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CLIMATE CHANGE RESEARCH

# Workshop on “Developments in isotope ratio measurements for gas analysis”, Bern, 10.10.2019

## Challenges of using noble gas isotope ratios for reconstructing mean global ocean temperatures, deep ocean circulation and Greenland temperature reconstruction

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# Mean Ocean Temperature (MOT) reconstruction based on noble gases

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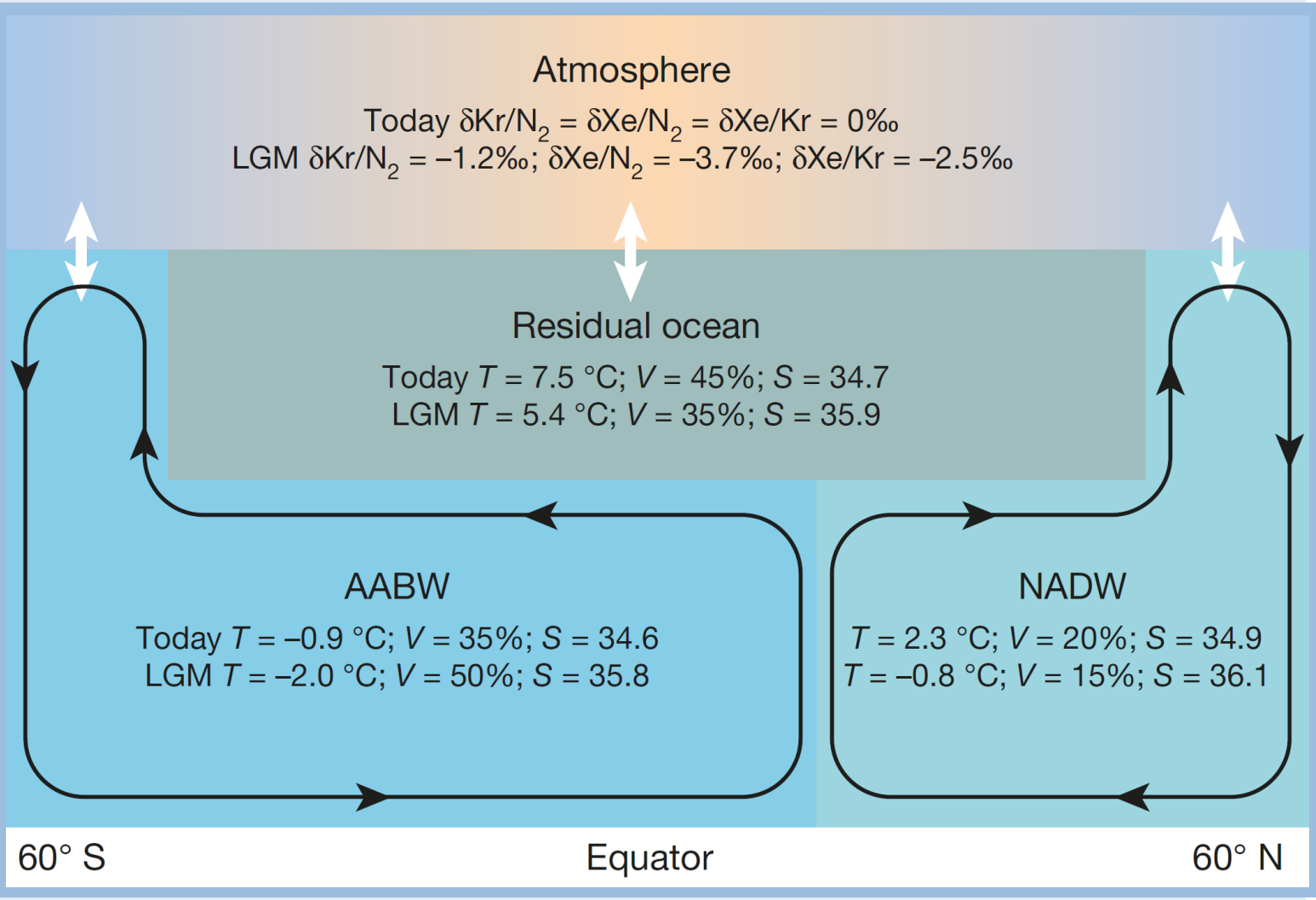


