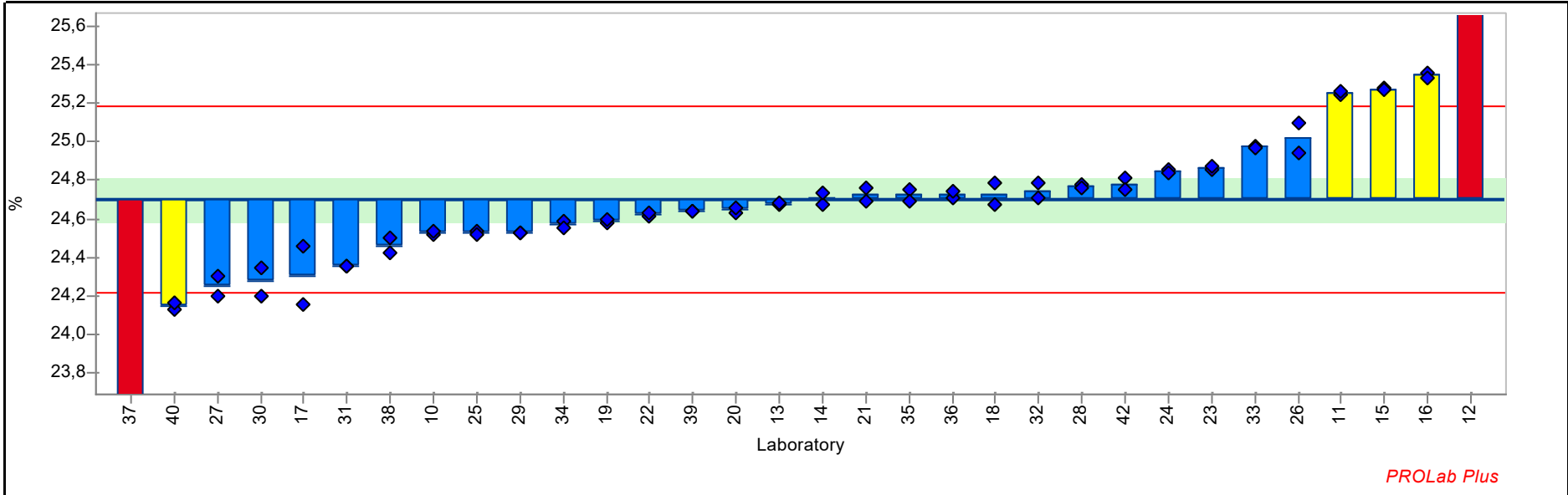


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	0,161	0,162	0,162	0,001	0,0	XRF (fusion)	no accreditation	
12	0,130	0,191	0,161	0,043	-0,2	XRF (pressed pellet)	no accreditation	Info only
13	0,170	0,160	0,165	0,007	0,6	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	0,166	0,163	0,165	0,002	0,5	XRF (fusion)	no accreditation	
15	0,167	0,170	0,169	0,002	1,3	XRF (fusion)	ISO 17025	PN-EN ISO 12677:2011
16	0,155	0,152	0,153	0,002	-1,5	XRF (fusion)	no accreditation	DIN EN 196-2
17	0,230	0,230	0,230	0,000	12,9	XRF (fusion)	no accreditation	DIN EN 196-2; Info only
18	0,169	0,170	0,170	0,001	1,5	XRF (fusion)	ISO 17025	ISO 29581-2 2010

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
19	0,164	0,164	0,164	0,000	0,4	XRF (fusion)	no accreditation	
20	0,162	0,164	0,163	0,001	0,3	XRF (fusion)	no accreditation	ISO 29581-2
21	0,156	0,161	0,159	0,004	-0,6	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	0,160	0,160	0,160	0,000	-0,3	XRF (fusion)	no accreditation	
23	0,159	0,160	0,160	0,001	-0,4	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	0,162	0,160	0,161	0,001	-0,1	XRF (fusion)	no accreditation	DIN 51418-2-2015-03
25	0,159	0,159	0,159	0,000	-0,5	Other Method	no accreditation	ICP-OES
26	0,170	0,170	0,170	0,000	1,6	XRF (fusion)	no accreditation	
27	0,160	0,155	0,158	0,004	-0,8	Other Method	no accreditation	
28	0,168	0,168	0,168	0,000	1,2	XRF (fusion)	no accreditation	
29	0,162	0,162	0,162	0,000	0,1	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	0,169	0,166	0,168	0,002	1,1	XRF (fusion)	no accreditation	Info only
31	0,166	0,165	0,166	0,001	0,7	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	0,146	0,144	0,145	0,001	-3,1	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	0,167	0,166	0,167	0,001	0,9	XRF (pressed pellet)	no accreditation	DIN EN 196-2, Info only
34	0,171	0,160	0,166	0,008	0,7	XRF (fusion)	no accreditation	ISO 12677
35	0,160	0,160	0,160	0,000	-0,3	XRF (fusion)	ISO 17025	DIN EN 196-2
36	0,159	0,154	0,157	0,004	-1,0	XRF (fusion)	no accreditation	DIN EN 196-2
37	0,136	0,136	0,136	0,000	-4,8	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	0,143	0,153	0,148	0,007	-2,6	Other Method	ISO 17025	
39	0,161	0,159	0,160	0,001	-0,3	XRF (fusion)	ISO 17025	DIN EN 196-2
40	0,159	0,159	0,159	0,000	-0,5	XRF (fusion)		
42	0,162	0,165	0,164	0,002	0,3	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,243 %
Measurand: SiO2 **Repeat. s.d:** 0,024 %
Mean ± U(Mean): 24,700 ± 0,113 % **Range of tolerance:** 24,215 - 25,185 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 28 **Statistical method:** Q/Hampel

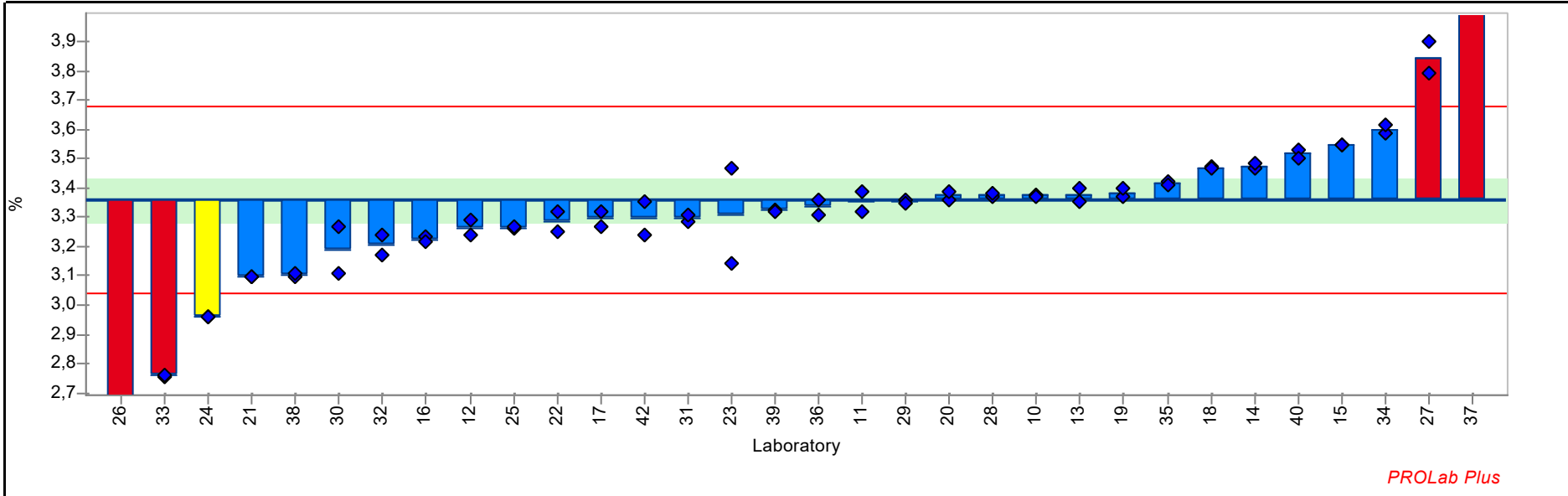


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	24,514	24,531	24,523	0,012	-0,7	XRF (fusion)	no accreditation	
11	25,250	25,266	25,258	0,011	2,3	XRF (fusion)	no accreditation	
12	26,570	26,687	26,629	0,083	7,9	XRF (pressed pellet)	no accreditation	Info only
13	24,670	24,680	24,675	0,007	-0,1	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	24,677	24,735	24,706	0,041	0,0	XRF (fusion)	no accreditation	
15	25,277	25,269	25,273	0,006	2,4	XRF (fusion)	ISO 17025	PN-EN ISO 12677:2011
16	25,362	25,336	25,349	0,018	2,7	XRF (fusion)	no accreditation	DIN EN 196-2
17	24,150	24,460	24,305	0,219	-1,6	XRF (fusion)	no accreditation	DIN EN 196-2; Info only

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
18	24,674	24,785	24,730	0,078	0,1	XRF (fusion)	ISO 17025	ISO 29581-2 2010
19	24,575	24,593	24,584	0,013	-0,5	XRF (fusion)	no accreditation	
20	24,631	24,657	24,644	0,018	-0,2	XRF (fusion)	no accreditation	ISO 29581-2
21	24,757	24,690	24,724	0,047	0,1	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	24,610	24,630	24,620	0,014	-0,3	XRF (fusion)	no accreditation	
23	24,860	24,870	24,865	0,007	0,7	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	24,854	24,837	24,846	0,012	0,6	XRF (fusion)	no accreditation	DIN 51418-2-2015-03
25	24,536	24,515	24,526	0,015	-0,7	XRF (fusion)	no accreditation	
26	24,940	25,100	25,020	0,113	1,3	XRF (fusion)	no accreditation	
27	24,300	24,200	24,250	0,071	-1,9	Other Method	no accreditation	
28	24,775	24,760	24,767	0,011	0,3	XRF (fusion)	no accreditation	
29	24,529	24,524	24,526	0,004	-0,7	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	24,345	24,200	24,273	0,103	-1,8	XRF (fusion)	no accreditation	Info only
31	24,356	24,356	24,356	0,000	-1,4	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	24,790	24,705	24,747	0,060	0,2	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	24,976	24,973	24,974	0,002	1,1	XRF (fusion)	no accreditation	DIN EN 196-2
34	24,587	24,556	24,572	0,022	-0,5	XRF (fusion)	no accreditation	ISO 12677
35	24,752	24,695	24,724	0,040	0,1	XRF (fusion)	ISO 17025	DIN EN 196-2
36	24,710	24,740	24,725	0,021	0,1	XRF (fusion)	no accreditation	DIN EN 196-2
37	20,240	20,306	20,273	0,047	-18,2	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	24,421	24,502	24,462	0,057	-1,0	Other Method	ISO 17025	
39	24,640	24,638	24,639	0,001	-0,3	XRF (fusion)	ISO 17025	DIN EN 196-2
40	24,124	24,159	24,142	0,025	-2,3	XRF (fusion)		
42	24,816	24,748	24,782	0,048	0,3	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,159 %
Measurand: SO3 **Repeat. s.d:** 0,025 %
Mean ± U(Mean): 3,359 ± 0,074 % **Range of tolerance:** 3,040 - 3,678 % (|z-score| <= 2,0)
Number of laboratories in calculation: 26 **Statistical method:** Q/Hampel

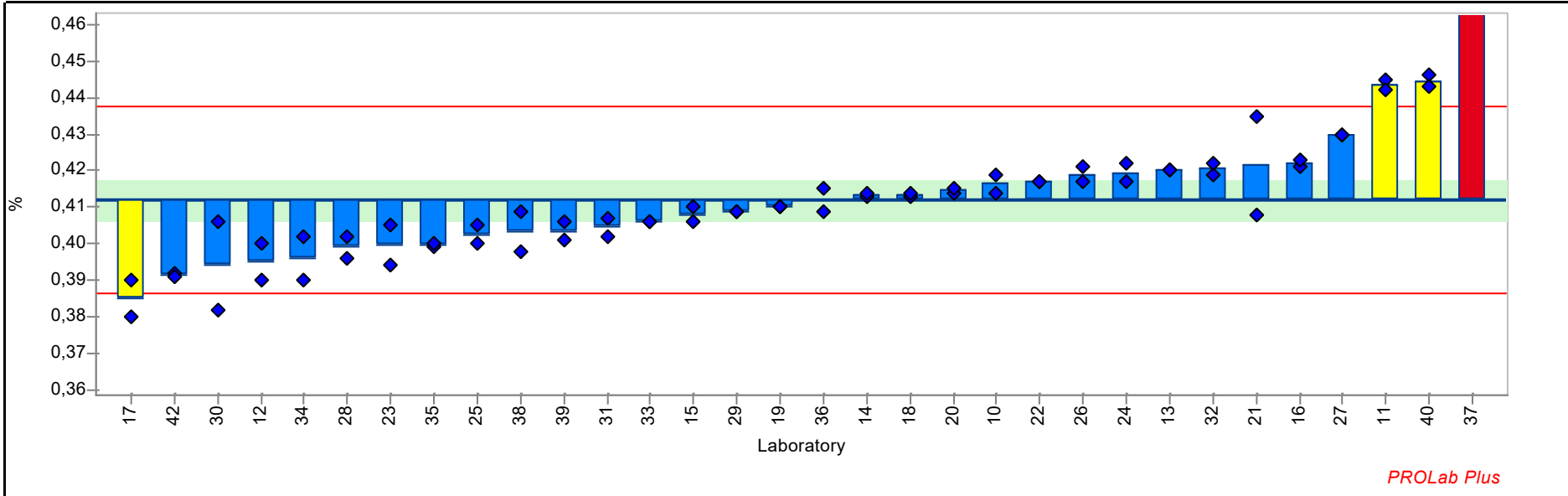


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	3,377	3,372	3,374	0,004	0,1	XRF (fusion)	no accreditation	
11	3,385	3,319	3,352	0,047	0,0	XRF (fusion)	no accreditation	
12	3,237	3,288	3,263	0,036	-0,6	XRF (pressed pellet)	no accreditation	Info only
13	3,351	3,398	3,375	0,033	0,1	Other Method	no accreditation	EN ISO 12677:2011
14	3,469	3,482	3,476	0,009	0,7	XRF (fusion)	no accreditation	
15	3,546	3,546	3,546	0,000	1,2	Other Method	ISO 17025	PBA 43 w yd. 1 z 27.07.2016
16	3,231	3,219	3,225	0,008	-0,8	XRF (fusion)	no accreditation	DIN EN 196-2
17	3,320	3,270	3,295	0,035	-0,4	XRF (fusion)	no accreditation	DIN EN 196-2; Info only

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
18	3,471	3,465	3,468	0,004	0,7	XRF (fusion)	ISO 17025	ISO 29581-2 2010
19	3,370	3,398	3,384	0,020	0,2	XRF (fusion)	no accreditation	
20	3,357	3,390	3,373	0,023	0,1	XRF (fusion)	no accreditation	ISO 29581-2
21	3,099	3,098	3,099	0,001	-1,6	XRF (fusion)	no accreditation	ISO 29581-2 2010
22	3,320	3,250	3,285	0,049	-0,5	Other Method	no accreditation	
23	3,465	3,145	3,305	0,226	-0,3	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	2,961	2,961	2,961	0,000	-2,5	XRF (pressed pellet)	no accreditation	DIN 51418-2-2015-03, Info only
25	3,263	3,265	3,264	0,001	-0,6	XRF (fusion)	no accreditation	
26	2,310	2,510	2,410	0,141	-5,9	XRF (fusion)	no accreditation	
27	3,900	3,790	3,845	0,078	3,0	Other Method	no accreditation	
28	3,369	3,379	3,374	0,007	0,1	XRF (fusion)	no accreditation	
29	3,359	3,348	3,353	0,008	0,0	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	3,267	3,110	3,188	0,111	-1,1	XRF (fusion)	no accreditation	Info only
31	3,286	3,308	3,297	0,016	-0,4	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	3,172	3,238	3,205	0,047	-1,0	Other Method	ISO 17025	DIN EN ISO 15350:2010:08
33	2,757	2,759	2,758	0,001	-3,8	XRF (pressed pellet)	no accreditation	DIN EN 196-2, Info only
34	3,586	3,614	3,600	0,020	1,5	Other Method	no accreditation	DIN 51085
35	3,423	3,413	3,418	0,007	0,4	Other Method	ISO 17025	DIN EN 196-2
36	3,310	3,360	3,335	0,035	-0,1	XRF (fusion)	no accreditation	DIN EN 196-2
37	4,250	4,275	4,263	0,018	5,7	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	3,096	3,110	3,103	0,010	-1,6	Other Method	ISO 17025	
39	3,325	3,321	3,323	0,003	-0,2	XRF (fusion)	ISO 17025	DIN EN 196-2
40	3,529	3,504	3,516	0,018	1,0	Other Method		Combustion IR
42	3,354	3,238	3,296	0,082	-0,4	Other Method	ISO 17025	DIN EN 196-2

Sample: FLX-1004 **Reprod. s.d.:** 0,013 %
Measurand: TiO2 **Repeat. s.d:** 0,004 %
Mean ± U(Mean): 0,412 ± 0,006 % **Range of tolerance:** 0,386 - 0,438 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 28 **Statistical method:** Q/Hampel

