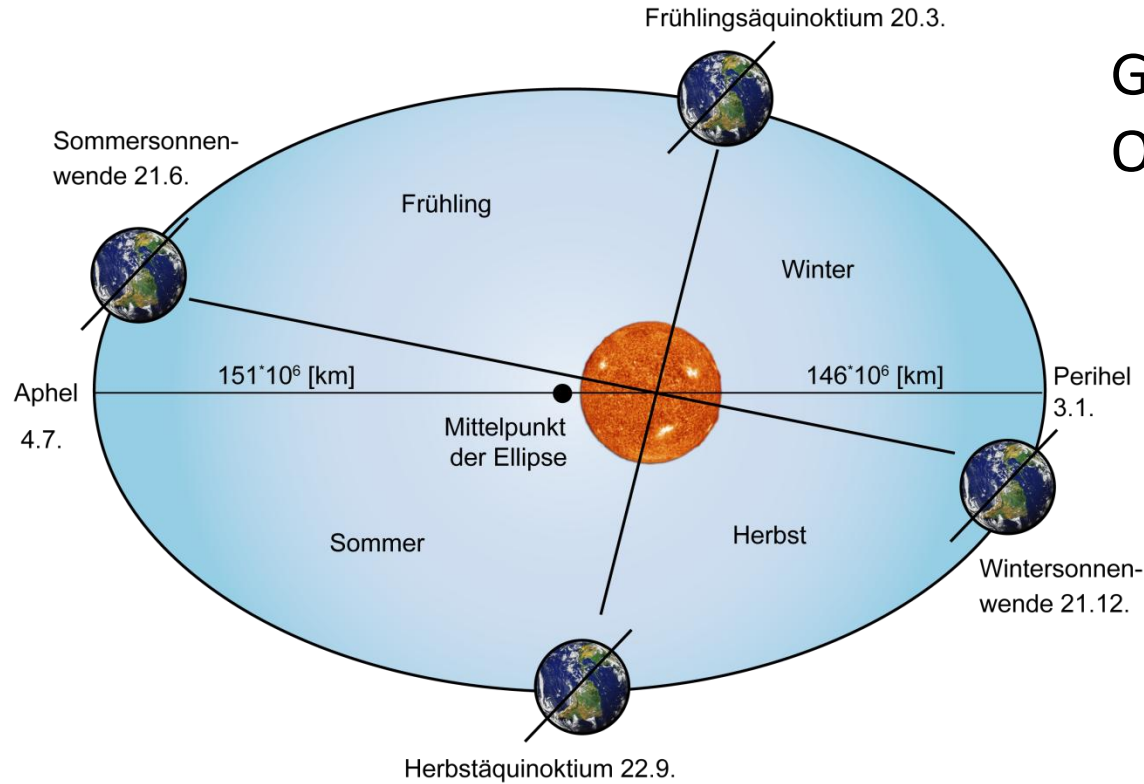


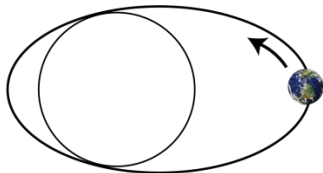
# Handout Quartärgeologie

## WS 09/10

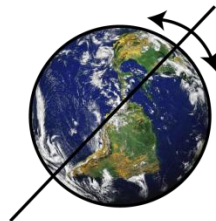
# Global Player 1: Orbitale Konstellation



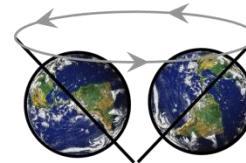
Exzentrizität der Umlaufbahn  
100.000 Jahre



Schiefe der Erdachse  
40.000 Jahre 23,5° ± 1,5°

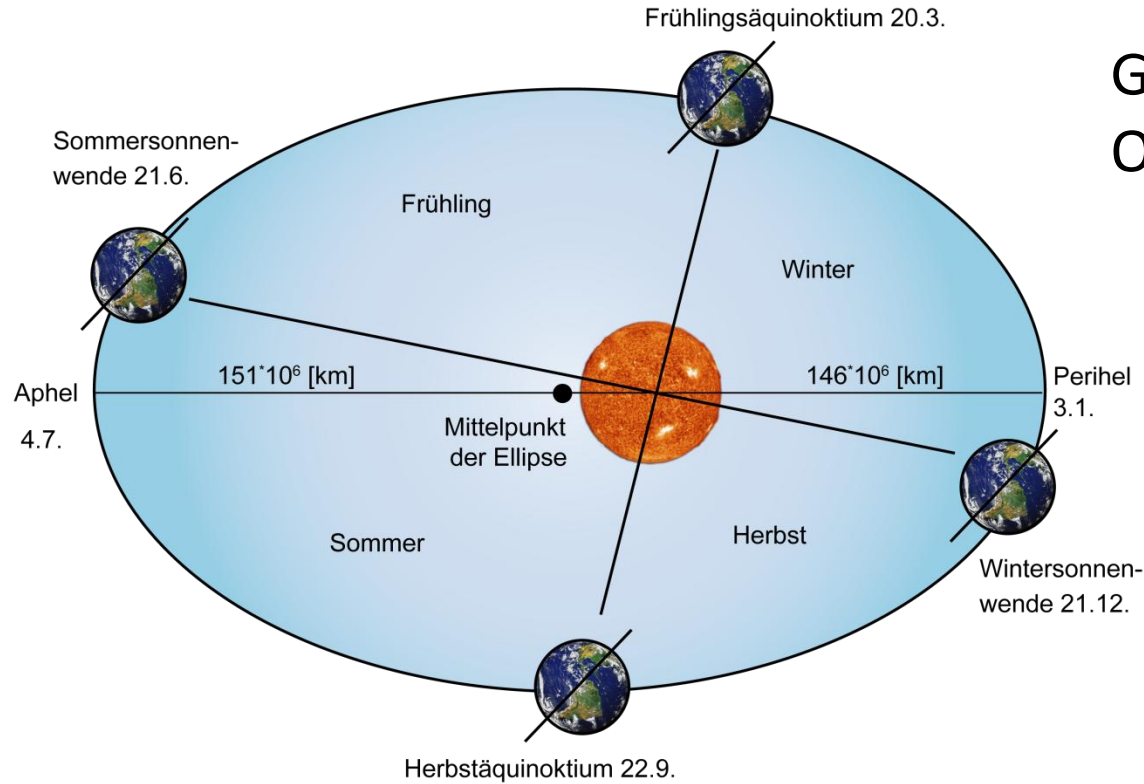


Präzession der Erdachse  
22.000 Jahre

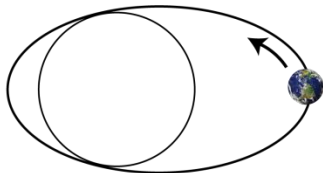


nach M. Milankovic  
(Imbrie, SPECMAP)

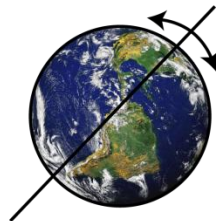
# Global Player 1: Orbitale Konstellation



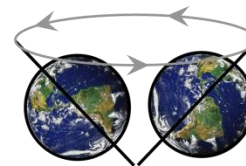
Exzentrizität der Umlaufbahn  
100.000 Jahre



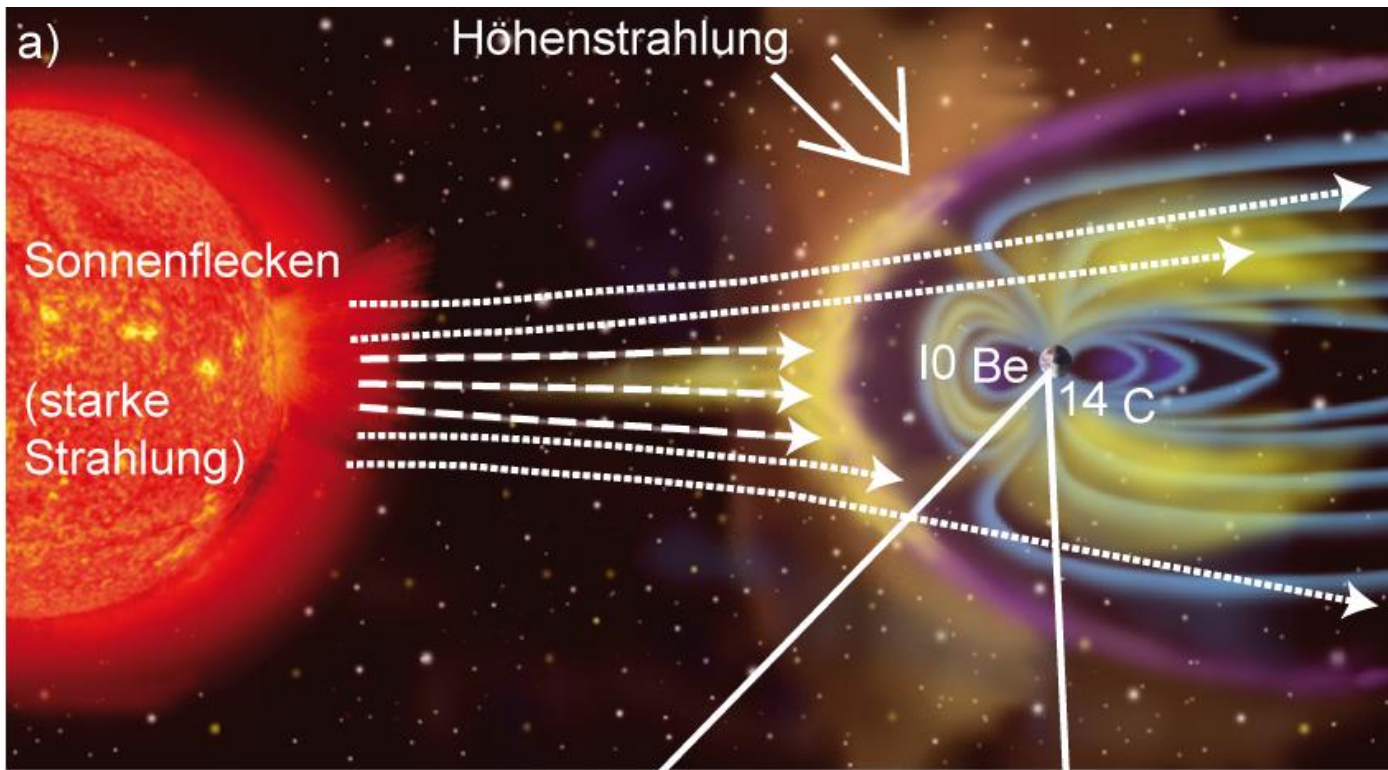
Schiefe der Erdachse  
40.000 Jahre  $23,5^\circ \pm 1,5^\circ$



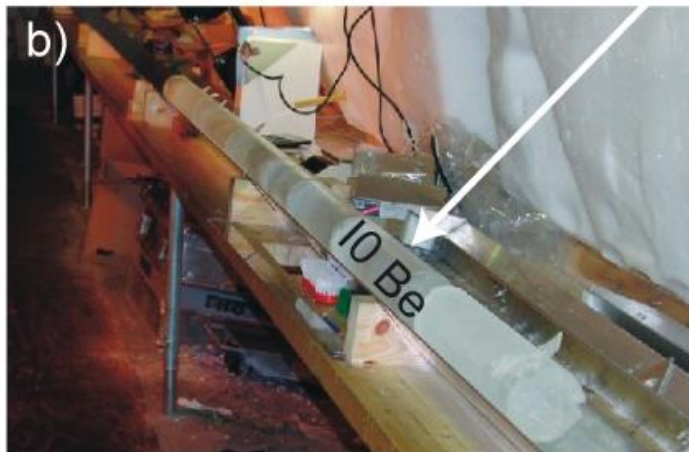
Präzession der Erdachse  
22.000 Jahre



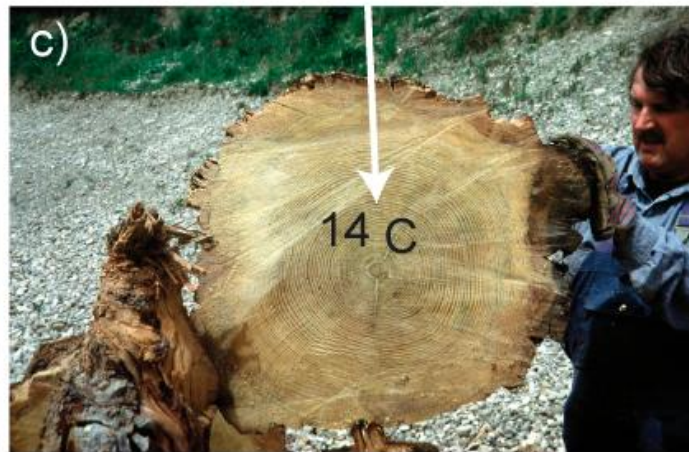
nach M. Milankovic  
(Imbrie, SPECMAP)



## Global Player 2: Sonnenaktivität



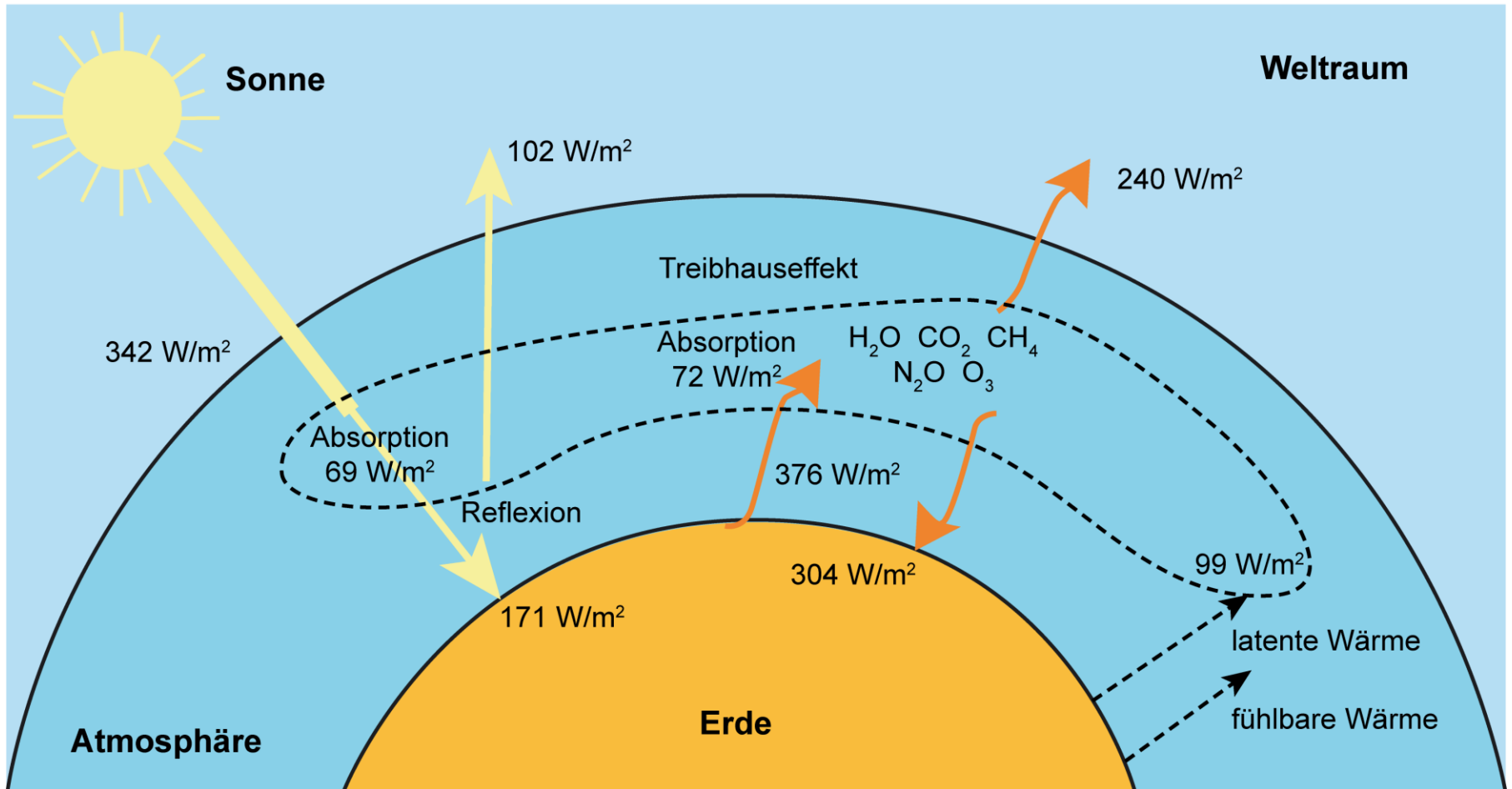
Niederschlag von  $^{10}\text{Be}$  mit Schneefall,  
konserviert in einem Eiskern



