

FLUXANA®

XRF Application Solutions

RV-2021-01

Final Proficiency Test Report for Iron Ore

FLX-2001



Bedburg-Hau, November 12, 2021

Coordinator of PT

Charlotte Winkels-Herding

Statistics and Report

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FLX-2001	Al2O3	CaO	Fe2O3	Loss on Ignition	MgO	Mn2O3	P2O5	SiO2	TiO2
Unit	%	%	%	%	%	%	%	%	%
No. of laboratories	20	16	21	22	17	18	20	21	20
Mean m	1,400	0,033	96,548	3,495	0,081	0,135	0,196	1,628	0,135
Reproducibility standard deviation s_R	0,081	0,020	0,789	0,091	0,032	0,011	0,015	0,065	0,015
Repeatability standard deviation s_r	0,018	0,002	0,082	0,016	0,006	0,003	0,002	0,019	0,003
Robust standard deviation s^*	0,086	0,020	0,786	0,077	0,028	0,009	0,016	0,065	0,014
Uncertainty U (s^*)	0,048	0,012	0,429	0,041	0,017	0,005	0,009	0,036	0,008
Uncertainty U (s_R)	0,045	0,013	0,430	0,049	0,019	0,006	0,008	0,035	0,008
Mean - 2*s_R	1,239	-0,007	94,970	3,314	0,017	0,113	0,165	1,499	0,105
Mean + 2*s_R	1,561	0,072	98,126	3,677	0,145	0,157	0,227	1,758	0,164

All values are in mass % and are based on annealed 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



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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.

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Participants

IMERYS TALC Austria	Austria
voestalpine Stahl Linz GmbH	Austria
Lhoist R&D	Belgium
Nait Industry Solutions	Canada
Kemira Oyj	Finland
Air Liquide	France
Lafarge Ciments	France
AG der Dillinger Hüttenwerke	Germany
Currenta GmbH & Co.KG	Germany
Daimler Truck AG	Germany
DIFK GmbH	Germany
Dr. Robert-Murjahn-Institut GmbH	Germany
ESF Elbe-Stahlwerke Feralpi GmbH	Germany
FLUXANA GmbH & Co.KG	Germany
Fraunhofer Institut für Keramische Technologien und Systeme IKTS	Germany
Horn & Co. Analytics GmbH	Germany
IME Metallurgische Prozesstechnik und Metallrecycl	Germany
PK Rohstoffe GmbH	Germany
Rigaku Europe Se	Germany
SGS Institut Fresenius	Germany
THYSSEN KRUPP STEEL EUROPE AG	Germany
TU Bergakademie Freiberg, Institut für Eisen- und Stahltechnologie	Germany
SINTEF Norlab as	Norway
Lafarge Cement S.A.	Poland
Jura Cement	Switzerland
ISKENDERUN IRON AND STEEL CO.	Turkey
X-ray Mineral Services Ltd	United Kingdom



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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 13528:2020)

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:

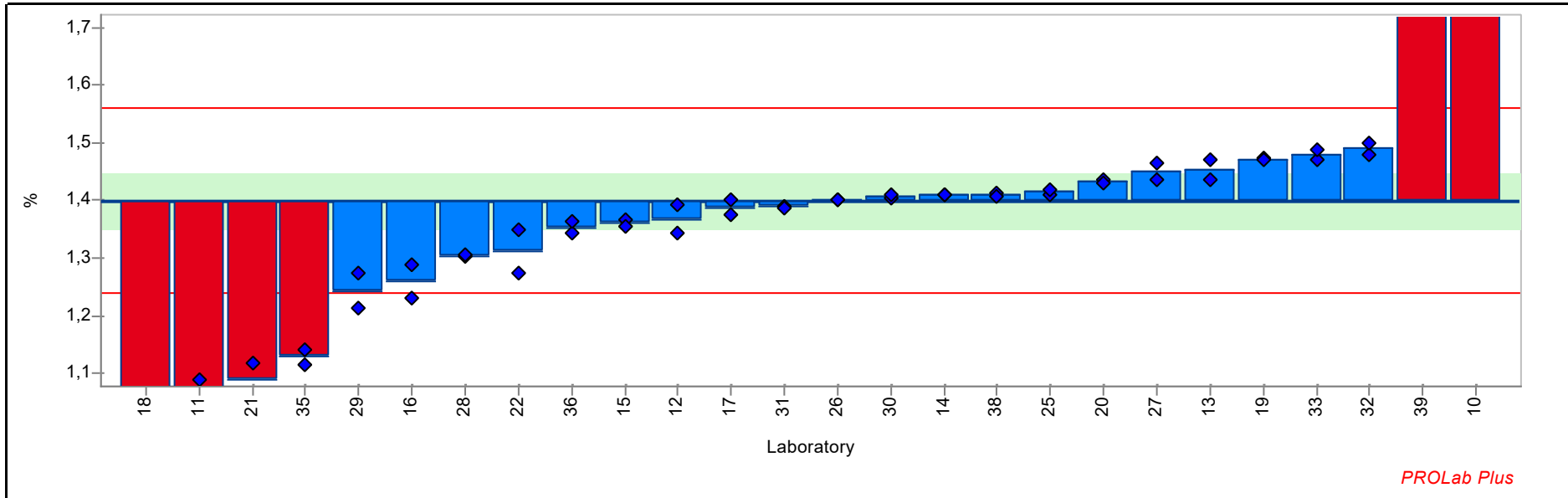
$ z \leq 2.0$	indicates "satisfactory" performance = generates no signal
$2.0 < z < 3.0$	indicates "questionable" performance = generates a warning signal
$ z \geq 3.0$	indicates "unsatisfactory" performance = generates an action signal

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.

RV_2021_01_iron ore

Summary results

Sample: FLX-2001 iron ore **Reproducibility s.d.:** 0,081 %
Measurand: Al₂O₃ **Repeatability s.d.:** 0,018 %
Mean ± U(Mean): 1,400 ± 0,048 % **Range of tolerance:** 1,239 - 1,561 % (|z-score| ≤ 2,000)
No. of laboratories: 20 **Statistical method:** Q/Hampel



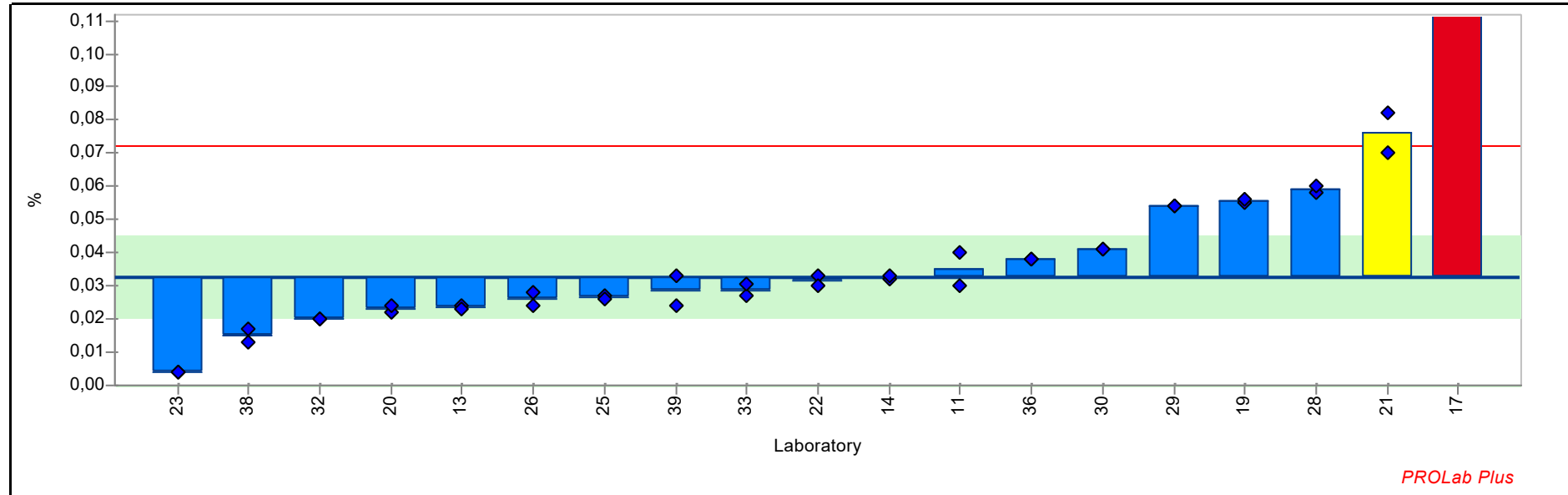
Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
10	3,020	0,000	20,083	3,020	3,020	no accreditation	XRF (fusion)	information only
11	1,060	0,042	-4,214	1,030	1,090	no accreditation	XRF (fusion)	
12	1,367	0,035	-0,402	1,392	1,343	no accreditation	XRF (fusion)	information only
13	1,453	0,025	0,658	1,471	1,435	no accreditation	XRF (fusion)	ISO 9516 1:2003
14	1,410	0,000	0,124	1,410	1,410	ISO 17025	XRF (fusion)	DIN EN ISO 12677
15	1,361	0,010	-0,483	1,368	1,354	no accreditation	XRF (fusion)	

RV_2021_01_iron ore

Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
16	1,260	0,040	-1,741	1,231	1,288	no accreditation	XRF (fusion)	
17	1,388	0,019	-0,154	1,401	1,374	no accreditation	XRF (fusion)	
18	1,058	0,027	-4,239	1,077	1,039	no accreditation	XRF (fusion)	ISO DIN 51001:2003
19	1,472	0,003	0,893	1,474	1,470	no accreditation	XRF (fusion)	
20	1,433	0,004	0,403	1,435	1,430	ISO 17025	XRF (fusion)	ISO 9516 1:2003
21	1,088	0,041	-3,867	1,059	1,117	no accreditation	XRF (fusion)	ISO DIN 51001:2003
22	1,311	0,052	-1,103	1,274	1,348	no accreditation	XRF (fusion)	ISO DIN 51001:2003; information only
25	1,414	0,005	0,180	1,411	1,418		XRF (fusion)	ISO 9516 1:2003
26	1,400	0,000	0,001	1,400	1,400	no accreditation	XRF (fusion)	ISO DIN 51001:2003
27	1,451	0,020	0,633	1,465	1,437	no accreditation	XRF (fusion)	
28	1,304	0,001	-1,190	1,303	1,305	no accreditation	XRF (fusion)	
29	1,243	0,042	-1,946	1,213	1,273	ISO 17025	XRF (fusion)	information only
30	1,407	0,003	0,087	1,405	1,409	no accreditation	XRF (fusion)	ISO DIN 51001:2003
31	1,389	0,001	-0,142	1,389	1,388	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
32	1,490	0,014	1,116	1,480	1,500	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
33	1,480	0,013	0,992	1,471	1,489	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
35	1,128	0,019	-3,365	1,115	1,142	no accreditation	Other Method	information only
36	1,353	0,013	-0,576	1,344	1,363	ISO 17025	XRF (fusion)	DIN EN ISO 12677
38	1,411	0,004	0,137	1,414	1,408	ISO 17025	XRF (fusion)	ISO 9516 1:2003
39	2,798	0,066	17,337	2,845	2,752	no accreditation	XRF (pressed pellet)	information only

RV_2021_01_iron ore

Sample: FLX-2001 iron ore **Reproducibility s.d.:** 0,020 %
Measurand: CaO **Repeatability s.d.:** 0,002 %
Mean ± U(Mean): 0,033 ± 0,012 % **Range of tolerance:** -0,007 - 0,072 % (|z-score| <= 2,000)
No. of laboratories: 16 **Statistical method:** Q/Hampel



PROLab Plus

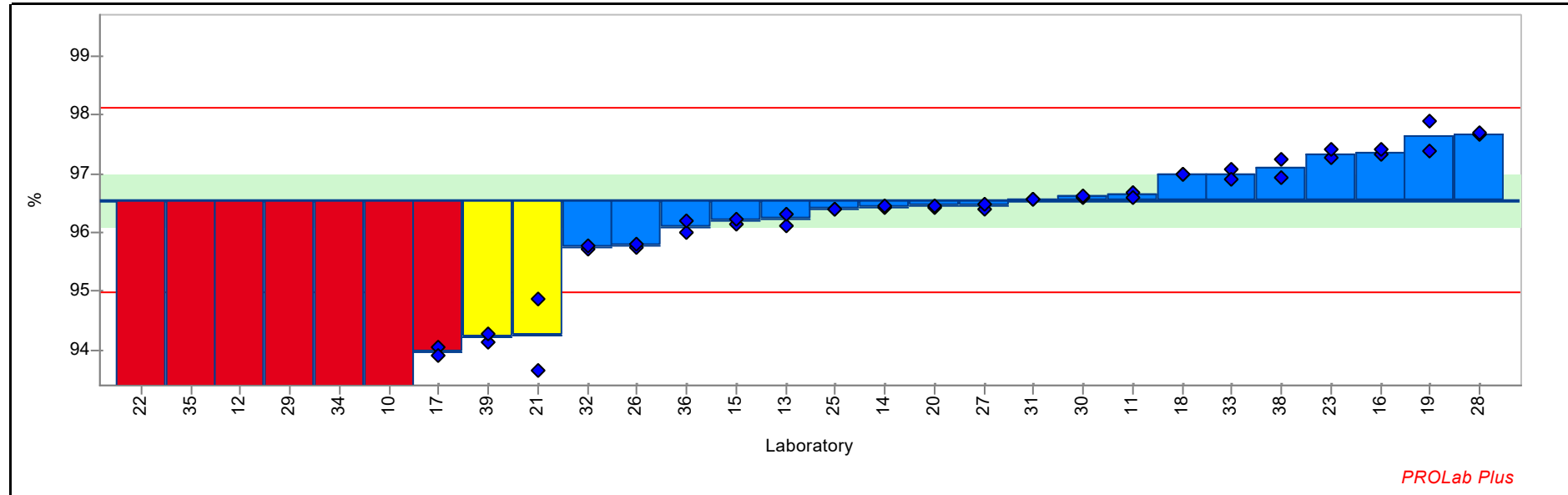
Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
11	0,035	0,007	0,117	0,040	0,030	no accreditation	XRF (fusion)	
13	0,024	0,001	-0,464	0,024	0,023	no accreditation	XRF (fusion)	ISO 9516 1:2003
14	0,033	0,001	-0,009	0,032	0,033	ISO 17025	XRF (fusion)	DIN EN ISO 12677
17	0,262	0,045	11,592	0,230	0,294	no accreditation	XRF (fusion)	
19	0,056	0,001	1,154	0,055	0,056	no accreditation	XRF (fusion)	
20	0,023	0,001	-0,489	0,022	0,024	ISO 17025	XRF (fusion)	ISO 9516 1:2003
21	0,076	0,008	2,190	0,082	0,070	no accreditation	XRF (fusion)	ISO DIN 51001:2003
22	0,032	0,002	-0,059	0,033	0,030	no accreditation	XRF (fusion)	ISO DIN 51001:2003; information only

RV_2021_01_iron ore

Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
23	0,004	0,000	-1,450	0,004	0,004	no accreditation	XRF (fusion)	
25	0,026	0,001	-0,312	0,027	0,026		XRF (fusion)	ISO 9516 1:2003
26	0,026	0,003	-0,338	0,028	0,024	no accreditation	XRF (fusion)	ISO DIN 51001:2003
28	0,059	0,001	1,331	0,058	0,060	no accreditation	XRF (fusion)	
29	0,054	0,000	1,078	0,054	0,054	ISO 17025	XRF (fusion)	information only
30	0,041	0,000	0,421	0,041	0,041	no accreditation	XRF (fusion)	ISO DIN 51001:2003
32	0,020	0,000	-0,641	0,020	0,020	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
33	0,029	0,003	-0,196	0,027	0,031	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
36	0,038	0,000	0,269	0,038	0,038	ISO 17025	XRF (fusion)	DIN EN ISO 12677
38	0,015	0,003	-0,894	0,017	0,013	ISO 17025	XRF (fusion)	ISO 9516 1:2003
39	0,029	0,006	-0,211	0,024	0,033	no accreditation	XRF (pressed pellet)	information only

RV_2021_01_iron ore

Sample: FLX-2001 iron ore **Reproducibility s.d.:** 0,789 %
Measurand: Fe2O3 **Repeatability s.d.:** 0,082 %
Mean ± U(Mean): 96,548 ± 0,429 % **Range of tolerance:** 94,970 - 98,126 % (|z-score| <= 2,000)
No. of laboratories: 21 **Statistical method:** Q/Hampel



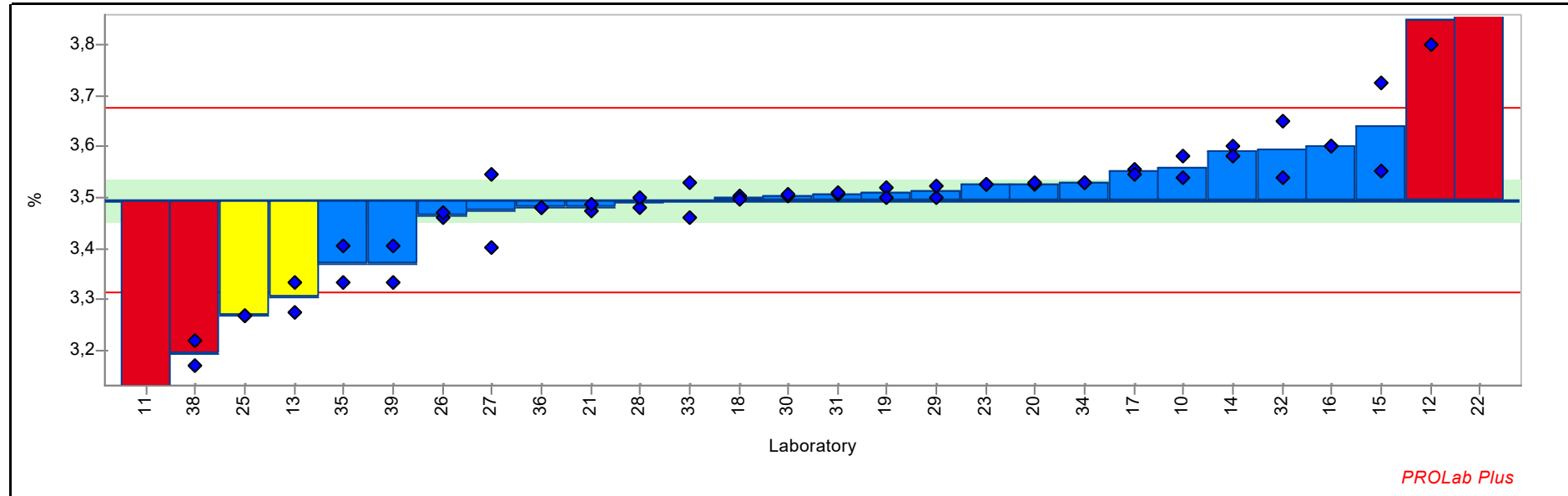
Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
10	92,995	0,148	-4,504	92,890	93,100	no accreditation	XRF (fusion)	information only
11	96,635	0,049	0,110	96,670	96,600	no accreditation	XRF (fusion)	
12	92,244	0,032	-5,456	92,221	92,266	no accreditation	XRF (fusion)	information only
13	96,209	0,144	-0,430	96,107	96,311	no accreditation	XRF (fusion)	ISO 9516 1:2003
14	96,428	0,022	-0,152	96,413	96,444	ISO 17025	XRF (fusion)	DIN EN ISO 12677
15	96,185	0,061	-0,460	96,142	96,228	no accreditation	XRF (fusion)	
16	97,366	0,055	1,037	97,327	97,405	no accreditation	XRF (fusion)	
17	93,964	0,104	-3,276	94,037	93,890	no accreditation	XRF (fusion)	

