

INTRODUCTION TO GEOMORPHOLOGY

It is thought that the Earth was formed 4.6 billion (460 million) years ago.

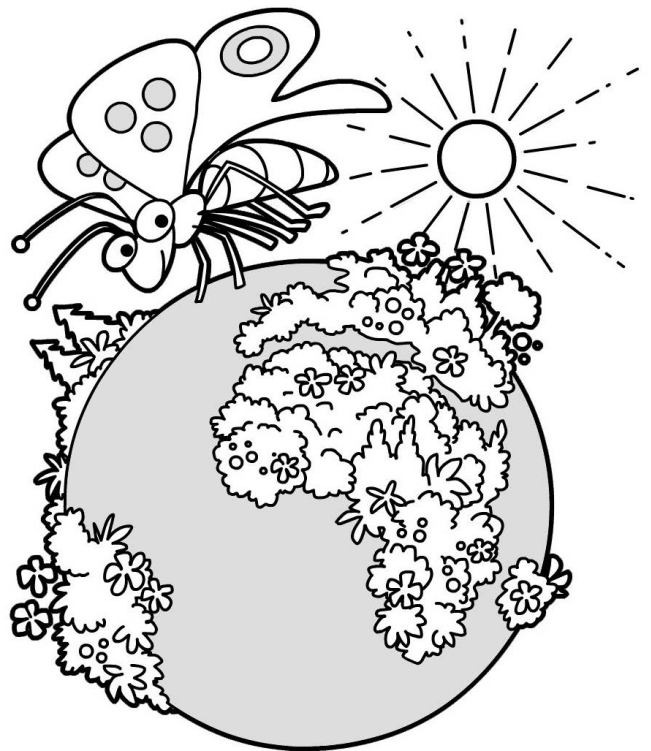
In his book "Restless Earth", Nigel Calder gave an easier method of comprehending the age of the Earth. He took away the 8 zeros and compared the 46 years left over the life of a 46-year old lady.

Case Study: A simplified history of the Earth, Nigel Calder

"...Or we can depict Mother Earth as a lady of 46, if her 'years; are mega centuries. The first seven of those years are wholly lost to the biographer, but the deeds of her later childhood are to be seen in old rocks in Greenland and South Africa. Like the human memory, the surface of our planet distorts the record, emphasising more recent events and letting the rest pass into vagueness – or at least into unimpressive joints worn down mountain chains.

Most of what we recognise of Earth, including all substantial animal life, is the product of the past six years of the lady's life. She flowered, literally, in her middle age. Her continents were quite bare of life until she was getting on for 42 and flowering plants did not appear until she was 45 – just one year ago. At that time, the great reptiles, including the dinosaurs, were her pets and the break-up of the last super-continent was in progress.

The dinosaurs passed away eight months ago and the upstart mammals replaced them. In the middle of last week, in Africa, some man-like apes turned into ape-like men and at the weekend, Mother Earth began shivering with the latest series of ice ages. Just over four hours have elapsed since a new species



calling itself Homo sapiens started chasing the other animals and in the last hour it has invented agriculture and settled down. A quarter of an hour ago, Moses led his people to safety across a crack in the Earth's shell, and about five minutes later Jesus was preaching on a hill farther along the fault line. Just one minute has passed, out of Mother Earth's 46 'years', since man began his industrial revolution, three human lifetimes ago. During that time, he has multiplied his numbers and skills prodigiously and ransacked the planet for metal and fuel!"

Geologists (People who study the Earth) have been able to draw up a **geological timescale** to show major events in the Earth’s history.