Speicherung von atmosphärischem  
 $^{14}\text{C}$  in Holz

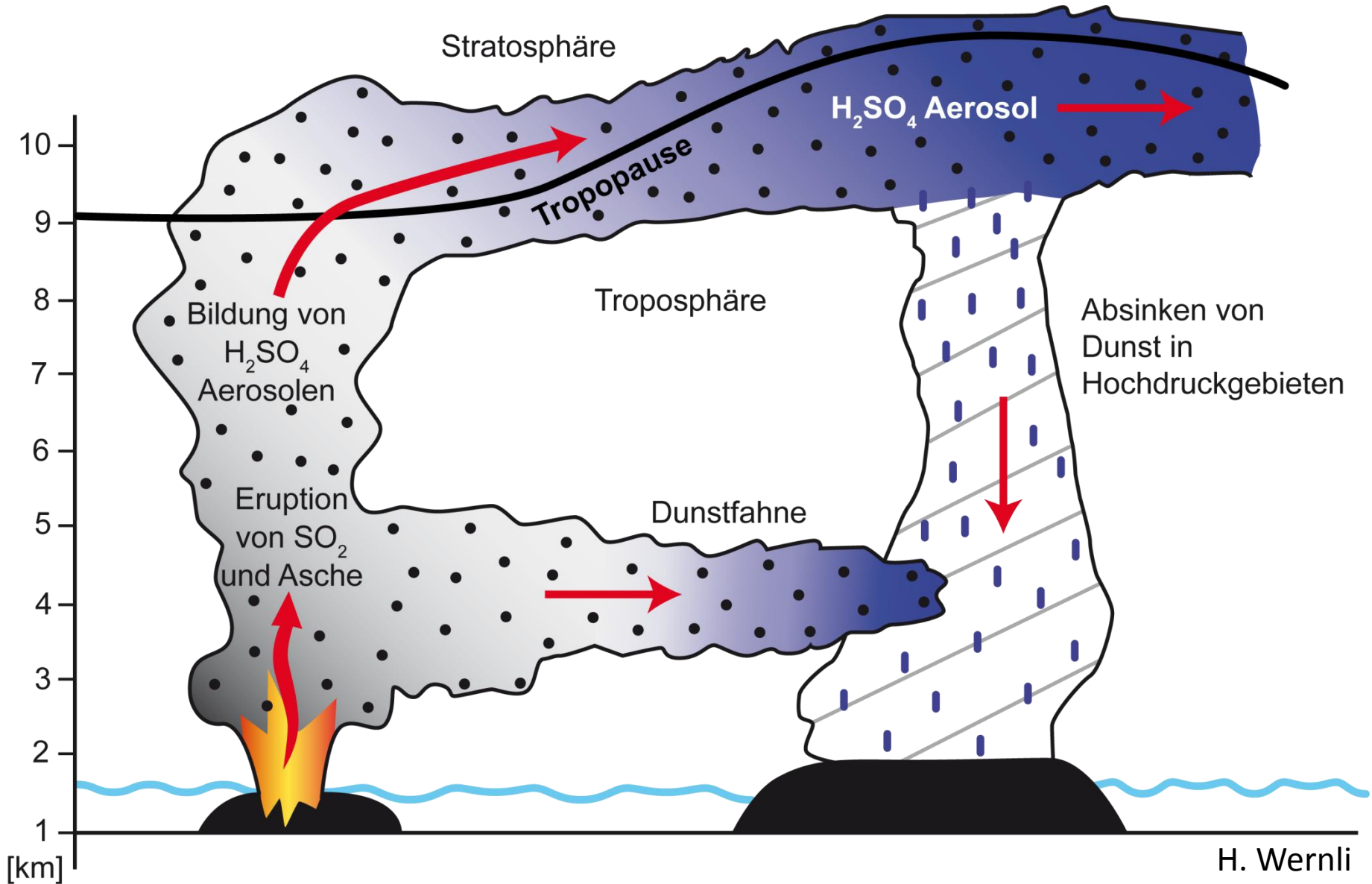
# Globale Energiebilanz

## Global Player 3: Treibhausgas CO<sub>2</sub>



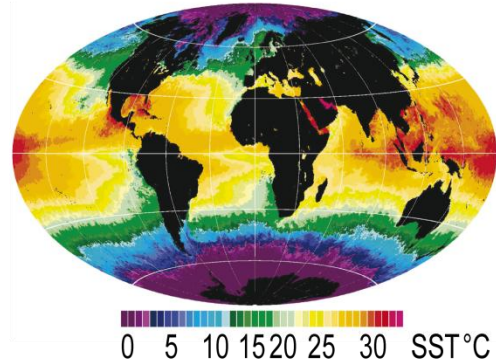
H. Wernli

# Global Player 4: Vulkanaerosole



# Meridionaler Energietransport durch Luft- und Meeresströmungen

## a) Temperatur des Meeresoberflächenwassers



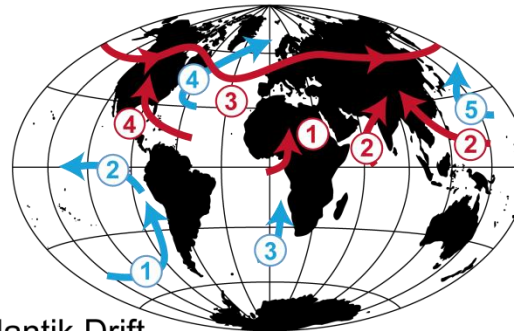
Global Player 5a

Meeresströmungen

## b) Meeresströmungen und Luftströmungen

Meeresströmungen

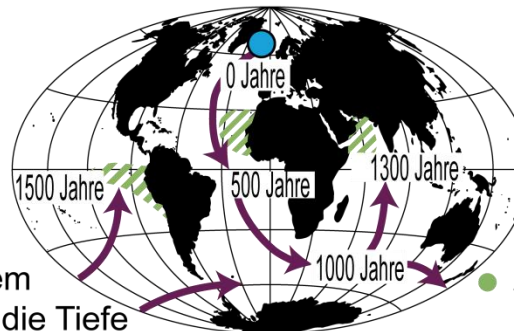
- ① Humboldt Strom
- ② La Niña
- ③ Benguela Strom
- ④ Golfstrom/Nordatlantik Drift
- ⑤ Kuroshio



Luftströmungen

- ① afrikanischer Monsun
- ② asiatischer Monsun
- ③ Westwindzone
- ④ atlantische Wirbelstürme  
(indopazifische Wirbelstürme nicht eingezeichnet)

## c) Alter und Fließrichtung der ozeanischen Tiefenströmungen

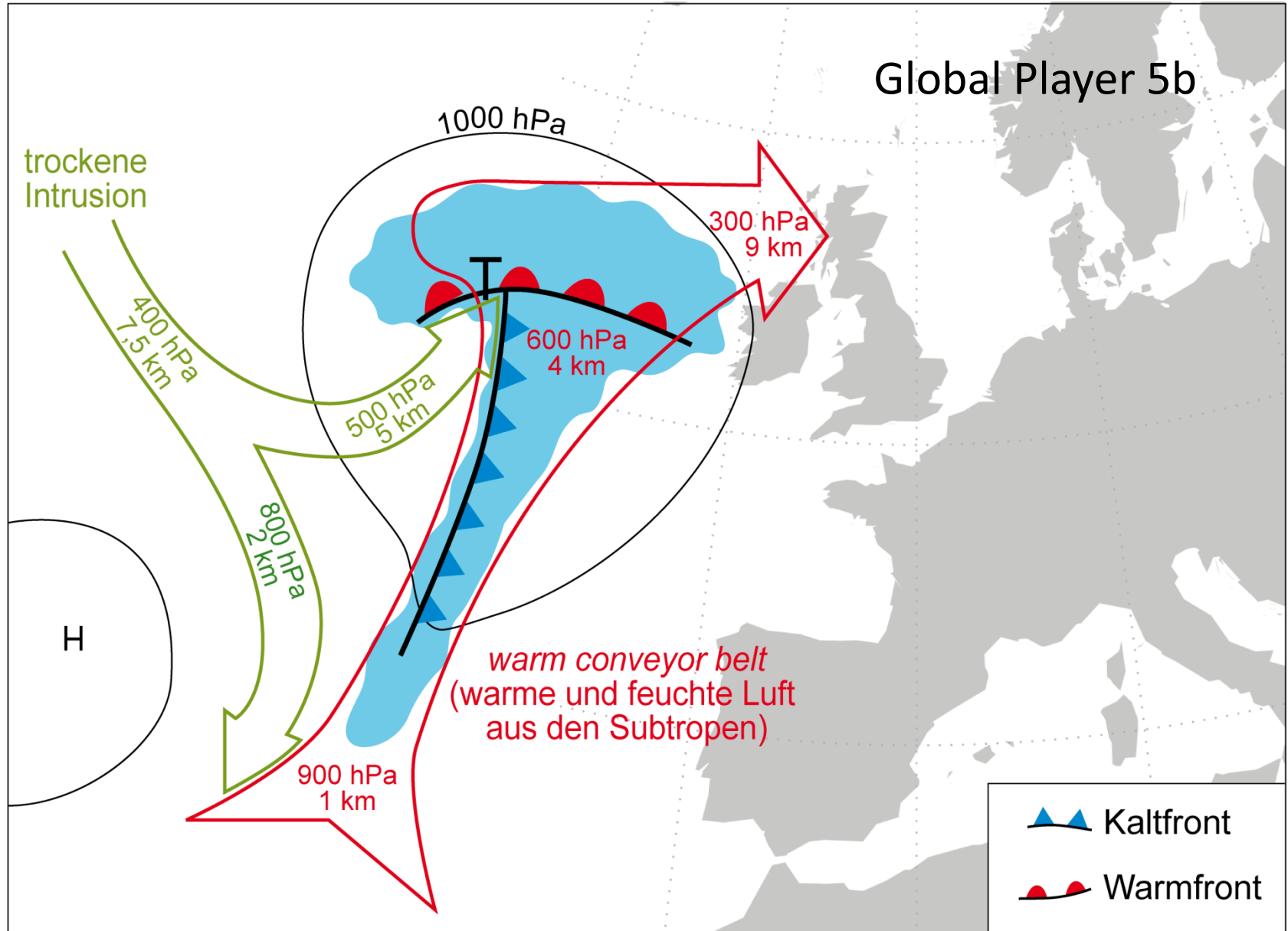


● Absinken von schwerem Oberflächenwasser in die Tiefe

● Auftrieb von Tiefenwasser an die Meeresoberfläche

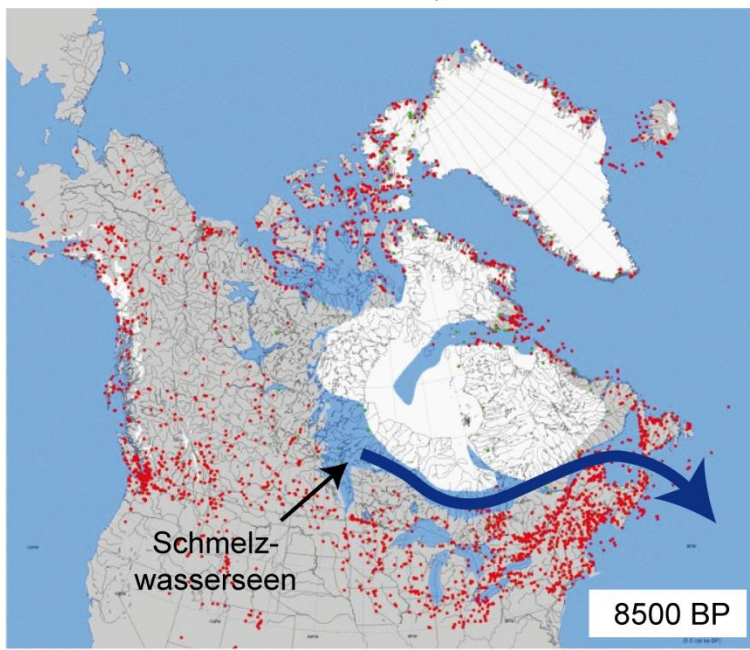
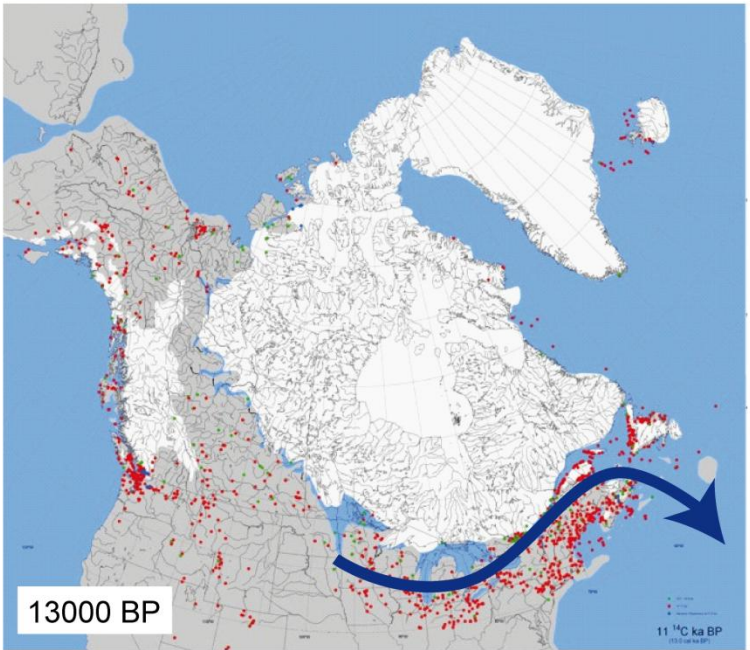
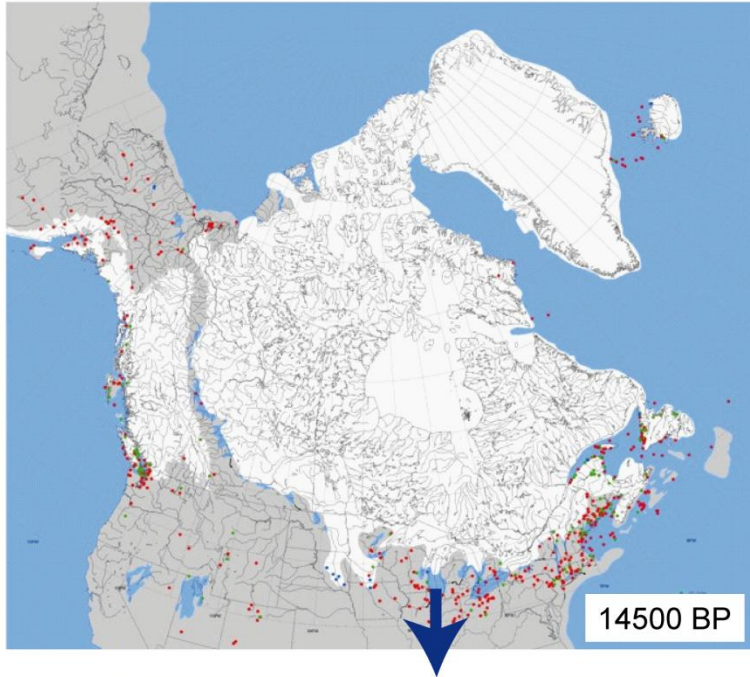
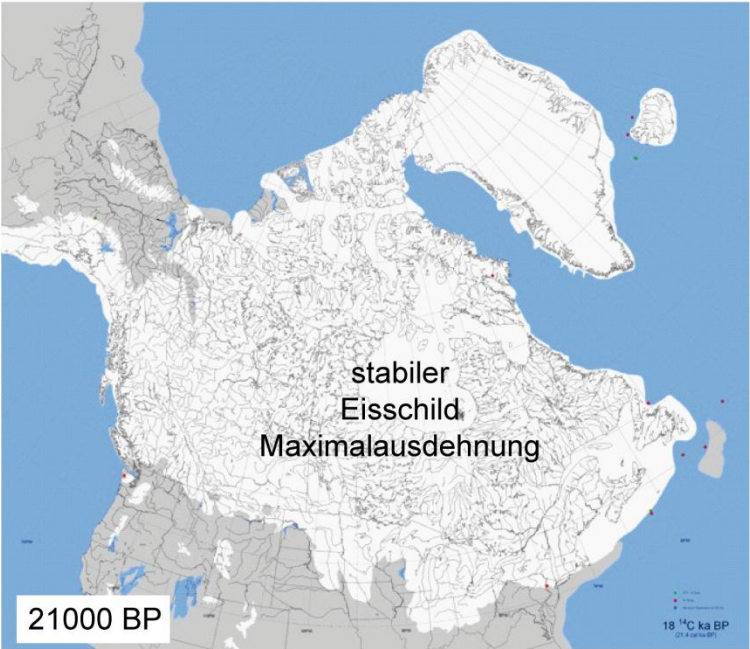
Abbildung aus: Sirocko (2009)

