$^{10}$Be in the South Pole Ice Core

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Why South Pole $^{10}\text{Be}$ now?

$^{10}\text{Be}$ in South Pole snow good measure for $10\text{Be}$ production $\rightarrow$ solar irradiance

1990 South Pole $^{10}\text{Be}$ record has become reference record for climate models

Ice clean, aerosols don’t interfer with analytics

Making use of recent geochemical-analytical advances in $^{10}\text{Be}$ measurement

Raisbeck et al., 1990
ECHAM5-HAM is forced by observed SST/sea ice (1950-2015) but constant $^{10}$Be production rate

Examine the sensitivity of $^{10}$Be concentration to large scale climate

$^{10}$Be flux and concentration are very sensitive to larger scale climate almost everywhere in the Antarctic (except the South Pole)
How much ice do we need for $^{10}$Be measurements from ice cores?

$^{10}$Be concentration at South Pole

$\sim 3 - 10 \times 10^4$ $^{10}$Be at/g

Blank levels: $\sim 5000 \pm 3000$ at

$\rightarrow$ 10 g of ice enough

At 10 ka: annual layer $\sim 5$ cm thick

$\rightarrow$ annual resolution possible!
SPICE $^{10}$Be - Method

- Decontaminate ice sample by melting outer 30-50%
- $^9$Be spike added to melted ‘inner samples’ (we use between 20 - 100 g ice, can further reduces this by a factor of 2-3)
- SPICE ice clean enough that no column chemistry needed, Be-hydroxide precipitation, followed by conversion to BeO (baking) $\rightarrow$ fast, low blanks!
- Total $^{10}$Be atoms in SPICE core measurements are 2 to 3 orders of magnitude above blank levels
South Pole Ice Core - Last millennium Be-10 records

Red bars=solar minima; D=Dalton; M=Maunder; S=Spörer; W=Wolf

Raisbeck et al., 1990
Glacial – Interglacial, $^{10}$Be flux
Preliminary Conclusions

• South Pole a prime location to record atmospheric $^{10}$Be production → Solar Irradiance

• Excellent agreement between SPICE $^{10}$Be measurements and Raisbeck et al. (1990) $^{10}$Be South Pole record → solar minima detected!

• Glacial $^{10}$Be flux to South Pole slightly higher than Inter-glacial $^{10}$Be flux

• Next 1: SPICE $^{10}$Be extended at 1 m resolution back to 3000 BP

• Next 2: Annual resolution $^{10}$Be measurements at selected intervals! 11-year solar cycle visible and trackable through time?