

# *Gold ruby an environmental friendly red colour*



Christina Stålhandske  
Glafo

**Aim:** Better understanding of  
gold ruby and if possible  
achieve colouration without  
heat treatment

# Red colours

Selenium



Gold ruby



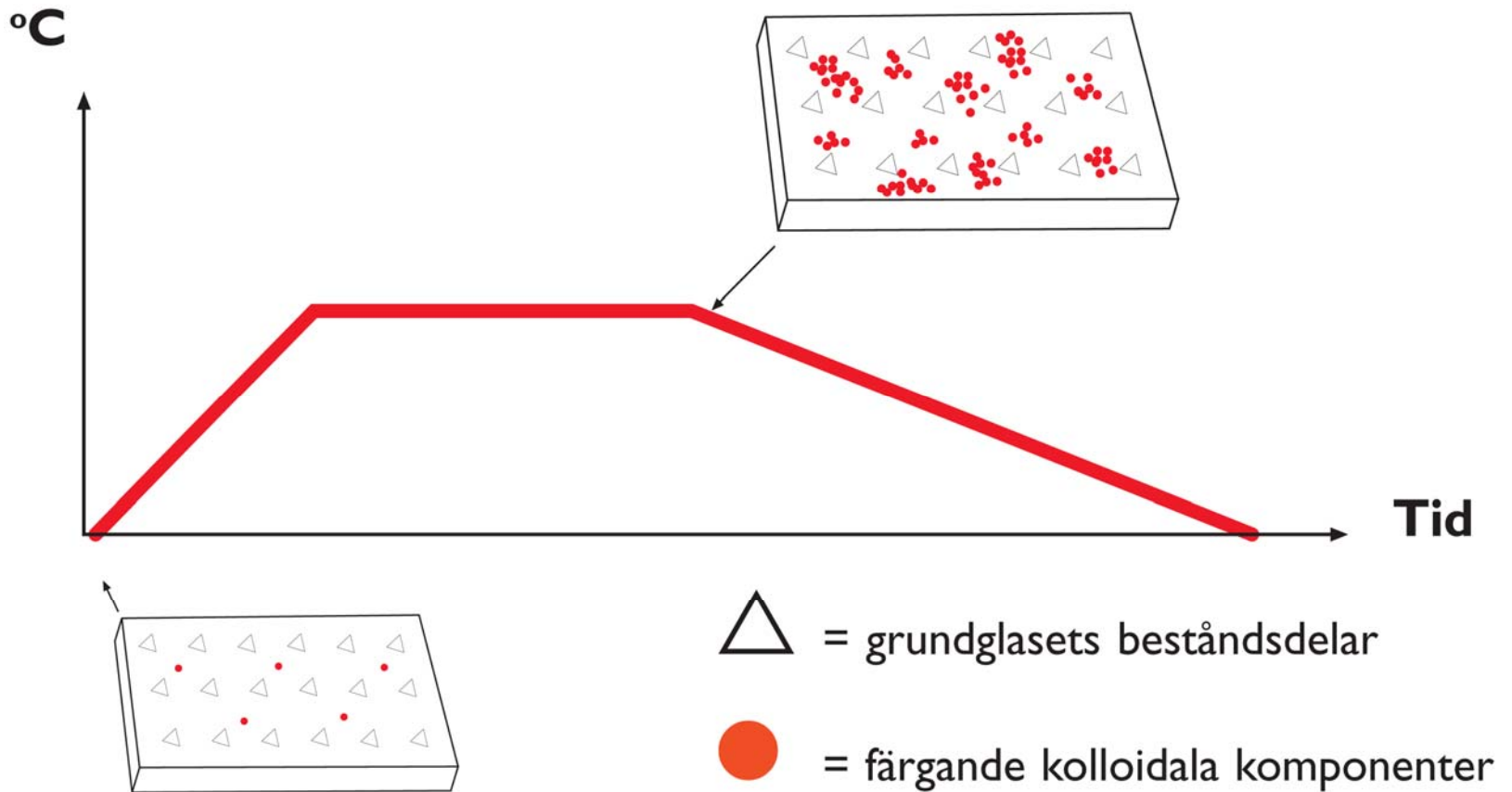
Copper ruby



Cadmium



# Gold ruby- development

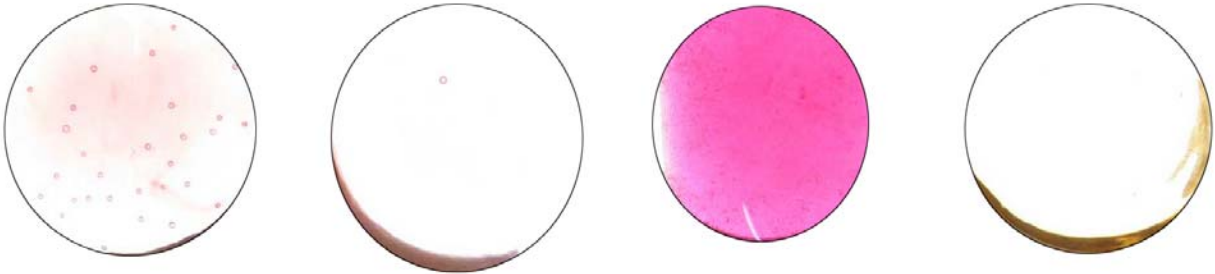


10-80 nm

# Gold ruby- colour

Visually determined

Weak



Normal



Strong



Red

Gold ruby

