Identifying Laurentide Ice Sheet freshwater discharge in the western Labrador Sea during the 8.2 ka Cold Event

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8.2 ka Cold Event Extent

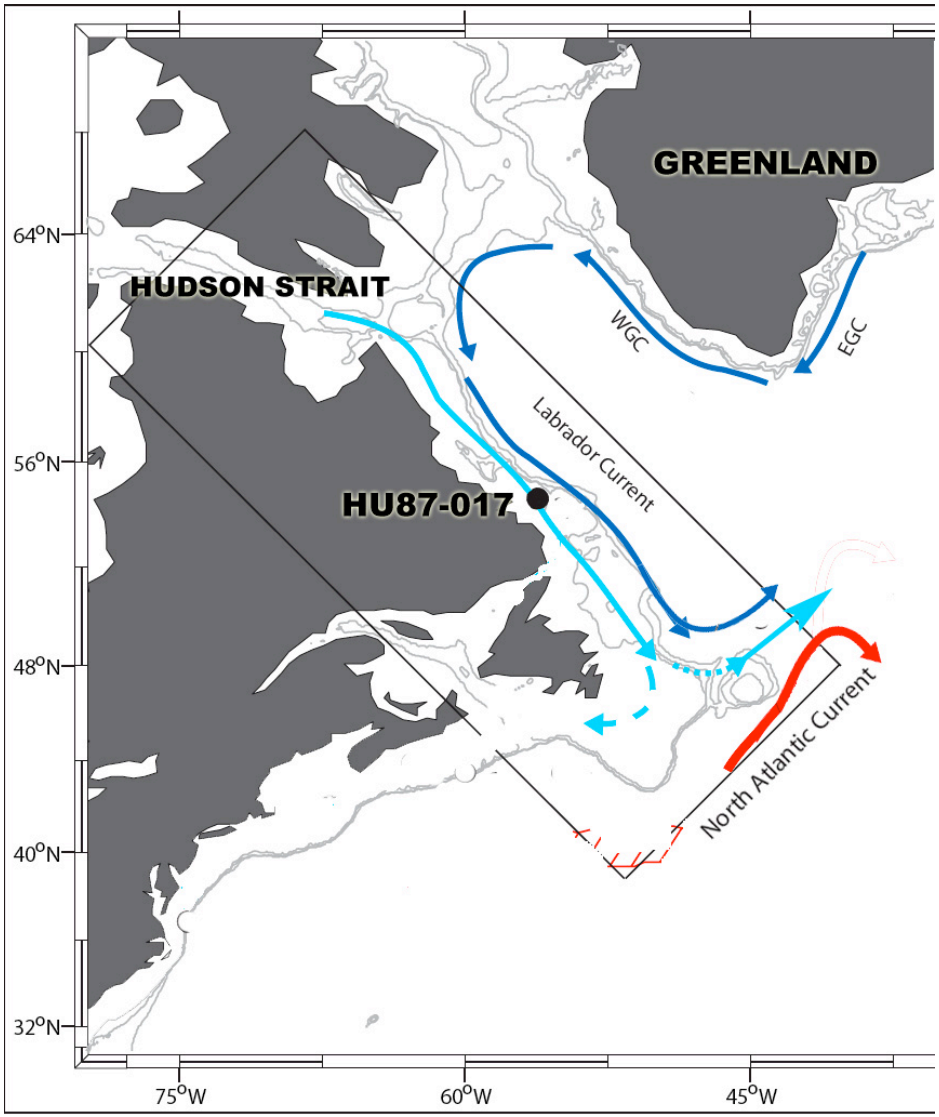
Alley & Ágústsdóttir, 2005

8.2 ka Event Forcing

- Caused by a reduction in at least the eastern branch of the Atlantic Meridional Overturning Circulation (AMOC)[1,2,3]
- Forced by drainage of Lake Agassiz into the Labrador Sea[4] and attendant routing of western Canadian Plains runoff[5]
- However, evidence for a freshwater signal in the Labrador Sea has yet to be identified[6,7]
- High-resolution ocean models also suggest freshwater would not make it to sites of convection and rather end up in subtropical gyre[8]

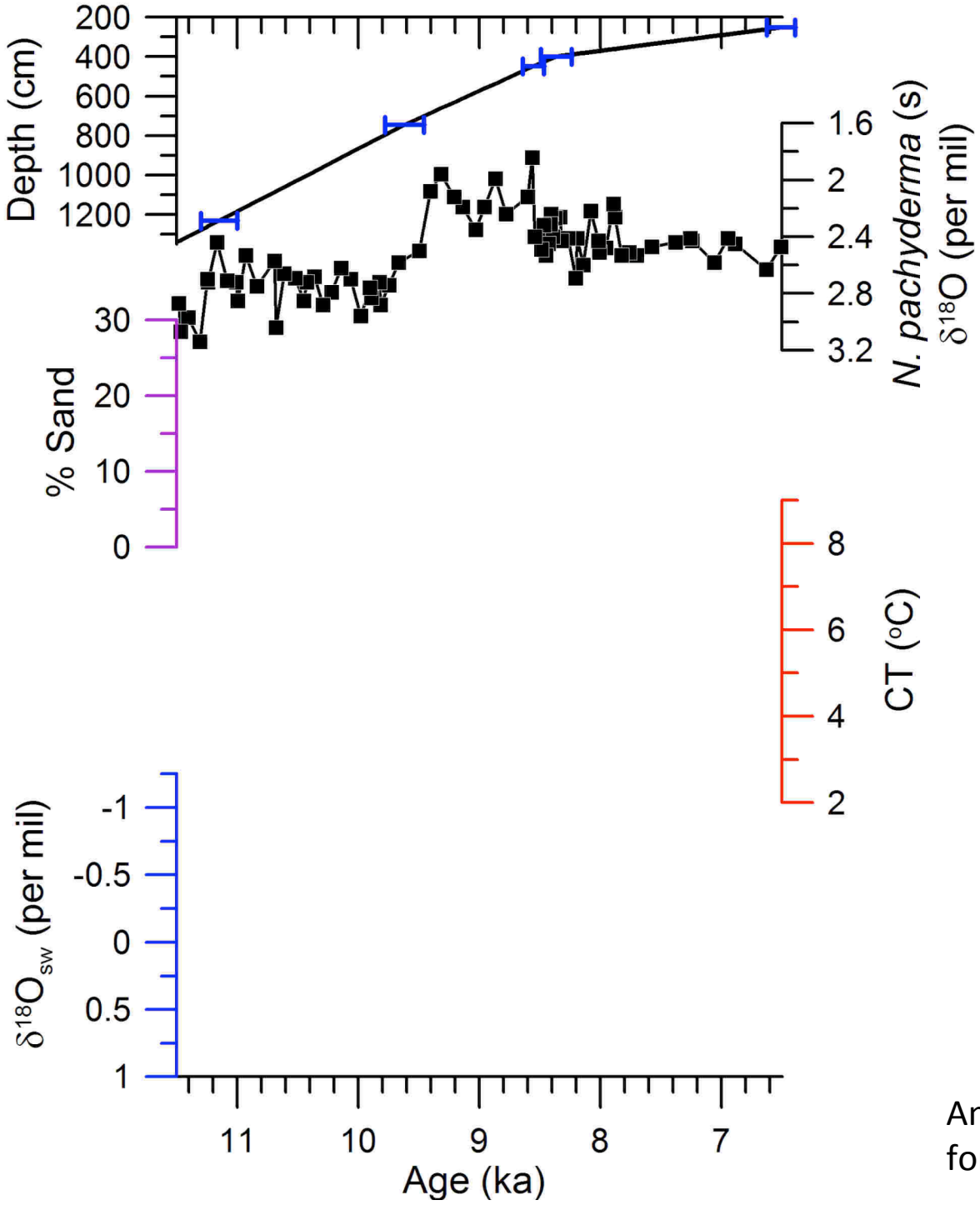
1. LeGrande et al., 2006; 2. Ellison et al., 2006; 3. Kleiven et al., 2008; 4. Barber et al., 1999; 5. Carlson et al., 2009; 6. Keigwin et al., 2005; 7. Hillaire-Marcel et al., 2007; 8. Condron & Winsor, 2011

