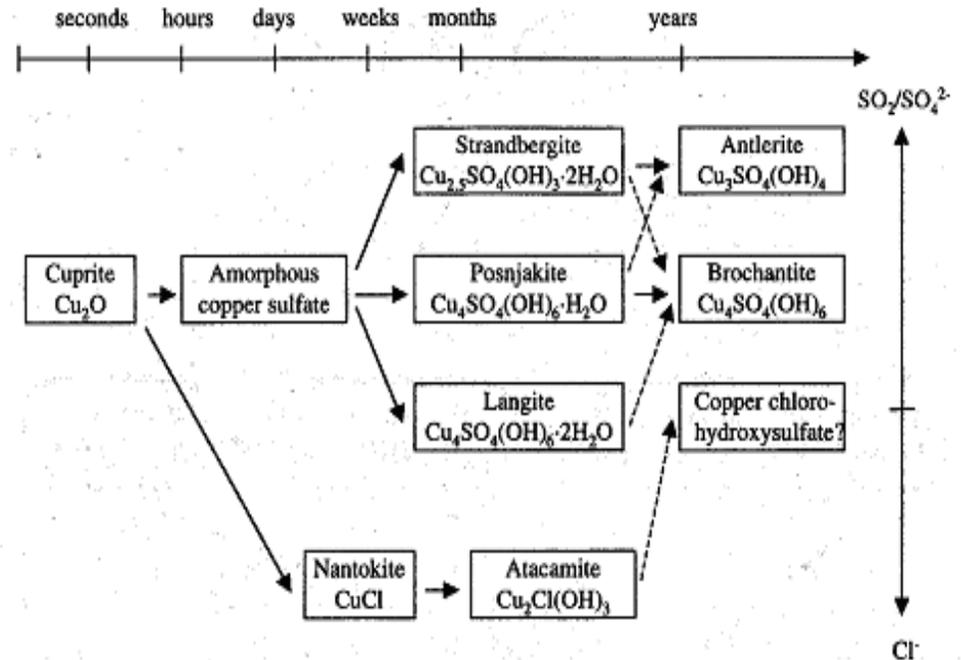


# Formation of Natural Patina

- » Brown oxide and later green patina forms on copper outdoors with a varying rate depending on where and how the surface is exposed. Under certain unfavourable conditions, however, the green patina may not form at all.
- » Development work within Aurubis has resulted in a patina called Nordic Green which has the appearance and properties of natural patina.
- » This presentation describes the formation of natural patina and behaviour and chemical background of commercial patina's



