Event Stratigraphy

a quick summary

Banded Iron Formations, Soudan, Minnesota

Event Stratigraphy

- Event Stratigraphy is the correlation of sedimentary sequences via marker beds or event horizons
- Marker beds and event horizons represent synchronous surfaces throughout their extension
- As such, they separate an older sequence below from a younger sequence above

what are Marker Beds?

- A marker bed is a bed, or horizon (a thin subdivision of a layer) with characteristics distinctly different from those of the host sediment above and below it.

- A marker bed can be easily traced over long distances

what are Event Horizons?

- An event horizon is a
  - discontinuity surface in an otherwise "normal" sequence, or
  - a layer with exceptional fossil content, or
  - a layer with specific, distinctive characteristics within a sequence

What is an “event” in general?

- An **event** can be any kind of
  - depositional,
  - non-depositional or
  - erosional **episode** that has occurred synchronously (at the same time) within a sedimentary basin
-

what controls Events?

- These episodes or events are mainly controlled and/or triggered by the physical environment (for instance, volcanic eruptions, tsunamis, turbidites, storms, etc.)

- Still, some events do not affect directly the sedimentary record but rather the faunas and floras. As a consequence, this kind of event is marked by a change or an anomaly in the fossil record

what kind of Events do we recognize?

- There are four main categories of events:
  - Depositional events
  - Non-depositional and erosional events
  - Other rare physical events
  - Biological events

Depositional Events

- Depositional events occur within hours or days, or instantaneously from a geologic point of view.

- Examples of synchronous deposits are:
  - Shallow-marine storm sands (Tempestites), and Tsunami deposits
  - Gravity Flow deposits and Turbidites
  - Deposits controlled by relative sea-level change
    - transgression = rise in sea level
    - regression = drop in sea level
  - Continental deposits, such as those left by sheetfloods and flash floods
  - Volcanic ash layers and other volcaniclastic (pyroclastic) sediments, known as *tephra*

Turbidites from the Miocene Marnoso-Arenacea Formation

Each layer represents a submarine turbidity flow, that was deposited synchronously over a vast area.
While every layer may have been deposited just in a few hours, the time between layers is in the order of centuries to millennia

Coniale, Firenze, Italy

A tephra deposit

Individual layers of pyroclasts marked single volcanic explosions that deposited volcanic ash synchronously over a vast area

