



# Taste and chemical safety of drinking water as a function of aquifer geochemistry and land use.

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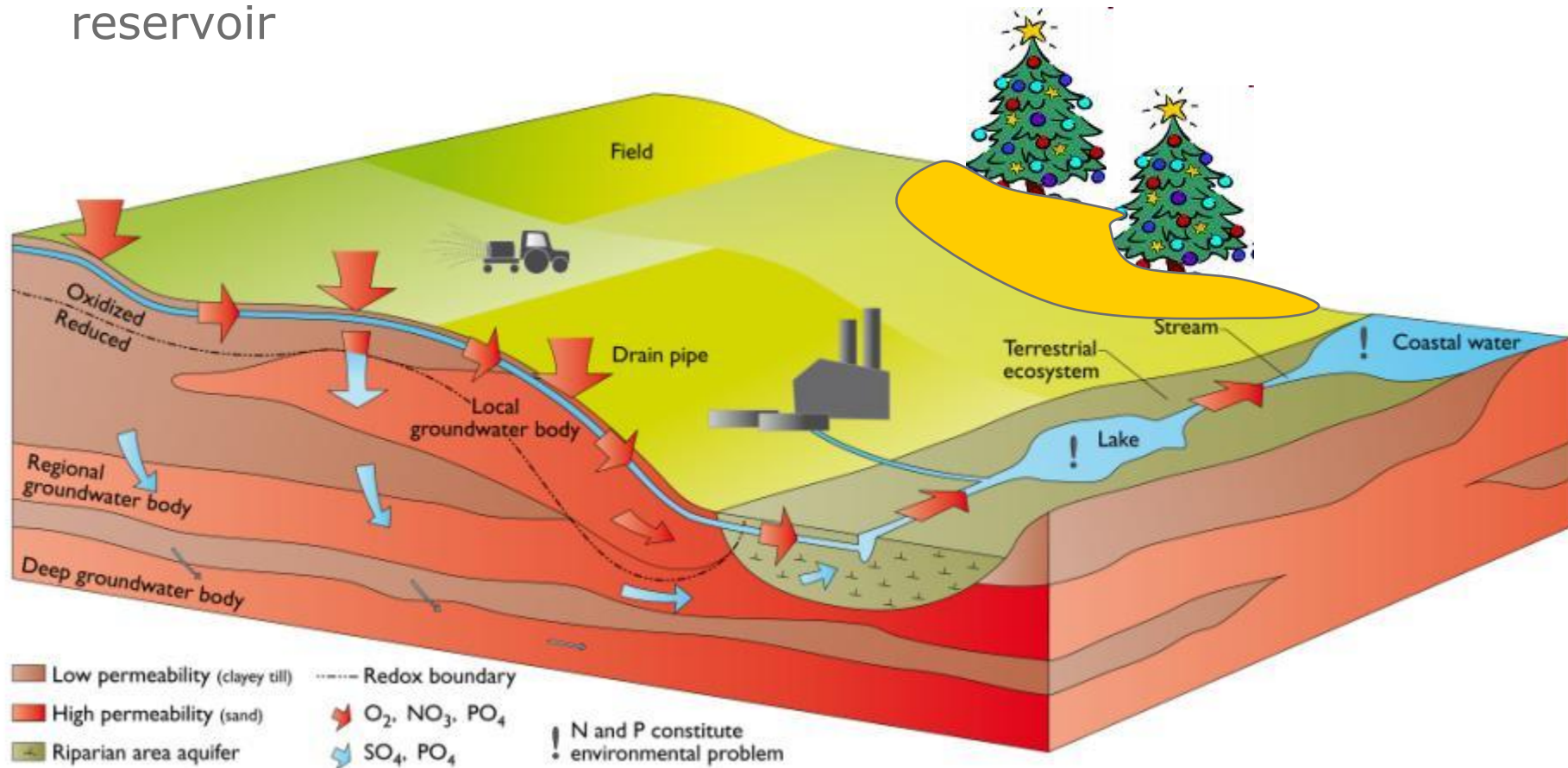
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# The research idea

Land use will influence the discharge of natural and anthropogenic substances and their transport to ground water reservoir



# Why focus on the taste of water?

The water sector has focus on consumer satisfaction and most consumer complaints are related to bad taste qualities of tap water.

The consumption of bottled water is increasing worldwide due to:

- Lack of trust in the quality of tap water
- Marketing of bottled water as specially healthy, tasty and trendy

The bottling and transportation of water add an unnecessary stress to nature and high costs for the consumer.

Relatively little is known about taste preferences for drinking water.