Cartwright Saddle Record

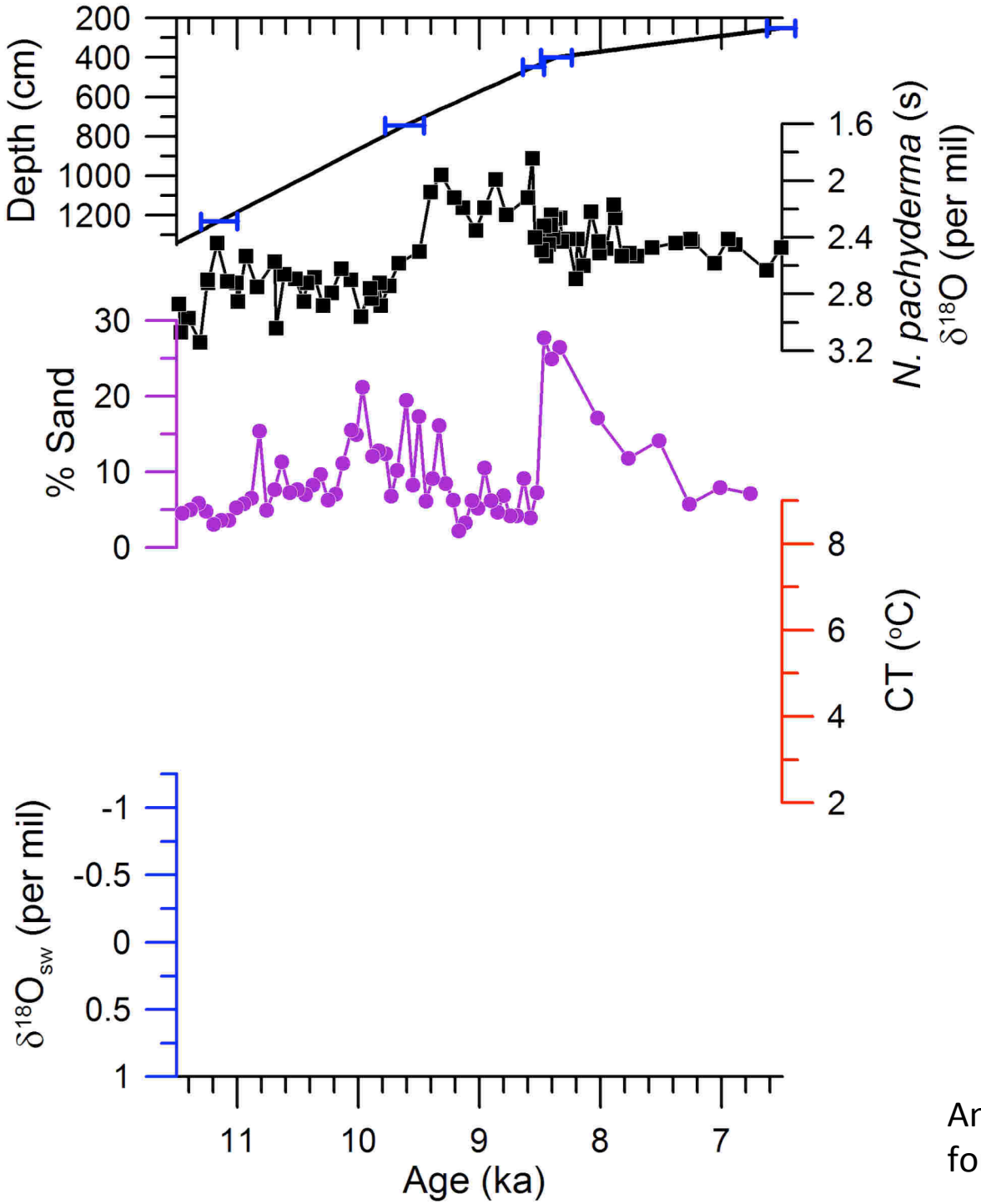


- Analyzed Mg/Ca on *N. pachyderma* (s) from piston core HU87033-017 from Cartwright Saddle converted to calcification temperature (CT) (Mashiotta et al., 1999)
- Existing $\delta^{18}O$ and ^{14}C chronology from Andrews et al. (1999) allows calculation of $\delta^{18}O_{sw}$ – salinity proxy (Bemis et al., 1998)

Modified from Condron & Winsor, 2011



Andrews et al., 1999
for $\delta^{18}O$ & ^{14}C



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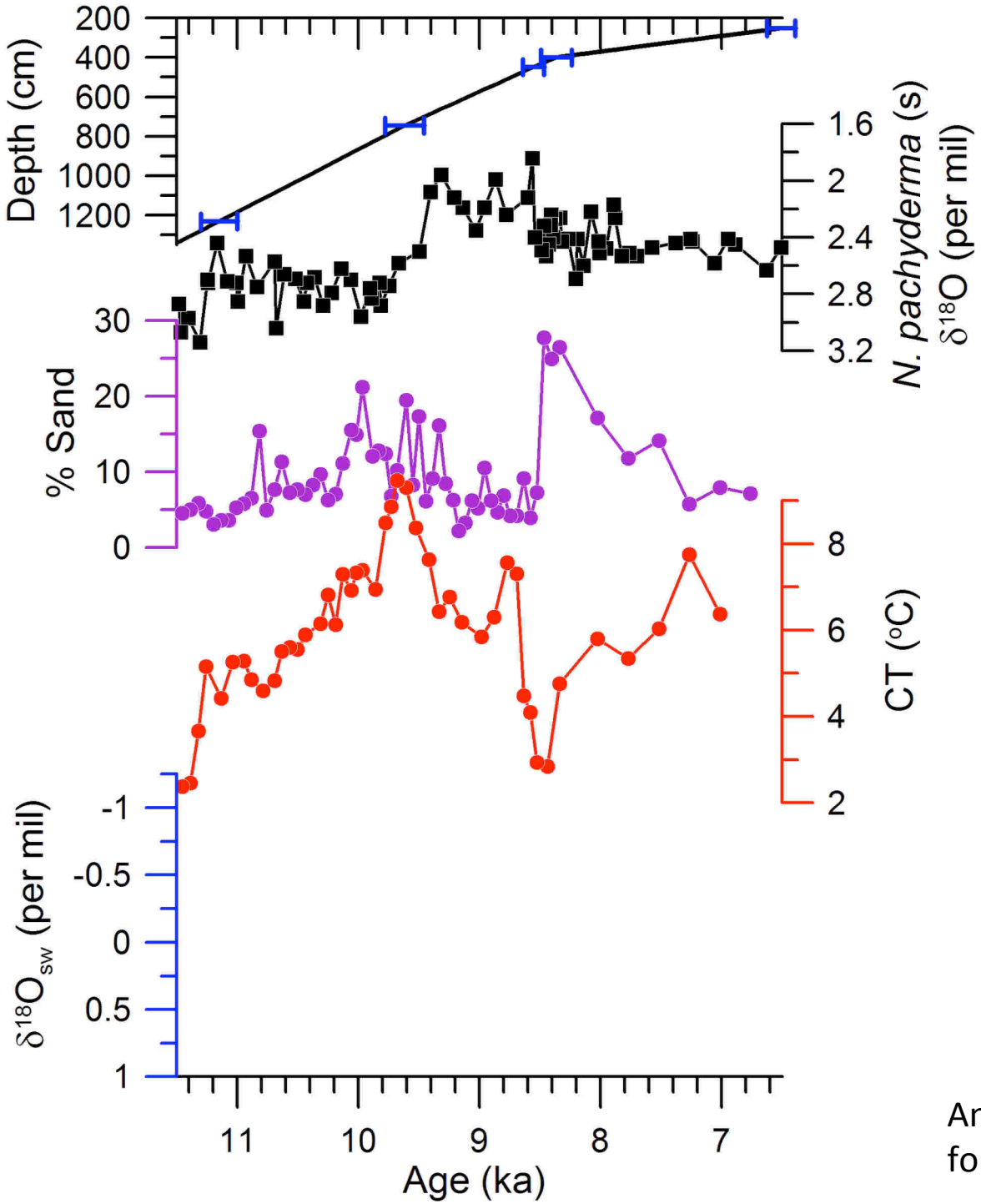

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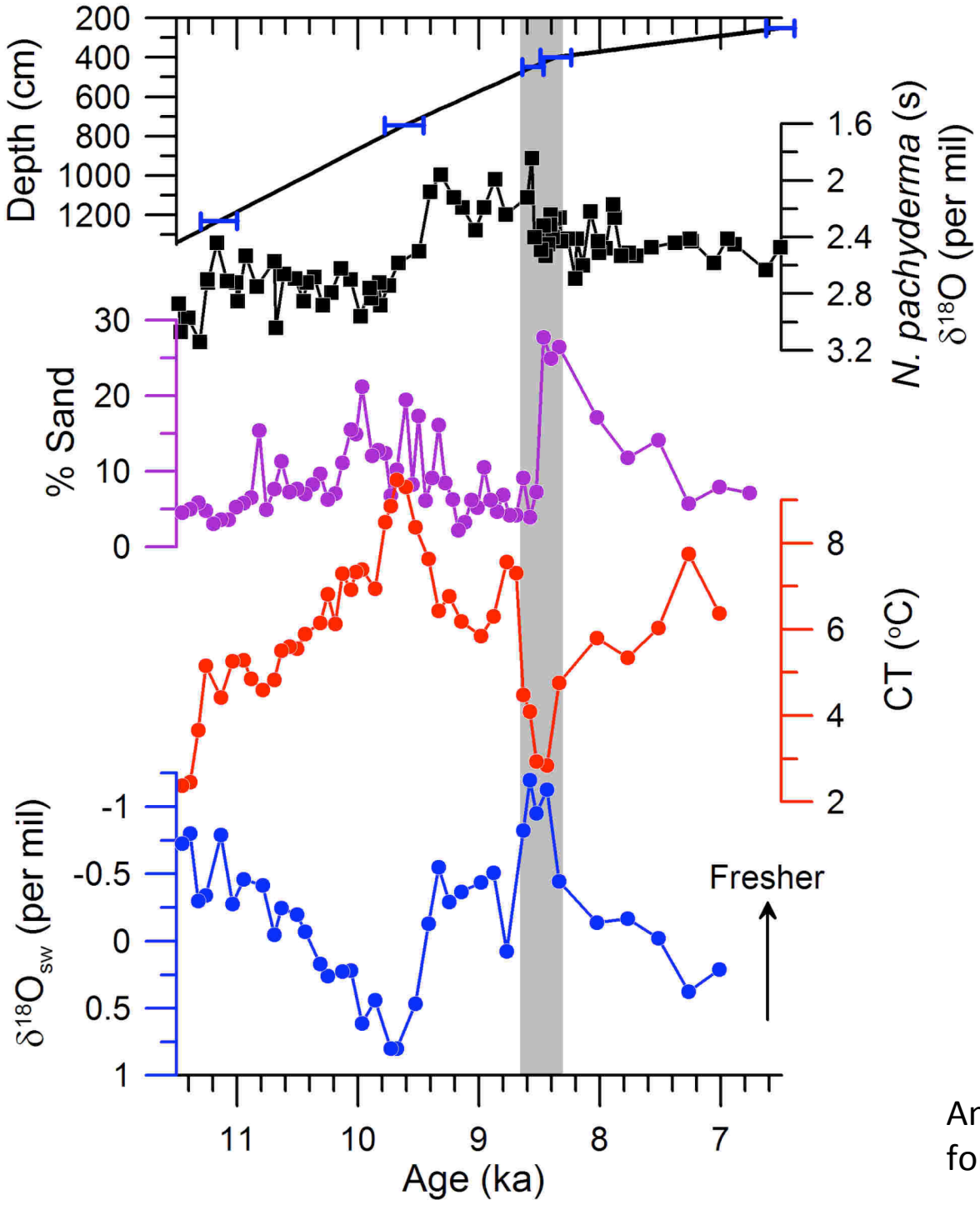