Leon Viejo, Nicaragua

Non-Depositional and Erosional Events

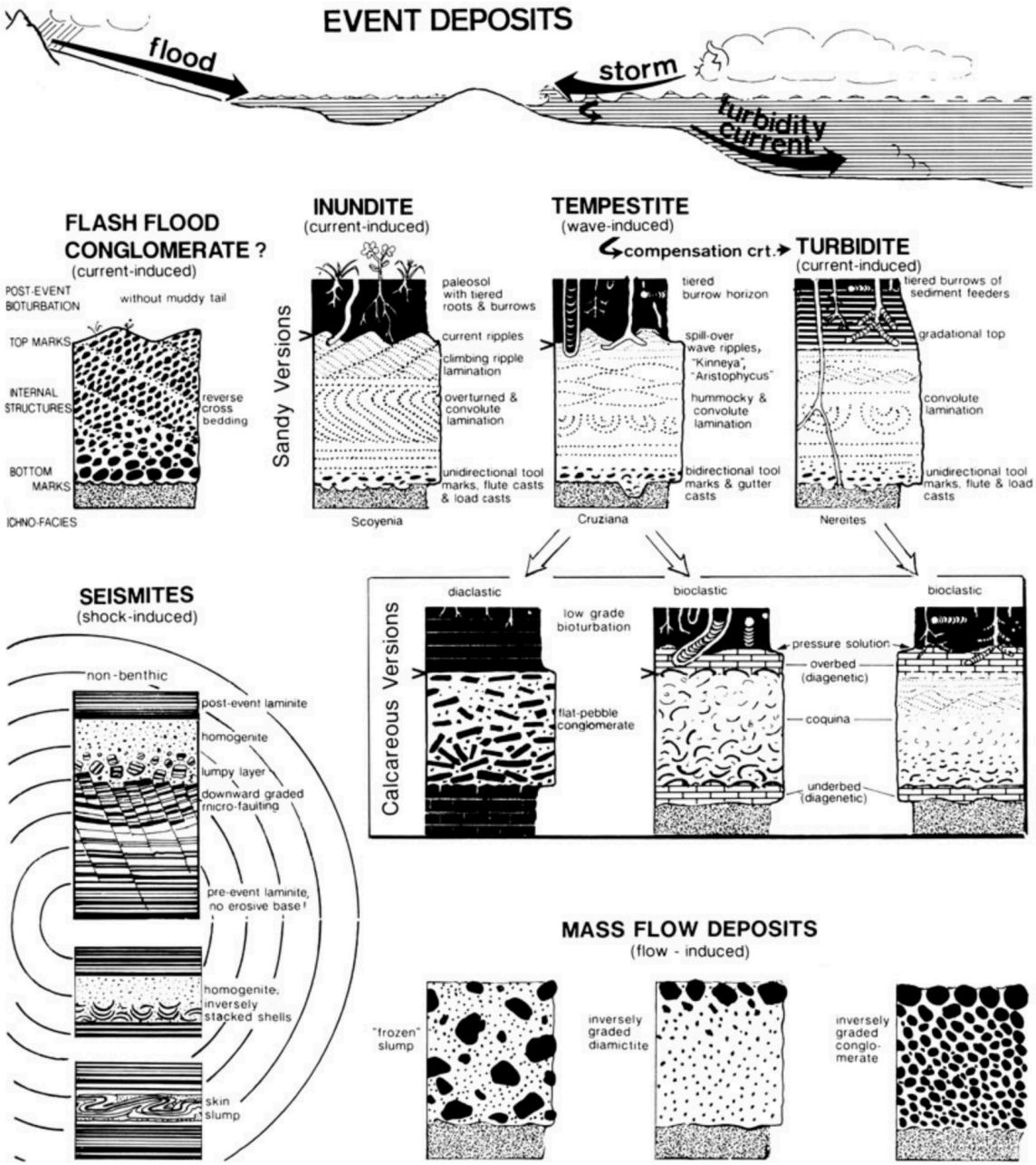
- Non-depositional and erosional events do not create distinct beds (there is no sediment available!), but rather leave a trace, a mark, at a specific surface or horizon.

- Many of these events are limited in areal extension and may not be important in correlation. Only the few events that occur over wide areas can acquire a more global role.

- Examples are:
  - On land: paleosols, coal seams, karst surfaces
  - Under water: lag deposits (deposits of material "left behind" by currents or waves in shallow waters, such as shell beds, coarse sands beds, beds of minerals and concretions that form and/or concentrate in these conditions)

Coal seams

Nanaimo (Vancouver Island), British Columbia, Canada



Basic pattern of event deposits ***(SEILACHER, 1991)***

Other Rare Physical Events

- Events of this kind would still be synchronous, but would only occur occasionally
  - Shallow-marine storm sands
  - Meteorite impacts
    - such an impact would form characteristic sedimentary layers and/or leave behind traces of a specific elements, as in the case of the iridium at the K/Pg boundary
  - Earthquakes
    - earthquakes might trigger the formation of distinct deposits, called *seismites*, that would be synchronous over a certain area

A layered coquina limestone (coin for scale)
These oyster shells were concentrated by storms along an ancient coastline and as such individual layers are deposited in a short amount of time and synchronously