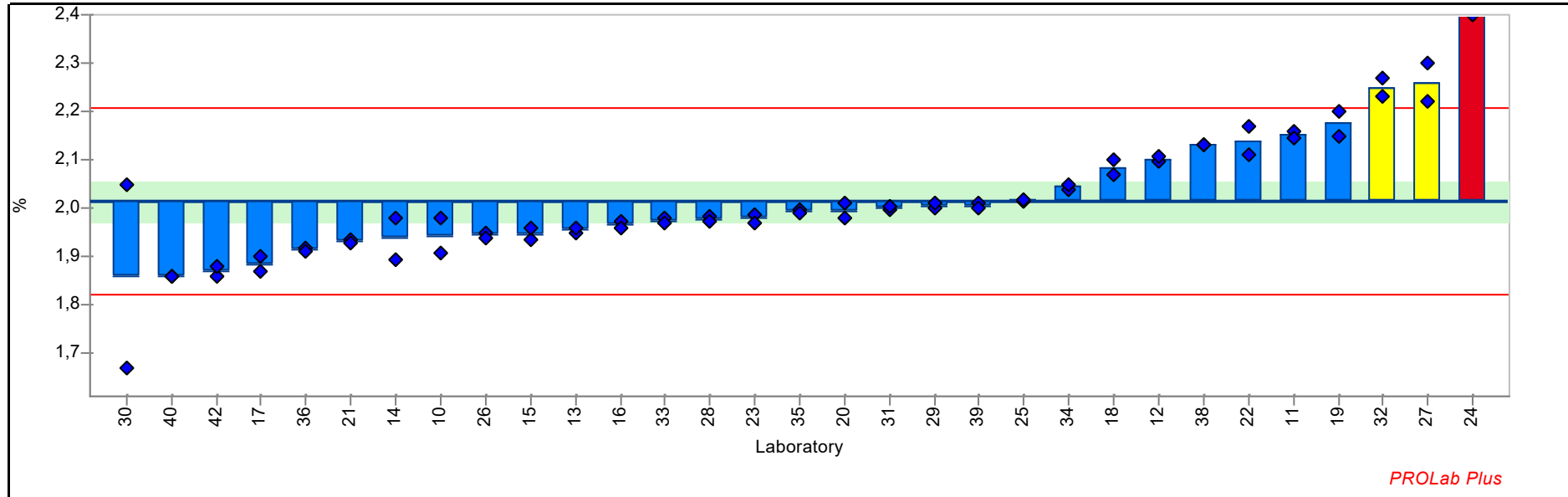


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	0,419	0,414	0,416	0,004	0,4	XRF (fusion)	no accreditation	
11	0,445	0,442	0,444	0,002	2,5	XRF (fusion)	no accreditation	
12	0,400	0,390	0,395	0,007	-1,3	XRF (pressed pellet)	no accreditation	Info only
13	0,420	0,420	0,420	0,000	0,6	XRF (fusion)	no accreditation	EN ISO 12677:2011
14	0,413	0,414	0,413	0,001	0,1	XRF (fusion)	no accreditation	
15	0,410	0,406	0,408	0,003	-0,3	XRF (fusion)	ISO 17025	PN-EN ISO 12677:2011
16	0,421	0,423	0,422	0,001	0,8	XRF (fusion)	no accreditation	DIN EN 196-2
17	0,390	0,380	0,385	0,007	-2,1	XRF (fusion)	no accreditation	DIN EN 196-2; Info only

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
18	0,413	0,414	0,413	0,001	0,1	XRF (fusion)	ISO 17025	ISO 29581-2 2010
19	0,410	0,410	0,410	0,000	-0,2	XRF (fusion)	no accreditation	
20	0,414	0,415	0,414	0,001	0,2	XRF (fusion)	no accreditation	ISO 29581-2
21	0,435	0,408	0,421	0,019	0,7	XRF (fusion)	no accreditation	ISO 29581-2 2010, LOI @ 950°C
22	0,417	0,417	0,417	0,000	0,4	XRF (fusion)	no accreditation	
23	0,405	0,394	0,400	0,008	-1,0	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	0,417	0,422	0,419	0,004	0,6	XRF (fusion)	no accreditation	DIN 51418-2-2015-03
25	0,405	0,400	0,403	0,004	-0,7	XRF (fusion)	no accreditation	
26	0,417	0,421	0,419	0,003	0,5	XRF (fusion)	no accreditation	
27	0,430	0,430	0,430	0,000	1,4	Other Method	no accreditation	
28	0,402	0,396	0,399	0,004	-1,0	XRF (fusion)	no accreditation	
29	0,409	0,409	0,409	0,000	-0,2	XRF (fusion)	no accreditation	ISO 29581-2 2010
30	0,406	0,382	0,394	0,017	-1,4	XRF (fusion)	no accreditation	Info only
31	0,402	0,407	0,404	0,004	-0,6	XRF (fusion)	ISO 17025	ISO DIN 51001:2003
32	0,419	0,422	0,420	0,002	0,7	XRF (fusion)	ISO 17025	ISO DIN 51001 2003
33	0,406	0,406	0,406	0,000	-0,5	XRF (fusion)	no accreditation	DIN EN 196-2
34	0,402	0,390	0,396	0,008	-1,3	XRF (fusion)	no accreditation	ISO 12677
35	0,399	0,400	0,400	0,001	-1,0	XRF (fusion)	ISO 17025	DIN EN 196-2
36	0,409	0,415	0,412	0,004	0,0	XRF (fusion)	no accreditation	DIN EN 196-2
37	0,493	0,493	0,493	0,000	6,3	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	0,409	0,398	0,403	0,008	-0,7	Other Method	ISO 17025	
39	0,406	0,401	0,404	0,004	-0,7	XRF (fusion)	ISO 17025	DIN EN 196-2
40	0,446	0,443	0,445	0,002	2,5	XRF (fusion)		
42	0,392	0,391	0,392	0,001	-1,6	XRF (fusion)	ISO 17025	ISO 29581-2 2010

Sample: FLX-1004 **Reprod. s.d.:** 0,096 %
Measurand: Loss on Ignition **Repeat. s.d.:** 0,012 %
Mean ± U(Mean): 2,015 ± 0,043 % **Range of tolerance:** 1,822 - 2,207 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 29 **Statistical method:** Q/Hampel

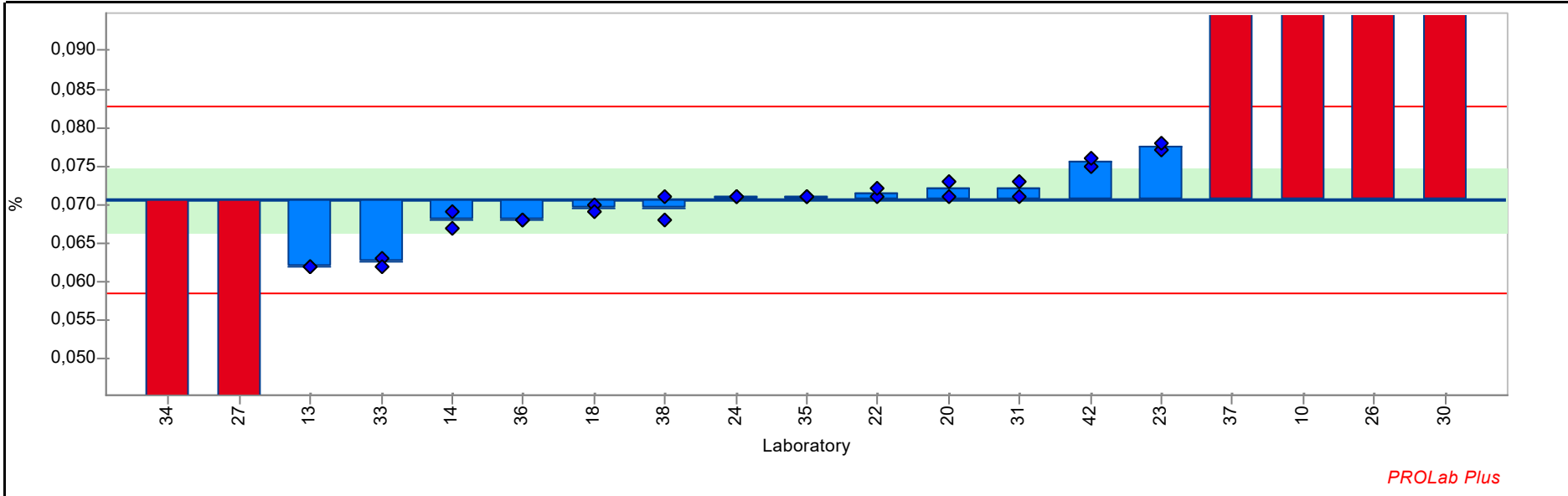


Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	1,908	1,980	1,944	0,051	-0,7	Other Method	no accreditation	LOI @ 950°C
11	2,158	2,144	2,151	0,010	1,4	XRF (fusion)	no accreditation	LOI @ 950°C
12	2,096	2,106	2,101	0,007	0,9	Other Method	no accreditation	LOI @ 950°C, Info only
13	1,950	1,960	1,955	0,007	-0,6	Other Method	no accreditation	LOI @ 950°C
14	1,980	1,895	1,938	0,060	-0,8	Other Method	no accreditation	DIN EN 196-2, LOI @ 950°C
15	1,934	1,960	1,947	0,018	-0,7	Other Method	no accreditation	LOI @ 950°C
16	1,974	1,960	1,967	0,010	-0,5	Other Method	no accreditation	DIN EN 196-2, LOI @ 950°C
17	1,900	1,870	1,885	0,021	-1,3	XRF (fusion)	no accreditation	DIN EN 196-2, LOI @ 950°C; Info only

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
18	2,100	2,070	2,085	0,021	0,7	Other Method	ISO 17025	ISO 29581-2 2010, LOI @ 950°C
19	2,150	2,200	2,175	0,035	1,7	Other Method	no accreditation	LOI @ 950°C
20	2,010	1,980	1,995	0,021	-0,2	Other Method	no accreditation	DIN EN 196-2, LOI @ 950°C
21	1,936	1,930	1,933	0,004	-0,8	XRF (fusion)	no accreditation	ISO 29581-2:2010
22	2,110	2,170	2,140	0,042	1,3	Other Method	no accreditation	LOI @ 950°C
23	1,987	1,971	1,979	0,011	-0,4	XRF (fusion)	no accreditation	ISO 29581-2 2010, LOI @ 950°C
24	2,400	2,400	2,400	0,000	4,0	Other Method	no accreditation	DIN 51418-2-2015-03, LOI @ 950°C
25	2,015	2,018	2,016	0,002	0,0	Other Method	no accreditation	LOI @ 950°C
26	1,950	1,940	1,945	0,007	-0,7	Other Method	no accreditation	LOI @ 950°C
27	2,300	2,220	2,260	0,057	2,5	Other Method	no accreditation	LOI @ 950°C
28	1,982	1,974	1,978	0,006	-0,4	Other Method	no accreditation	LOI @ 950°C
29	2,000	2,010	2,005	0,007	-0,1	XRF (fusion)	no accreditation	LOI @ 950°C
30	1,670	2,050	1,860	0,269	-1,6	Other Method	no accreditation	LOI @ 950°C, Info only
31	1,996	2,006	2,001	0,007	-0,1	Other Method	ISO 17025	DIN 51081
32	2,230	2,270	2,250	0,028	2,4	Other Method	ISO 17025	DIN 51081:2002-12
33	1,980	1,970	1,975	0,007	-0,4	Other Method	no accreditation	DIN EN 196-2, EN 50196-2, LOI @
34	2,040	2,050	2,045	0,007	0,3	Other Method	no accreditation	ISO 26845, LOI @ 950°C
35	1,999	1,990	1,994	0,006	-0,2	Other Method	ISO 17025	DIN EN 196-2, LOI @ 950°C
36	1,920	1,910	1,915	0,007	-1,0	Other Method	no accreditation	DIN EN 196-2, LOI @ 950°C
38	2,130	2,130	2,130	0,000	1,2	Other Method	ISO 17025	DIN EN 196-2, LOI @ 950°C
39	2,010	2,000	2,005	0,007	-0,1	Other Method	ISO 17025	DIN EN 196-2
40	1,860	1,860	1,860	0,000	-1,6	Other Method		LOI @ 950°C
42	1,860	1,880	1,870	0,014	-1,5	Other Method	ISO 17025	ISO 29581-2 2010, LOI @ 950°C

Sample: FLX-1004 **Reprod. s.d.:** 0,006 %
Measurand: CI **Repeat. s.d.:** 0,001 %
Mean ± U(Mean): 0,071 ± 0,004 % **Range of tolerance:** 0,058 - 0,083 % (|z-score| ≤ 2,0)
Number of laboratories in calculation: 13 **Statistical method:** Q/Hampel



Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
10	0,107	0,106	0,106	0,001	5,9	XRF (pressed pellet)	no accreditation	Info only
13	0,062	0,062	0,062	0,000	-1,4	Other Method	no accreditation	Ionometry
14	0,069	0,067	0,068	0,001	-0,4	Other Method	no accreditation	EN 196-2:2013
18	0,070	0,069	0,070	0,001	-0,2	XRF (fusion)	ISO 17025	DIN 51001-2003-08
20	0,073	0,071	0,072	0,001	0,2	Other Method	no accreditation	EN196-2, ASTM C114
22	0,071	0,072	0,071	0,001	0,1	Other Method	no accreditation	
23	0,077	0,078	0,077	0,001	1,1	XRF (fusion)	no accreditation	ISO 29581-2 2010
24	0,071	0,071	0,071	0,000	0,1	XRF (pressed pellet)	no accreditation	DIN 51418-2-2015-03, Info only

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Lab code	Conc. 1	Conc. 2	Lab mean	s.d.	z-score	Analytical method	Accreditation	Comment
26	0,124	0,122	0,123	0,001	8,6	XRF (pressed pellet)	no accreditation	Info only
27	0,013	0,013	0,013	0,000	-9,5	Other Method	no accreditation	
30	0,151	0,151	0,151	0,000	13,2	XRF (pressed pellet)	no accreditation	Info only
31	0,073	0,071	0,072	0,001	0,2	Other Method	ISO 17025	DIN 51084
33	0,063	0,062	0,063	0,001	-1,3	XRF (pressed pellet)	no accreditation	DIN EN 196-2, Info only
34	0,000	0,000	0,000	0,000	-11,6	Other Method	no accreditation	ISO 9297
35	0,071	0,071	0,071	0,000	0,1	Other Method	ISO 17025	DIN EN 196-2
36	0,068	0,068	0,068	0,000	-0,4	Other Method	no accreditation	DIN EN 196-2
37	0,103	0,104	0,103	0,001	5,4	XRF (pressed pellet)	no accreditation	Standardless method, Info only
38	0,071	0,068	0,070	0,002	-0,2	Other Method	ISO 17025	DIN EN 196-2
42	0,075	0,076	0,075	0,001	0,8	Other Method	ISO 17025	DIN EN 196-2

z-scores (per sample)