RV_2021_01_iron ore

Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
18	96,981	0,011	0,549	96,973	96,989	no accreditation	XRF (fusion)	ISO DIN 51001:2003
19	97,636	0,375	1,379	97,371	97,901	no accreditation	XRF (fusion)	
20	96,439	0,028	-0,139	96,419	96,458	ISO 17025	XRF (fusion)	ISO 9516 1:2003
21	94,252	0,873	-2,911	93,635	94,869	no accreditation	XRF (fusion)	ISO DIN 51001:2003
22	87,045	1,492	-12,046	88,100	85,990	no accreditation	XRF (fusion)	ISO DIN 51001:2003; information only
23	97,340	0,113	1,004	97,260	97,420	no accreditation	XRF (fusion)	
25	96,383	0,004	-0,209	96,386	96,381		XRF (fusion)	ISO 9516 1:2003
26	95,761	0,044	-0,998	95,730	95,792	no accreditation	XRF (fusion)	ISO DIN 51001:2003
27	96,445	0,059	-0,131	96,403	96,487	no accreditation	XRF (fusion)	
28	97,678	0,026	1,433	97,660	97,697	no accreditation	XRF (fusion)	
29	92,470	0,806	-5,169	93,040	91,900	ISO 17025	XRF (fusion)	information only
30	96,605	0,035	0,072	96,580	96,630	no accreditation	XRF (fusion)	ISO DIN 51001:2003
31	96,564	0,018	0,020	96,576	96,551	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
32	95,745	0,049	-1,018	95,710	95,780	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
33	96,987	0,107	0,556	97,063	96,911	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
34	92,813	0,680	-4,735	93,294	92,332	no accreditation	XRF (fusion)	information only
35	87,712	0,131	-11,201	87,619	87,804	no accreditation	Other Method	information only
36	96,084	0,141	-0,588	95,984	96,184	ISO 17025	XRF (fusion)	DIN EN ISO 12677
38	97,091	0,211	0,689	96,942	97,241	ISO 17025	XRF (fusion)	ISO 9516 1:2003
39	94,207	0,100	-2,968	94,136	94,278	no accreditation	XRF (pressed pellet)	information only

RV_2021_01_iron ore

Sample: FLX-2001 iron ore **Reproducibility s.d.:** 0,091 %
Measurand: Loss on Ignition **Repeatability s.d.:** 0,016 %
Mean ± U(Mean): 3,495 ± 0,041 % **Range of tolerance:** 3,314 - 3,677 % (|z-score| ≤ 2,000)
No. of laboratories: 22 **Statistical method:** Q/Hampel



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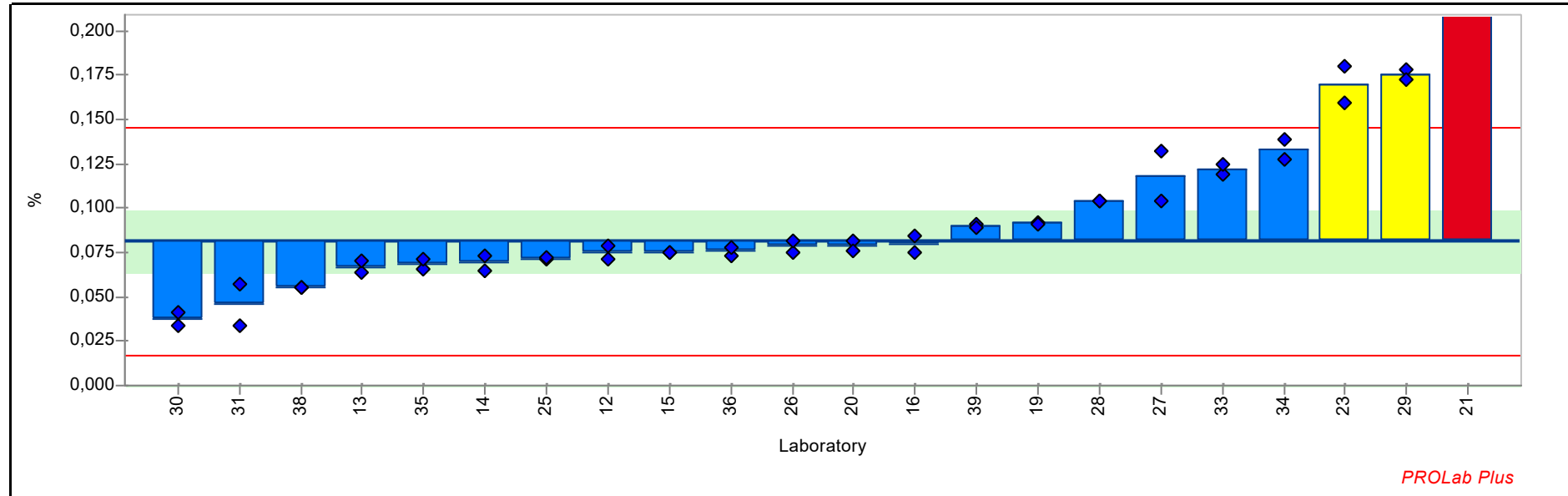
Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
10	3,560	0,028	0,714	3,540	3,580	no accreditation	Other Method	LOI @ 950°C; information only
11	2,990	0,000	-5,566	2,990	2,990	no accreditation	Other Method	LOI @ 950°C
12	3,850	0,071	3,910	3,800	3,900	no accreditation	Other Method	LOI @ 950°C; information only
13	3,304	0,042	-2,101	3,275	3,334	no accreditation	Other Method	LOI @ 950°C
14	3,590	0,014	1,045	3,600	3,580	ISO 17025	Other Method	LOI @ 950°C
15	3,639	0,121	1,579	3,724	3,553	no accreditation	Other Method	LOI @ 950°C
16	3,600	0,000	1,155	3,600	3,600	no accreditation	Other Method	LOI @ 950°C
17	3,551	0,006	0,615	3,555	3,547	no accreditation	Other Method	LOI @ 950°C

RV_2021_01_iron ore

Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
18	3,500	0,004	0,053	3,503	3,497	no accreditation	Other Method	LOI @ 950°C
19	3,510	0,014	0,164	3,520	3,500	no accreditation	XRF (fusion)	LOI @ 950°C
20	3,526	0,002	0,345	3,525	3,528	ISO 17025	Other Method	LOI @ 950°C
21	3,481	0,008	-0,161	3,475	3,486	no accreditation	Other Method	LOI @ 950°C
22	9,650	1,344	67,813	8,700	10,600	no accreditation	Other Method	LOI @ 950°C; information only
23	3,525	0,000	0,329	3,525	3,525	no accreditation	Other Method	LOI @ 950°C
25	3,270	0,000	-2,481	3,270	3,270		Other Method	LOI @ 950°C
26	3,466	0,006	-0,327	3,461	3,470	no accreditation	XRF (fusion)	ISO DIN 51001:2003
27	3,473	0,100	-0,244	3,402	3,544	no accreditation	Other Method	LOI @ 950°C
28	3,490	0,014	-0,057	3,480	3,500	no accreditation	Other Method	LOI @ 950°C
29	3,512	0,016	0,186	3,501	3,523	ISO 17025	Other Method	LOI @ 950°C; information only
30	3,505	0,001	0,103	3,504	3,505	no accreditation	Other Method	LOI @ 950°C
31	3,507	0,003	0,131	3,505	3,509	ISO 17025	Other Method	LOI @ 950°C
32	3,595	0,078	1,100	3,540	3,650	no accreditation	Other Method	LOI @ 950°C
33	3,495	0,049	-0,002	3,460	3,530	no accreditation	Other Method	LOI @ 950°C
34	3,530	0,000	0,384	3,530	3,530	no accreditation	XRF (fusion)	LOI @ 950°C; information only
35	3,369	0,051	-1,390	3,405	3,333	no accreditation	Other Method	LOI @ 950°C; information only
36	3,480	0,000	-0,167	3,480	3,480	ISO 17025	Other Method	LOI @ 950°C
38	3,195	0,035	-3,307	3,170	3,220	ISO 17025	Other Method	LOI @ 950°C
39	3,369	0,051	-1,390	3,405	3,333	no accreditation	Other Method	LOI @ 950°C

RV_2021_01_iron ore

Sample: FLX-2001 iron ore **Reproducibility s.d.:** 0,032 %
Measurand: MgO **Repeatability s.d.:** 0,006 %
Mean ± U(Mean): 0,081 ± 0,017 % **Range of tolerance:** 0,017 - 0,145 % (|z-score| ≤ 2,000)
No. of laboratories: 17 **Statistical method:** Q/Hampel



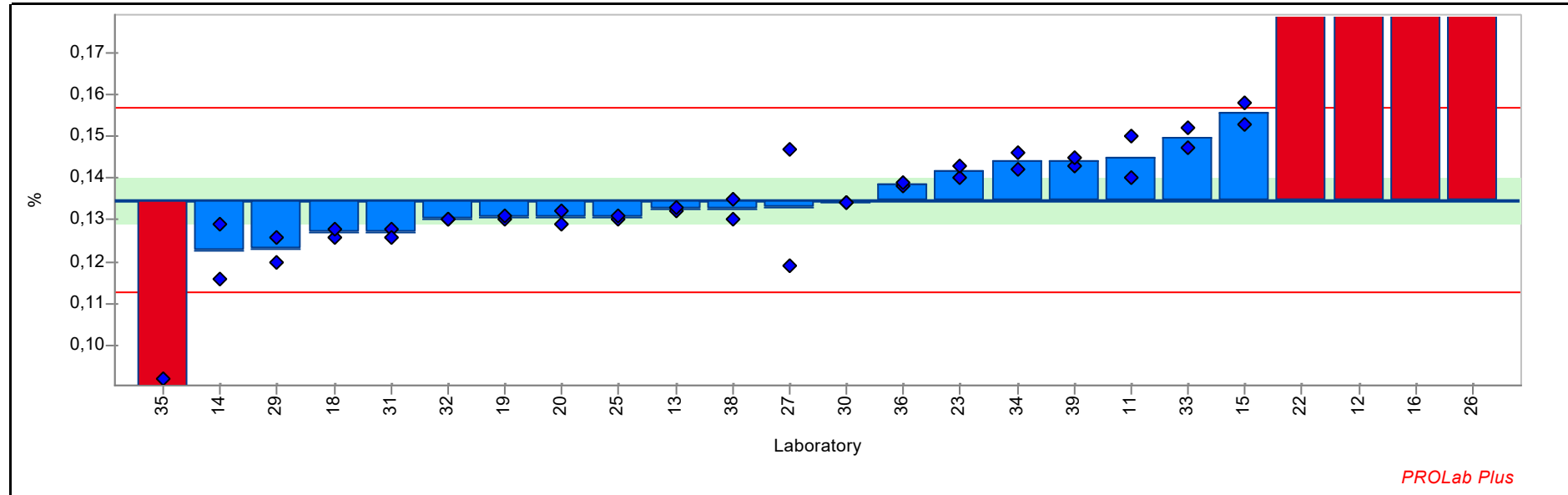
Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
12	0,075	0,006	-0,190	0,079	0,071	no accreditation	XRF (fusion)	information only
13	0,067	0,004	-0,440	0,064	0,070	no accreditation	XRF (fusion)	ISO 9516 1:2003
14	0,069	0,006	-0,378	0,065	0,073	ISO 17025	XRF (fusion)	DIN EN ISO 12677
15	0,075	0,000	-0,190	0,075	0,075	no accreditation	XRF (fusion)	
16	0,080	0,006	-0,050	0,075	0,084	no accreditation	XRF (fusion)	
19	0,091	0,001	0,326	0,092	0,091	no accreditation	XRF (fusion)	
20	0,079	0,004	-0,065	0,082	0,076	ISO 17025	XRF (fusion)	ISO 9516 1:2003
21	0,615	0,033	16,696	0,592	0,638	no accreditation	XRF (fusion)	ISO DIN 51001:2003

RV_2021_01_iron ore

Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
23	0,169	0,015	2,765	0,159	0,180	no accreditation	XRF (fusion)	
25	0,071	0,001	-0,300	0,071	0,072		XRF (fusion)	ISO 9516 1:2003
26	0,079	0,005	-0,081	0,075	0,082	no accreditation	XRF (fusion)	ISO DIN 51001:2003
27	0,118	0,020	1,154	0,132	0,104	no accreditation	XRF (fusion)	
28	0,104	0,000	0,717	0,104	0,104	no accreditation	XRF (fusion)	
29	0,175	0,004	2,937	0,178	0,172	ISO 17025	XRF (fusion)	information only
30	0,038	0,005	-1,363	0,034	0,041	no accreditation	XRF (fusion)	ISO DIN 51001:2003
31	0,045	0,016	-1,113	0,057	0,034	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
33	0,122	0,004	1,274	0,119	0,125	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
34	0,133	0,008	1,623	0,127	0,139	no accreditation	XRF (fusion)	information only
35	0,069	0,004	-0,394	0,066	0,071	no accreditation	Other Method	information only
36	0,075	0,004	-0,175	0,073	0,078	ISO 17025	XRF (fusion)	DIN EN ISO 12677
38	0,055	0,000	-0,816	0,055	0,055	ISO 17025	XRF (fusion)	ISO 9516 1:2003
39	0,090	0,001	0,279	0,091	0,089	no accreditation	XRF (pressed pellet)	information only

RV_2021_01_iron ore

Sample: FLX-2001 iron ore **Reproducibility s.d.:** 0,011 %
Measurand: Mn2O3 **Repeatability s.d.:** 0,003 %
Mean ± U(Mean): 0,135 ± 0,005 % **Range of tolerance:** 0,113 - 0,157 % (|z-score| ≤ 2,000)
No. of laboratories: 18 **Statistical method:** Q/Hampel



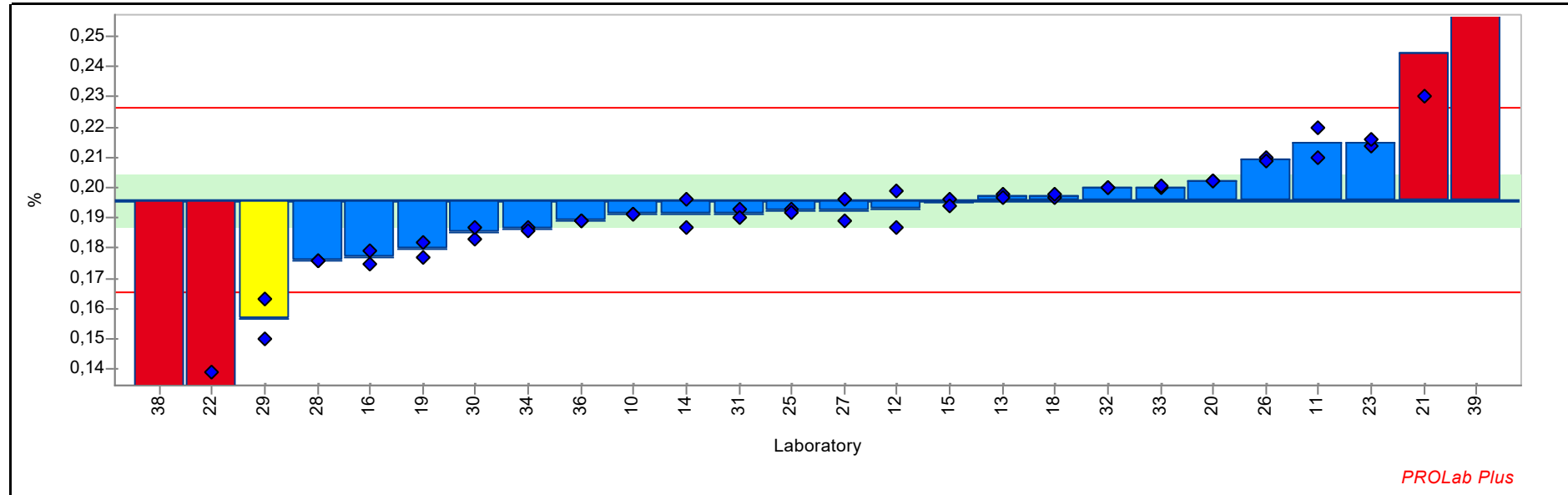
Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
11	0,145	0,007	0,927	0,140	0,150	no accreditation	XRF (fusion)	
12	0,510	0,006	33,875	0,514	0,505	no accreditation	XRF (fusion)	information only
13	0,133	0,001	-0,203	0,132	0,133	no accreditation	XRF (fusion)	ISO 9516 1:2003
14	0,122	0,009	-1,107	0,129	0,116	ISO 17025	XRF (fusion)	DIN EN ISO 12677
15	0,155	0,004	1,876	0,158	0,153	no accreditation	XRF (fusion)	
16	0,565	0,016	38,846	0,576	0,553	no accreditation	XRF (fusion)	
18	0,127	0,001	-0,701	0,126	0,128	no accreditation	XRF (fusion)	ISO DIN 51001:2003
19	0,131	0,001	-0,384	0,130	0,131	no accreditation	XRF (fusion)	

