9. Summary

Atmospheric aerosols carrying ecotoxic trace elements play an important part for environmental pollution. Pollutants such as sulfur compounds as well as persistant organic pollutants are transported over long distances into less polluted areas far away.

The aim of this thesis is to determine the source of aerosols transported by southeasterly winds into the German Bight. These aerosols are characterized by high arsenic concentrations. To examine the aerosol transport a two-year-study was performed sampling aerosols at four monitoring stations from July 1994 to June 1996. A low-volume-sampling-system, driven by wind direction, was installed on a platform in 175 m height of a radio tower in the south-east of Hamburg to collect aerosols transported by southeasterly winds before being mixed with emissions from Hamburg. At the same time high-volume-samplers were run at the other three sampling stations, Itzehoe, Westerhever and Heligoland, forming an axis from Hamburg into the German Bight. Aerosol was collected for two weeks respectively one week. Altogether, 1500 samples were obtained. As southeasterly winds were mainly observed during winter only samples taken in winter were analysed by atomic spectroscopy after acid digestion.

Averaged concentrations of trace elements are nearly the same at all three high-volume sampling stations. Results of earlier investigations at Westerhever and Heligoland by KRIEWS (1992) show similar concentrations for the trace elements. Only earth and seaspray elements display lower concentrations. In winter 1995/96 dominated by southeasterly winds the station nearby Hamburg, Itzehoe, shows higher concentrations of trace elements because of the influence of the largest copper smelting facility in Europe, the Norddeutsche Affinerie in Hamburg.

By using the distribution of the local wind direction elemental concentrations for selected wind sectors are able to be calculated from the weekly concentrations. The highest concentrations for trace elements are found in the sector for southeasterly winds. This sector contributes 30-45 % to the average concentrations of the trace elements at each station, even though southeasterly winds only occur 25 % of the time. Arsenic shows the highest contribution of the trace elements (45 %).

Aerosols transported from the southeast are characterized by low element/As-concentration ratios as found by STEIGER (1991). In winter 1995/96 low ratios were obtained at all three monitoring stations when the wind was mainly blowing from the southeast (> 30 %).

Therefore, a general elemental profile for southeasterly aerosol transport could be obtained from these cases.

To determine the source region of southeasterly aerosol transport, this elemental profile was compared to others from various highly industrialized regions in East Europe, for example the so-called middle German region between Halle and Leipzig, Upper Silesia in South Poland and Northern Bohemia in the Czech Republic. As a result of this comparison, the elemental profile of aerosols transported by southeasterly winds is consistant with those ones from the so-called Black Triangle Region. This region was named after the lignite deposits and the damages to ecosystem, which were caused by coal mining during the last decades. The Black Triangle is located on the borders of Germany, Poland and the Czech Republic and compromises the southern part of Saxony in Germany, the south-western part of Lower Silesia in Poland and Northern Bohemia in the Czech Republic.

The source of the high arsenic concentrations can be confirmed by comparing the elemental profile from the southeast with those for coal burning and copper smelting obtained from STEIGER (1991). It is consistant with coal-burning, but not with copper smelting. As a conclusion the burning of lignite for producing energy is the specific source of the high arsenic concentrations because lignite from the mines in Northern Bohemia and Western Lower Silesia contains high amounts of arsenic, up to 1500 mg/kg. Up to now, papers dealing with this problem had suggested copper smelting as the main source of arsenic pollution in Europe.

Comparing elemental ratios is an easy, but powerful tool for the identification of aerosol sources. The key to this method is to obtain a characteristic elemental profile from the receptor by using a marker element and comparing it to the elemental profile of the suspected source. In this case the marker element is arsenic. This characteristic elemental profile is then used as the fingerprint of the source region. This tool is easier to handle than other ones like statistical analysis or transport models. It allows a direct comparison of elemental concentration at the receptor site and the source region.