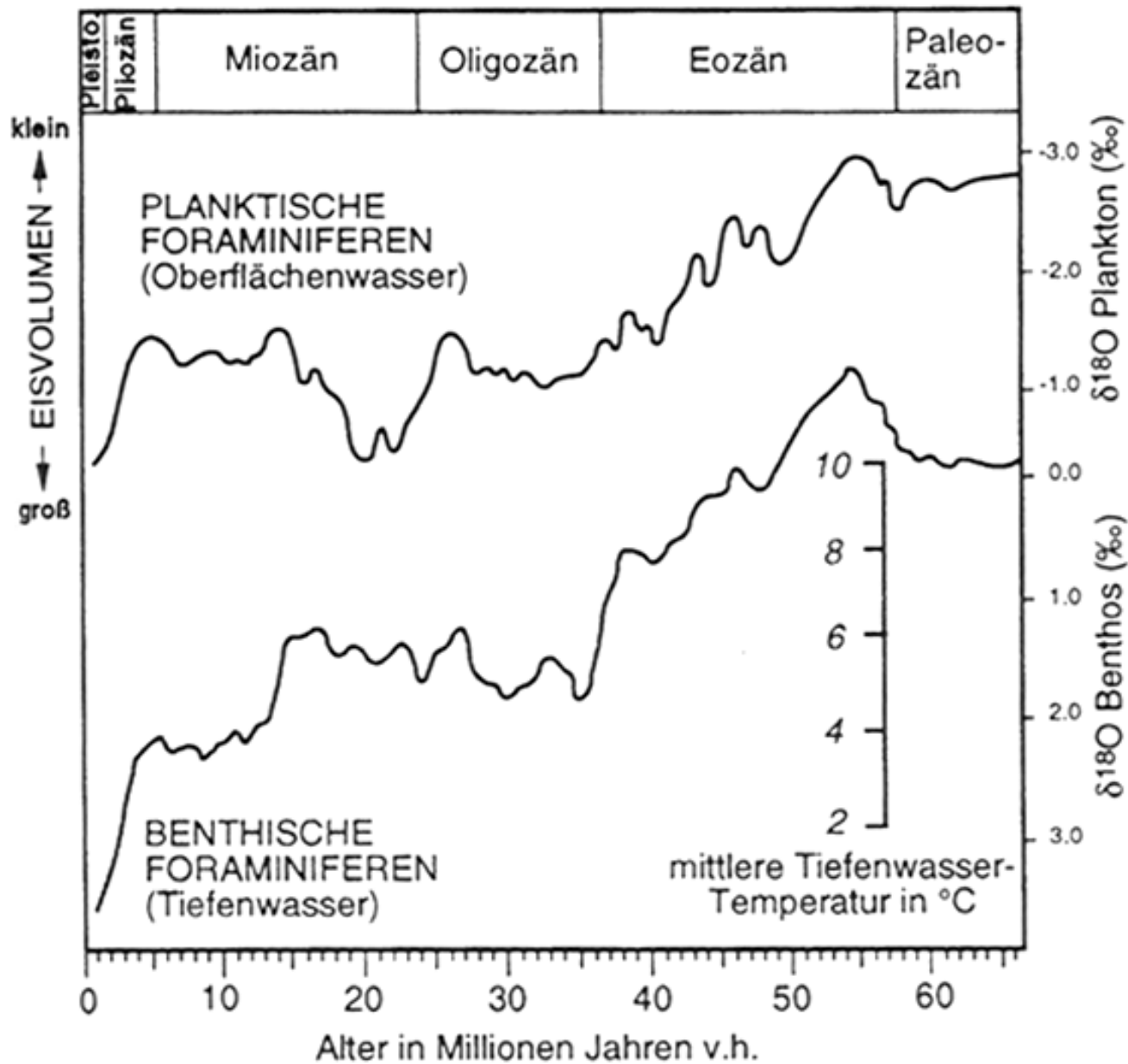
# Grundstruktur der Wärmeadvektion vom Nordatlantik nach Europa



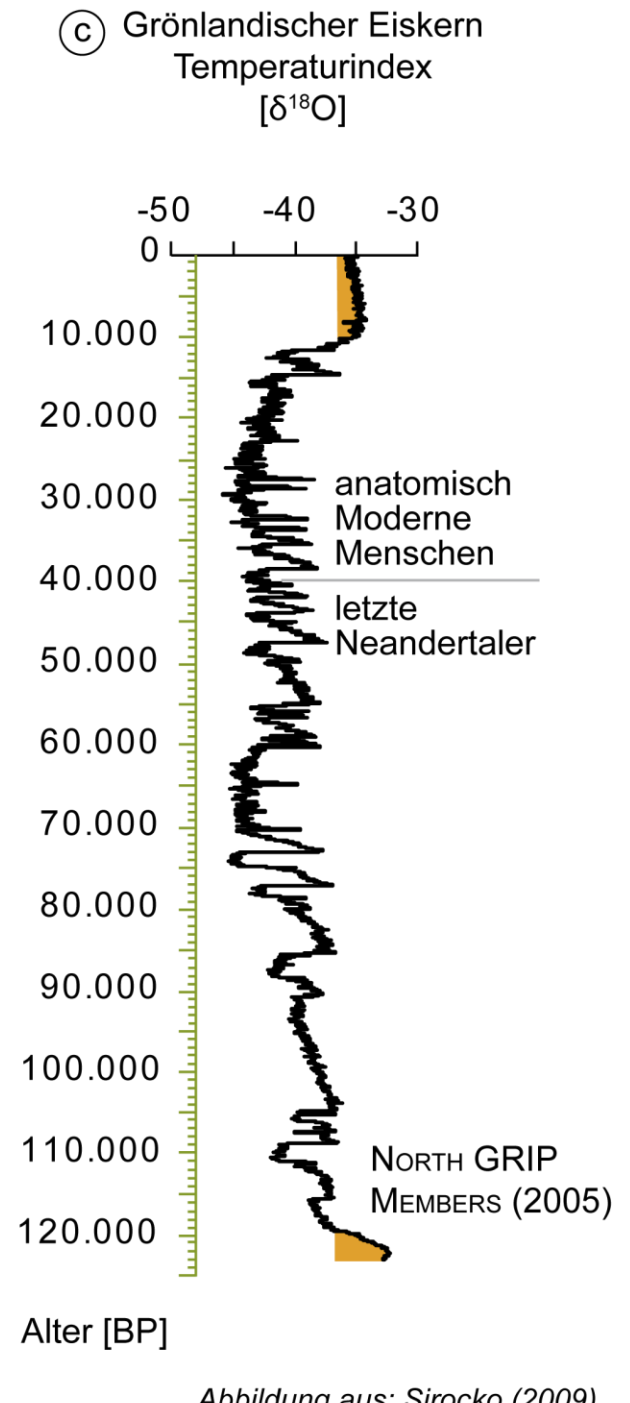
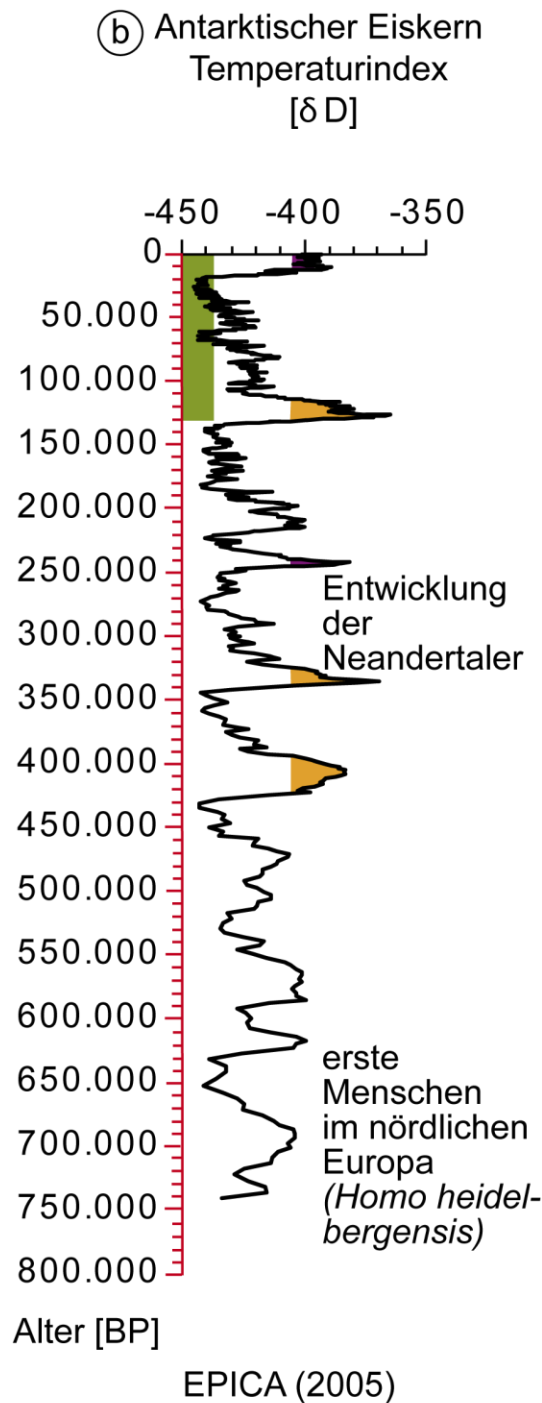
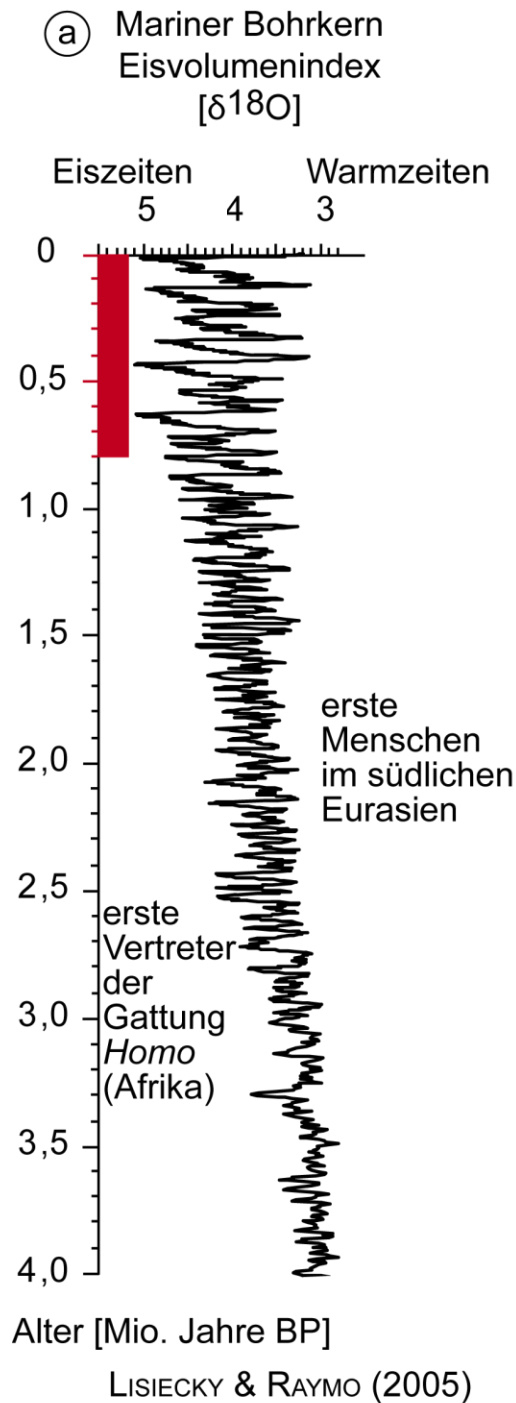


