SW Ar, Kr, and Xe from Bulk Collector Array CZ-Si targets

Talk: Wednesday 1:45 pm

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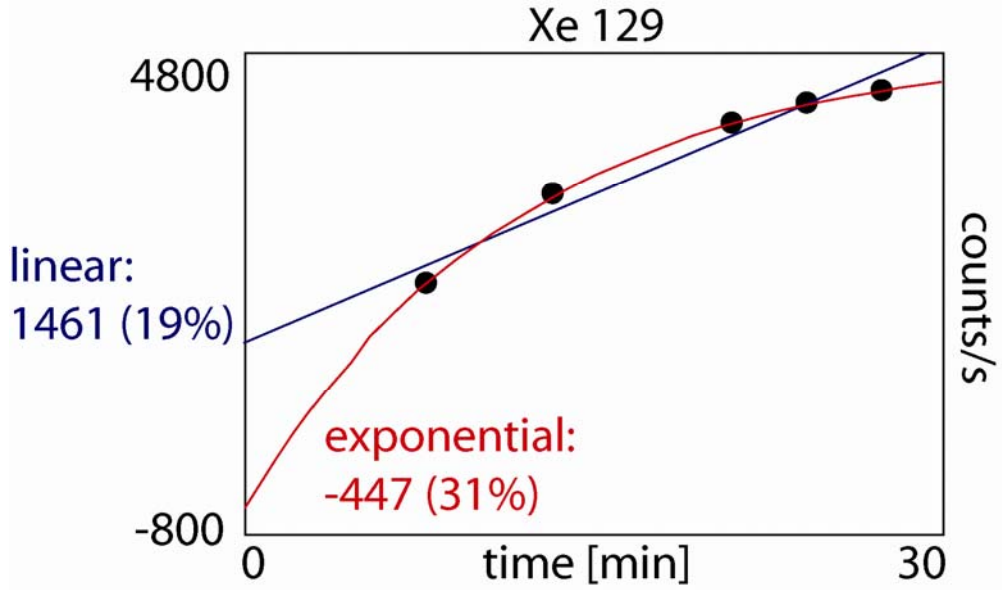
Outline

- State of the project Aug/Sept 2008; memory problem
- Data
- Comparison of our data set to:
    - other Genesis AKX data,
    - lunar SW record,
    - solar photosphere data

State of project Aug/Sept 08

- 5 successful UV-laser ablation AKX analyses of CZ-Si targets by V. Heber
- Spectrometer memory problem:



CZ-Si material blank (Nadia)

Non-linear increase of gas amounts (KX) → regression impossible!

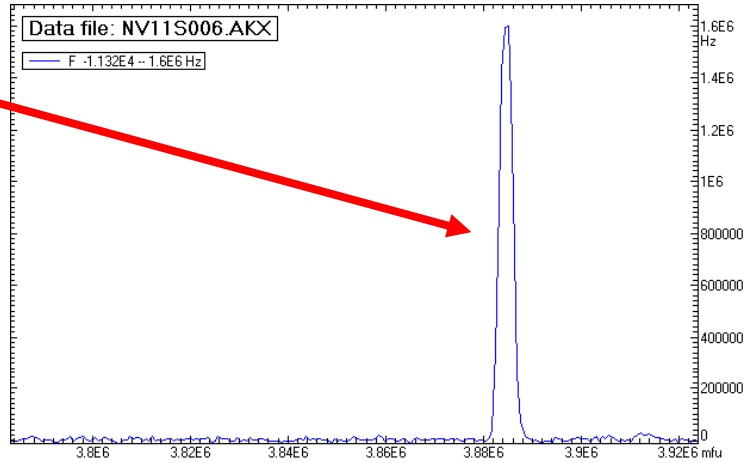
Unknown species causes memory

⇒ first task: specification & elimination of unknown species

What causes SMP?

Search for culprit (Nov. 2008):

- Unusual peaks on masses **19 (F)**, 34.5, **69**



⇒ **Memory causing ion: $(CF_3)^+$ (?)**

Potential source: teflon $(C_2F_4)_n$?

