STANDARD SOIL REFERENCE MATERIAL FOR Au-REE DEPOSITS

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UpDeep_MIN_B1

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1. INTRODUCTION

UpDeep standard reference materials (SRM) are intended to be used in weak leach (i.e. geochemical) analysis for providing an affordable method of controlling the quality of soil samples for mineral exploration purposes. SRMs are produced less rigorously compared to e.g certified reference materials. The UpDeep SRM samples do not follow the ISO standardization and are therefore not certified reference materials (CRM). However, the UpDeep standard reference materials are more affordable and can thus be inserted in the analysis sequence more frequently than CRMs. For the user of the UpDeep SRMs, the purpose is to quantify laboratory accuracy externally in the form of bias.

2. SOURCE MATERIALS

UpDeep_MIN_B1 is mineral soil material collected from B-horizon on the Au-REE bearing quartz-hematite vein in the Mäkärä exploration target, northern Finland, in 2017.

UpDeep_MIN_B1 is one of six reference materials (Ah- and B-horizon, common juniper foliage, Scots pine bark, Norway spruce bark and foliage) collected from the Mäkärä exploration target in the UpDeep project.

3. COMMINUTION AND HOMOGENISATION PROCEDURES

The UpDeep_MIN_B1 SRM was prepared as follows:

- sampling of the B horizon samples in the field
- homogenization of the bulk sample in the field
- dividing and packaging in 120 g units ziplog plastic bags
- drying at 40°C for a day

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4. ANALYTICAL PROGRAM

UpDeep_MIN_B1 SRM samples were analyzed in one geochemical laboratory (ALS Minerals/ALS Global (Vancouver, Canada through, ALS Sodankylä, Finland). The methods used were:

- super trace modified weak aqua regia by ICP-MS with REE add-on (method code ME-MS41WREE)
- Sodium pyrophosphate leach with ICP-MS (method code ME-MS07)
- Leach pH
- LOI 500 for XRF (WST-SEQ)

Ten UpDeep_MIN_B1 SRM aliquots were sent to the laboratory. Tables 1 and 2 (Chapter 6) present information values for the laboratory results. The RSD% values < 5 are marked as green, the 5≤RSD%≥15 are marked with orange and the RSD%>15 are marked with red. Elements having less than four observations between the detection limits are coloured gray.

5. STATISTICAL ANALYSIS

Analysed elements, units, lower (LDL) and upper detection limits (UDL), percentage of <LDL, >UDL and discretized values, mean, median, standard deviation (SD), relative standard deviation (RSD%) and median absolute deviation (MAD) are presented in Chapter 6.

Original data, quality control monitoring and statistical measures are available upon request.

6. PARTICIPANT LABORATORIES

ALS, Vancouver, Canada

Table 1. Statistics for UpDeep_MIN_B1 analysed with super trace modified weak aqua regia method by ICP-MS with REE add-on (method code ME-MS41W-REE), based on ten aliquots. LDL =

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lower detection limit, pct_LDL = percent of samples under lower detection limit, UDL = upper detection limit, pct_UDL = percent of samples over upper detection limit, pct_discr = percent of discretized values, SD = standard deviation, RSD% = relative standard deviation percent and MAD= median absolute deviation. The RSD% values < 5 are marked as green, the 5≤RSD%≥15 are marked with orange and the RSD%>15 are marked with red. Elements having less than four observations between the detection limits are coloured gray.

