

cal analysis for the original study. The explanation, he says, lies in the fact that the person has several siblings who have the same DNA markers, but are healthy, making the appearance in the brother of both illness and the markers look like a chance event.

The addition of several other new subjects did little to affect the lod scores. But 31 of the 40 added make up what is called a lateral extension of the pedigree—that is, they are linked to the core family by a marriage. And they dealt the scores another devastating blow. This new branch clearly has an inherited form of manic depression, but when Egeland and Kelsoe's teams analyzed the group independently, the depression gene carried by its members showed no linkage whatsoever to the markers on chromosome 11. And when the group was analyzed together with the rest of the pedigree, it lowered the lod scores to 1.

These gloomy results raised two possibilities: either the gene for manic depression in the Amish is not on chromosome 11 or the Amish have two such genes, one of which may be on chromosome 11. But the evidence to date cannot distinguish these possibilities and so it is back to the drawing board for the researchers.

How did it feel to Egeland's team to have the rug pulled out from under their results? "I would much prefer to hear it over the phone than to see it in print," says Yale's Pauls. "They didn't have to [call us]," he says, "but by doing it they really strengthened the scientific finding."

The lessons the group learned are myriad. With the capriciousness of lod scores, and the drastic changes that can be introduced with just one new diagnosis, it is vitally important for the results in such a study to be checked and rechecked, and for the study group to be followed for a long time to pick up any new diagnoses. Egeland adds that it is crucial to carefully define the diagnosis criteria used, since even one false positive diagnosis of illness can be devastating to the results.

Egeland, whose commitment to understanding manic depression in the Amish goes back 30 years, to a time when she lived with one of the affected families, said that watching the data weaken was a little like the experience of manic depression itself. "There was the euphoria and the ecstasy [when we thought] we had made a significant step in trying to track a gene for this common and terrible illness, and then, wham . . . lod scores drop when you don't expect them to drop, and you're down into the depression." But she says she is proud of the collaborative effort of the two groups and grateful for the lessons learned.

■ MARCIA BARINAGA

Deep Water: "Phase B" Is Decoded

Not all of Earth's water lies in its oceans, rivers, and lakes. Much of it may be locked hundreds of miles underground. But even though this subterranean water could hold the key to several basic questions about the behavior of Earth's mantle and the evolution of its environment, no one knows exactly how much water is down there.

Now a team of seven geophysicists at the Carnegie Institution of Washington and the State University of New York at Stony Brook has solved one piece of the puzzle (*Nature*, 14 September, p. 140). The researchers have decoded the structure of "phase B," the only mineral known to retain water at the intense pressures of the earth's deep mantle. The work should give new insights into the complex chemistry that goes on in the mantle, and it has already led to the prediction of other water-bearing minerals that may exist in the mantle, perhaps even deeper than phase B.

One of the reasons that geophysicists want to know the structures of such minerals as phase B is that it may help them determine where Earth's water came from, says the Carnegie Institution's Robert Hazen. Although the planet as it was originally formed had plenty of water, some theories suggest that the early earth collided with a Mars-sized object to form the moon, a process that would have stripped away all the surface water. If so, then much of the water on Earth today may have been released by volcanic activity from water-bearing rocks deep in the mantle.

Because scientists can't obtain rock samples directly from the mantle, they have been forced to try to duplicate mantle conditions in the laboratory by building presses that subject mineral samples to high pressures and temperatures. That was how phase B was discovered in 1967 by researchers who mixed water with normal silicates, such as quartz or feldspar, at more than 100,000 atmospheres of pressure. However, because no one was able to grow single crystals of the material, scientists were unable to determine its complicated crystalline and chemical structures.

That changed this year when Jaidong Ko, Tibor Gasparik, and Donald Weidner at Stony Brook used a split-sphere, multi-anvil press to mimic conditions that exist at about 360 kilometers below Earth's surface. A mixture of water, magnesium, and silicon heated to 1200°C at 120,000 atmospheres yielded phase B crystals that were up to 0.1 millimeter across. Weidner attributed the success to a combination of high technology and human skill. The Japanese-made press is state of the art for large presses, he says, and "Jaidong has a green thumb for growing crystals."

But even with the crystals, the phase B structure is so complicated that the team needed a bit of luck to be able to decipher it. Claude Herzberg at Rutgers University provided that luck earlier this year when he discovered a mineral closely related to phase B, but without the water. The Stony Brook team also succeeded in making single crystals of this mineral, called AnhB, for anhydrous phase B.

Because AnhB has a much simpler makeup than phase B, Hazen, Larry Finger, Russell Hemley, and Charles Prewitt of the Carnegie Institution were able to determine its structure from x-ray diffraction experiments. This in turn gave them enough clues to infer phase B's structure from the diffraction data they had accumulated on that mineral. "Larry [Finger, who calculated the crystalline structures] says he couldn't have done it without anhydrous B, because the crystals of phase B weren't of high enough quality," Hemley says.

The chemical composition of phase B is $\text{Mg}_{12}\text{Si}_4\text{O}_{19}(\text{OH})_2$, while that of AnhB is $\text{Mg}_{14}\text{Si}_5\text{O}_{24}$. Specifying phase B's crystalline structure involves 40 atom positions, Hazen says, which makes it the most complex silicate structure described.

Finger and Prewitt have now used what they learned about phase B to predict structures for other water-bearing magnesium silicates that would be stable in the deep mantle. They have received a partial confirmation from Gasparik, who had independently synthesized a new mineral, called superhydrous B, that seems to have one of the compositions they predicted. If this is confirmed, superhydrous B would contain more water than phase B and be formed at even hotter temperatures.

In addition to shedding light on the origin of Earth's water, the properties of phase B may help explain some of the intriguing seismic behavior that takes place in a region of the mantle called the transition zone, Hemley says. "The complex chemistry we're inferring from these experiments may or may not be consistent with [this behavior]," he says. The next step, he adds, will be to determine the mechanical properties of the mineral and see if they can be fitted to what is observed seismically. ■ ROBERT POOL