St. Augustine, Florida

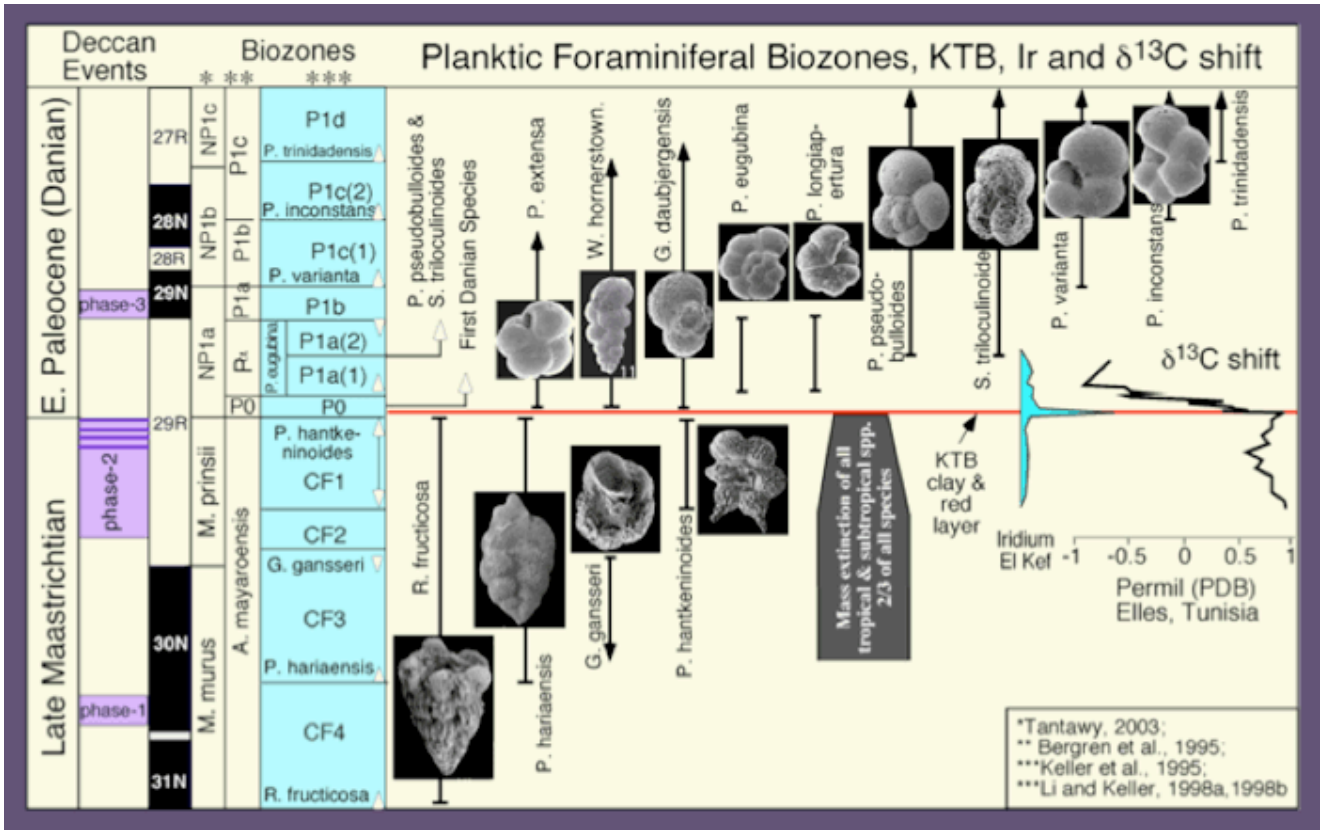
Biological Events

- The sudden appearance of new taxa in the rock record usually reflects a drastic change in environmental conditions
  - (a climate change, a change in water currents or chemistry, a change in the amount of nutrients, a change in the oxygen content of the water, etc.).

