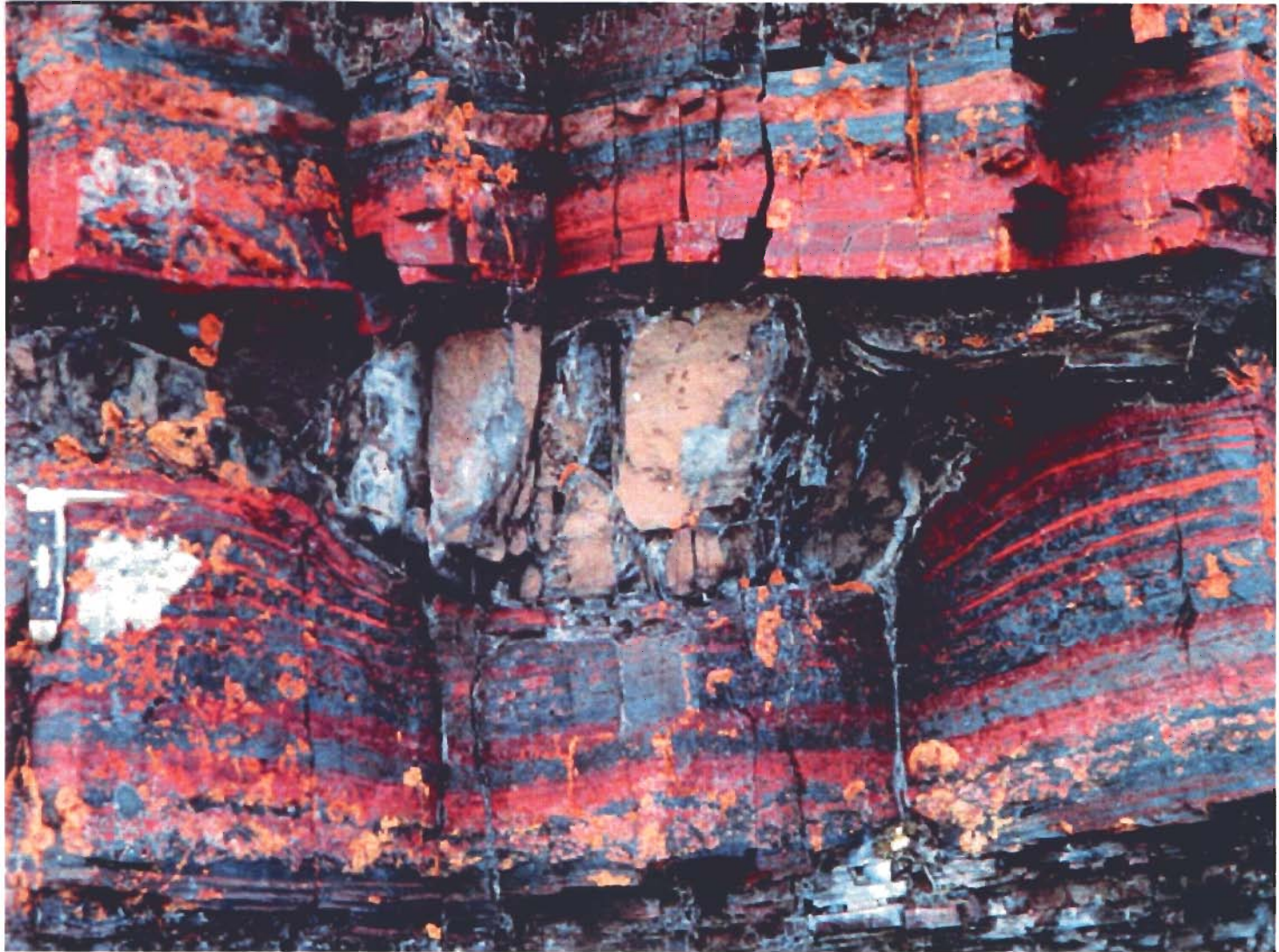
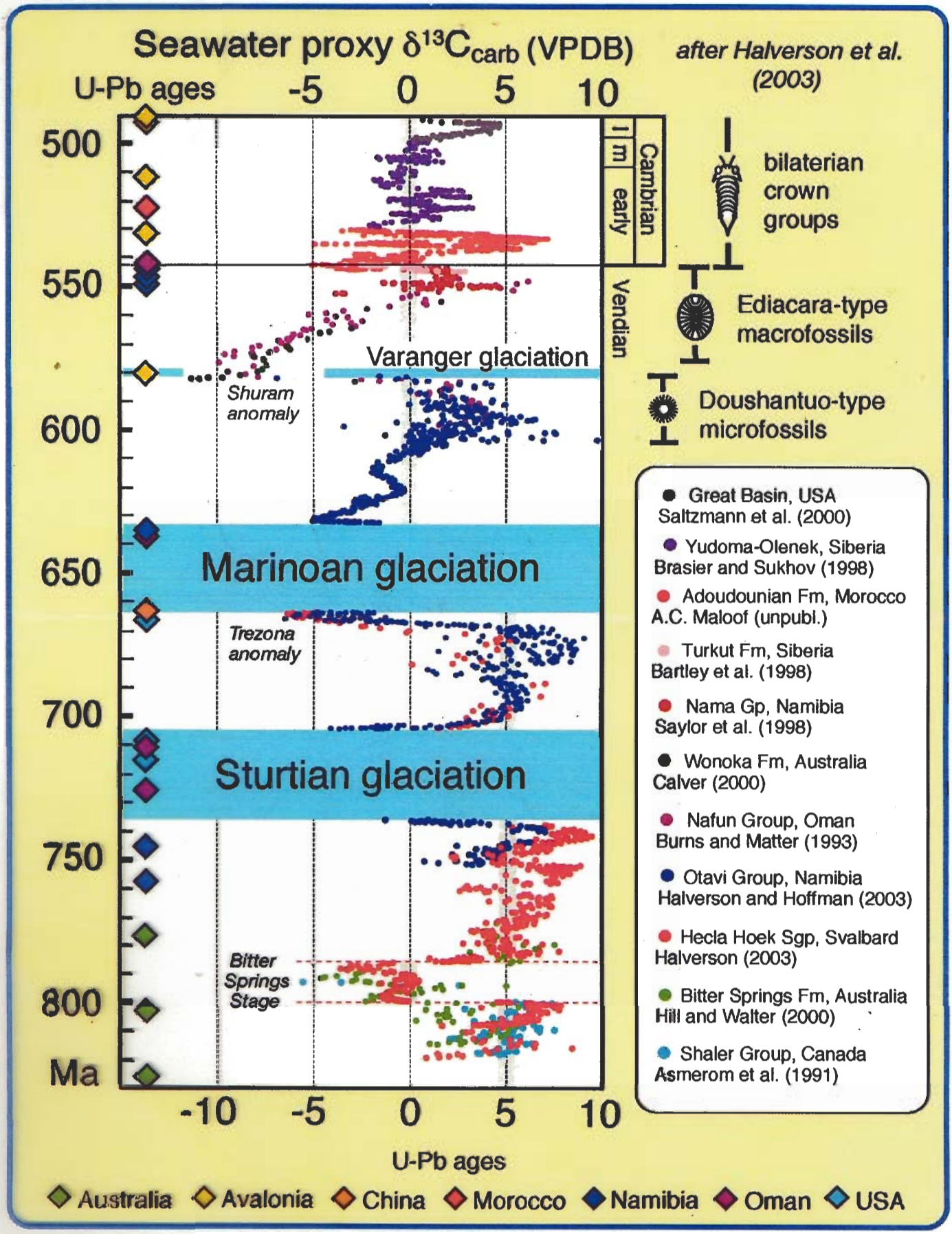
