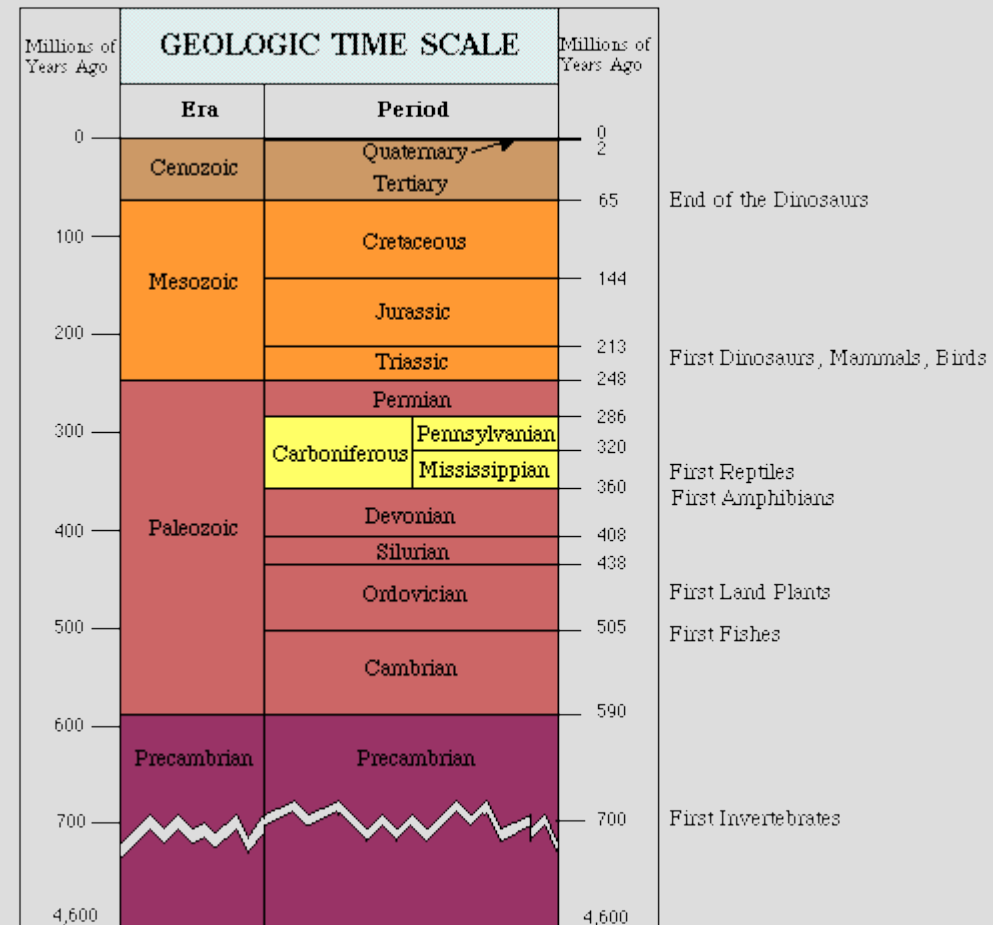


# Evolutionary catastrophes

Chetan Vaity

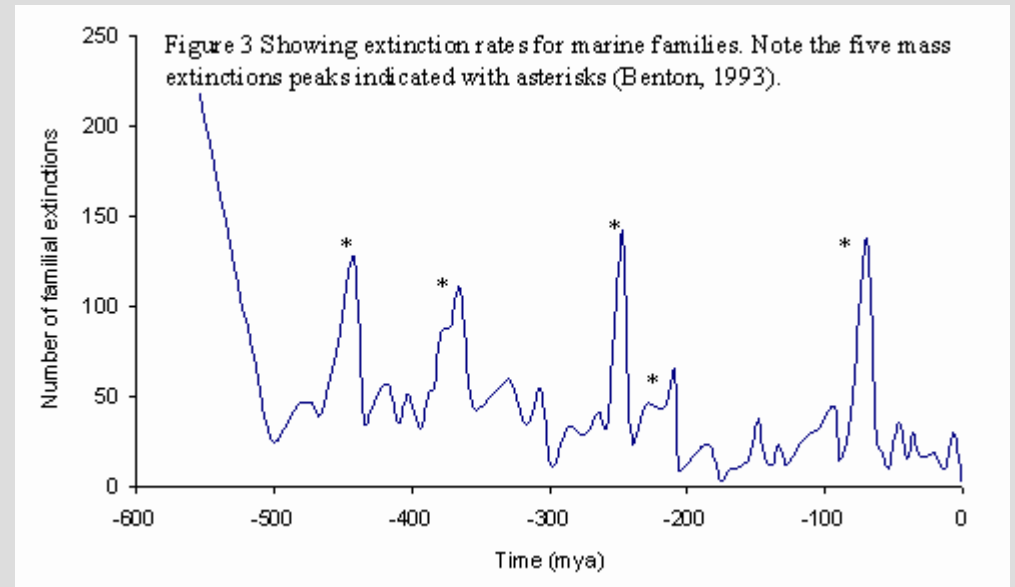
# Geological Timescale

- Fossils appear only after 600 Ma
- Creatures with hard shells (and later, skeletons)



# Extinction Events

- 5 major extinction events since 600Ma
- Peaks in the species extinction rate



- PT (250Ma) and KT (65 Ma) boundaries
- In the PT event, 90% of all species vanished
- Perhaps 99% of all living creatures died

# The end of the dinosaurs

- A thin layer of darker clay
- Iridium concentrations much higher in the layer
- Some meteorites contain very high Ir concentrations
- Earth hit by 10 km diameter object
  - 10,000 times the planet's nuclear arsenal

