

Skaftafelljokull (glacier)

Part 0: Social Media



What is it?



Ice Cave

Nice view of the very dirty ice at the bottom of the glacier





definitely a pothole

nothing definitive that pothole due to glacial meltwater



superficially striae but close examination probably thrugoing



Big cliff, but lots of processes can make cliffs



These may be aretes so might be glacial



These may be aretes so might be glacial



Could this be an esker?



rather too straight

looks more like a layer of lesserodible rock protruding from the ground

not glacial





aretes on distant hills (red) U-shaped valley



is this a moraine crossing the valley?







possible cirque and moraine



is that a roche muttonette ?

possible there's a cirque in the mountains

so maybe ...





beautiful U-shaped valley (red)

with horn in distance (yellow)

Part 1: What glacial geology gets fossilized?

glacial striae?





yes, sediment

protects striae

then later erodes away

glacial till



but might be hard to differentiate from a conglomerate of other origin

(unless clasts have striae)

glacial till?



glacial till



but might be hard to differentiate from a conglomerate of other origin

(unless clasts have striae)

drop-stone?



drop-stone?



yes

glacial boulder ?



glacial boulder



yes, it it might be hard to tell its glacial

(unless it has striae)

varves?



yes

U-shaped valley?



U-shaped valley



Possibly

but might be hard to recognize it unless the exposure is very good

Part 2: Factors influencing Earth's temperature

Insolation

temperature warms so that outgoing infrared equals incoming solar energy flux

$$f = \sigma T^4$$

$$T = \sqrt[4]{f/\sigma}$$

current temperature: 255K



sunlight reflected back to space does not contribute to surface warming

$$f = (1 - \alpha) f_{solar}$$

current albedo: 0.3

Greenhouse effect

Ground temperature T_g is warmer than top of atmosphere

$$T_g = \sqrt[4]{(1+n)} T$$

n effective optical thickness of atmosphere currently about n = 2

Insolation: The sun is getting brighter $f_{now} = \sigma T_{now}^4$



Albedo: We're not sure







Venus

current albedo

0.3

0.7

 $\frac{(1-0.7)}{(1-0.3)} = \left[\frac{T_A}{T_{now}}\right]^4$

 $T_A = 0.81 T_{now}$

 $\Delta T = T_A - T_A = -51 K$

Greenhouse Gas: probably much more CO2 early



very good data for last 66 my

Greenhouse Gas: probably much more CO2 early



Greenhouse Gas: probably much more CO2 early on



some measurements for last 400 my



speculations for the early Earth



speculations for the early Earth



Temperature of the Earth during the last 500 my



Temperature of the Earth during the last 500 my



Plate tectonics matters at these time scales!



Drawn from DiMichele et al. 2005, Plant Biodiversity Partitioning in the Late Carboniferous and Early Permian

Boulder with striae (Saudi Arabia)



weathered out of a sandstone



Striae on bedrock

in Brazil



Striae on glacial cobble

in Brazil



Tillite or glacial diamictite (lithified till) (Saudi Arabia)



Tillite or glacial diamictite (lithified till) (Scotland)

neoProterozoic Ice Age and Snowball Earth





tillite

(Australia)



varves (Brazil)





"Snowball Earth"

hypothesis that Earth froze over during the Cryogenian

and especially that the oceans were frozen In a low-insolation era

albedo feedback could lead to frozen conditions In a low-insolation era

albedo feedback could lead to frozen conditions colder ... more ice more ice ... higher albedo

higher albedo ... less sunlight absorbed

less sunglight absorbed ... colder

What turns it off?

CO2 from volcanos





colder ... less chemical weathering

less weathering ... more buildup of volcanic CO2

more CO2 ... more greenhouse effect

more greenhouse ... hotter



Droptone







Cap carbonate (south Australia)

limestone ... CaCO3

dolomite ... (Ca,Mg) CO3

abiogenic deposit 1-30 m at top of glacial deposits

suggests major change in ocean chemistry

breakup of sea ice that covered the ocean for a very long time ???





Contact between glacial marine Ghaub Fm (DF, debris flows; IRD, ice-rafted debris) & Keilberg Mb (CD, post-glacial cap dolostone) on Otavi foreslope, northern Namibia.