Element	unit	LDL	pct_LDL	UDL	pct_UDL	pct_discr	MEAN	MEDIAN	SD	RSD %	MAD
Ag	ppm	NA	0	NA	0	0	0.0311	0.0315	0.0026	8.3642	0.003
Al	%	NA	0	NA	0	40	0.92	0.915	0.0236	2.562	0.0074
As	ppm	NA	0	NA	0	0	0.533	0.535	0.0427	8.0114	0.0371
Au	ppm	NA	0	NA	0	0	0.005	0.0036	0.0044	86.7229	0.0016
B	ppm	10	100	NA	0	100	7.5	7.5	0	0	0
Ba	ppm	NA	0	NA	0	40	16.17	16.2	0.4739	2.9306	0.3706
Be	ppm	NA	0	NA	0	90	0.197	0.2	0.0067	3.4261	0.0074
Bi	ppm	NA	0	NA	0	30	0.0551	0.0545	0.0023	4.143	0.0022
Ca	%	NA	0	NA	0	100	0.02	0.02	0	0	0
Cd	ppm	NA	0	NA	0	60	0.0209	0.021	0.0014	6.9337	0.0015
Ce	ppm	NA	0	NA	0	0	8.779	8.715	0.498	5.673	0.3484
Co	ppm	NA	0	NA	0	0	3.455	3.46	0.1615	4.6755	0.1779
Cr	ppm	NA	0	NA	0	0	33.3	33.3	0.8179	2.456	0.8896
Cs	ppm	NA	0	NA	0	0	0.3671	0.366	0.0182	4.9559	0.0163
Cu	ppm	NA	0	NA	0	0	16.275	16.2	0.5458	3.3537	0.4077
Dy	ppm	NA	0	NA	0	0	0.628	0.6325	0.0323	5.1396	0.0297
Er	ppm	NA	0	NA	0	0	0.3193	0.3225	0.0147	4.6053	0.0096
Eu	ppm	NA	0	NA	0	0	0.1456	0.1455	0.0052	3.5937	0.0044
Fe	%	NA	0	NA	0	0	2.413	2.4	0.065	2.6932	0.0445
Ga	ppm	NA	0	NA	0	0	7.207	7.155	0.2058	2.8549	0.1483
Gd	ppm	NA	0	NA	0	0	0.7012	0.7075	0.0345	4.9177	0.0215
Ge	ppm	NA	0	NA	0	30	0.0474	0.048	0.0032	6.8326	0.003
Hf	ppm	NA	0	NA	0	30	0.0405	0.0405	0.0021	5.2378	0.0022
Hg	ppm	NA	0	NA	0	40	0.0218	0.022	0.002	9.1232	0.0022
Ho	ppm	NA	0	NA	0	0	0.1159	0.116	0.0053	4.5737	0.0059
In	ppm	NA	0	NA	0	30	0.0247	0.0245	0.0025	9.9261	0.0015
K	%	NA	0	NA	0	100	0.02	0.02	0	0	0
La	ppm	NA	0	NA	0	0	5.046	5.01	0.3535	7.0055	0.215
Li	ppm	NA	0	NA	0	80	1.84	1.8	0.0843	4.583	0.0741