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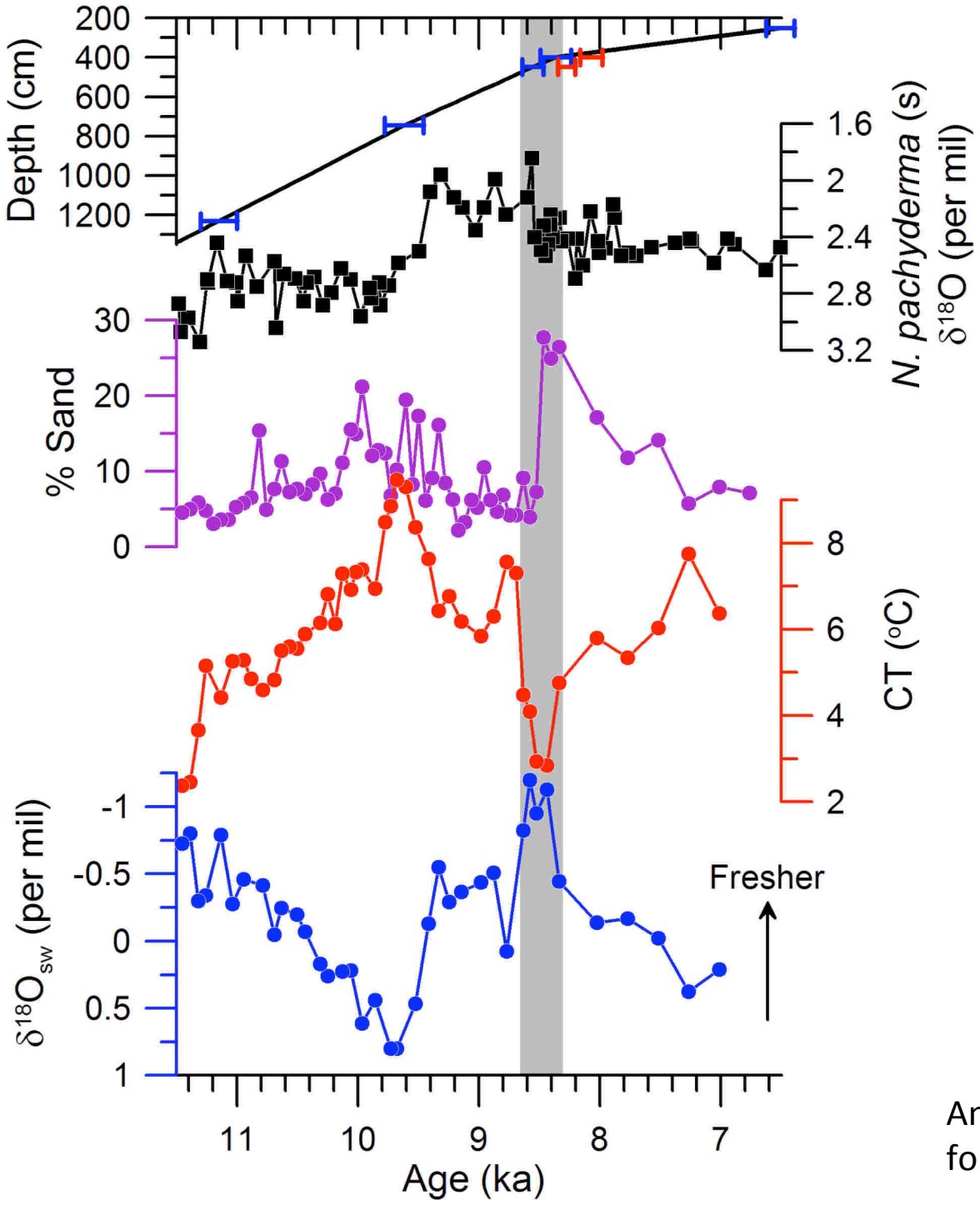

