The reviewer stated that "Overall, I feel the study was well conducted and worthy of publication, yet at the moment I feel the statistical approaches need to be re-addressed (or explained more clearly if these approaches are not valid?"
We appreciate the positive evaluation of our work and we greatly revised statistical treatment following the recommendations of reviewer as described below.

The main concern of this reviewer with the manuscript is how the statistics have been conducted and with the potential for improvements to be made in the analysis and then potentially the interpretation. A lot of new statistical treatments were performed (PCA, Kruskal-Wallis). Results are presented in this reply. The essential of the interpretation has not been modified.

For example, how were each of the variables normalized before the PCA was conducted and can you demonstrate that the PCA results explain a significant proportion of the variance in your dataset? The identification of factors was performed using the method of Raw Data and the extraction method was principal component. All the variables were normalized as necessary in standard package of Statistica-7 given that the units of various components are different. We do not expect that the PCA is capable explaining high proportion of variance in all major and trace element concentration. Given the high number of variables and the diversity of environmental conditions responsible for soil solution composition formation, 20 and 9 % of total variation is not a bad result. Note that the PCA treatment of the river water in western Siberia also allowed explanation of "only" 20 and 10% of the variance in a much larger dataset (Pokrovsky et al., 2016a).

I think you show that the 2 extracted PCA axes explain only 29% of the total variance in the dataset? Would you not be better served trying to improve this, or using a prior step to remove variables that do not show significant differences between sites (e.g. using a Kruskal-Wallis test). Including only the significant data may improve the PCA and allow for wider patterns to be identified. This is very pertinent comment. We did attempt to remove part of the components (variables) in order to improve the PCA. This exercise was not successful because the number of individual measurements was not sufficiently high.

You may be advised to apply a Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy for the overall data set to detect if you have sufficient sampling adequacy to include all of these parameters together. Good point. Unfortunately, in this study we used standard STATISTICA-7 package which, unlike SPSS, does not allow realization of Kaiser-Meyer-Olkin (KMO) criterion. Nevertheless, following this useful advice, we computed the KMO criterion using Excel. As we expected, the KMO value was equal to 0.533 which suggests rather low adequacy: the analysis does not make sense at KMO < 0.5.

Another approach, maybe to break the dataset down and conduct separate PCA. We tried this: removal a part of the data series and conducting separate PCA for major elements, TE, various forms of micro-relief and various geographical sites did not yield any better description because of insufficient size of the dataset.

Also, how did you define the number of eigenfactors you chose for the PCA? The number of maximal number of eigenfactors was based on the criterion of PCA values decrease. We used a scree test for determining the number of factors to retain in a factor analysis or principal components analysis. The scree test involves plotting the eigenvalues in descending order of their magnitude against their factor numbers and determining where they level off.
The PCA values demonstrated significant decrease of the values between F2 and F3 (**Fig. 1R** of this Reply) suggesting therefore that at least two factors are interpretable.

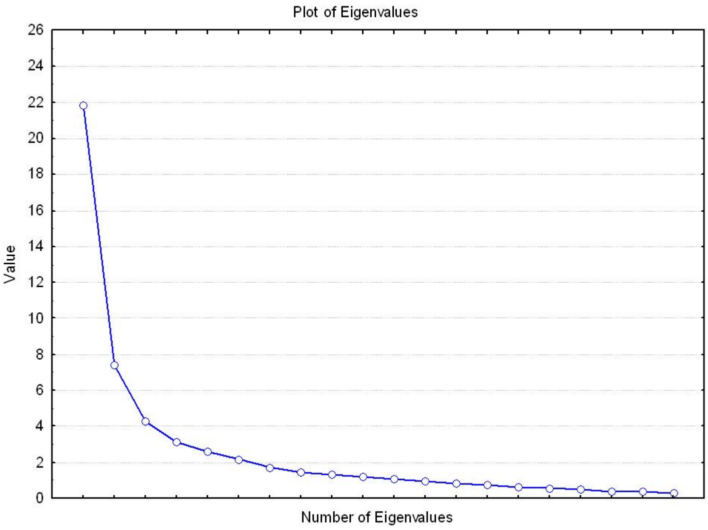
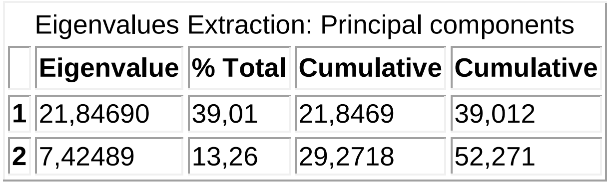


Fig. 1R. The PCA value as a function of the number of eigenvalues.

This produced the following table of eigenvalues:



Eigenvalues Extraction: Principal components

	Eigenvalue	% Total	Cumulative	Cumulative
1	21,84690	39,01	21,8469	39,012
2	7,42489	13,26	29,2718	52,271

Furthermore, the study often uses multiple Mann-Whitney U tests between pairs of variables, even when a more appropriate approach maybe to use a test that allows more than 2 parameters to be compared (e.g. one-way ANOVA on ranks/ KruskalWallis).

This is really important advice and we directly followed this recommendation. Major and TE concentrations in soil porewaters of (1) five main sampling sites and (2) four main micro-relief landscapes (polygon, permafrost/subsidence, frost crack and hollow) were additionally processed using nonparametric H-criterion Kruskal–Wallis test. This test is suitable for evaluation of difference of each component among several samplings simultaneously. It is considered statistically significant at $p < 0.05$. Results of two tests are listed in **Tables R1** and **R2** below. For all components and micro-landscapes, we observed full consistency between Kruskal–Wallis and Mann–Whitney U tests.

Table R1. Statistical differences in elements concentration between different forms of microrelief for each key sites. p-values are determined by Mann–Whitney U test (1st line) and Kruskal–Wallis test (2nd line) for each component. Note that Kogalym and Pangody sites present only Mann–Whitney U test because they have only two forms of microrelief (mound and hollow).

Component	Kogalym	Khanymey			Pangody	Urengoy			Tazovskiy		
	mound – hollow	mound – hollow	mound – permafrost subsidence	hollow – permafrost subsidence	mound – hollow	mound – hollow	mound – permafrost subsidence	hollow – permafrost subsidence	polygon – hollow	polygon – frost crack	hollow – frost crack
Cond	**0.035**	**0.032**	0.441	0.083	0.107	**0.034**	0.564	**0.029**	0.387	0.544	0.302
		H = 6.20; **p = 0.045**				H = 6.11; **p = 0.047**			H = 0.879; p = 0.644		
pH	0.519	0.114	0.685	0.312	0.693	**0.050**	**0.048**	0.355	0.592	0.130	0.302
		H = 2.57; p = 0.277				H = 6.3; p = **0.043**			H = 2.257; p = 0.324		
Cl^{-}	0.086	0.292	0.465	0.564	0.294	0.724	0.564	0.729	0.435	0.182	0.121
		H = 1.492; p = 0.474				H = 0.278; p = 0.87			H = 2.038; p = 0.361		
SO_4^{2-}	0.238	**0.028**	**0.015**	0.072	**0.038**	**0.034**	**0.028**	0.749	**0.016**	**0.018**	**0.025**
		H = 9.21; **p = 0.01**				H = 6.975; p = **0 .031**			H = 15.568; **p = 0.0004**		
DOC	**0.043**	**0.023**	0.283	**0.049**	0.082	**0.037**	**0.048**	**0.046**	**0.027**	**0.033**	0.535
		H = 6.291; **p = 0.043**				H = 6.475; **p = 0.039**			H = 8.206; **p = 0.017**		
DIC	0.643	0.194	0.626	**0.017**	**0.031**	0.485	0.718	0.157	0.093	0.140	0.180
		H = 6.103; **p = 0.047**				H = 0.078; p = 0.962			H = 1.492; p = 0.474		
Ca	0.479	**0.043**	0.256	**0.017**	0.304	0.067	**0.042**	**0.043**	0.195	0.124	0.540
		H = 6.66; **p = 0.036**				H = 6.475; **p = 0.039**			H = 0.37; p = 0.831		
Mg	0.542	**0.029**	0.639	**0.044**	0.641	**0.048**	**0.045**	**0.041**	0.730	0.390	0.530
		H = 6.315; **p = 0.042**				H = 6.291; **p = 0.043**			H = 0.877; p = 0.645		
K	0.157	0.271	0.631	0.164	0.132	0.097	**0.036**	**0.049**	0.320	0.210	0.180
		H = 0.083; p = 0.959				H = 5.468; **p = 0.047**			H = 3.531; p = 0.171		
Al	**0.046**	**0.047**	0.517	**0.043**	0.082	**0.047**	**0.048**	0.157	**0.049**	0.058	0.540
		H = 6.9; **p = 0.032**				H = 6.3; **p = 0.043**			H = 5.468; **p = 0.047**		
Fe	**0.048**	**0.046**	**0.043**	0.234	0.634	**0.039**	**0.048**	**0.031**	**0.048**	**0.029**	**0.042**
		H = 6.568; **p = 0.038**				H = 6.737; **p = 0.034**			H = 7.606; **p = 0.022**		
Si	**0.039**	0.283	0.221	0.308	**0.045**	**0.04**	0.363	**0.043**	0.554	**0.032**	**0.048**
		H = 1.636; **p = 0.44**				H = 6.275; p = **0.043**			H = 6.522; **p = 0.038**		
Li	**0.029**	0.192	0.746	0.564	0.638	**0.047**	0.818	0.050	**0.045**	0.054	0.053
		H = 1.15; p = 0.563				H = 6.112; **p = 0.047**			H = 6.44; **p = 0.038**		
B	**0.038**	**0.039**	**0.029**	0.386	0.221	–	–	–	**0.023**	0.098	0.074
		H = 7.01; **p = 0.03**				–			H = 10.258; **p = 0.006**		
Na	0.397	0.194	0.265	0.248	0.063	0.289	0.083	0.064	0.102	0.506	0.202
		H = 2.01; p = 0.367				H = 2.8; p = 0.247			H = 1.509; p = 0.47		
Ti	**0.031**	0.441	0.156	0.083	0.453	0.157	0.248	0.355	0.654	0.066	0.091
		H = 2.56; p = 0.278				H = 4.54; p = 0.103			H = 0.959; p = 0.619		