# What is taste?

## Basic tastes

Salty  
Sour  
Sweet  
Bitter  
Umami  
Fatty

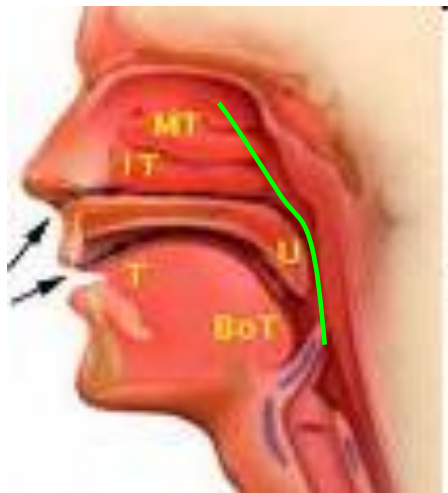
## Tactile sensations

Astringency  
Mouth watering

## Irritation/pain

Chemical (e.g. CO<sub>2</sub>)  
Temperatur-related

## Odor



## Conceptual quality attributes

Freshness, Harmonic, etc.

# What is known about the taste of water?

The focus within research of water taste has been more on off-taste than on good taste qualities.

Good tasting water has been perceived as water free from off-taste.

Off-tastes in water are often due to odor.

A taste and odor wheel describes known tastes and odor of drinking water.



# The taste and odor wheel



Adapted from Suffet et al., 1999



# The good taste of water

The few studies which have focused on the good taste of water is rather old from the 1960'ties to the early 90'ties.

The only sensory property investigated was the pleasantness of the water and this was compared to the content of major anions and cations.

These studies showed that the good taste of water decrease with increasing TDS and that a TDS of 450 mg/l is the limit for good tasting water (Bruvold and Daniels, 1990).



# A study of the taste of Danish drinking water

## **Aim**

To determine the taste of Danish drinking water collected from aquifers under different types of land use and geochemistry.

To correlate taste of drinking water to the chemical content.

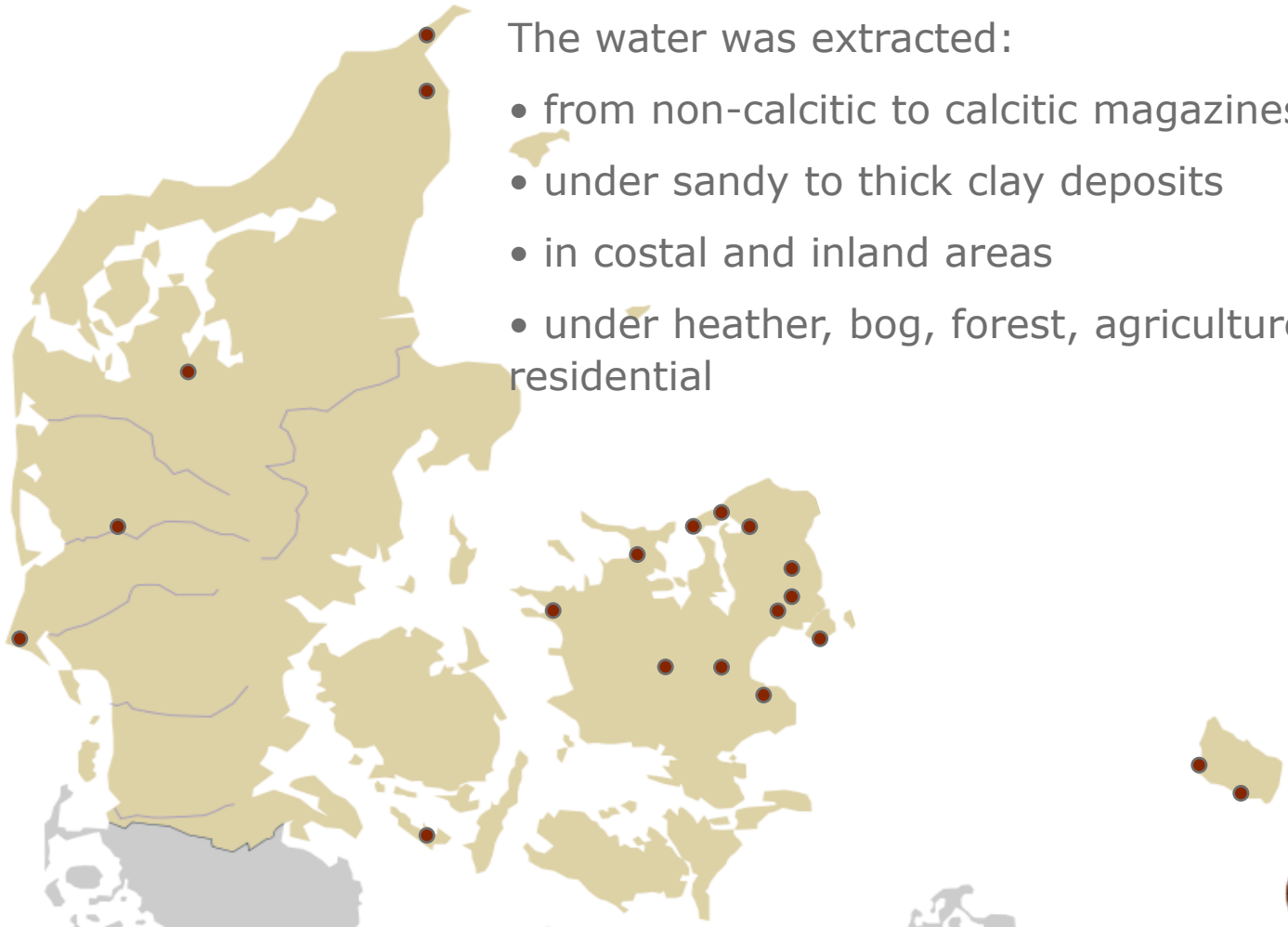


# Sampling sites

Treated water were collected from 20 Danish water works.