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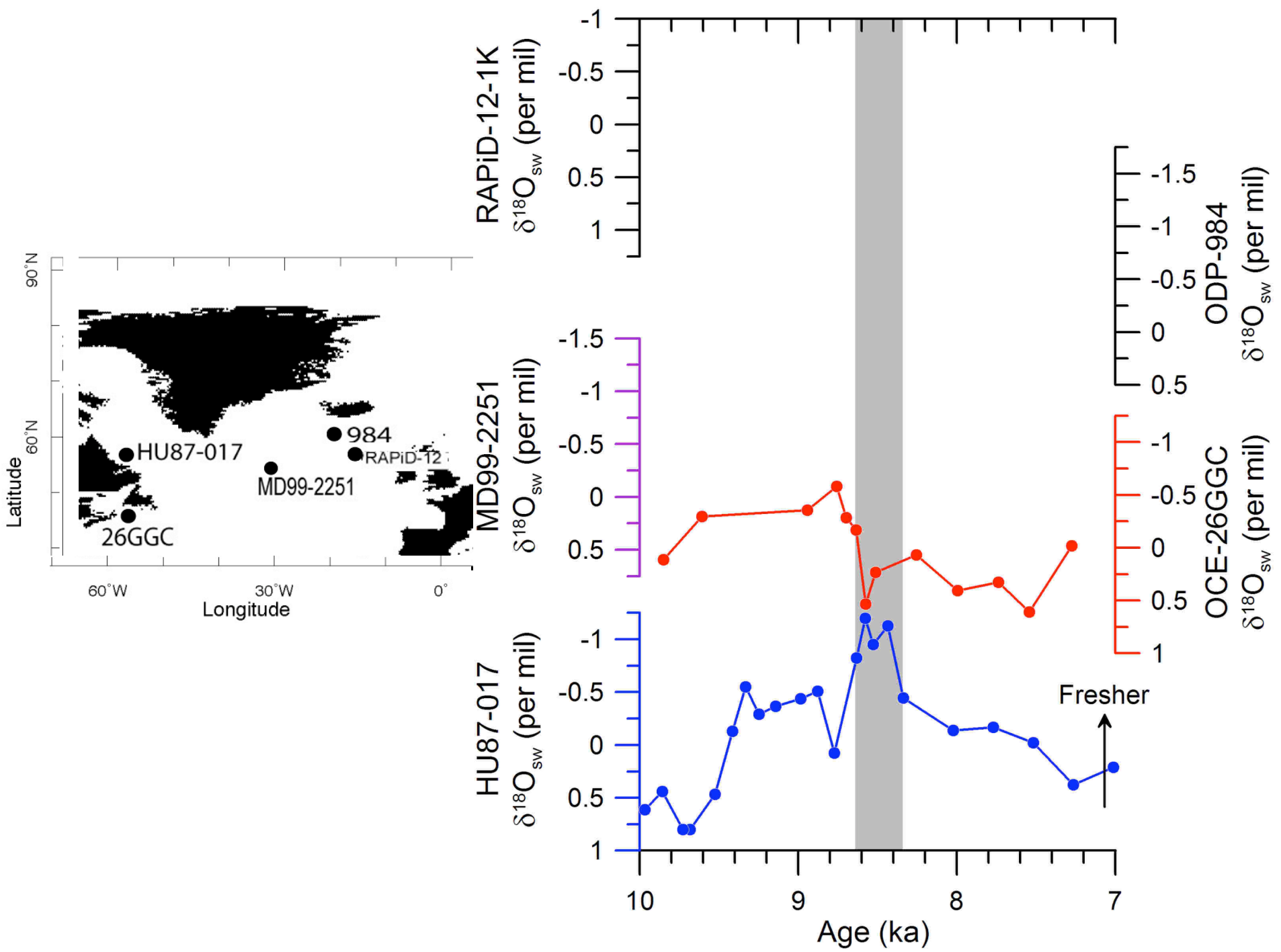
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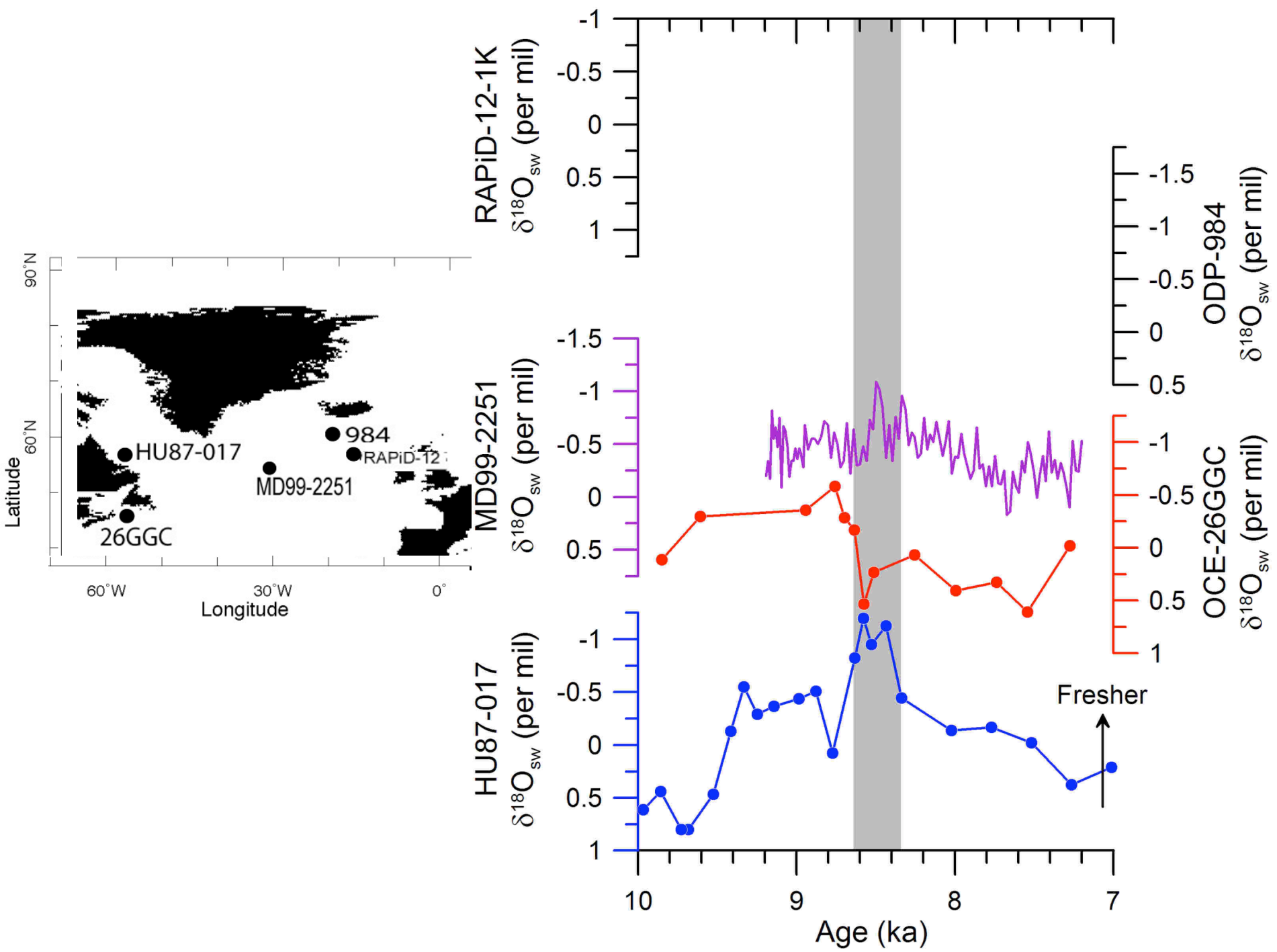
RAPiD-12
MD99-2251
26GGC
60°W
30°W
0°
Longitude
RAPiD-12-1K
δ18Osw (per mil)
MD99-2251
δ18Osw (per mil)
HU87-017
δ18Osw (per mil)
ODP-984
δ18Osw (per mil)
OCE-26GGC
δ18Osw (per mil)
Fresher
10
9
8
7
Age (ka)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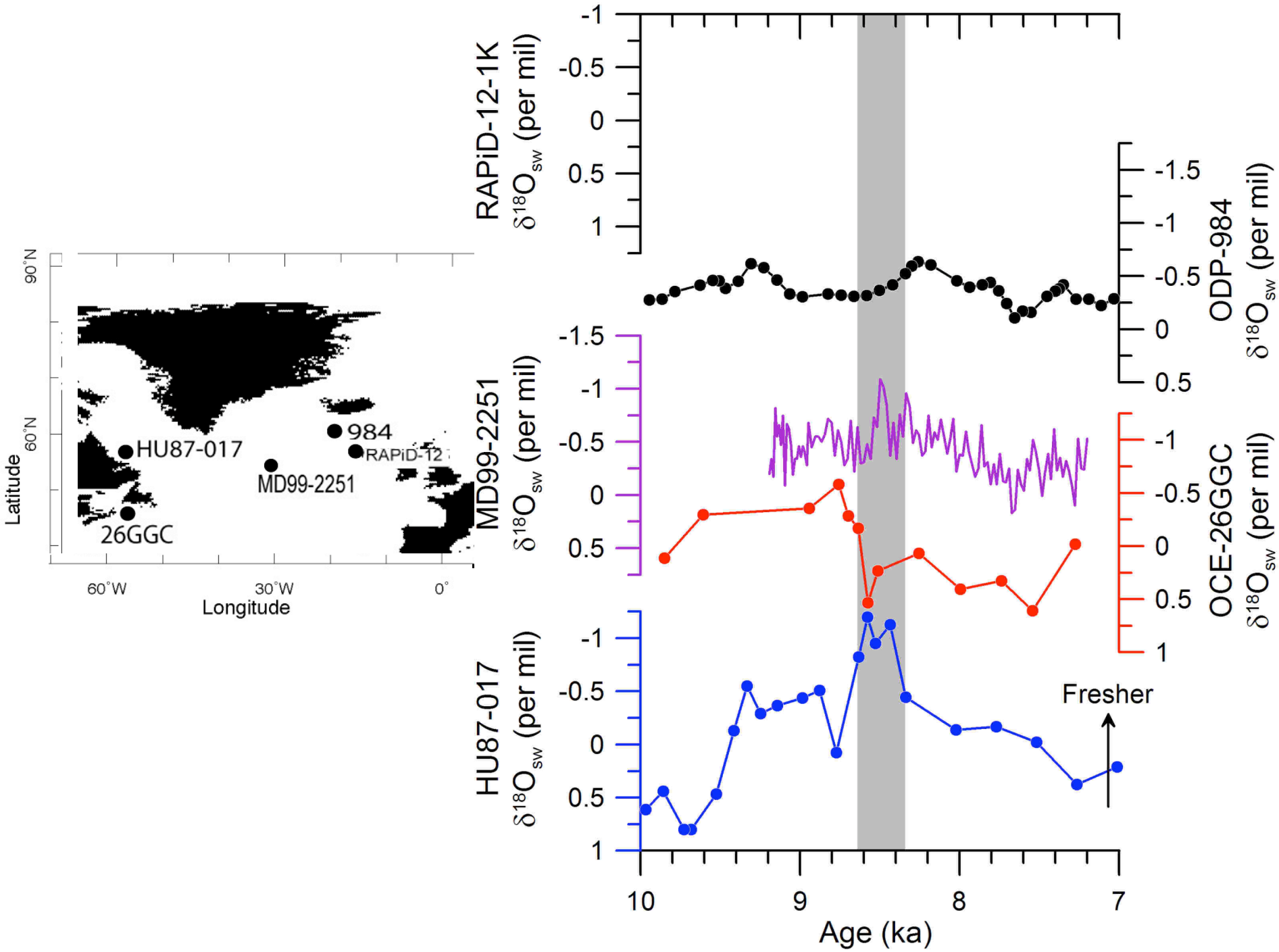