RV_2021_01_iron ore

Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
20	0,131	0,002	-0,384	0,129	0,132	ISO 17025	XRF (fusion)	ISO 9516 1:2003
22	0,227	0,002	8,294	0,228	0,225	no accreditation	XRF (fusion)	ISO DIN 51001:2003; information only
23	0,142	0,002	0,610	0,140	0,143	no accreditation	XRF (fusion)	
25	0,131	0,001	-0,384	0,130	0,131		XRF (fusion)	ISO 9516 1:2003
26	0,683	0,003	49,558	0,685	0,681	no accreditation	XRF (fusion)	ISO DIN 51001:2003
27	0,133	0,020	-0,158	0,147	0,119	no accreditation	XRF (fusion)	
29	0,123	0,004	-1,062	0,120	0,126	ISO 17025	XRF (fusion)	information only
30	0,134	0,000	-0,068	0,134	0,134	no accreditation	XRF (fusion)	ISO DIN 51001:2003
31	0,127	0,001	-0,701	0,128	0,126	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
32	0,130	0,000	-0,429	0,130	0,130	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
33	0,150	0,003	1,347	0,152	0,147	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
34	0,144	0,003	0,836	0,146	0,142	no accreditation	XRF (fusion)	information only
35	0,087	0,007	-4,316	0,082	0,092	no accreditation	Other Method	information only
36	0,139	0,001	0,339	0,138	0,139	ISO 17025	XRF (fusion)	DIN EN ISO 12677
38	0,133	0,004	-0,203	0,130	0,135	ISO 17025	XRF (fusion)	ISO 9516 1:2003
39	0,144	0,001	0,836	0,143	0,145	no accreditation	XRF (pressed pellet)	information only

RV_2021_01_iron ore

Sample: FLX-2001 iron ore **Reproducibility s.d.:** 0,015 %
Measurand: P2O5 **Repeatability s.d.:** 0,002 %
Mean ± U(Mean): 0,196 ± 0,009 % **Range of tolerance:** 0,165 - 0,227 % (|z-score| ≤ 2,000)
No. of laboratories: 20 **Statistical method:** Q/Hampel



PROLab Plus

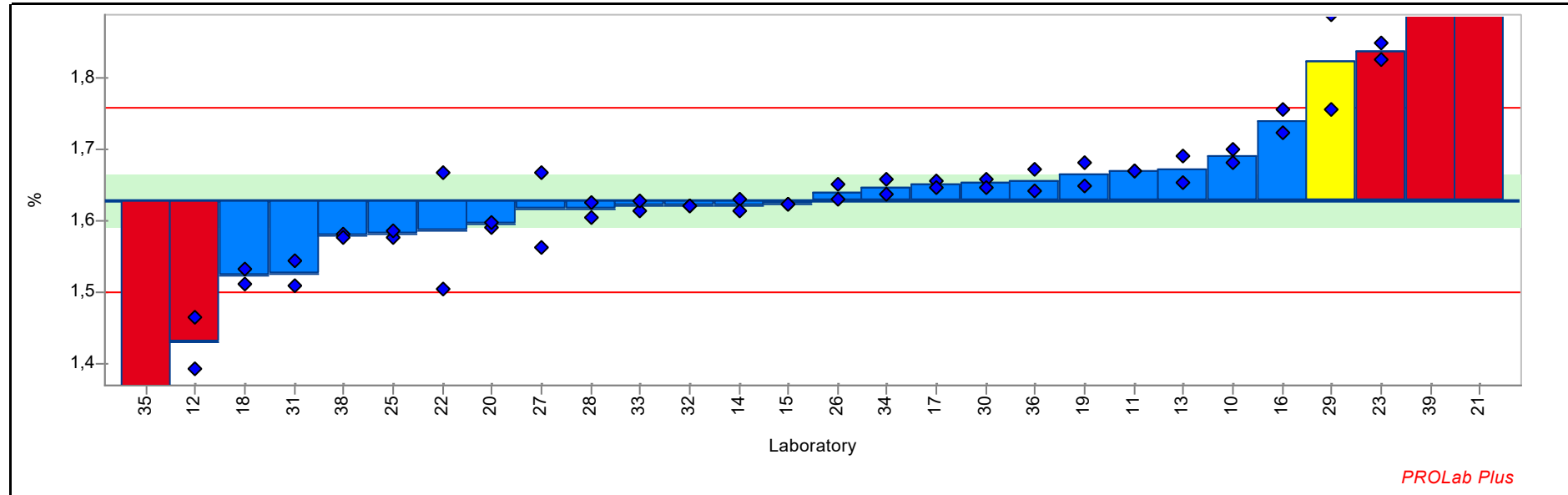
Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
10	0,191	0,000	-0,321	0,191	0,191	no accreditation	XRF (fusion)	information only
11	0,215	0,007	1,246	0,220	0,210	no accreditation	XRF (fusion)	
12	0,193	0,008	-0,191	0,199	0,187	no accreditation	XRF (fusion)	information only
13	0,198	0,001	0,103	0,198	0,197	no accreditation	XRF (fusion)	ISO 9516 1:2003
14	0,192	0,006	-0,289	0,196	0,187	ISO 17025	XRF (fusion)	DIN EN ISO 12677
15	0,195	0,001	-0,060	0,196	0,194	no accreditation	XRF (fusion)	
16	0,177	0,003	-1,235	0,179	0,175	no accreditation	XRF (fusion)	
18	0,198	0,001	0,103	0,197	0,198	no accreditation	XRF (fusion)	ISO DIN 51001:2003

RV_2021_01_iron ore

Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
19	0,179	0,004	-1,072	0,177	0,182	no accreditation	XRF (fusion)	
20	0,202	0,000	0,397	0,202	0,202	ISO 17025	XRF (fusion)	ISO 9516 1:2003
21	0,244	0,021	3,172	0,259	0,230	no accreditation	XRF (fusion)	ISO DIN 51001:2003
22	0,121	0,025	-4,859	0,104	0,139	no accreditation	XRF (fusion)	ISO DIN 51001:2003; information only
23	0,215	0,001	1,246	0,214	0,216	no accreditation	XRF (fusion)	
25	0,193	0,001	-0,223	0,193	0,192		XRF (fusion)	ISO 9516 1:2003
26	0,209	0,001	0,887	0,210	0,209	no accreditation	XRF (fusion)	ISO DIN 51001:2003
27	0,193	0,005	-0,223	0,189	0,196	no accreditation	XRF (fusion)	
28	0,176	0,000	-1,301	0,176	0,176	no accreditation	XRF (fusion)	
29	0,157	0,009	-2,574	0,150	0,163	ISO 17025	XRF (fusion)	information only
30	0,185	0,003	-0,713	0,183	0,187	no accreditation	XRF (fusion)	ISO DIN 51001:2003
31	0,192	0,002	-0,289	0,193	0,190	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
32	0,200	0,000	0,267	0,200	0,200	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
33	0,200	0,000	0,280	0,200	0,200	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
34	0,186	0,001	-0,615	0,187	0,186	no accreditation	XRF (fusion)	information only
36	0,189	0,000	-0,452	0,189	0,189	ISO 17025	XRF (fusion)	DIN EN ISO 12677
38	0,087	0,001	-7,112	0,088	0,086	ISO 17025	XRF (fusion)	ISO 9516 1:2003
39	0,270	0,002	4,805	0,271	0,268	no accreditation	XRF (pressed pellet)	information only

RV_2021_01_iron ore

Sample: FLX-2001 iron ore **Reproducibility s.d.:** 0,065 %
Measurand: SiO2 **Repeatability s.d.:** 0,019 %
Mean ± U(Mean): 1,628 ± 0,036 % **Range of tolerance:** 1,499 - 1,758 % (|z-score| ≤ 2,000)
No. of laboratories: 21 **Statistical method:** Q/Hampel



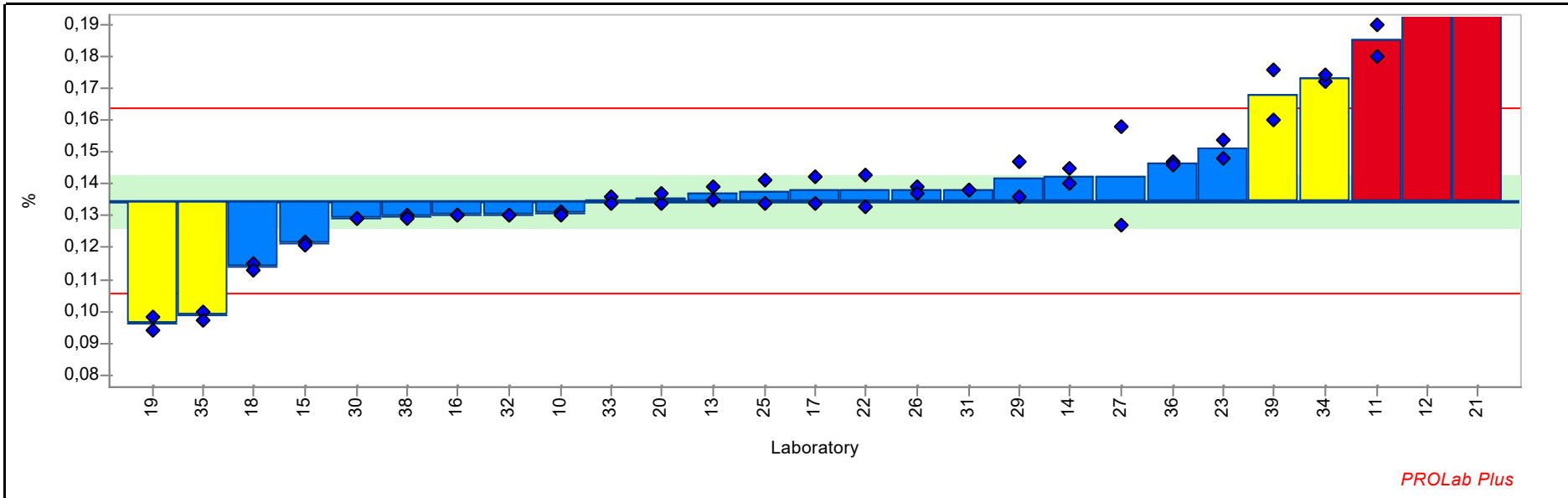
Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
10	1,690	0,014	0,948	1,700	1,680	no accreditation	XRF (fusion)	information only
11	1,670	0,000	0,640	1,670	1,670	no accreditation	XRF (fusion)	
12	1,429	0,050	-3,082	1,464	1,393	no accreditation	XRF (fusion)	information only
13	1,672	0,026	0,678	1,654	1,691	no accreditation	XRF (fusion)	ISO 9516 1:2003
14	1,621	0,011	-0,116	1,629	1,613	ISO 17025	XRF (fusion)	DIN EN ISO 12677
15	1,622	0,000	-0,100	1,622	1,622	no accreditation	XRF (fusion)	
16	1,739	0,024	1,703	1,722	1,756	no accreditation	XRF (fusion)	
17	1,650	0,007	0,331	1,655	1,645	no accreditation	XRF (fusion)	

RV_2021_01_iron ore

Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
18	1,522	0,015	-1,634	1,512	1,533	no accreditation	XRF (fusion)	ISO DIN 51001:2003
19	1,664	0,022	0,555	1,649	1,680	no accreditation	XRF (fusion)	
20	1,594	0,006	-0,532	1,590	1,598	ISO 17025	XRF (fusion)	ISO 9516 1:2003
21	2,898	0,041	19,566	2,869	2,927	no accreditation	XRF (fusion)	ISO DIN 51001:2003
22	1,587	0,115	-0,647	1,505	1,668	no accreditation	XRF (fusion)	ISO DIN 51001:2003; information only
23	1,837	0,016	3,221	1,849	1,826	no accreditation	XRF (fusion)	
25	1,580	0,007	-0,747	1,575	1,585		XRF (fusion)	ISO 9516 1:2003
26	1,640	0,014	0,177	1,650	1,630	no accreditation	XRF (fusion)	ISO DIN 51001:2003
27	1,615	0,075	-0,208	1,668	1,562	no accreditation	XRF (fusion)	
28	1,615	0,015	-0,200	1,605	1,626	no accreditation	XRF (fusion)	
29	1,822	0,093	2,982	1,756	1,888	ISO 17025	XRF (fusion)	information only
30	1,652	0,007	0,362	1,657	1,647	no accreditation	XRF (fusion)	ISO DIN 51001:2003
31	1,526	0,024	-1,580	1,509	1,543	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
32	1,620	0,000	-0,131	1,620	1,620	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
33	1,620	0,010	-0,134	1,613	1,627	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
34	1,647	0,016	0,285	1,658	1,636	no accreditation	XRF (fusion)	information only
35	0,265	0,008	-21,015	0,259	0,271	no accreditation	Other Method	information only
36	1,656	0,021	0,424	1,641	1,671	ISO 17025	XRF (fusion)	DIN EN ISO 12677
38	1,578	0,003	-0,778	1,580	1,576	ISO 17025	XRF (fusion)	ISO 9516 1:2003
39	2,220	0,016	9,116	2,231	2,209	no accreditation	XRF (pressed pellet)	information only

RV_2021_01_iron ore

Sample: FLX-2001 iron ore **Reproducibility s.d.:** 0,015 %
Measurand: TiO2 **Repeatability s.d.:** 0,003 %
Mean ± U(Mean): 0,135 ± 0,008 % **Range of tolerance:** 0,105 - 0,164 % (|z-score| ≤ 2,000)
No. of laboratories: 20 **Statistical method:** Q/Hampel



Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
10	0,131	0,001	-0,284	0,131	0,130	no accreditation	XRF (fusion)	information only
11	0,185	0,007	3,447	0,190	0,180	no accreditation	XRF (fusion)	information only
12	0,333	0,003	13,576	0,331	0,335	no accreditation	XRF (fusion)	information only
13	0,137	0,003	0,161	0,135	0,139	no accreditation	XRF (fusion)	ISO 9516 1:2003
14	0,143	0,004	0,538	0,145	0,140	ISO 17025	XRF (fusion)	DIN EN ISO 12677
15	0,121	0,001	-0,900	0,122	0,121	no accreditation	XRF (fusion)	
16	0,130	0,000	-0,318	0,130	0,130	no accreditation	XRF (fusion)	
17	0,138	0,006	0,230	0,142	0,134	no accreditation	XRF (fusion)	

RV_2021_01_iron ore

Lab code	Lab mean	s.d.	z-score	Conc. 1	Conc. 2	Accreditation	Analytical method	Comment
18	0,114	0,001	-1,413	0,115	0,113	no accreditation	XRF (fusion)	ISO DIN 51001:2003
19	0,096	0,003	-2,645	0,094	0,098	no accreditation	XRF (fusion)	
20	0,136	0,002	0,059	0,134	0,137	ISO 17025	XRF (fusion)	ISO 9516 1:2003
21	0,738	0,005	41,260	0,741	0,734	no accreditation	XRF (fusion)	ISO DIN 51001:2003
22	0,138	0,007	0,230	0,143	0,133	no accreditation	XRF (fusion)	ISO DIN 51001:2003; information only
23	0,151	0,004	1,120	0,154	0,148	no accreditation	XRF (fusion)	
25	0,138	0,005	0,196	0,141	0,134		XRF (fusion)	ISO 9516 1:2003
26	0,138	0,001	0,230	0,139	0,137	no accreditation	XRF (fusion)	ISO DIN 51001:2003
27	0,143	0,022	0,538	0,127	0,158	no accreditation	XRF (fusion)	
29	0,142	0,008	0,469	0,147	0,136	ISO 17025	XRF (fusion)	information only
30	0,129	0,000	-0,386	0,129	0,129	no accreditation	XRF (fusion)	ISO DIN 51001:2003
31	0,138	0,000	0,230	0,138	0,138	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
32	0,130	0,000	-0,318	0,130	0,130	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
33	0,135	0,001	0,021	0,136	0,134	ISO 17025	XRF (fusion)	ISO DIN 51001:2003
34	0,173	0,001	2,625	0,172	0,174	no accreditation	XRF (fusion)	information only
35	0,099	0,002	-2,474	0,100	0,097	no accreditation	Other Method	information only
36	0,146	0,001	0,812	0,147	0,146	ISO 17025	XRF (fusion)	DIN EN ISO 12677
38	0,130	0,001	-0,352	0,130	0,129	ISO 17025	XRF (fusion)	ISO 9516 1:2003
39	0,168	0,011	2,283	0,176	0,160	no accreditation	XRF (pressed pellet)	information only

RV_2021_01_iron ore

z-scores (per sample)