- not removed by heating
- cracked by UV-laser light

Source elimination:

- Unsuccessful: memory worse with each test (different blank material, viewport cleaning, viewport, sample holder, preheating….)

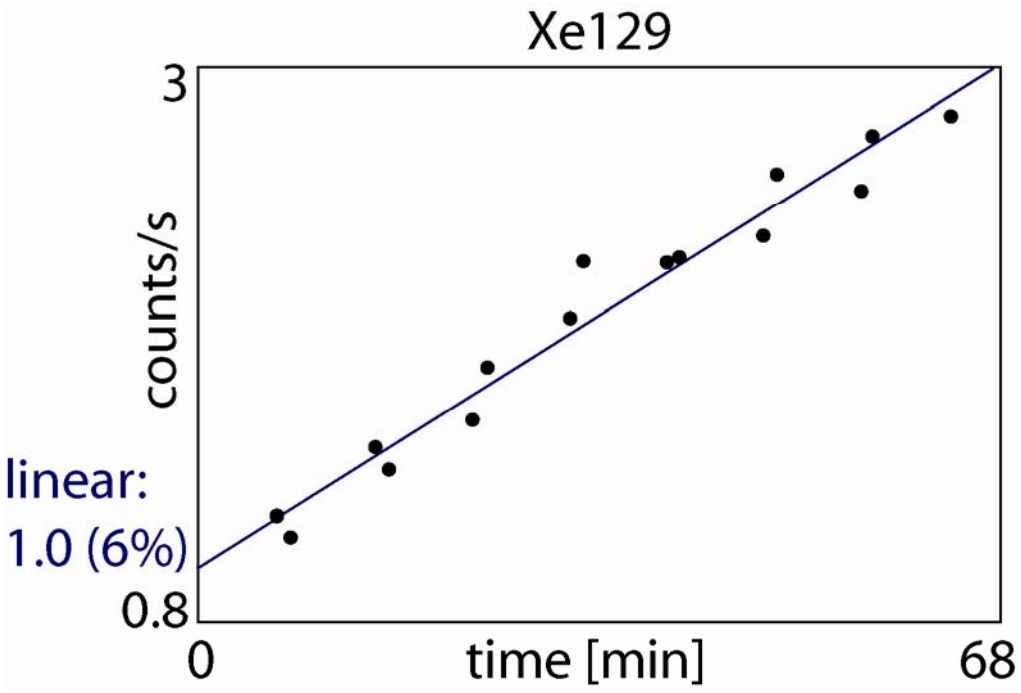
Different gas cleaning:

- Unsuccessful: mass 69 behaves identical to Kr

Solution of SMP (christmas 08)