Global  
Player 6  
Eisschild

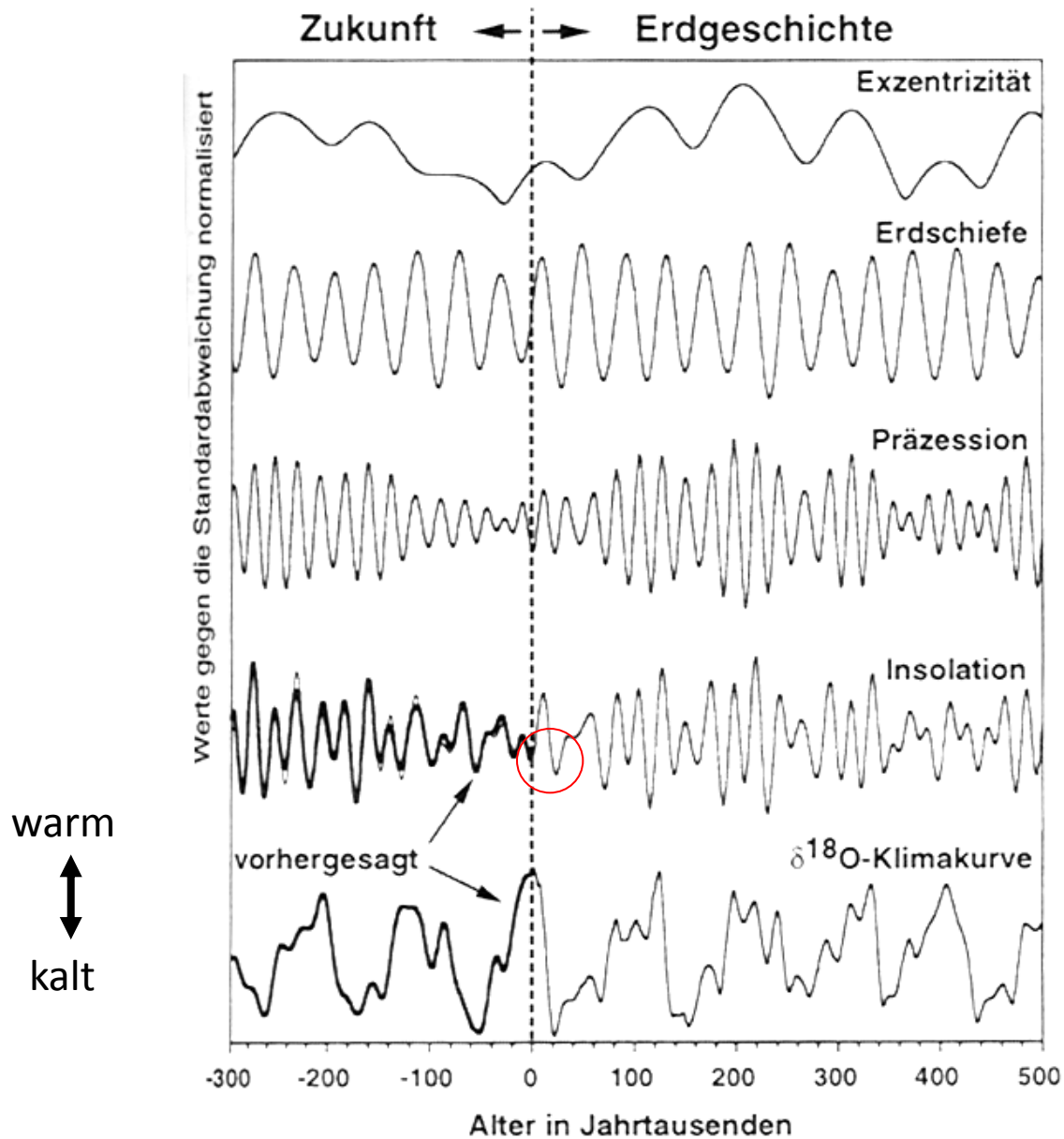




Abkühlung der Ozeane im Tertiär



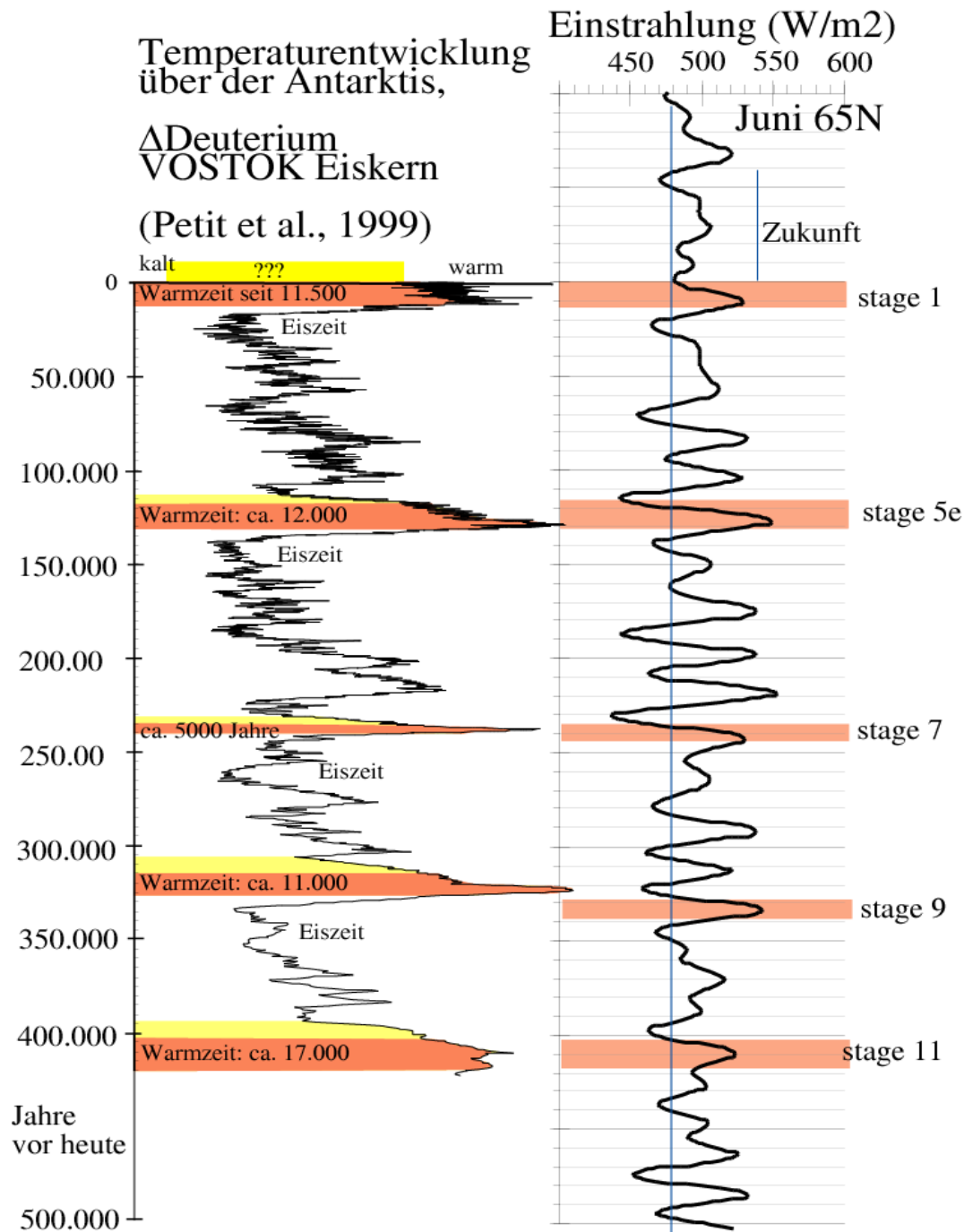
# Insolation: die bedeutendste Größe der Klimaentwicklung



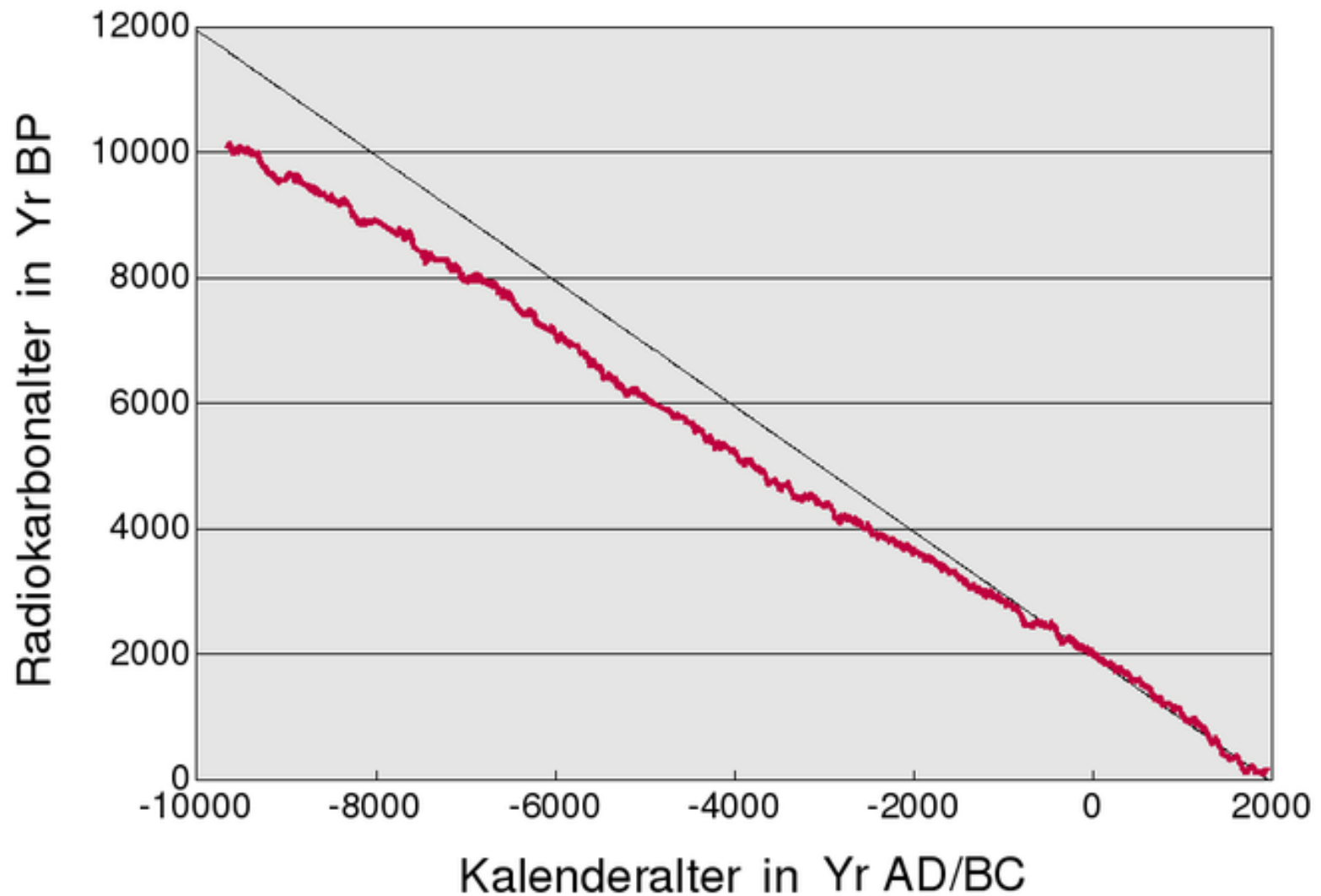
# Temperaturentwicklung über der Antarktis,

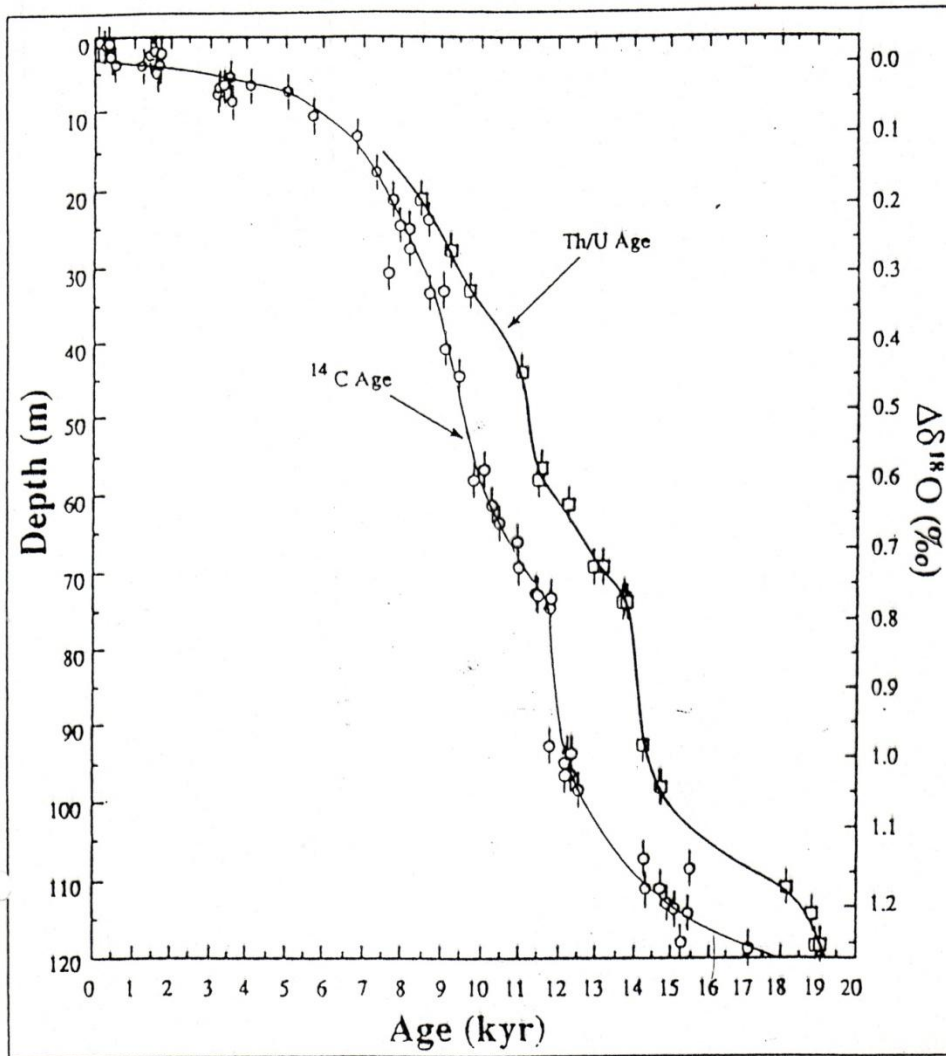
$\Delta$ Deuterium  
VOSTOK Eiskern

(Petit et al., 1999)

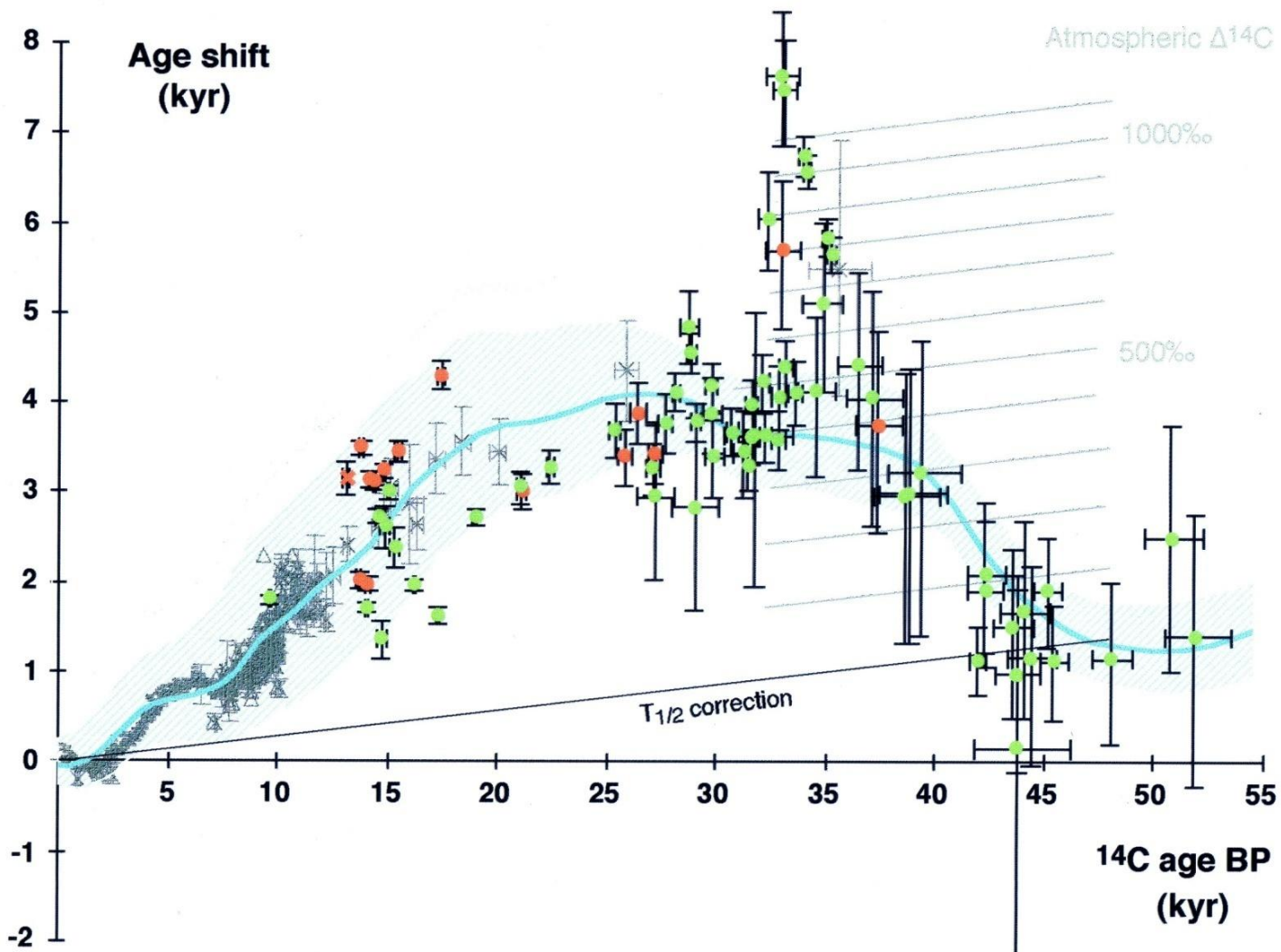


Kalibrationskurve (Quelle: Stuiver et al., 1998)





6. Radiocarbon and uranium thorium dates on corals from borings made off the coast of Barbados (Bard et al., 1990). The *Acropora Palmata* samples on which the age determinations were made are thought to have grown within a few meters of sea level. The difference between the Libby years of the radiocarbon scale and the calendar years of the Th/U scale is discussed in the chapter on clocks.