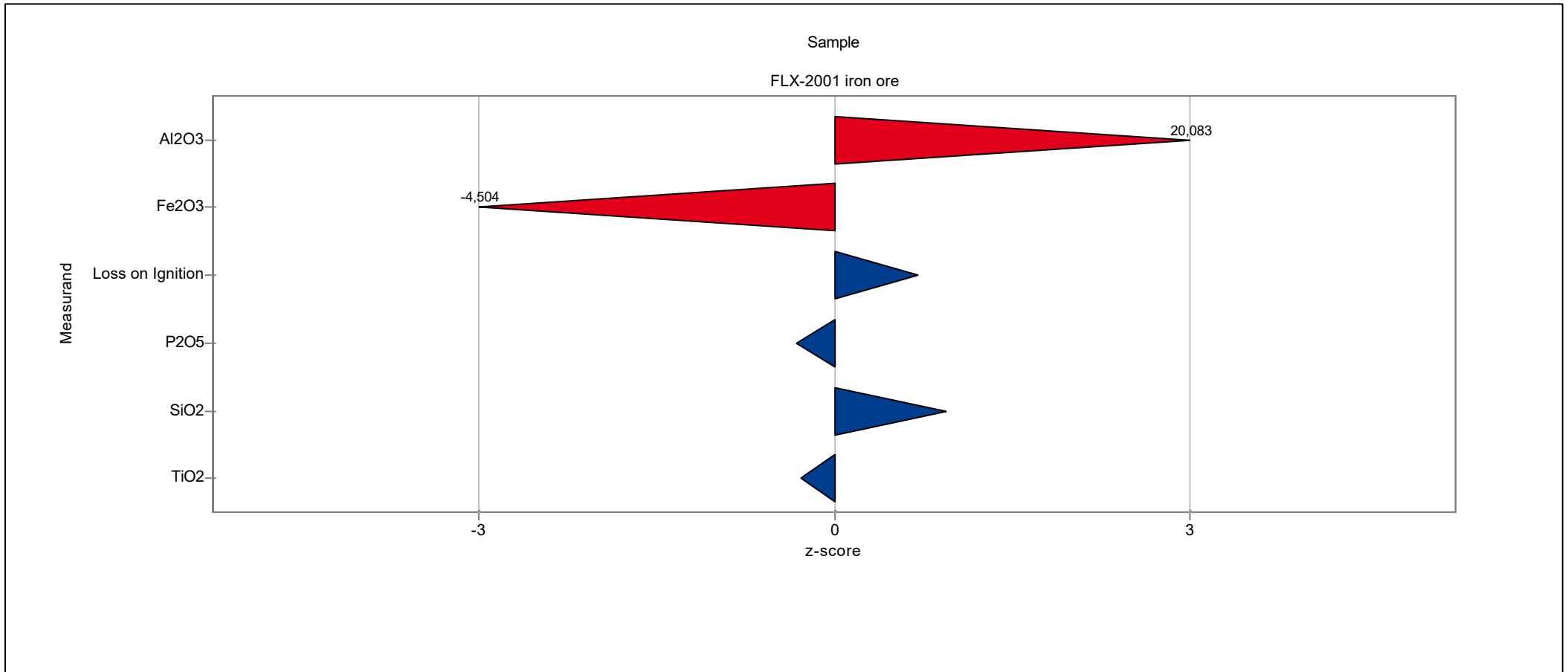
Sample: FLX-2001 iron ore

Lab code	Al2O3	CaO	Fe2O3	Loss on Ignition	MgO	Mn2O3	P2O5	SiO2	TiO2
10	20,083		-4,504	0,714			-0,321	0,948	-0,284
11	-4,214	0,117	0,110	-5,566		0,927	1,246	0,640	3,447
12	-0,402		-5,456	3,910	-0,190	33,875	-0,191	-3,082	13,576
13	0,658	-0,464	-0,430	-2,101	-0,440	-0,203	0,103	0,678	0,161
14	0,124	-0,009	-0,152	1,045	-0,378	-1,107	-0,289	-0,116	0,538
15	-0,483		-0,460	1,579	-0,190	1,876	-0,060	-0,100	-0,900
16	-1,741		1,037	1,155	-0,050	38,846	-1,235	1,703	-0,318
17	-0,154	11,592	-3,276	0,615				0,331	0,230
18	-4,239		0,549	0,053		-0,701	0,103	-1,634	-1,413
19	0,893	1,154	1,379	0,164	0,326	-0,384	-1,072	0,555	-2,645
20	0,403	-0,489	-0,139	0,345	-0,065	-0,384	0,397	-0,532	0,059
21	-3,867	2,190	-2,911	-0,161	16,696		3,172	19,566	41,260
22	-1,103	-0,059	-12,046	67,813		8,294	-4,859	-0,647	0,230
23		-1,450	1,004	0,329	2,765	0,610	1,246	3,221	1,120
25	0,180	-0,312	-0,209	-2,481	-0,300	-0,384	-0,223	-0,747	0,196
26	0,001	-0,338	-0,998	-0,327	-0,081	49,558	0,887	0,177	0,230
27	0,633		-0,131	-0,244	1,154	-0,158	-0,223	-0,208	0,538
28	-1,190	1,331	1,433	-0,057	0,717		-1,301	-0,200	
29	-1,946	1,078	-5,169	0,186	2,937	-1,062	-2,574	2,982	0,469
30	0,087	0,421	0,072	0,103	-1,363	-0,068	-0,713	0,362	-0,386
31	-0,142		0,020	0,131	-1,113	-0,701	-0,289	-1,580	0,230
32	1,116	-0,641	-1,018	1,100		-0,429	0,267	-0,131	-0,318
33	0,992	-0,196	0,556	-0,002	1,274	1,347	0,280	-0,134	0,021
34			-4,735	0,384	1,623	0,836	-0,615	0,285	2,625
35	-3,365		-11,201	-1,390	-0,394	-4,316		-21,015	-2,474
36	-0,576	0,269	-0,588	-0,167	-0,175	0,339	-0,452	0,424	0,812
38	0,137	-0,894	0,689	-3,307	-0,816	-0,203	-7,112	-0,778	-0,352
39	17,337	-0,211	-2,968	-1,390	0,279	0,836	4,805	9,116	2,283