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Lu	ppm	NA	0	NA	0	30	0.0342	0.034	0.0016	4.7349	0.0015
Mg	%	NA	0	NA	0	100	0.086	0.09	0.0052	6.0046	0
Mn	ppm	NA	0	NA	0	0	101.04	97.15	9.0601	8.9668	3.3358
Mo	ppm	NA	0	NA	0	60	0.219	0.22	0.012	5.4668	0.0148
Na	%	NA	0	NA	0	90	0.0021	0.002	0.0003	15.0585	0
Nb	ppm	NA	0	NA	0	0	1.503	1.485	0.0703	4.679	0.0482
Nd	ppm	NA	0	NA	0	0	4.805	4.84	0.2356	4.9027	0.1779
Ni	ppm	NA	0	NA	0	0	9.223	9.125	0.3133	3.3966	0.2669
P	%	NA	0	NA	0	80	0.0245	0.0245	0.0008	3.4687	0.0007
Pb	ppm	NA	0	NA	0	0	4.78	4.705	0.2001	4.1853	0.0815
Pd	ppm	0.001	80	NA	0	80	0.0008	0.0008	0.0001	13.1762	0
Pr	ppm	NA	0	NA	0	0	1.174	1.17	0.0591	5.0304	0.0593
Pt	ppm	0.002	100	NA	0	100	0.0015	0.0015	0	0	0
Rb	ppm	NA	0	NA	0	0	5.635	5.605	0.18	3.1946	0.1557
Re	ppm	0.001	100	NA	0	100	0.0008	0.0008	0	0	0
S	%	NA	0	NA	0	100	0.01	0.01	0	0	0
Sb	ppm	NA	0	NA	0	0	0.0442	0.046	0.0069	15.5946	0.0059
Sc	ppm	NA	0	NA	0	0	1.5445	1.5375	0.0775	5.0162	0.0371
Se	ppm	NA	0	NA	0	80	0.38	0.4	0.0422	11.0957	0
Sm	ppm	NA	0	NA	0	0	0.8104	0.8195	0.0367	4.5283	0.04
Sn	ppm	NA	0	NA	0	0	1.065	1.02	0.1509	14.166	0.0593
Sr	ppm	NA	0	NA	0	0	1.199	1.195	0.0605	5.0419	0.0741
Ta	ppm	NA	0	NA	0	60	0.007	0.007	0.0012	17.8174	0.0015
Tb	ppm	NA	0	NA	0	0	0.1059	0.1065	0.004	3.7889	0.0044
Te	ppm	NA	0	NA	0	90	0.026	0.025	0.007	26.8925	0.0074
Th	ppm	NA	0	NA	0	0	1.603	1.61	0.0669	4.1724	0.063
Ti	%	NA	0	NA	0	30	0.0841	0.0835	0.0022	2.596	0.0022
Tl	ppm	NA	0	NA	0	50	0.0373	0.038	0.0017	4.5655	0.0007
Tm	ppm	NA	0	NA	0	0	0.0414	0.041	0.0022	5.2428	0.0015
U	ppm	NA	0	NA	0	0	0.3937	0.396	0.0098	2.4888	0.0082
V	ppm	NA	0	NA	0	0	55.51	55	2.5942	4.6734	1.2602
W	ppm	NA	0	NA	0	60	0.0328	0.033	0.0016	4.937	0.0015
Y	ppm	NA	0	NA	0	0	2.869	2.865	0.113	3.9381	0.0964
Yb	ppm	NA	0	NA	0	0	0.2589	0.257	0.013	5.0145	0.0104
Zn	ppm	NA	0	NA	0	0	18.15	18	0.6042	3.3287	0.4448
Zr	ppm	NA	0	NA	0	0	1.827	1.82	0.1076	5.8897	0.1112

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Table 2. Statistics for UpDeep_MIN_B1 analysed with sodium pyrophosphate leach method by ICP-MS (method code ME-MS07), based on ten aliquots. LDL = lower detection limit, pct_LDL = percent of samples under lower detection limit, UDL = upper detection limit, pct_UDL = percent of samples over upper detection limit, pct_discr = percent of discretized values, SD = standard deviation, RSD% = relative standard deviation percent and MAD= median absolute deviation. The RSD% values < 5 are marked as green, the 5≤RSD%≥15 are marked with orange and the RSD%>15 are marked with red. Elements having less than four observations between the detection limits are coloured gray.

