The Moon's Tug Stretches Out the Day

If the hours seem to streak by and each day ends too quickly, stop a moment and consider the tempo of time during the Proterozoic era, 900 million years ago. Earth revolved 30 percent faster back then, and the day lasted only 18.2 hours, according to a team of scientists studying ancient rock deposits that record lunar tides.

Using theories of celestial mechanics, physicists long ago surmised that the day should be growing longer because tides raised principally by the moon put a brake on Earth's rotation. By robbing Earth of momentum, the moon edges farther away, thus increasing its velocity through space.

Modern measurements have verified part of the theory by showing that the moon is receding from Earth at 3.8 centimeters per year. But proving that the Earth has slowed down requires records from the distant past.

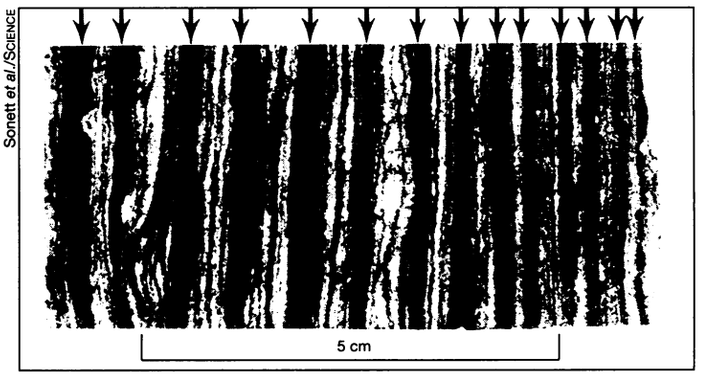
Charles P. Sonett of the University of Arizona in Tucson and his colleagues gleaned the history of Earth's spin from sedimentary stones known as tidal rhythmites. These rare rocks formed along prehistoric shorelines, where tides deposited alternating bands of dark- and light-colored silt and sand.

The rhythmites display layers of varying thickness, reflecting the high spring tides and low neap tides that mark the lunar month. By analyzing how the tidal cycles vary in thickness with the seasons, the scientists could count the number of lunar months per year. This enabled them to calculate how much momentum the moon had stolen from Earth. From that, they could figure ancient Earth's rate of rotation.

Sonett's group examined four sets of tidal rhythmites, from Indiana, Alabama, Australia, and Utah, with ages ranging from 305 million to 900 million years. When the oldest rocks formed, each year had 481 days, the scientists report in the July 5 SCIENCE.

Although simple in theory, the study of these deposits is complicated; ancient storms and other factors have erased some of the tidal layers. To work around these irregularities, Sonett's group analyzed the tidal record mathematically—by ranking the frequency of variations in the layers—to pull out the lunar cycles. "It's not an easy thing. It's taken us the last year to satisfy ourselves of these numbers," says Sonett.

Previous reports of ancient astronomical cycles have run into trouble. In the 1960s and 1970s, paleontologists used bands in corals and clams to infer information about the number of days per year, but these studies drew a great deal of criticism and the field foundered, says paleontologist Gary D. Rosenberg of Indiana and Purdue Universities in Indianapolis. Skeptics charged that the counting of growth bands was subjective and that researchers had failed to account for uncertainties in their work.



Arrows mark ancient tidal layers.

Tidal rhythmites provide more accurate records because they have fewer irregularities than corals and other organisms. Sonett and coauthor Erik Kvale of the Indiana Geolgical Survey in Bloomington have "really given new life to the field," says Rosenberg.

Although previous studies have made use of tidal rhythmites, they have not included the Utah deposits, discovered 2 years ago (SN: 9/10/94, p. 165). "Sonett has analyzed the oldest recognized rhythmites, and he has clearly used the most sophisticated mathematical methods to date. For that reason, it is significant," comments Gregory Ojakangas, a space scientist at the University of Minnesota in Duluth.

Ojakangas cautions, however, that scientists will need to test this analysis against other tidal rhythmites and records of ancient algal mounds. "There is a lot more data out there. Tidal rhythmites are being discovered in more and more places." In fact, he has recently found 2-billion-year-old rhythmites in Minnesota and is currently analyzing them.

— R. Monastersky

Appeals panel reverses fraud finding

After nearly a decade of fighting charges of scientific misconduct, immunologist Thereza Imanishi-Kari has been cleared of wrongdoing by a federal appeals panel.

The Department of Health and Human Services panel concluded that the Office of Research Integrity (ORI), the division of HHS charged with investigating misconduct cases, had not proved its case against Imanishi-Kari. ORI had concluded that she intentionally fabricated experimental data that went into a 1986 paper published in CELL.

The panel rejected all 19 of the scientific misconduct charges brought against Imanishi-Kari. The ruling means that she no longer faces ORI's proposed 10-year ban on federal funding of her research.

The victory for Imanishi-Kari also affects CELL coauthor David Baltimore, a Nobel prize-winning molecular biologist at the Massachusetts Institute of Technology. Although Baltimore's scientific work in the CELL paper had never been in question, the long-running investigation had negative consequences for him. In 1991, he resigned as president of Rockefeller University in New York City (SN: 12/14/91, p. 399).

In explaining its decision, the appeals panel noted that some previous scientific reviewers who examined the Imanishi-Kari case had found "no evidence that scientific misconduct had occurred."

The panel also rejected the forensic analysis of Imanishi-Kari's laboratory notebooks, saying that it "provided no independent or convincing evidence that the data or documents were not authentic." ORI had cited that analysis, conducted by the Secret Service, as strong evidence that Imanishi-Kari had fabricated data underpinning the CELL paper (SN: 3/30/91, p. 196). The appeals panel also panned a statistical analysis by ORI that suggested Imanishi-Kari had committed fraud.

The 183-page HHS decision criticized ORI's probe of the Imanishi-Kari case. "Much of what ORI presented was irrelevant . . . was not credible or not corroborated, or was based on unwarranted assumptions," the panel concluded.

— K. Fackelmann