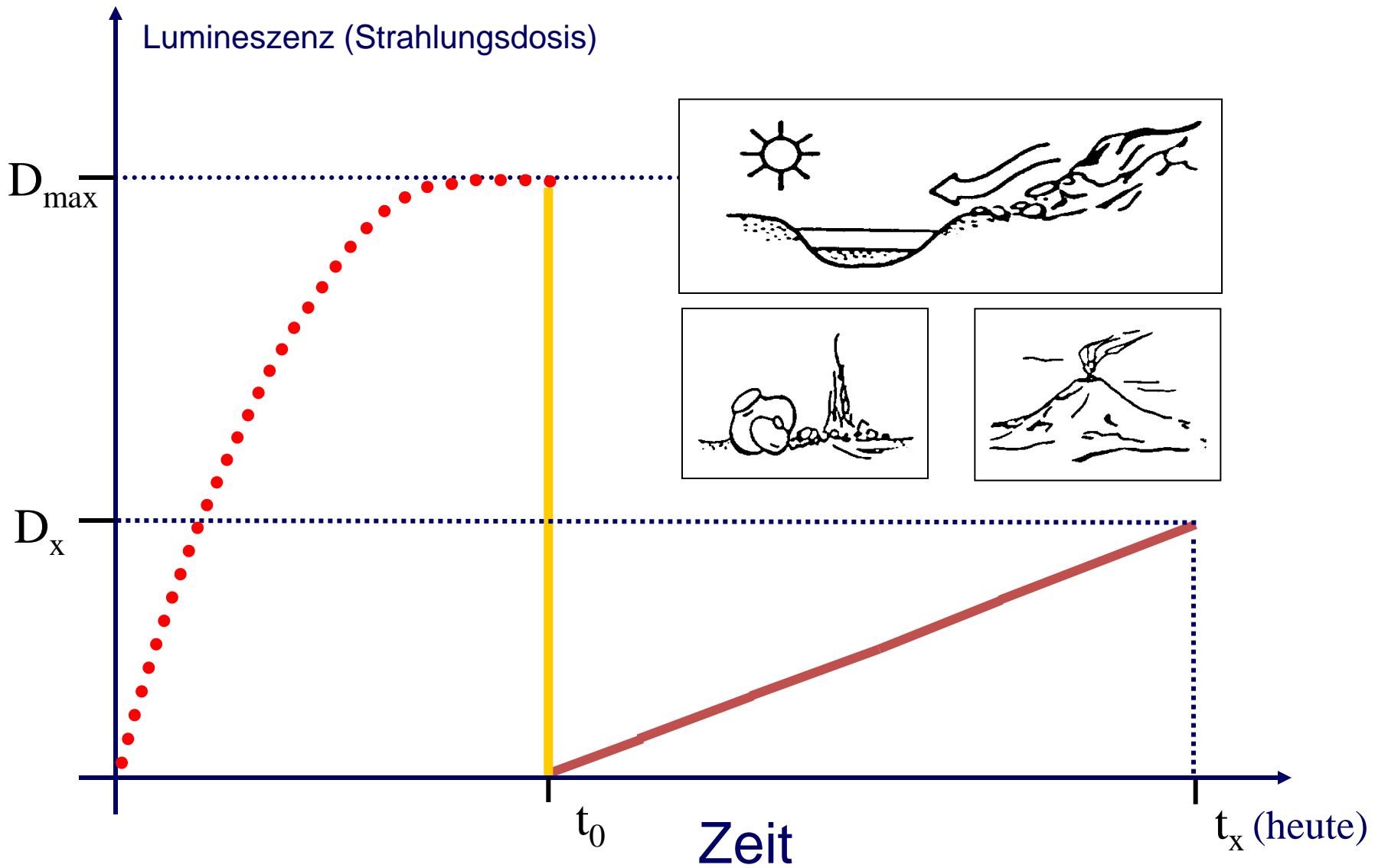


- Planktonic values of core PS2644 ( $\pm 1\sigma$ )
- Benthic values of core PS2644 and planktonic values of cores 23071 & 23074 ( $\pm 1\sigma$ )
- Geomagnetic correction (Laj et al., 1996)

- Dendrochronology
- X, ✕ Corals ( $\pm 2\sigma$ )
- △ Lake sediments



# Grundlagen - Lumineszenz-Datierung



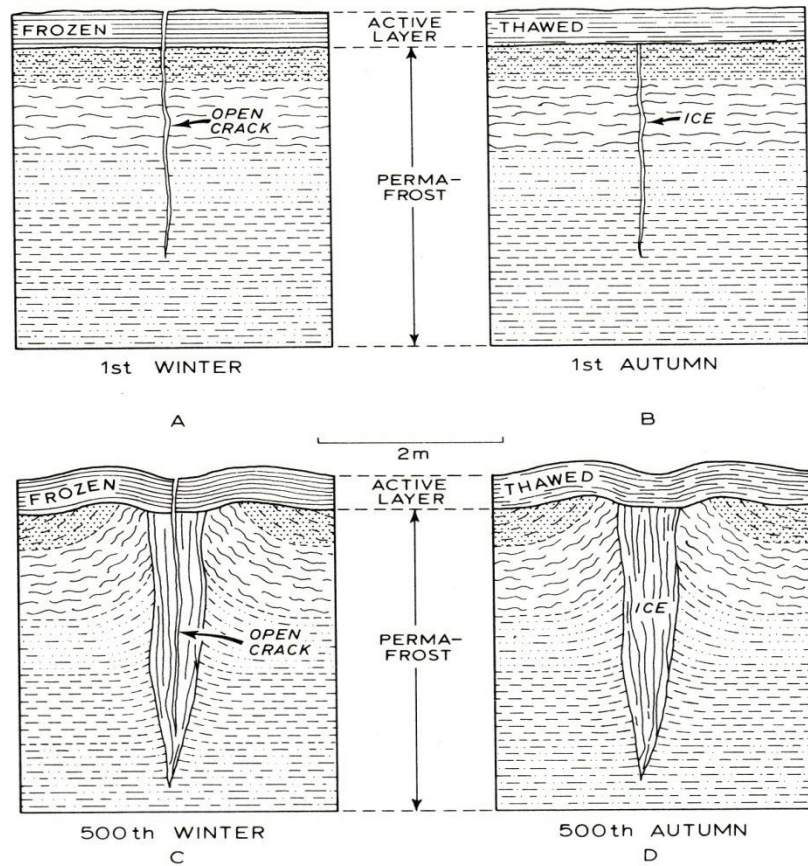


Abb. 41. Entstehung eines Eiskeils nach der Kontraktionstheorie von LACHENBRUCH 1962.  
Aus EMBELTON & KING 1975, Fig. 2.7.

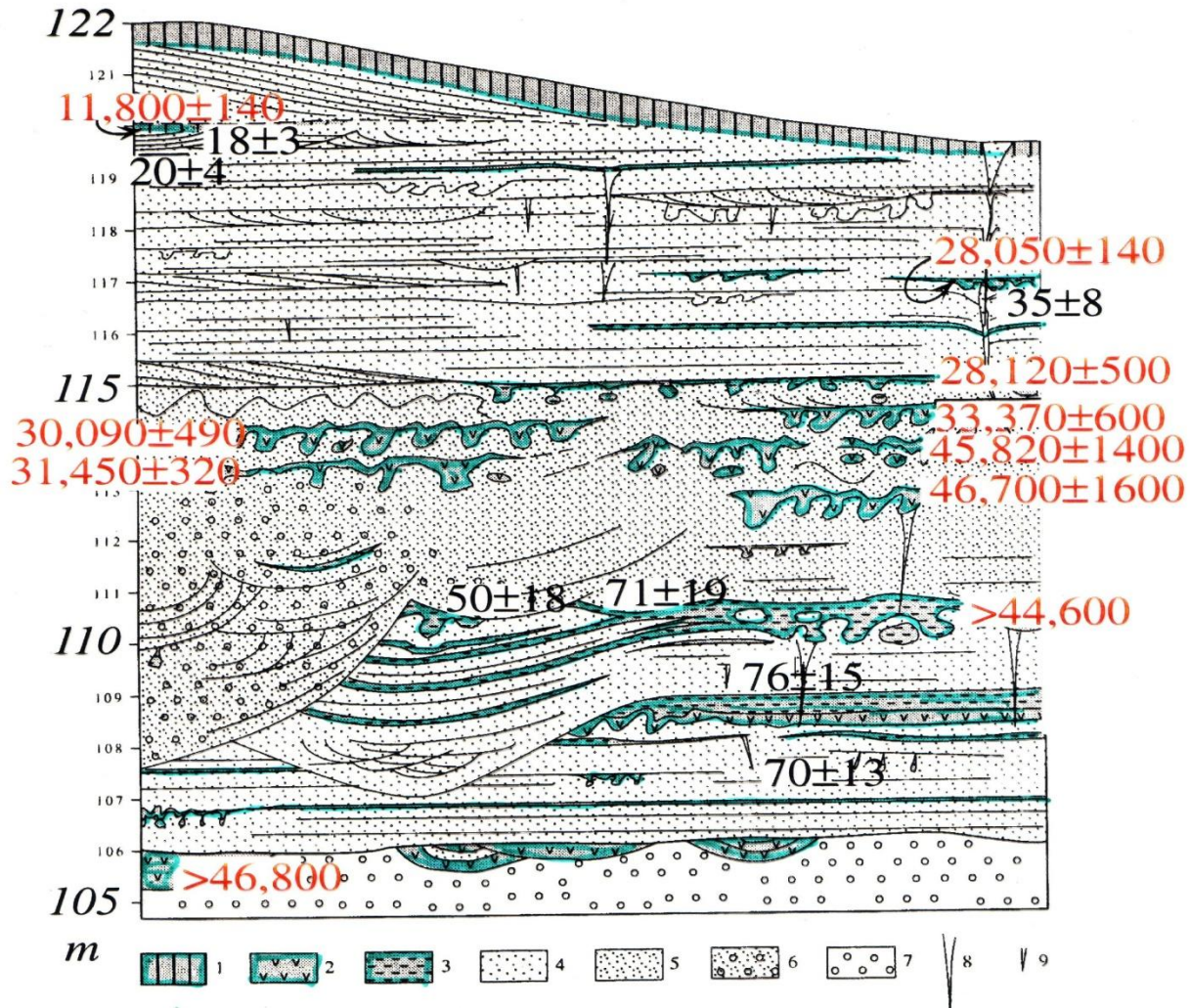
Schreiner 1992

Temperatursturz auf  $-30^{\circ}\text{C}$

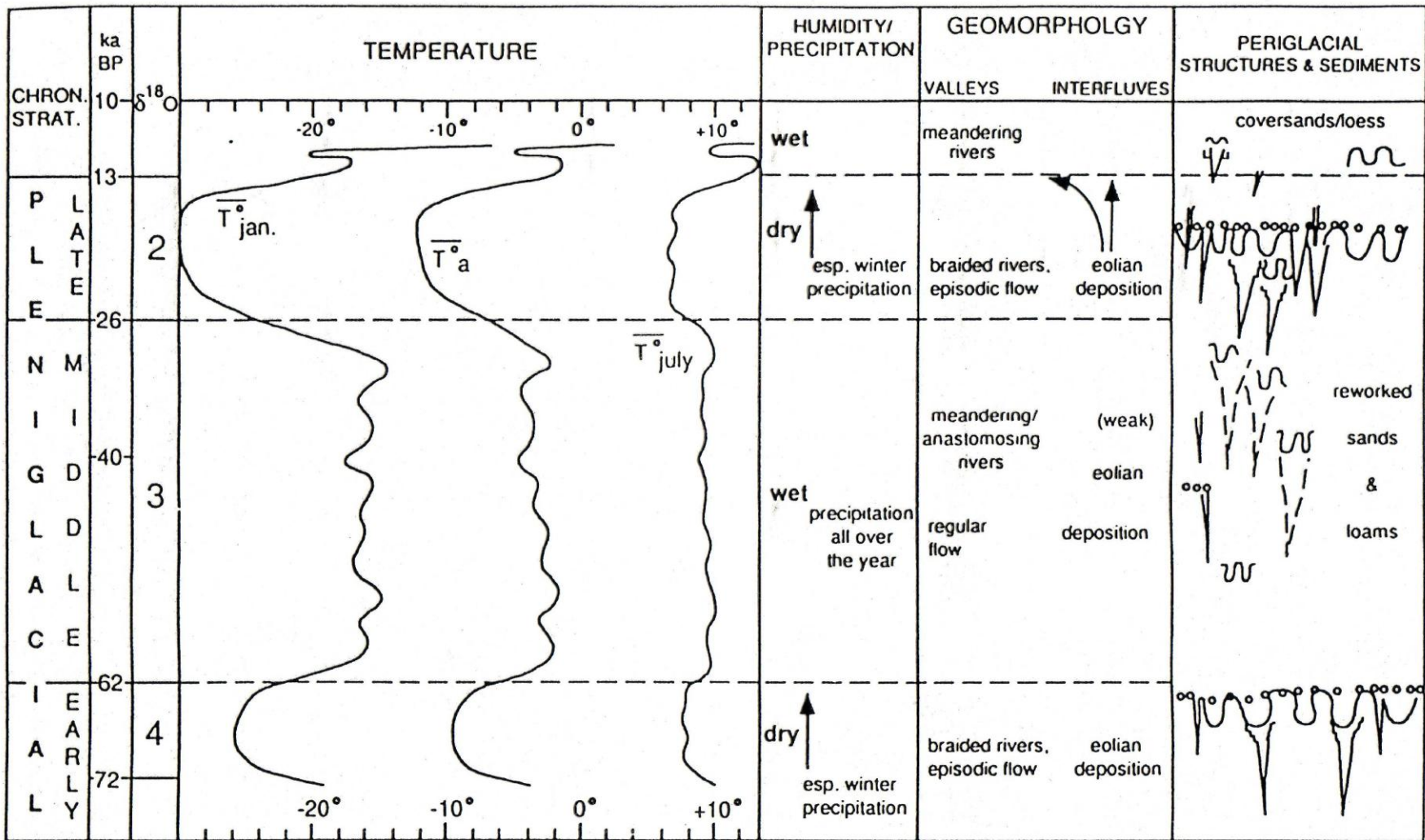
(bei Keilabstand von 10 m entwickelt sich eine Spalte von 5 mm Breite durch Frostkonzentration)

(Weise 1983)

# "Tagebau Scheibe", Niederlausitz (Mol, 1997)



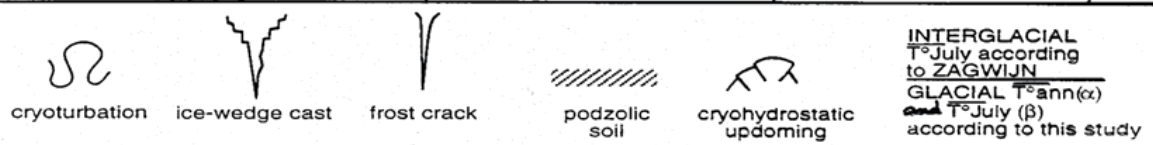
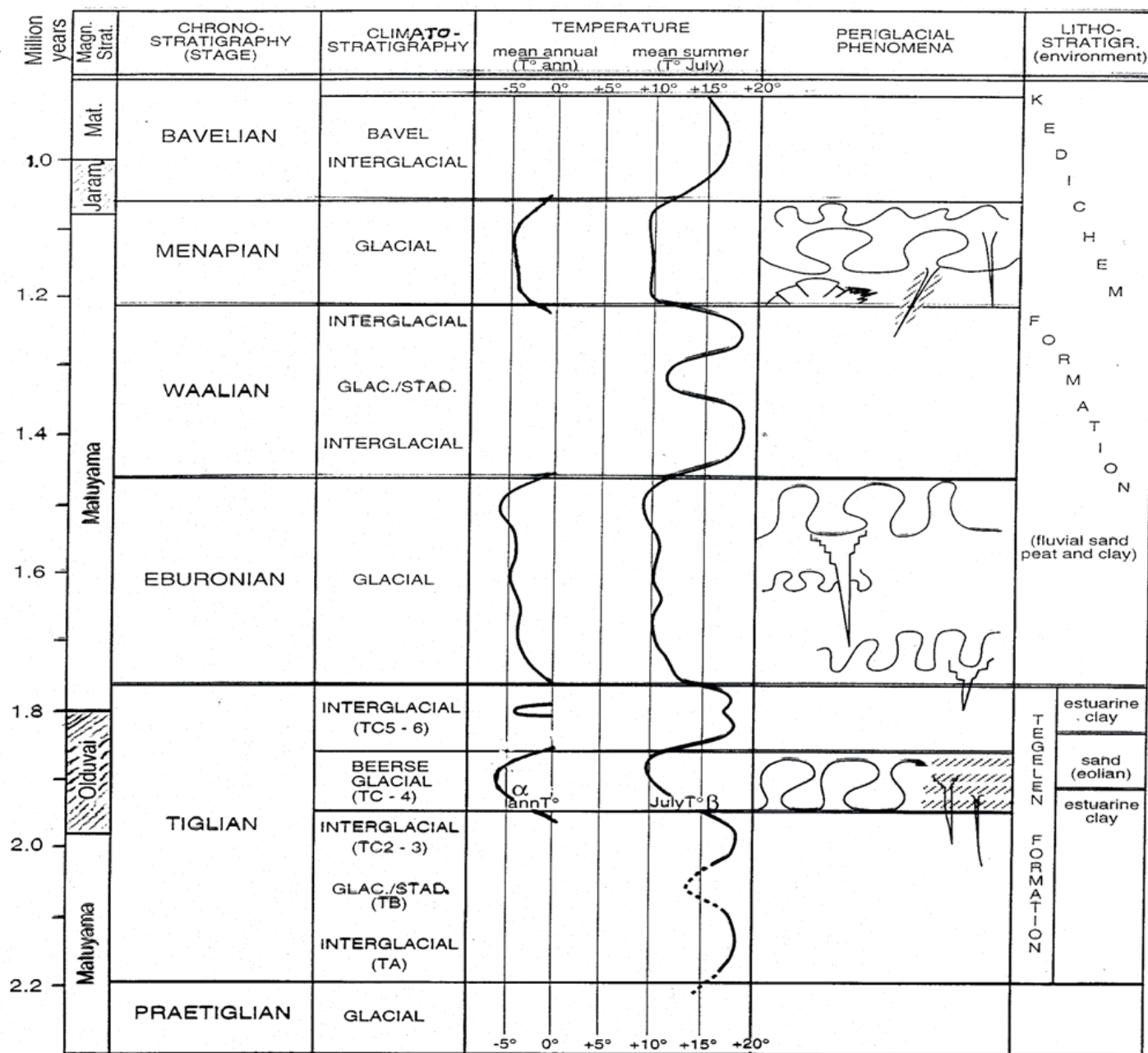
Humose Ablagerungen, <sup>14</sup>C Alter, OSL Alter



