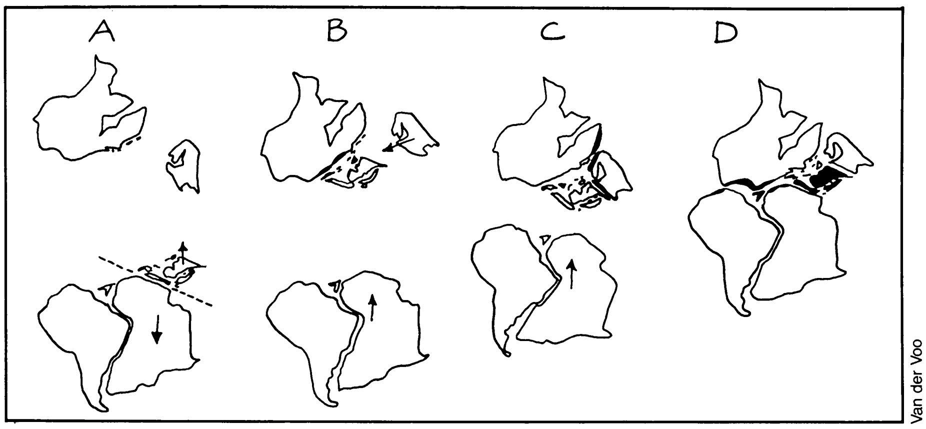
Nor does it seem to be locked to the planet's sub-solar point, where the sun's incoming heat is greatest. The warmest part of the atmosphere visible to the orbiter's infrared heat sensor, in fact, is not the sub-solar point at all, but the north polar region. Surrounding the pole is a "collar" of high, cool atmosphere at whose center are a pair of hotspots, dubbed "the eyes" by project scientists. Although the dominant winds go from east to west, Jet Propulsion Laboratory's Fred W. Taylor suggests that poleward heat transport pours enough rapidly descending atmosphere into the collar (believed to be a vortex) to "clear away" the clouds and reveal the lower-altitude hotspots.

This poleward movement is a key element in the evolving conception of Venus's circulation system, now believed to involve a three-tiered stack of circulation "cells" that carry energy from the equatorial regions to the high latitudes. The earth's atmosphere has a similar structure, with the cell circulation driven primarily from the bottom, where land and water absorb and re-emit the sun's heat. On Venus, however, says Alvin Seiff of the NASA Ames Research Center, the stack of cells is driven by the middle cell, where cloud particles and droplets are the dominant heat absorber.

Yet the shifting patterns, longitudinal heat flow and latitudinal winds of the atmosphere seem almost simple compared with the ionosphere. With virtually no inherent magnetic field to hold it in place (if there is an inherent field, says Christopher Russell of UCLA, it is less than a ten-thousandth as strong as earth's), the nightside ionosphere in particular is a highly erratic phenomenon, whose outer edge has been detected as far as 3,100 km from the planet and as close in as 180 km.

Emerging more slowly is the picture of the surface from the orbiter's radar mapper, which may need nearly two more years to cover the planet's circumference. An early radar image has revealed a pair of large, apparently ancient impact craters in the planet's lowlands, while similar terrain found on other worlds, says Harold Masursky of the U.S. Geological Survey, has all been in highland regions. Elsewhere on Venus, a huge northern-hemisphere plateau (SN: 4/7/79, p. 231) is described by Gordon Pettengill of the Massachusetts Institute of Technology as "almost inarguable proof of tectonic activity." A deep canyon and high uplifts also mark the surface, but some of these features do not show up as mass-distribution variations in early data on the planet's gravitational field. The range of gravity variations so far (only about a tenth of the planet has been measured) extends from only about +34 to −24 milligals, compared with about 500 for Mars's Olympus Mons and 100 for a typical "mascon" on earth's moon. Perhaps this is the one way in which Venus, planet of extremes, may be considered "mild." □

Continental collisions: Pangea revised



Van der Voo's reconstruction of Pangea: (A) 500 million years ago, newly postulated plate, Armorica (southern England, Wales, northern Germany, Poland, France and Spain), breaks off from Gondwanaland (South America, Africa, India, Antarctica, Australia). (B) Armorica collides with North America to form early Appalachians (shaded area). (C) North America-Armorica bumps eastern Euro-Russia, forming the Caledonians and creating the northern supercontinent. (D) 300 million years ago, Gondwanaland and the northern continent meet, forming Pangea.

Armorica, a previously undescribed continental plate, may have been involved in collisions that helped form the Atlantic-bordering mountain belts, reported Robert Van der Voo of the University of Michigan at the AGU meeting. Van der Voo's hypothesis offers a new model for the formation about 250 million years ago of the supercontinent Pangea, which included all of the earth's landmasses.

Researchers had long believed that Europe and North America welded together about 400 million years ago to form a huge northern continent, which, when the southern continent, Gondwanaland, collided with it, created Pangea. But recent years have exposed problems with that theory, in the form of two mountain belts: the Taconic, which was the predecessor of the Appalachians, and the Caledonians, which are found in northern England and Scotland and eastern Greenland. The Appalachian-Caledonian features had long been ascribed to the closure of the ancient Atlantic and the collision of Europe and North America. The Appalachians, however, apparently peaked about 450 million years ago, while the main phase of Caledonian formation was 395 million years ago. Moreover, the Caledonians have recently been traced from Wales through the North Sea, the Netherlands, northern Germany and into southern Poland, making a nearly 90° angle with the Greenland-Scotland branch. How could the closure of one ocean have managed to create not one but two belts of such different age and shape?

Van der Voo and co-workers believe they have found the answer in paleomagnetic data from southern England and Wales, France and Czechoslovakia. Paleomagnetic dating, because it measures the direction of magnetization that is preserved in a rock when it forms, can give the polar wander path, or the ancient latitude of a landmass relative to the pole. Paleomagnetic data from these regions, compared for the first time, show "striking similarities" in their polar wander paths, Van der Voo says, meaning that they were once part of the same continent. And, up until 500 million years ago, the polar wander path of these regions and of Gondwanaland were the same. Apparently, says Van der Voo, this section of Europe and the United Kingdom was part of Gondwana until 500 million years ago. These areas were previously believed always to have been part of the rest of the Euro-Russian landmass, not meeting Gondwana until the collision 300 million years ago that formed the Hercynian range that runs through central Europe, Spain and France.

Based on these results, Van der Voo proposes the existence of the Armorica plate, named for the Armorica Massif in Brittany from which one of the critical pieces of data came. Armorica, he says, consisted of southern England, Wales, the northern border of Germany, Poland, France and Spain and possibly New England and Newfoundland. He envisions the following scenario:

- The Armorica plate separated from Gondwana about 500 million years ago and collided with North America to produce the early Appalachian features.
- The combined North America-Armorica continent collided with the Baltic Shield and the Russian Platform about 395 million to 345 million years ago, forming the Caledonians and welding together to form the northern supercontinent.
- Gondwana drifted up about 300 million years ago and smacked into the northern landmass, crumpling the Hercynian, Alleghenian and Acadian (in New England, Canadian Maritimes and Newfoundland) mountains and forming Pangea. □