The water was extracted:

- from non-calclitic to calcitic magazines
- under sandy to thick clay deposits
- in costal and inland areas
- under heather, bog, forest, agriculture and residential



# Methods

## Chemical analysis

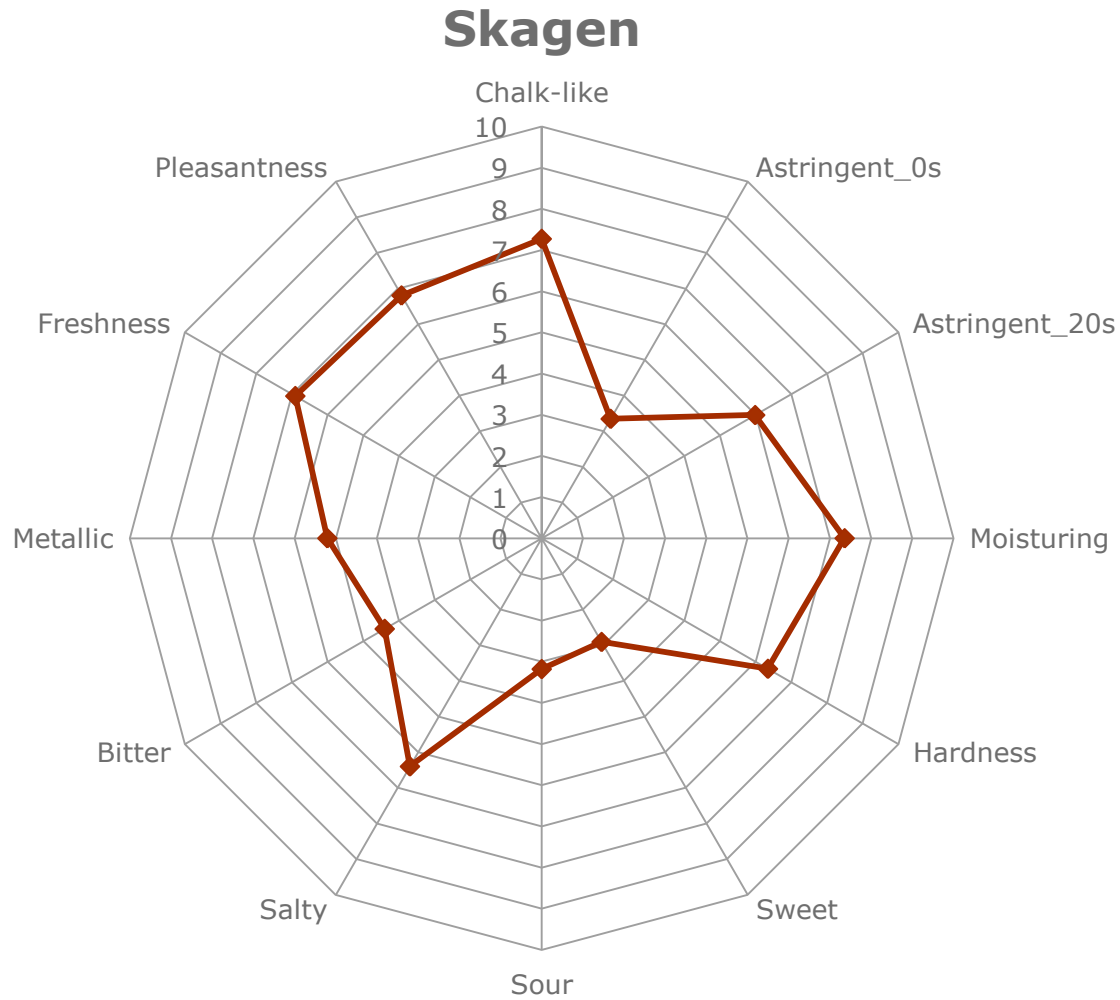
- pH, conductivity, TDS, NVOC
- $\text{Cl}^-$ ,  $\text{F}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$
- Na, Mg, Al, P, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Cd, Ba, and Pb