Element	unit	LDL	pct_LDL	UDL	pct_UDL	pct_discr	MEAN	MEDIAN	SD	RSD %	MAD
Ag	ppm	NA	0	NA	0	30	0.005	0.005	0.0016	32.660	0.0015
Al	ppm	NA	0	NA	0	0	4698	4695	163.6935	3.484	111.195
As	ppm	NA	0	NA	0	40	0.293	0.285	0.0279	9.525	0.0074
Au	ppm	0.001	100	NA	0	100	0.0008	0.0008	0	0	0
B	ppm	NA	0	NA	0	0	0.73	0.7	0.2003	27.435	0.1483
Ba	ppm	NA	0	NA	0	0	6.09	6.09	0.195	3.203	0.2446
Be	ppm	NA	0	NA	0	0	0.0936	0.0935	0.0065	6.982	0.0067
Bi	ppm	NA	0	NA	0	30	0.0158	0.016	0.002	12.588	0.0015
Br	ppm	NA	0	NA	0	70	4.1	4	0.5676	13.845	0
Ca	ppm	NA	0	NA	0	80	28	30	4.2164	15.059	0
Cd	ppm	NA	0	NA	0	0	0.0074	0.008	0.0022	30.015	0.003
Ce	ppm	NA	0	NA	0	0	1.665	1.6625	0.0718	4.315	0.0556
Co	ppm	NA	0	NA	0	0	0.5746	0.562	0.0376	6.541	0.0341
Cr	ppm	NA	0	NA	0	30	11.4	11.35	0.3488	3.060	0.4077
Cs	ppm	NA	0	NA	0	0	0.0647	0.0643	0.0073	11.246	0.0067
Cu	ppm	NA	0	NA	0	0	3.247	3.2	0.1333	4.107	0.1483
Dy	ppm	NA	0	NA	0	30	0.2272	0.224	0.0108	4.749	0.0074
Er	ppm	NA	0	NA	0	0	0.1167	0.1155	0.0094	8.090	0.0059
Eu	ppm	NA	0	NA	0	0	0.0465	0.0461	0.0034	7.318	0.0044
Fe	ppm	NA	0	NA	0	0	6580	6665	270.0617	4.104	340.998
Ga	ppm	NA	0	NA	0	0	2.327	2.335	0.1058	4.548	0.1038
Gd	ppm	NA	0	NA	0	0	0.2161	0.2145	0.0146	6.778	0.0156
Ge	ppm	NA	0	NA	0	0	0.0794	0.08	0.005	6.317	0.003
Hf	ppm	NA	0	NA	0	0	0.0993	0.1025	0.0102	10.264	0.0096
Hg	ppm	NA	0	NA	0	90	0.011	0.01	0.0032	28.748	0
Ho	ppm	NA	0	NA	0	0	0.041	0.0413	0.0021	5.107	0.0027