V	0.086	0.570	0.330	0.083	0.267	**0.037**	**0.026**	0.443	0.134	0.467	0.302
		H = 1.977; p = 0.372				H = 7; **p = 0.03**			H = 1.324; p = 0.516		
Cr	0.053	0.521	0.465	0.172	0.221	0.157	0.564	0.064	0.676	0.544	0.339
		H = 0.438; p = 0.803				H = 2.5; p = 0.286			H = 0.641; p = 0.726		
Mn	0.091	**0.046**	**0.044**	0.064	**0.031**	**0.037**	**0.048**	0.095	0.108	0.476	0.239
		H = 6.78; **p = 0.034**				H = 6.051; **p = 0.048**			H = 2.177; p = 0.337		
Co	0.283	0.144	**0.043**	0.386	0.307	0.480	0.564	0.165	0.532	0.090	0.121
		H = 6.283; **p = 0.043**				H = 1.94; p = 0.378			H = 3.188; p = 0.203		
Ga	0.053	0.05	0.775	**0.021**	**0.041**	0.289	0.083	0.355	0.053	0.052	**0.046**
		H = 6.23; **p = 0.044**				H = 3.3; p = 0.192			H = 6.05; **p = 0.048**		
As	0.190	**0.022**	0.023	0.148	0.074	0.624	**0.046**	0.101	0.312	0.115	0.058
		H = 6.131; **p = 0.047**				H = 6.05; **p = 0.048**			H = 3.548; p = 0.169		
Rb	0.043	0.072	0.808	0.564	**0.041**	0.480	**0.038**	**0.046**	**0.049**	0.052	0.614
		H = 0.823; p = 0.663				H = 6.14; **p = 0.046**			H = 5.968; **p = 0.050**		
Zr	**0.032**	0.570	0.256	0.149	0.053	0.706	0.148	0.063	0.095	0.467	0.108
		H = 2.044; p = 0.359				H = 0.811; p = 0.666			H = 1.23; p = 0.54		
Nb	**0.048**	0.168	0.746	0.564	0.414	0.527	0.564	0.455	0.284	0.782	0.210
		H = 1.817; p = 0.403				H = 1; p = 0.607			H = 0.964; p = 0.618		
Mo	**0.042**	0.317	0.144	0.441	0.579	0.724	0.585	0.643	0.272	**0.037**	**0.020**
		H = 2.38; p = 0.311				H = 0.1 p = 0.95			H = 6.48; **p = 0.039**		
Cd	**0.032**	0.105	**0.037**	0.342	**0.044**	**0.029**	**0.023**	0.052	**0.044**	0.132	0.233
		H = 6.568; p = **0.038**				H = 7; **p = 0.03**			H = 6.05; **p = 0.048**		
Ni	0.147	**0.044**	0.162	0.381	0.732	0.057	0.560	0.408	0.446	0.467	0.089
		H = 6.045; **p = 0.0487**				H = 1.34; p = 0.511			H = 2.128; p = 0.345		
Cu	**0.035**	**0.028**	0.268	**0.018**	0.641	0.485	**0.028**	**0.027**	0.128	**0.029**	**0.036**
		H = 7.408; **p = 0.025**				H = 6.437; **p = 0.038**			H = 6.737; **p = 0.034**		
Zn	0.479	0.372	0.372	0.734	**0.021**	0.720	**0.038**	**0.037**	0.270	0.740	0.250
		H = 1.373; p = 0.503				H = 7; **p = 0.03**			H = 1.648; p = 0.439		
Sr	0.358	0.516	0.424	0.712	0.571	0.512	0.183	0.094	**0.047**	0.762	0.345
		H = 1.54; p = 0.463				H = 2.24; p = 0.326			H = 6.05; **p = 0.049**		
Sb	0.519	0.224	0.746	0.248	0.480	0.480	**0.048**	**0.040**	0.176	0.808	0.302
		H = 1.788; p = 0.409				H = 6.141; **p = 0.046**			H = 1.991; p = 0.369		
Cs	0.667	0.681	0.685	0.773	0.307	0.289	0.564	0.255	0.052	**0.018**	**0.012**
		H = 0.21; p = 0.9				H = 1.61; p = 0.447			H = 9.9; **p = 0.007**		
Ba	0.083	0.675	0.426	0.703	0.105	0.089	**0.048**	0.155	0.781	0.225	0.197
		H = 0.053; p = 0.974				H = 6.112; **p = 0.047**			H = 1.684; p = 0.431		
La	0.133	**0.046**	**0.041**	0.386	0.130	**0.045**	**0.041**	0.307	0.091	0.544	**0.039**
		H = 6.278; **p = 0.043**				H = 6.141; **p = 0.046**			H = 6.275; **p = 0.043**		
Ce	**0.048**	0.685	0.685	0.386	0.414	**0.046**	**0.038**	0.343	0.176	0.587	0.097
		H = 0.391; p = 0.823				H = 6.475; **p = 0.039**			H = 2.31; p = 0.316		
Pr	**0.043**	0.165	0.246	0.106	**0.044**	0.157	0.248	0.543	0.108	0.674	0.071