RV_2021_01_iron ore

Laboratory chart of z-scores

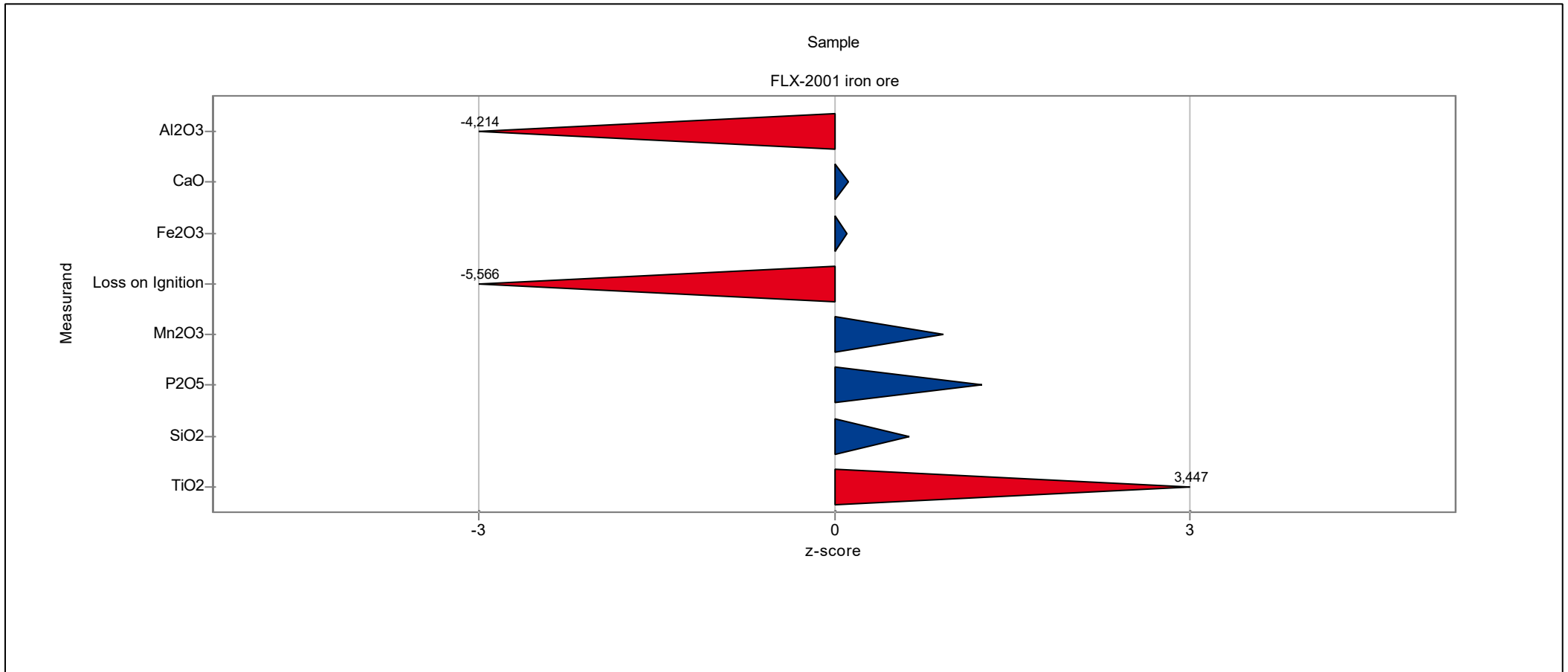
Laboratory: 10



RV_2021_01_iron ore

Laboratory chart of z-scores

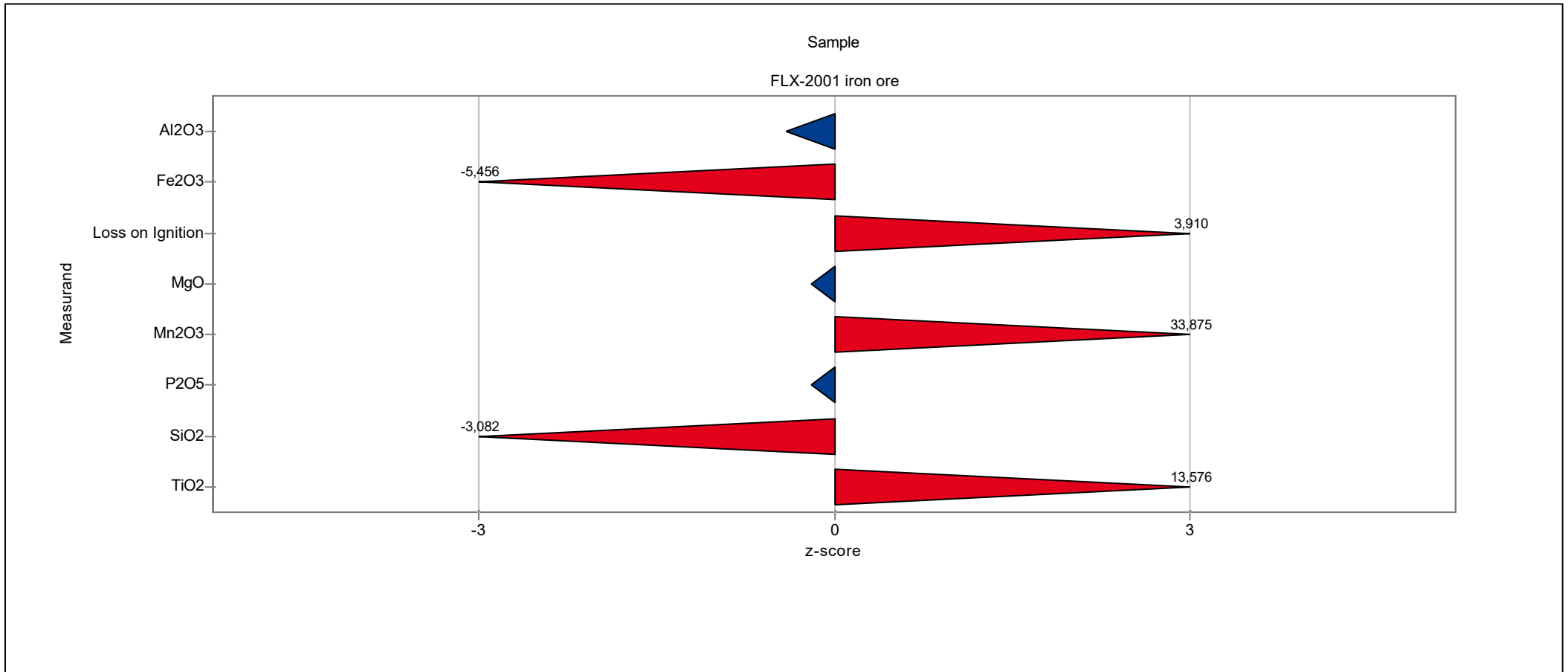
Laboratory: 11



RV_2021_01_iron ore

Laboratory chart of z-scores

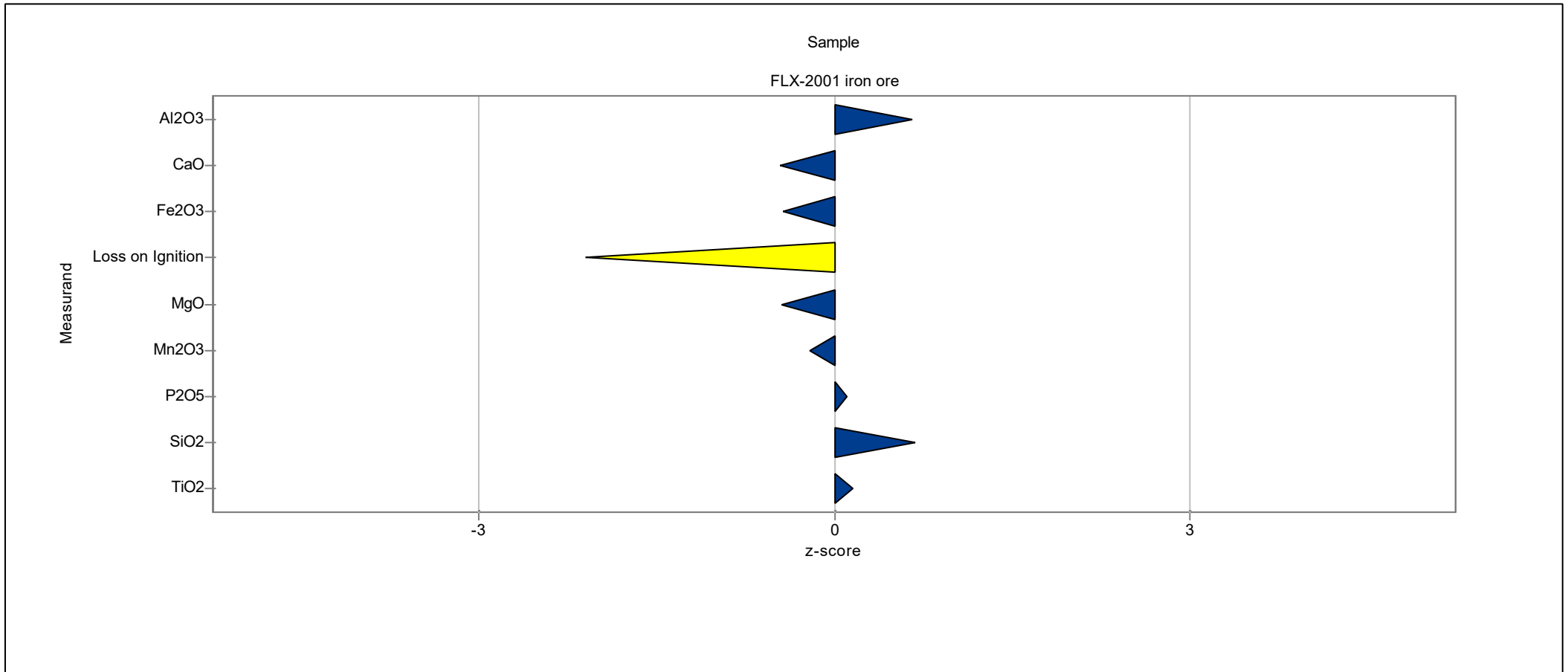
Laboratory: 12



RV_2021_01_iron ore

Laboratory chart of z-scores

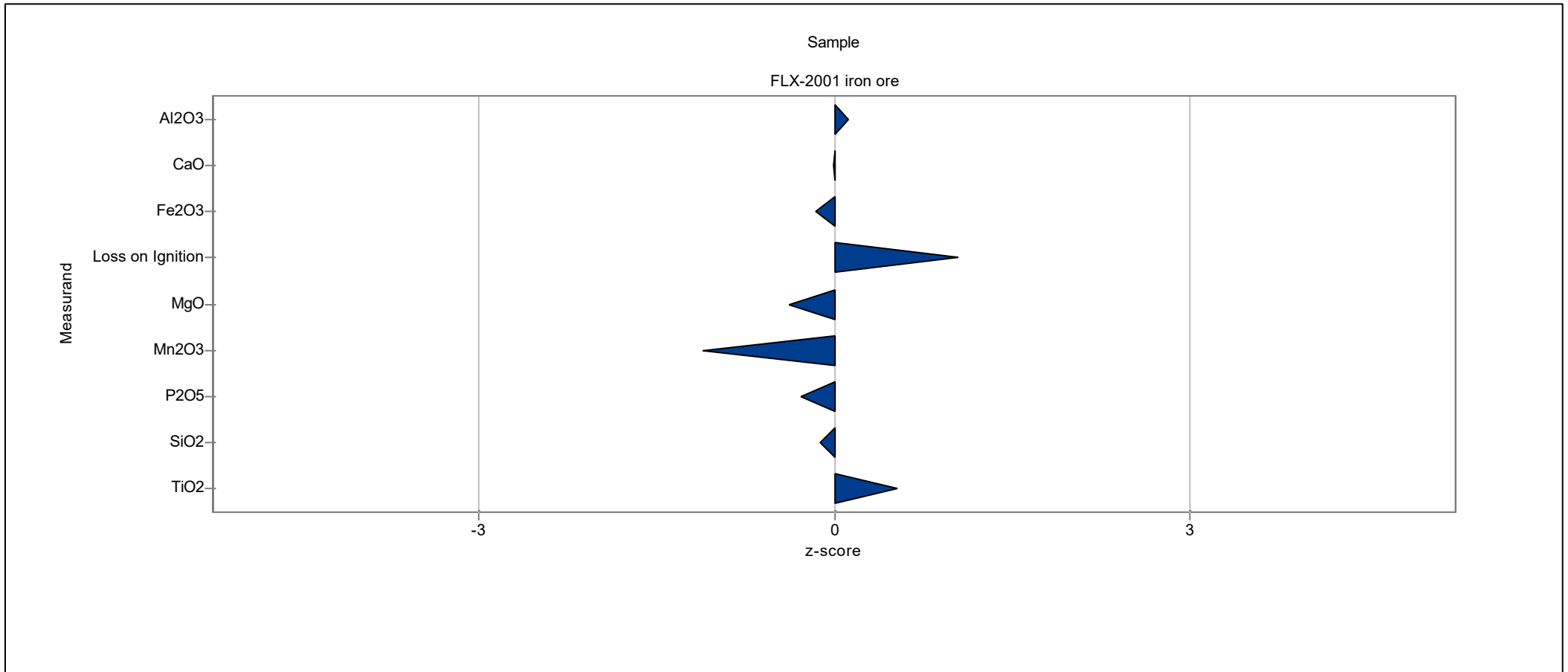
Laboratory: 13



RV_2021_01_iron ore

Laboratory chart of z-scores

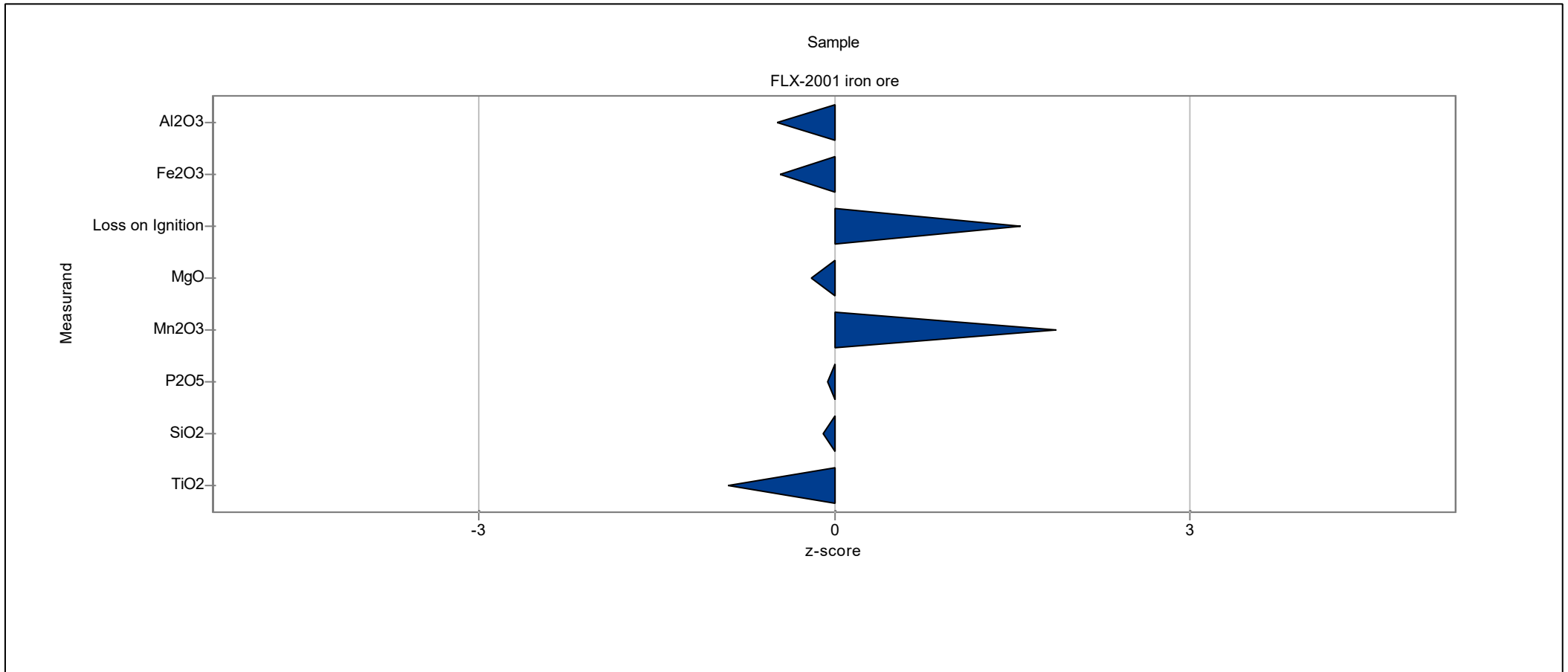
Laboratory: 14



RV_2021_01_iron ore

Laboratory chart of z-scores

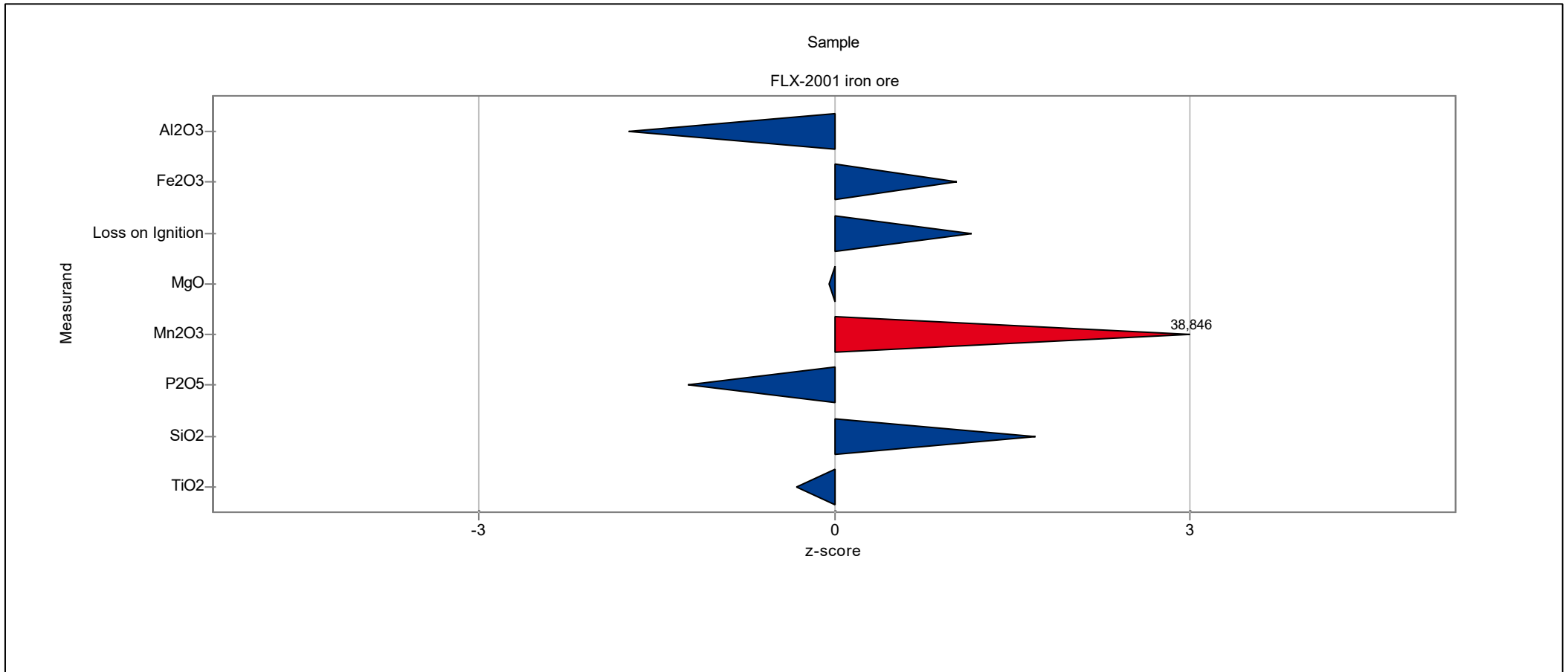
Laboratory: 15



RV_2021_01_iron ore

Laboratory chart of z-scores

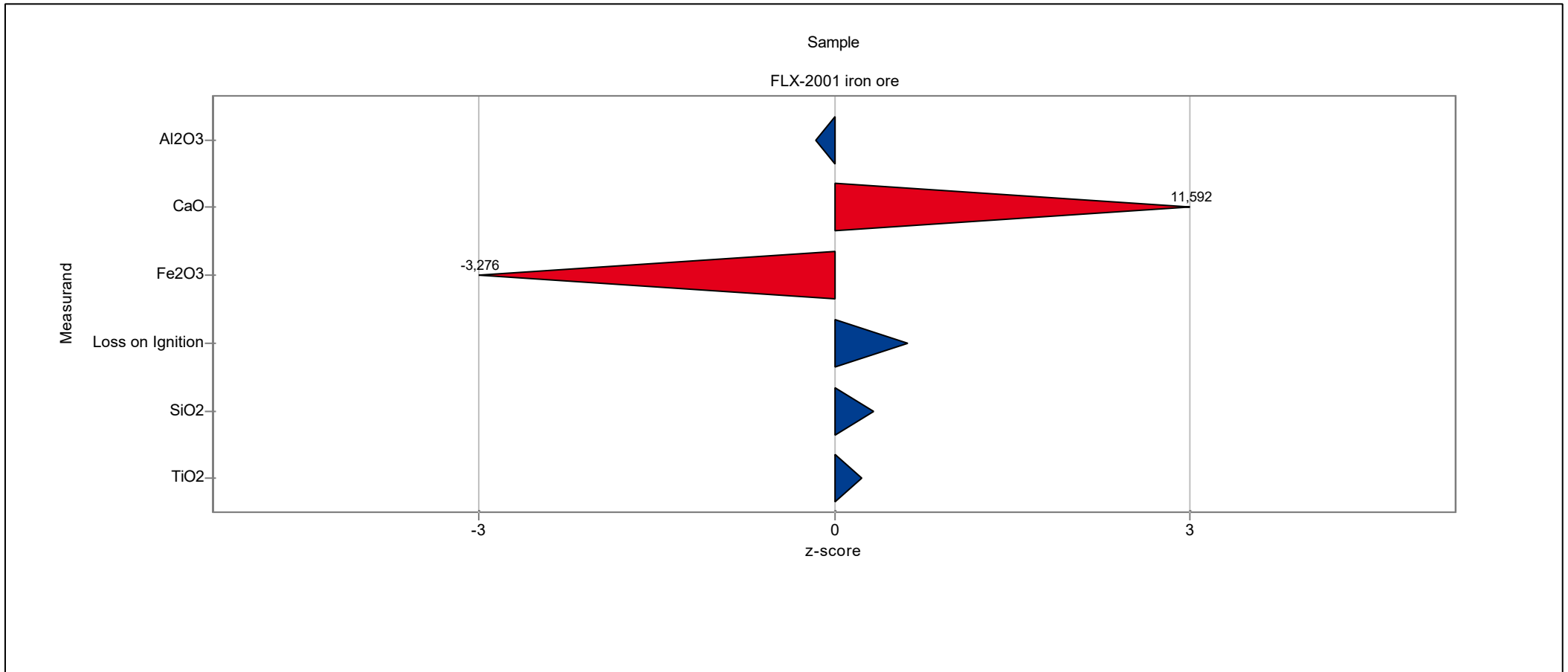