frostcracks  
 sands-wedge cast

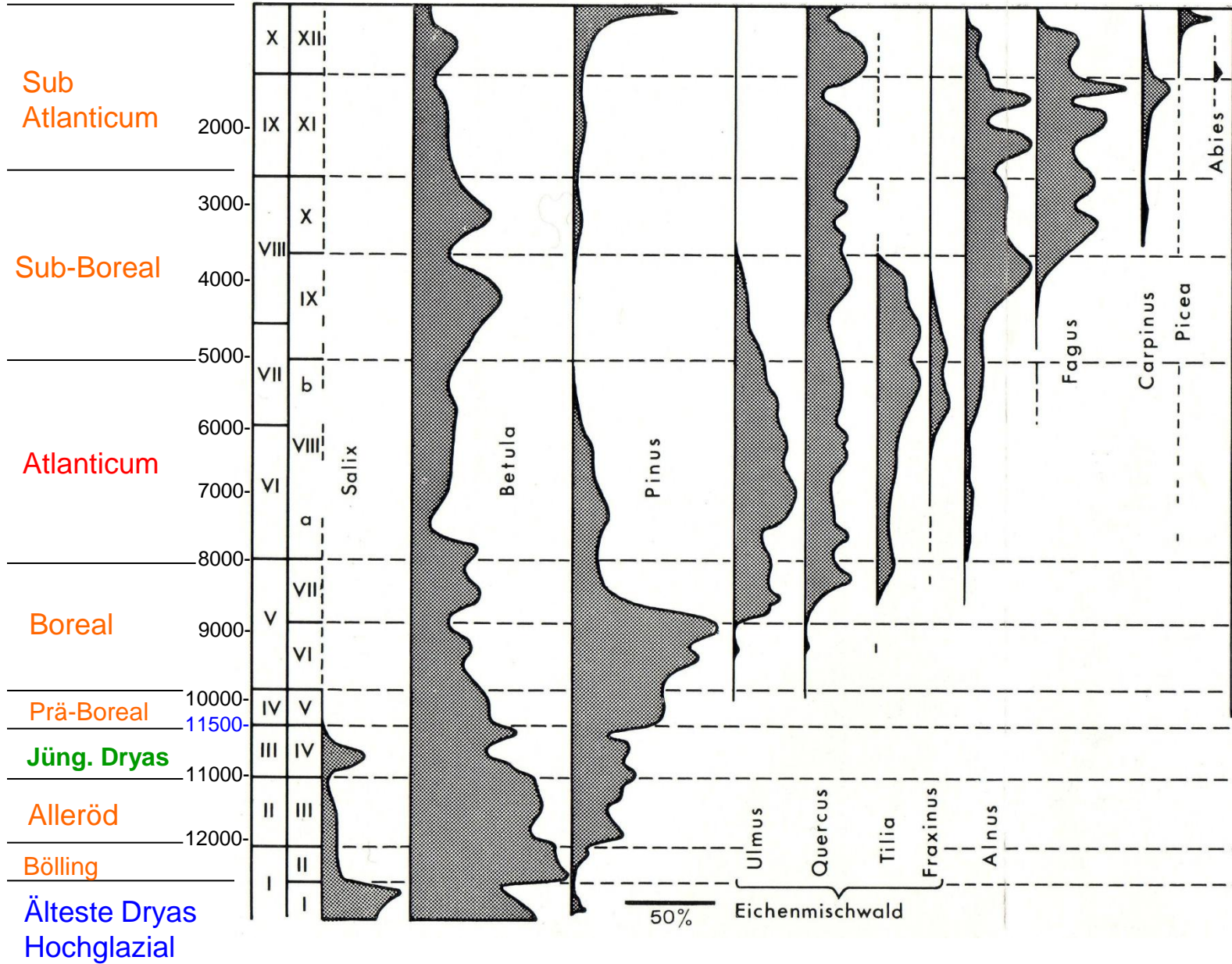
ice-wedge cast  
 ice-wedge cast (only in silt subsoil)

desert pavement  
 small cryoturbations  
 large cryoturbations

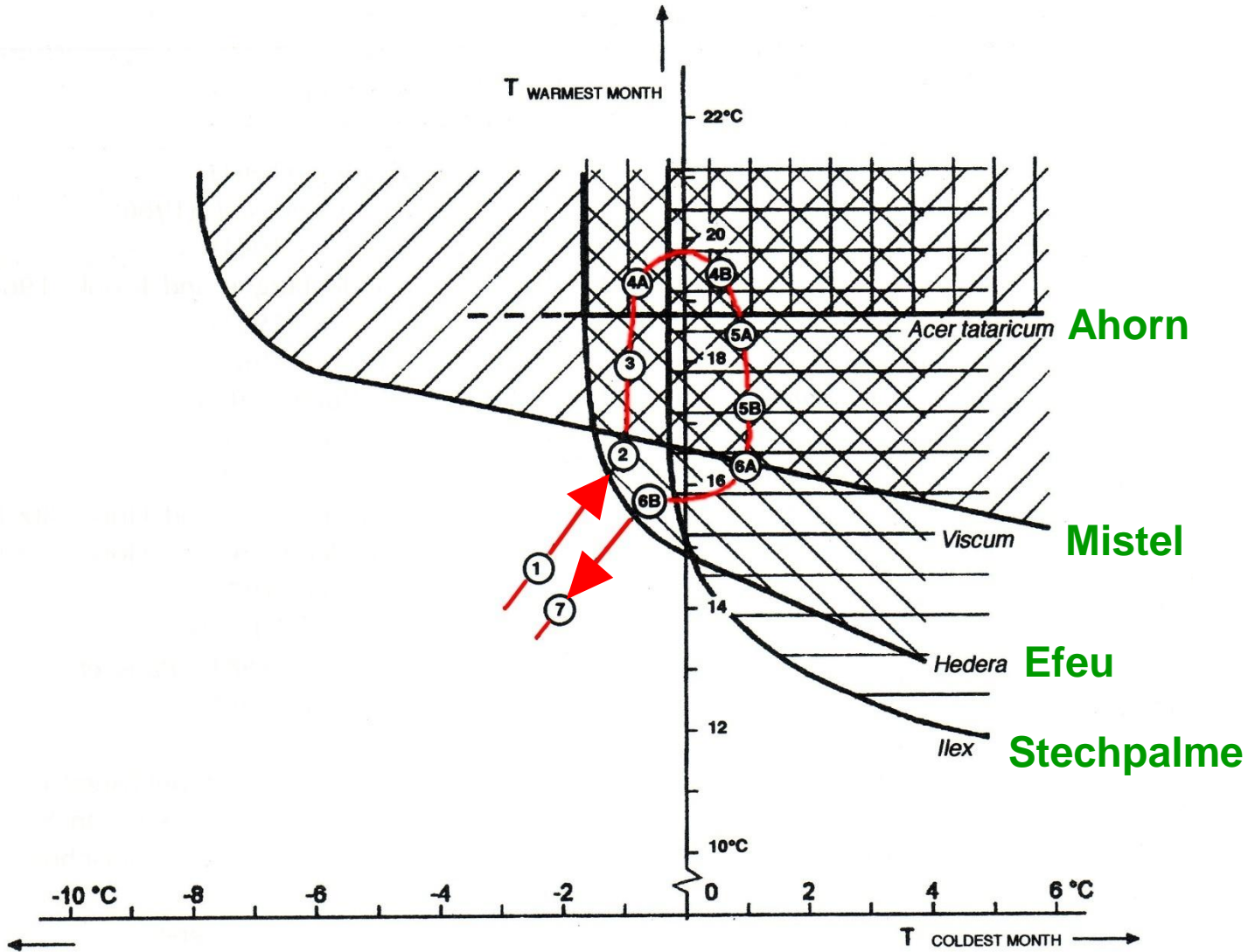


# Generalisiertes Pollenprofil für Holozäne Maare der Eifel

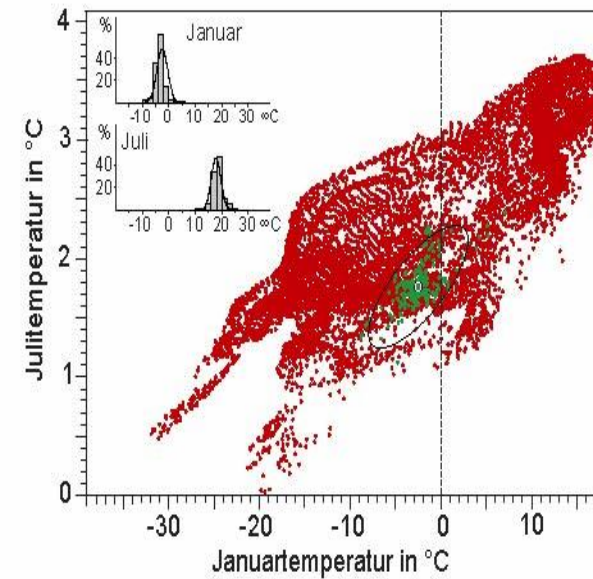
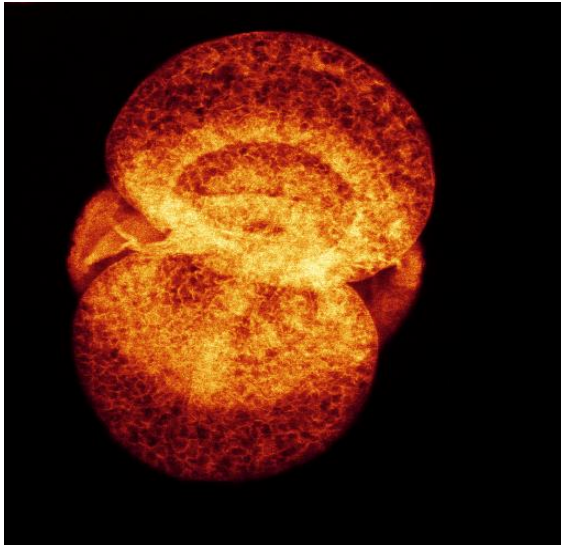
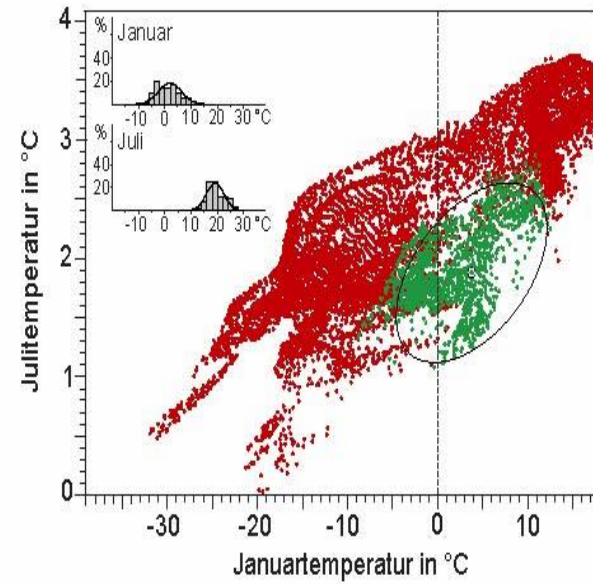
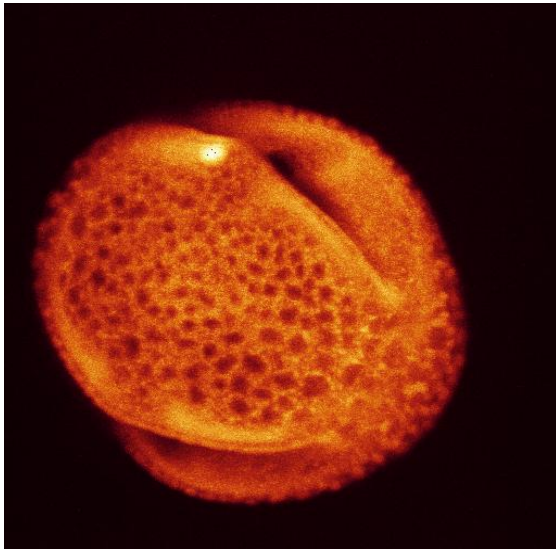
Firbas  
Overbeck