		H = 0.716; p = 0.699				H = 1.84; p = 0.398			H = 3.681159 p = 0.1587		
Nd	**0.032**	0.208	0.226	0.386	0.540	**0.034**	0.053	0.073	0.094	0.875	0.121
		H = 0.246; p = 0.884				H = 5.97; **p = 0.051**			H = 3.29; p = 0.193		
Sm	**0.032**	0.417	0.146	0.248	0.535	0.289	0.248	0.556	0.105	0.853	0.097
		H = 0.94; p = 0.625				H = 1.84; p = 0.398			H = 3.29; p = 0.193		
Eu	**0.043**	0.064	0.087	0.328	0.838	0.289	0.232	0.643	**0.043**	0.396	**0.047**
		H = 0.744; p = 0.689				H = 1.84; p = 0.398			H = 6.112; **p = 0.047**		
Gd	0.133	0.685	0.113	0.248	0.540	0.089	**0.038**	0.243	**0.046**	0.822	0.197
		H = 0.378; p = 0.828				H = 6.475; **p = 0.039**			H = 6.141; **p = 0.046**		
Tb	0.086	**0.042**	**0.015**	0.128	0.414	0.089	**0.048**	0.343	**0.043**	0.716	0.107
		H = 8.229; **p = 0.016**				H = 6.051; **p = 0.049**			H = 5.967; **p = 0.05**		
Dy	**0.048**	0.385	0.187	0.248	0.221	0.128	**0.042**	0.720	**0.046**	0.628	0.057
		H = 0.378; p = 0.828				H = 6.05; **p = 0.049**			H = 6.395; **p = 0.041**		
Ho	0.086	0.771	0.372	0.473	0.540	0.359	**0.048**	0.643	0.053	0.828	0.067
		H = 0.011; p = 0.99				H = 1.42; **p = 0.049**			H = 3.758; p = 0.153		
Er	**0.043**	0.775	0.871	0.128	0.783	0.480	0.068	0.533	0.108	0.628	0.065
		H = 0.244; p = 0.885				H = 1.34; p = 0.51			H = 3.165; p = 0.21		
Tm	0.086	0.062	0.187	0.248	0.740	0.480	0.098	0.546	0.148	0.889	0.121
		H = 0.172; p = 0.92				H = 1.34; p = 0.511			H = 3.29; p = 0.193		
Yb	0.053	0.626	0.708	0.248	0.767	0.512	**0.037**	0.146	0. 51	0.808	0.302
		H = 0.599; p = 0.74				H = 6.522; **p = 0.038**			H = 3.548; p = 0.169		
Lu	0.086	0.111	0.181	0.386	0.844	0.724	0.248	0.494	0.128	0.840	0.097
		H = 0.083; p = 0.959				H = 1; p = 0.607			H = 2.794; p = 0.247		
Hf	**0.032**	**0.029**	0.292	0.563	0.414	0.562	0.091	0.147	0.399	0.467	0.121
		H = 7.335; **p = 0.026**				H = 1; p = 0.607			H = 1.592; p = 0.45		
W	0.519	0.716	0.372	0.423	0.556	**0.048**	**0.021**	**0.024**	0.612	0.220	0.079
		H = 0.637; p = 0.727				H = 7.336; **p = 0.026**			H = 0.732; p = 0.694		
Tl	0.378	0.042	0.746	0.564	0.683	0.157	0.265	0.064	0.838	**0.025**	**0.039**
		H = 0.744; p = 0.689				H = 4.2; p = 0.123			H = 6.467; **p = 0.039**		
Pb	**0.048**	0.082	0.081	0.264	0.093	**0.048**	**0.038**	**0.046**	0.615	**0.039**	**0.035**
		H = 0.117; p = 0.943				H = 6.144; **p = 0.046**			H = 6.467; **p = 0.039**		
Th	0.053	0.072	0.087	0.248	0.827	0.096	0.056	0.130	0.076	0.399	0.121
		H = 1.103; p = 0.576				H = 1.11; p = 0.574			H = 3.766; p = 0.152		
U	0.667	0.094	0.087	0.248	**0.044**	**0.046**	0.064	0.063	0.351	0.467	0.302
		H = 0.186; p = 0.91				H = 6.395; **p = 0.041**			H = 2.379; p = 0.304		

Table R2. Statistical differences of elements concentration between sites in peat soil solutions within different micro-landscapes. p-values are determined first by Kruskal–Wallis H-test and then by Mann–Whitney U test for each component.

Study site	Chemical elements, p-value is determined by Wilcoxon-Mann Whitney test																									
	DOC	DIC	Ca	Mg	K	Na	Si	Al	Fe	Zn	Li	Cu	Ni	Sr	Mn	Rb	As	Co	Cd	Pb	Ba	La	Nd	Yb	Th	U
Mound/polygon																										
Results of all site comparison on the mound/polygon for each component (Kruskal–Wallis H-test)																										
Kogalym Khanymey Pangody Urengoy Tazovskiy	H = 10.101 p = 0.039	H = 9.851 p = 0.043	H = 11.91 p = 0.018	H =10.07 p = 0.039	H = 23.109 p = 0.0001	H = 9.611 p = 0.048	H =11.59 p = 0.021	H =12.56 p =0.014	H =18.91 p =0.001	H = 9.768 p = 0.046	H =18.562 p = 0.001	H = 9.564 p =.048	H = 24.36 p = 0.0001	H = 9.795 p = 0.044	H = 33.17 p = 0.0001	H = 9.641 p = 0.047	H =10.94 p = 0.027	H = 31.91 p = 0.0001	H = 9.909 p = 0.042	H = 9.666 p = 0.047	H = 9.933 p = 0.042	H =1.395 p = 0.845	H =10.49 p = 0.033	H =10.11 p = 0.037	H = 9.658 p = 0.0466	H = 10.269 p = 0.036
Pairwise comparison of key sites for each component (Mann–Whitney U test)																										
Kogalym																										
Khanymey	**0.035**	0.315	**0.033**	0.516	**0.009**	**0.044**	**0.042**	0.277	**0.041**	0.461	0.074	0.646	**0.048**	0.570	**0.029**	0.052	**0.033**	0.746	0.256	0.570	0.224	0.626	0.212	0.516	0.516	0.57
Pangody	**0.028**	0.081	**0.012**	0.231	0.395	0.534	0.256	**0.018**	0.234	0.496	0.092	0.645	**0.017**	**0.011**	0.071	**0.032**	0.396	**0.017**	0.097	0.497	0.734	0.308	0.079	0.396	**0.049**	0.234
Urengoy	**0.043**	0.634	**0.047**	**0.028**	**0.033**	**0.053**	**0.023**	**0.047**	**0.034**	0.367	**0.044**	**0.045**	0.475	0.684	0.324	**0.034**	**0.034**	0.157	**0.048**	**0.034**	0.480	0.077	**0.031**	0.180	0.087	0.089
Tazovskiy	**0.047**	0.084	**0.026**	0.258	**0.018**	**0.048**	**0.021**	**0.021**	**0.025**	**0.047**	0.115	0.331	**0.045**	**0.045**	**0.01**	**0.042**	0.703	**0.011**	**0.011**	**0.048**	0.396	0.115	0.090	**0.042**	**0.039**	0.146
Khanymey																										
Pangody	0.061	0.253	**0.013**	**0.013**	**0.007**	0.067	**0.005**	**0.015**	**0.006**	0.794	**0.005**	0.731	**0.004**	**0.024**	**0.004**	0.143	0.243	**0.01**	0.113	**0.042**	**0.047**	0.559	0.516	0.330	0.144	0.746
Urengoy	**0.044**	0.084	**0.039**	0.117	0.387	**0.037**	**0.008**	**0.035**	**0.012**	0.748	**0.031**	0.702	0.104	**0.043**	**0.047**	0.138	**0.044**	0.363	**0.037**	**0.038**	**0.024**	0.662	**0.045**	0.473	0.299	**0.044**
Tazovskiy	**0.017**	0.076	**0.049**	**0.037**	**0.022**	**0.026**	0.612	**0.017**	**0.019**	**0.028**	0.089	0.612	**0.004**	**0.046**	**0.002**	0.316	0.075	**0.002**	**0.033**	**0.043**	**0.005**	0.394	0.073	**0.045**	**0.043**	0.374
Pangody																										
Urengoy	**0.047**	**0.045**	**0.039**	**0.046**	**0.014**	**0.033**	**0.016**	0.631	**0.014**	**0.041**	**0.014**	0.706	**0.041**	**0.024**	0.068	**0.021**	**0.023**	**0.014**	**0.033**	0.066	**0.043**	0.783	**0.031**	**0.061**	0.307	**0.036**
Tazovskiy	**0.016**	**0.036**	**0.039**	0.408	**0.004**	**0.021**	**0.028**	0.169	**0.044**	0.364	**0.002**	0.537	0.396	**0.048**	**0.001**	0.076	0.347	**0.043**	**0.045**	0.280	0.280	0.643	0.440	**0.044**	0.67	0.077
Urengoy																										
Tazovskiy	0.094	**0.048**	**0.031**	**0.039**	**0.047**	0.094	**0.030**	0.506	**0.009**	0.053	**0.009**	0.885	**0.048**	**0.038**	**0.009**	0.147	**0.014**	**0.014**	0.312	0.131	0.470	0.785	**0.041**	**0.030**	**0.573**	**0.014**
Hollow																										
Results of all site comparison in the hollow for each component (Kruskal–Wallis H-test)																										
Kogalym Khanymey Pangody Urengoy Tazovskiy	H = 12.709 p = 0.013	H = 9.889 p = 0.04	H = 9.984 p = 0.041	H =10.117 p = 0.039	H =12.937 p = 0.012	H = 9.871 p = 0.043	H = 9.865 p = 0.043	H =13.673 p = 0.008	H = 9.997 p = 0.041	H =10.235 p = 0.037	H = 10.01 p = 0.04	H =10.112 p = 0.037	H = 10.397 p = 0.034	H = 9.705 p = 0.046	H = 15.095 p = 0.005	H = 9.611 p = 0.048	H = 9.805 p = 0.044	H = 11.32 p = 0.023	H =15.728 p = 0.003	H = 9.716 p = 0.046	H =10.157 p = 0.038	H = 9.877 p = 0.043	H = 10.129 p = 0.038	H =10.072 p = 0.039	H =10.119 p = 0.039	H =10.071 p = 0.039
Pairwise comparison of key sites for each component (Mann–Whitney U test)																										
Kogalym																										
Khanymey	**0.022**	0.795	**0.049**	**0.035**	**0.036**	0.255	**0.024**	**0.041**	0.051	0.253	0.144	**0.045**	**0.044**	**0.022**	**0.034**	**0.045**	0.355	0.165	0.443	**0.045**	**0.042**	**0.043**	**0.034**	**0.045**	**0.045**	0.065
Pangody	**0.016**	0.343	**0.048**	**0.016**	**0.038**	0.643	**0.034**	**0.016**	**0.035**	**0.007**	0.143	**0.029**	**0.014**	**0.041**	0.155	0.096	0.305	**0.024**	**0.034**	0.355	0.065	**0.024**	**0.014**	**0.034**	**0.032**	**0.024**
Urengoy	**0.038**	**0.048**	**0.046**	0.064	**0.026**	**0.035**	**0.013**	**0.019**	**0.047**	**0.034**	**0.035**	**0.014**	0.147	**0.032**	0.095	**0.045**	**0.034**	**0.045**	**0.024**	**0.044**	**0.045**	0.243	0.443	0.355	0.165	0.443