$Kr/N_2$
1‰ → 2°C

$Xe/N_2$
4‰ → 2.5°C

Xe/Kr
1‰ → 1°C



Baggenstos et al., PNAS 2019 

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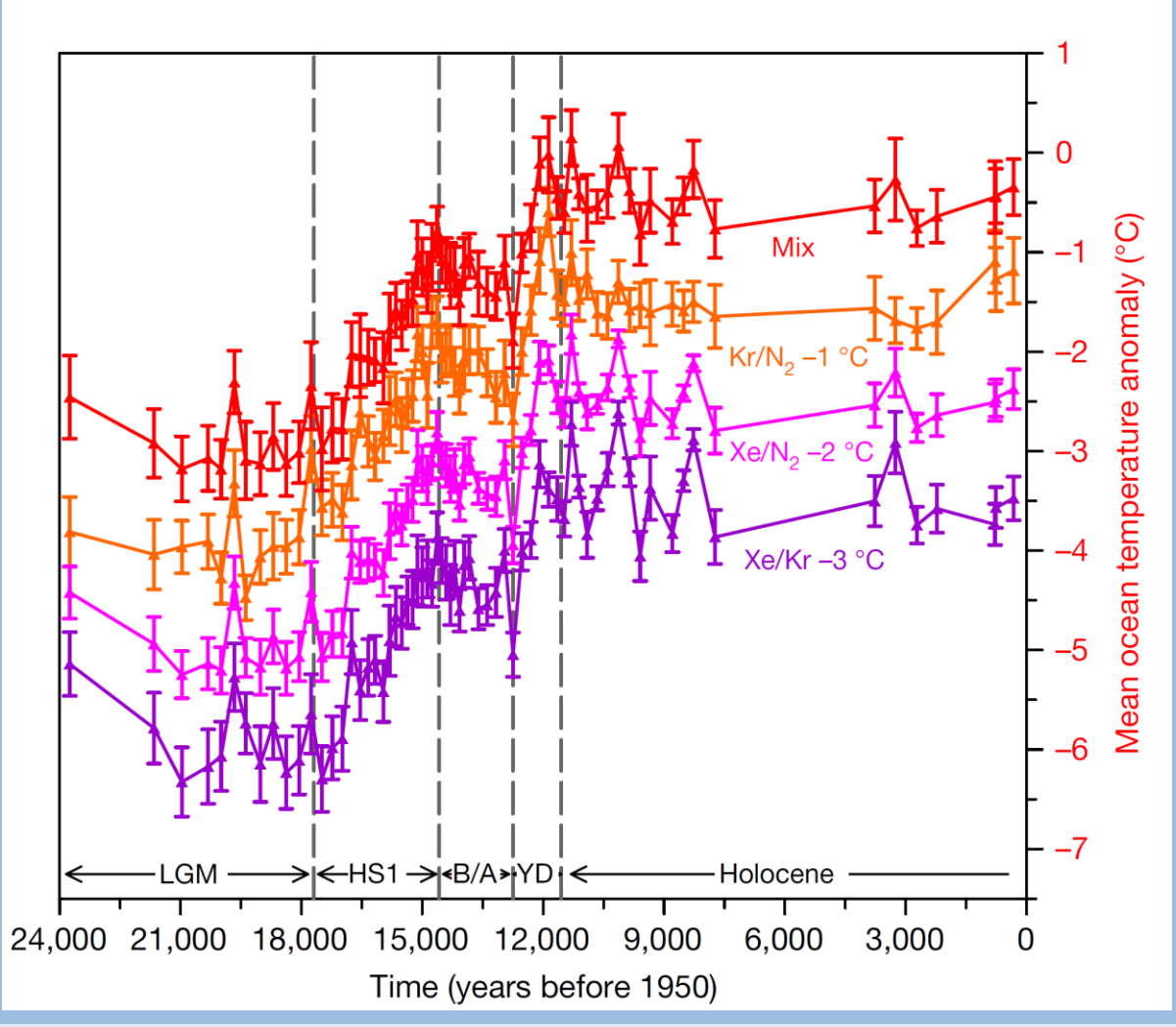


