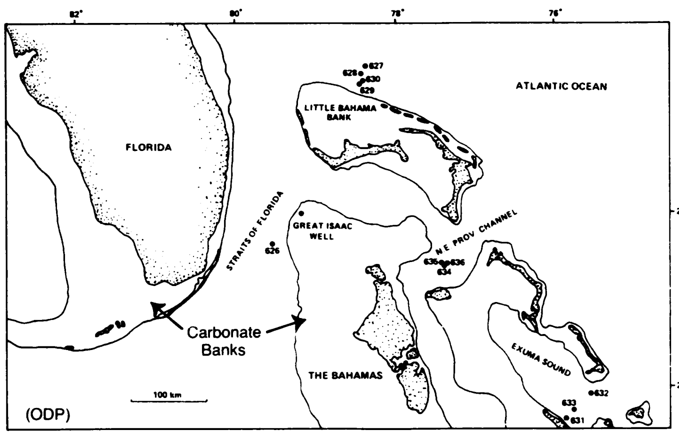
Ocean drilling: Banking on the Bahamas for a Leg to stand on

The *JOIDES Resolution* churned up more than ocean waters as it steamed across the Bahamas on Leg 101 of the Ocean Drilling Program. It also left in its wake scientific waters churning over the interpretation of some of its drilling results. The cruise, which lasted from Jan. 31 to March 14, sampled 11 sites in the Bahama archipelago in order to learn more about the carbonate platform there, one of the oldest in the world. But even as papers on the findings are being submitted to NATURE and GEOTIMES, there is still considerable disagreement among the shipboard scientists over just what was learned.

The primary purpose of Leg 101 (SN: 2/2/85, p. 68) was to test essentially two theories explaining the underwater topography of the Bahama region. Today, Florida, the Bahamas and other islands overlie shallow-water carbonate platform banks — hundreds of square kilometers of calcium carbonate produced by tiny ocean animals. Carved between these banks are deep channels. By studying how these channels and banks came to be, scientists hope to better understand carbonate sedimentary processes and why carbonate platforms, abundant in the oceans 100 million years ago, are scarce today.



One of the hypotheses proposed to explain the origin of the Bahama banks and basins — and the idea most emphasized in the upcoming papers — supposes that the entire region, from Mexico to partway up the eastern seaboard, was once underlain by one vast carbonate platform or "megabank." "At some time in the middle Cretaceous [about 100 million years ago], for some reasons not completely clear to us, that platform arrangement died off; the depositional system was disrupted," says James A. Austin Jr., co-chief scientist on Leg 101 and a marine seismologist at the University of Texas at Austin.

According to this theory, some parts of the platform that stopped growing were eroded by ocean currents to become the channels seen today. Other regions that continued to grow and accumulate sediments became banks. A few scientists believe that the demise of the Bahama megabank, as well as of carbonate platforms the world over, was related to rising sea levels that drowned the platform and/or oxygen deficiencies in the ocean. Austin adds that faults, reactivated at the end of the Cretaceous, may have helped to sculpt the present topography.

Austin and others have leaned toward the megabank theory because seismic reflection profiles (SN: 12/8/84, p. 364) reveal the presence of reflectors — regions where the velocity of sound changes abruptly as it travels through rock layers, denoting a change in rock type — under channels in several places in the Bahamas. The researchers suspect that these reflectors mark the top of the sunken megabank. On Leg 101, they hoped to drill through these reflectors to see if they were indeed made of shallow-water carbonates; if such limestones of Cretaceous age were found under basins, the megabank idea would be supported.

If, on the other hand, no shallow-water platform material could be found underlying the channels, the evidence would favor the other major theory, called the graben hypothesis. This contends that the platform began to grow about 160 million years ago, after the African and North American plates were rifted apart, opening the Atlantic Ocean. According to Henry Mullins, a marine geologist at Syracuse University in New York, who first proposed this theory and who also participated in Leg 101, the rifting left both topographical highs and deep gulleys. The carbonate platform formed, he and others believe, only where the animals that contribute to the banks prefer to live: at the topographical highs, where the surface waters are relatively warm, sunny and oxygen rich. Mullins thinks that only this hypothesis, involving tectonic rifting, can explain the abrupt 90-degree turns of channels.

Unfortunately, Leg 101 did not settle the debate. Drilling and logistical problems prevented the researchers from probing as deep as many would have liked. Nonetheless, Austin and others believe the results are very encouraging for the megabank theory. At site 627 at the Blake Plateau, the researchers hit shallow-water carbonates at 500 meters below the seafloor. "What we proved at 627," says Austin, "is that the [seismic] velocity discontinuity which we see in many places in the Bahamas is the top of the shallow-water platform." At all other locations, he says, shallow-water carbonates were out of reach. But the scientists did establish a stratigraphic tie between some layers cored at site 626 and those drilled on a nearby bank, at the Great Isaac well, prior to Leg 101. Since seismic reflectors appear continuous between the two sites, Austin and others infer that the platform, which had been sampled at Great Isaac, reaches both sites. According to Austin, the drilling results also indicated that the drowning of the platform occurred in steps, progressing from the southeastern perimeter of the megabank toward its center.

But Mullins and others have a different interpretation. "We've known for 20 years that the Blake Plateau is underlain by shallow-water carbonates, so that's nothing new," Mullins told SCIENCE NEWS. "It's also irrelevant because Blake Plateau is not a Bahama channel." Austin counters that no one really knows whether or not the Bahamas and Blake Plateau are distinct provinces, and even if they were, site 627 still showed that the seismic reflector at the plateau — and, by inference, elsewhere — is made of shallow-water carbonates.

Mullins also points out that sediments at site 635 and those previously dredged at the southeastern tip of the Great Bahama Bank are early Cretaceous in age and are not made of shallow-water material. "So if there was a megabank," he says, "it would have been at least of late Jurassic age [about 150 million years], much older than originally proposed, and that's getting close to the time of rifting." Moreover, Mullins disagrees with Austin's interpretation of seismic data, noting that the *character* of the reflectors — their amplitude, continuity and shape — differs from region to region in the Bahamas.

One way to settle the issue would be to drill down through the Jurassic layers, but Austin notes that the *Resolution* will not have an opportunity to return to the Bahamas until the 1990s.

Leg 101 did provide a few scientific goodies about which there is little argument. The drilling confirmed, for example, the notion that carbonate platforms "shed" the most sediments when sea level is high — the opposite of the trend seen on continental shelves. The *Resolution* also encountered mature hydrocarbons in a number of holes, vastly increasing the known oil and gas potential of the Bahamas, according to Austin. One of the most important treasures of Leg 101, says Austin, "is that we got some very complete sections of parts of the rock record that have historically been undersampled.

"Inevitably in any drilling program you open as many doors as you close," concludes Austin. "That's not a bad thing. That's just science." — *S. Weisburd*