

Rearranging Pangea

Once upon a time, according to the theory of plate tectonics and continental drift, a "supercontinent" called Pangea existed. Northwest Africa snuggled up to the eastern seaboard of North America, South America fit jigsaw-puzzle-like beside Africa and a wide ocean called Tethys stretched between Africa and Europe. About 150 million years ago, most geologists agree, the huge land mass began to break apart into the present-day continents. But what the geologists disagree on is how long the supercontinent existed stably in that configuration. The answer is important for several reasons. On the practical side, for example, rocks that are 300 to 175 million years old contain mature accumulations of oil, gas and coal, and locating potential sources de-

pends on understanding their tectonic history. On the academic side, the concept of a stable Pangea as opposed to an evolving, mobile one has implications for theories about the driving force behind continental drift.

Now, two researchers in Canada provide evidence for a "mobile" Pangea. The accepted version of the supercontinent existed only a short time, they say, possibly from 200 to 170 million years ago. Before that, they propose, Pangea existed in a different form.

The researchers, Patrick Morel and Edward Irving of Energy, Mines and Resources Canada in Ottawa, Ontario, base their conclusions on paleomagnetic data. Paleomagnetism is a tool that tells geologists the former position of a rock—and therefore of the continent on which it rides—relative to the ancient magnetic pole. Morel and Irving gathered from around the

world paleomagnetic data that date as far back as 295 million years. They then compared the paleomagnetically derived positions and movements of the pieces of the supercontinent to those suggested by the accepted reconstruction, which they call Pangea A. They found that the data and the reconstruction agree until 200 million years ago, but by 280 million years ago, the rocks show paths far different from the theorized movements. Such discrepancies were noted many years ago, but Morel and Irving have extended the time period and added more data.

The researchers then rearranged the Pangea of 280 million years ago according to the demands of the paleomagnetic data. In their reconstruction, called Pangea B, Africa lies below Europe, northwestern South America is opposite the southern Appalachians and the continents around what is now the Atlantic lie a little farther apart than they do in Pangea A.

Morel and Irving believe that Pangea B existed from 290 to 250 million years ago. Beginning about 250 million years ago, they suggest in the *JOURNAL OF GEOPHYSICAL RESEARCH* (86:B3), the northern and southern continents slid past each other a minimum of 3,500 kilometers with some minor movements of Europe and North America. By 200 million or 190 million years ago, the pieces had jostled into the familiar arrangement of Pangea A.

Refigured in this fashion, Pangea B solves many geologic problems that Pangea A could not. Pangea B, for example, matches up several mountain belts. Mountain belts are believed to have been formed by collision of land masses, and mountains should therefore appear on both participating land masses. In Pangea A, the Hercynian mountain chain in western and central Europe had no companion; in Pangea B it is matched with the mountains of northwest Africa. Likewise, the Appalachians are opposite the ancient mountains of South America. Pangea B also explains why no evidence exists for a Tethys ocean older than 250 million years; no room exists in Pangea B for such an ocean. In addition, Morel and Irving's model provides space for the pieces of Central America, which are usually troublesome left-overs in tectonic reconstructions.

When a less detailed version of Pangea B was proposed by Irving in 1977, it was not well received, says Morel. Since then, he says, other paleomagneticians have found similar data and noted the unsolved geologic problems that Pangea A presents. So far, says Morel, their reconstruction has been "excellently accepted."

Piecing together a puzzle long since destroyed is next to impossible, Morel admits, and he notes that sufficient data from South America, France and Europe in general are still lacking. "We're just saying this could be the answer, with the emphasis on 'could be,'" he says. "One major goal is to force people to work on this." □

