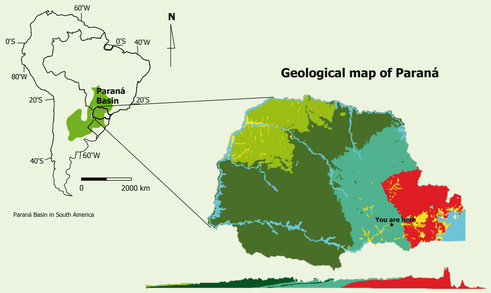
Geology of Paraná



EON	ERA	PERIOD	EPOCH	Age (million years)	Features	Geology of Paraná
Phanerozoic	Cenozoic	Quaternary	Holocene	Today 1,1	Mankind, Northern Hemisphere glaciation	Sediments
			Pleistocene	1,8		
		Tertiary	Pliocene	5,3		
			Miocene	23		
			Oligocene	34	Primates proliferate	
			Eocene	53		
			Paleocene	65	First horses appear	
	Mesozoic	Cretaceous		142	Dinosaurs appear; flowers	Bauru Basin (sedimentary rocks)
		Jurassic		206	First birds and mammals appear	Paraná Basin: Basalt
		Triassic		248	First Dinosaurs appear	Paraná Basin: Sedimentary rocks
		Permian		290	Trilobites disappear	Formation of this striae
	Paleozoic	Carboniferous		354	Reptiles, primitive large trees appear	
		Devonian		417	Amphibians appear	
		Silurian		443	Terrestrial plants appear	
		Ordovician		495	First fish appear	
		Cambrian		545	First shells, trilobites previal	Paranaense Shield
Precambrian	Proterozoic			2500	First pluricellular organisms	
	Archean			4000	First unicellular organisms	
	Hadean			4560	Earth forms	

The geological evolution of Paraná is recognized when the State is crossed westward. The oldest rocks, formed more than three billion years ago, are found on the coastal plain. There and all over Serra do Mar Range and the First Paraná Highland, igneous and metamorphic rocks of Archean to early Paleozoic age outcrop. The strong relief reflects their resistance to weathering, the region in which they occur being called the PARANAENSE SHIELD.

From the Devonian scarp known as São Luiz do Purunã Range on to the west border of the State, the shield is covered by Paraná Basin, a massive sequence of sedimentary and also volcanic rocks of Silurian to Cretaceous age sustaining the state's Second and Third highlands. In the beginning of its evolution, South America and Africa were still unseparated parts of a megacontinent named Gondwana, and their geographical posit ions were quite different from today´s.

Paraná Basin evolved for more than 300 million years, in long transgression-regression cycles of an ancient ocean that surrounded Gondwana. Such cycles, immensely slow as compared to the time scale of human events, allowed generation of different marine, lacustrine, fluvial, glacial rocks in Paleozoic times.

In Jurassic times, the region turned into to a desert spreading more than 1.500.000 km2 over parts of now Southern Brazil, Paraguay, Uruguay and Argentina.

Breakup of Gondwana took place in Cretaceous, when South America and Africa separated and, hence, spreading of the Southern Atlantic Ocean begun. As part of the breakup process, extensive, up to 1,500 m thick basaltic magma flows covered more than 1,200,000 km2 of the Paleozoic sedimentary rocks of Paraná Basin. It was weathering of such magma flows that generated the remarkably fertile "Terra Roxa" soils. By the end of Cretaceous, desertic terrains (Bauru Basin) spread over those magma flows in Northwestern Paraná forming the so called Caiuá Sandstones. Unlike "Terra Roxa," however, soils derived from these rocks are agriculturally poor and highly susceptible to erosion.

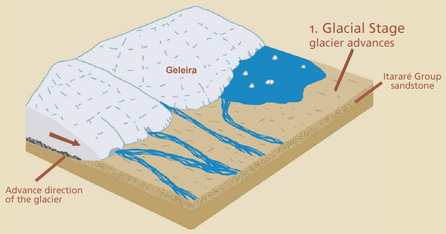
The most recent geological units to form in Paraná are sediments of Quaternary age. Most representative examples are those generated under arid to semi-arid conditions over part of Curitiba and Tijucas do Sul regions, those formed from weathering of crystalline rocks at Serra do Mar Range; marine sand deposits along the Eastern Coast, and also countless alluvial deposits along the rivers, streams etc. of Paraná.

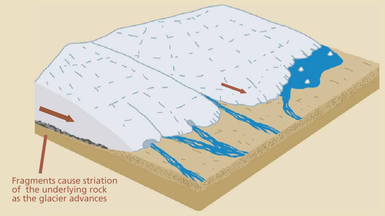
Geological Site

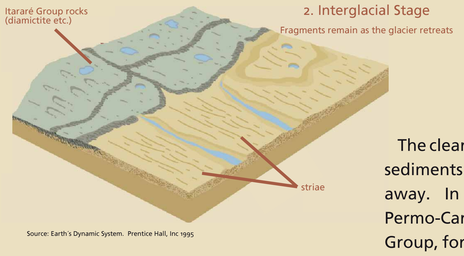
Glacial striae at Witmarsum

What do I see?

