Factor analysis interpretation of Geochemical Atlas of Europe data

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Factor analysis was performed on the analytical results of different sample media of the FOREGS-EuroGeoSurveys "Geochemical Atlas of Europe" baseline project (http://www.gtk.fi/publ/foregsatlas/). It was found that the element associations for solid media (subsoil, topsoil, stream sediment and floodplain sediment) are very similar, whereas the pattern for stream water is completely different. This reflects differences in the mode of geochemical dispersion. In each case, the factor structure is little affected by the statistical procedure, indicating that the factors are rather robust.

In the solid media, over 60 determinands are reduced to 7 factors. Straightforward geological explanations can be given for factor 1 (rare earth and alkaline elements), factor 2 (mafic and ultramafic rocks), factor 4 (elements of felsic rocks), factor 5 (carbonate versus clastic silicate rocks), and factor 7 (siliciclastics and especially zircon). Factor 3 is related to grain size and inversely to sodium, with Fennoscandia standing out as a region with Na_2O rich rocks. Factor 6 groups sulphur, phosphate, total organic carbon and several chalcophile elements typical of human pollution, such as Cd, Hg and Pb. The relative importance of these factors varies, and some interesting differences are apparent between the different solid media. Factors 1, 2 and 4 account for the largest part of the variance and show the most stable patterns.

The factor analysis interpretation of stream water data shows a completely different picture. Factor 2 is related to the general mineralisation of stream water, i.e. all major ions (Cl, SO_4, HCO_3, Na, K, Mg, Ca, Sr, etc.) have high loadings. Factor 1 is related, among others, to REE, Al, Fe, Zr and dissolved organic carbon, and inversely to pH; it groups acidic samples of low mineralisation, especially well represented in Fennoscandia. Factor 3 groups chalcophile elements such as Pb, Zn, Cd and Cu, and seems to be related to anthropic contamination. Influence of geological substrate is apparent in factors 4 (alkaline rock elements), 5 (W and Mo), and 6 (ultramafic versus felsic elements). Factor 7 is related to Mn, Fe and dissolved organic carbon, and factor 8 to elements such as I, Br, Na and Cl, influenced by salinisation through sea water, saline aquifers, or in the case of the southern Iberian Peninsula, deficient drainage in an arid climate. Factors 1 and 2 carry most of the total variance.

Dust and aerosol pollution from stationary man-caused sources in Novosibirsk city: Geochemical aperiodicities and numerical models

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The main sources of the air pollution in Novosibirsk besides transport are thermal power stations and plant facilities. In the winter time dust which they supplied are accumulated in blanket of snow. In that case, study and estimation aerosol pollution can base on snow survey data.

Snow sample was taken in the regions with man-cased pollution sources and in the regions without it for estimation of background. The level of pollution from each specific anthropogenic source was evaluated by ration average element concentration to average background value of this element. Thus for each element of considering man-cased source pollution level coefficients were calculate.

Concentrations of all analyzed elements in suspended part of snow samples in regions of Novosibirsk thermal power stations № 2 and №3 exceed background values at least at three times. The top concentrations in this region observed for Sb, Ge, Sn, Br, Cd, they are in 10-40 times more then background ones. In the region of Novosibirsk thermal power station № 5 in suspended part of snow samples predominate Br, Se, Mo, I, Sb, Sr. The list pollution level coefficients has Cr and Pb. Differences in emissions chemical composition enplanes various fuel types, thermal power stations № 2 and №3 used Kuznetsk bituminous coal, but heat power plant № 5 used mainly mazut, that verify high Br concentration in it emission.

In suspended part of snow samples in regions of Novosibirsk tin plant observed huge amount of Sn, it concentration in 255 times more then background ones, As - 166 times, Se – 68 times, Cd - 54 times, Sb – 12 times.

Solving inverse task of aerosol transport estimation was applied for forecasting pollution distribution from stationary source. It's allow to aggregate parameters which can't be measured (turbulence, particles deposition velocity and est.) and estimate they using natural measuring of pollution concentration in snow blanket.