Sample: FLX-1004

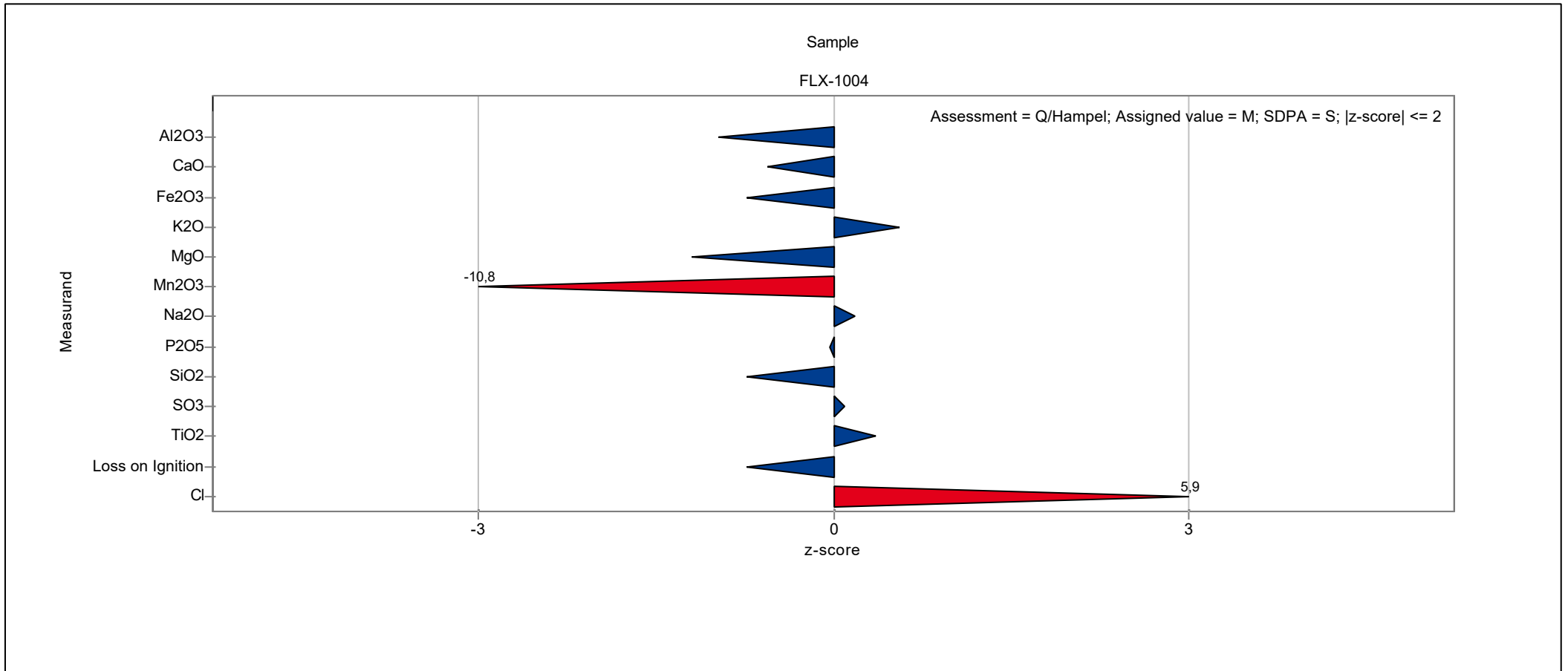
Lab code	Al2O3	CaO	Fe2O3	K2O	MgO	Mn2O3	Na2O	P2O5	SiO2	SO3	TiO2	Loss on Ignition	Cl
10	-1,0	-0,6	-0,7	0,6	-1,2	-10,8	0,2	0,0	-0,7	0,1	0,4	-0,7	5,9
11	-1,5	9,0	-0,2		2,3	-1,1	3,6		2,3	0,0	2,5	1,4	
12	-2,7	1,5	-6,1	-3,8	-17,0	-3,3		-0,2	7,9	-0,6	-1,3	0,9	
13	-1,0	1,1	-1,1	-0,6	-0,8	0,2	0,8	0,6	-0,1	0,1	0,6	-0,6	-1,4
14	0,1	-0,4	0,2	0,6	-0,5	-1,7	0,3	0,5	0,0	0,7	0,1	-0,8	-0,4
15	-0,2	-0,8	-0,3	1,7	-0,7	-6,2	-0,4	1,3	2,4	1,2	-0,3	-0,7	
16	-1,2	-1,6	-0,4	-1,5	2,8	0,3	2,3	-1,5	2,7	-0,8	0,8	-0,5	
17	-5,3	1,0	0,2	0,6	-9,1		-5,7	12,9	-1,6	-0,4	-2,1	-1,3	
18	2,2	0,1	-0,2	0,7	0,2	0,4	-0,3	1,5	0,1	0,7	0,1	0,7	-0,2
19	0,0	-0,3	-0,2	0,4	-0,3		0,1	0,4	-0,5	0,2	-0,2	1,7	
20	1,1	-0,5	1,1	0,7	1,1	0,1	-0,5	0,3	-0,2	0,1	0,2	-0,2	0,2
21	-1,0	0,4	1,3	-2,4	1,4	0,5	2,6	-0,6	0,1	-1,6	0,7	-0,8	
22	0,2	0,4	-0,5	0,7	-0,2	17,0	-1,2	-0,3	-0,3	-0,5	0,4	1,3	0,1
23	-0,3	-0,4	-1,7	-0,5	0,1	-0,2	-0,3	-0,4	0,7	-0,3	-1,0	-0,4	1,1
24	0,0	-0,5	0,4	0,9	0,3		0,0	-0,1	0,6	-2,5	0,6	4,0	0,1
25	-5,8	2,2	-5,5	-1,1	-5,8	-1,4		-0,5	-0,7	-0,6	-0,7	0,0	
26	1,7	12,1	2,2	-0,4	0,0	1,4	2,7	1,6	1,3	-5,9	0,5	-0,7	8,6
27	-0,8	-0,5	-1,0	1,9	0,5	1,6	1,7	-0,8	-1,9	3,0	1,4	2,5	-9,5
28	-0,4	-0,9	-1,0	0,7	-0,3	0,3	0,0	1,2	0,3	0,1	-1,0	-0,4	
29	0,2	1,6	-0,1	0,7	-1,5	0,2	-0,8	0,1	-0,7	0,0	-0,2	-0,1	
30	-2,3	-2,7	-0,5	-1,3	-0,6	-0,1	-0,5	1,1	-1,8	-1,1	-1,4	-1,6	13,2
31	-0,1	-0,9	-0,1	-0,7	0,8	-0,6	-0,4	0,7	-1,4	-0,4	-0,6	-0,1	0,2
32	0,3	-0,4	0,4	-0,7	-0,5	-0,4	-0,5	-3,1	0,2	-1,0	0,7	2,4	
33	1,9	2,2	2,0	-1,5	0,1	-1,7	1,2	0,9	1,1	-3,8	-0,5	-0,4	-1,3
34	-0,5	-0,4	0,4	-0,1	0,5	0,4	-0,5	0,7	-0,5	1,5	-1,3	0,3	-11,6

2023_01 Cement

Lab code	Al2O3	CaO	Fe2O3	K2O	MgO	Mn2O3	Na2O	P2O5	SiO2	SO3	TiO2	Loss on Ignition	Cl
35	1,7	-0,6	-2,0	0,3	-1,0	0,2	0,6	-0,3	0,1	0,4	-1,0	-0,2	0,1
36	0,6	0,8	-0,3	0,0	0,3	0,1	-0,4	-1,0	0,1	-0,1	0,0	-1,0	-0,4
37	-10,7	8,8	8,4	-0,4	0,5	4,9	-2,4	-4,8	-18,2	5,7	6,3		5,4
38	-0,3	0,2	0,4	0,6	0,0	1,0	-0,6	-2,6	-1,0	-1,6	-0,7	1,2	-0,2
39	-0,2	-0,1	-0,1	0,0	-0,3	-0,2	-0,3	-0,3	-0,3	-0,2	-0,7	-0,1	
40	-0,5	1,0	0,4	-2,0	-3,4	0,4	-1,8	-0,5	-2,3	1,0	2,5	-1,6	
42	0,3	0,4	1,8	-2,1	0,1	0,1	-1,2	0,3	0,3	-0,4	-1,6	-1,5	0,8