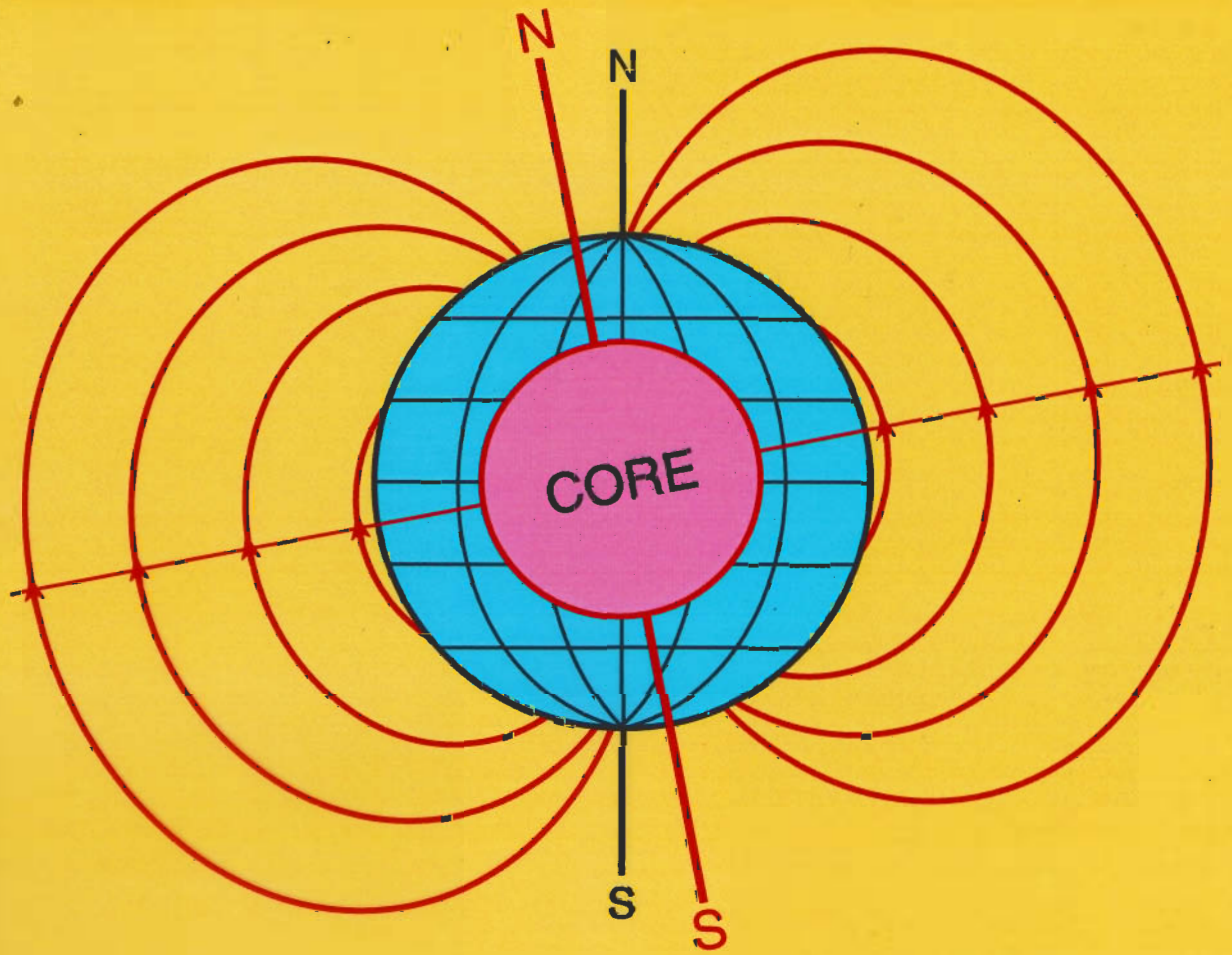