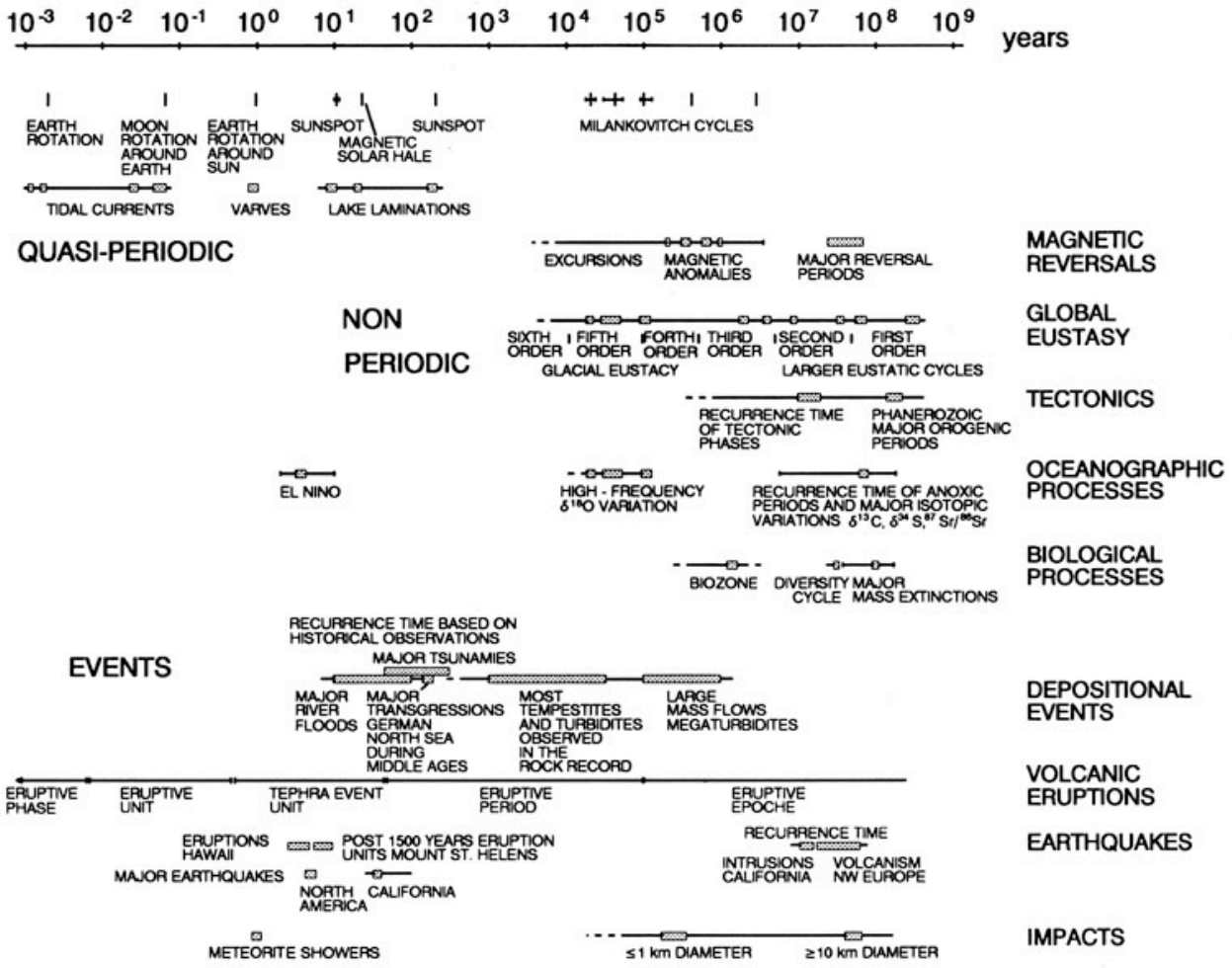
A record of a meteorite impact and extinction (biological event) at the Cretaceous/Paleogene boundary
After a meteorite hit Earth, fine debris was thrown into the atmosphere and distributed all over the Planet, eventually settling and blanketing land and water. Those clays are now identified throughout the world as separating a pre-impact Cretaceous from a post-impact Paleogene.
The impact happened in the Yucatan peninsula of Mexico. This location is in Denmark.

Støre Heddinge, Sjælland, Denmark

Extinction patterns at the K/Pg boundary



How often do these Events occur?



Major recurrence time of quasi-periodic and nonperiodic processes as well as events.

Einsele, Ricken, & Seilacher (1991)

Event Stratigraphy: **The End**