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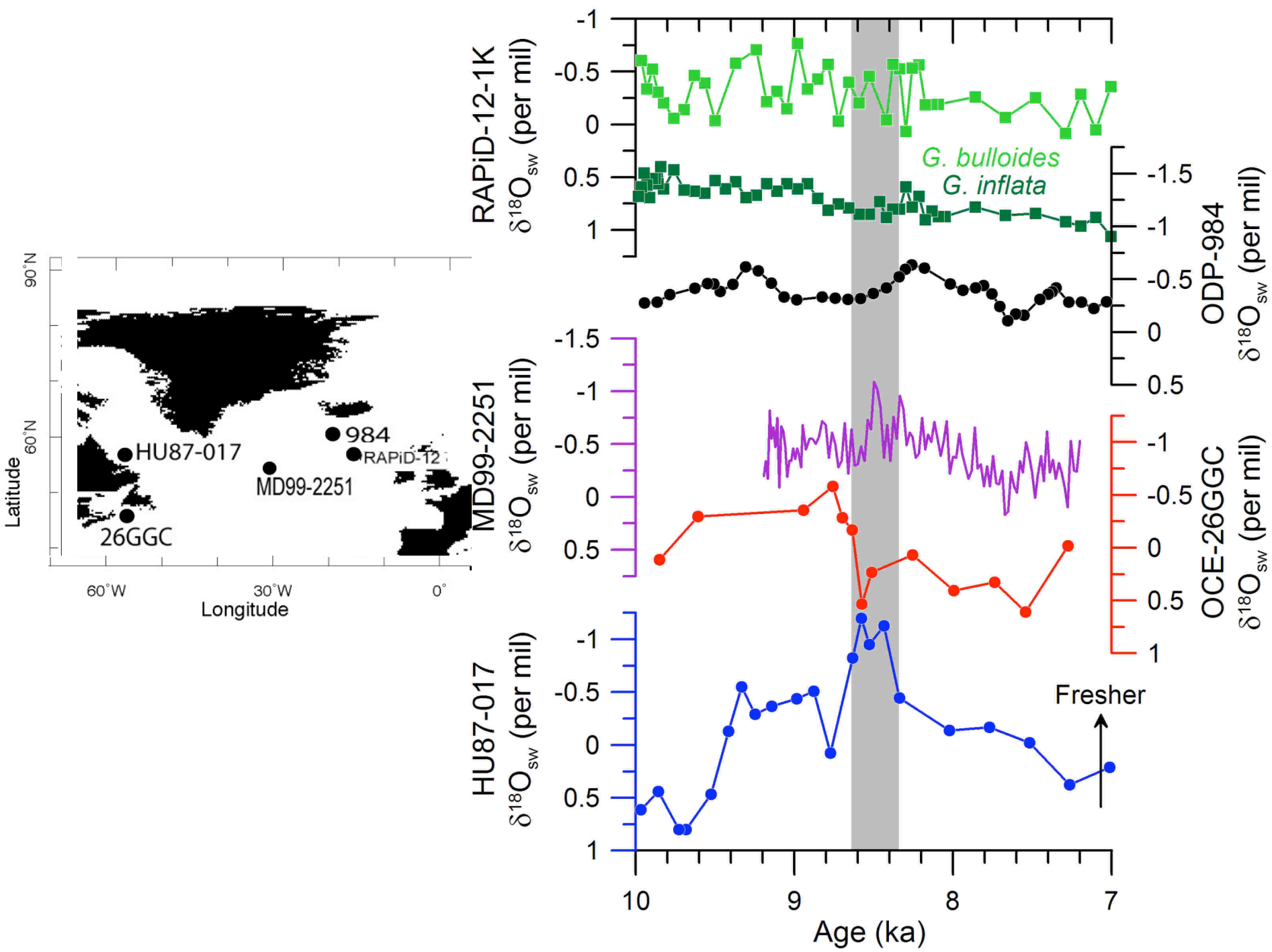
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G. inflata
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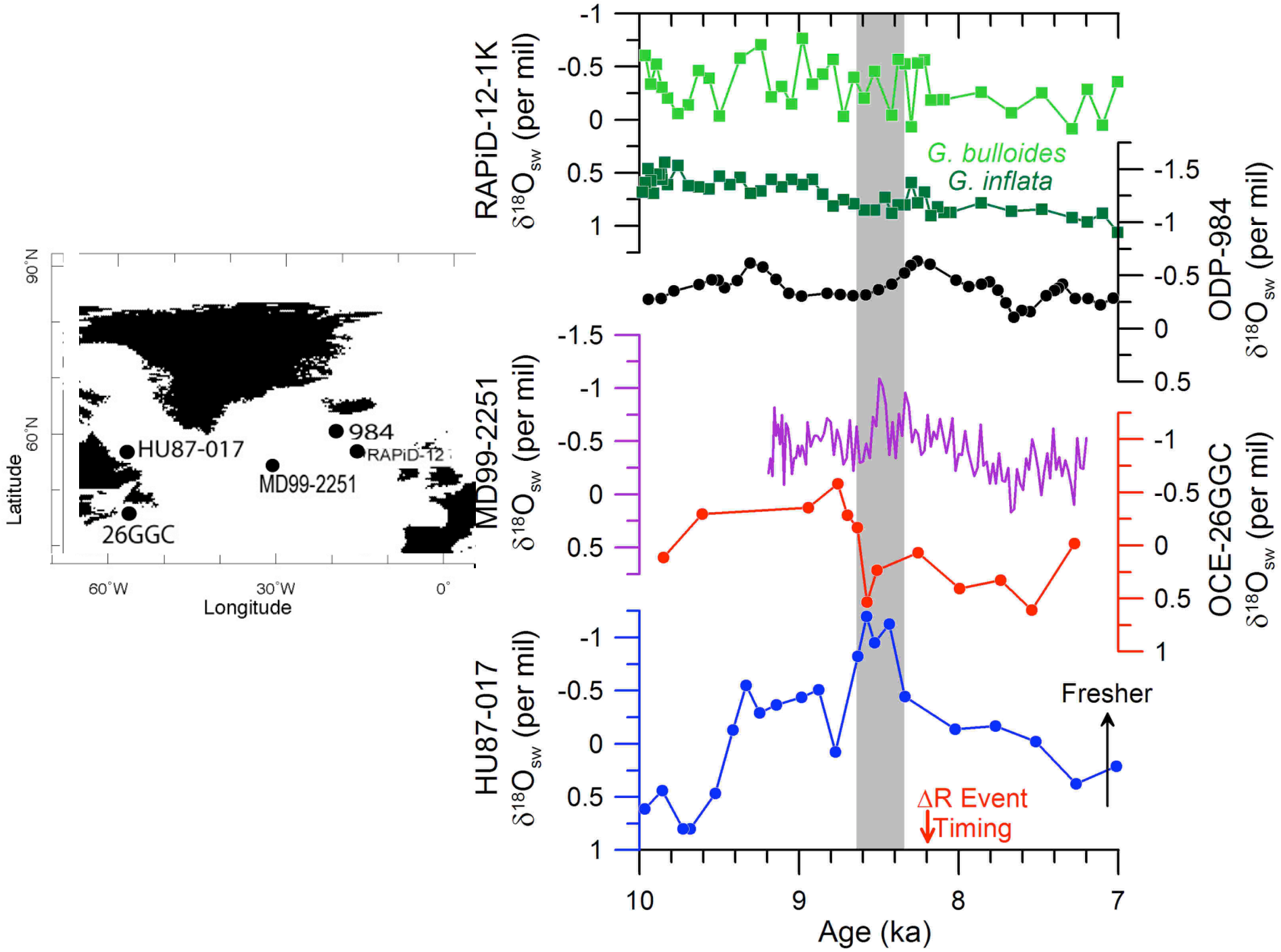
δ18Osw (per mil)
Fresher
Age (ka)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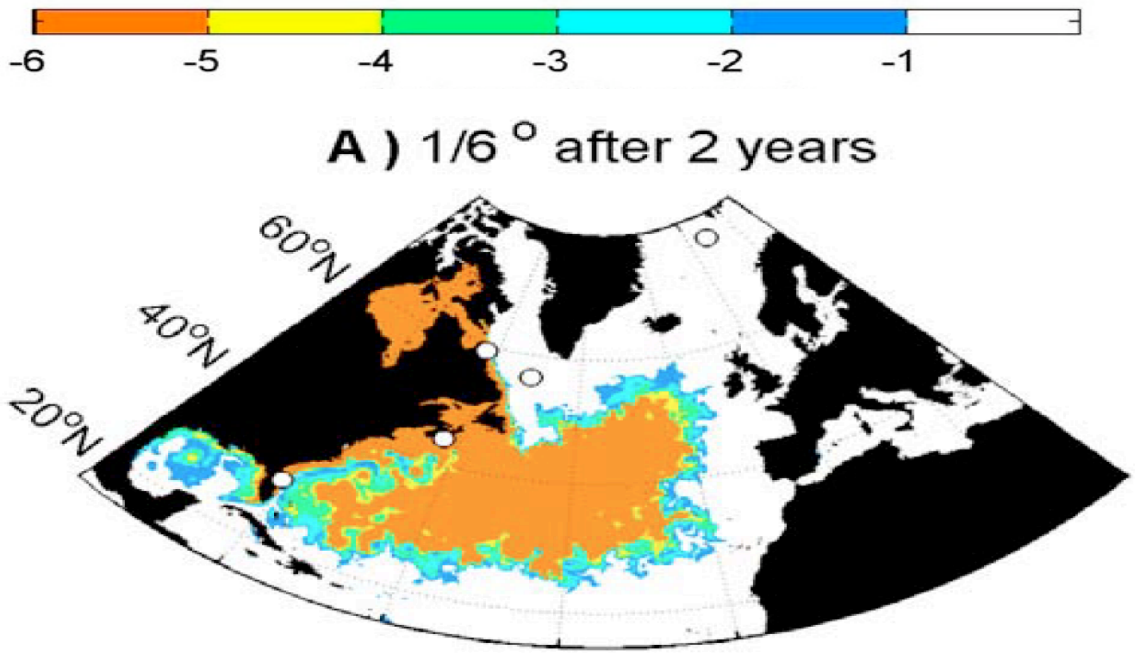
δ18Osw (per mil)
Fresher
ΔR Event
Timing
Age (ka)