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I	ppm	NA	0	NA	0	0	3.257	3.16	0.1824	5.600	0.1186
In	ppm	NA	0	NA	0	0	0.0086	0.009	0.0023	26.402	0.003
K	ppm	NA	0	NA	0	0	108.7	110	5.5388	5.095	4.4478
La	ppm	NA	0	NA	0	0	1.061	1.065	0.0406	3.827	0.0408
Li	ppm	NA	0	NA	0	30	0.367	0.37	0.0258	7.041	0.0297
Lu	ppm	NA	0	NA	0	0	0.0134	0.0128	0.0018	13.069	0.0009
Mg	ppm	NA	0	NA	0	0	101.77	102.5	4.9237	4.838	4.4478
Mn	ppm	NA	0	NA	0	0	17.5	16.4	3.5244	20.139	1.0008
Mo	ppm	NA	0	NA	0	0	0.0723	0.074	0.0084	11.683	0.0096
Nb	ppm	NA	0	NA	0	0	1.098	1.1025	0.0476	4.337	0.0519
Nd	ppm	NA	0	NA	0	0	1.0568	1.0425	0.0657	6.220	0.0497
Ni	ppm	NA	0	NA	0	0	2.081	2.06	0.1134	5.448	0.1334
Pb	ppm	NA	0	NA	0	0	1.2795	1.2775	0.0703	5.494	0.0815
Pr	ppm	NA	0	NA	0	0	0.2658	0.262	0.0123	4.628	0.0059
Rb	ppm	NA	0	NA	0	0	1.442	1.425	0.0586	4.064	0.0408
Re	ppm	0.0002	70	NA	0	70	0.0002	0.0001	0.0001	0	0
Sb	ppm	NA	0	NA	0	0	0.0467	0.0459	0.0054	11.629	0.0044
Se	ppm	NA	0	NA	0	0	0.265	0.26	0.075	28.309	0.089
Sm	ppm	NA	0	NA	0	0	0.2358	0.238	0.0117	4.957	0.0082
Sn	ppm	NA	0	NA	0	0	0.2982	0.2915	0.0263	8.809	0.023
Sr	ppm	NA	0	NA	0	0	0.3729	0.367	0.037	9.925	0.0297
Ta	ppm	NA	0	NA	0	30	0.0468	0.047	0.0026	5.590	0.0015
Tb	ppm	NA	0	NA	0	0	0.0355	0.0344	0.0033	9.200	0.0036
Te	ppm	0.005	10	NA	0	0	0.0199	0.018	0.0109	54.987	0.0111
Th	ppm	NA	0	NA	0	0	0.653	0.653	0.0217	3.328	0.0237
Ti	ppm	NA	0	NA	0	0	513.2	514.5	23.6587	4.610	28.1694
Tl	ppm	NA	0	NA	0	40	0.0092	0.009	0.0019	20.367	0.0015
Tm	ppm	NA	0	NA	0	0	0.0147	0.0146	0.0016	10.787	0.0016
U	ppm	NA	0	NA	0	0	0.1101	0.111	0.0049	4.459	0.0037
V	ppm	NA	0	NA	0	0	14.4	14.425	0.9286	6.448	0.4818
W	ppm	NA	0	NA	0	0	0.0455	0.0455	0.0039	8.559	0.003
Y	ppm	NA	0	NA	0	0	0.9828	0.98	0.0347	3.527	0.04
Yb	ppm	NA	0	NA	0	0	0.1064	0.1055	0.0055	5.204	0.0052
Zn	ppm	NA	0	NA	0	0	3.86	3.9	0.2162	5.601	0.2446
Zr	ppm	NA	0	NA	0	30	3.086	3.09	0.0945	3.064	0.1038

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7. PREPARER ANS SUPPLIER

UpDeep_MIN_B1 SRMs are prepared by the Geological Survey of Finland (GTK) in a project Upscaling deep buried geochemical exploration techniques into European business (UpDeep) and supplied by GTK and Scandinavian Geopool.

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8. INTENDED USE

UpDeep_MIN_B1 SRMs are intended to quantify laboratory accuracy and to monitor laboratory precision, drift, periodic concentration shifts, unusual breaks and outliers in analytical results of soil B horizon samples for mineral exploration.

9. STABILITY AND STORAGE INSTRUCTIONS

UpDeep_MIN_B1 SRM should be stored in a room temperature unopened in their own plastic containers. Stability of the materials are not tested.

10. INSTRUCTIONS FOR CORRECT USE

UpDeep_MIN_B1 SRM is a dry sample, but needs to be sieved to a requisite size prior to analysis. It should be only used with samples of same matrix and concentration ranges.

11. HANDLING INSTRUCTIONS

Keep dry and do not touch with bare hands to avoid SRM contamination.

12. TRACEABILITY

The analyzed SRM samples represent the entire batch of prepared SRM. All the analyzed samples have individual names and can be traced back into the original analytical results. The laboratory was chosen on the basis the availability of the analytical services specific to soils and offered range of elements usable for mineral exploration. The laboratory has ISO/IEC 17025:2005 accreditation.

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13. LEGAL NOTICE

Geological Survey of Finland and Scandinavian Geopool have prepared and Geological Survey of Finland and Vienna Technical University have statistically evaluated the property values of this reference material to the best of their ability. Geological Survey of Finland, Scandinavian Geopool and Vienna Technical University assume no liability for any errors in this material and information. Geological Survey of Finland, Scandinavian Geopool and Vienna Technical University shall be free from, and indemnified by the user against, any liability for any damage or loss, whether direct or consequential, arising from or as a result of the use of this material and information.

14. REFERENCES

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