

The Ice Ages

Ice ages are periods when glaciers and ice-sheets are created, that advance and cover the earth. There are at least six ice ages known to have occurred in the Earth's history. The earliest ice-age dates back to about 2.2 billion years ago, a colossally devastating one that was trailed by about 1 billion years of warm period. There followed another ice age, even more devastating than the first one when massive freezing occurred on the earth, known as the Cryogenian or super ice age, creating conditions where no life could exist on the earth - a situation popularly known as Snowball Earth. The subsequent ice-ages, however, seem pretty small compared with the *Cryogenian* outbreak. The most recent and best known ice-age commenced about 2.5 million years ago (the Pleistocene ice-age) and lasted until the retreat of the ice to its present extent about 11,000 years ago, start of Holocene epoch.

Why do we have these periodic cycles of cold ice ages punctuated by warmth? As the earth moves through space, it is subject not just to variations in the length and shapes of the orbit, but also to shifts in its angle of orientation to the Sun. In particular, it is subject to three changes in position, known as its obliquity, precession and eccentricity over long periods of time which affect the duration and amount of sunlight falling on the earth. The freezing was due to a fall in solar radiation and a drop off in the production of greenhouse gases, which made the Earth lose its ability to hold on to its heat. Temperature fell by as much as 45 degrees Celsius and the entire surface of the earth may have frozen solid, with ocean ice up to 800 metres thick at higher altitudes and tens of metres of thick even in the tropics. The ice ages were caused by summers that were too cool to melt all the snow that fell causing more incoming sunlight to be reflected back and thereby aggravating the cooling effect to encourage yet more snow to fall. As snow accumulated into ice sheets, the region grew cooler, prompting more ice to accumulate, consequently breeding a self-perpetuating condition.

So a planet with ice surface should continue to reflect much heat and would continue to stay frozen for ever. Then how did it ever get back its warmth again? Plate tectonics in which the continents rifted and drifted led to eruption of volcanoes which pushed through the buried surface, pumping out lots of heat and gases that melted the snows and re-formed the atmosphere.

Large masses of ice, mainly re-crystallized snow known as glaciers, move slowly outwards and stop where the rate of melting is equal to the deviance of the glaciers. Glaciers are of three types - mountain or valley glaciers in the mountainous regions, the piedmont that develops when the valley glaciers spread over low lands and the ice sheets. Ice-ages are notorious but are also useful to the earth as glaciation grinds down rocks leaving behind new soils of richness and gouges out freshwater lakes that support life on the planet.