## Sensory evaluation

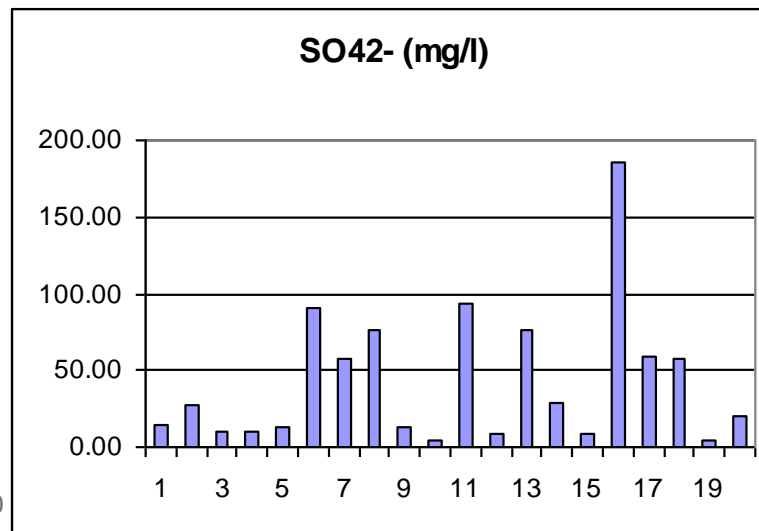
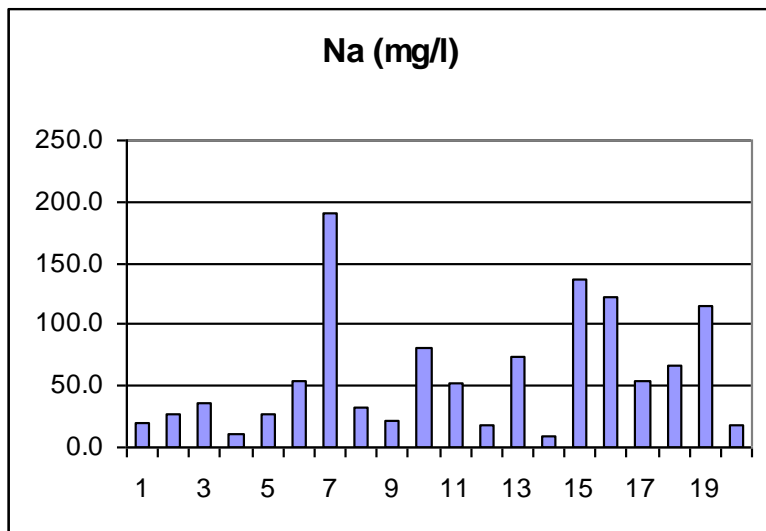
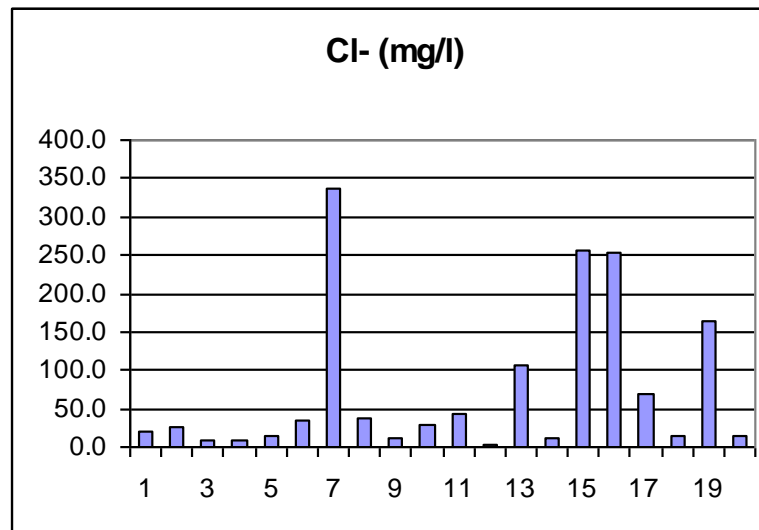
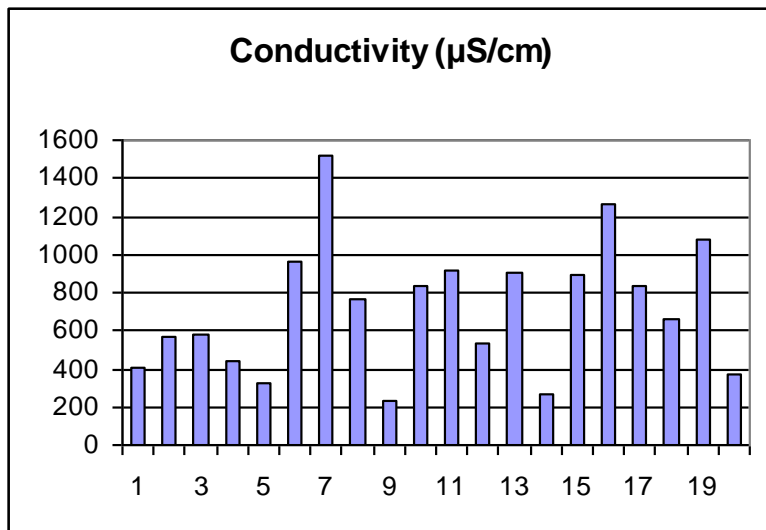
- Trained 11-membered sensory panel under standardized conditions (ISO/ASTM).
- Descriptive analysis with descriptors for taste, tactile sensations and conceptual qualities
  - Salty, sweet, sour, bitter
  - Metallic, astringent, hardness, chalk-like, fresh, moisturizing, pleasantness.
  - Intensity evaluation on a 15 cm scale.
- The sensory evaluation was carried out with 4 replicates.