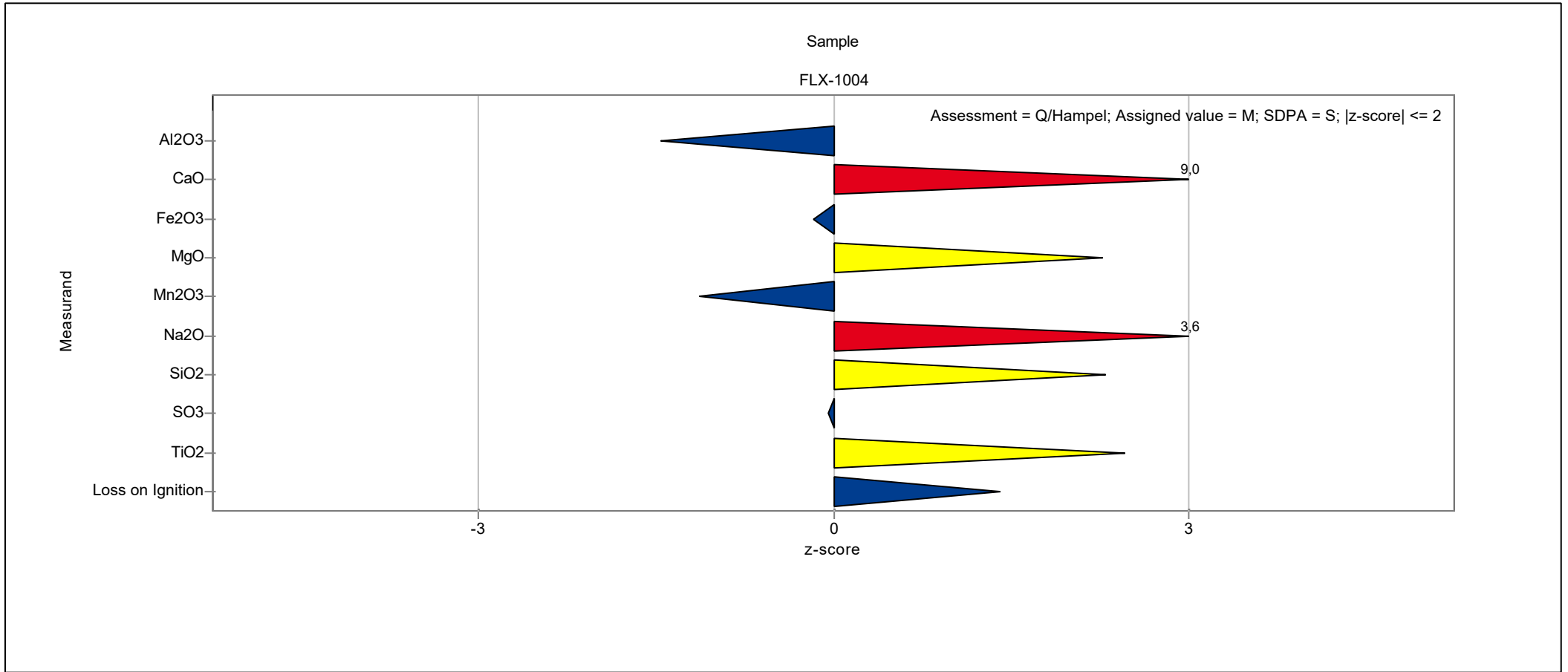
Laboratory chart of z-scores

Laboratory: 10



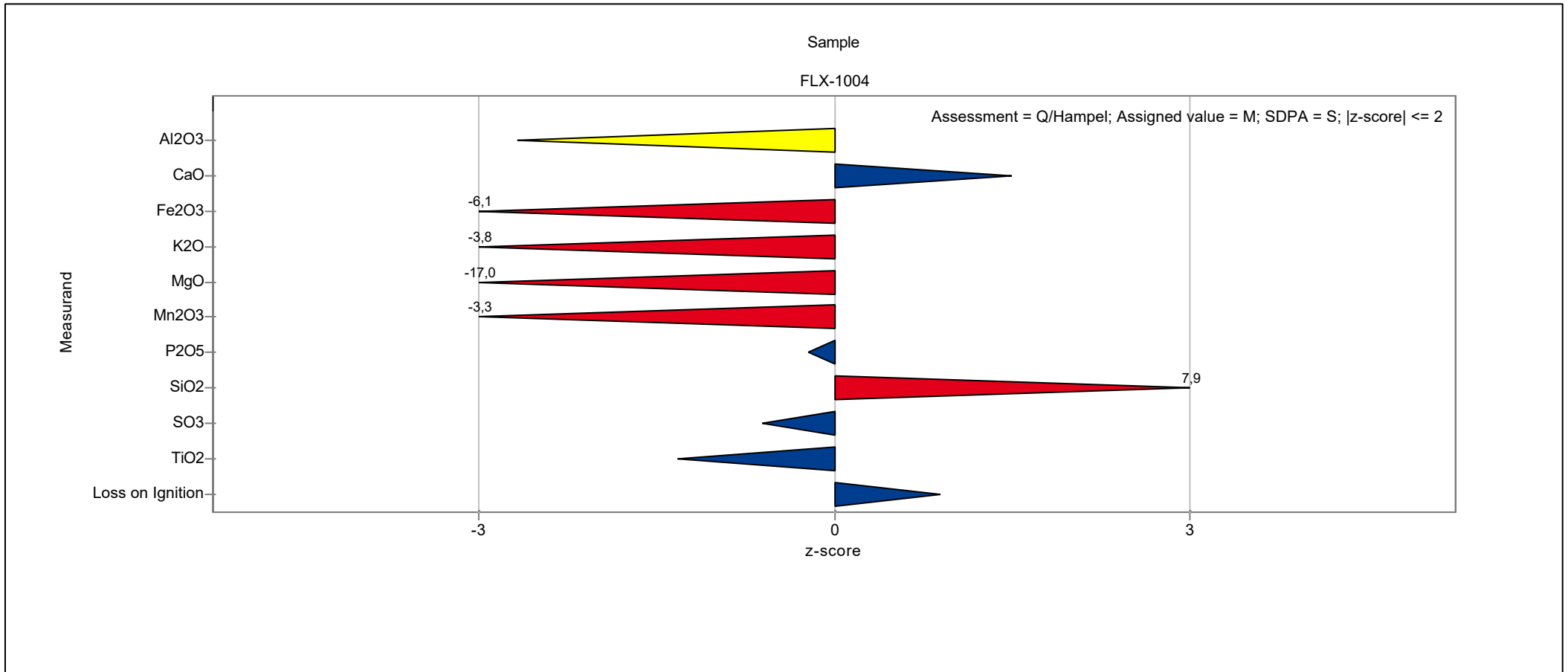
Laboratory chart of z-scores

Laboratory: 11



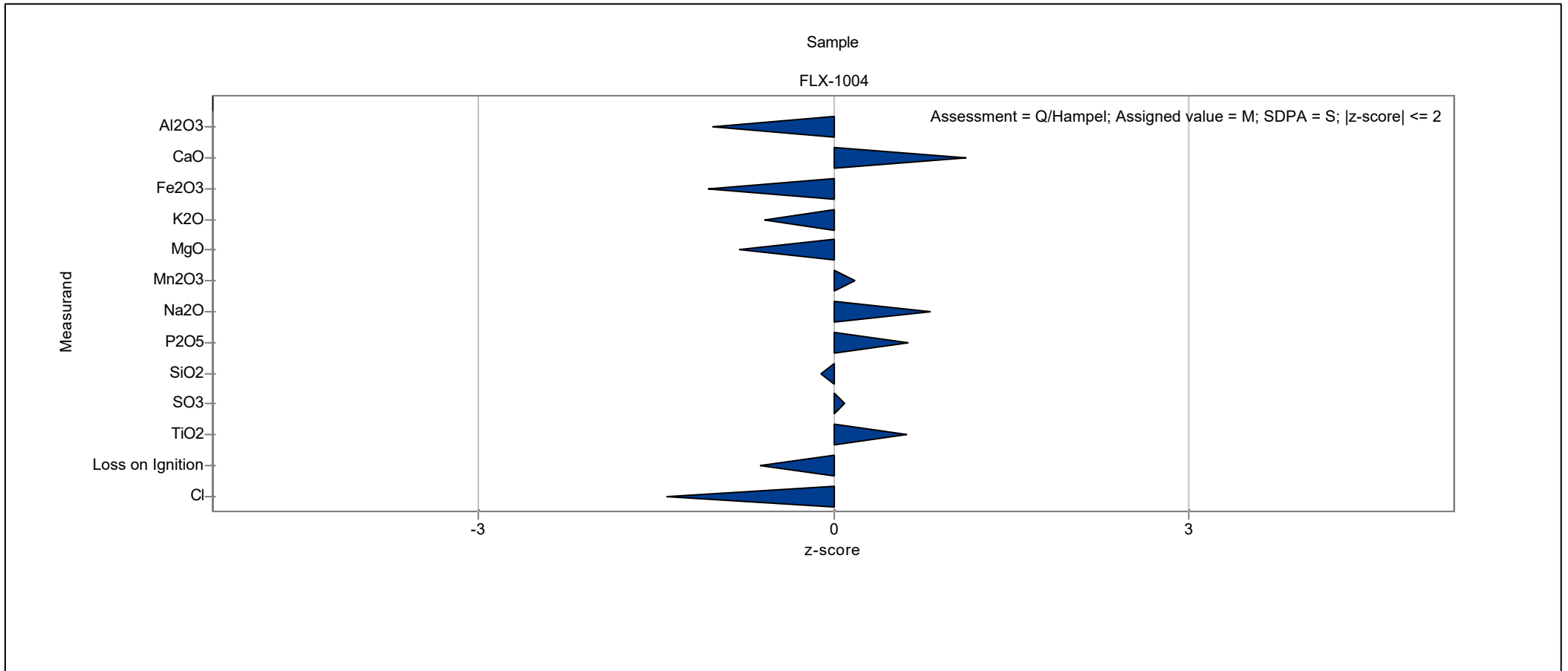
Laboratory chart of z-scores

Laboratory: 12



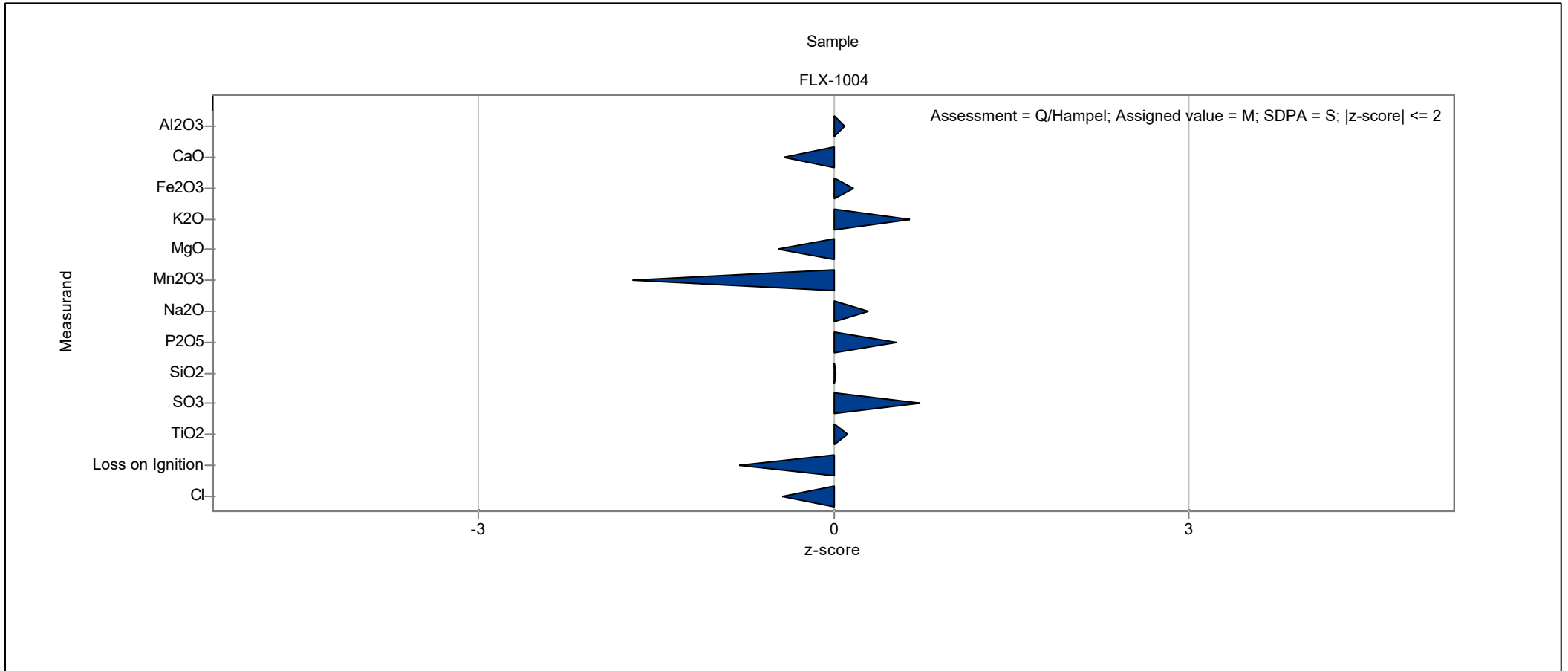
Laboratory chart of z-scores

Laboratory: 13



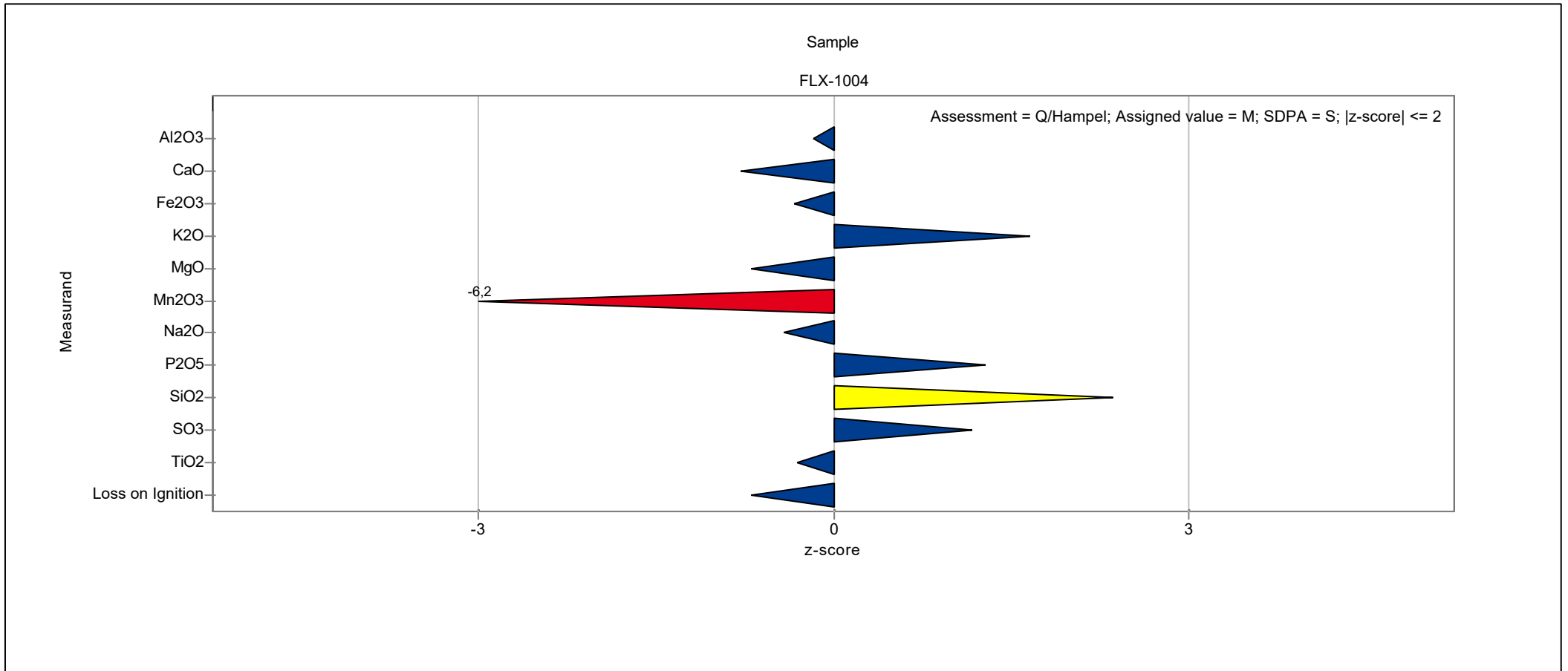
Laboratory chart of z-scores

Laboratory: 14



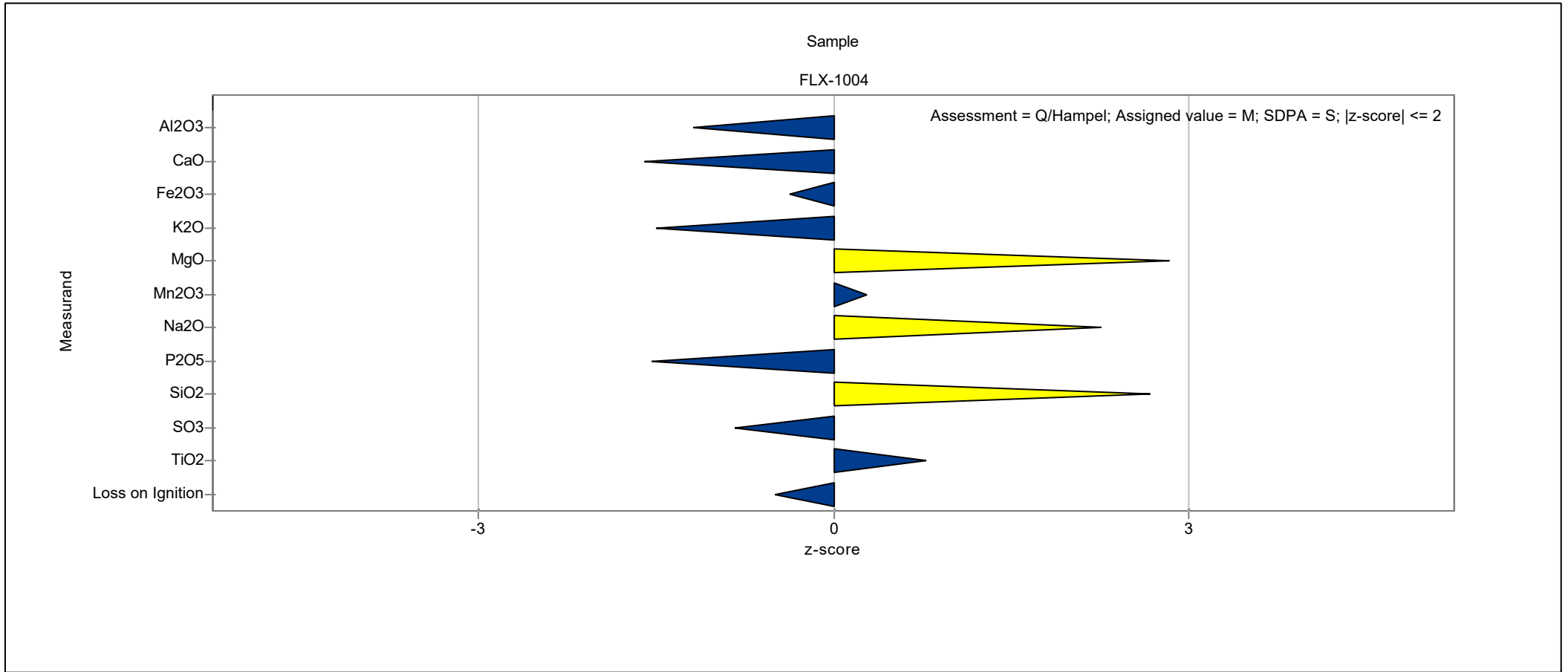
Laboratory chart of z-scores

Laboratory: 15