Tazovskiy	**0.044**	0.379	**0.037**	**0.037**	**0.040**	**0.041**	**0.045**	**0.031**	0.055	**0.024**	0.570	**0.048**	**0.014**	**0.044**	**0.021**	0.570	0.245	**0.019**	**0.03**	0.612	0.092	0.093	**0.048**	**0.040**	**0.040**	0.343
Khanymey																										
Pangody	**0.028**	**0.046**	**0.035**	**0.046**	**0.037**	0.149	**0.021**	**0.036**	**0.016**	**0.025**	**0.021**	**0.024**	**0.048**	**0.038**	0.364	**0.048**	0.564	**0.021**	**0.039**	0.149	0.573	**0.033**	0.248	0.248	**0.033**	**0.032**
Urengoy	**0.021**	0.386	**0.045**	0.248	**0.026**	**0.048**	**0.035**	**0.021**	**0.019**	**0.046**	0.248	**0.020**	0.056	**0.047**	**0.021**	0.051	**0.021**	0.564	**0.021**	**0.021**	**0.043**	0.673	**0.048**	0.564	0.673	**0.049**
Tazovskiy	**0.037**	**0.026**	**0.042**	0.085	**0.023**	**0.048**	**0.041**	**0.026**	**0.048**	**0.047**	**0.045**	**0.046**	0.057	0.085	**0.008**	0.571	0.695	**0.038**	**0.014**	**0.048**	**0.048**	0.750	0.062	0.345	0.450	0.705
Pangody																										
Urengoy	**0.008**	0.752	**0.048**	0.248	**0.021**	0.03	**0.022**	**0.020**	**0.019**	**0.048**	**0.043**	0.051	**0.032**	**0.044**	**0.043**	0.564	**0.021**	**0.021**	**0.021**	**0.043**	**0.021**	**0.021**	**0.021**	**0.043**	**0.021**	**0.043**
Tazovskiy	**0.020**	0.449	**0.047**	0.055	**0.008**	0.014	**0.020**	0.185	**0.045**	**0.043**	0.245	**0.046**	**0.048**	**0.048**	**0.008**	0.105	0.624	0.145	**0.014**	0.571	**0.023**	**0.038**	**0.048**	0.571	**0.049**	**0.038**
Urengoy																										
Tazovskiy	0.128	0.386	**0.036**	**0.045**	**0.020**	0.257	**0.044**	**0.018**	**0.023**	**0.044**	**0.035**	**0.034**	0.185	0.051	**0.025**	**0.045**	**0.014**	**0.032**	0.631	**0.023**	0.605	0.186	0.059	**0.048**	0.186	0.250
Permafrost subsidence/frost crack																										
Pairwise comparison of key sites for each component (Mann–Whitney U test)																										
Khanymey																										
Urengoy	**0.045**	**0.048**	**0.046**	**0.046**	**0.034**	**0.044**	**0.047**	0.164	**0.045**	**0.040**	0.089	0.327	0.354	**0.022**	**0.042**	**0.03**	**0.034**	0.164	**0.022**	**0.033**	**0.03**	**0.048**	**0.044**	**0.033**	**0.048**	**0.03**
Tazovskiy	**0.046**	0.804	**0.036**	**0.044**	0.354	0.386	0.672	**0.035**	**0.046**	**0.025**	0.523	0.386	**0.043**	**0.048**	**0.01**	0.503	**0.026**	**0.02**	**0.043**	0.673	**0.043**	0.264	0.086	**0.048**	0.603	0.564
Urengoy																										
Tazovskiy	**0.036**	**0.035**	**0.044**	**0.036**	**0.038**	0.505	**0.026**	**0.042**	**0.016**	**0.036**	**0.046**	**0.016**	**0.046**	**0.026**	**0.006**	**0.018**	**0.016**	**0.016**	**0.048**	**0.026**	0.505	**0.036**	**0.024**	**0.03**	**0.036**	**0.026**

Specific comments of Reviewer # 2 (related to line number in the manuscript):

15 - "is one of the major consequences" currently unclear. Should be corrected as "…is expected to enhance under…"
16 - deepening not "rise" Agree
21 - "expected decrease" why would you expect the intensity of DOC and TE mobilisation to decrease? I think you need to provide a rationale for this hypothesis earlier on. We agree with this remark but it is hard to provide this information in the Abstract. As it is stated in L 347-352, "One can expect that dissolved element decreases its concentration in the peat porewater northward regardless of the micro-landscape due to *i*) decrease of the thickness of peat deposits in total and the active soil (peat) layer in particular (Beilman et al., 2009; Novikov et al., 2009: Stepanova et al., 2015) which decreases the amount of peat interacting with downward penetrating fluids; *ii*) decrease of plant biomass (Frey and Smith, 2007), which diminishes the amount of plant litter that can release the elements (Pokrovsky et al., 2006; Fraysse et al., 2010), and also decrease the plant ability to weather minerals within the soil profile (Moulton et al., 2000); *iii*) shortening the unfrozen period of the year leading to the decrease of the residence time of water in soil pores and *iv*) overall decrease of the intensity of chemical weathering, CO2 consumption and riverine fluxes with mean annual temperature decrease (Dessert et al., 2003)".

27 - Need to define REEs on first use. What does this stand for (rare earth elements?) and what are you including in this group? actual values ? The rare-earth elements (REE) include all naturally occurring lanthanides except promethium.

33-36 "will not exceed 20%" actual values - do you mean they will not change from current values? - Yes, we do not expect any significant change from current values.
55- misspelt arctic - Agree, will be corrected
65-67 - please check these references with what you are referring too. For example, I do not think Mann et al 2015 examines lakes or Vonk et al. 2015b soil leachates? - We totally agree and thank the reviewer for this remark. Indeed, Mann et al examined rivers, not lakes. We also corrected the reference of Olefeldt et al and that of Vonk et al. 2015a, not 2015b.