## Copper sheet

- plain copper with specified thickness

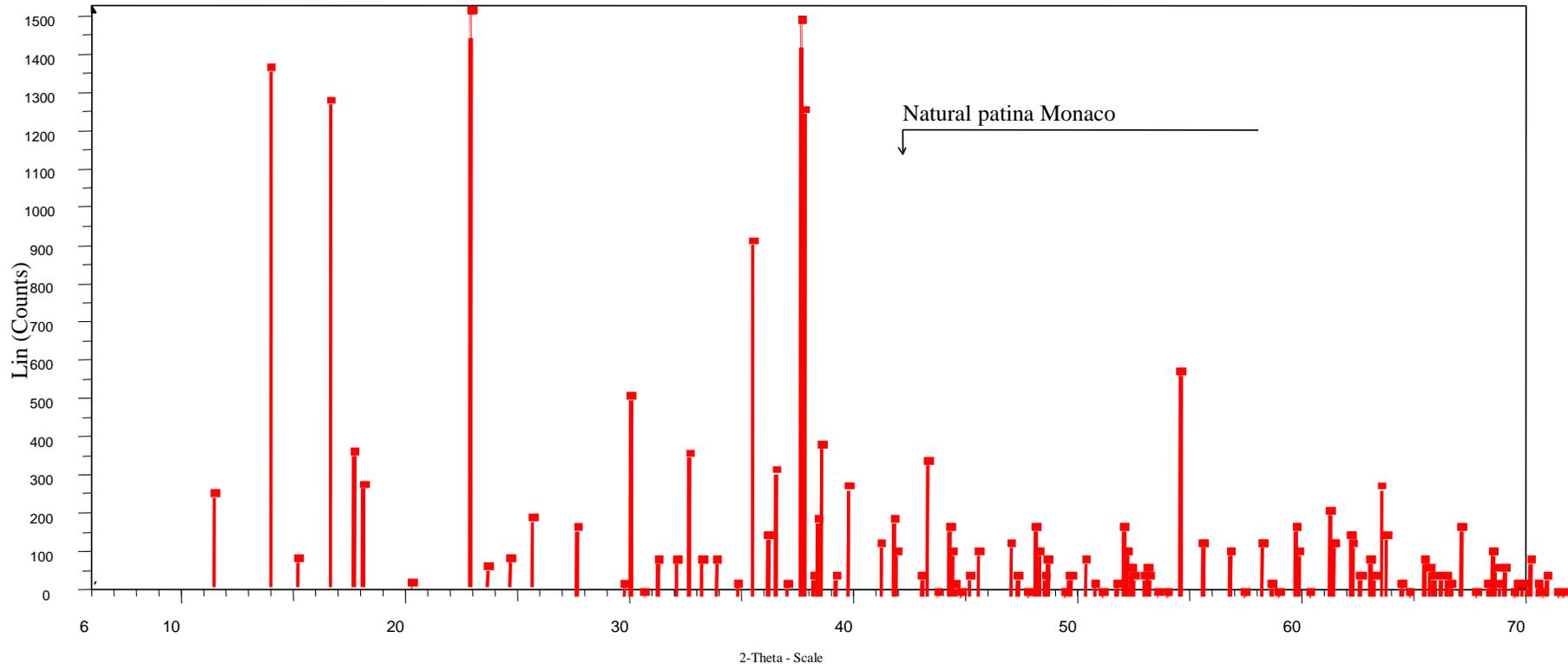
## Oxide

- made in a mill process
- resembling natural oxide formed on copper in the atmosphere

## Patina

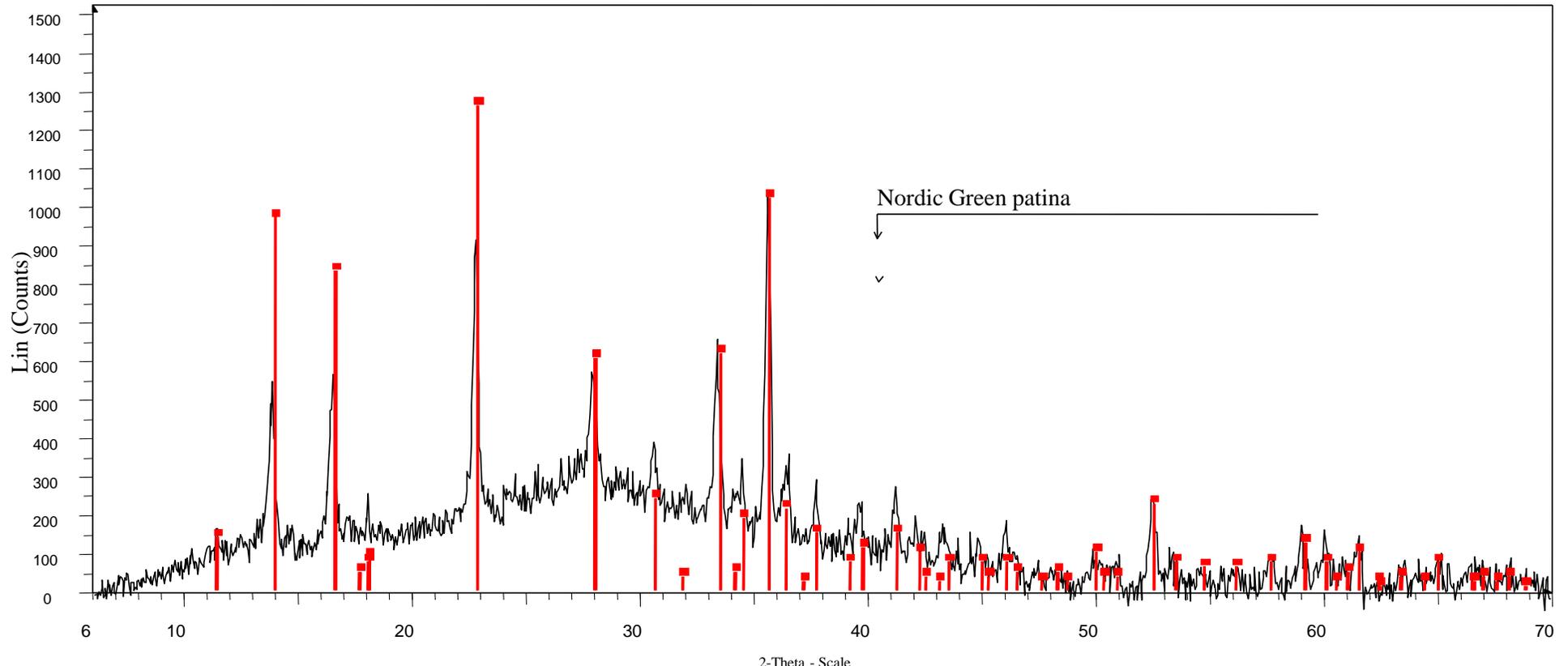
- ***Nordic Green patina is pure brochantite patina with stable colour***
  - ***Brochantite is the most common compound found in natural patinas***
  - Nordic Green patina layer is porous and natural reactions between environment, patina and underlying copper can take place.
-