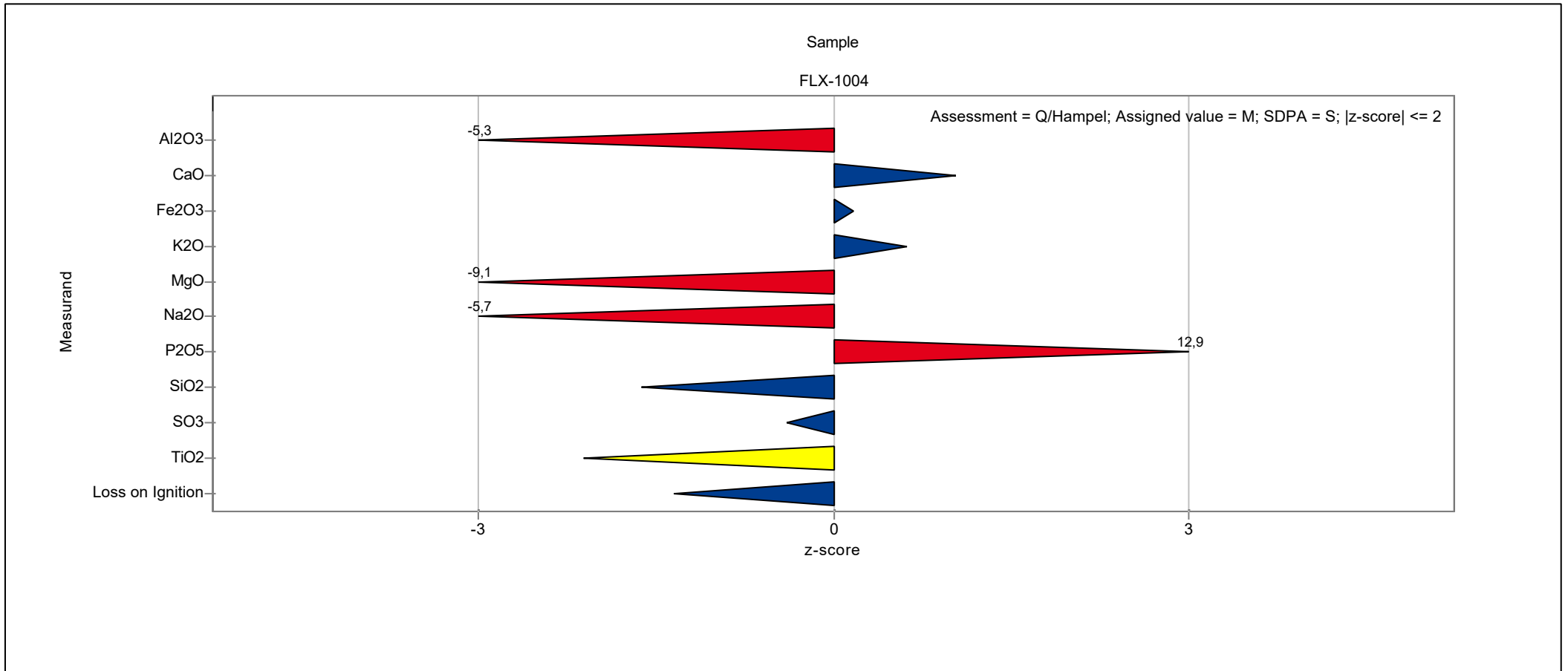
Laboratory chart of z-scores

Laboratory: 16



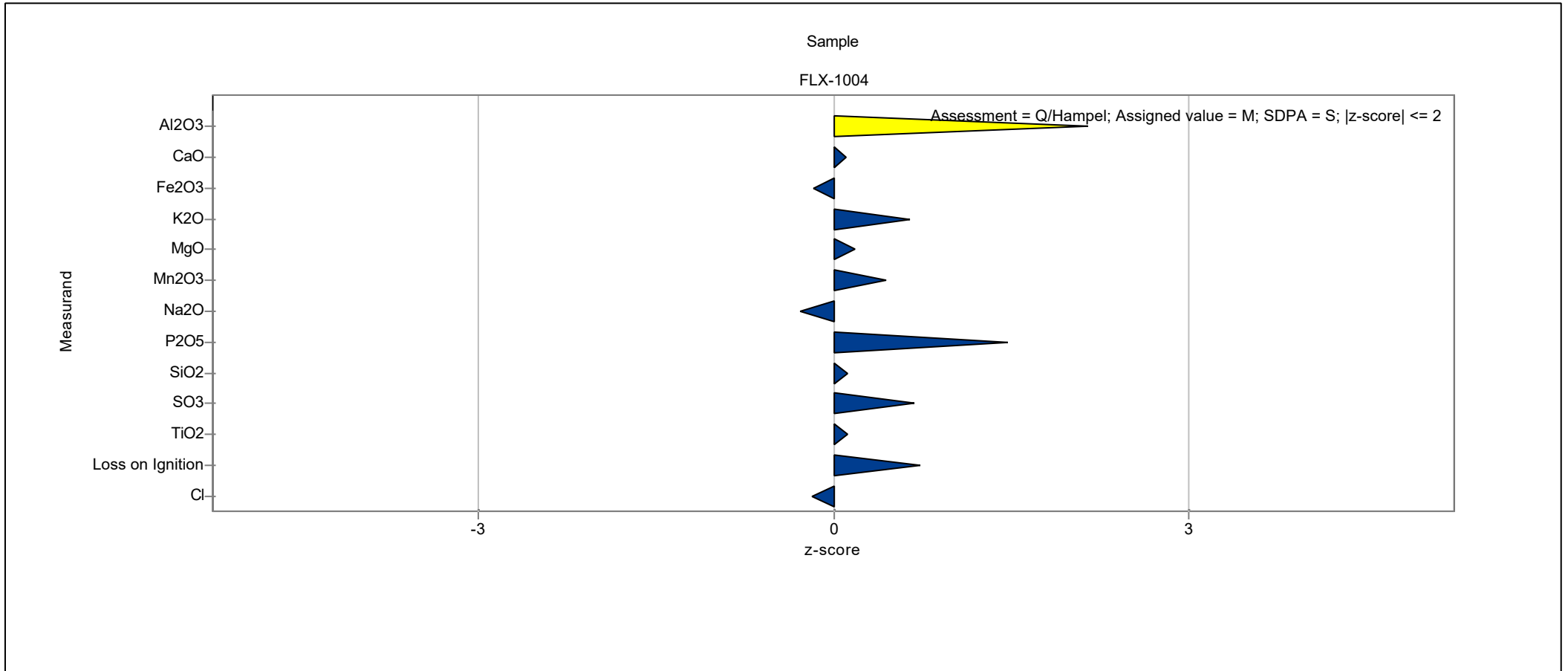
Laboratory chart of z-scores

Laboratory: 17



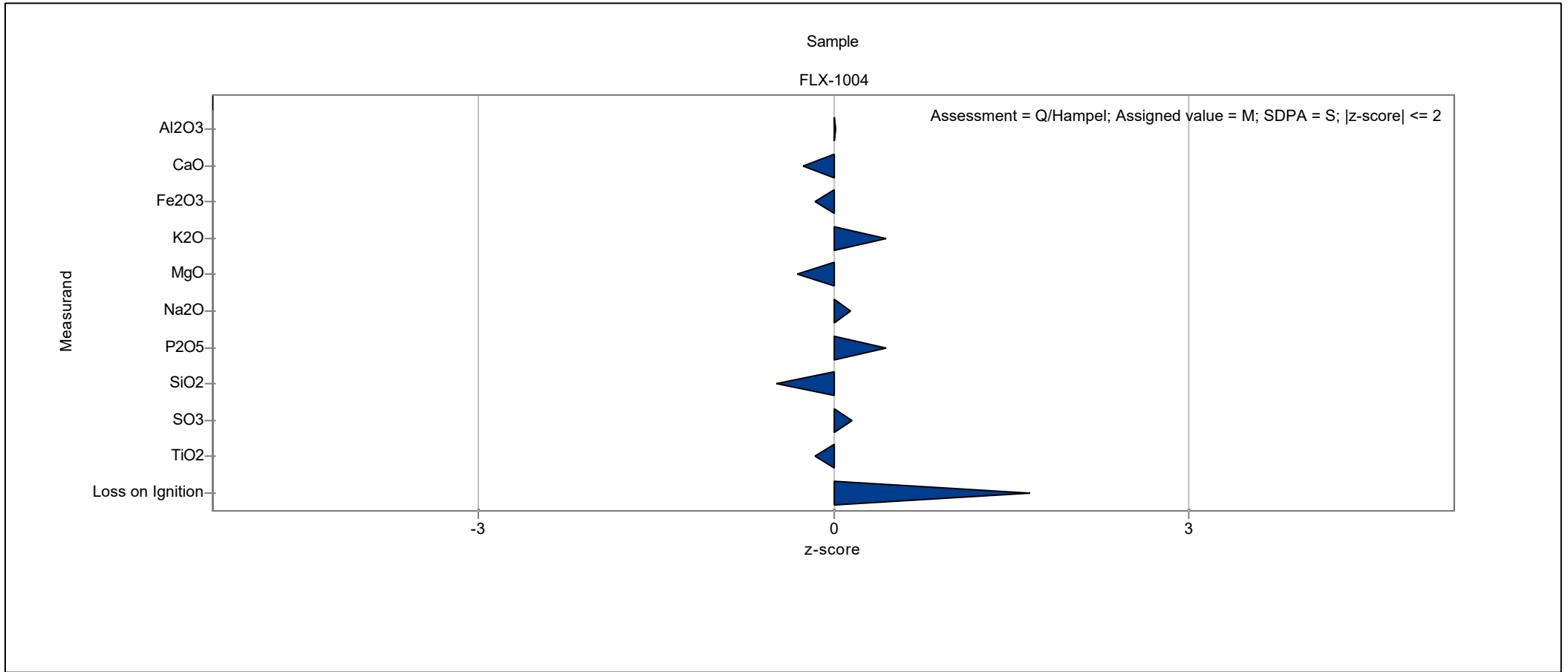
Laboratory chart of z-scores

Laboratory: 18



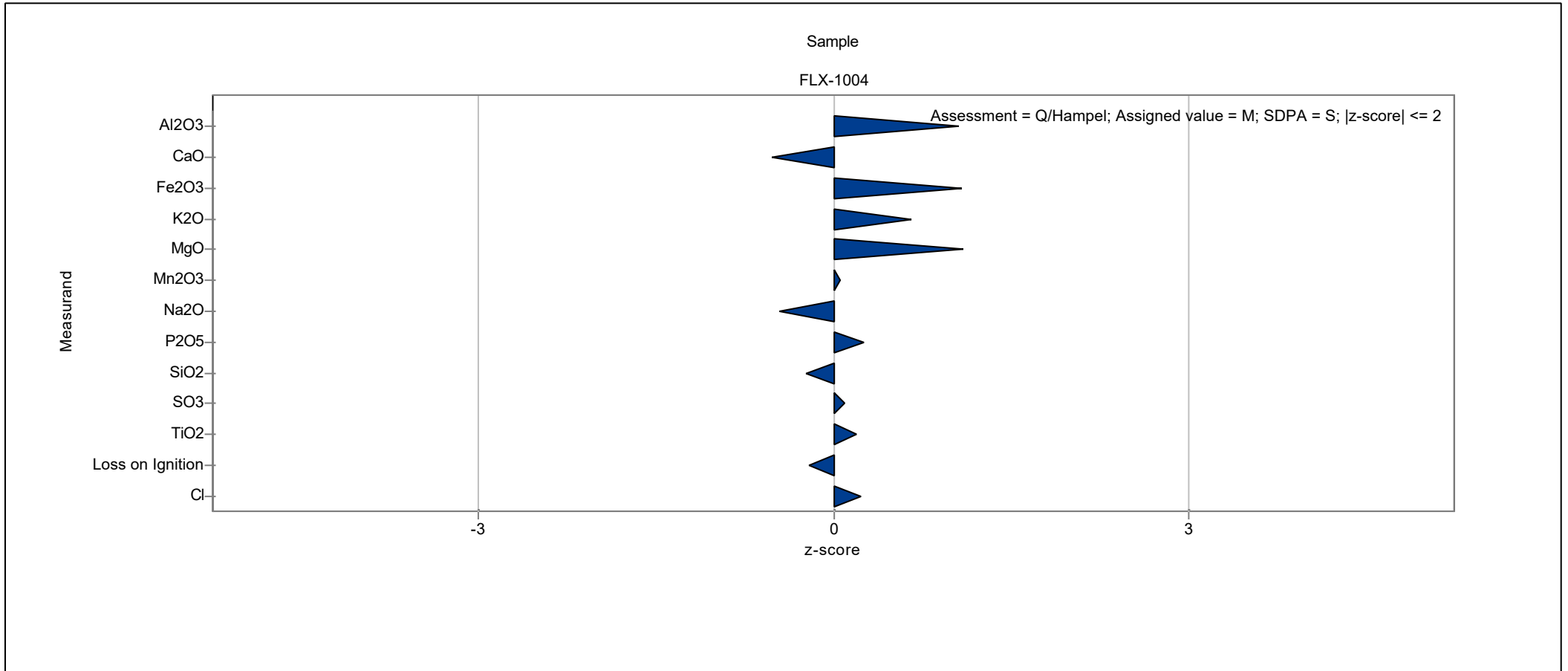
Laboratory chart of z-scores

Laboratory: 19



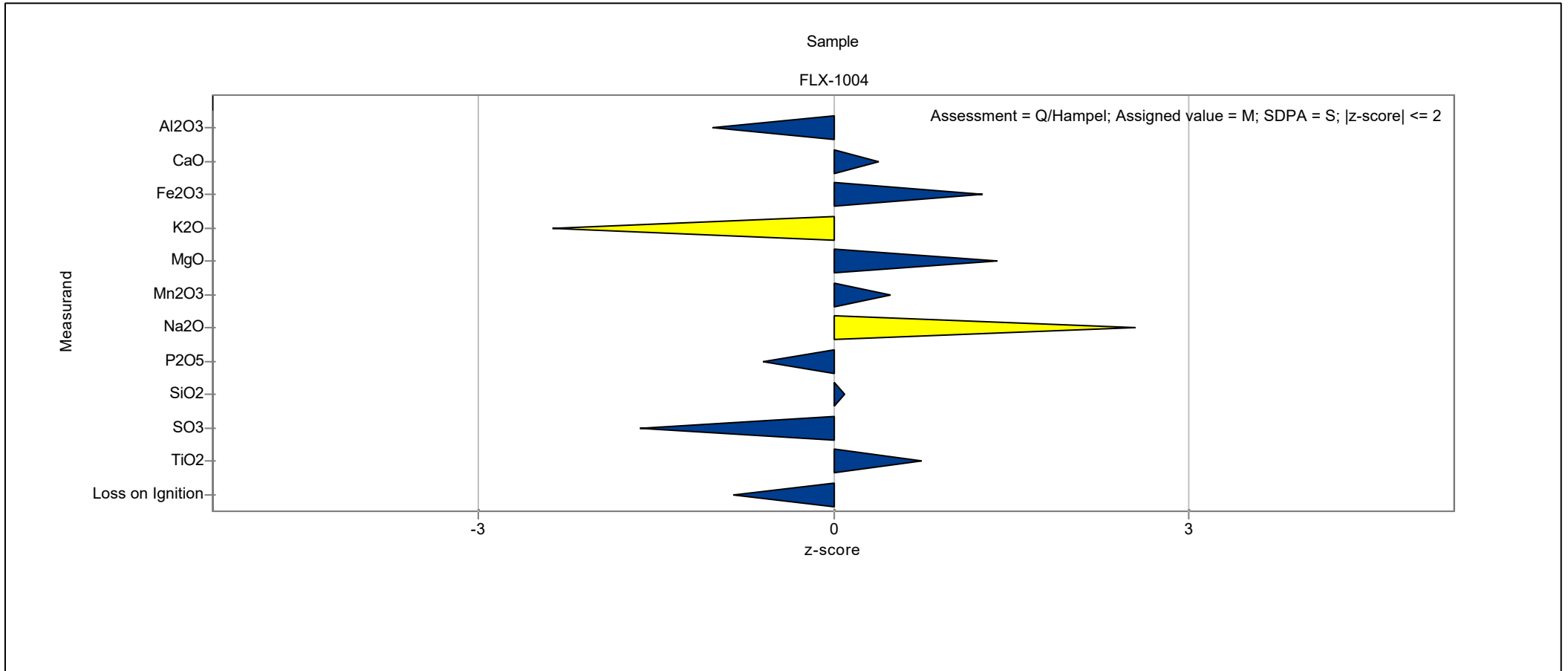
Laboratory chart of z-scores

Laboratory: 20



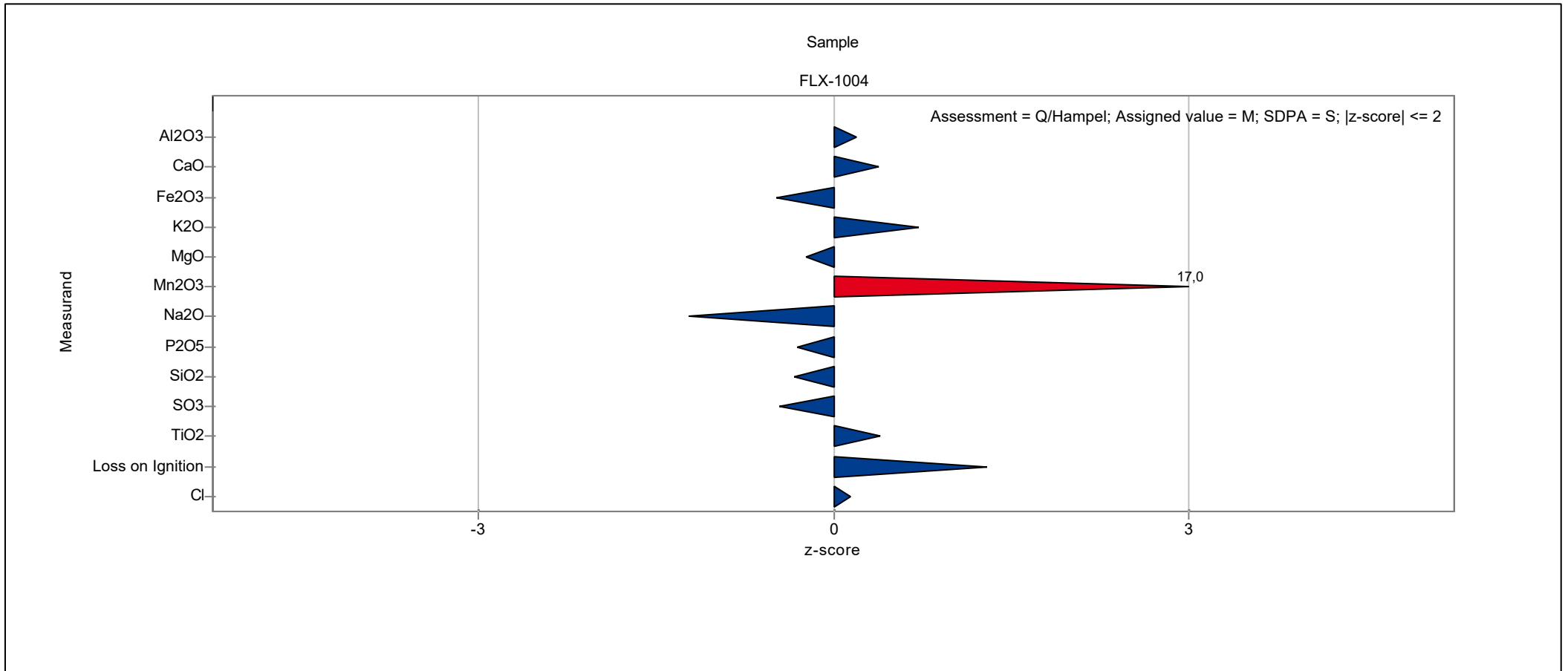
Laboratory chart of z-scores

Laboratory: 21



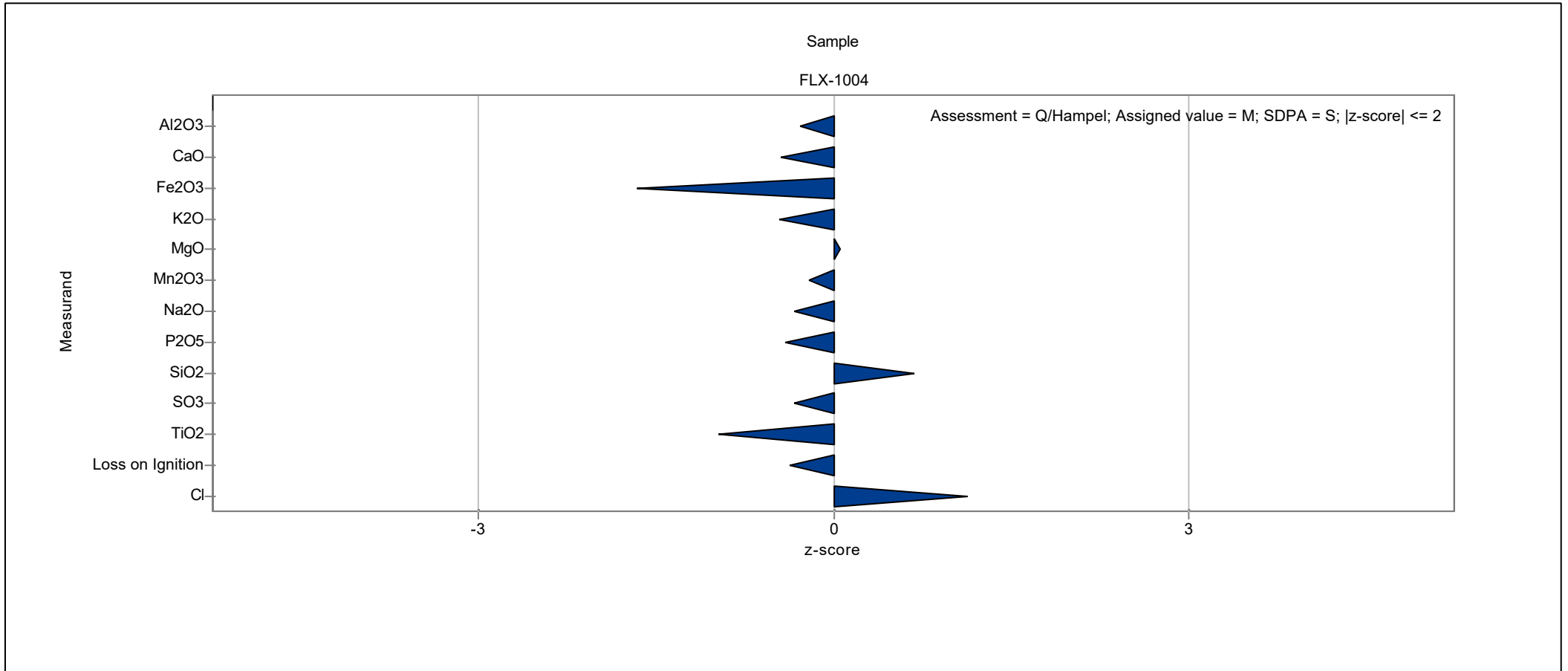