Also, if you are discussing soil porewaters, you should likely include: "Optical properties and bioavailability of dissolved organic matter along a flow-path continuum from soil pore waters to the Kolyma River mainstream, East Siberia Frey et al. Biogeosciences" Thank you very much for this valuable reference, which we have missed in our analysis!

General - should be consistent with use of either trace element or TE throughout. - Agree and corrected accordingly to "TE" in the main text.

82 - elements replaced to TE
86 - "feeding of" is awkward, maybe use "source to" Agree with this suggestion
87 - reference needed for this statement. - Added Novikov et al. (2009)
152 - its not clear to me where you used the ANOVA in the results - maybe I missed it? Following the recommendation of this reviewer, we performed the non-parametric Kruskal-Wallis test which is suitable for our multi-component data set, as presented above.

158-162 Here is where I think we need far more info on the approach used in the PCA. We agree and greatly extended this part of the text as following:
"The PCA analysis allowed to test the influence of various parameters, notably the latitude and the ALT on the soil porewater DOC and element variability. All the variables were normalized as required in standard package of STATISTICA-7 (http://www.statsoft.com) given that the units of measurements of various components are different. The identification of factors was

performed using the method of Raw Data and the extraction method was principal component. The scree test involved plotting the eigenvalues in descending order of their magnitude against their factor numbers and determining where they level off. The PCA values demonstrated significant decrease of the value between F2 and F3 suggesting therefore that at least two factors are interpretable.”

161 - I don’t think it really acts upon (as this suggests its constrained in some way) rather it ‘explains’ a greater variance in. - Agree and corrected accordingly

162 - Need more information here on how you used the PCA to test the influence of lat and ALT on DOC and TE.
We used factor analysis to better understand the data via distinguishing the cluster structure, separation of data sets on similar groups and identifying the groups of elements exhibiting similar distribution pattern. For this, we run the Factor Analysis, Principal Components and Classification Analysis. For determination of the number of variables used for evaluation of element concentration pattern in the data sets and computing the degree of similarity between the elements we used the Cluster Analysis.

Were you planning to relating the PC loadings or running constrained PCAs?
This is certainly very good idea. Running the CPCA (i.e., Yoshio Takane «Constrained Principal Component Analysis and Related Techniques») which combines both regression analysis and PCA could provide new view of the multi-componential soil pore water data; unfortunately, we could not realize this approach on our software resources. We do plan to run such analysis using MATCAD and simultaneously analyze, across the same latitudinal profile of the WSL, soil solutions (this study), atmospheric aerosols (Shevchenko et al., 2016 HESS in review), river water (Pokrovsky et al., 2016b), lake water (Manasypov et al., 2014, 2016) and peat elementary composition (Stepanova et al., 2014). However performing such a comprehensive analysis goes beyond the scope of the present work.

168 - Did you normalize and standardize each of the measurements? This can have a dramatic effect upon PCA loadings and the potential weighting effects of each measurement. The identification of factors was performed using the method of Raw Data and the extraction method was principal component. All the variables were normalized as necessary in standard package of Statistica-7 given that the units of components are different. The variation method was Varimax Raw because it efficiently minimizes the number of variables having high factor loading.
We have also attempted Principal Components and Classification Analysis. The PCCA yielded the same factor structure but less representative dispersion diagram as shown below in **Fig 2R**.

169 - I don’t think it really acts upon (as this suggests its constrained in some way) rather it ‘explains’ a greater variance in. - Agree and corrected accordingly.

173-176 - Does this mean all of the these were significant to «0.05 and have greater R value of > 0.5? - Yes, this is true.
In associated supplemental – can you example what the colored arrows on this plot refer to? The colored arrows on this plot refer to 6 different group of elements.
and what W stands for? W stands for tungsten. It does not exhibit any clear link to other elements. We interpret this behavior as due to important atmospheric loading of W, Cd and B as confirmed by mass balance analyses of atmospheric snow deposition in the WSL (Shevchenko et al., 2016). As a result, these elements are not influenced by intra-soil processes and not affected by mobilization either from peat or from underlying mineral deposits.

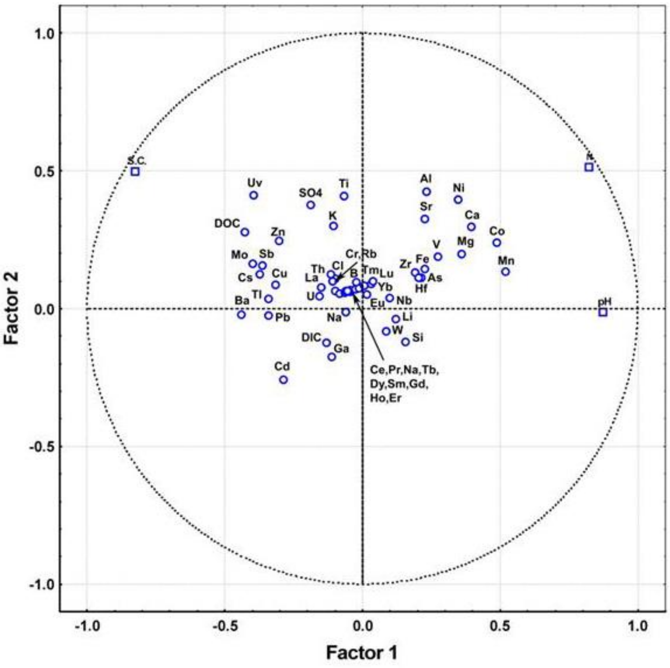


Fig. 2R. Element dispersion diagram using Principal Components and Classification Analysis.
`Eigenvalues: 3,02341  1,29455  1,07612  ,955973  ,860014  ...`

206 - this is unclear to me. So you did separate tests for each possible site? I think you should run one capable of testing for overall differences first and then examining significant differences. This is exactly what has been done. We understand that the reviewer is confused. The way it was written in original text was unclear. We revised this sentence as following: “In order to examine the latitudinal trend of element concentration in the porewater, first we run the Wilcoxon-Mann Whitney and Kruskal-Wallis tests for overall differences. After that we assessed, which micro-landscape exhibited the largest difference between sites.”

216 - So why show linear regressions? I would only add these if there is are significant differences between at least the two end member sites. Adding them to all of the graphs just makes its harder to see the values and error bars. We totally agree and revised Fig 3, 4, 5, S4 and S5. We kept only the correlations that were statistically significant and removed all the lines and equations in the plots where no statistically significant link between the element concentration and latitude was observed. The revised figures (3, 4, 5, S4 and S5) are given in the end of this reply.

Fig S3 figure text needs an explanation of the circled areas of A. Two circled areas on Fig S3A correspond to two factors separated by PCA treatment. The first factor explains a greater variance in heavy element hydrolysates such as REEs, Cr, Nb, Zr, Hf, Th and U whereas the second factor was pronounced for soluble and biogenic elements (Mn, Co, Ni, V, Si, Ca, Mg, Sr), pH and latitude but also included Al and Fe, presumably due to organic complexation.

Also, are both not containing the same explanatory variables and neither showing site loadings? The PCA loading map is shown in Fig. S3 B. We did not completely understand this question.

228 - does this mean that R-values varied between these? This way of showing the range is unusual to me. Yes, the R- values ranged from 0.45 to 0.62 which signifies statistically significant correlation and that is what we aimed to illustrate.

243 - were these also SUVA 280? As most studies use SUVA at 254 nm. The UV absorbance of the filtered samples was measured at 280 nm using quartz 10-mm cuvette on Cary-50 spectrophotometer. The specific UV-absorbency at 280 nm ($SUVA_{280}$, L $mg^{-}1m^{-1}$) is used as a proxy for aromatic C, molecular weight and source of DOM (Uyguner and Bekbolet, 2005; Weishaar et al., 2003; Ilina et al., 2014 and references therein). The main reason of using $SUVA_{280}$ instead of $SUVA_{245}$ or $SUVA_{254}$ in the present study is for consistency with numerous previous measurements of lakes and rivers in western Siberia (Shirokova et al., 2013; Manasypov et al., 2015, 2017; Pokrovsky et al., 2015) and permafrost-draining rivers in Central Siberia (Prokushkin et al., 2011). More importantly, there is a strong and linear relationship between the absorption at various UV-range wavelength in western Siberian surface waters as shown in **Figure 3R** below. Overall, we believe that the $SUVA_{280}$ can adequately represent the optical properties of DOM in WSL peat porewaters.

