ECOLOGICAL SEASONS IN THE HIGH ARCTIC (NW-SPITSBERGEN) DETERMINED BY TEMPORAL VARIATION OF STREAMWATER CHEMISTRY AND ITS SOURCES WITHIN THE CATCHMENT*

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INTRODUCTION

The University of Basel took part in all the three field campaigns of the Geoscientific Spitsbergen Expedition to Liefdefjorden during 1990-1992. This multi- and interdisciplinary project was connected to the larger programme PONAM of the European Science Foundation (EFS) and was titled "Land to Sea Sediment Transports and Material Fluxes in Polar Geosystems". Seventeen geo-and bioscientific institutes from Germany, Norway, and Switzerland were involved in this programme. Some results from the working groups were published in Blümel (ed 1992, 1994). Combined results of all research teams will be published in a synthesis-like study. For the Basel approach of research, compare Leser (1991, 1993).

THE STUDY AREA

The base camp was located on the south shore of the Liefdefjorden at almost 80°N (13°E) and within the investigated (approx.) 5 km² drainage basin of the Kvikkåa, which drains into the fjiord. The catchment is partly glacierised (approx. 35 %, Barsch et al. 1994) and the elevation rises up to 840masl. Because of the influence of the gulfstream, the climate has to be characterised, despite the high latitude, as mild.

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THE FIELD WORK

The Basel research group for landscape ecology (led by Prof. H. Leser) started the fieldwork in mid May, to be there in time for the slush (initial snowmelt), and stayed until the end of August, the end of the ecologically relevant season. The field work was carried out during the years from 1990 to 1992.

Discharge was measured by means of flow meters and tracer dilution from the research group of Heidelberg. Data for discharge and detailed discription of methods are published in Barsch et al. (1993) and are briefly outlined below.

ISCO 2700 sampler for stream water sampling (chemistry), sample interval 210 min

Suction cups (ceramic, Soil moisture Corp. CA) for soil water extraction, sample interval 48 hours

Temperature corrected conductivity and pH (K_{25}:WTW LATI) and NO_3^-, NH^+ and PO_4^{3-} (photometer) were measured directly in the field laboratory. All samples were stabilised by adding 1 Vol % HNO_3 sp. and stored until analysis in prewashed polyethylene bottles and at c. 2 °C in the dark. Cations and anions were run at the University of Basel, Department of Geography. For detailed information on the analytical methodology and precision for ions, see Potschin (1995) or Potschin and Leser (1994).

RESULTS

Field studies were conducted to examine the environmental factors which influence or control ion composition and amount. Specially, these studies focussed on variations in solute chemistry during the high arctic seasons. In all three years, a significant seasonal pattern in the discharge and solutes can be recognised and divided into five distinct phases. The highest values of electrical conductivity (>100mS/cm) and concentrations of various ions are measured in the first part of phase I (first snow ablation phase = slush), while the lowest (30-50 mS/cm) appear in phase IV, the so-called "ice-melting (ablation) phase".

The hydrograph of the Kvikkåa responds directly to changes in melting energy input to the catchment (Scherer 1994) and therefore peaks can be related to the melting of snow, ice, and permafrost. The following figure demonstrates a typical seasonal trend for the discharge and conductivity of the Kvikkåa runoff, which represents all the three years (compare Fig.1). The electrical

conductivity here is acting as one example of the streamwater chemistry and should not been seen as the sum of all analysed ions as most of the time its values are below 100 [mS/cm].

The presentation will concentrate on the results of the ecological seasons. The single phases and sources of water and its chemistry throughout the catchment will be discussed on the basis of detailed data.

FURTHER PREDICTIONS

This investigation at 80°N was carried out to study the ecological parameter in detail, to finally develop a model for material flux in a so-called "black box" (quasi-closed system). The study area was selected as an example of a landscape not influenced by human beings. The results of this study, therefore, set a zero-variant for further studies. The consequences climate warming will have on the introduced ecological seasons will be discussed. Comparison of this study with similar studies in the Swiss Alps are under investigation (compare Döbeli, C., this volume).

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Figure 1. Seasonal distribution of discharge [l/s] and electrical conductivity [mS/cm] for the Kvikkåa runoff. "I" to "V" represents distinct phases determined by the Spearman regression