EARTH SCIENCES

Old rocks in North America

Are the oldest rocks on earth in West Greenland or in Minnesota? Three earth scientists have new data upholding the West Greenland claim in the most-ancient-rock race. And they have evidence for a new entrant in the competition: Labrador.

A year ago Samuel S. Goldich and Carl E. Hedge reported that granitic and gneissic rocks from southwestern Minnesota had been dated at 3.8 billion years old, give or take 100 million years (SN: 12/7/74, p. 358). This would make them at least as old, and perhaps slightly older than similar rocks found in Greenland two years earlier (SN: 10/9/72, p. 374).

Now Richard Hurst of the University of California at Santa Barbara, J. Farhat of the University of Jordan at Amman and George Wetherill of the Carnegie Institution of Washington report that their work with the Minnesota samples has been unable to reproduce the 3.8-billion-year dates reported by Goldich. "[This] suggests that their result could be an artifact caused by incomplete sampling of badly disturbed isotopic systems." Hurst and colleagues note that metamorphism has largely reset the radiometric clocks in the Minnesota rock system, "causing it to be very difficult to uniquely identify the original ages of these rocks." The Hurst group's uranium-lead data suggest an age of about 3.3 billion years; their rubidium-strontium data clearly demonstrate only that the original age of crystallization was about 3.1 billion years.

"It is concluded that while it is clear that these rocks are among the oldest yet found in North America, their similarity in age with those of Greenland and Labrador remains to be demonstrated," Hurst and colleagues reported at a symposium on the Chemical Evolution of the Precambrian last week at the University of Maryland. The Oct. 23 NATURE carries a version of their report, plus a response from Goldich and Hedge essentially disagreeing with the criticisms.

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Labrador comes into the question because of geological similarities between Saglek Bay, Labrador, and Godthaab, West Greenland. Subsequent geologic mapping has tentatively shown that the Labrador rock units (Precambrian gneisses) are the same as those in West Greenland. Hurst, Farhat and Wetherill report that whole-rock rubidium-strontium measurements show that one group of rocks in Labrador is 3.622 billion years old, plus or minus 72 million years.

"Taken altogether these data suggest an extensive region of very old rocks in Labrador, which probably were contiguous with those of West Greenland prior to Tertiary North Atlantic rifting."

No biogenic signs in Greenland rocks

Could there be any evidence of early forms of life, or at least of early carbon chemistry, in those very old Greenland rocks? Three scientists from the University of Arizona's Laboratory of Organic Geochemistry have analyzed a 3.7-billion-year-old sample from the Isua Series of Southwestern Greenland (a moderately metamorphosed rock of sedimentary origin). They found that it contained only traces of methane but no evidence of other organic compounds. It contained no finely dispersed carbonaceous matter.

In contrast, analyses of the Onverwacht (3.4 billion years old) and Fig Tree (3.0 billion years old) sedimentary rocks from Africa have revealed complex aromatic hydrocarbons in the former and aromatic hydrocarbons and long-chain normal alkanes in the latter. Rocks from the Transvaal show evolution of complex biochemistry by about 2.3 billion years ago.

But the ancient Isua rocks from Greenland show no such thing, Bartholomew Nagy, John E. Zumberge and Phillip Anderson reported to the symposium on the Chemical Evolution of the Precambrian. "This constitutes mounting evidence that at the time this Isua micaceous metaquartzite was deposited in water, biologically derived compounds were absent from this depositional site."

When did cells begin to diversify?

New microfossils revealed by scanning electron microscopy of a 2.3-billion-year-old Transvaal stromatolite shed light on the question of when cells began to diversify.

Lois Anne Nagy of the University of Arizona reported to the symposium on Chemical Evolution of the Precambrian that the morphology of some of the microfossils was complex. Filamentous blue-green algal microfossils contained specialized structures, some of which have modern morphological analogs, Nagy says. "This suggests that by at least 2.3 billion years ago cells had begun to diversify."

A study still underway on 2.6-billion-year-old rocks of the Vaal Reef Carbon Seam revealed microfossils of a much simpler morphology, and she says no cell diversification has yet been found in these samples.

Colorado lineament: Precambrian fault

From the Grand Canyon region, into Utah and diagonally across Colorado and into Wyoming runs a northeast-trending system of faults related to the Colorado mineral belt and known to have its ancestry a billion or so years ago in the Precambrian. Together they constitute a fault lineament more than 600 miles long and 100 miles wide.

The northern margin of the zone, a fault across southeastern Wyoming, separates older Precambrian (2.5 billion years) rocks in central Wyoming from younger rocks in Colorado. The boundary of this zone extends subsurface to Precambrian rocks in the Lake Superior region.

Geologist Lawrence A. Warner of the University of Colorado says this Colorado lineament was once a San Andreas-type fault system. "The relationships suggest that a fault system comparable to the San Andreas probably formed along the southeastern margin of the ancestral North American continent in connection with Penokean orogeny [mountain building in Minnesota and Michigan 1.7 billion years ago]." If so, he reported to the meeting of the Geological Society of America in Salt Lake City, it may represent a Precambrian counterpart of fault systems that commonly formed along continental plate margins during episodes of mountain building in the last 600 million years.

Sea-floor spreading in Philippine Sea

The Mariana Trench in the western Pacific is a site where the Pacific crustal plate is being consumed. But just to the west, in the Philippine Sea, the sea floor is very young and increases in age from east to west. Measurements taken by the research vessel George Washington, during the Scripps Institution of Oceanography's Tasaday expedition to that area, now show that sea-floor spreading is taking place there. The conclusion comes from 21 new heat-flow measurements along a north-south series of rough peaks and troughs west of Guam and Saipan known as the Mariana Trough.

The high heat-flow, Roger N. Anderson of the Lamont-Doherty Geological Observatory reports in the Oct. 10 JOURNAL OF GEOPHYSICAL RESEARCH, is an indication . . . that sea-floor spreading is occurring in the Mariana Trough in a manner similar to its occurrence on midocean ridges (although on a smaller scale)."