EON	ERA	PERIOD	EPOCH	Ma	“FOSSIL RECORD”	
Phanerozoic	Cenozoic	Quaternary	Holocene	- 0.01	Human civilizations evolve, great extinctions begin	
			Pleistocene	- 2.6	Ice Ages and interglacial periods cause widespread changes in climate Modern humans evolve and migrate around the world	
		Tertiary	Neogene	Pliocene	- 5.3	First ice ages begin as Himalayan Mountains rise, Isthmus of Panama closes Grasses evolve and spread worldwide
				Miocene	- 23	Most modern families of mammals evolve and migrate across land bridges Yellowstone Hotspot migrates eastward, Colorado Plateau and Great Plains rise
				Oligocene	- 33.9	Great Basin extension begins as San Andreas Fault System develops Deciduous forests (leaves fall in winter) dominate temperate climates
			Paleogene	Eocene	- 56	Rocky Mountains rise, shedding sediments throughout western US region “Age of Mammals” begins
				Paleocene	- 66	Western Interior Seaway vanishes
	Mesozoic	Cretaceous	- 145	Cretaceous/Tertiary boundary extinction wipes out dinosaurs, ammonites, etc. “Greenhouse Earth” - Dinosaurs at their “peak” Western Interior Seaway forms in Great Plain region		
		Jurassic	- 201	Breakup of Supercontinent Pangaea, birds and early mammals appear		
		Triassic	- 252	Dinosaurs (warm blooded) replace reptiles (cold blooded) as dominant land animals		
	Paleozoic	Permian	- 299	End of Permian extinction greatest of all extinction events “Age of Reptiles” - Pangaea Supercontinent forms		
			Pennsylvanian	- 323	Carboniferous Period - great coal swamps form as Appalachian Mountains form	
			Mississippian	- 359	“Age of Amphibians”	
		Devonian	- 419	“Age of Fishes” First forests (coal beds) appear		
Silurian			- 444			
Ordovician		- 485	“Age of Invertebrates” - brachiopods, trilobites, corals First land plants evolve			
		Cambrian	- 541	First shelled invertebrates appear		
Precambrian	Proterozoic	- 541	Multicellular organisms evolve			
		- 2500	Modern continental shield regions of continents gradually assemble Banded Iron Formations are deposited as oxygen atmosphere forms Stromatolites appear in “fossil record” single-celled organisms evolve			
	Archean	- 4000	Oldest rocks preserved			
Hadean	- 4500	Solar System forms, Moon and Earth system forms by accretion of extraterrestrial materials				

<http://goo.gl/5tDCq3>

Figure 1: Geological Timescale

Eon: Geologic timeframe (an indefinitely long period of time) (Aeon)

Era: A major division of time that is divided into periods.

Period: A period of time – shorter than an era.

Epoch: Longer than age but shorter than a period.

The Geological Timescale for Southern Africa:

Millions of years before present	Significant Events in South Africa
100	Diamonds formed in Kimberlite pipes during volcanic eruptions.
160	Karoo dykes and sills formed. The sills form the resistant cap rock of the typical Karoo mesas and buttes.
180	South America and Africa split and South America drifts away to the West. Volcanic eruptions in Southern Africa build a lava plateau of which only the Drakensburg is left.
200	Dinosaurs in the Karoo.
250	Folding of the Cape Fold Mountains, Cedarberg, Langeberg, Great Swartberg.
300	Southern Africa and much of Gondwanaland covered in ice during a period called the Dwyka glaciation. Glacial striations and the tillite rock can be found in many places in the Karoo, e.g. Nieuwoudville and Laingsberg.
450	Parts of South Africa covered by sea and the sandstone of Table Mountain deposited into this sea.
550	Cape Granites intruded and solidified to form the SW Cape batholith, of which Paarl mountain is part.
1 950	The intrusion of the Bushveld Igneous Complex, one of the richest formations in the world for mining if formed (e.g. Platinum, chrome, manganese, iron ore and copper).
2 100	Transvaal dolomite deposits, which include the Ghaap Plateau near Kuruman, the Makapansgat and Sterkfontein Caves, and cause the sinkholes of Carltonville.
2 300	Thick lava deposits cover the gold bearing Witwatersrand sediments, known as the Ventersdorp lavas.
2 800	Gold bearing Witwatersrand sediments are deposited.
3 800	Oldest rocks in Southern Africa – granites of the Limpopo Valley.

Era	Period	Million years ago	Major geological events affecting Africa
Quaternary	Recent Pleistocene	2	Widespread formation of river terraces and raised beaches. Glaciation of East African mountains. Deposition of continental sediments in basin areas (Kalahari). Crustal warping of Chad Basin.
Cainozoic	Pliocene	11	Main period of volcanic activity in East Africa began. Alpine Earth movements forms Atlas Mountains. Main period of East African rift faulting began. Laval flows in Ethiopia.
	Miocene	25	
	Oligocene	40	
	Eocene	70	
Mesozoic	Cretaceous	135	Deposition of marine sediments in many areas, e.g. South Nigeria. Benue Rift formed. Cape Fold Mountains raised up. Drakensberg lavas.
	Jurassic	180	
	Triassic	225	
Palaeozoic	Permian	270	Ice Age in Central and Southern Africa. Crustal warping causing continental basins. Extensive deposition of sediments, e.g. Voltaian, Bandiagara and Table Mountain sandstones. Ice Age in parts of North Africa.
	Carboniferous	350	
	Devonian	400	
	Silurian	440	
	Obdovician	500	
Cambrian	600		
Precambrian	Upper	1000	Ancient mountain building periods and ancient glaciations. Oldest recorded rocks are 3 500 million years, from South Africa.
	Middle	3000	
	Lower		
	Azoic		