Laboratory chart of z-scores

Laboratory: 22



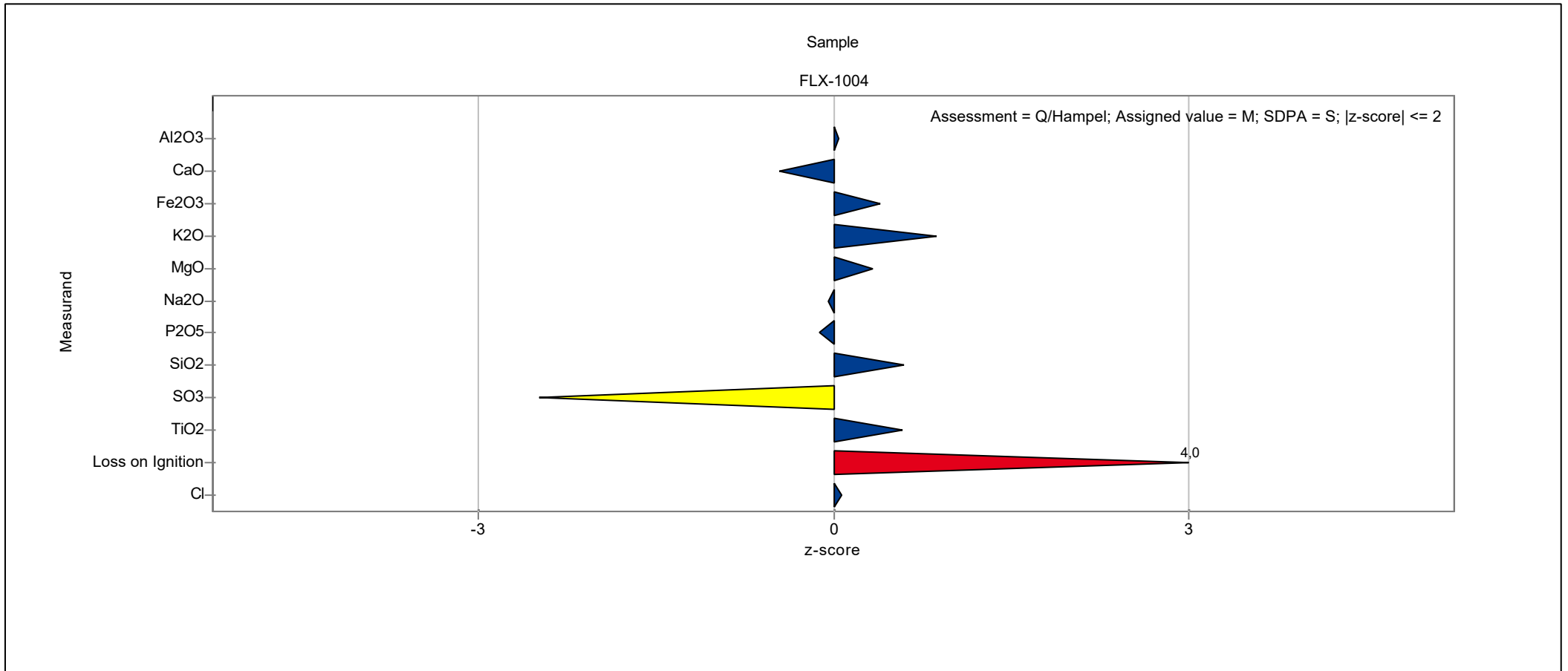
Laboratory chart of z-scores

Laboratory: 23



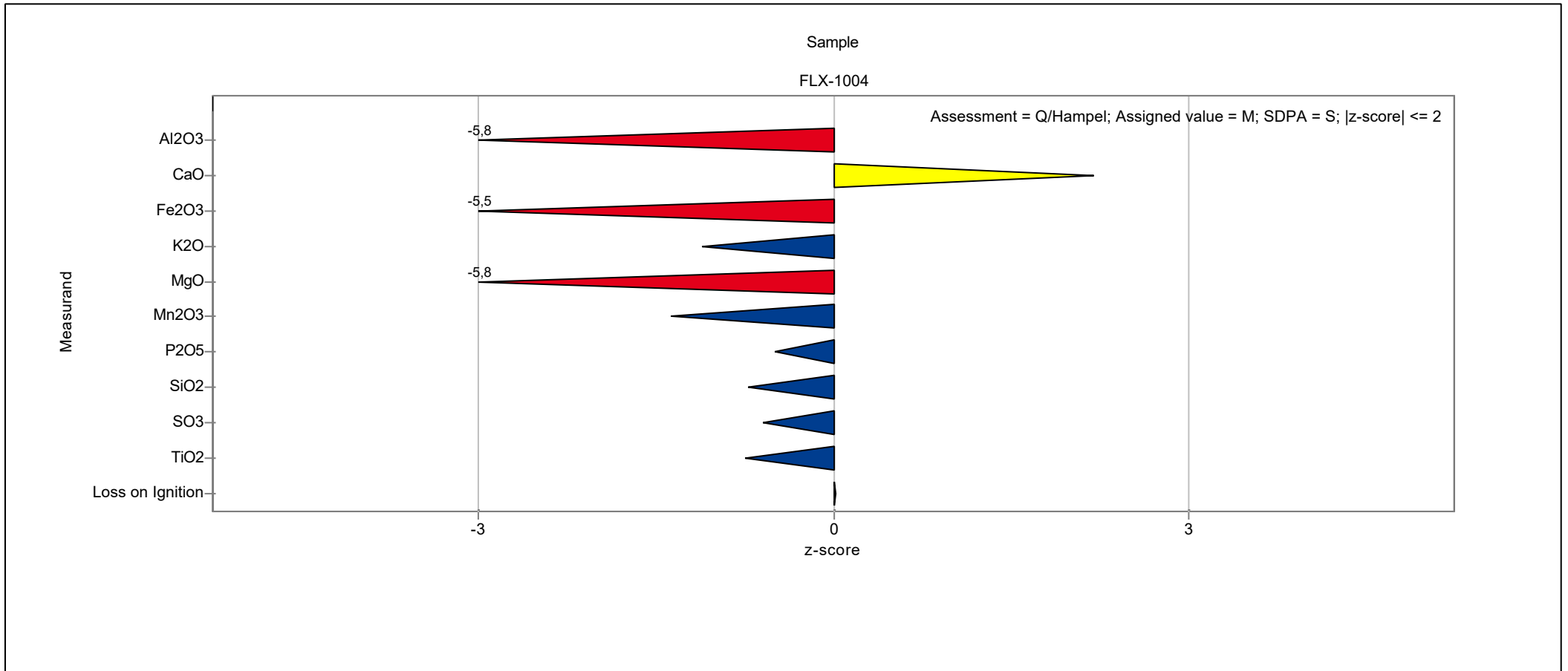
Laboratory chart of z-scores

Laboratory: 24



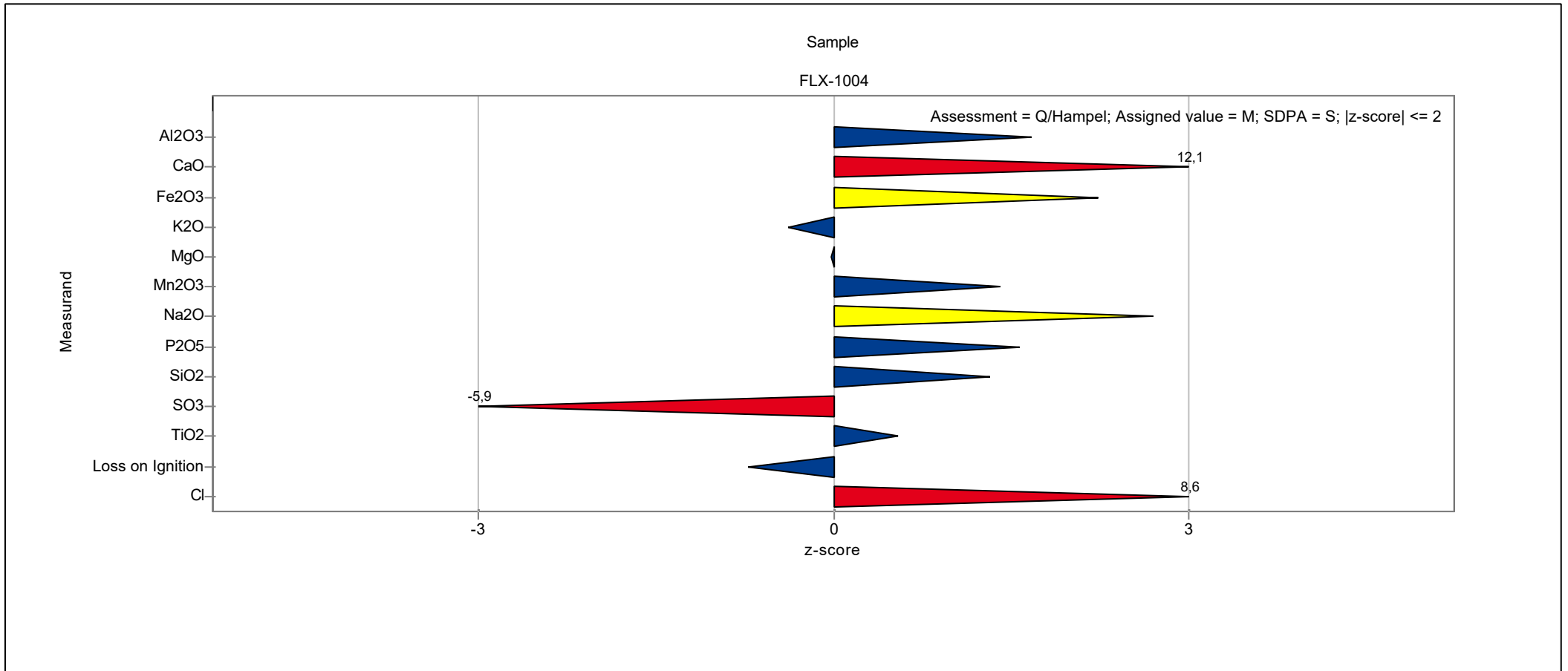
Laboratory chart of z-scores

Laboratory: 25



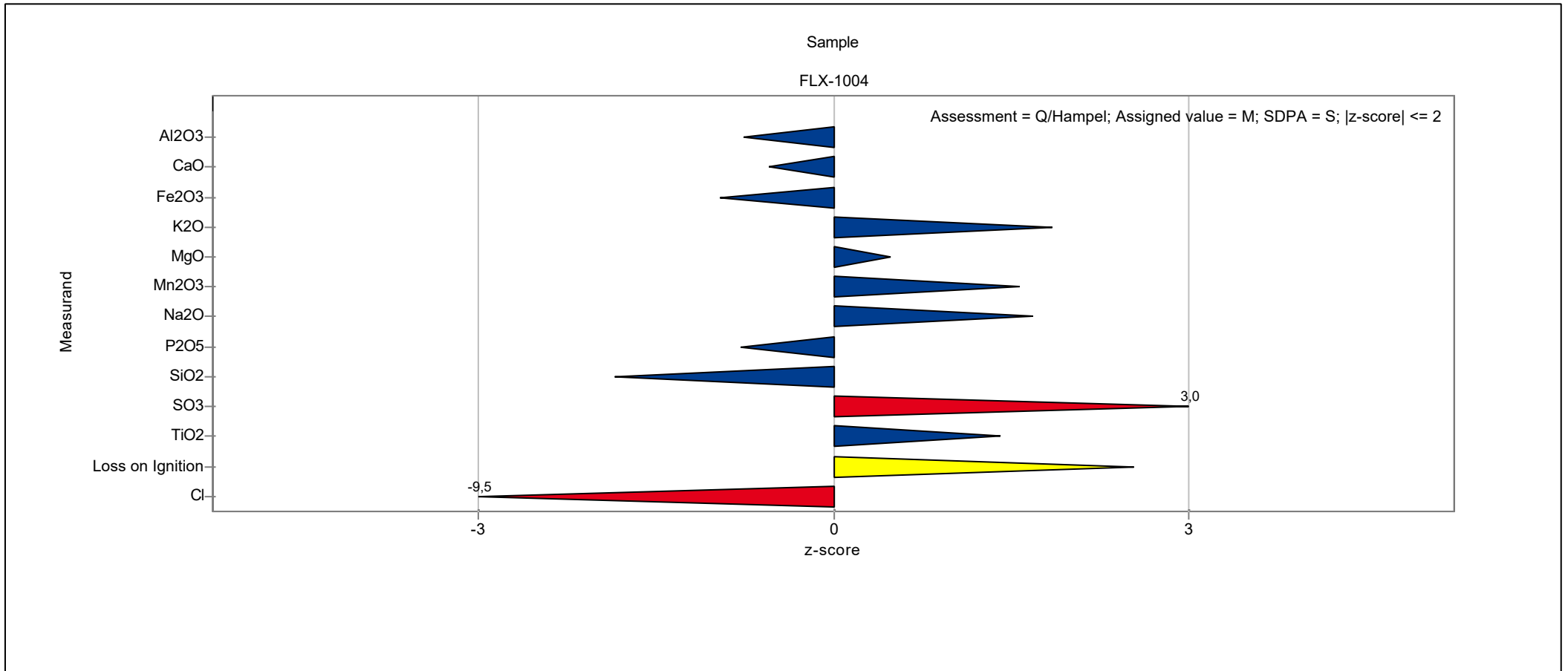
Laboratory chart of z-scores

Laboratory: 26



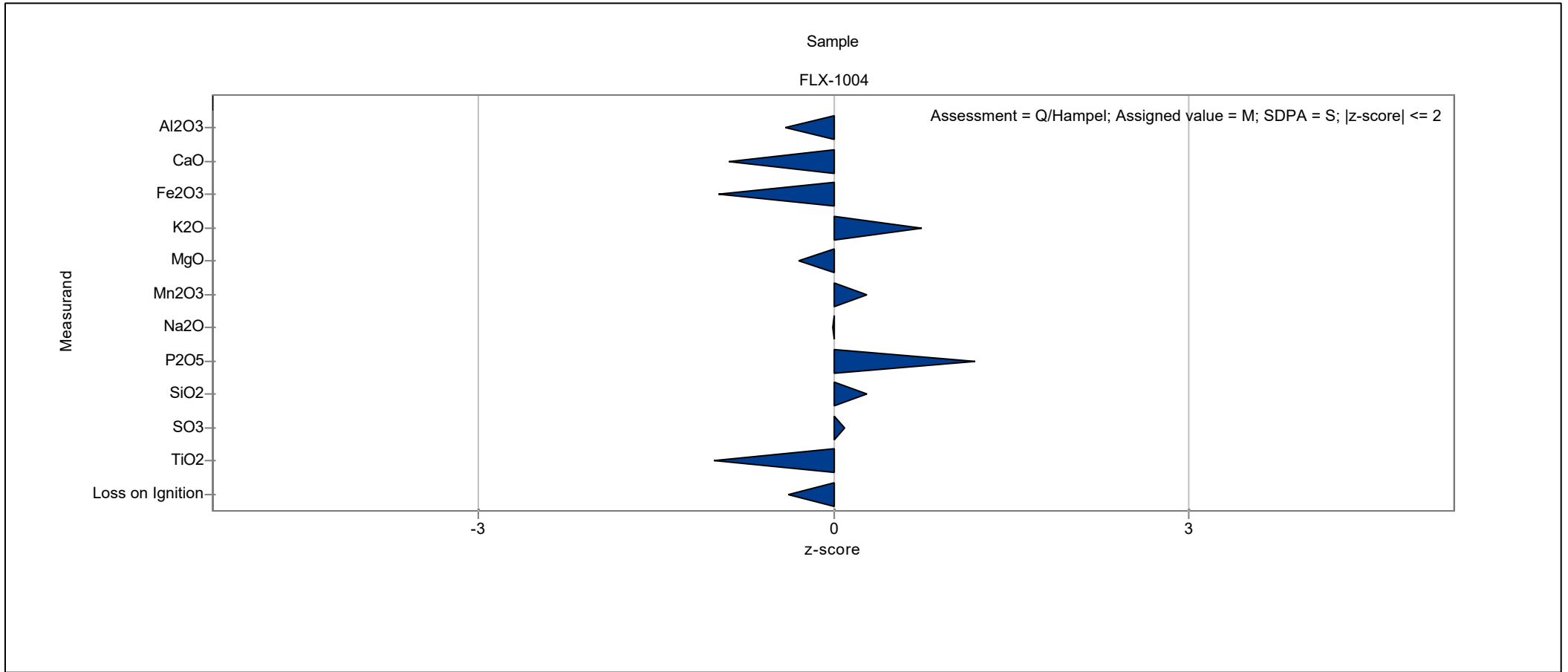
Laboratory chart of z-scores

Laboratory: 27



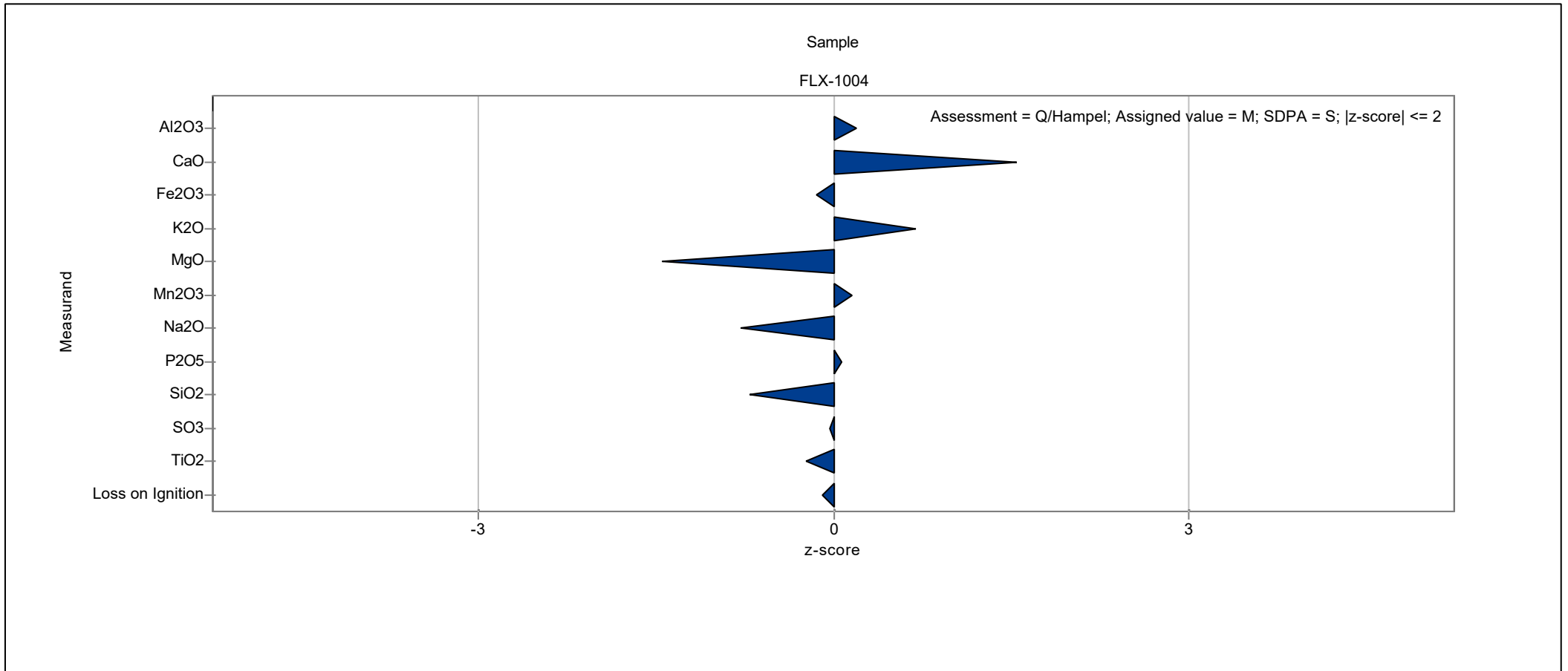
Laboratory chart of z-scores