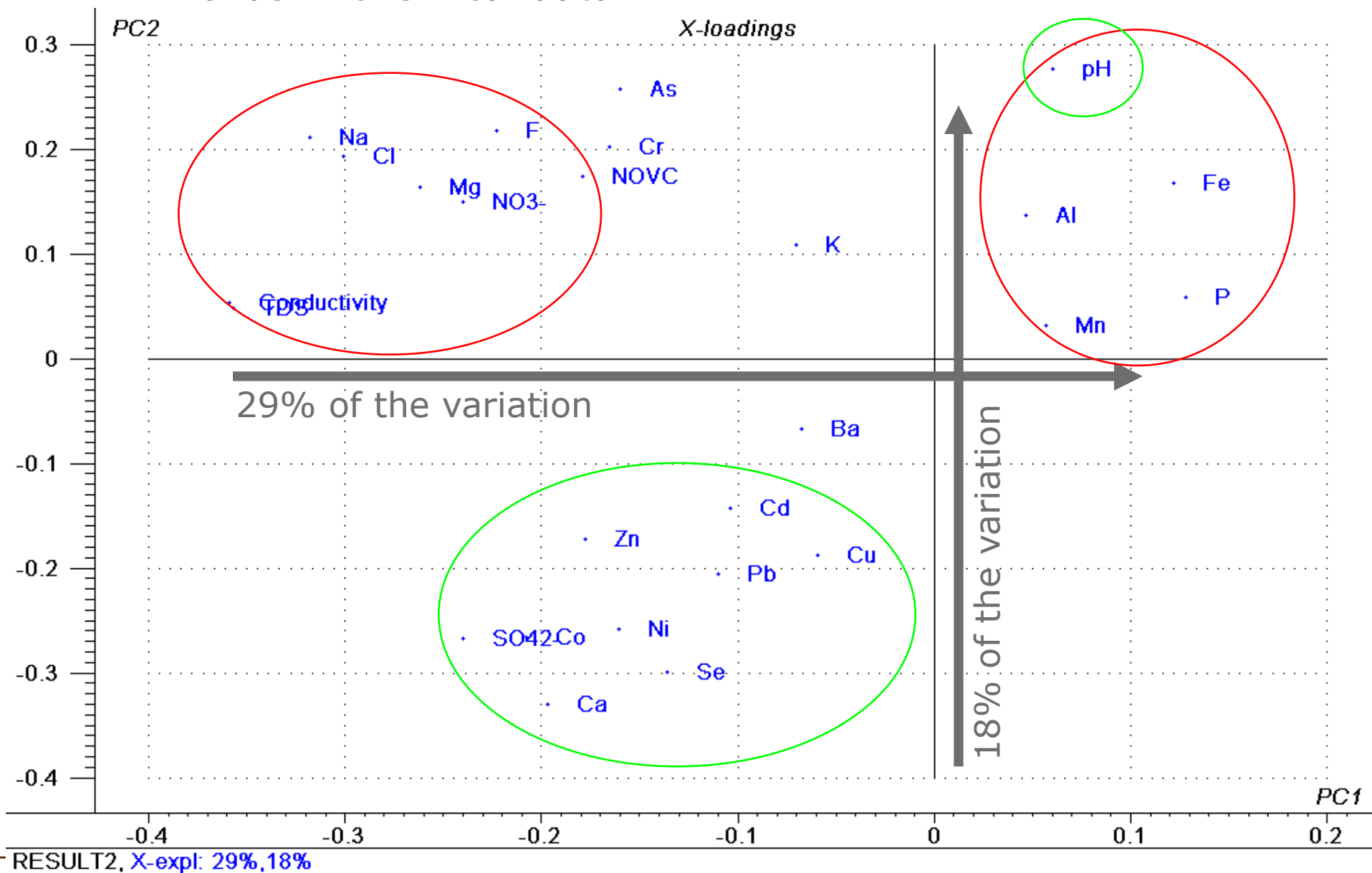
# Eksample of sensory evaluation



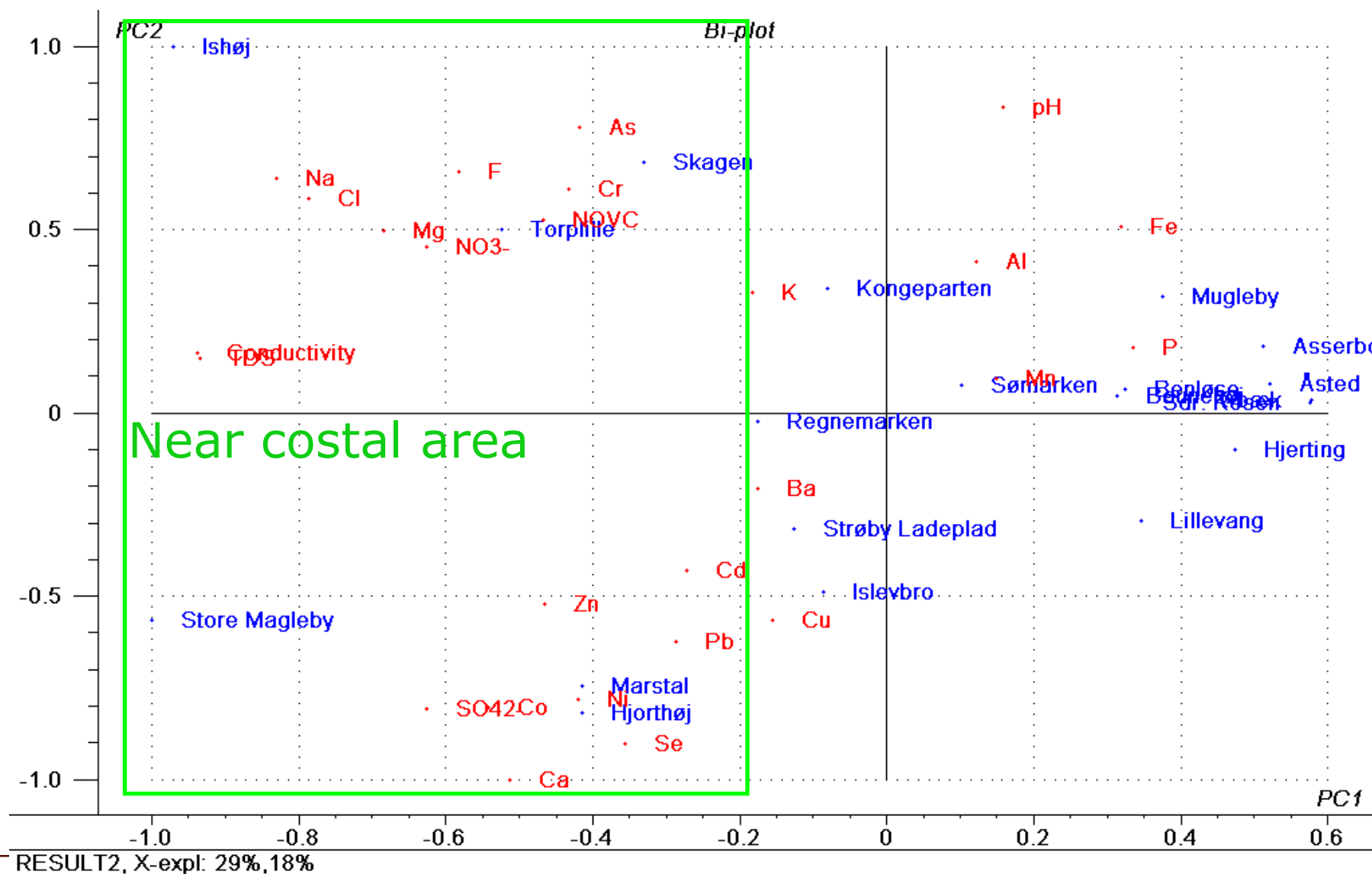