Seawater proxy δ13Ccarb (VPDB)
after Halverson et al. (2003)
U-Pb ages
-5
0
5
10
500
550
600
650
700
750
800
Ma
Cambrian
early
m
l
Vendian
bilaterian crown groups
Ediacara-type macrofossils
Doushantuo-type microfossils
Varanger glaciation
Shuram anomaly
Marinoan glaciation
Trezona anomaly
Sturtian glaciation
Bitter Springs Stage
Great Basin, USA Saltzmann et al. (2000)
Yudoma-Olenek, Siberia Brasier and Sukhov (1998)
Adoudounian Fm, Morocco A.C. Maloof (unpubl.)
Turkut Fm, Siberia Bartley et al. (1998)
Nama Gp, Namibia Saylor et al. (1998)
Wonoka Fm, Australia Calver (2000)
Nafun Group, Oman Burns and Matter (1993)
Otavi Group, Namibia Halverson and Hoffman (2003)
Hecla Hoek Sgp, Svalbard Halverson (2003)
Bitter Springs Fm, Australia Hill and Walter (2000)
Shaler Group, Canada Asmerom et al. (1991)
-10
-5
0
5
10
U-Pb ages
Australia
Avalonia
China
Morocco
Namibia
Oman
USA



THE EARTH'S DIPOLAR MAGNETIC FIELD

Radiative heat balance (at equilibium):

HEAT ABSORBED = HEAT EMITTED

$$R^2 E_s [1 - \alpha] = 4 R^2 [f \sigma T_s^4]$$

R = *radius of the Earth*
E_s = *solar irradiance*
α = *planetary albedo*
f = *effective infrared transmission factor (greenhouse effect)*
σ = *Stefan-Boltzman constant*
T_s = *surface temperature*

PLANETARY ALBEDO: The fraction of incoming radiation that is reflected back to space.
[sea water ~0.1; bare land ~0.3; sea ice ~0.6; fresh snow ~0.9]

ICE-ALBEDO FEEDBACK: For any imposed cooling (or warming), the resulting higher (or) albedo will cause further cooling (or warming). Thus, ice advance is self-stabilizing.

RUNAWAY ICE ALBEDO: If ice lines close to within ~30° of the equator, the ice albedo feedback becomes unstoppable and ice quickly covers the tropics.

see Budyko, M.I., The effect of solar radiation variations on the climate of the Earth; TELLUS 21: 611-619 (1969).