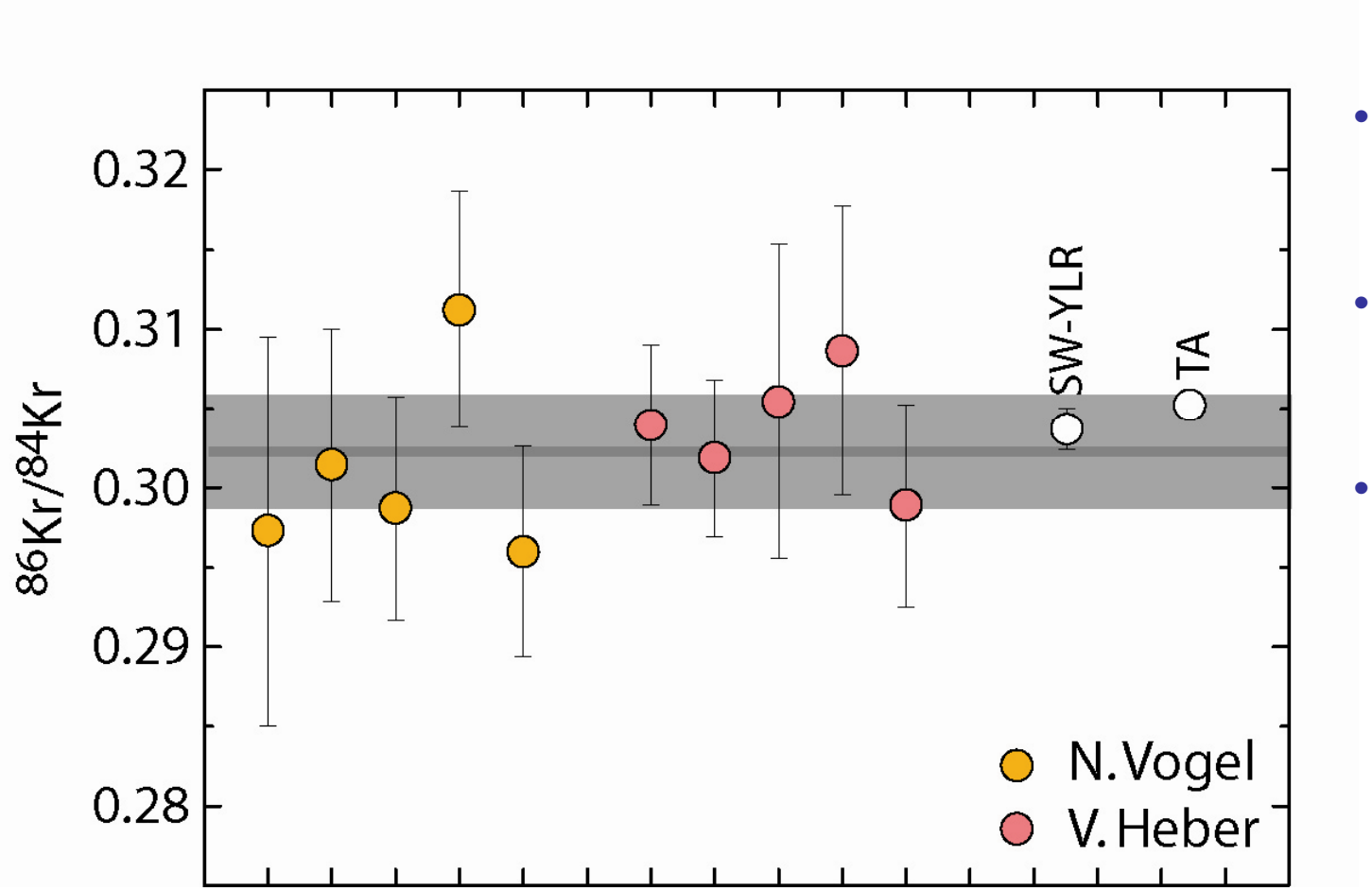
⇒ contaminant from oil in pressurized air despite filter?
⇒ Yes; moreover: filter made of teflon, old, crumbly

Procedure:
- no use of pressurized lab air for cleaning,
- exchange of contaminated chamber parts



CZ-Si material blank (10 mm²)