Ca. 2.5°C temperature change in the ocean from LGM to today



Bereiter et al., Nature 2018 

# Ocean Deep Circulation based on noble gases

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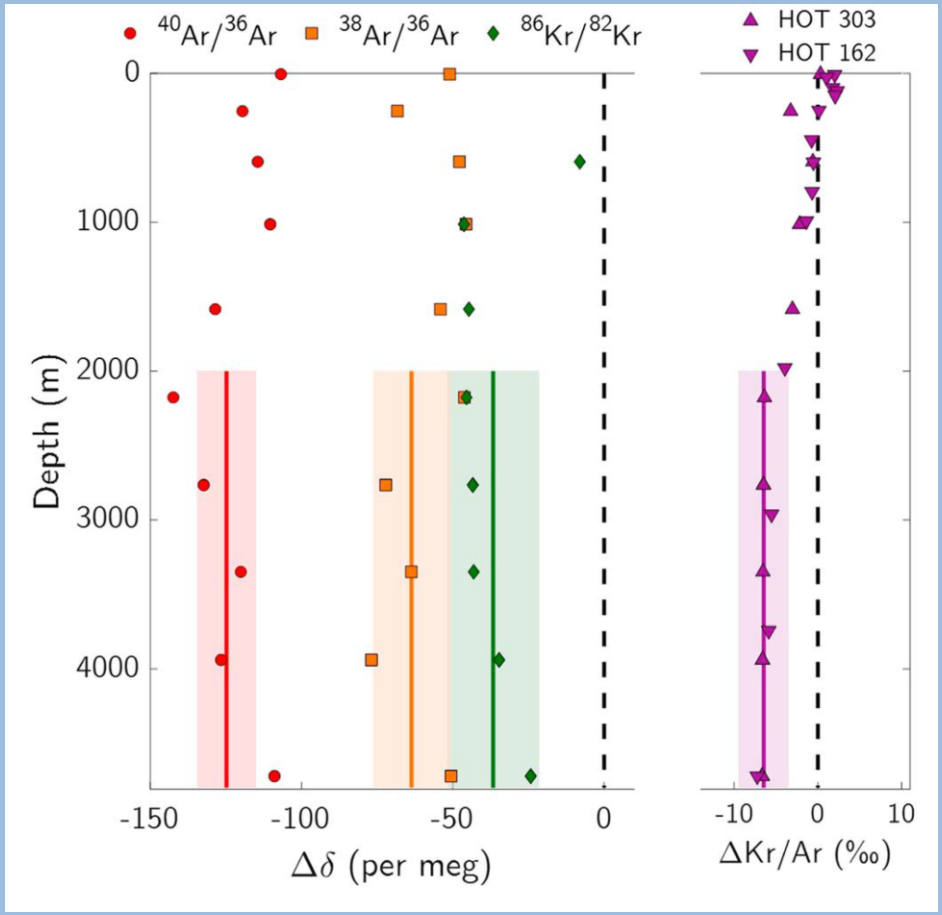


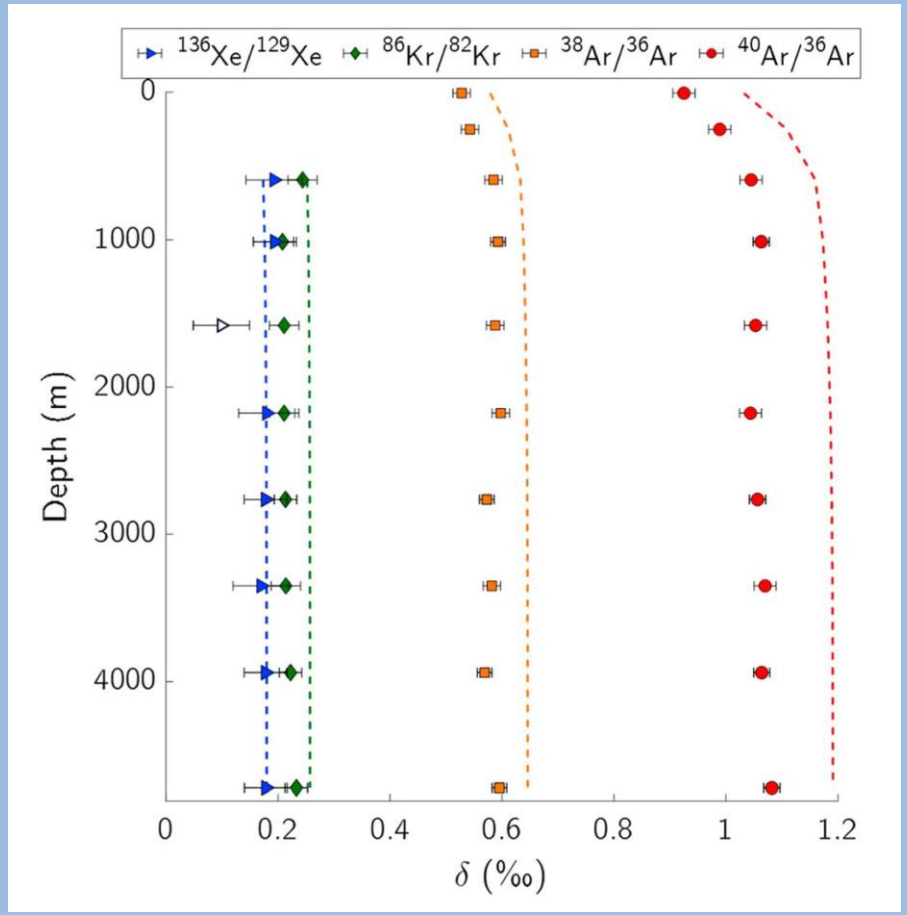




Seltzer et al., GRL 2019

# Ocean Deep Circulation based on noble gases

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Mean Δδ40/36Ar, Δδ38/36Ar, Δδ86/82Kr below 2000 m are −125 ± 10 per meg, −64 ± 13 per meg, −37 ± 15 per meg (±1 standard error), respectively, where 1 per meg = 0.001‰ = 0.0001%.