## Variation in chemical content



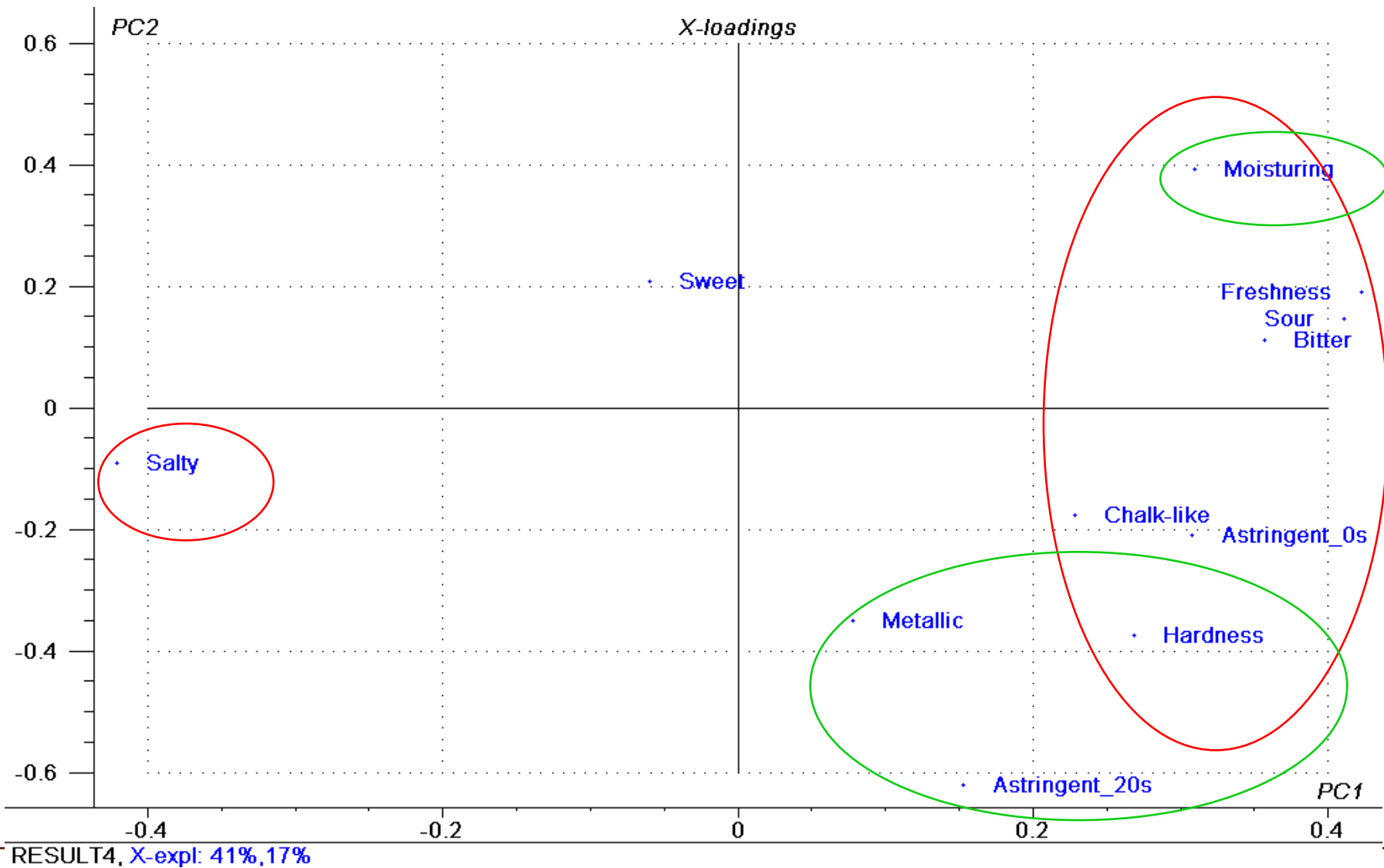
## Trends in chemical