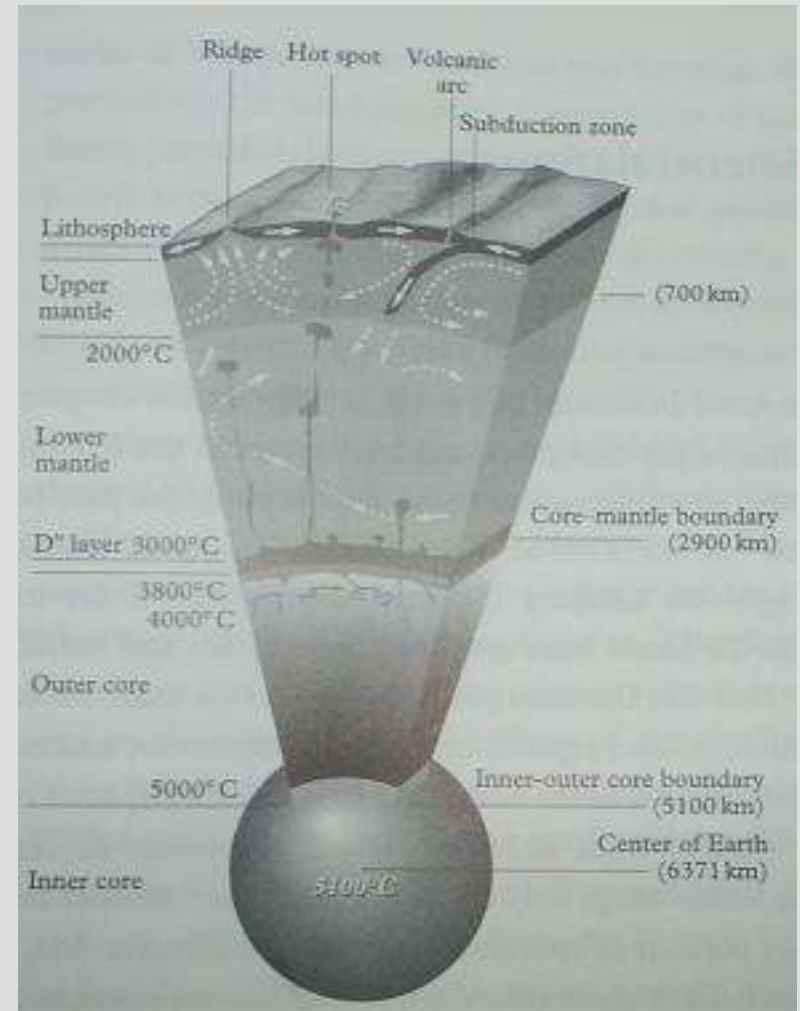


# Impacts or ...

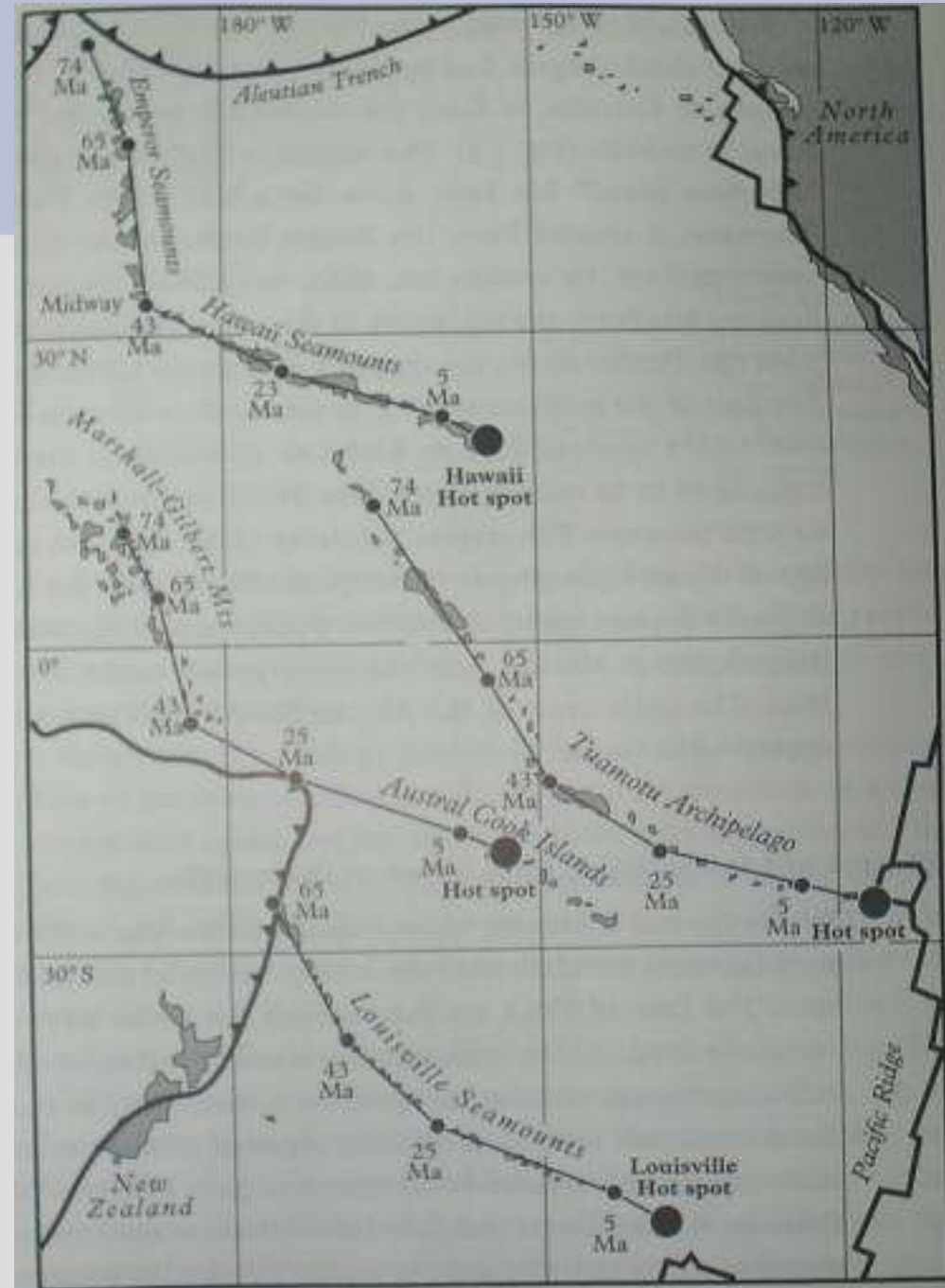
- Other geological boundaries reveal no abnormal concentrations
- Ir concentrations vary from 0.1 to 100 ppb
  - Natural concentrations 0.01 ppb
- Elevated Ir concentrations not limited to the boundary
  - Source of Ir may have been in operation for several hundred thousand years