Deep-ocean mean Δδ136/129Xe is −2 ± 25 per meg. While uncertainties prevent meaningful interpretation of this small value, we suggest that future gains in analytical precision and large-volume sampling campaigns could resolve Xe isotopic disequilibria at the single per meg level.



Seltzer et al., GRL 2019 5

# Temperature reconstruction based on nitrogen and argon isotopes from ice cores

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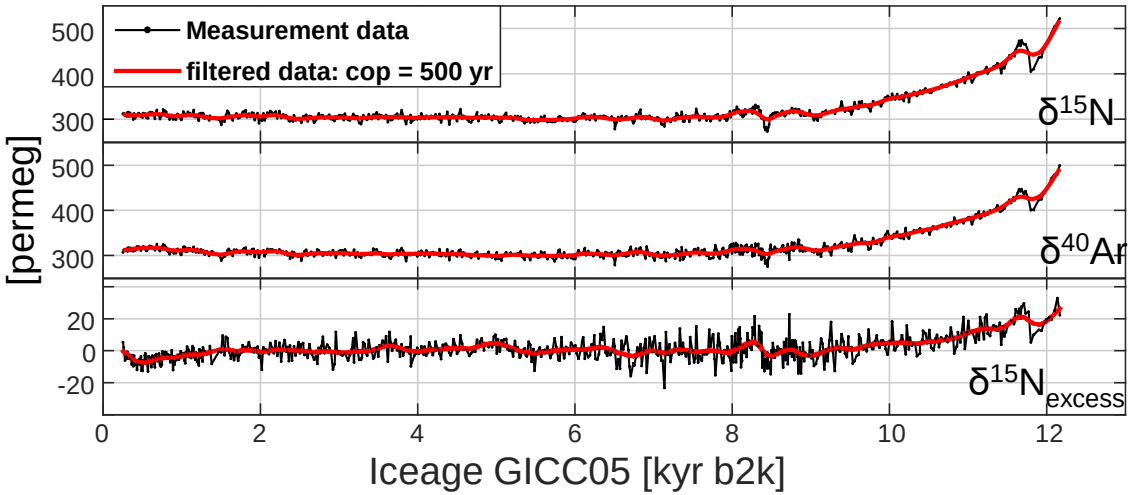


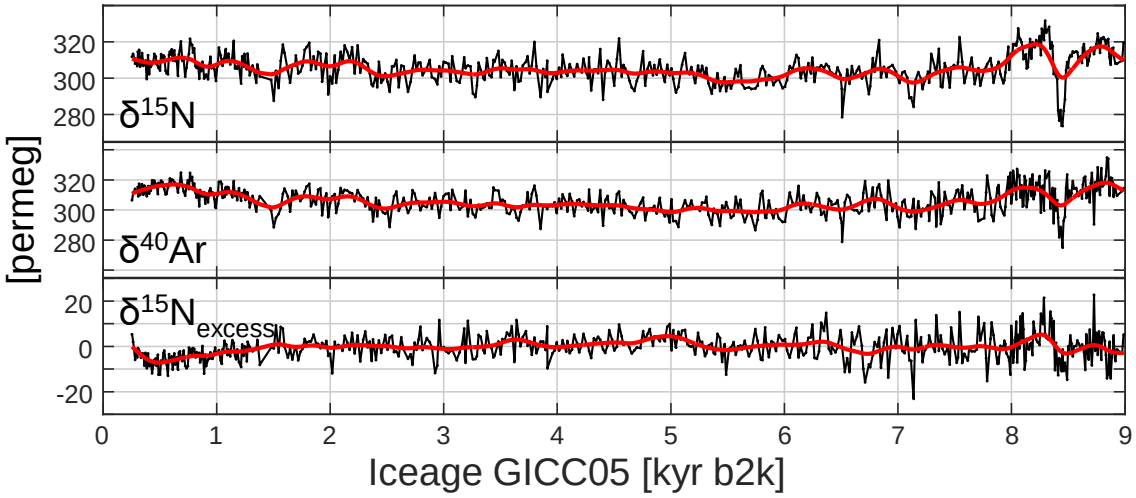


For $\delta^{15}N$
10°C →
0.15 permil or
150 per meg

1°C → 15 permeg

→ 8.2 kyr cooling
50 per meg
→ 3.5°C