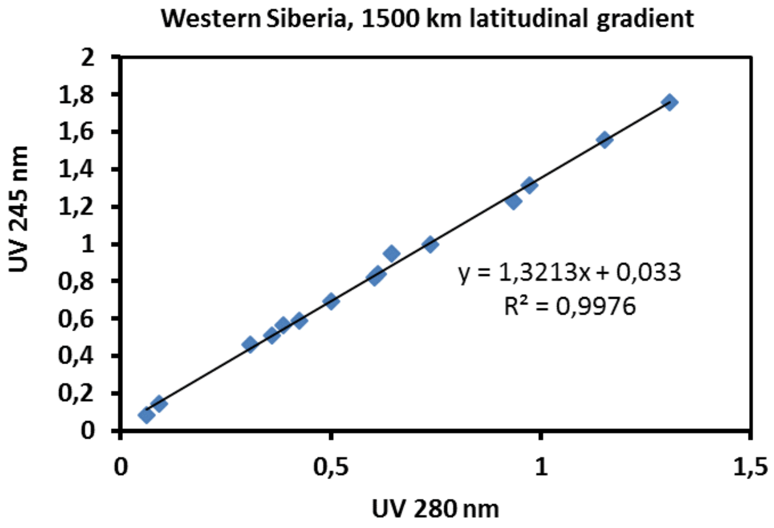


Fig. 3R. A linear correlation ($R^2 = 0.998$) between UV absorbency at 245 and 280 nm in surface waters of WSL rich in DOC.

249-256 - I think a range of 2 to 3.5 for SUVA is actually very large. For SUVA 254 for example, we may only expect a natural variation of between 1.5 to 5.5 in pore to coastal waters (in Eastern Siberian freshwaters). A change from 2 to 3.5 demonstrates a significant shift in the composition of the DOM and will have a pronounced effect upon the biogeochemical processing of DOM upon export. Here, we totally agree with the reviewer that the change of SUVA from 2.4 to 3.4 in hollows shown in Fig 4A demonstrates a significant shift in the composition of the DOM and may have a pronounced effect upon the biogeochemical processing of DOM upon export and we thank the reviewer for pointing out important findings of Frey et al. (2016) which will be cited in the text.

Leachates of permafrost and active layer peats will also demonstrate clearly that SUVA254 at least id much lower in permafrost material across at least most parts of Siberia and Alaska that have been studied. Would the values you have collected not simply be indicative of collecting waters predominately sources from active layer soils and limited permafrost thaw influence? We also agree with this proposition. However, the analogy between relatively “fresh” peat soil of Western Siberia (1-2 ky) and old organic matter (8-12 ky) in yedoma of Eastern Siberia is not straightforward.

Could the higher SUVA further North not instead be suggestive of lower rates of C processing within soil environments? Yes, statistically significant increase of $SUVA_{280}$ northward in hollows ($R^2 = 0.599$, see Table 3) may indicate the lower rates of DOM processing in soils in the north, linked to either shorter residence time of soil fluids or weaker processes of photo- and bio-degradation in continuous permafrost zone compared to sporadic and discontinuous zone.

399 - "incoming into" may be instead "prior to export to" Agree and corrected.

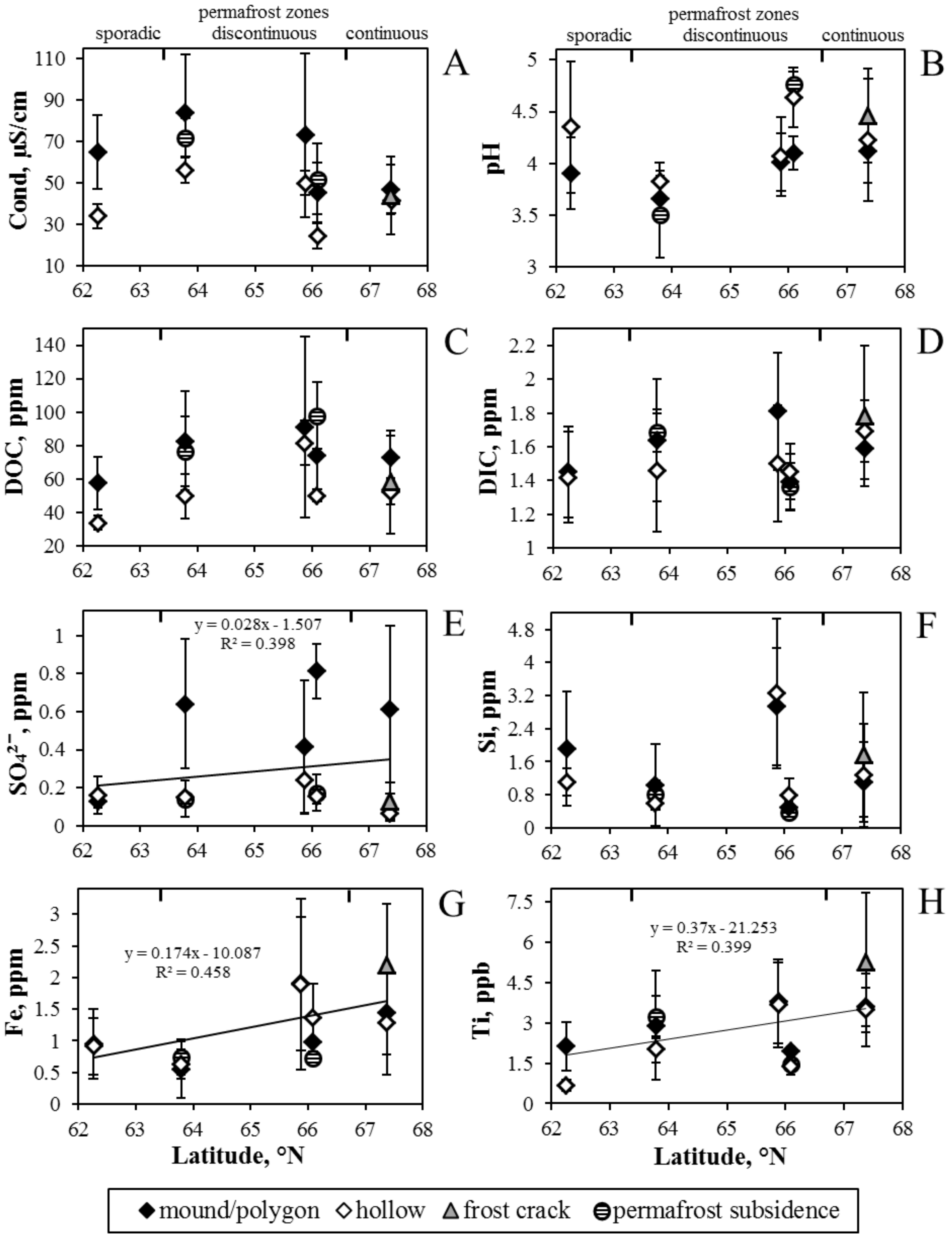


Figure 3. Mean values of Specific conductivity (A), pH (B), DOC (C), DIC (D), SO_4^{2-} (E), Si (F), Fe (G) and Ti (H) in peat porewaters of the WSL as a function of latitude for mound and polygons (solid diamonds), hollow (open diamonds), frost crack (grey triangles) and permafrost subsidence/depression (hatched circles). The solid line is a linear fit to all data with the regression equation given on each graph.