# climate indicator taxa

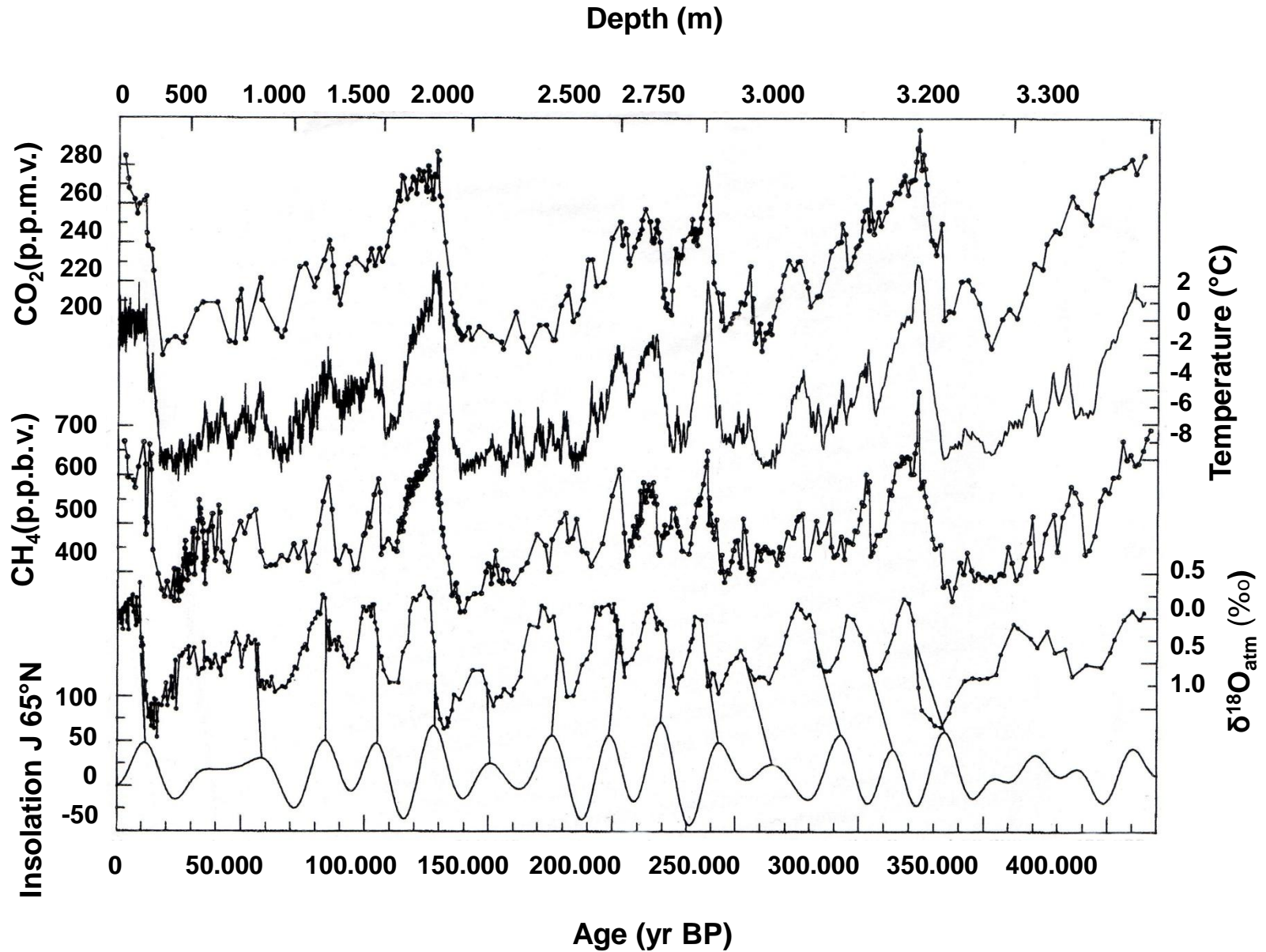


# Wahrscheinlichkeitsdichtefunktion





# Vostock time series and insolation



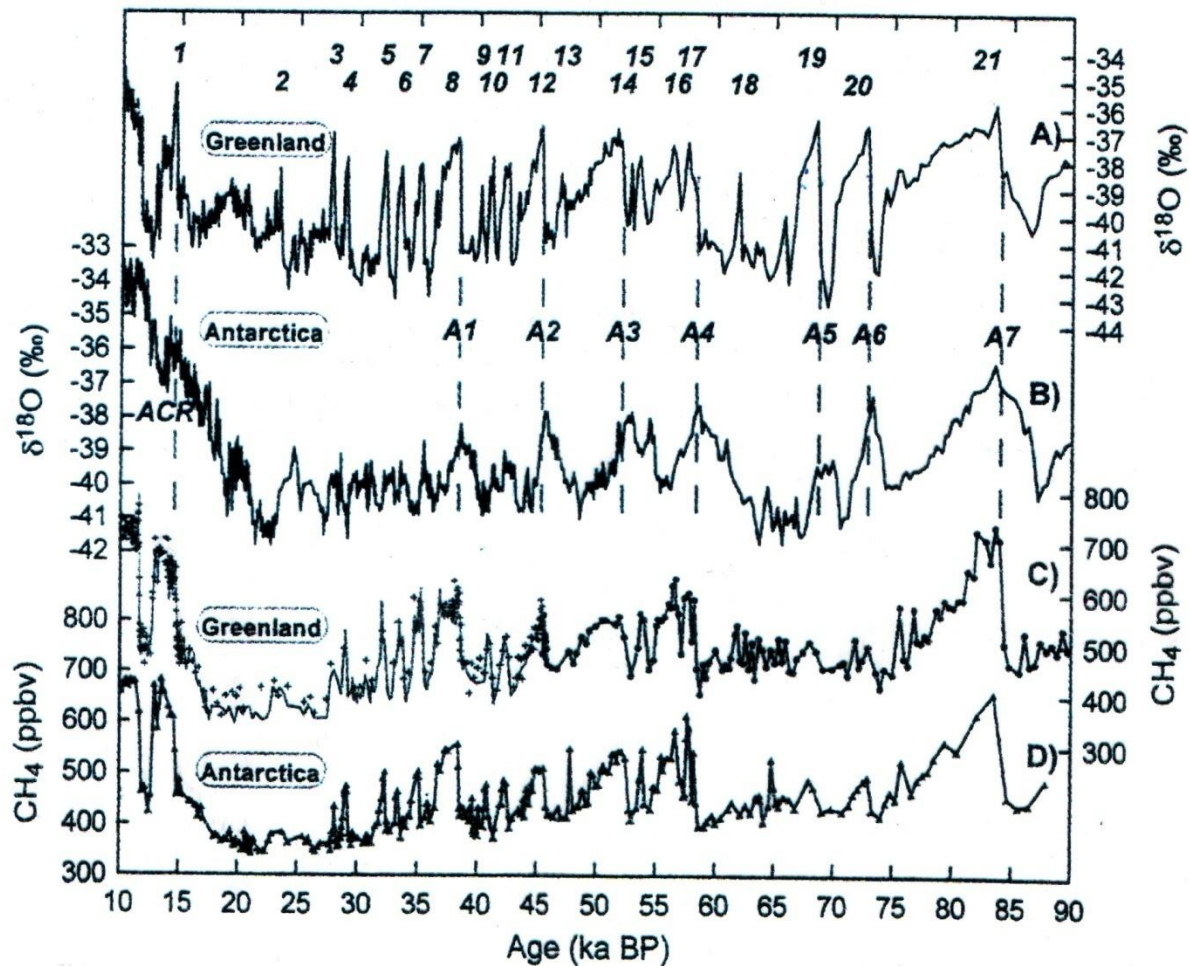
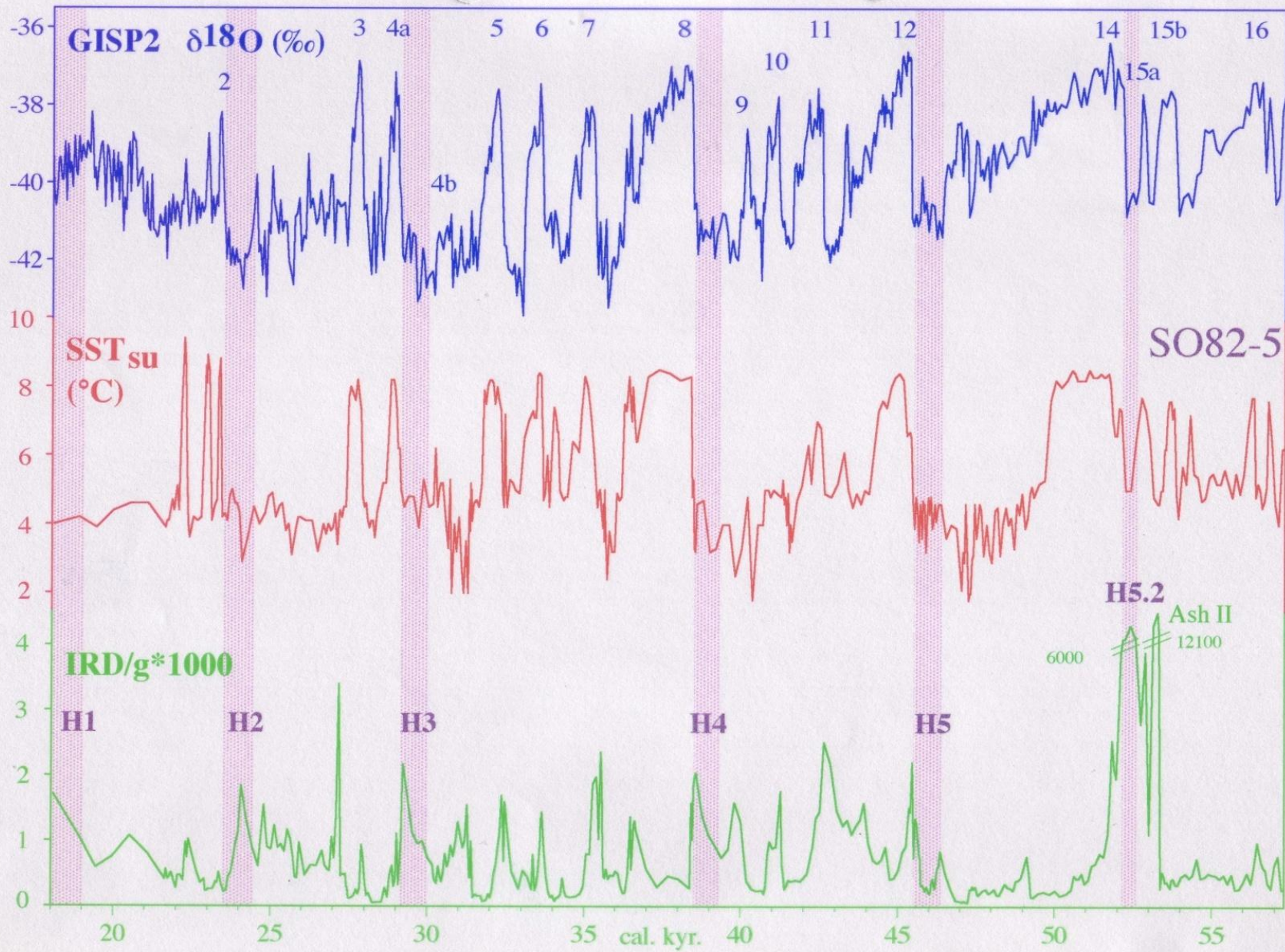
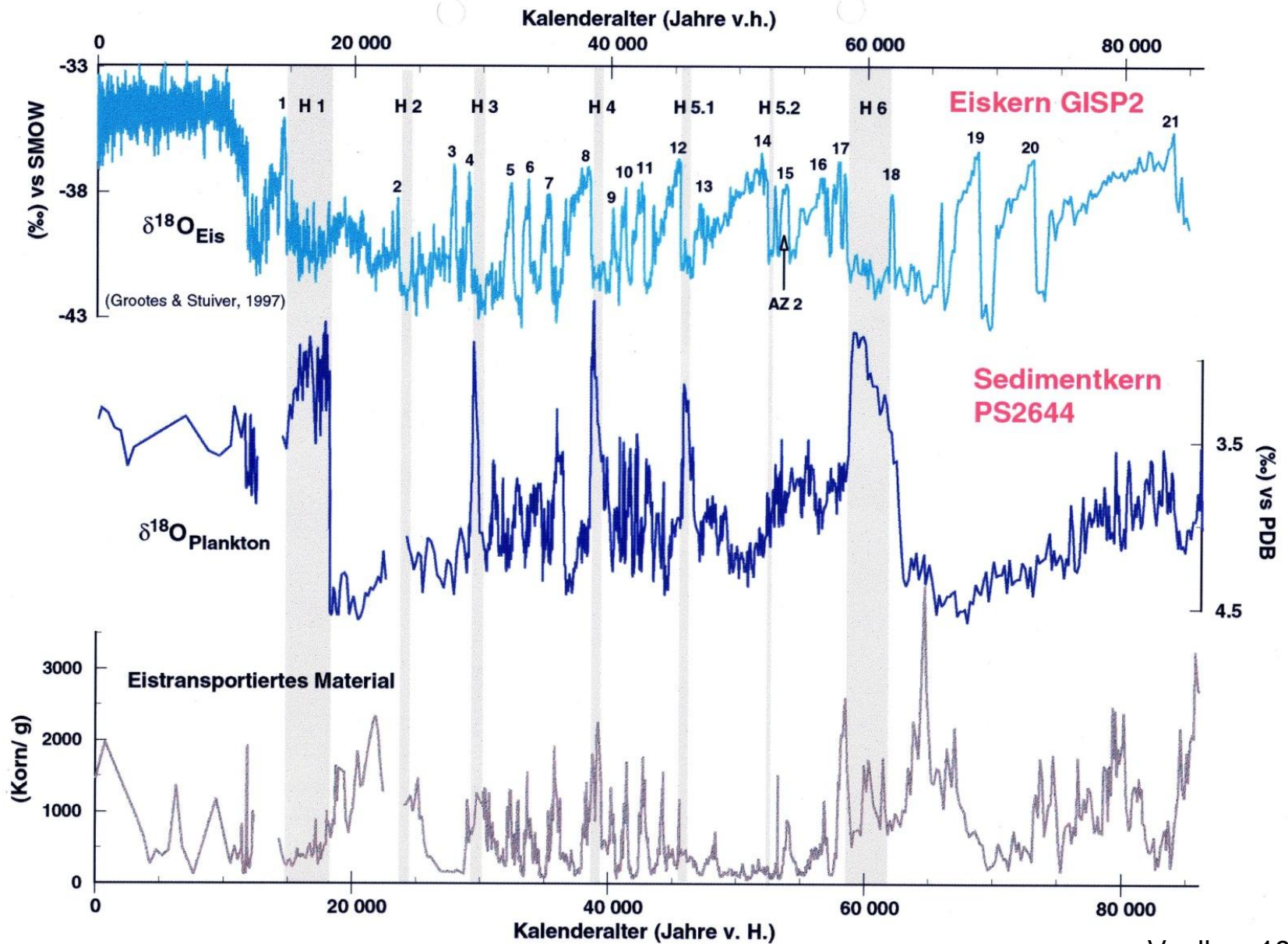


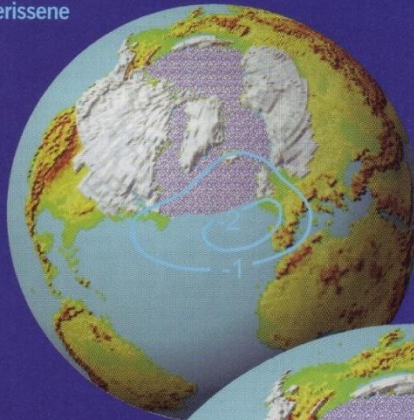
Fig. 1. Isotopic and  $\text{CH}_4$  data from Greenland and Antarctica on the GISP2 time scale. Dashed lines indicate the onset of major D-O events. (A)  $\delta^{18}\text{O}_{\text{ice}}$  from GISP2, Greenland (16). (B)  $\delta^{18}\text{O}_{\text{ice}}$  from Byrd station, West Antarctica (23). (C)  $\text{CH}_4$  data from GISP2 and GRIP. Crosses and dots are from GISP2 [(4) and new data]; the solid gray line is from GRIP (2, 8). The solid line runs through the data used for the synchronization: GISP2 (black line) up to 45.5 ka and GRIP data (gray line) from 45.5 ka to the Holocene. (D)  $\text{CH}_4$  data from Byrd station [(2) and new data]. Data are available as supplemental information on Science Online (10) and at the NOAA Geophysical Data Center (5).