# Hot spots

- Plate tectonics
- Some major volcanoes cannot be explained
  - eg: Hawaii (in the centre of the Pacific plate)
- Hot spot: hot matter rising from the mantle
- Chain of volcanic islands could be built by a plate moving over a hot spot

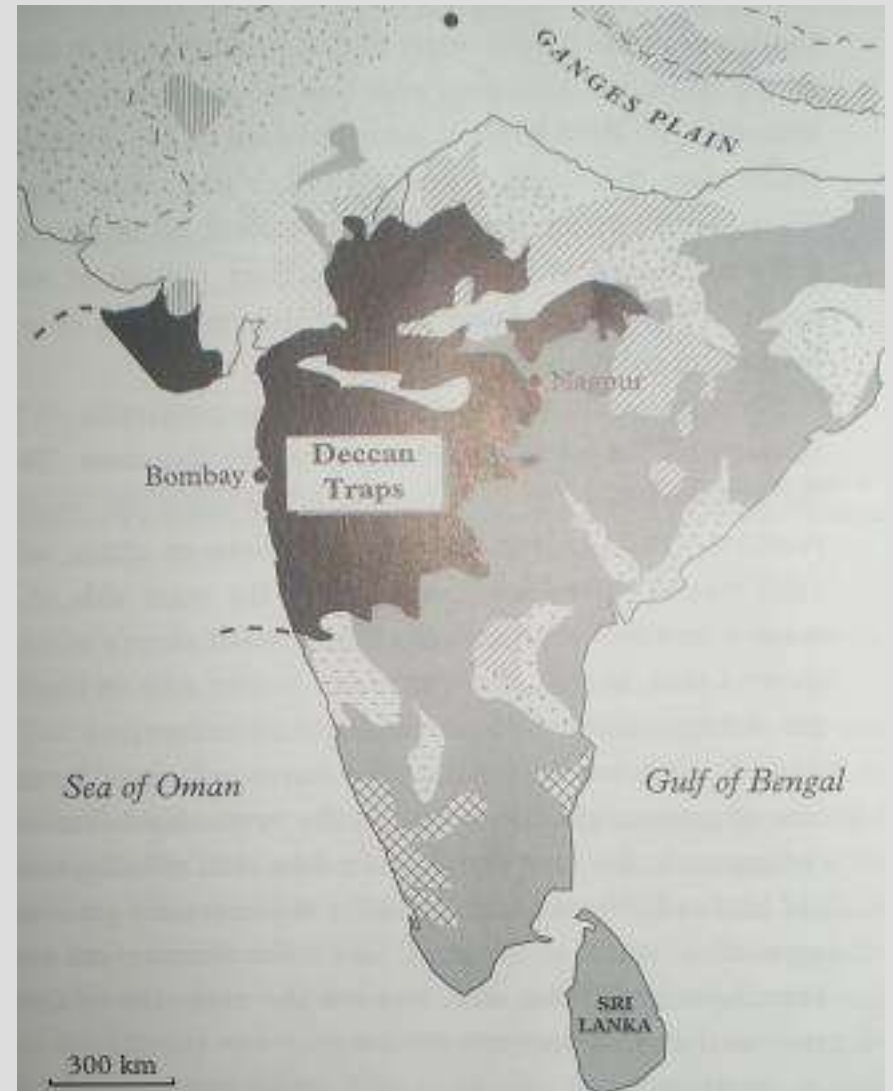


- 4 instances of island chains in the Pacific (many are submerged)
- All could be formed by hot spots
- All show a marked change in direction at 43Ma



# Deccan Traps

- Immense area covered with basaltic lava
- More than 2000m thick
- The stack of lavas had been laid down within half a million years
- The period is 65 Ma, exactly at the KT boundary!