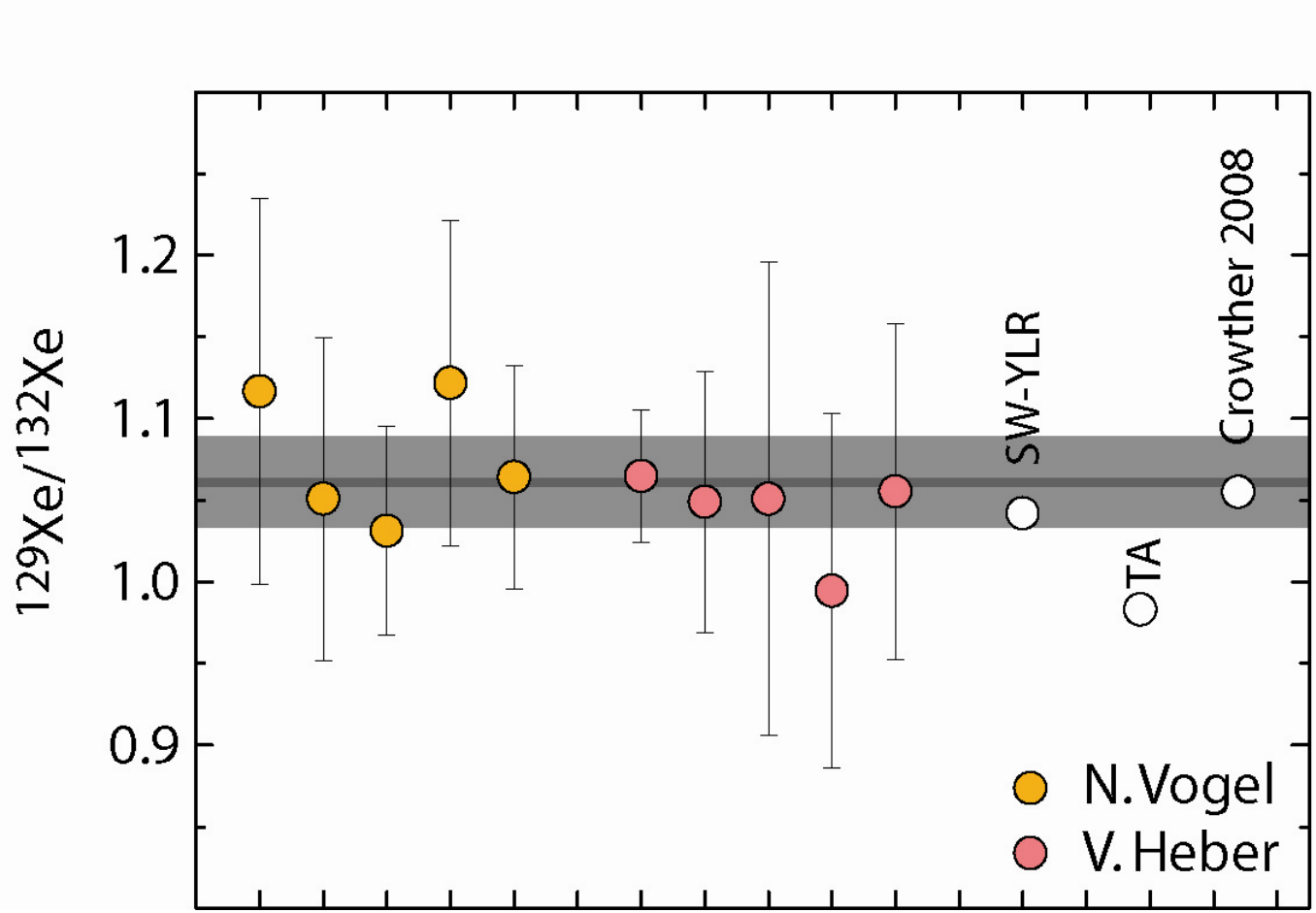
Finally - data! Kr isotopic composition



- Vogel & Heber identical
- **Average (n=10): 0.302 ± 0.004**
- Identical to lunar SW record