Laboratory: 28



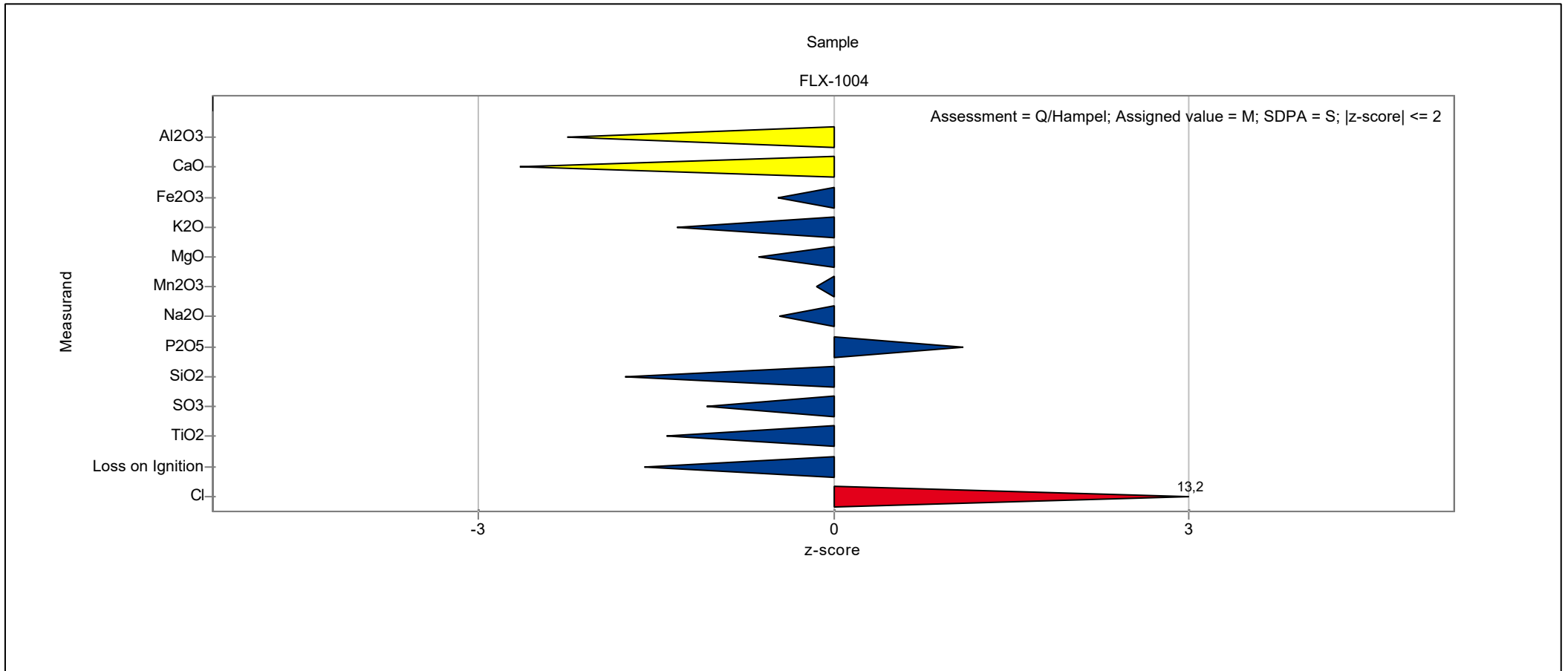
Laboratory chart of z-scores

Laboratory: 29



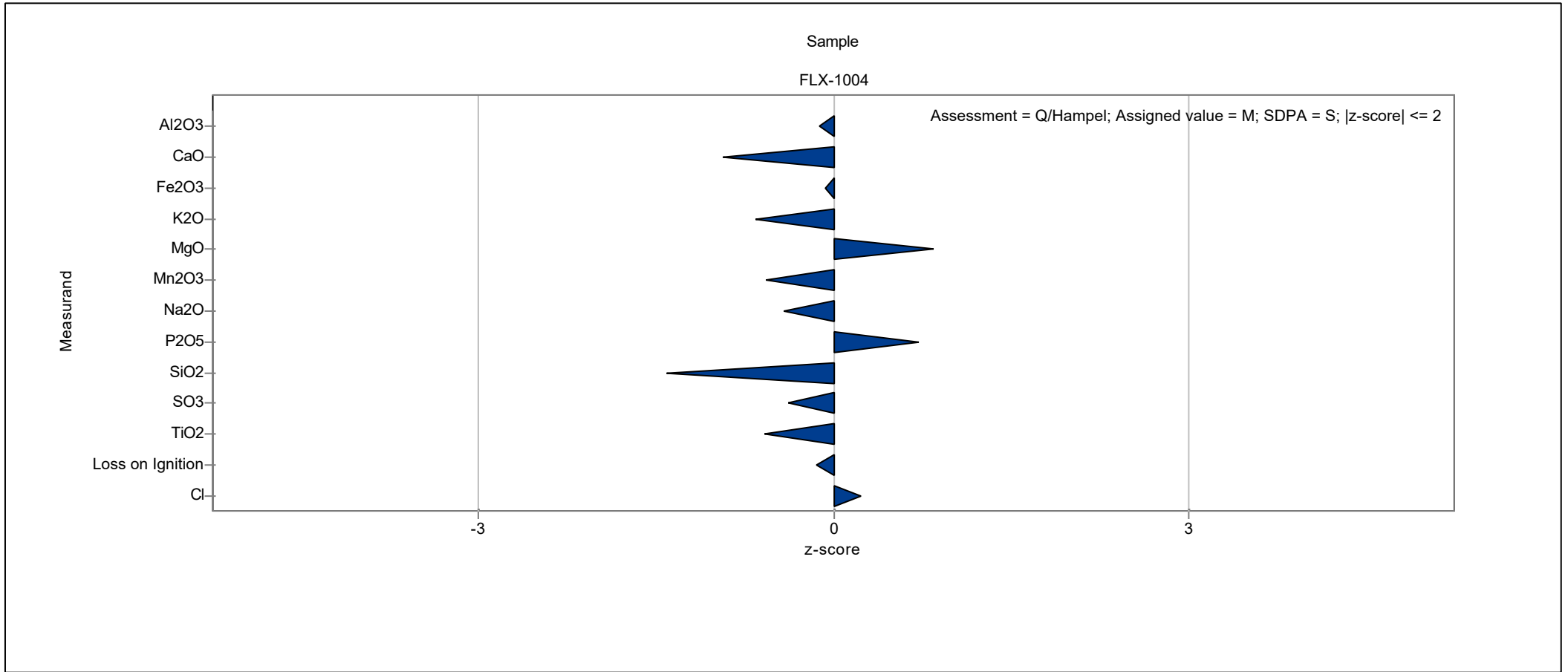
Laboratory chart of z-scores

Laboratory: 30



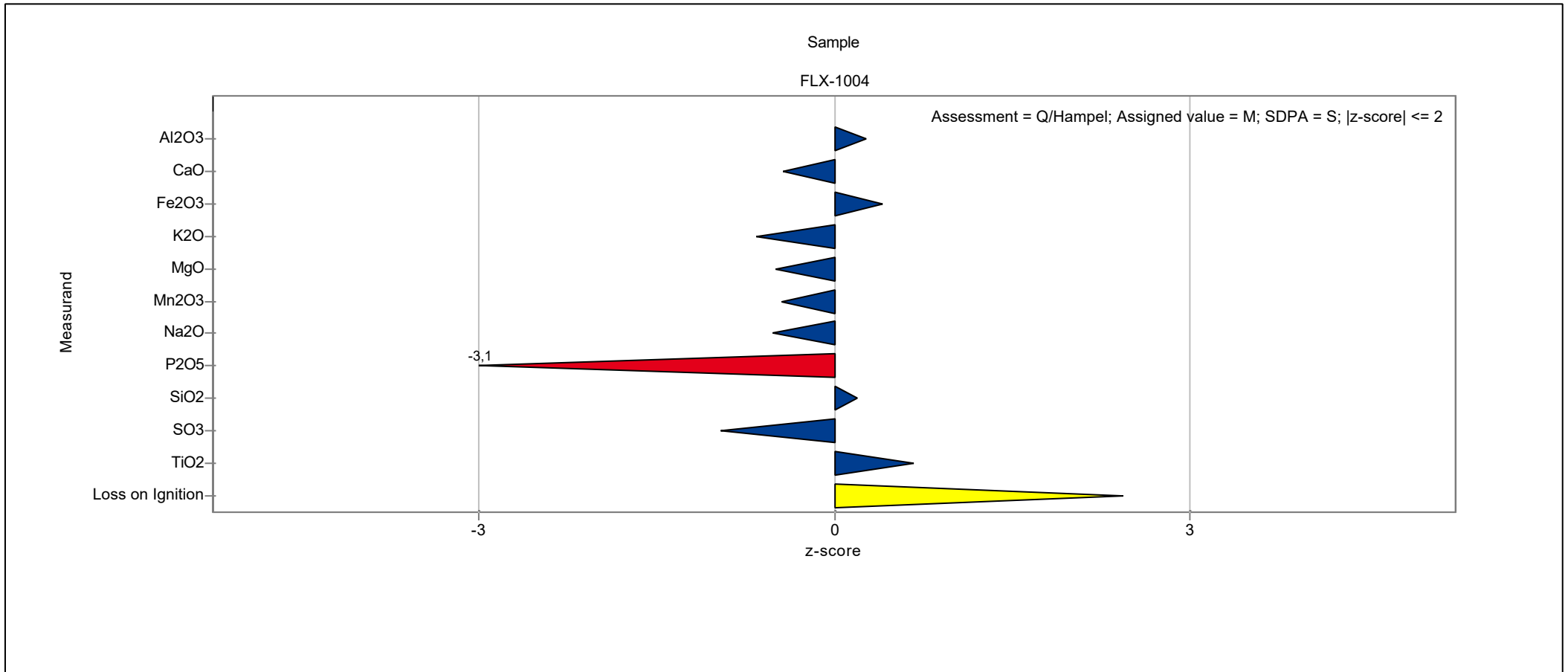
Laboratory chart of z-scores

Laboratory: 31



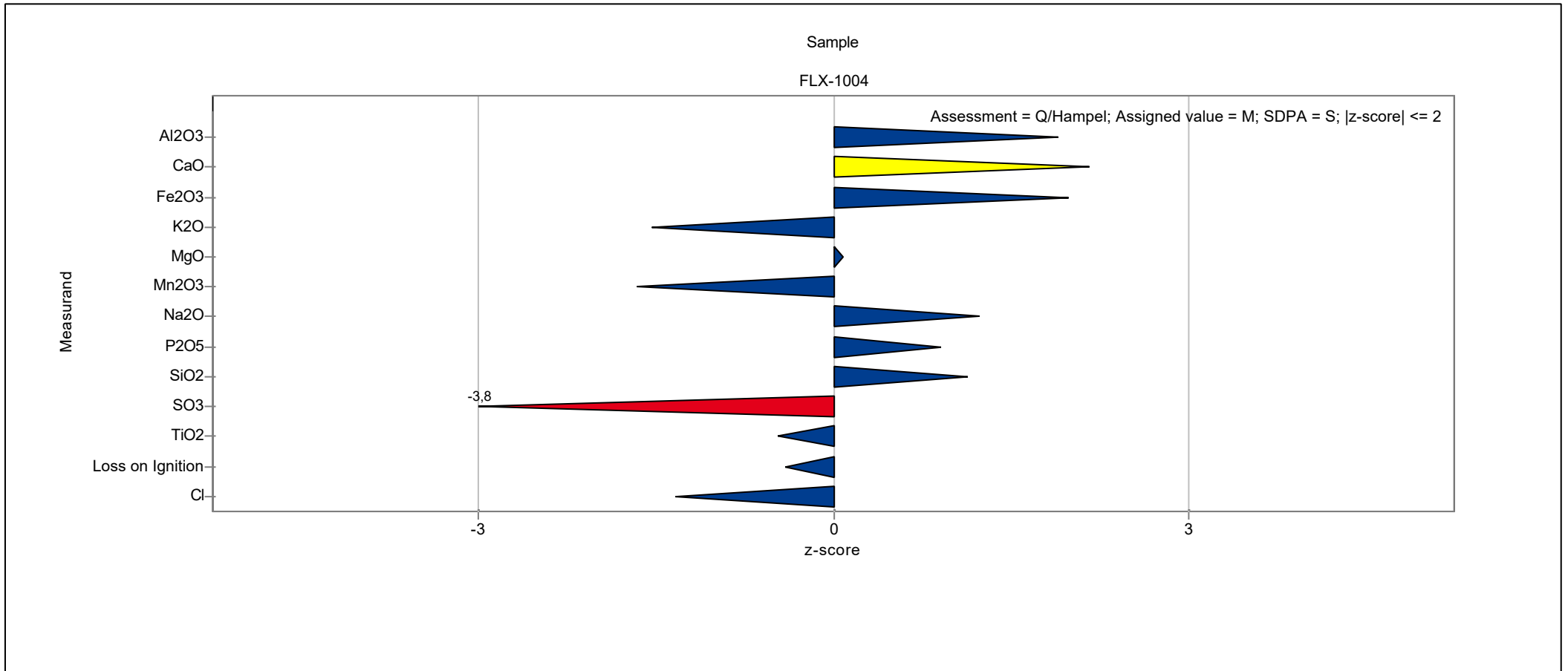
Laboratory chart of z-scores

Laboratory: 32



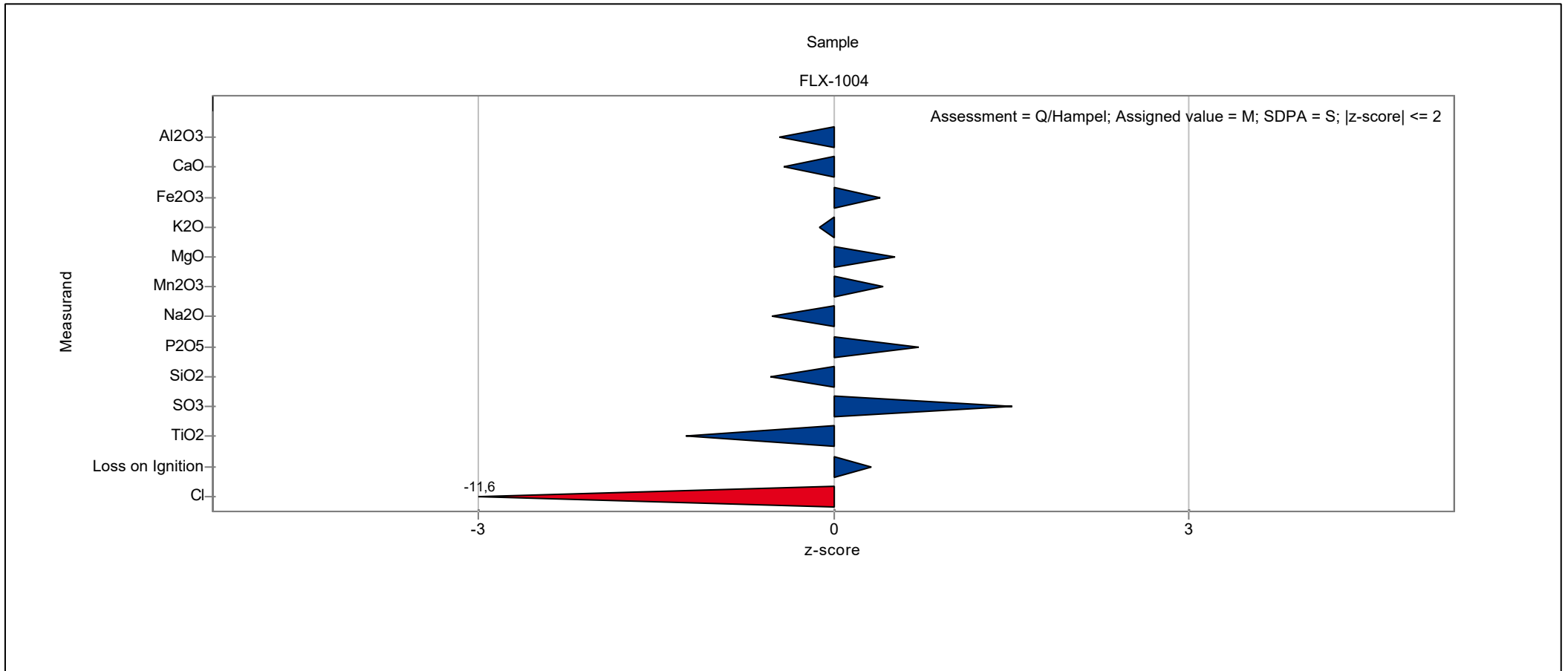
Laboratory chart of z-scores

Laboratory: 33



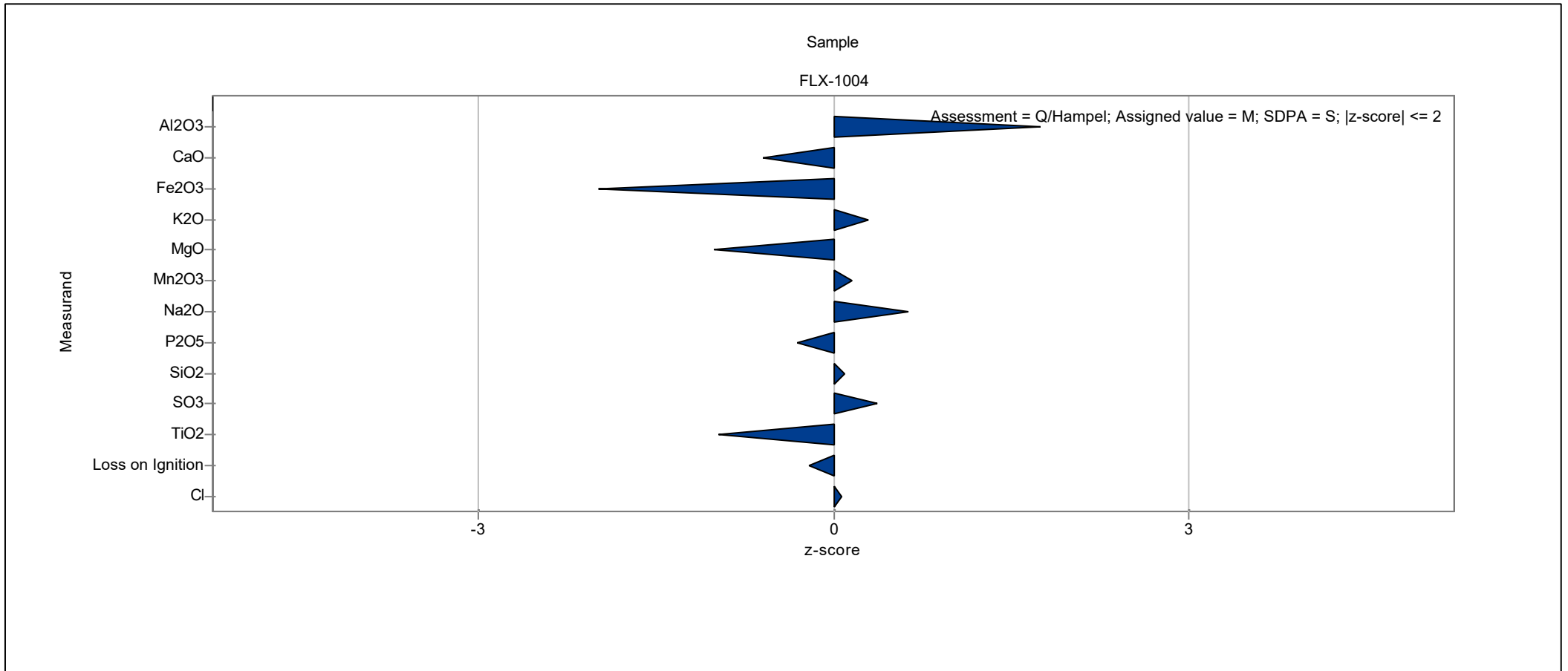
Laboratory chart of z-scores