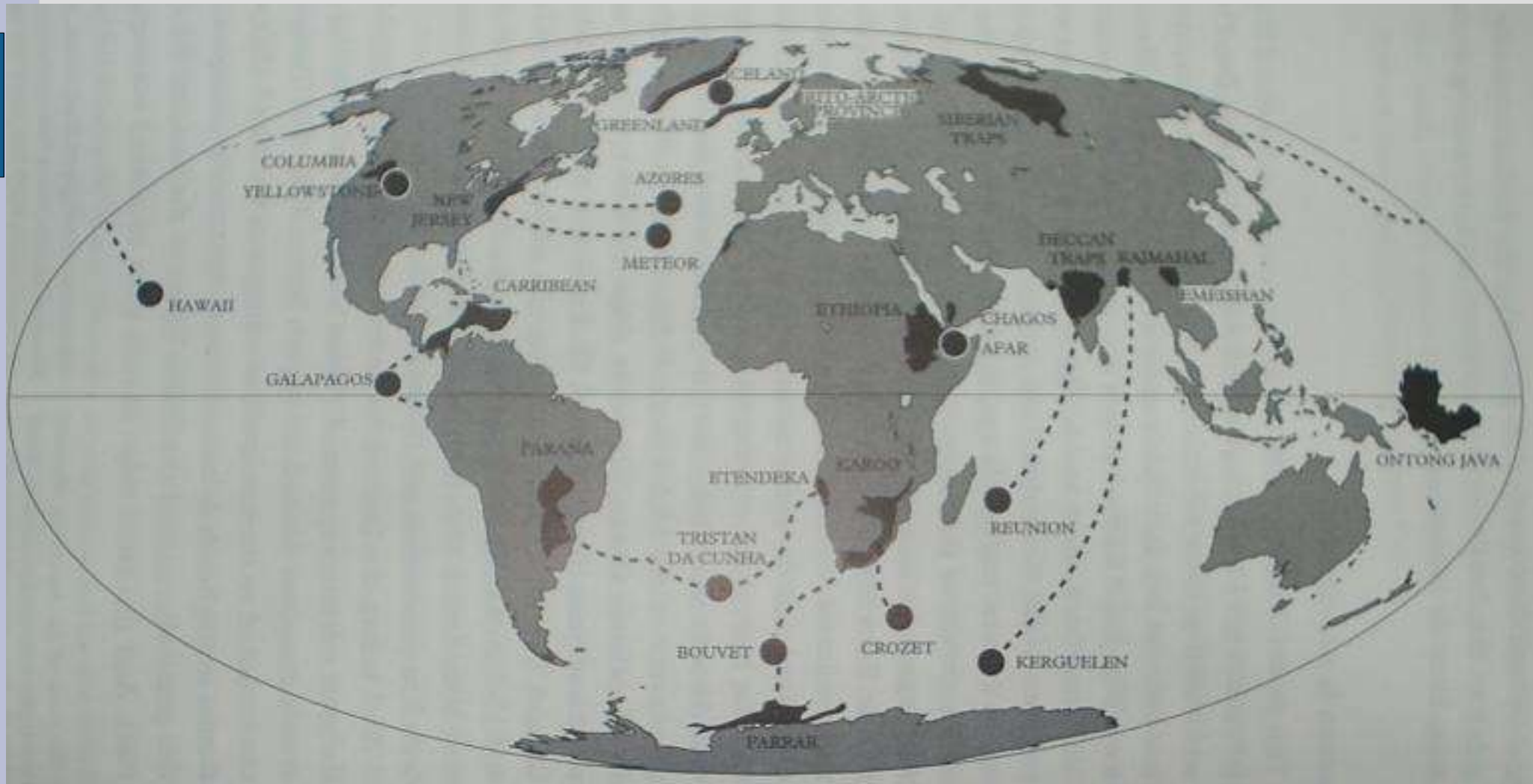




# Traps and Hot spots

- Traps record the events when the hot spots first emerge
- The hot spot responsible for Deccan traps now lies at Reunion (near Madagascar)
- In fact an island chain can be seen from Reunion to Deccan
  - This chain is broken because it goes over a plate boundary

# Traps worldwide



# Another brick in the wall...

- The Siberian traps were laid 250 Ma, almost exactly at the PT boundary!
- Other extinction events have also been correlated with traps
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- 
- Impact or volcanism – the debate is still on
- References:
  - Evolutionary Catastrophes – Vincent Courtillot
  - The Restless Earth – Nigel Calder