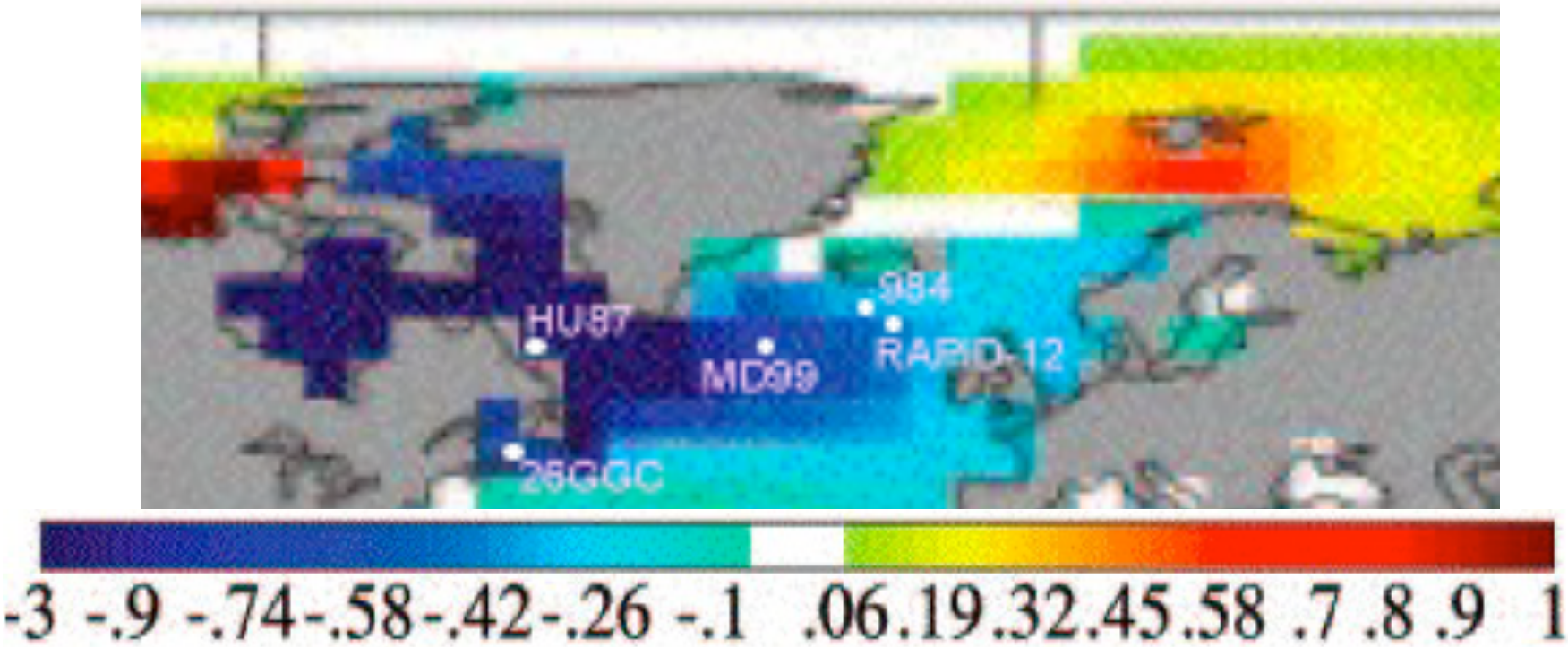
Freshwater Path



- Salinity change in response to 5 Sv freshwater added to Hudson Strait
- Pattern does not match $\delta^{18}O_{sw}$ records

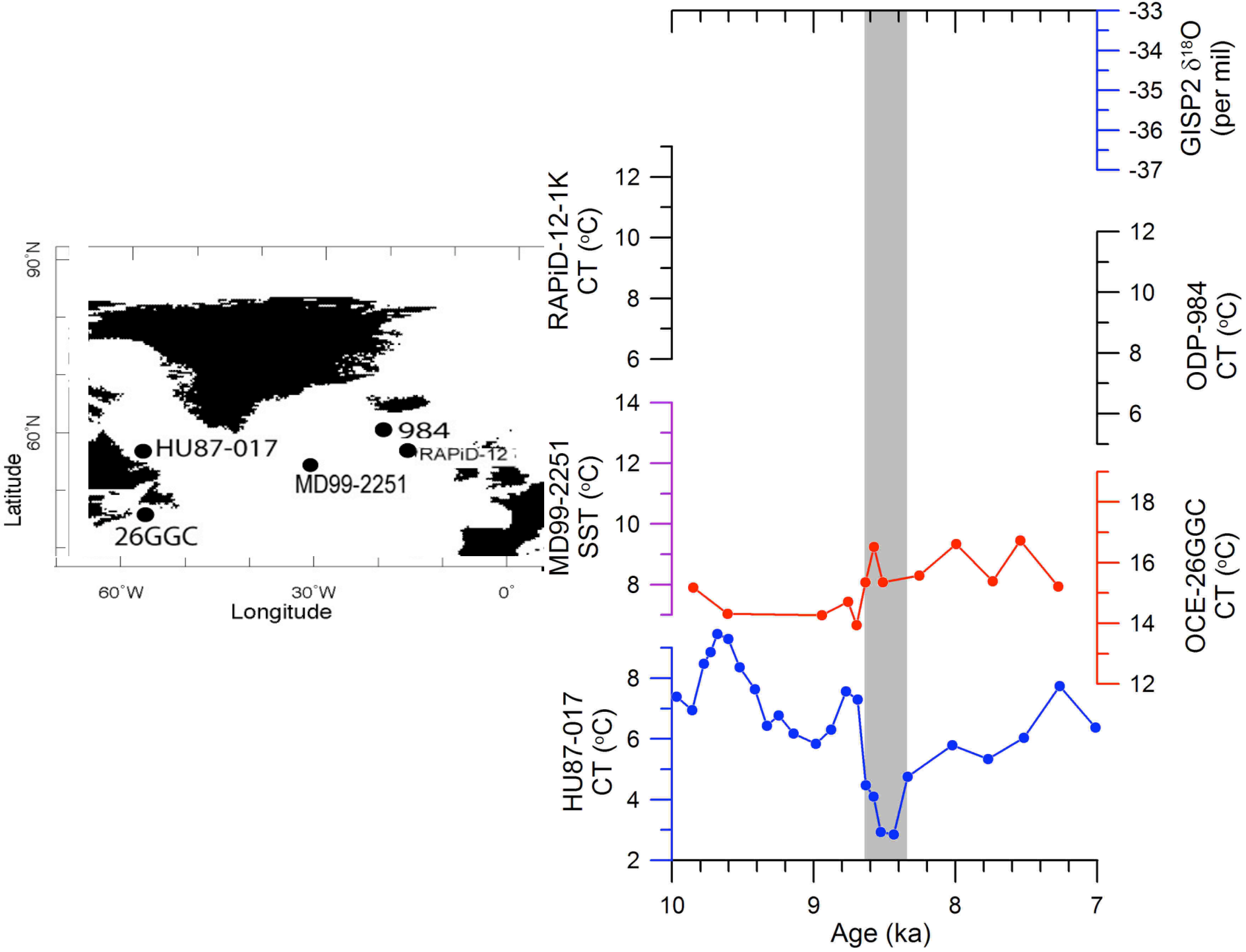
Condron & Winsor, 2011

Freshwater Path



- Blue is $\delta^{18}O_{sw}$ depletion from 5 Sv freshwater added to Hudson Strait
- Pattern matches $\delta^{18}O_{sw}$ records