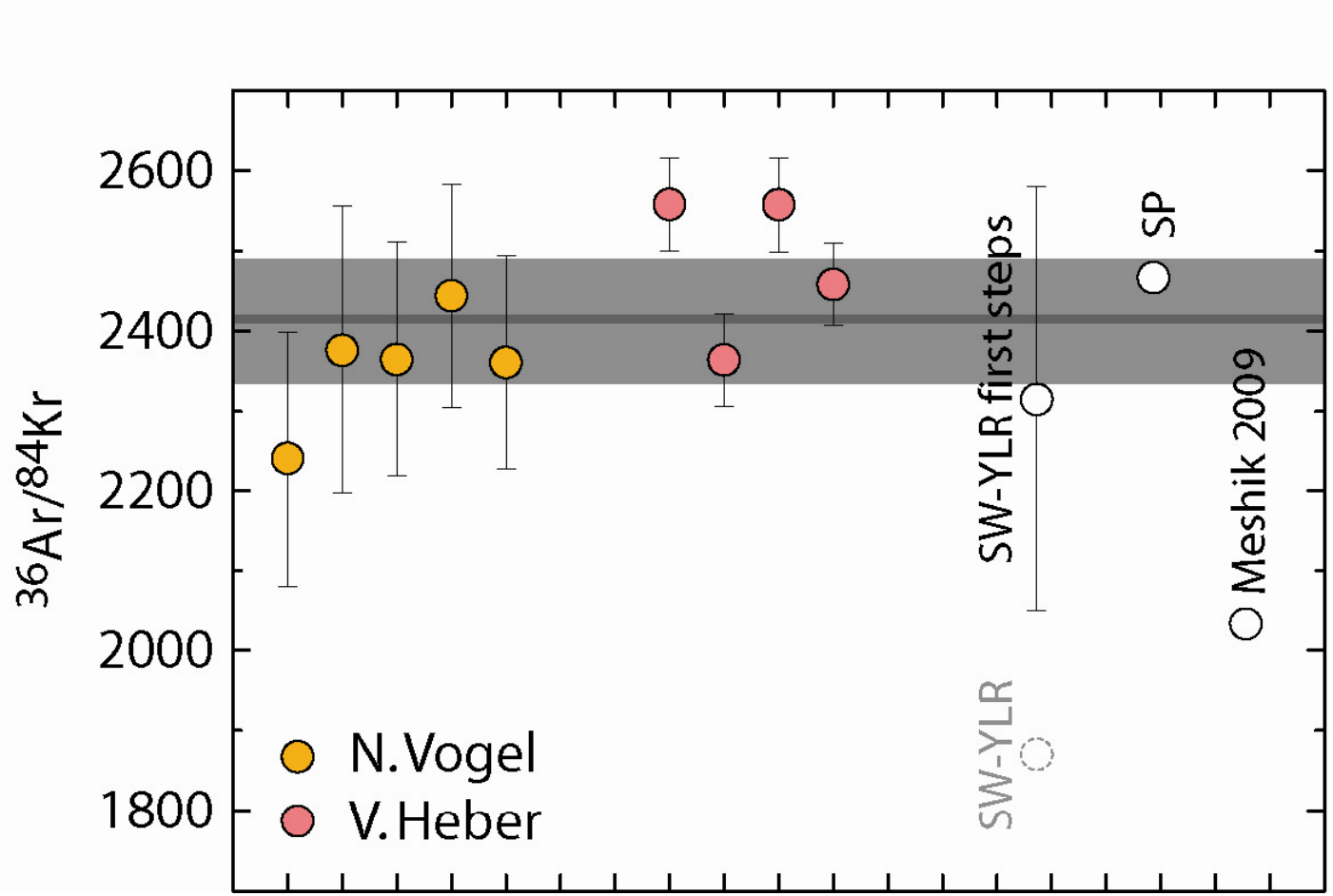
YLR = **Y**oung **L**unar **R**egolith
TA = **T**errestrial **A**tmosphere
SP= **S**olar **P**hotosphere
Averages with standard errors of the mean (95% confidence level)