Laboratory: 16



RV_2021_01_iron ore

Laboratory chart of z-scores

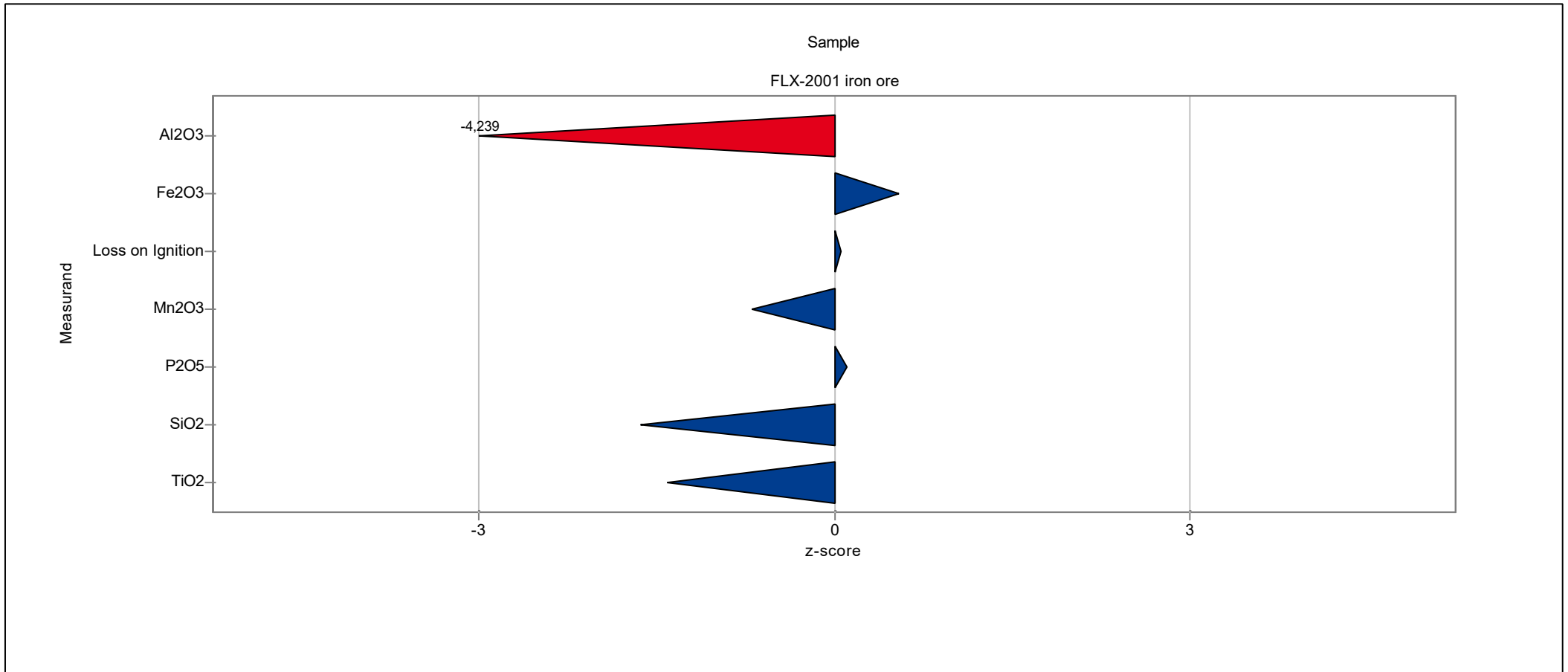
Laboratory: 17



RV_2021_01_iron ore

Laboratory chart of z-scores

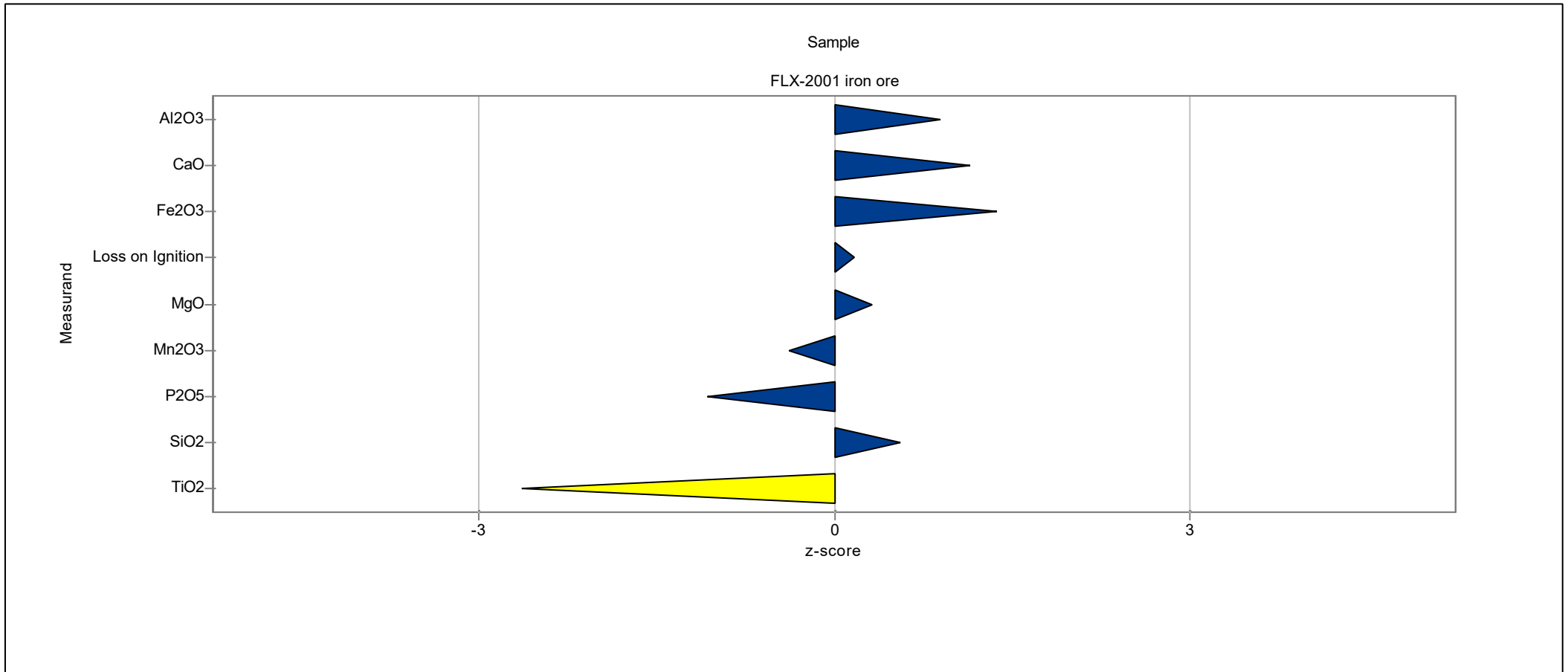
Laboratory: 18



RV_2021_01_iron ore

Laboratory chart of z-scores

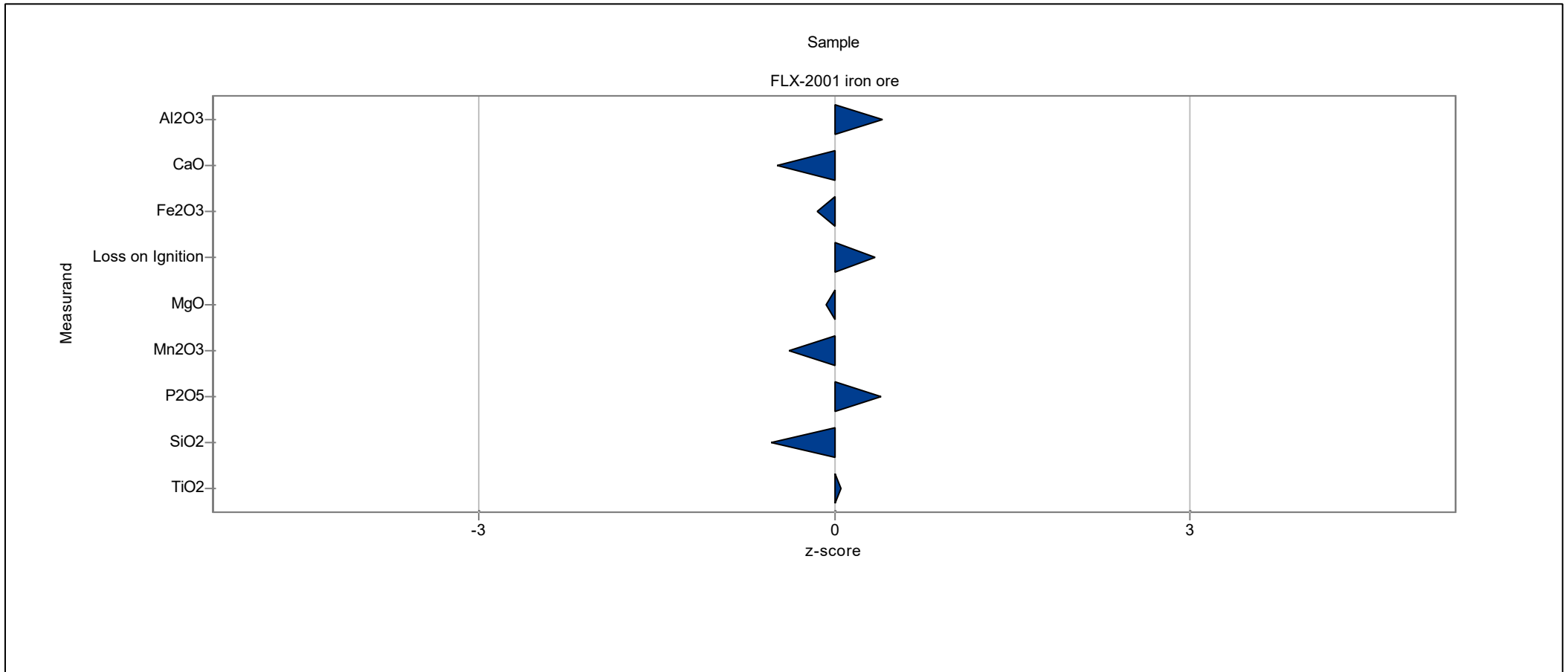
Laboratory: 19



RV_2021_01_iron ore

Laboratory chart of z-scores

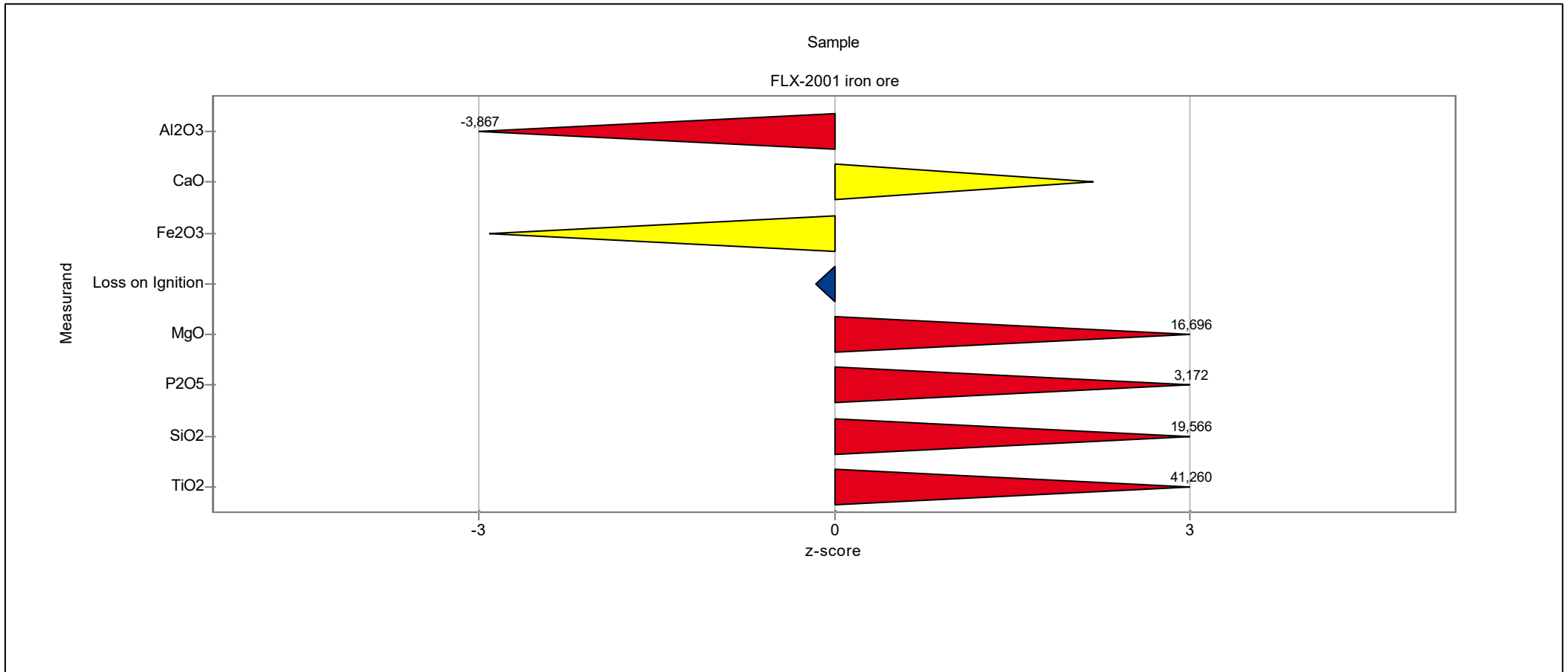
Laboratory: 20



RV_2021_01_iron ore

Laboratory chart of z-scores

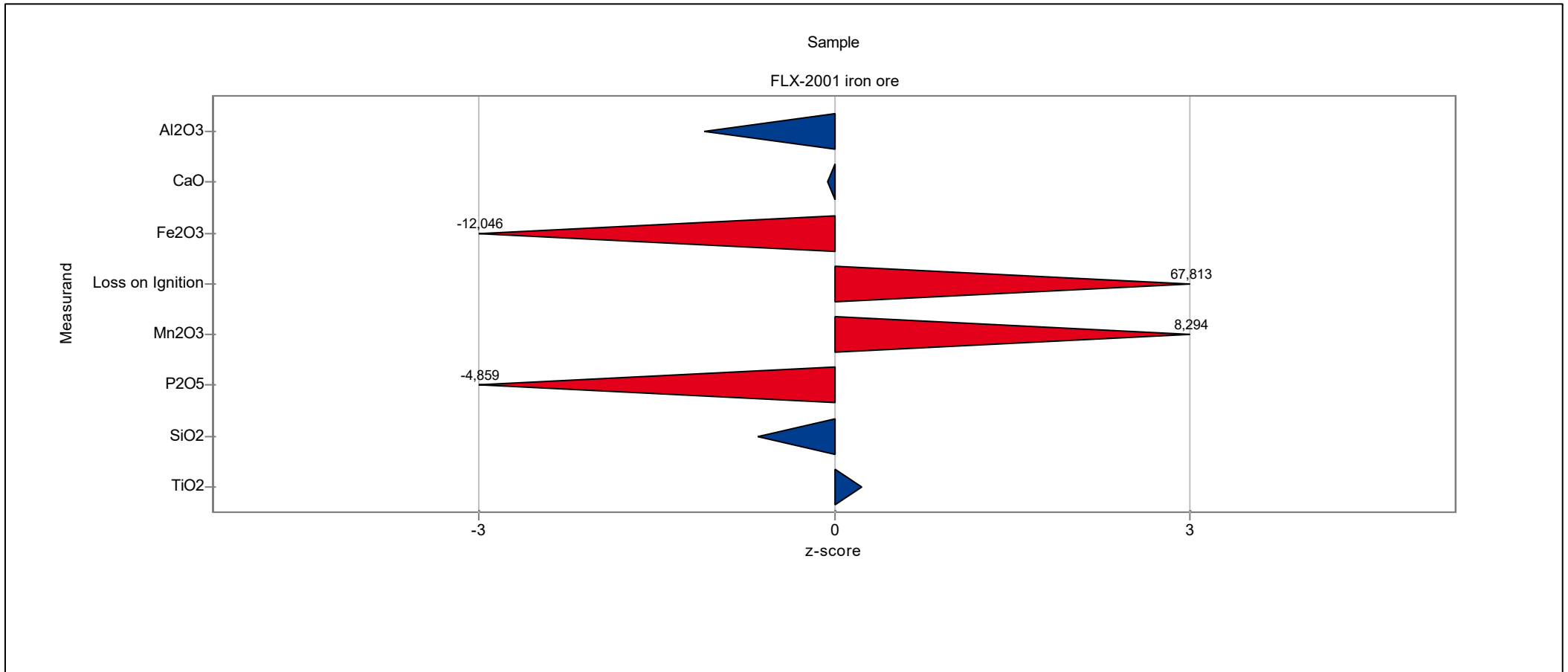
Laboratory: 21



RV_2021_01_iron ore

Laboratory chart of z-scores

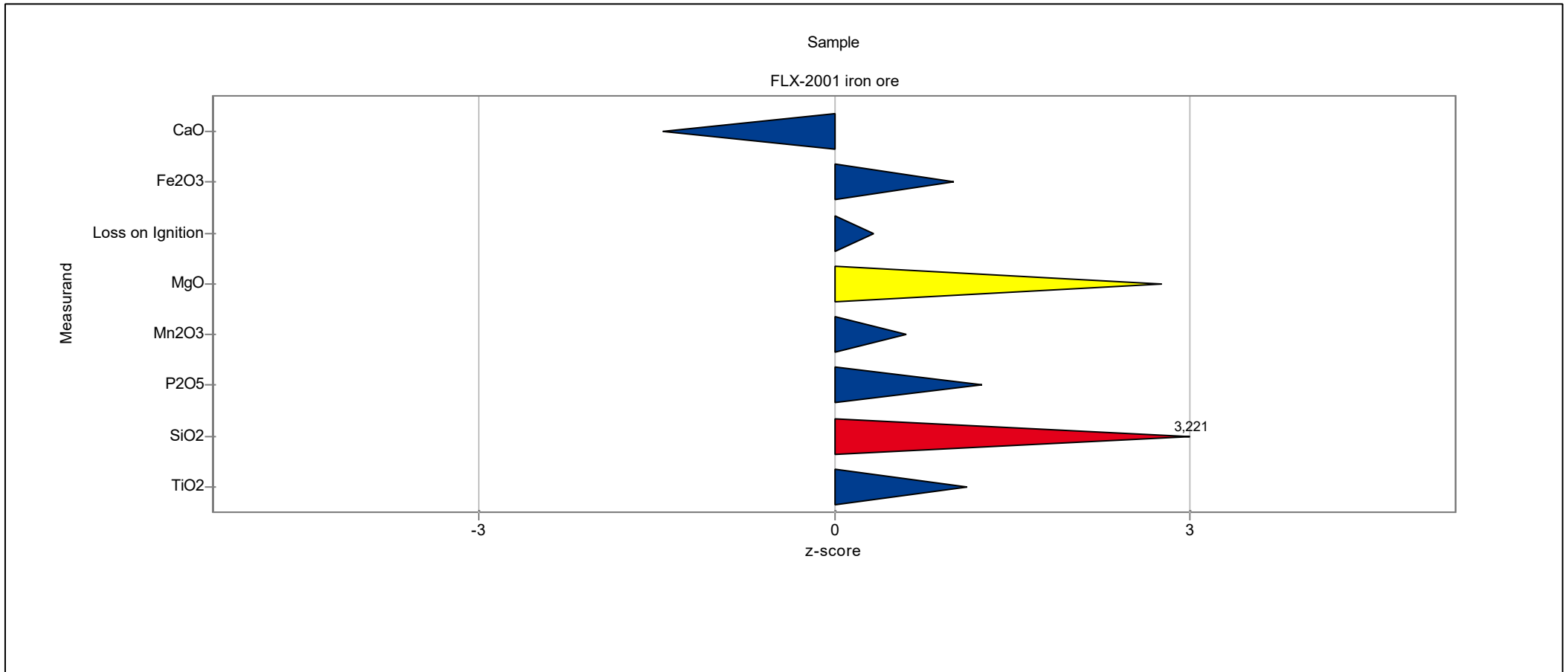
Laboratory: 22



RV_2021_01_iron ore

Laboratory chart of z-scores