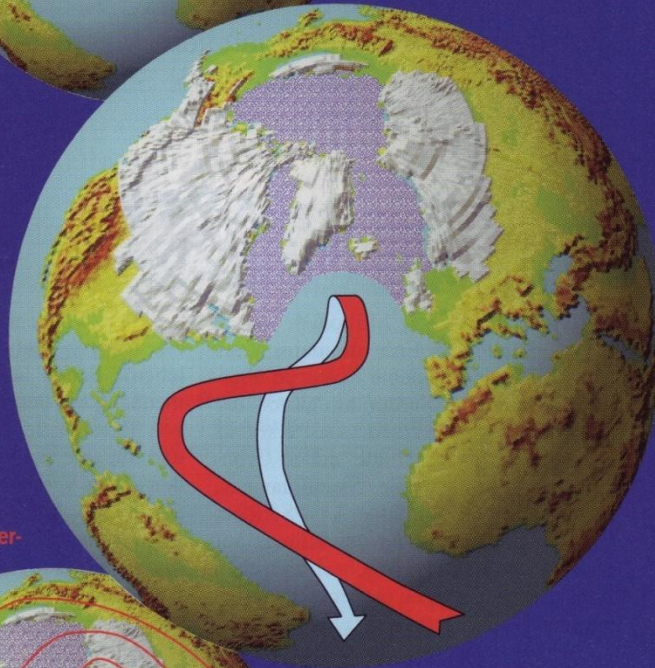


## Eiszeitliche Strömungsmuster im Atlantik

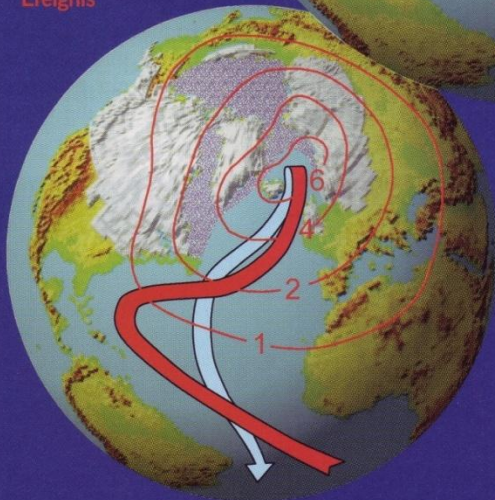
völlig abgerissene Strömung



Normalzustand

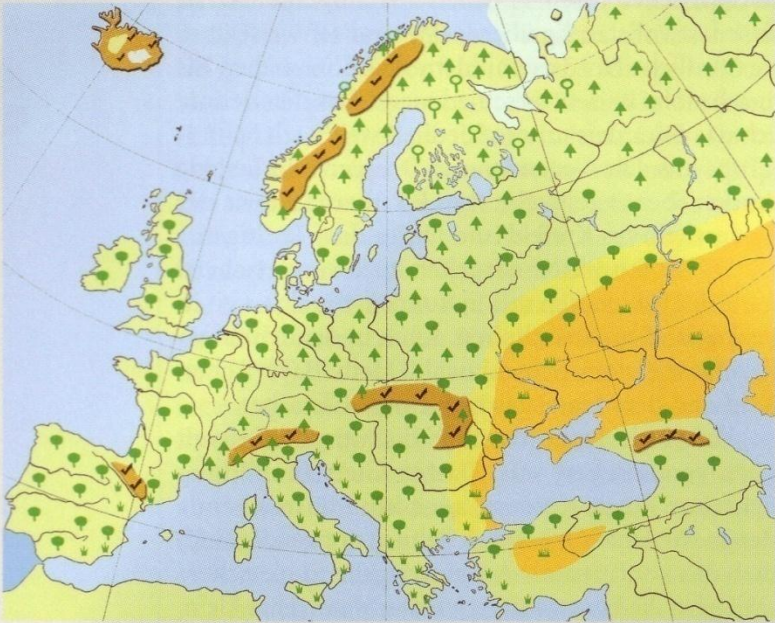


Dansgaard-Oeschger-Ereignis

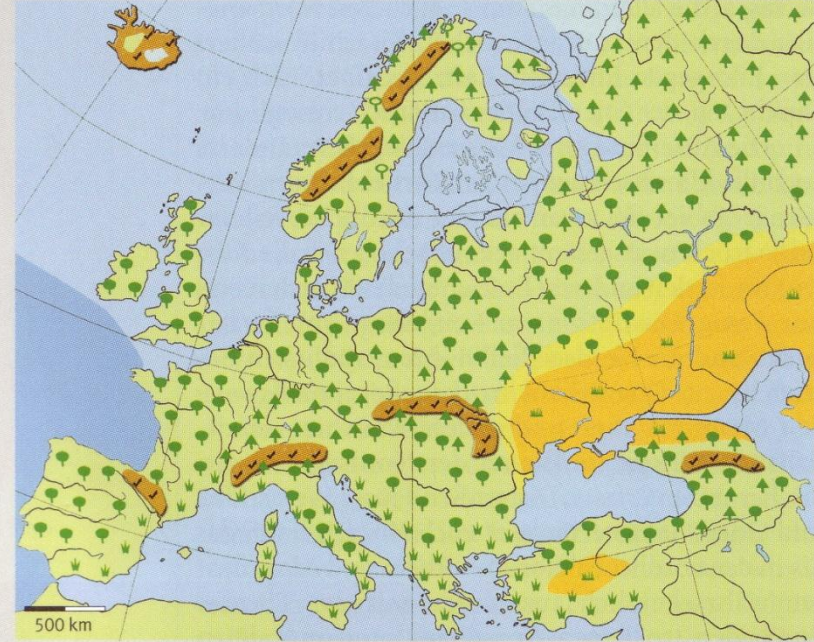


Die Simulation der eiszeitlichen Strömungsverhältnisse im Atlantik ergab drei Zustände. Beim vorherrschenden stabilen, kalten Zustand strömte warmes tropisches Wasser nur bis in mittlere Breiten (Mitte). Bei einer plötzlichen Erwärmung drang es dagegen – wie heute – bis ins Nordmeer vor (unten; Temperaturabweichungen in Grad Celsius). Die Strömung konnte aber auch völlig abreißen (oben). Die gezeigte Ausdehnung des Inlandeises beruht auf geologischen Daten und wurde bei den Computersimulationen vorgegeben.

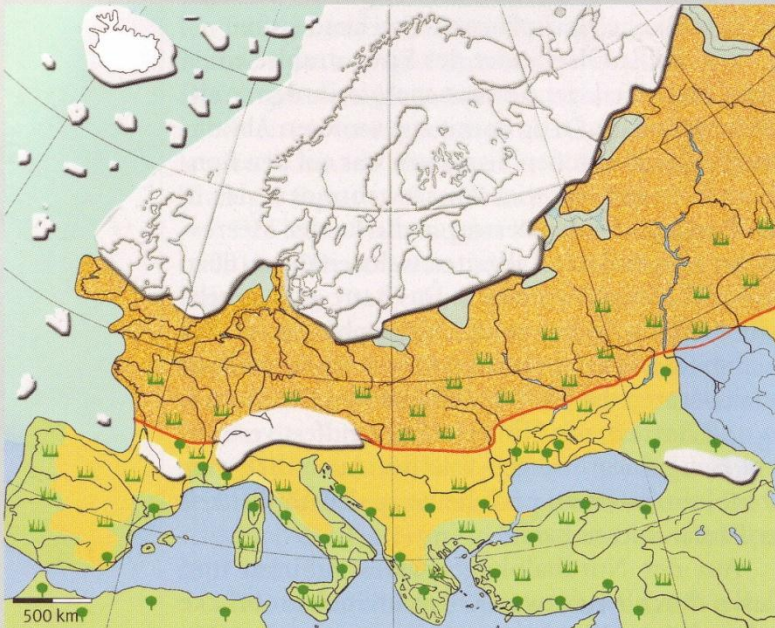
Holozän  
8000



Eem  
120 000



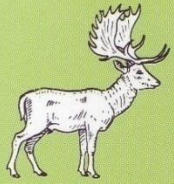
Weichsel  
20 000



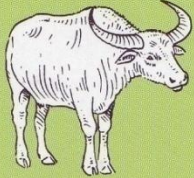
## Vegetation in Mitteleuropa



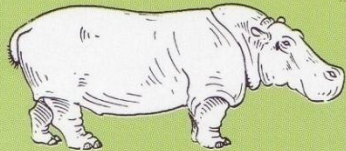
Waldelefanten-Fauna



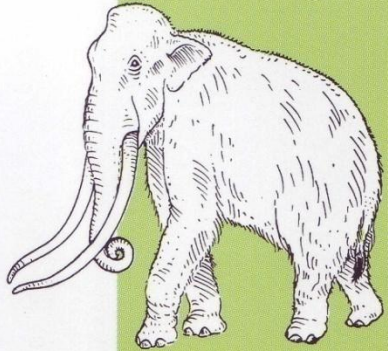
*Dama dama*



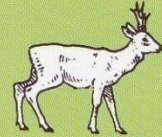
*Bubalus murrensis*



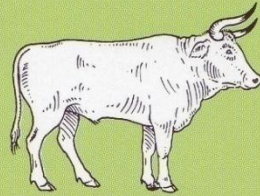
*Hippopotamus amphibius*



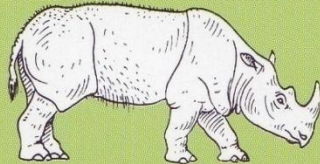
*Elephas antiquus*



*Capreolus capreolus*



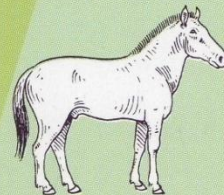
*Bos primigenius*



*Stephanorhinus kirchbergensis*



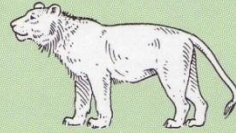
*Sus scrofa*



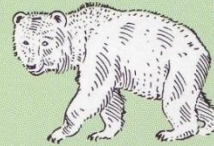
*Equus ferus*



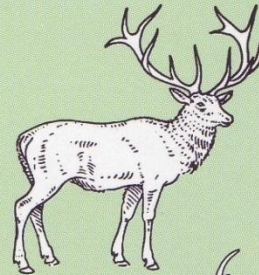
*Crocuta c. spelaea*



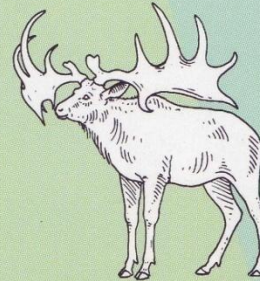
*Panthera leo spelaea*



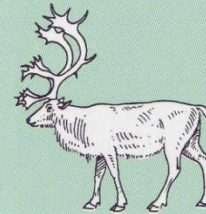
*Ursus spelaeus*



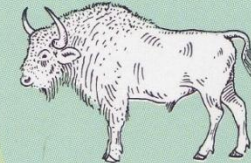
*Cervus elaphus*



Mammut-Fauna



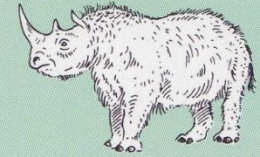
*Rangifer tarandus*



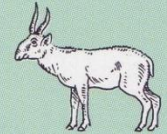
*Bison priscus*



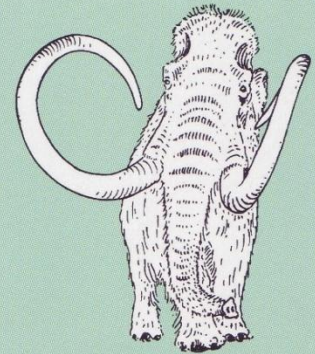
*Ovibos moschatus*



*Coelodonta antiquitatis*

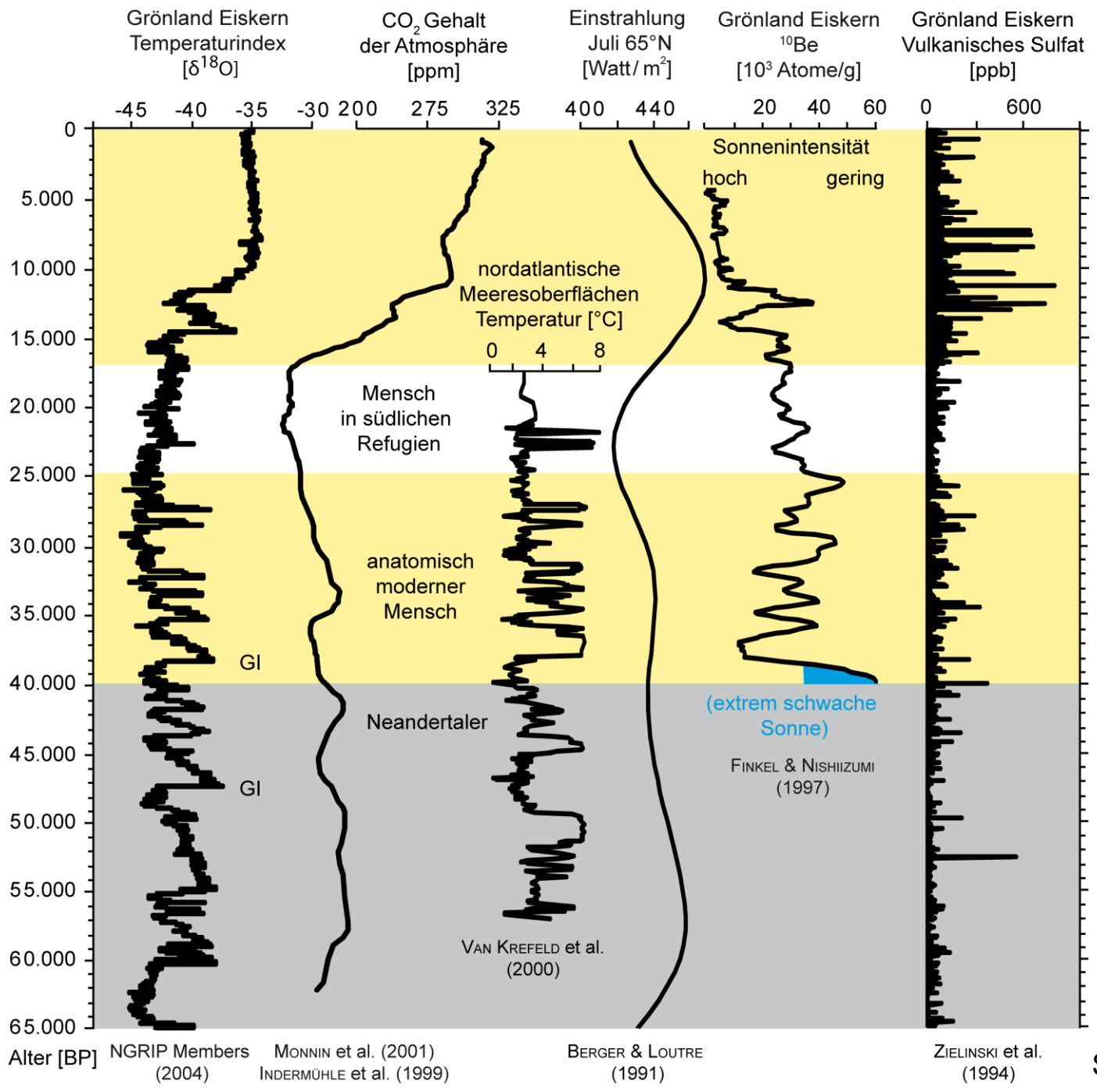


*Saiga tatarica*



*Mammuthus primigenius*

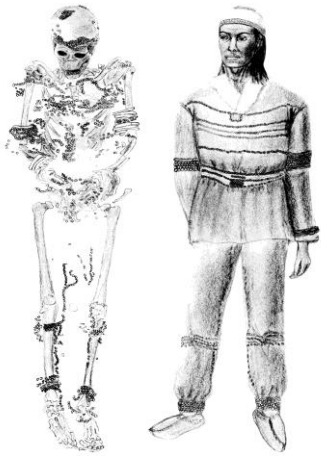
Gegenüberstellung der kaltzeitlichen und warmzeitlichen Faunengemeinschaften



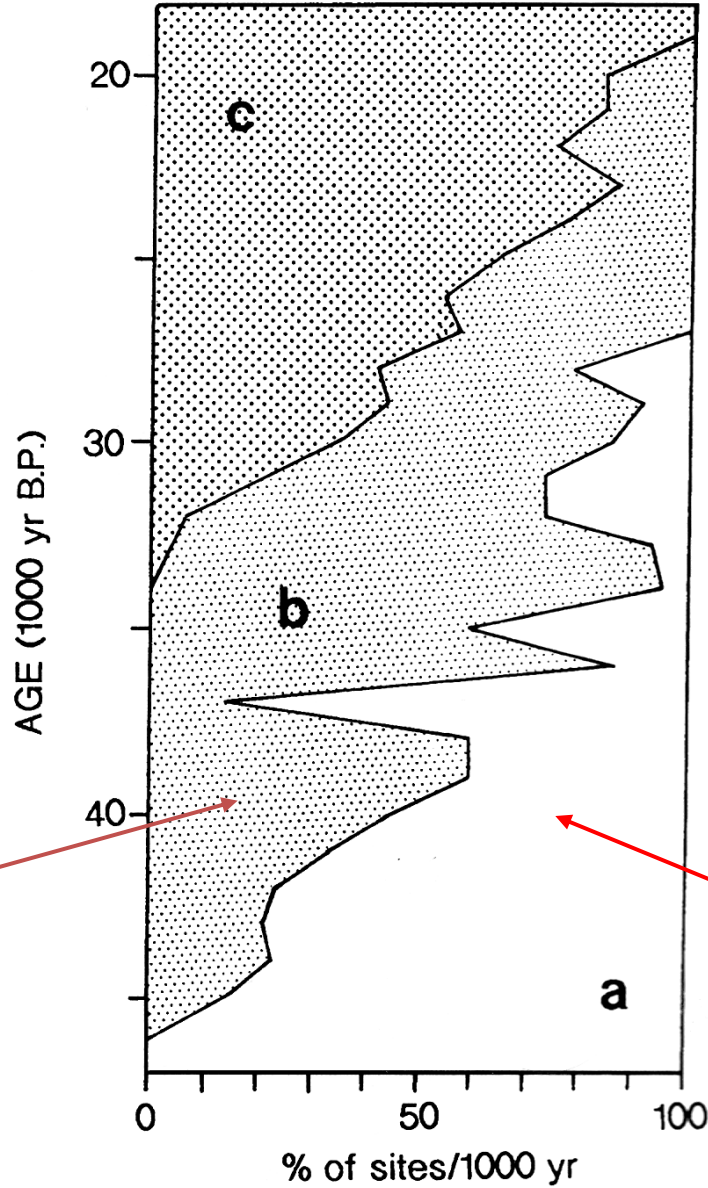
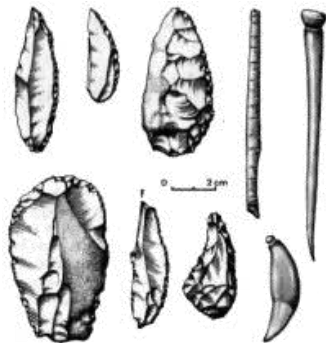
Alter [BP] NGRIP Members (2004) MONNIN et al. (2001) INDERMÜHLE et al. (1999) BERGER & LOUTRE (1991) ZIELINSKI et al. (1994)



# <sup>14</sup>C Datierungen archäologischer Fundplätze



33.000 J.v.h. älteste Höhlenmalerei (Chauvet Höhle) **Aurignacian**



Neandertaler - **Mousterian**

