

Summary Article: **Permian period**

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(pûr'mēƏn) [from Perm, Russia], sixth and last period of the Paleozoic era (see Geologic Timescale, table) from 250 to 290 million years ago.

Historical Geology of the Period

The Lower Permian

During the Permian period, changes in the earth's surface that had begun in the preceding Carboniferous period reached a climax. At the close of the Carboniferous, large areas of E North America were dry land. In the Lower Permian, sandy shales, sandstones, and thin limestones of the Dunkard formation (formerly called the Upper Barren measures) were deposited in the remaining submerged areas of West Virginia, Pennsylvania, and Ohio, but the continued rising of the land soon put an end to deposition. The Dunkard is the last Paleozoic formation of the E United States. More extensive deposits were formed in the West. Parts of Texas, Oklahoma, Kansas, and Nebraska were covered by an arm of the sea or possibly by one or more salt lakes or lagoons, now represented by masses of salt or gypsum in layers separated and overlaid by red beds. There are important Permian salt mines at Hutchinson and Lyons in Kansas and gypsum mines in Oklahoma, Texas, and Kansas. The longest marine submergence of the Lower Permian in North America was in W Texas and SE New Mexico, where there is a system of marine limestones and sandstones 4,000 to 6,000 ft (1,200–1,800 m) thick. The Cordilleran region was also submerged; here marine beds are more common toward the west, and land sediments, especially red beds, toward the east. The red beds are generally considered to be indicative of increasingly arid conditions in Permian times.

In Europe, the Lower Permian, or Rotliegendes [red layers], was marked principally by erosion from the Paleozoic Alps of the Carboniferous into the low-lying land to the north; the formations are chiefly shale and sandstone, with some conglomerate and breccia. Red is a prominent color for the beds. The Pangaea supercontinent formed from an aggregation of all continents at this time.

The Permian and late Carboniferous of the Southern Hemisphere were radically different from those of the Northern Hemisphere. Australia, S Africa, and South America experienced a series of glacial periods, as is shown by the presence of tillite and of conspicuous striations of the underlying rock formations. This condition prevailed also in India. Paleozoic glaciation in North America is suggested by the Squantum tillite near Boston, Mass. This glaciation and the aridity of which the red beds seem to be the result are the two most strongly marked characteristics of the Permian period.

The Upper Permian

In the Upper Permian practically all of North America was above sea level, and the continent was larger than at present. Toward the close of the Upper Permian the greatest earth disturbance of the Paleozoic era thrust up the Appalachian Mts. In Europe, the Upper Permian was a period of more extensive marine invasion; the Zechstein formation is predominantly limestone, though it includes rich deposits of copper, salt, gypsum, and potash. The Upper Permian beds of Germany were long the chief source of the world's potash.

Evolution of Plant and Animal Life

Many marine animals became extinct during the Permian, but there was at the same time an evolution to more modern types, a marked change in the insects, and a notable increase in numbers and varieties of reptiles mainly because of the continental changes. Among plants, *Lepidodendron* and *Sigillaria* became rare, but ferns and conifers persisted. The widely distributed “seed fern,” *Glossopteris*, which was apparently successful in resisting glacial conditions, was the most conspicuous development in the Permian flora. The presence of *Glossopteris* in South America, Antarctica, Australia, and S Africa is a strong argument favoring the interconnection of these land masses in a large supercontinent during Permian time. The end of the Permian is marked in the fossil record by the most devastating mass extinction known.

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