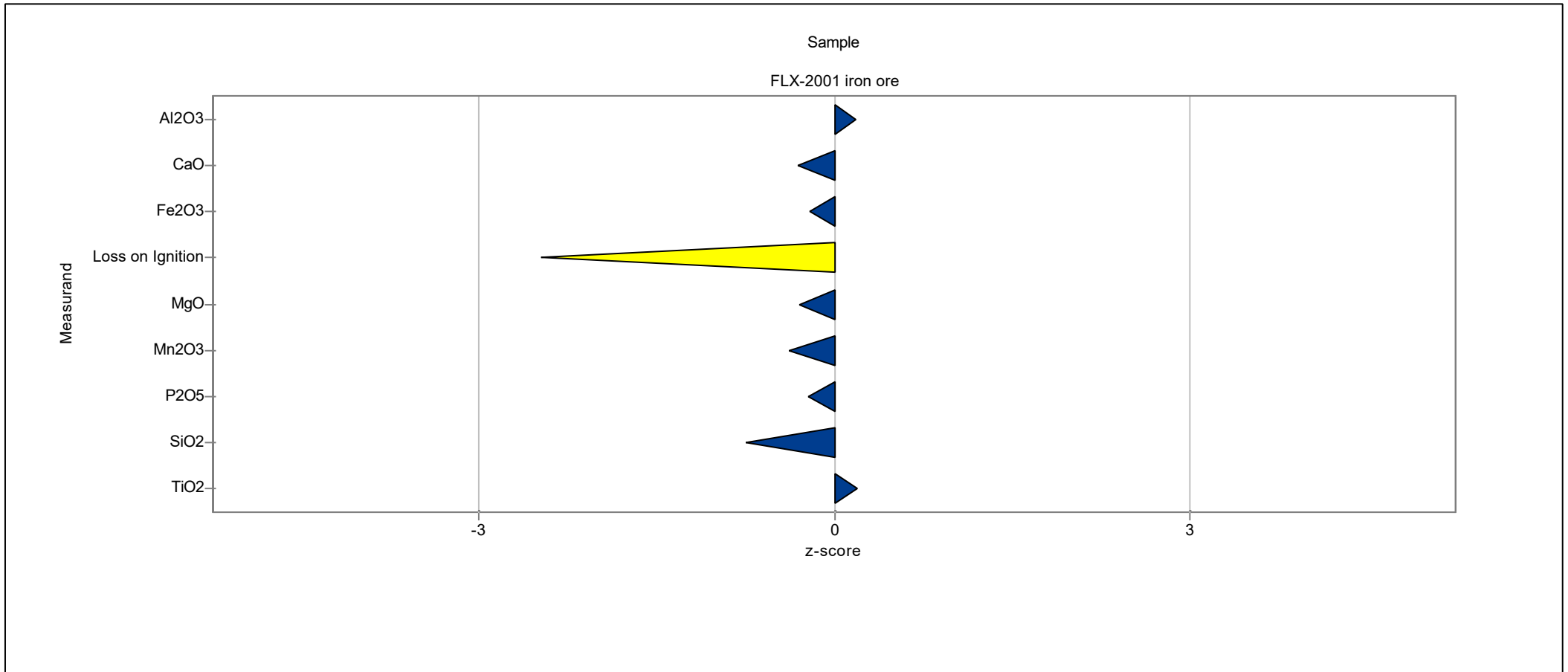
Laboratory: 23



RV_2021_01_iron ore

Laboratory chart of z-scores

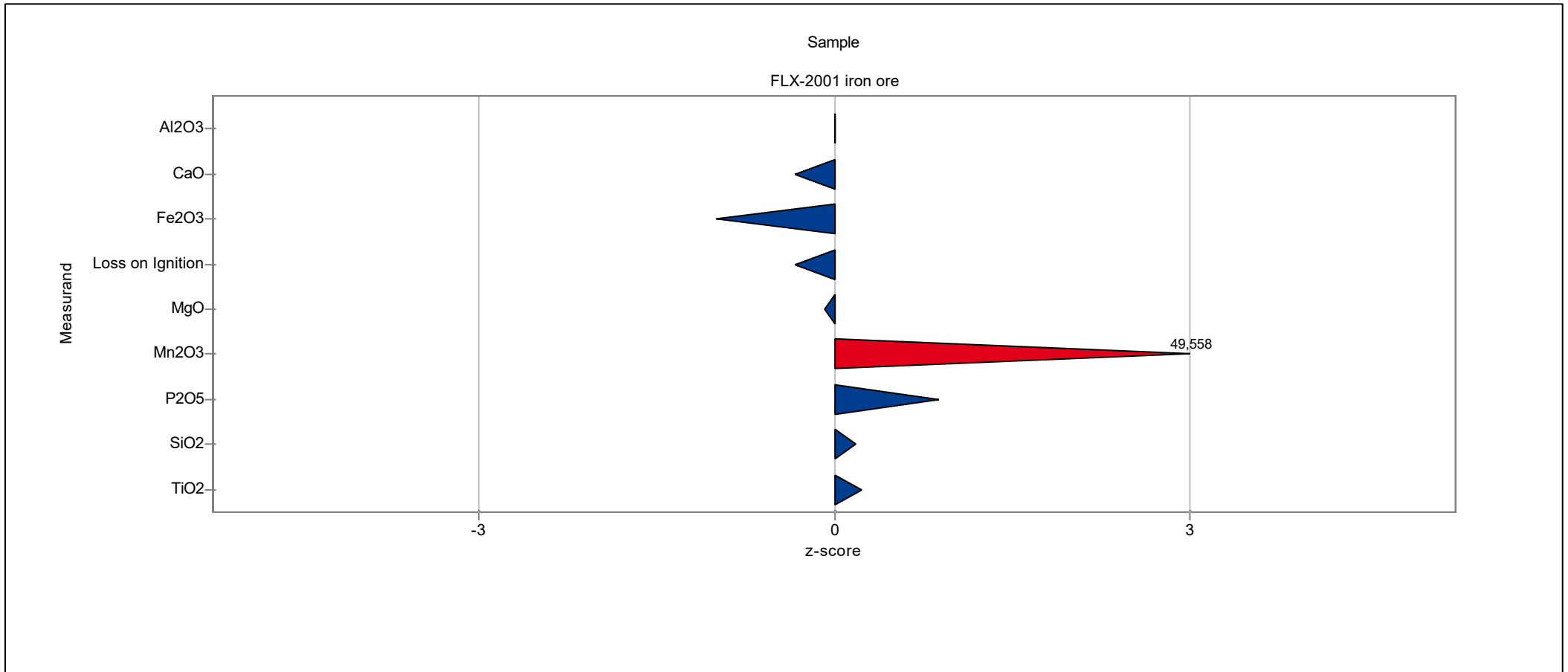
Laboratory: 25



RV_2021_01_iron ore

Laboratory chart of z-scores

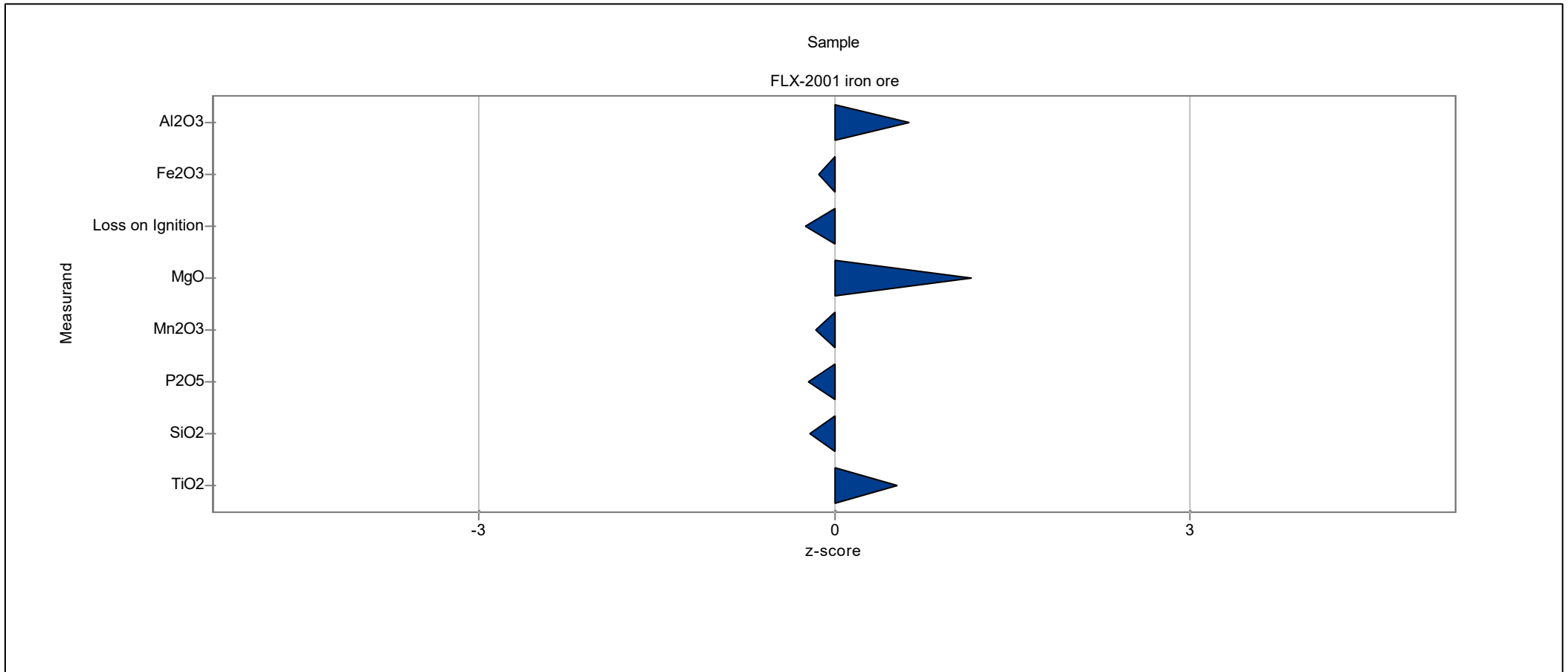
Laboratory: 26



RV_2021_01_iron ore

Laboratory chart of z-scores

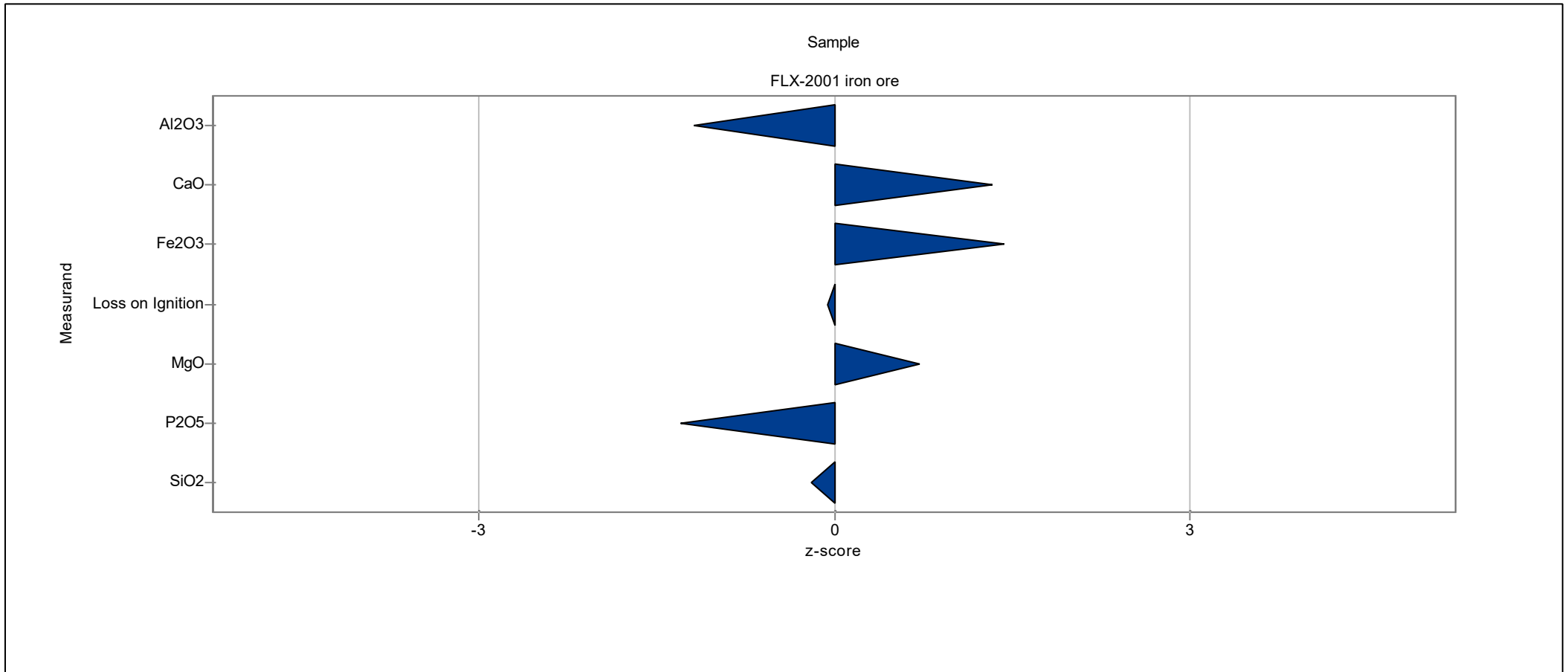
Laboratory: 27



RV_2021_01_iron ore

Laboratory chart of z-scores

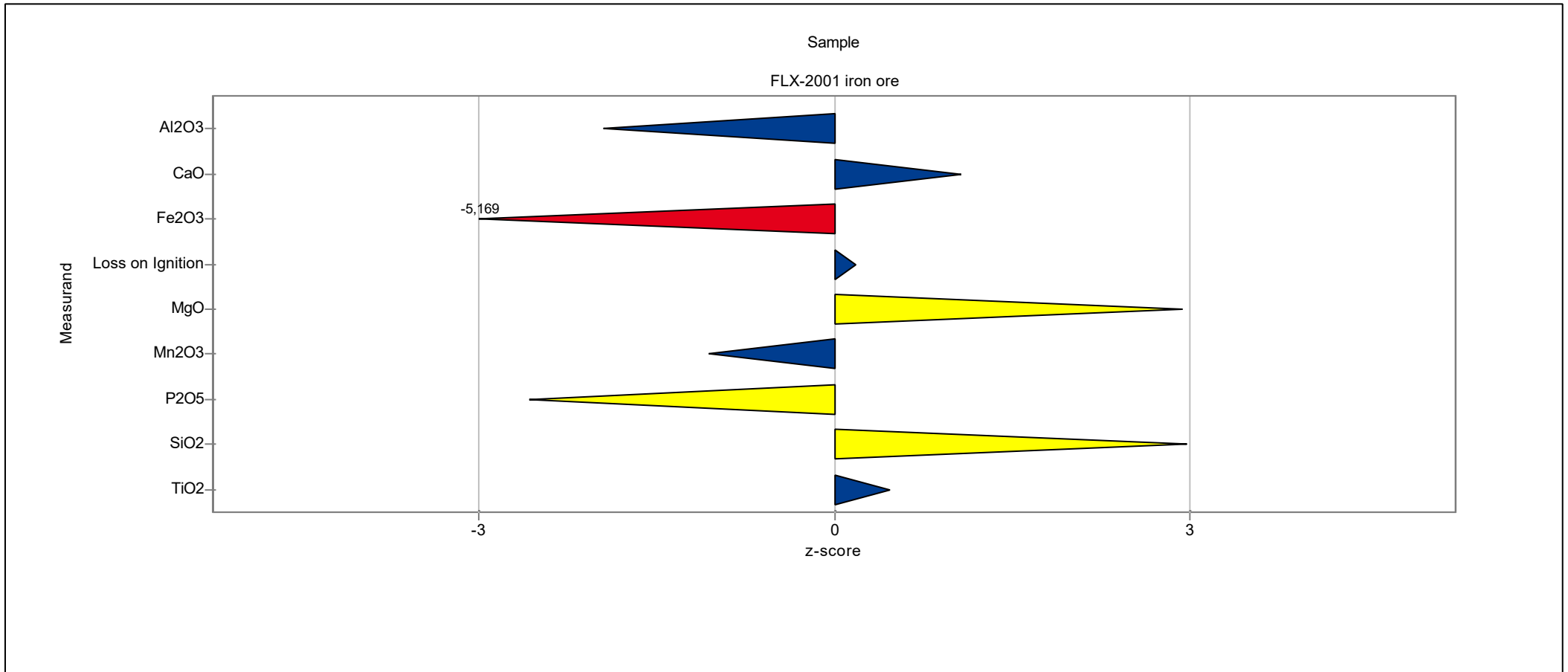
Laboratory: 28



RV_2021_01_iron ore

Laboratory chart of z-scores

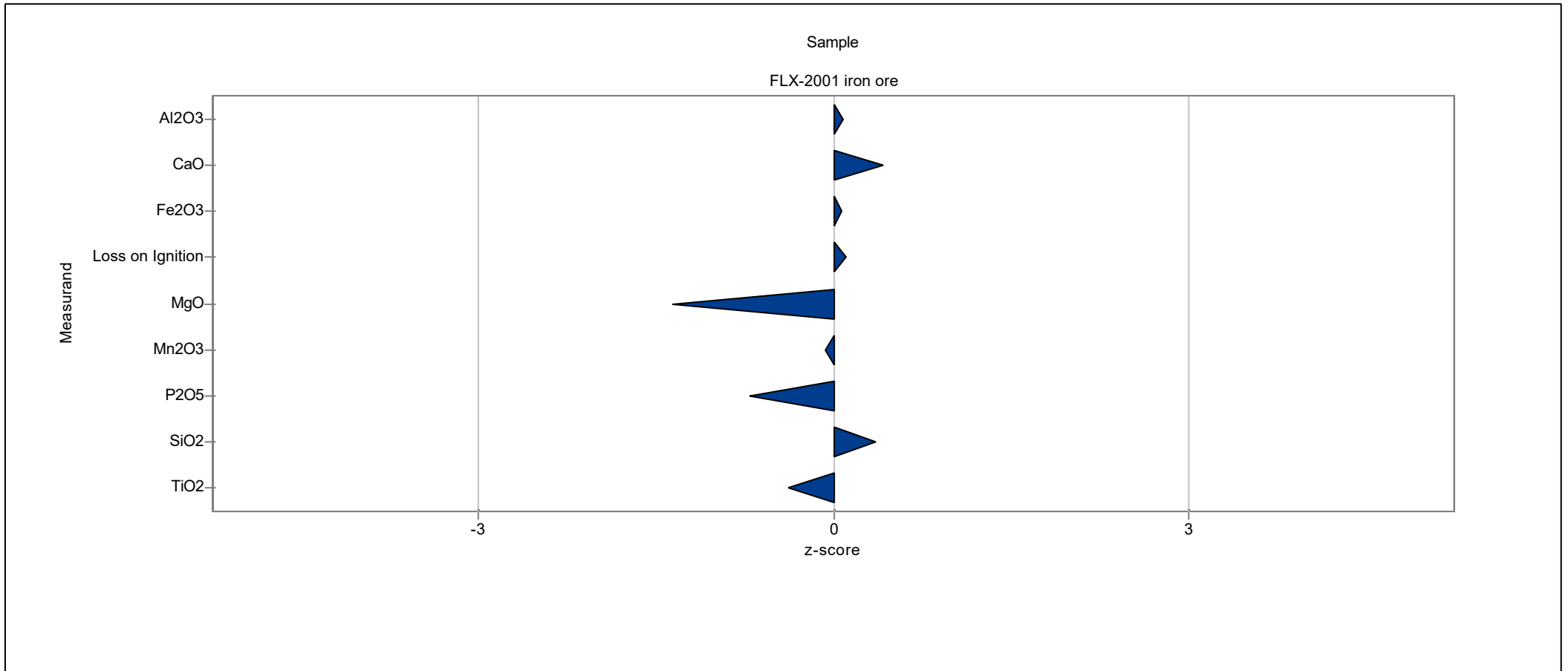
Laboratory: 29



RV_2021_01_iron ore

Laboratory chart of z-scores

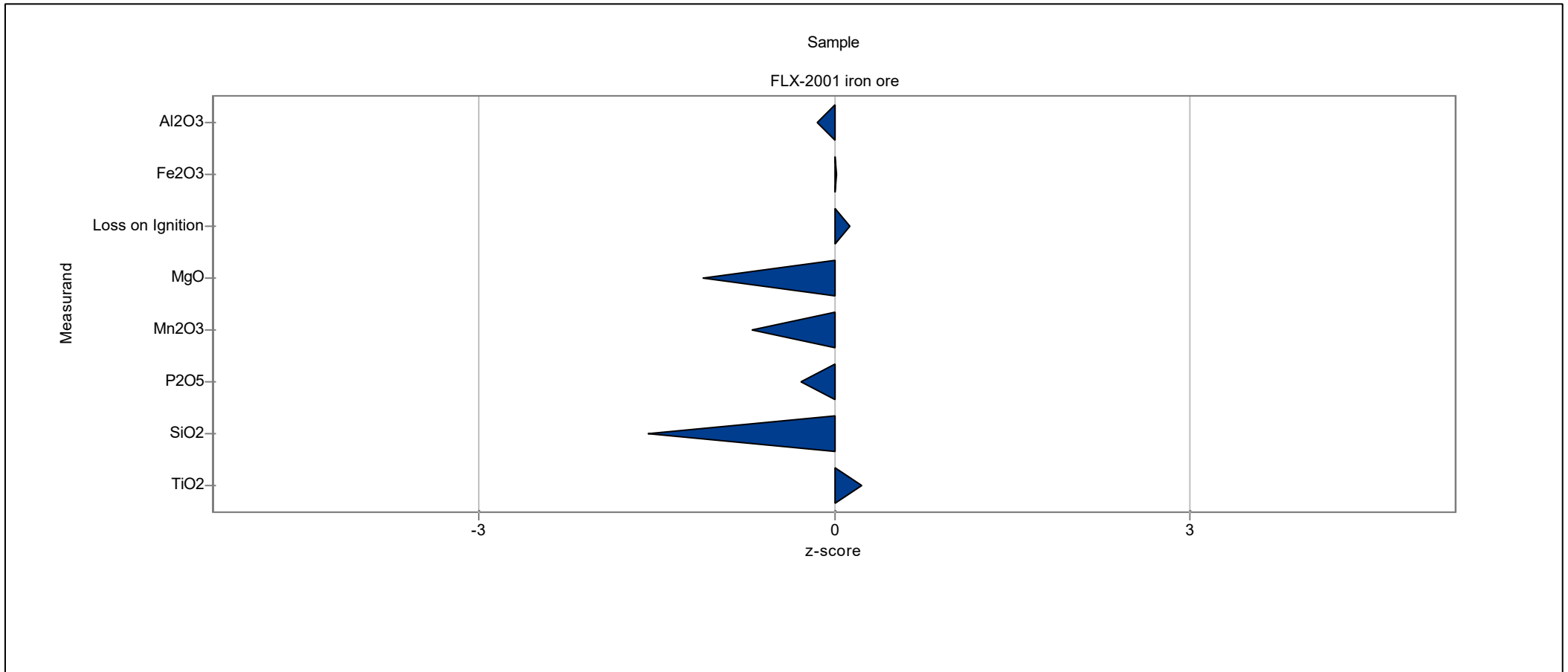
Laboratory: 30



RV_2021_01_iron ore

Laboratory chart of z-scores