data



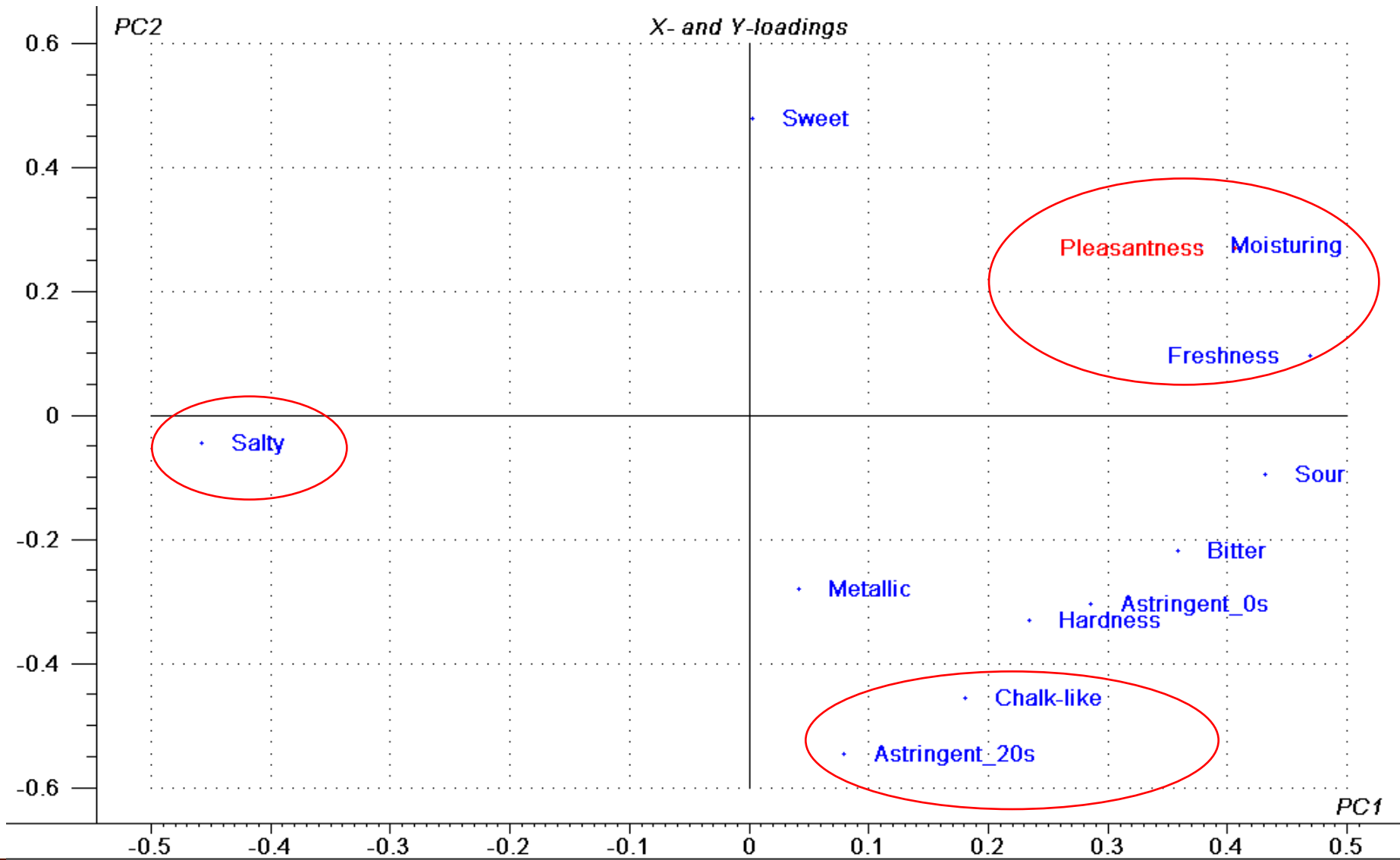
## Relations between samples and chemical content