LeGrande et al., 2006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Longitude
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CT (°C)
12
10
8
6
GISP2 δ18O
(per mil)
-33
-34
-35
-36
-37
ODP-984
CT (°C)
12
10
8
6
MD99-2251
SST (°C)
14
12
10
8
OCE-26GGC
CT (°C)
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16
14
12
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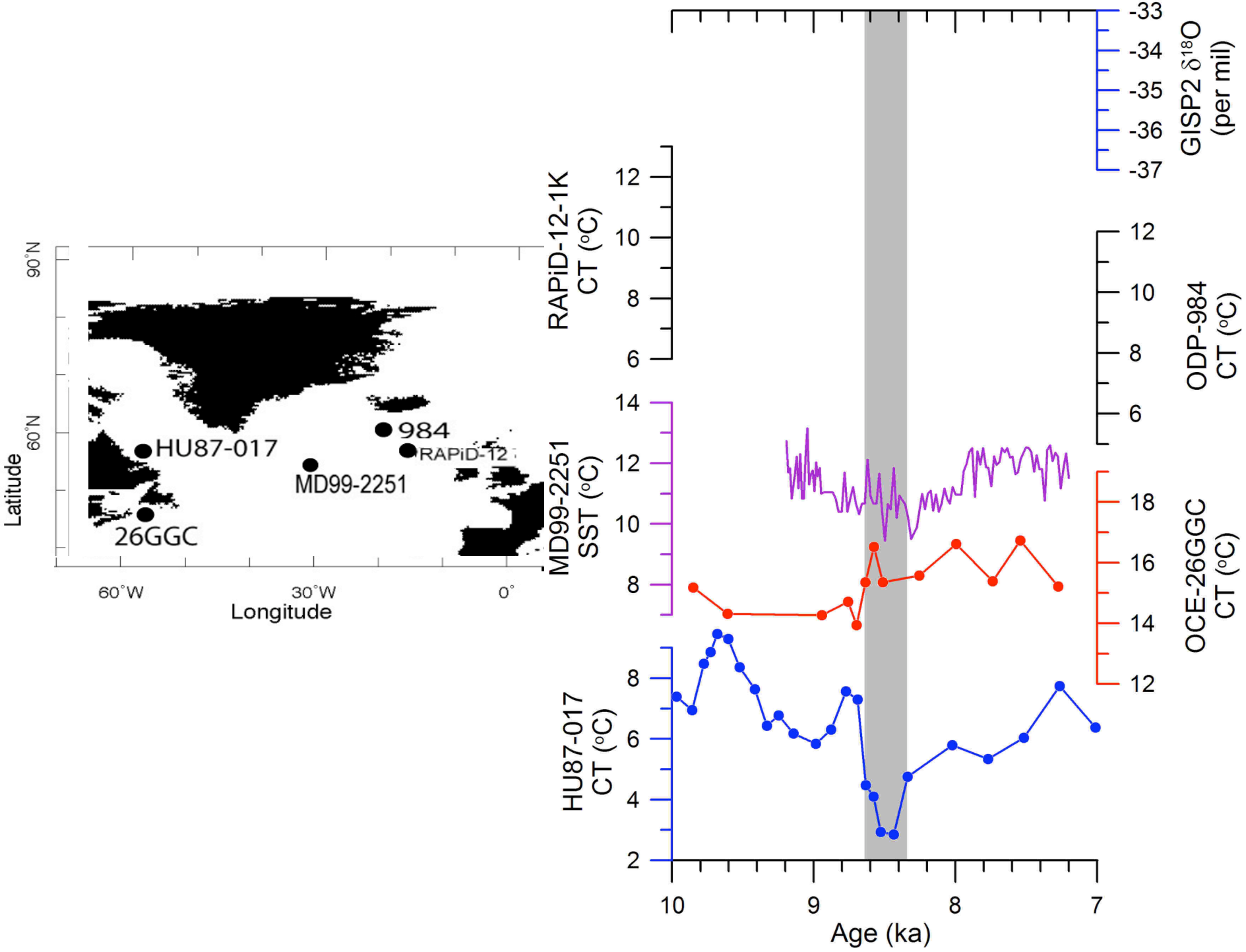
CT (°C)
8
6
4
2
10
9
8
7
Age (ka)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SST (°C)
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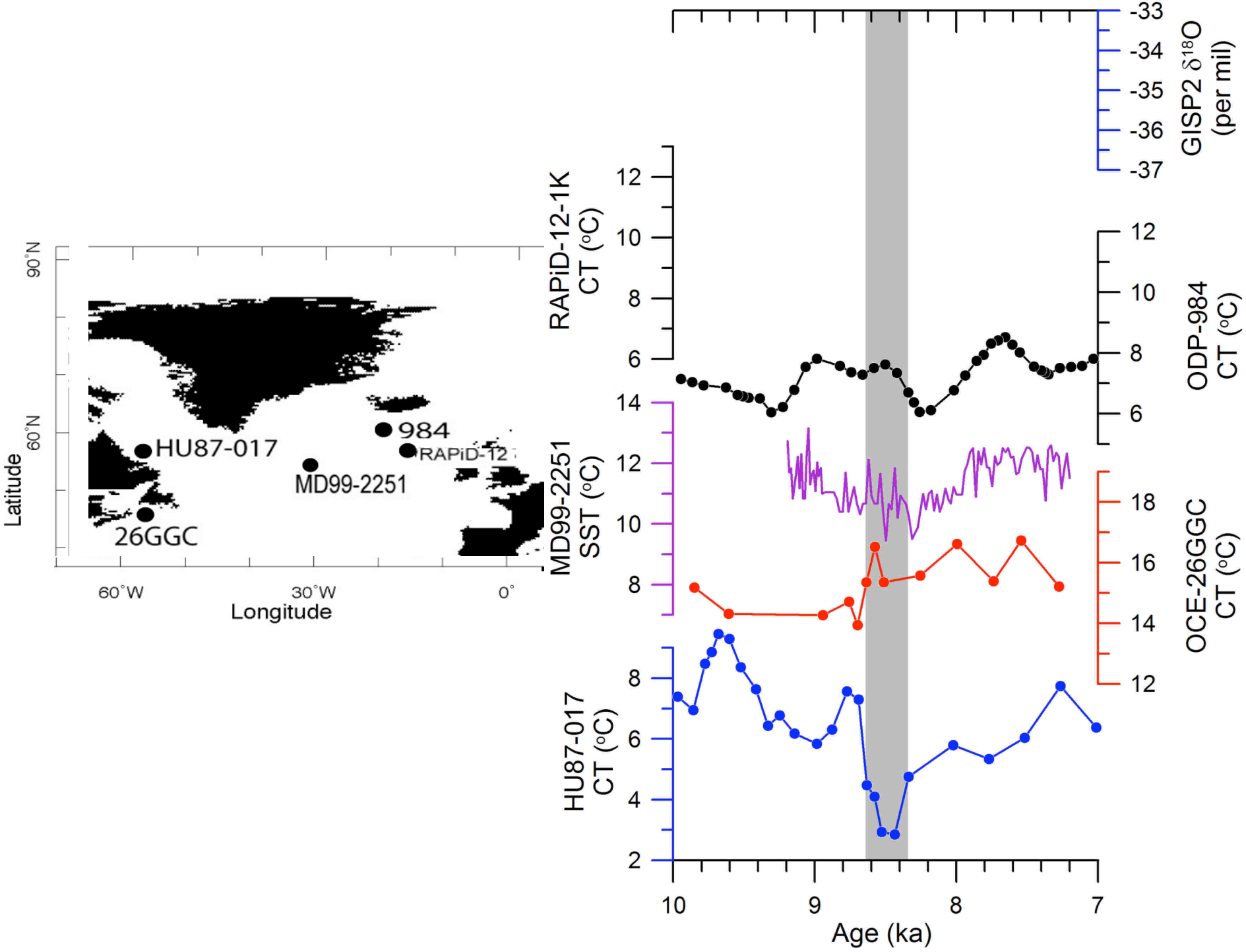
Age (ka)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GISP2 δ18O
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ODP-984
CT (°C)
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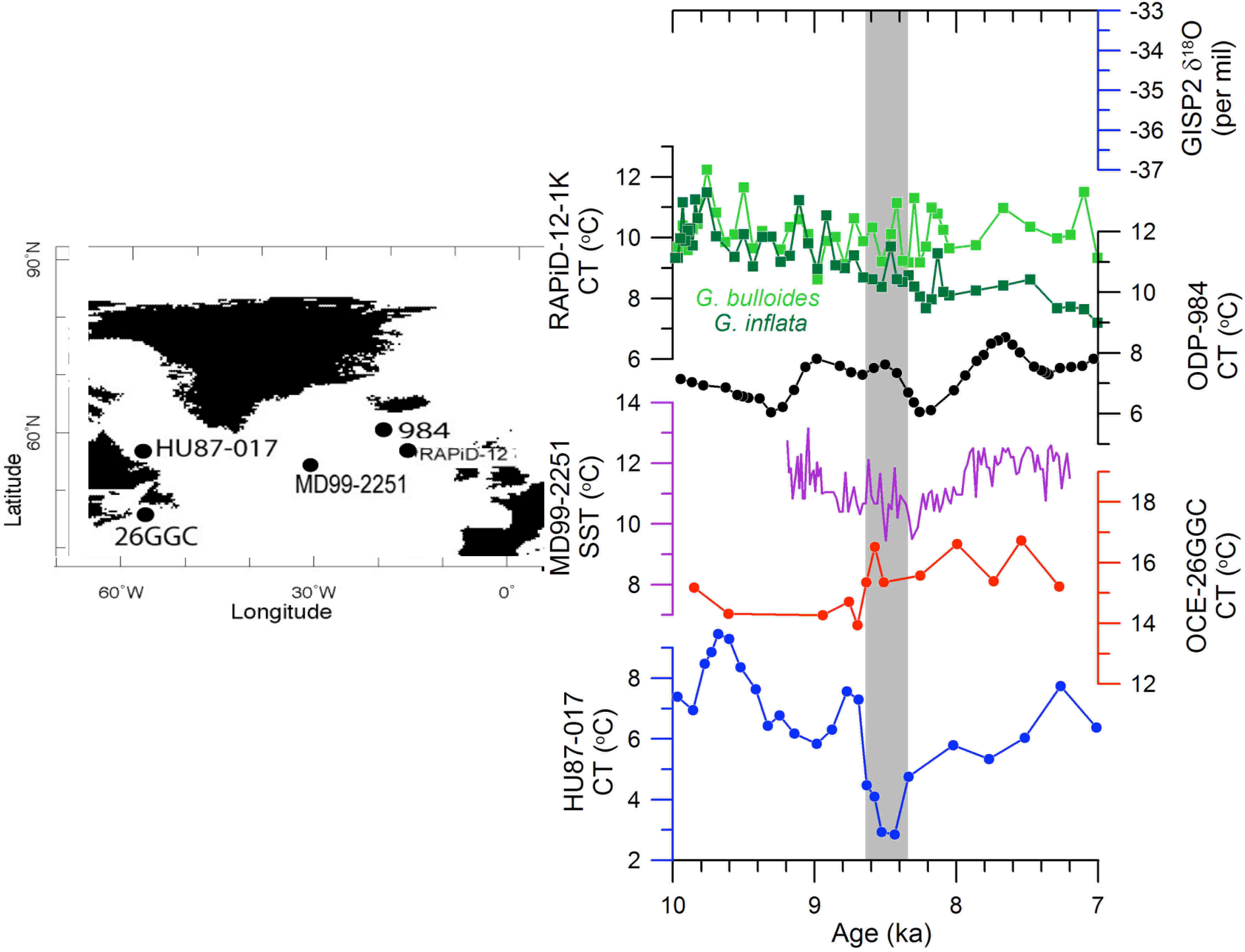
CT (°C)
HU87-017
CT (°C)
Age (ka)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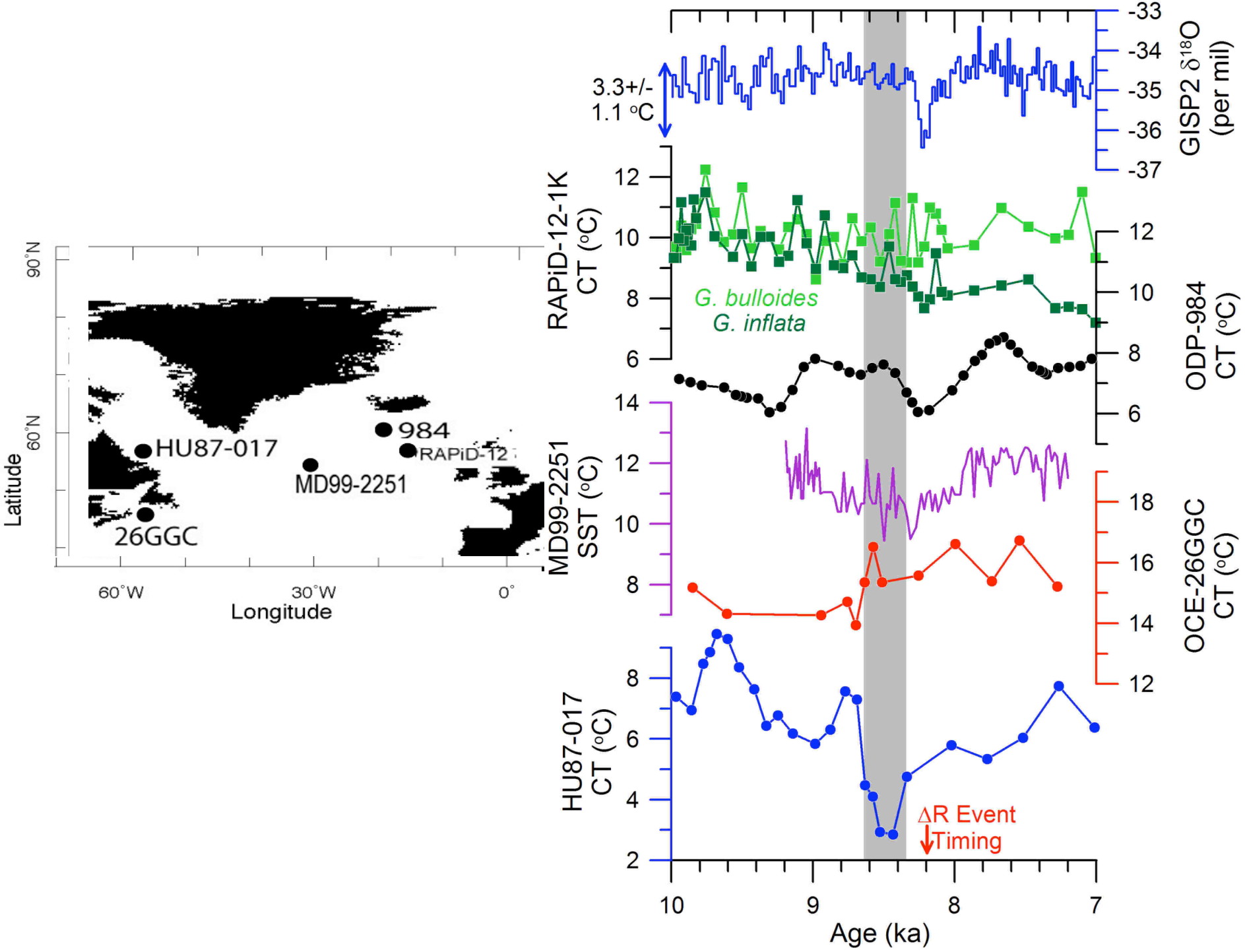
CT (°C)
Age (ka)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Longitude