Xe isotopic composition



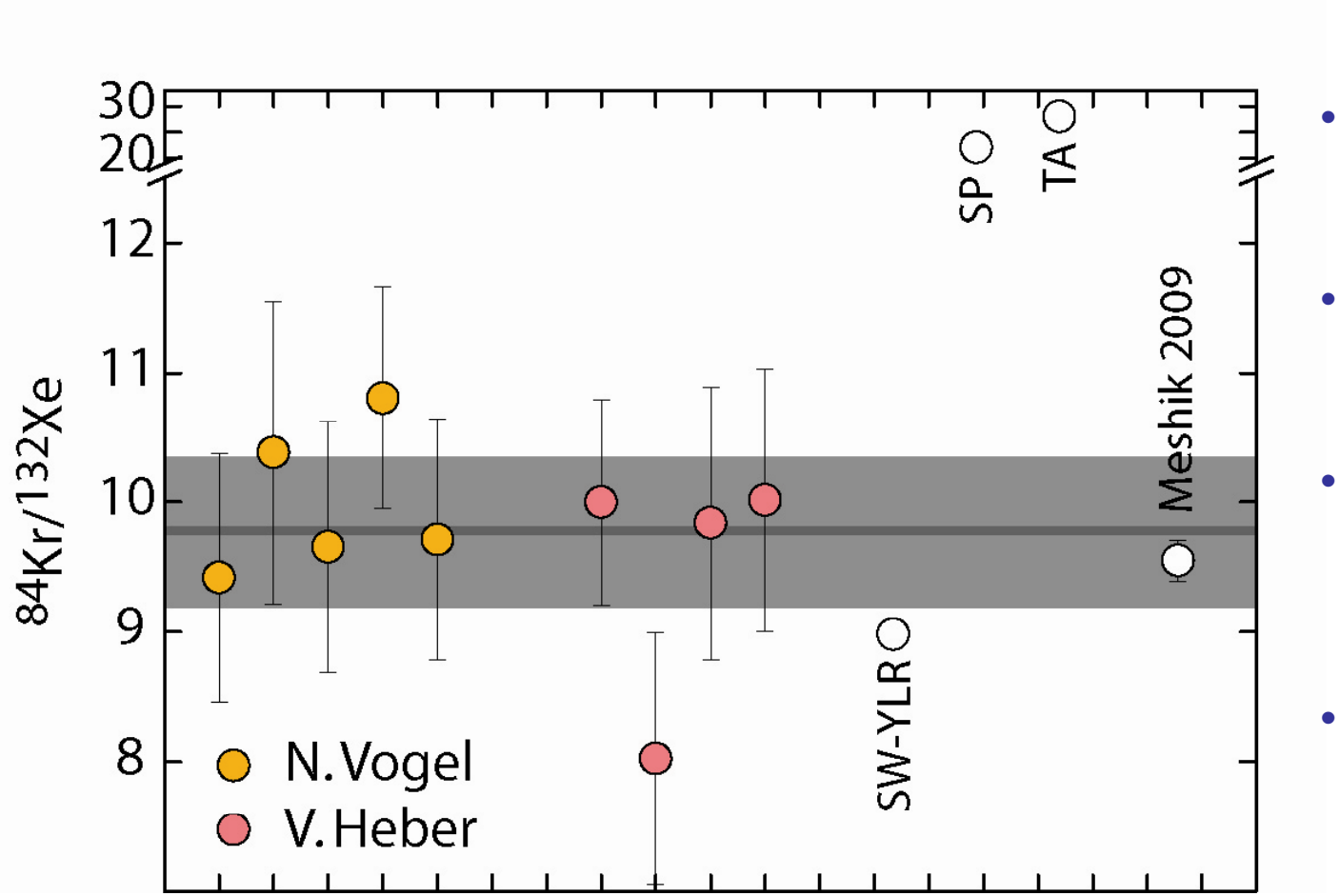
- Vogel & Heber identical
- **Average (n=10): 1.06 ± 0.03**
- Identical to lunar SW record
- Identical to Genesis data by Crowther et al. 2008 (RELAX)

Ar/Kr elemental ratio



- Difference Heber & Vogel → blank
- **Average (n=9): 2414 ± 77**
- Agreement with SW lunar record?
- Agrees with SP (Lodders 03/08)
- Low Meshik et al. 2009 Ar/Kr „Different Ar, Kr implantation“