Amethyst

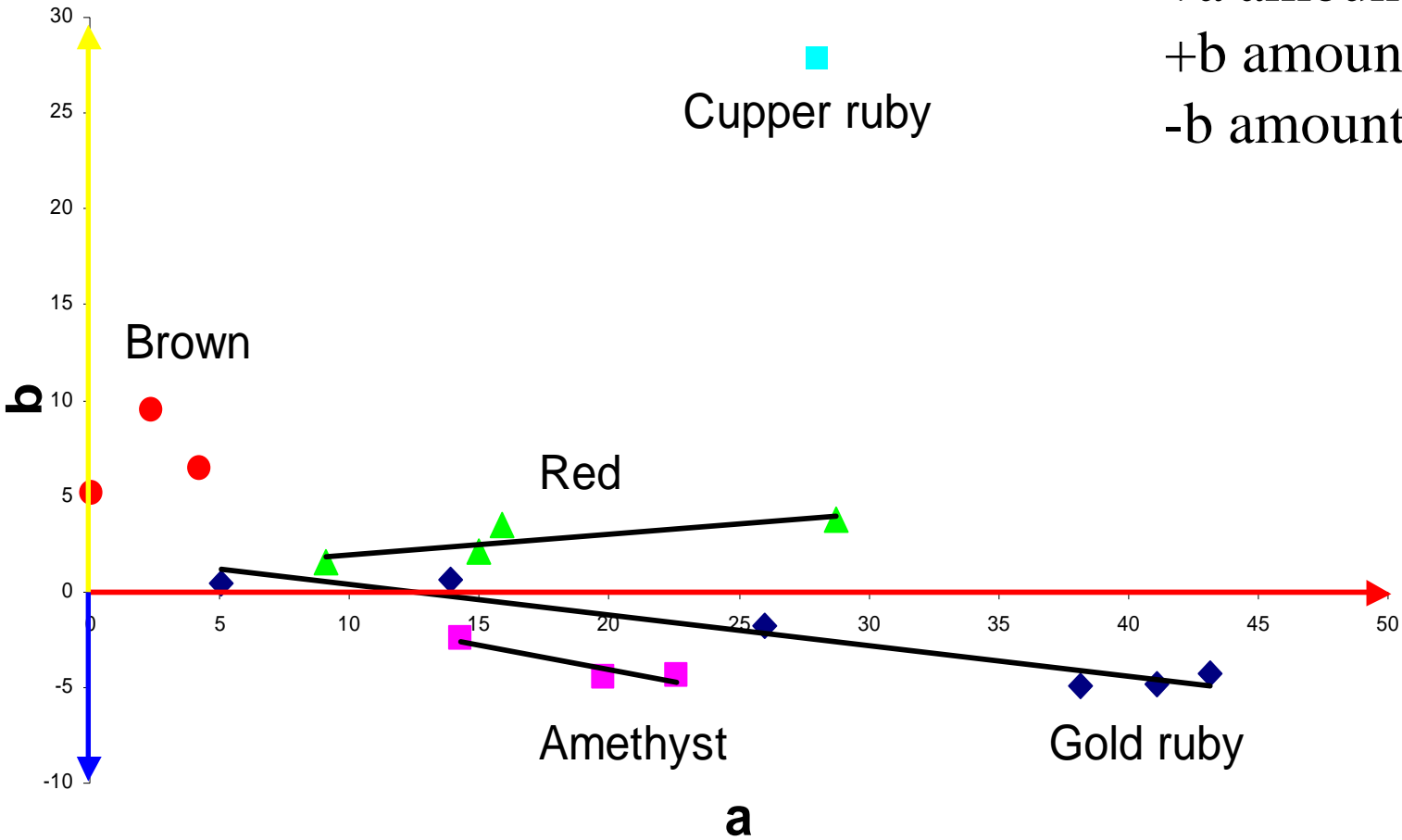
Brown

# Gold ruby- colour

Spectrophotometrically determined

**Colour coordinates**

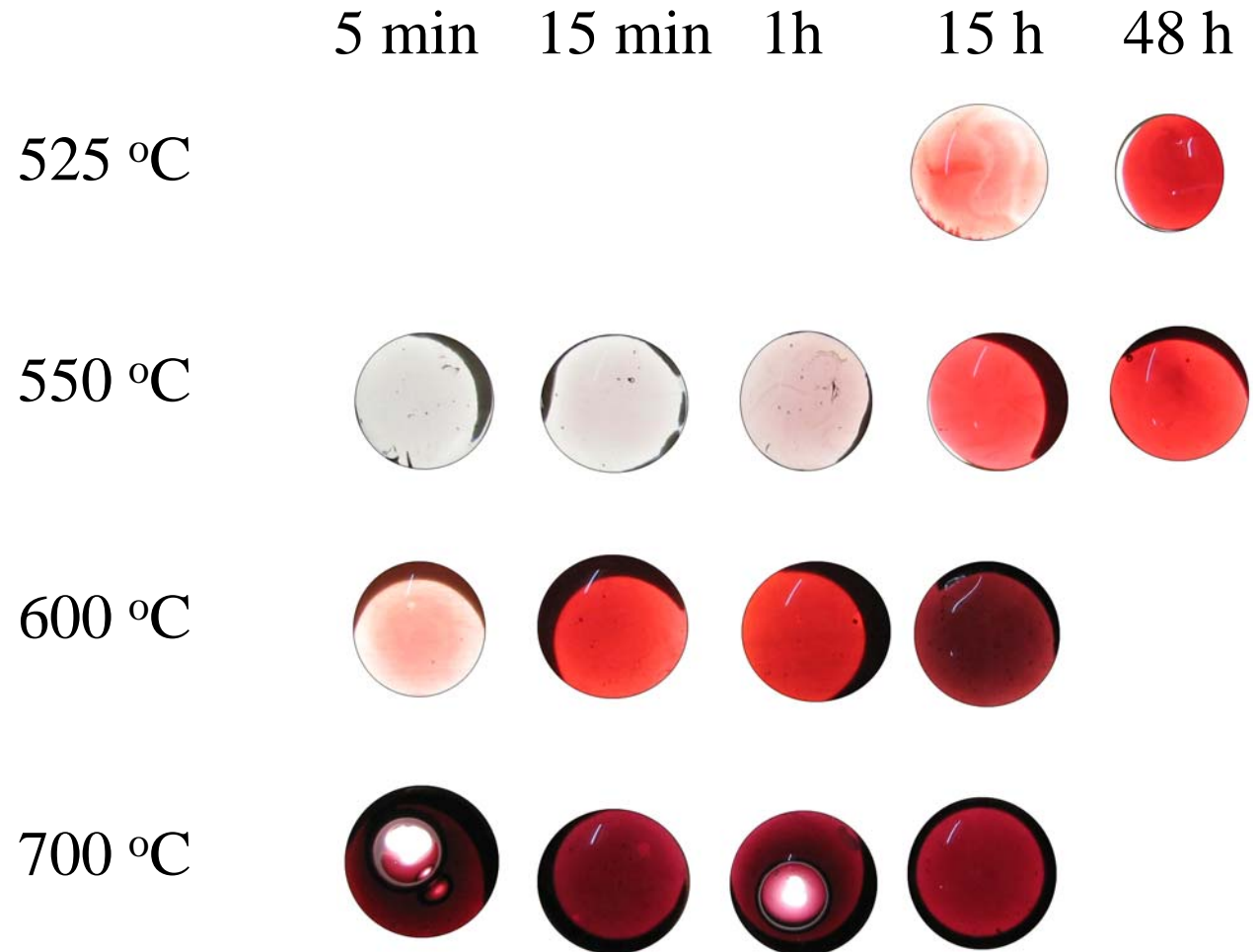
- +a amount red
- +b amount yellow
- b amount blue