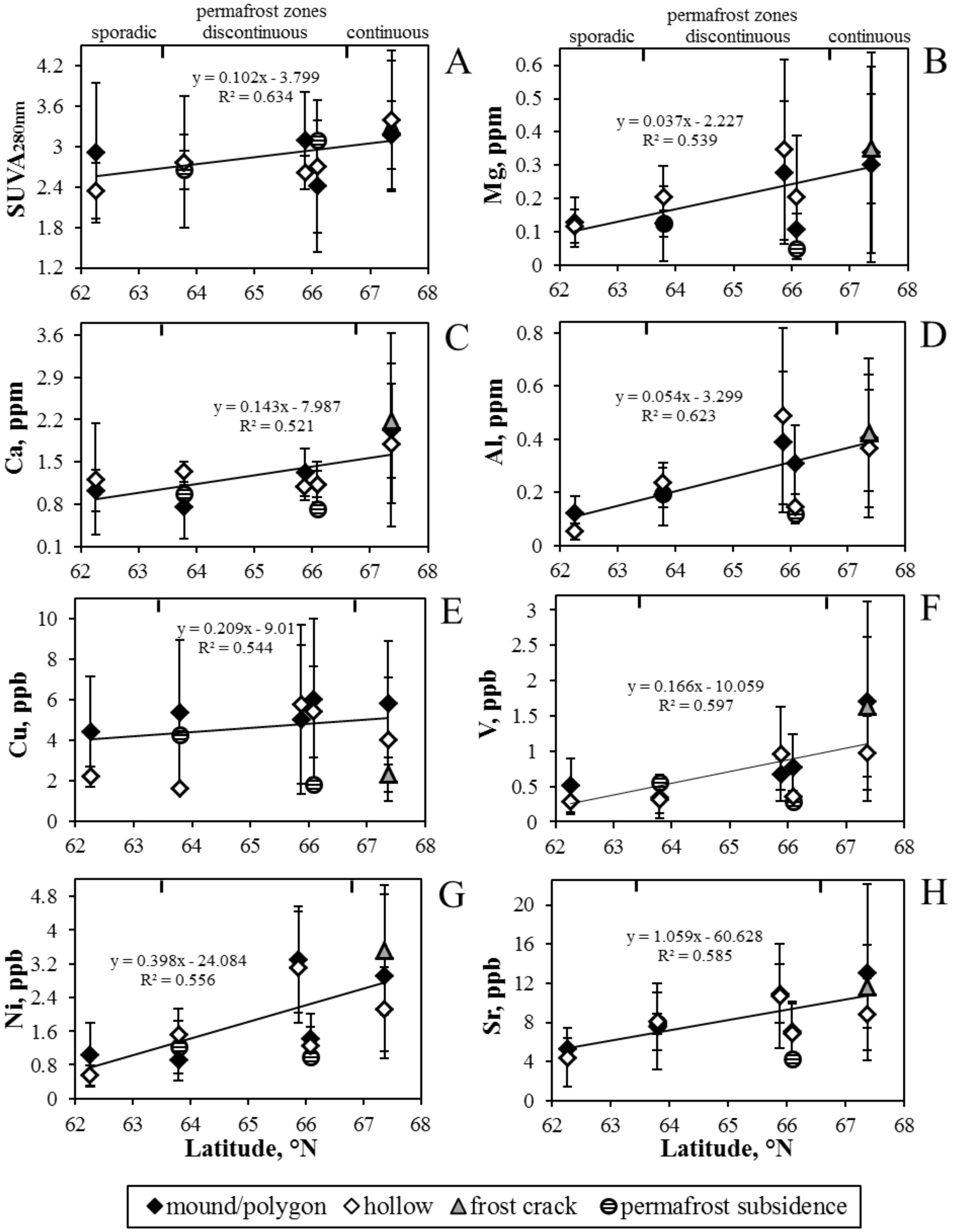


Figure 4. Mean values of SUVA280 (A), Mg (B), Ca (C), Al (D), Ti (E), V (F), Ni (G) and Sr (H) in peat porewaters of the WSL as a function of latitude for mound and polygons (solid diamonds), hollow (open diamonds), frost crack (grey triangles) and permafrost subsidence/depression (hatched circles). The solid line is a linear fit to all data with the regression equation given on each graph.

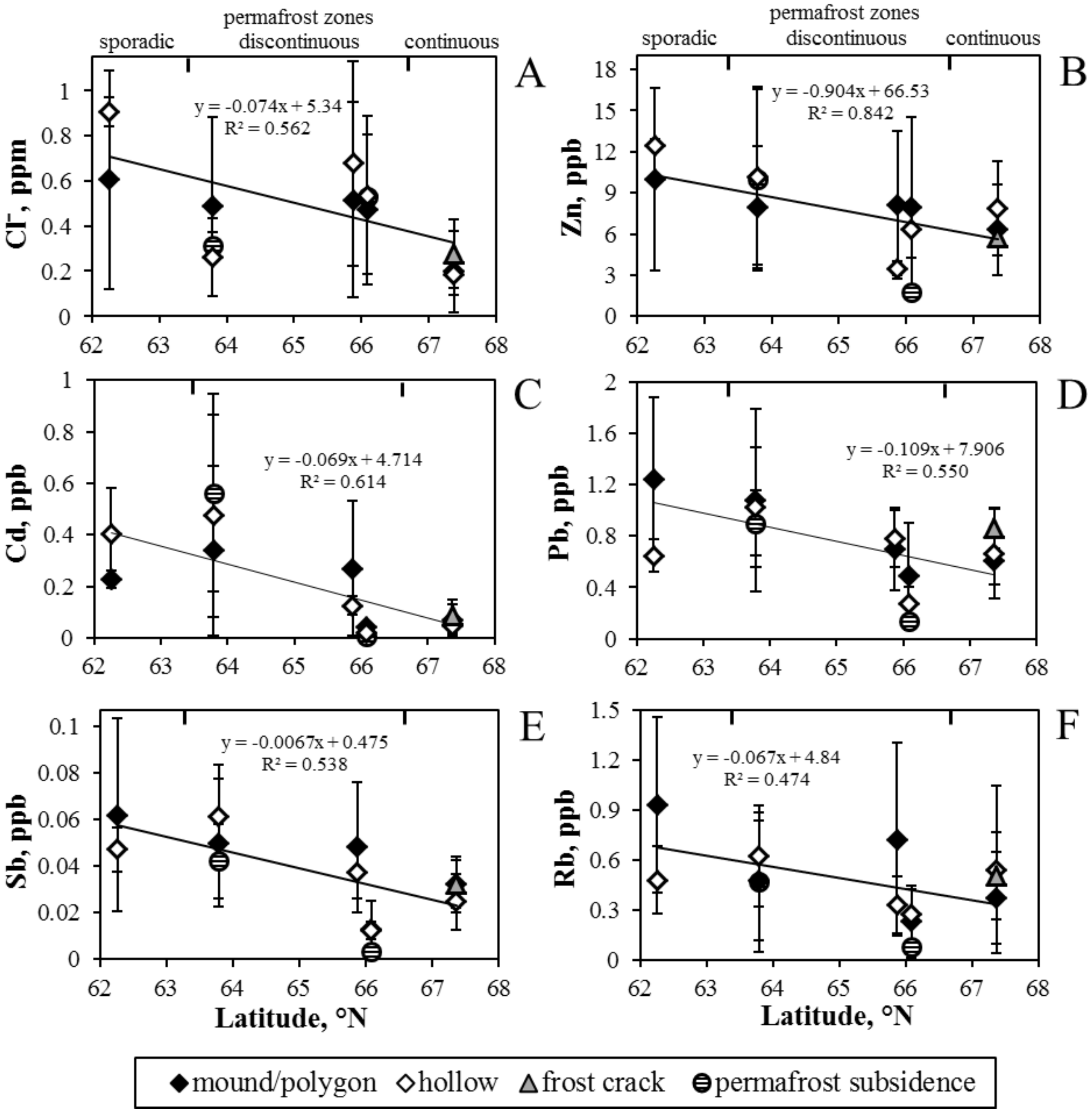


Figure 5. Mean values of Cl (A), Zn (B), Cd (C), Pb (D), Sb (E) and Rb (F) in peat porewaters of the WSL as a function of latitude for mound and polygons (solid diamonds), hollow (open diamonds), frost crack (grey triangles) and permafrost subsidence/depression (hatched circles). The solid line is a linear fit to all data with the regression equation given on each graph.