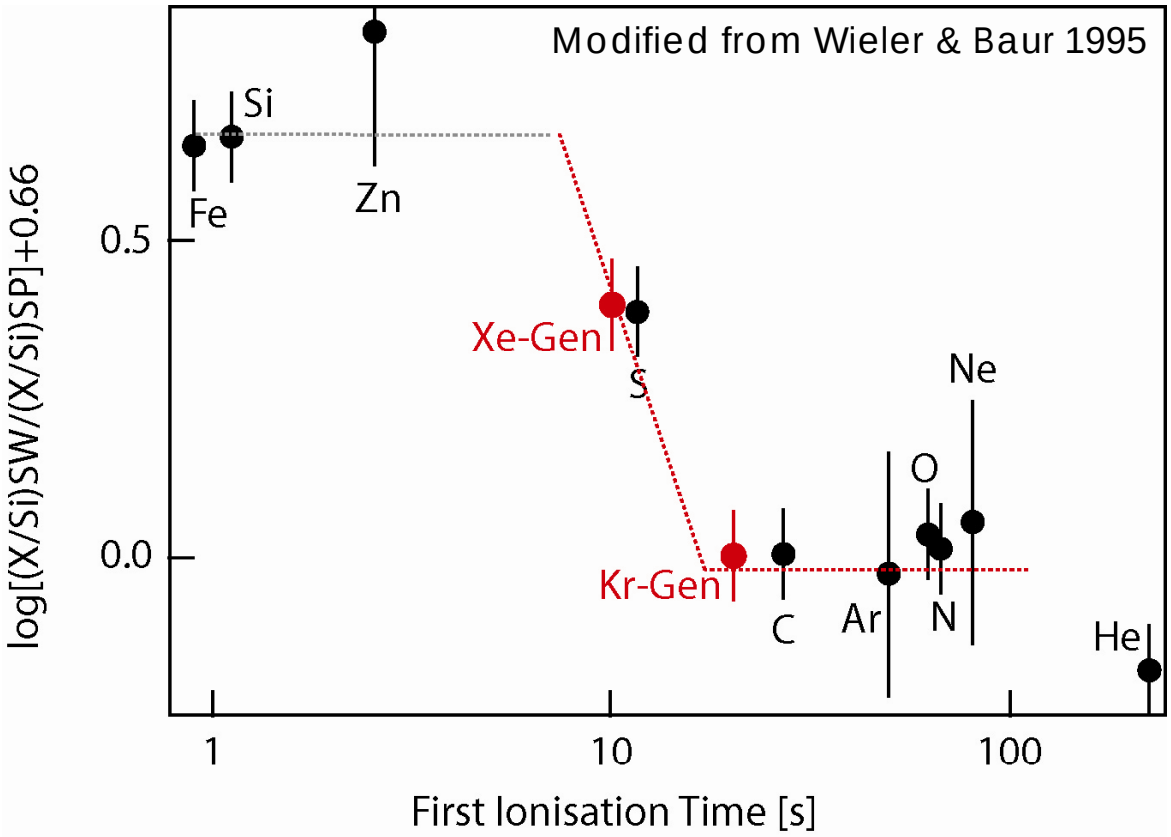
Kr/Xe elemental ratio



- Vogel & Heber identical
- **Average (n=9): 9.8 ± 0.6**
- Identical to lunar SW record & Meshik 2009
- Clearly different from SP → **element fractionation Sun - SW**