Laboratory: 34



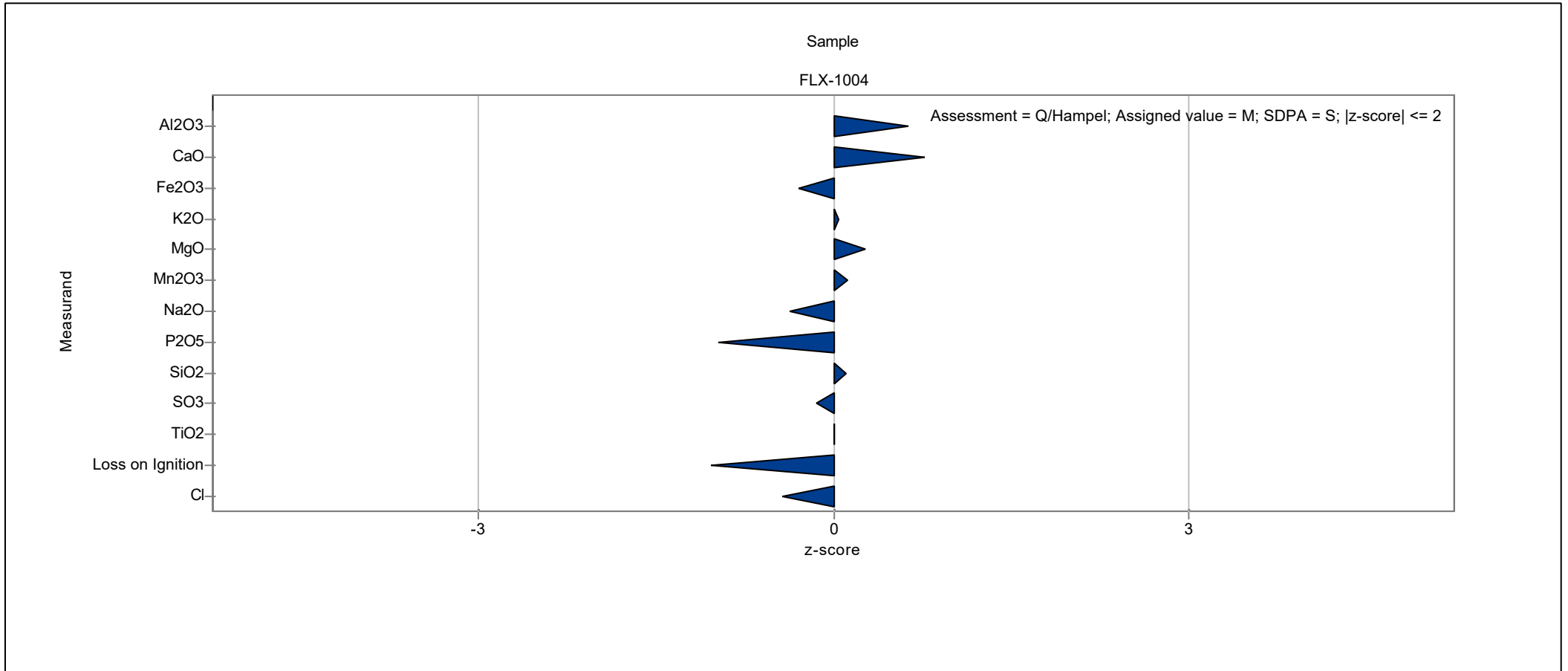
Laboratory chart of z-scores

Laboratory: 35



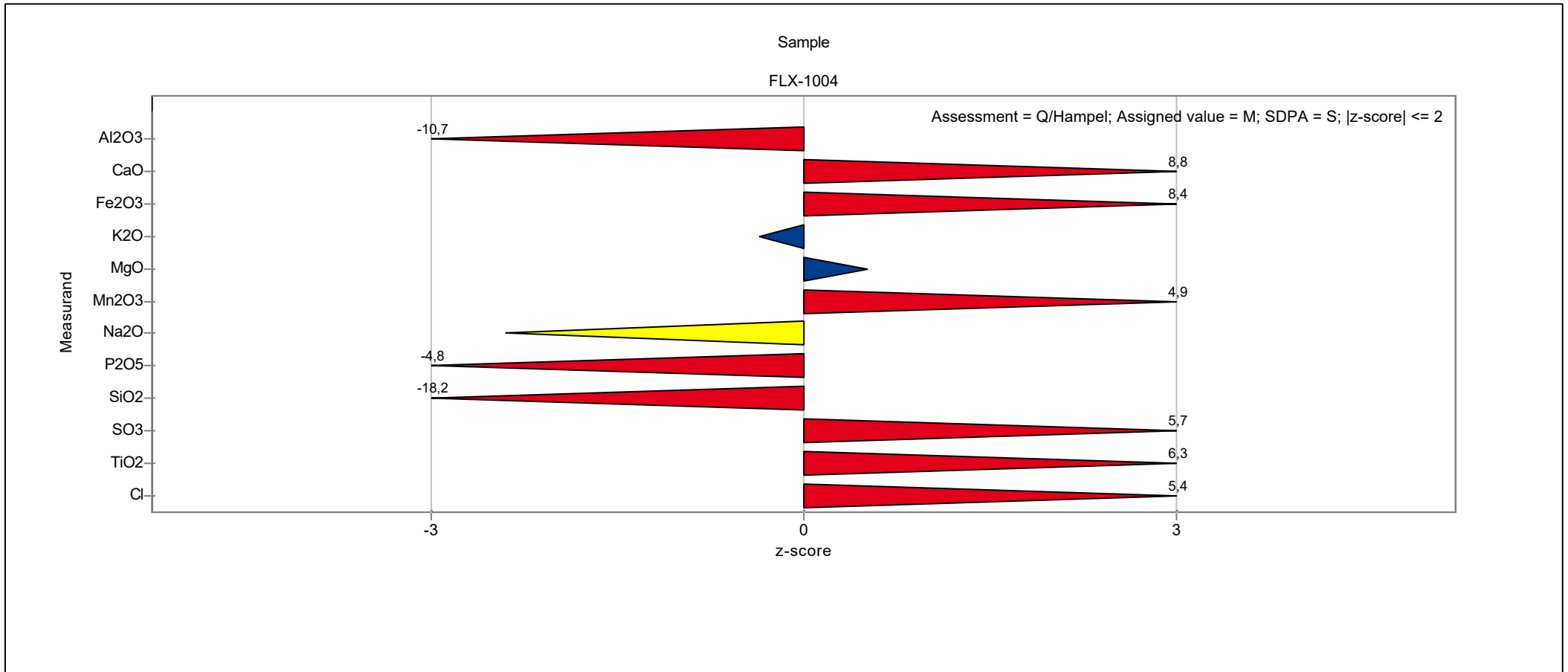
Laboratory chart of z-scores

Laboratory: 36



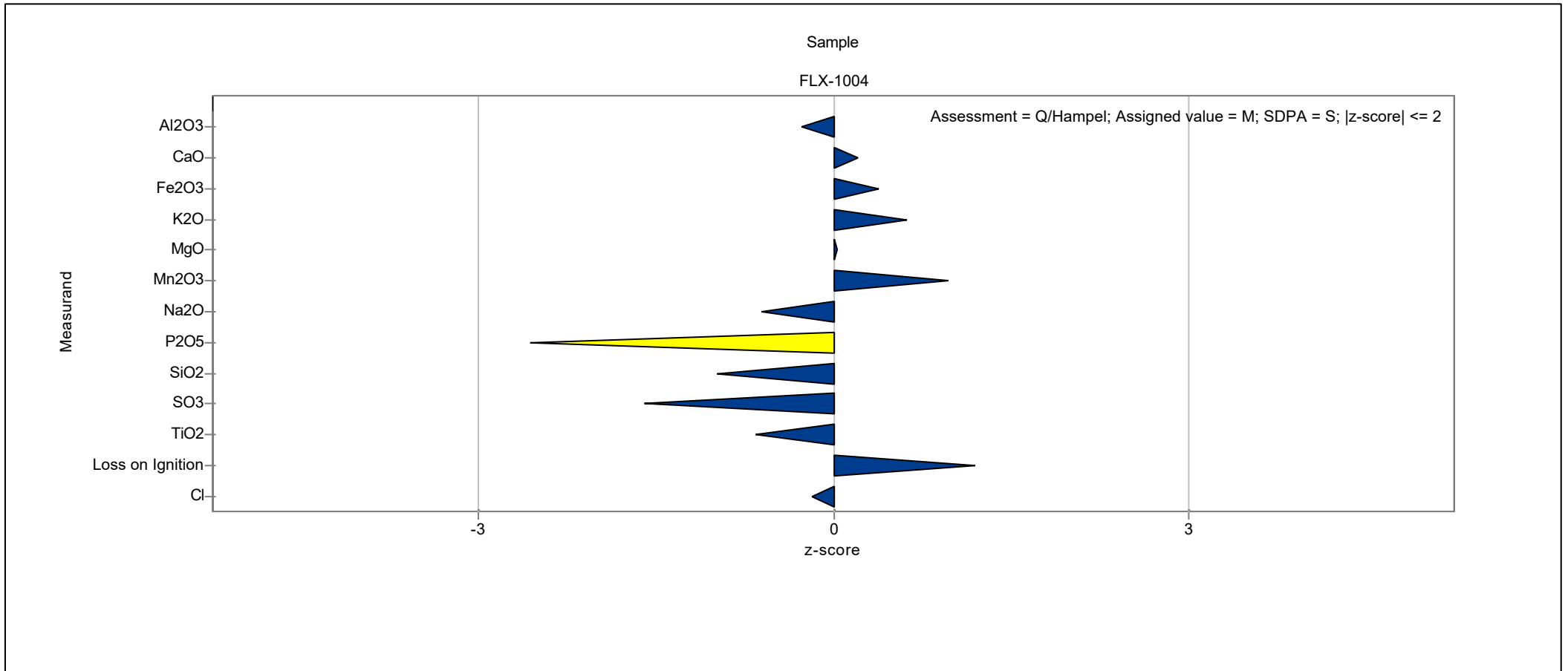
Laboratory chart of z-scores

Laboratory: 37



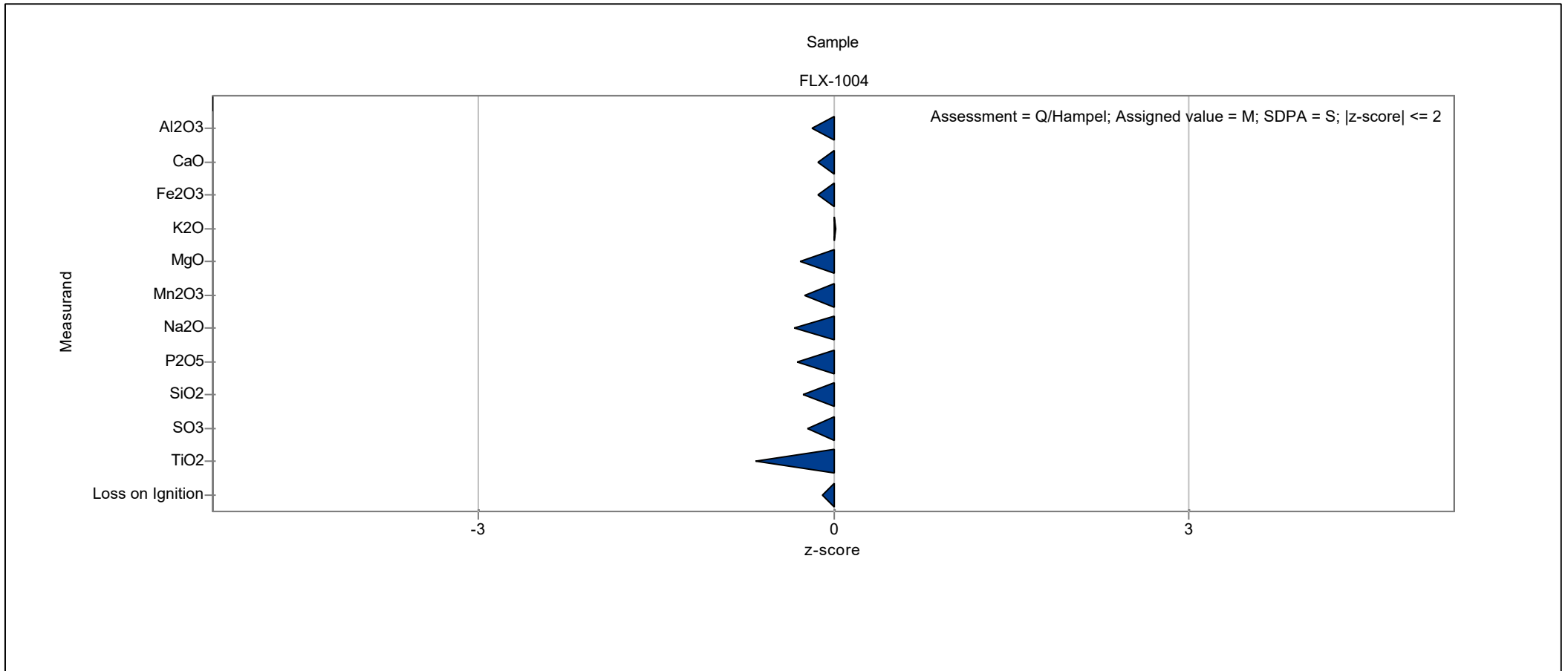
Laboratory chart of z-scores

Laboratory: 38



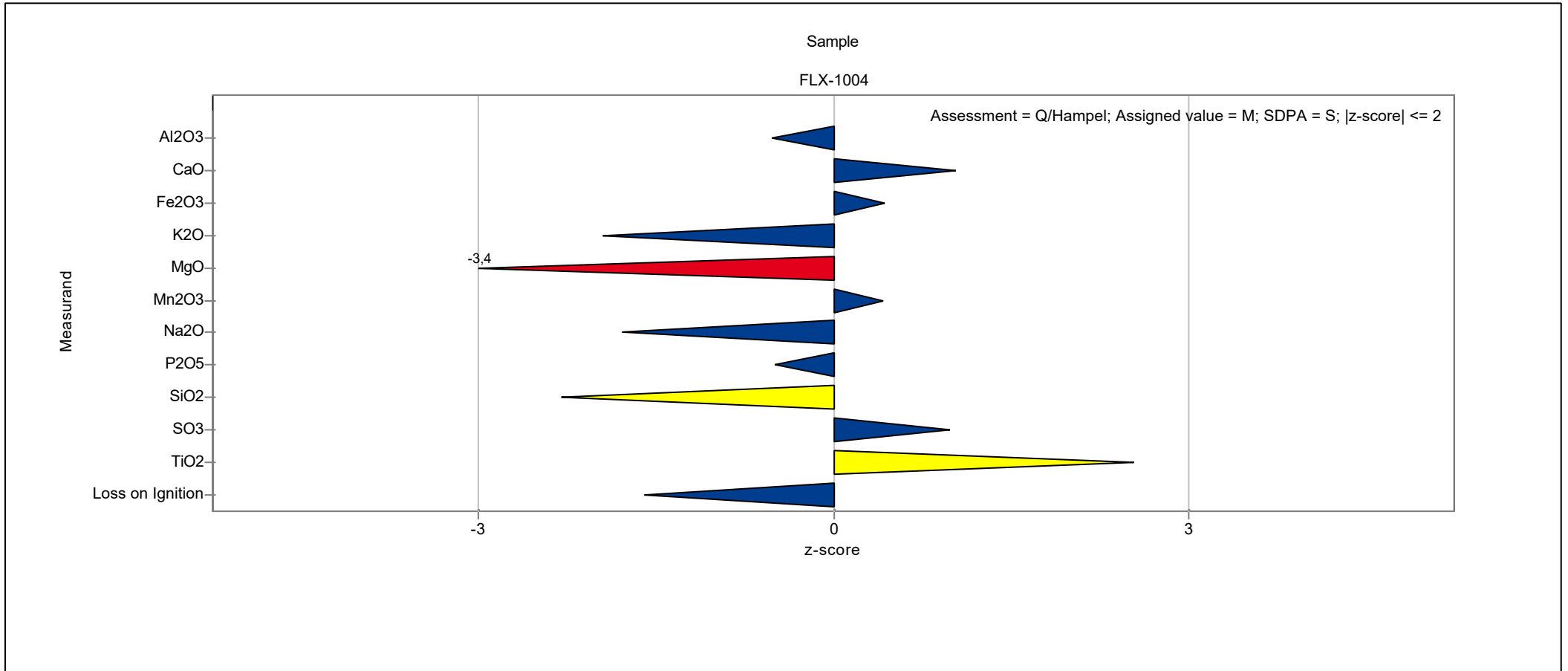
Laboratory chart of z-scores

Laboratory: 39



Laboratory chart of z-scores

Laboratory: 40



Laboratory chart of z-scores

Laboratory: 42