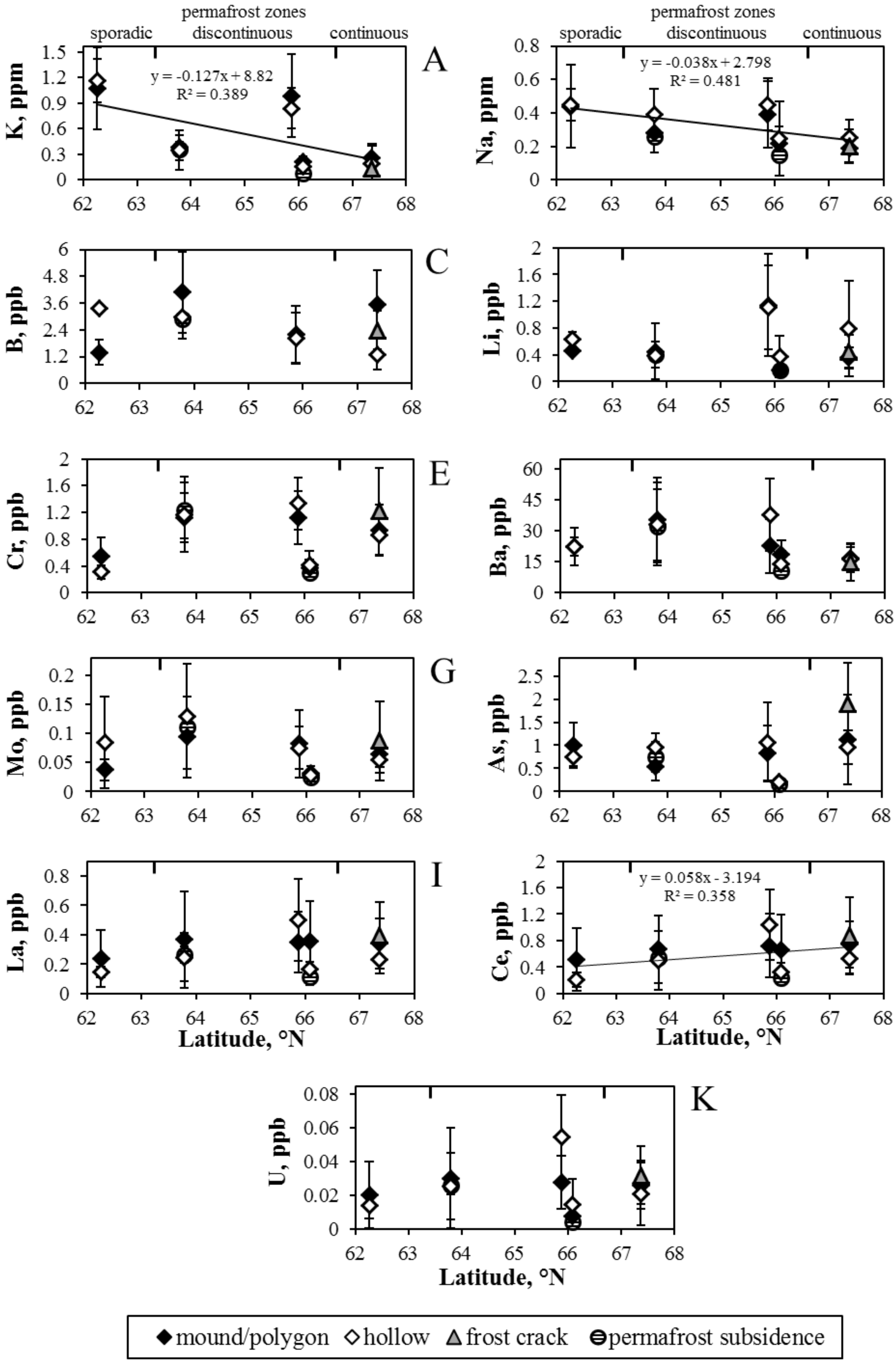


Figure S4. Mean values of K (A), Na (B), B (C), Li (D), Cr (E), Ba (F), Mo (G), As (H), La (I), Ce (J), U (K) in peat porewaters of the WSL as a function of latitude for mound and polygons (solid diamonds), hollow (open diamonds), frost crack (grey triangles) and permafrost subsidence/depression (hatched circles). The solid line is a linear fit to all data with the regression equation given on each graph.

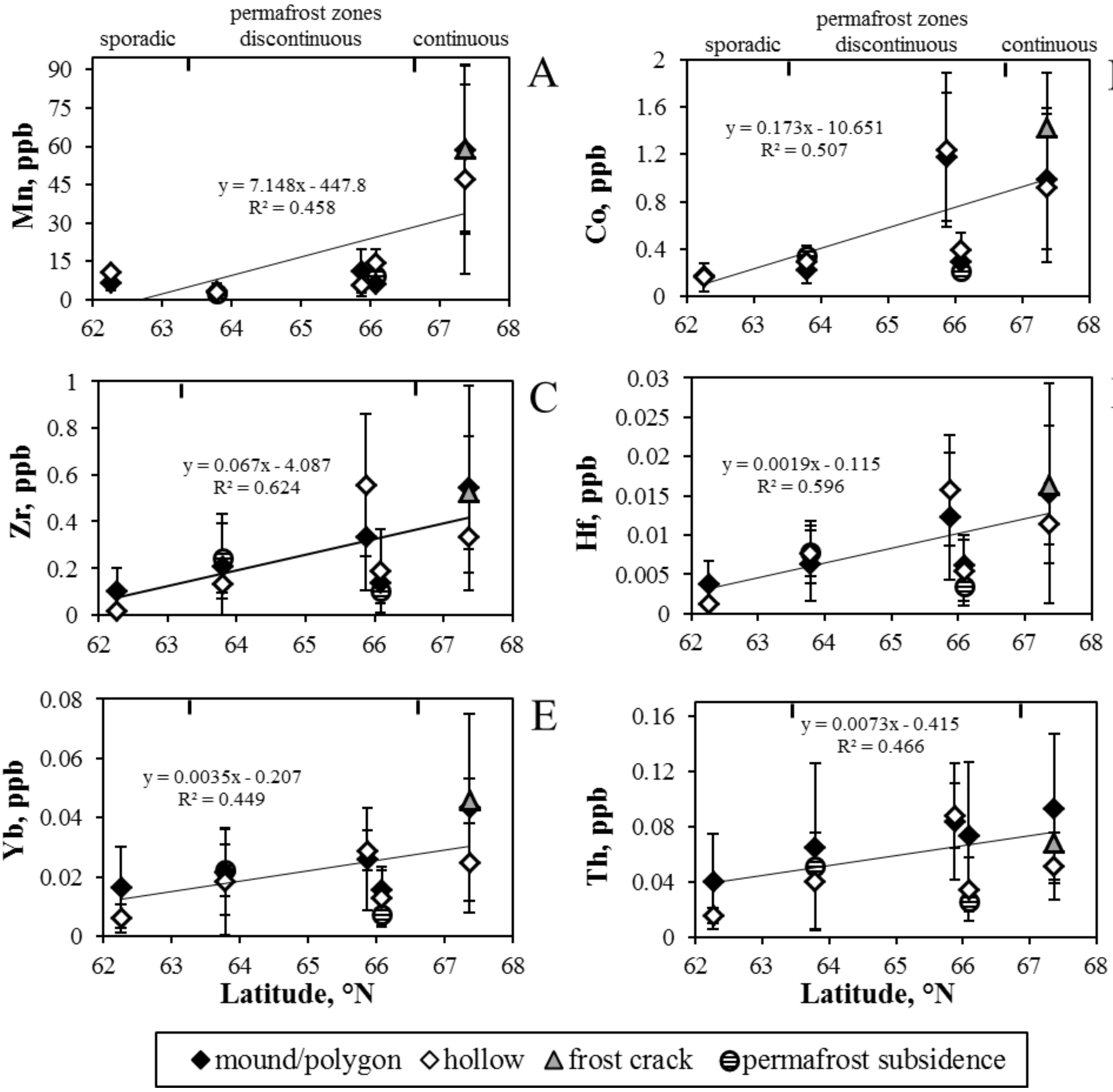


Figure S5. Mean values of Mn (A), Co (B), Zr (C), Hf (D), Yb (E), Th (F), Cs (G) in peat porewaters of the WSL as a function of latitude for mound and polygons (solid diamonds), hollow (open diamonds), frost crack (grey triangles) and permafrost subsidence/depression (hatched circles). The solid line is a linear fit to all data with the regression equation given on each graph.