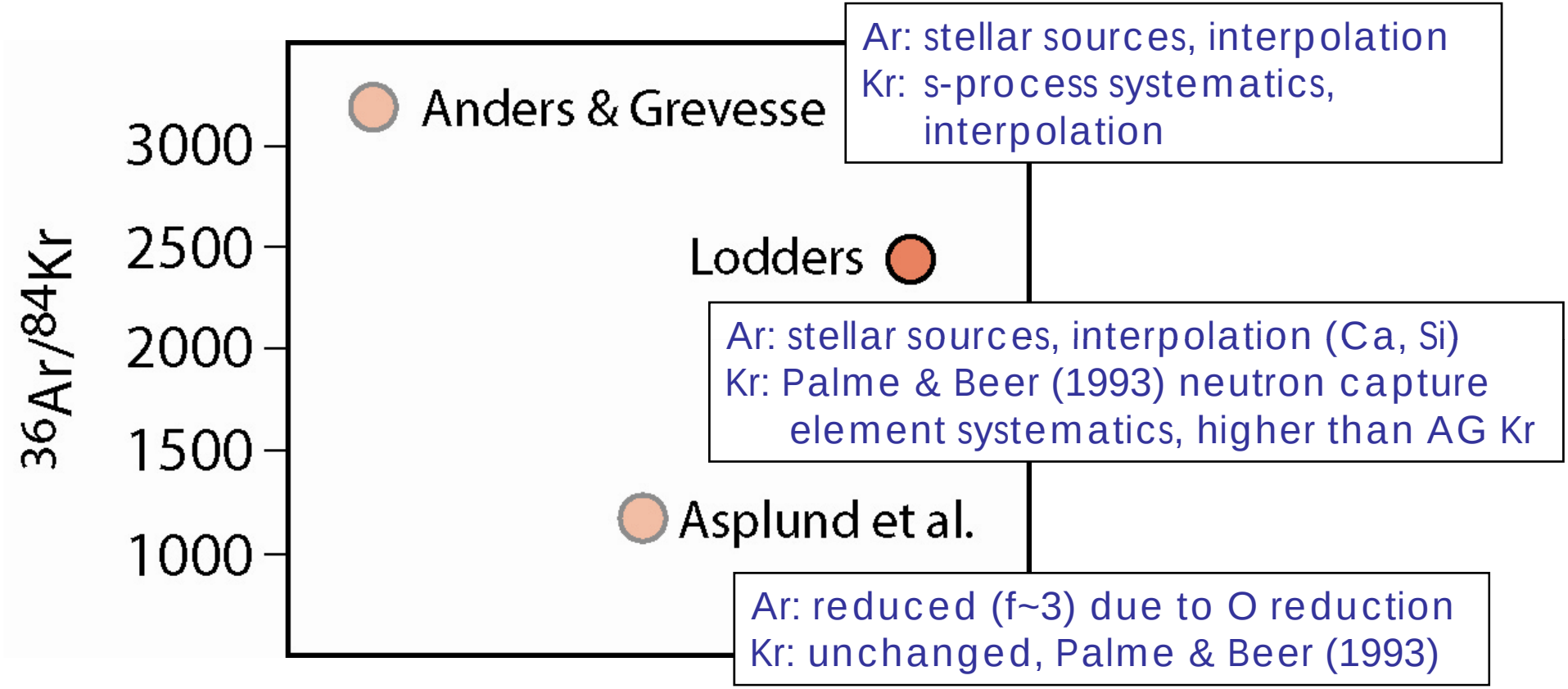
Element fractionation Sun - SW

Element fractionation during ion-neutral separation in upper chromosphere according to FIP and FIT (low FIP/FIT elements enriched in SW (e.g., Geiss 1989)



- W & B (1995):
  Kr: partial enrichment (x1.8) in SW
  Xe: enrichment = low FIT elements (x4) in SW
- SW Genesis, new SP data:
  Kr: no enrichment
  Xe: partial enrichment (x2.2)
- dependence on SP values, which are still not settled (e.g., Ar/Kr)

Example: solar photospheric Ar/Kr



⇒ **Lodders 2003/8: most reliable SP Ar/Kr**

⇒ **agreement with new Genesis data strengthens both ratios**

Conclusions

- **Don‘t use pressurized air…**
- **Genesis provides ~consistent data base for modern SW Ar, Kr, Xe**
  (Zürich, Manchester, St. Louis)

Isotopic, elemental ratios:

$^{86}Kr/^{84}Kr$:	0.302 ± 0.004
$^{129}Xe/^{132}Xe$:	1.06 ± 0.03
$^{36}Ar/^{84}Kr$:	2414 ± 77
$^{84}Kr/^{132}Xe$:	9.8 ± 0.6

Ar, Kr, Xe fluences [atoms/cm^2]:

^{36}Ar:	$(2.95 \pm 0.05) \times 10^{10}$ [n=10]
^{84}Kr:	$(1.22 \pm 0.04) \times 10^{7}$ [n=9]
^{132}Xe:	$(1.26 \pm 0.11) \times 10^{6}$ [n=9]

- **Agreement with SW record from young lunar regoliths**
- **Compared to SP no enrichment of Kr, partial enrichment of Xe in SW**
  (SP values might not be as settled as they appear!)
- **Final measurements**: 2-3 more samples + several large material blanks (significant source of uncertainty)

Origin of solar photospheric values

KX: based on theoretical values from neutron-capture systematics

Kr (in Lodders 2003) from Palme & Beer (1993)who consider contributions from main and weak s-process to 82Kr + isotopic composition of Wieler 2002 to derive Kr elemental abundance (13% higher than the value of A & G, in line with raitieri et al (1993)"A&G Kr value underestimated by ~20%

Xe (in Lodders 2003) most recent measured neutron cross sections for important Xe process nuclei (Reifarth et al. 2002) + Wieler et al 2002 isotopic ratios; elemental abundances 10-20 % higher than previously, much smaller uncertainties.
→ Different sources come up with K/X ratios of max 20% difference: does not explain factor of >2 for difference between SW – SP ratio