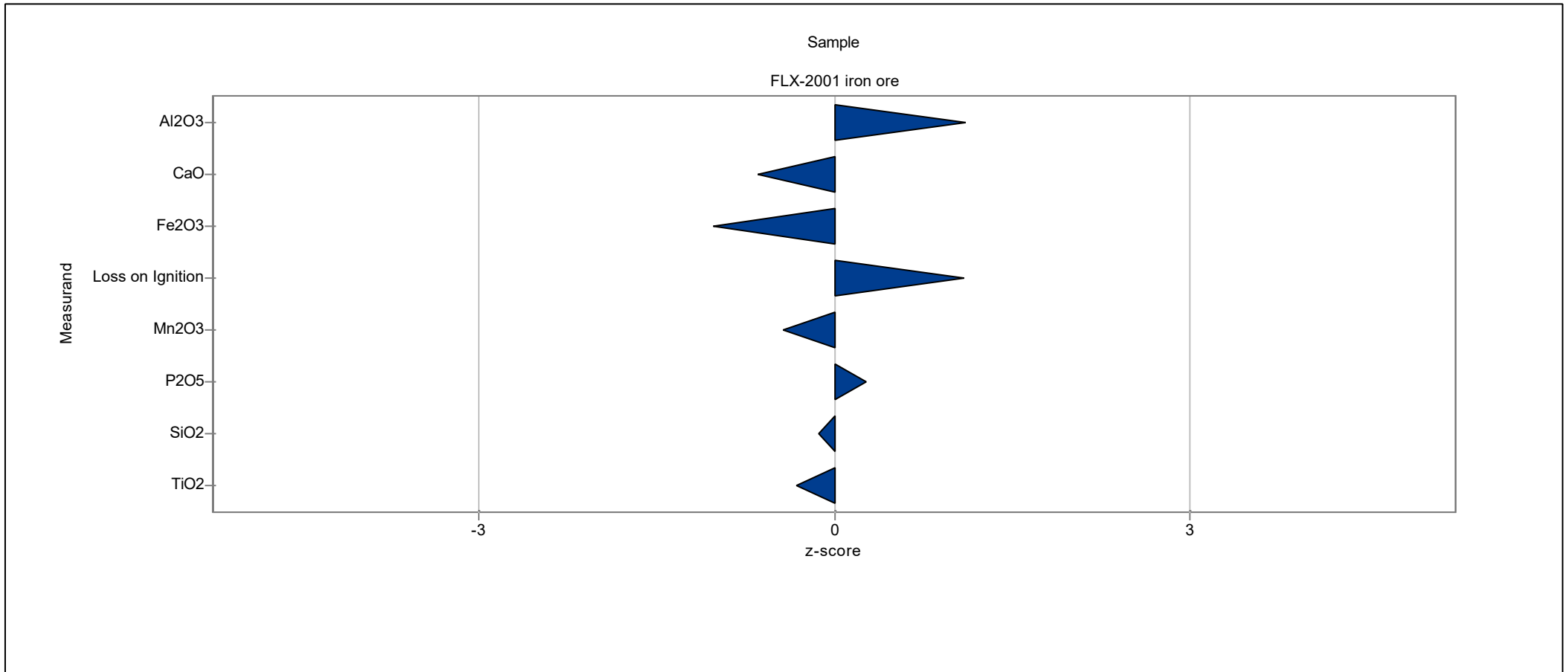
Laboratory: 31



RV_2021_01_iron ore

Laboratory chart of z-scores

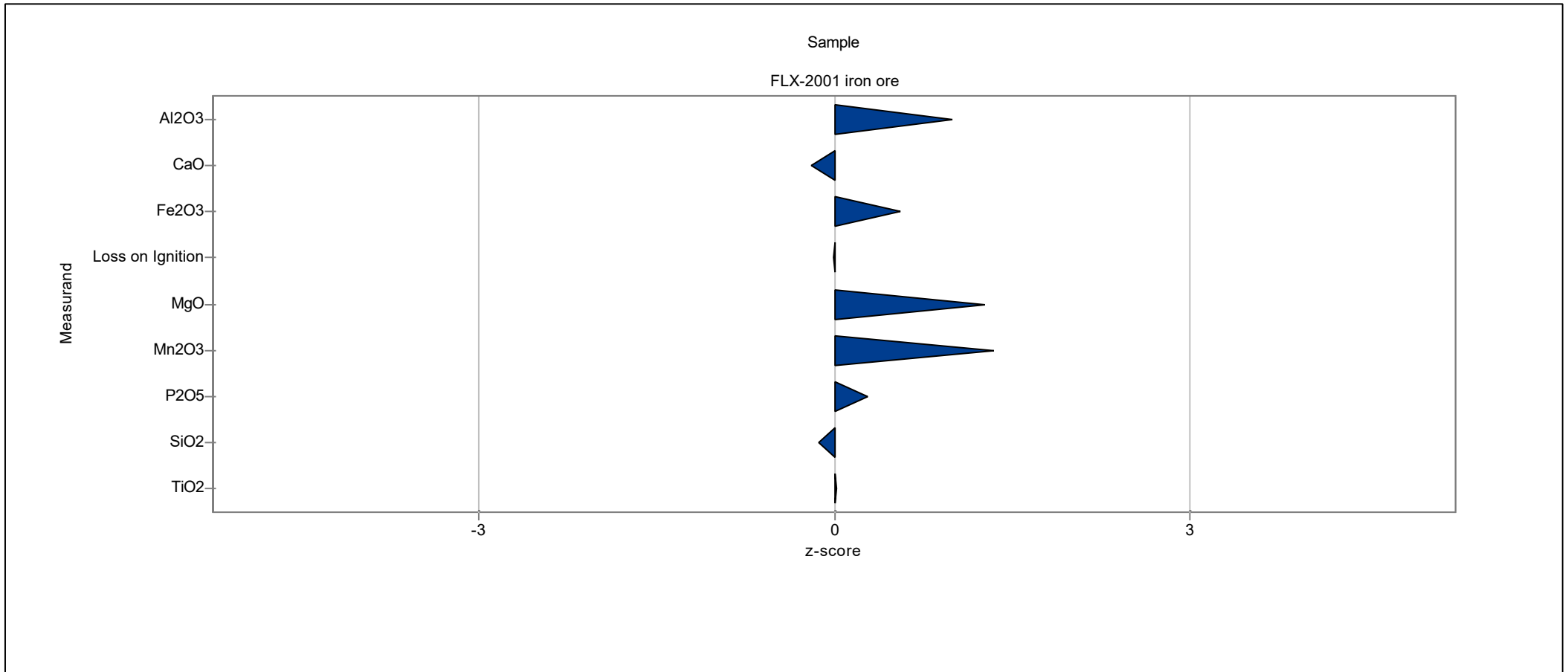
Laboratory: 32



RV_2021_01_iron ore

Laboratory chart of z-scores

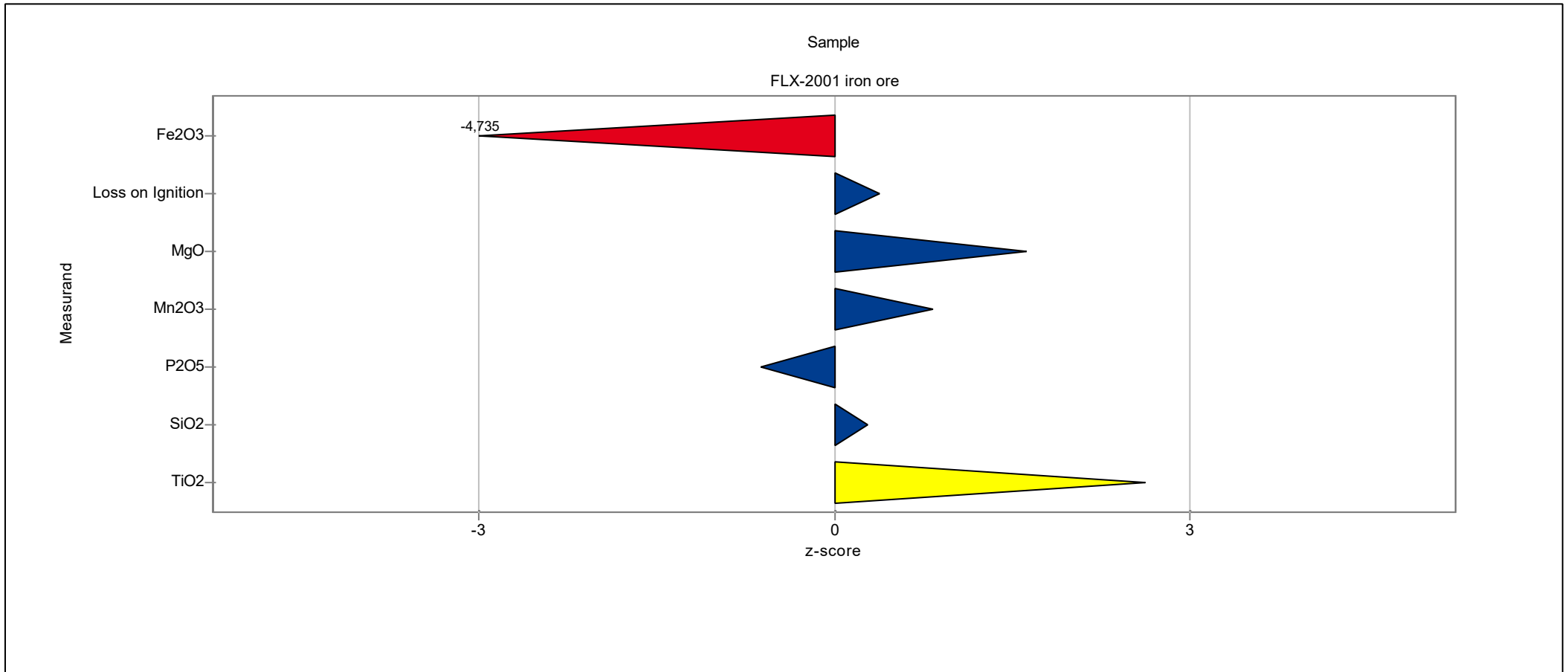
Laboratory: 33



RV_2021_01_iron ore

Laboratory chart of z-scores

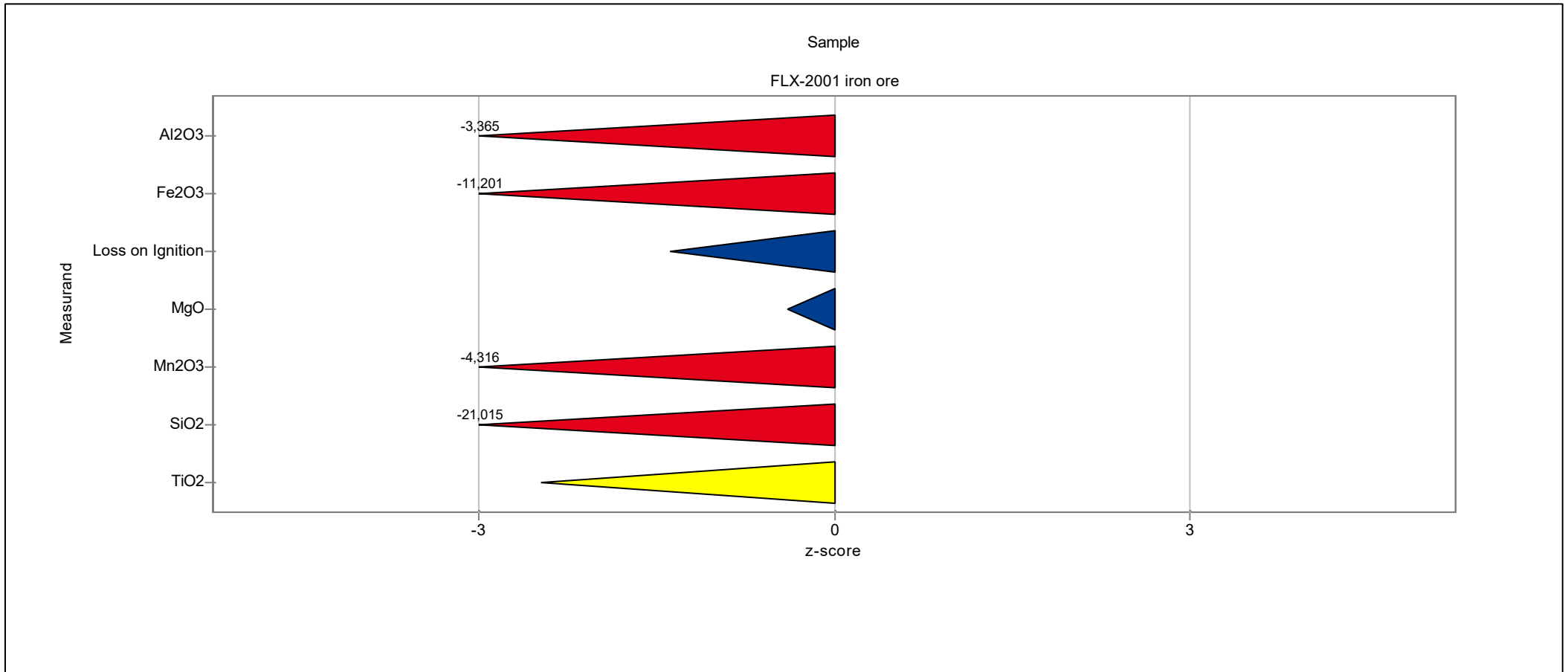
Laboratory: 34



RV_2021_01_iron ore

Laboratory chart of z-scores

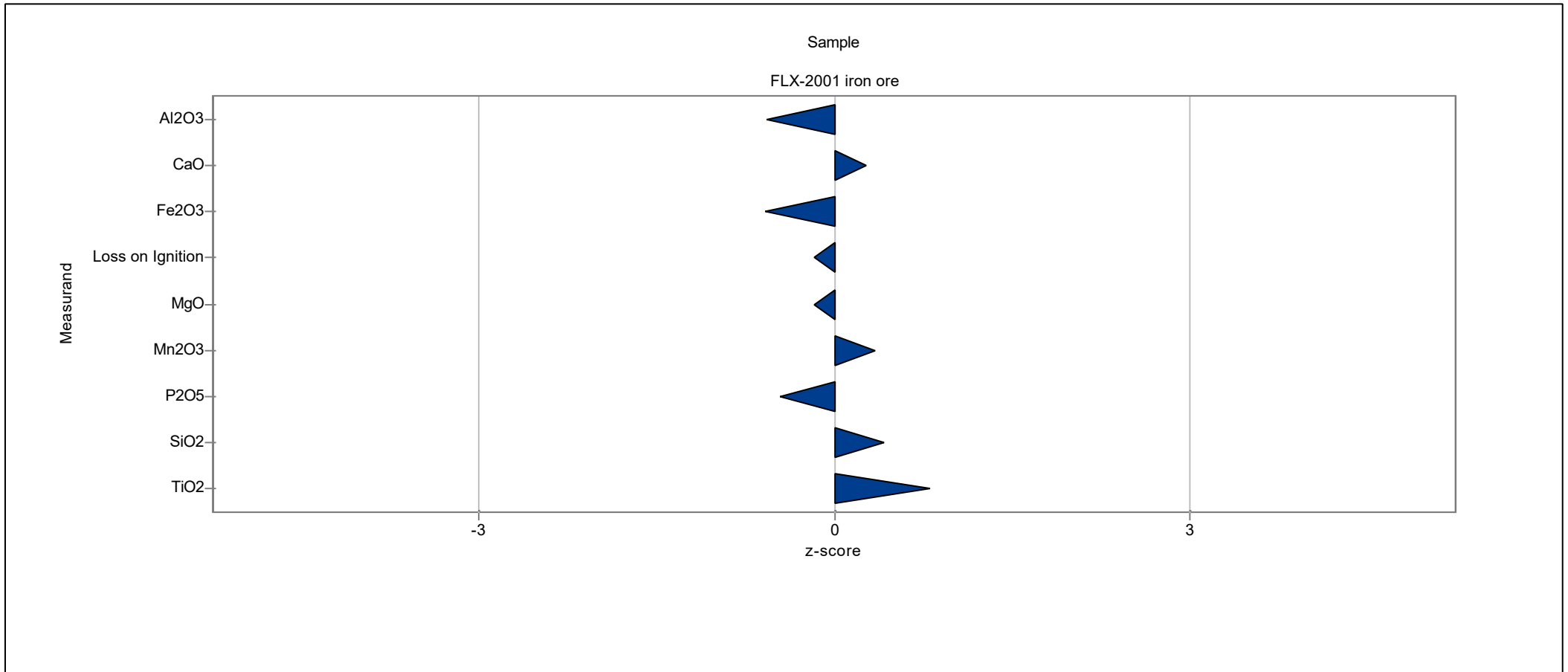
Laboratory: 35



RV_2021_01_iron ore

Laboratory chart of z-scores

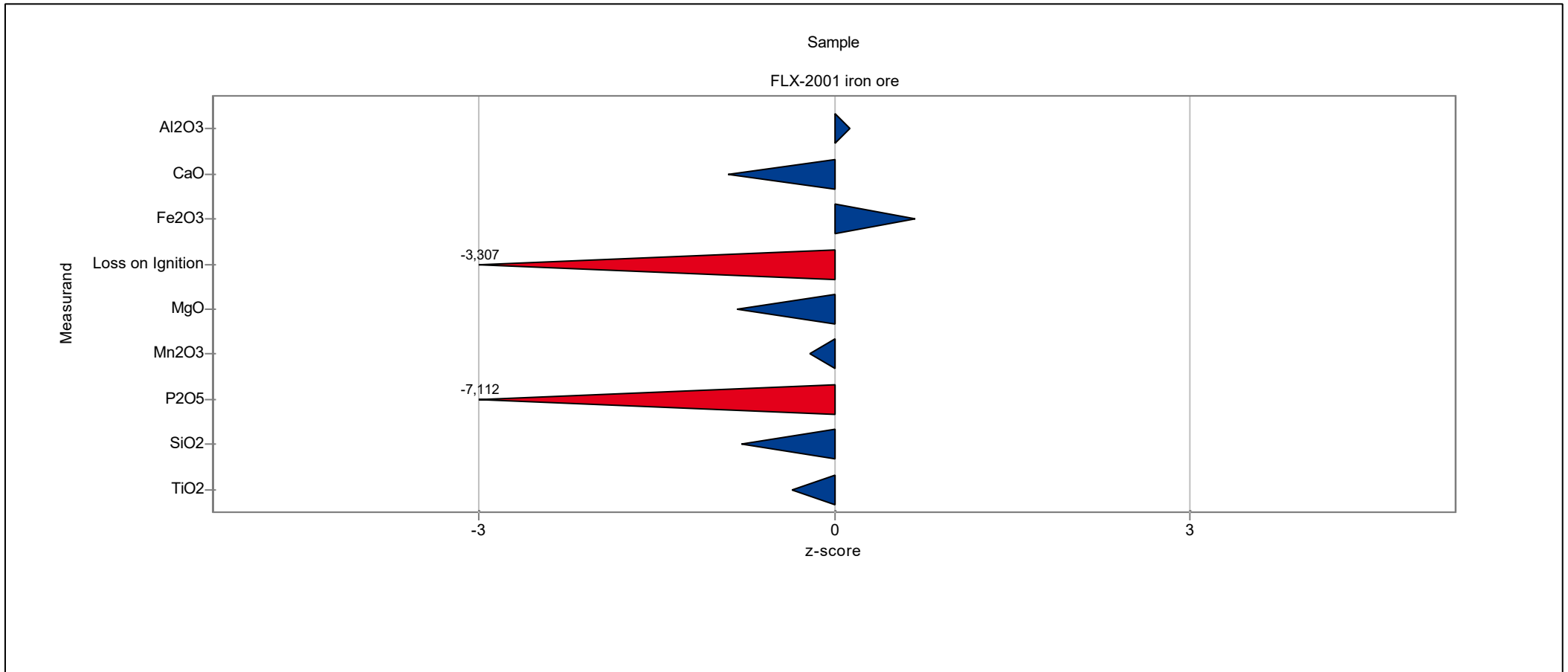
Laboratory: 36



RV_2021_01_iron ore

Laboratory chart of z-scores

Laboratory: 38



RV_2021_01_iron ore

Laboratory chart of z-scores

Laboratory: 39