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1.1 °C
GISP2 δ18O
(per mil)
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-36
-37
RAPiD-12-1K
CT (°C)
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G. bulloides
G. inflata
ODP-984
CT (°C)
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MD99-2251
SST (°C)
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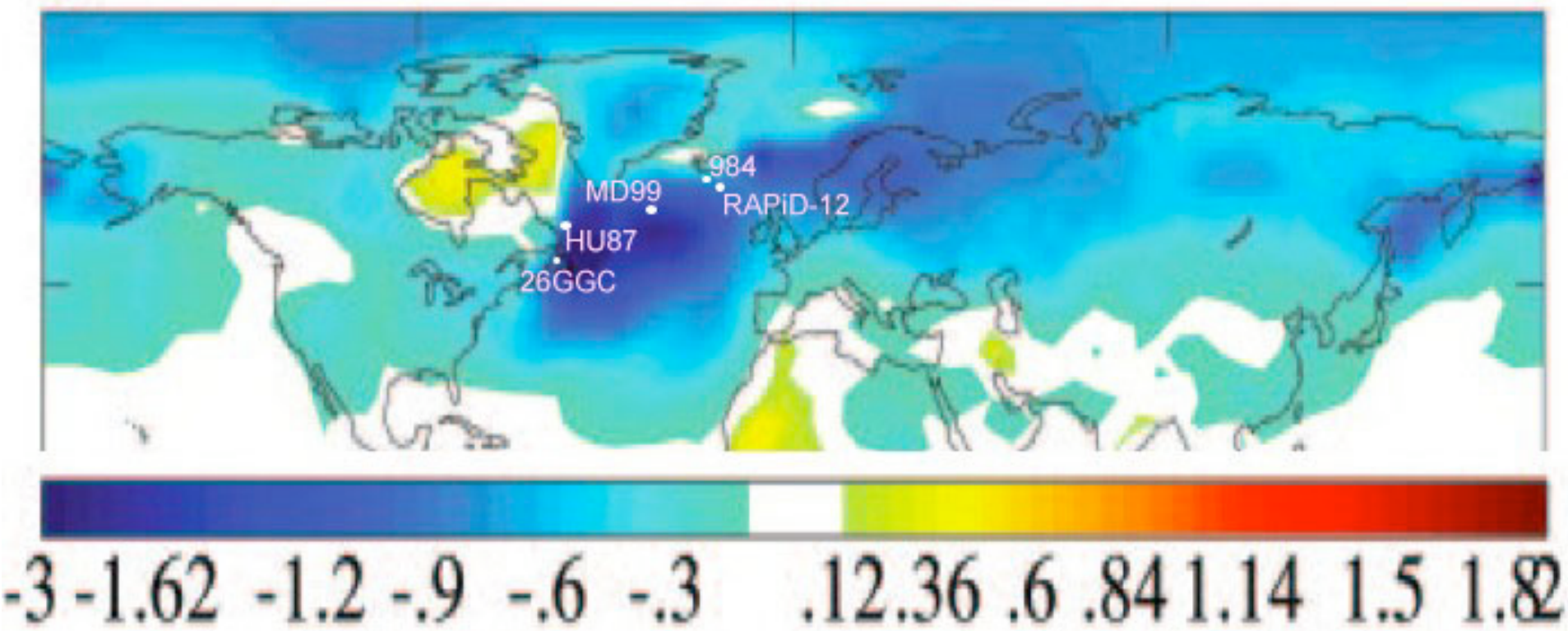
18
16
14
12
OCE-26GGC
CT (°C)
HU87-017
CT (°C)
8
6
4
2
ΔR Event
Timing
10
9
8
7
Age (ka)

Temperature Response



SAT Change (°C)

- Largest temp. change in Labrador Sea, consistent with our reconstruction

LeGrande et al., 2006

Conclusions

- Our $\delta^{18}O_{sw}$ record confirms the forcing of the 8.2 ka Cold Event from Lake Agassiz drainage and attendant routing of freshwater to the Labrador Sea

- The largest SST decrease in the Labrador Sea suggests that convection was also reduced in the Labrador Sea during the 8.2 ka event in addition to reduced convection in the Greenland-Iceland-Norwegian Sea (Ellison et al., 2006)

Questions