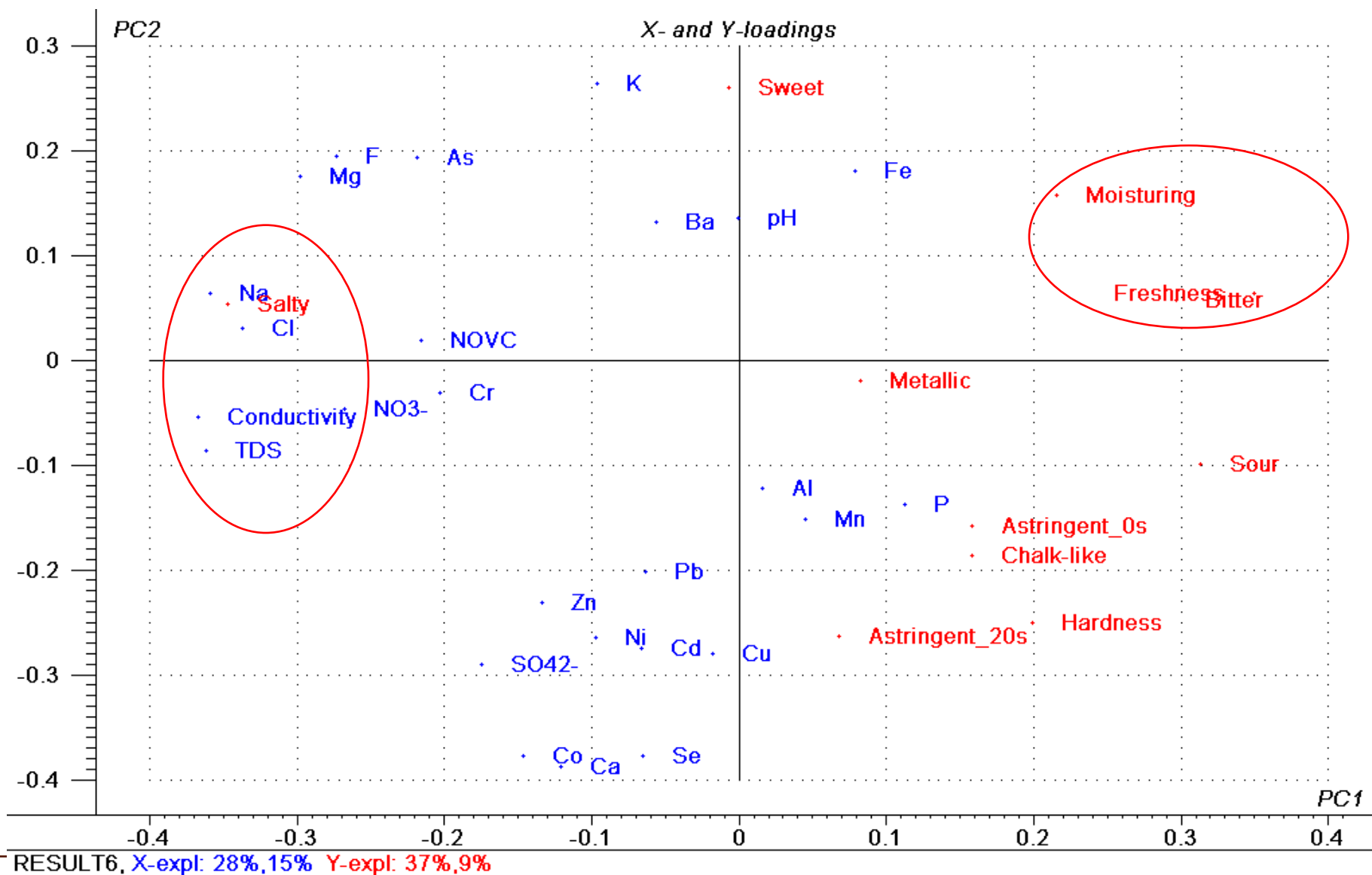
## Taste of water samples



## Taste in relation to pleasantness



## Taste and chemical content



# Conclusion

Saltiness is dominating variation in taste of Danish drinking water and saltiness is an undesired quality.

If the influence of other taste variables on the pleasantness of water should be investigated a new study with less variation in salt content should be carried out.



# Future research

## Aim

To study to what extent current and former land use can be tracked through the groundwater chemical composition and how it affects the taste of water.

## Study design

- Sites of different land use.
- Extract porewater in different depths and ground water.
- Determine organic and inorganic content.
- Study speciation and mobility.
- Correlate organic and inorganic chemical content to land use by multivariate data analysis.
- Find implications of the land use on the taste and chemical safety of water.