# First part: commercial glass composition

- Selenium and gold proportions

- time and temperature for heat treatment





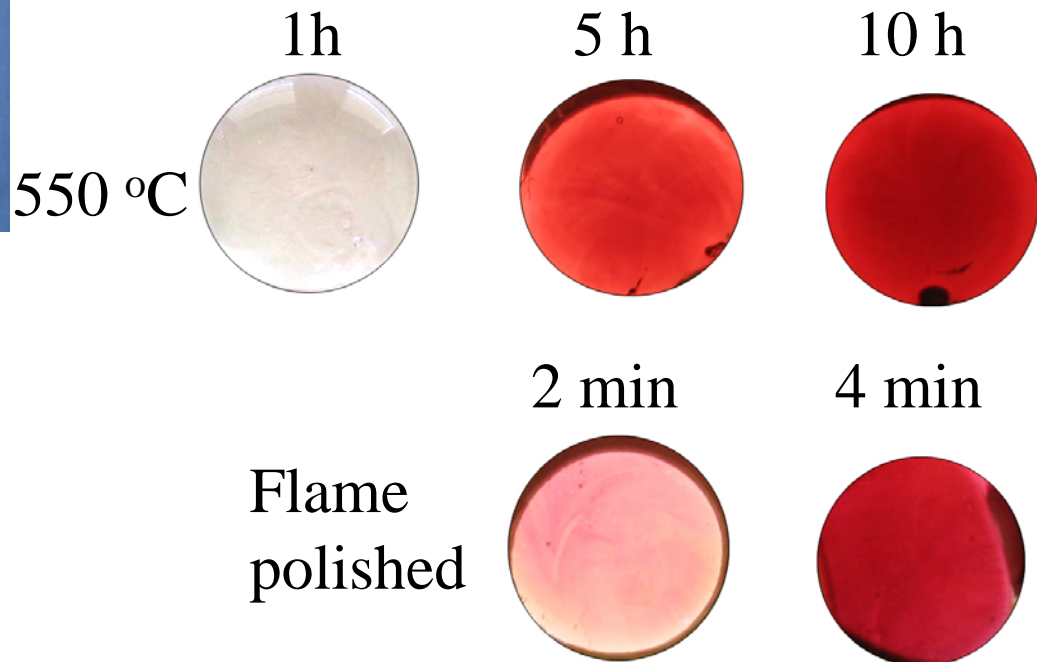


# Industrial melt **Glafo**

0,02 weight% gold

0,005 weight% selenium dioxide

0,5 weight% tin dioxide



- Two pot melts
- Producing mainly bowls
- Flame polishing
- Heat treatment
- Different mixing of gold raw material with batch
  1. Adding the gold raw material as it was
  2. Grinding and mixing gold with lime, crushing pellets somewhat

# Industrial melt- results

Similar results from both melts



550 °C: 96 h



48 h

15 h

5 h



Melt 1

melt 2

melt 2

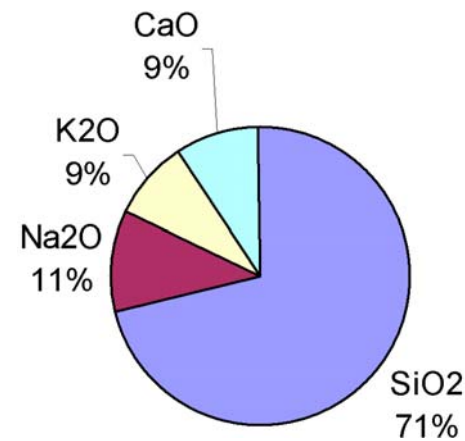


Zink cords



# Second part:

simplified composition



## Additions:

- Gold solubility
- Nucleation
- Growth

1 H																	2 He				
3 Li	4 Be															5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg															13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr				
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe				
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn				
87 Fr	88 Ra	89 Ac																			

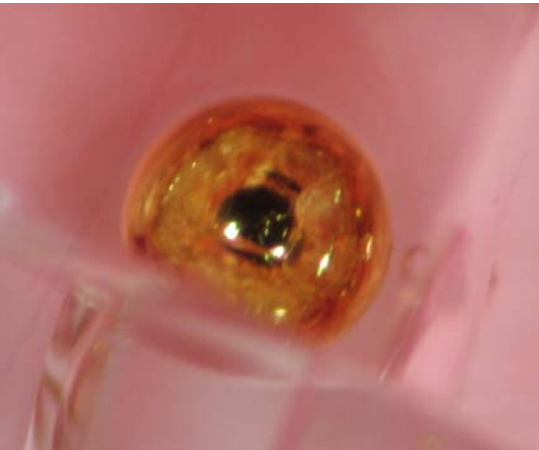
58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

# Gold Solubility

- Very low
- Hard to measure
  - difficult to distinguish between solubility nucleation and growth



Bottom of crucible



Light microscope

20-30  $\mu\text{m}$   
gold particles  
in most glasses

# Development influence by single components

Antimony

Tin

Selenium

Cerium

Lead



Bismuth

Titanium

Iron

Phosphorous

# Selenium

100 pm Au, 25 ppm SeO<sub>2</sub>



Oxidating



No addition



Reducing



250 ppm SeO<sub>2</sub>



50 pm Au



No Au

# Gold, selenium + one addition

Antimony



Lead



Bismuth



Titanium



Iron



Tin



# Conclusion

- Selenium the most important addition  
-problematic
- So far heat treatment in commercial  
batch is needed
- Possible to develop a commercial glass  
that strikes directly