Such elongate crests and ploughs, generically named "glacial striae," are caused by huge moving ice bodies analogous to the glaciers now in Antarctica, and were formed during the so called Permo-Carboniferous glaciation 300 million years ago.







Source: Earth s Dynamic System. Prentice Hall, Inc 1995

The rock on which the striae you see developed is a sandstone body generated by compaction and hardening of successive sand layers.

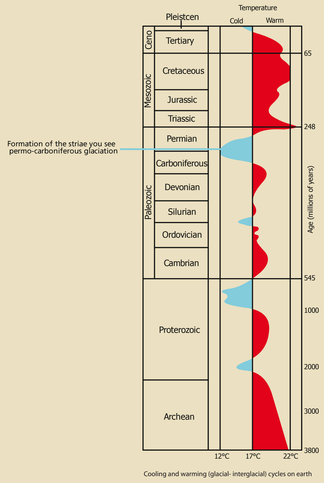
These particular layers were deposited during the Carboniferous Period 300 million years ago, when South America was still unseparated from Africa, Antarctica, Oceania and India forming a vast continent named Gondwana.

At the transition between Carboniferous and Permian, during one of the most important cooling events in Earth's history, this region was closer to the South Pole, with average temperatures much lower than today's. This age corrersponds to the so called Permo-Carboniferous glaciation 300 million years ago.

The rocks formed during this glacial event are grouped in Itararé Group, of the Parana Basin, as the sandstones of Vila Velha and the Gruta do Monge in the Lapa.

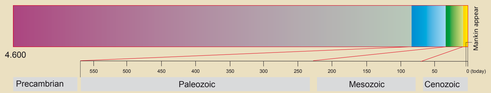
The cleared outcrop behind the striae is a diamictite i.e., sediments (now consolidated rock) left as glaciers moved away. In Paraná Basin, rocks formed during the Permo-Carboniferous glaciation are referred to as Itararé Group, formed from intervening marine and continental environments, always under glacial conditions. The well known sandstones at Vila Velha are Itararé Group rocks.

The uppermost projected globe on the right corresponds to Carboniferous-Permian in time i.e., when the striae formed This site was near the South Pole then, which explains the presence of glaciers. See also the projection for 50 million years from now. It shows that tectonic movements still change the continents distribution. Nothing really remains still: the distance between Brazil and Africa, for instance, increases about 4 cm a year.



Cooling and warming (glacial- interglacial) cycles on earth

If all of the 4.6 billion years since earth formed were scaled to one single year 365 days, mankind would have arisen almost at the end, at 08:14 p.m. December 31st, and would have lived for only three hours and forty-six minutes. Dinosaurs, that were present on earth for more than 100 million years, would then have lived for no more than eight days and a half.

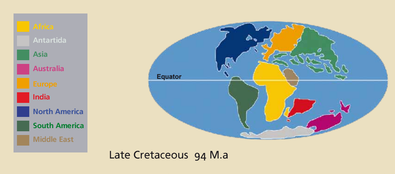


Late Carboniferous-Permian - 306 M.a

The whole region lies close to the South Pole and it is covered by huge moving ice bodies like those in Antartica today. The striae you see formed as such glaciers moved away.

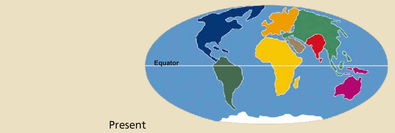
Early Jurassic 195 M.a

Climax of the Age of Dinosaurs. A vast ocean named Tethys separates Laurasia, to the north, from the Gondwana parts that now correspond South America, Africa, Australia, India and Antarctica.



Late Cretaceous 94 M.a

Breakup of Gondwana separates South America from Africa; spreading of the Southern Atlantic Ocean begins.



Present

A new continental collision stage begins, which in 250 million years will result in a new supercontinent. Global temperature increases as the last glaciation, the "Ice Age" recedes (its climax was 10,000 years ago) and atmospheric emissions follow human activity growth.

Paleomap Project www.scotese.com

The Future 50 M.a from now

Among other continental distribution changes, the Southern Atlantic Ocean spreads further and the Mediterranean closes as Africa and Europe collide.

Realization

Partners

Associação Comunitária dos Moradores Proprietários de Witmarsum

MINEROPAR SERVIÇO GEOLÓGICO DO PARANÁ

Cultura Secretaria de Estado

SEMA

PARANÁ TURISMO Secretaria de Estado do Turismo

IAP Instituto Ambiental do Paraná

DER PARANÁ

Conception
Gil F. Piekarz

Geology
Luiz Alberto Fernandes
Gilson Burigo Guimarães
Gil F. Piekarz

Graphic Design
Arno Siebert
SEEC/CDG

Digital Drawing
Eduardo Gameiro

Special participation
Prof. Dr. J. J. Bigarella