# XRD-analysis of the natural patina



87-0454 (C) - **Brochantite** -  $\text{Cu}_4(\text{SO}_4)(\text{OH})_6$  - Y: 141.11 % - d x by: 1. - WL: 1.5406 - Monoclinic - a 13.08700 - b 9.83500 - c 6.01500 - alpha 90.000 - beta 103.330 - gamma 90.000 - Primitive - P21/a (14) -

# XRD-analysis of the Nordic Green- patina

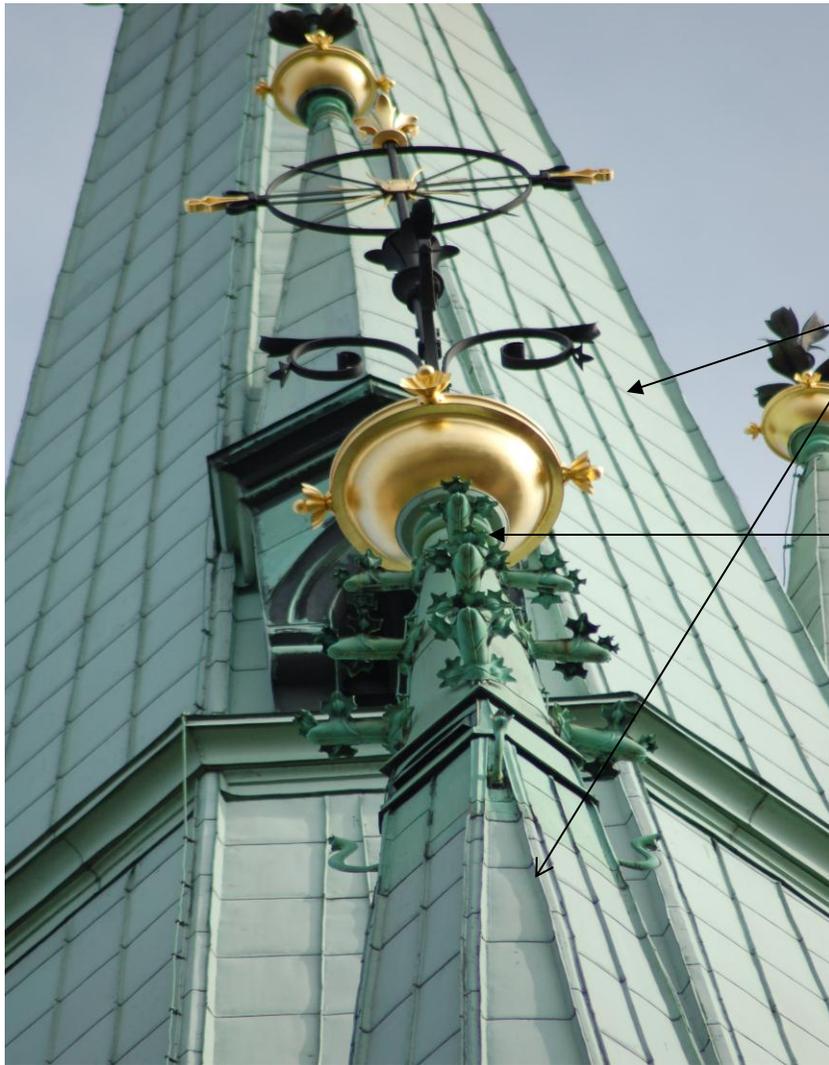


04tt10309 - File: 04tt10309.raw - Type: 2Th/Th locked - Start: 6.000 ° - End: 70.000 ° - Step: 0.050 ° - Step time: 1. s - Temp.: 27 °C - Time Started: 26 s - 2-Theta: 6.000 ° - Theta: 3.000 ° - Chi: 0.00 ° - Phi: 0  
 Operations: Background 0.068,1.000 | Import

43-1458 (I) - **Brochantite-M** -  $\text{Cu}_4+2\text{SO}_4(\text{OH})_6$  - Y: 121.62 % - d x by: 1. - WL: 1.5406 - Monoclinic - I/Ic PDF 1. -

## Example of natural patina together with Nordic Green

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Nordic Green patina after 6 years

Natural patina

Santa Klara kyrkan in Stockholm

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## Nordic Green patina after 12 years

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Private house in Pori, Finland



# Nordic Green patina after about 5 years



Ruschlikon Church roof, close to Zurich



Bank's roof in Colmar, France

## Quality Hotel in Tönsberg, Norway



June 2003



May 2011

Nordic Green Tallinn Art Museum "KUMU"



May 2005



June 2012

## Nordic Green patinated

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- » Brochantite is the most common compound found in natural patinas all over the world
  - » Nordic Green patina properties and colour is based on same mineralogy, brochantite.
  - » Just like natural patina also Nordic Green patinated undergoes continuous changes through environmental exposure depending on the local conditions and rainfall rate.
  - » Nordic Green treatment will improve the formation of natural patina by releasing copper and sulphate to react with the substrate.
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