The rock bottom

The Caribbean may be underlain by granite, once thought limited to continents

by Louise Purrett

Geologists have known for some time that the ocean crust is mostly basaltic rock, and that the continents are composed largely of granite. The classic explanation for this distribution of crustal materials is that the lighter granitic continental masses are floating in the heavier basalt.

Sea-floor spreading theory has altered this explanation somewhat, by attributing the presence of basalt on the ocean floor to upwelling from the mantle through rifts in the ocean floor. Granite also may be composed of mantle materials, but the mechanism by which it was formed and how it came to be restricted to continents has been disputed.

Until recently it was generally agreed that any granite found on the ocean floor came from the continents. Granite has often been found on the ocean floor as a relic of the days when sailing ships carried rocks for ballast. Also glaciers sometimes pick up rocks in their ponderous marches across the land and carry them to the sea.

But a team of geologists from Columbia University's Lamont-Doherty Geological Observatory has found granite—tons of it—on the floor of the Caribbean Sea under circumstances making it unlikely that either a ship or a glacier dropped it there.

The Lamont team, headed by Dr. Bruce Heezen, dredged up the rocks in the course of a 1969 survey aboard Duke University's research vessel Eastward. They came from depths as great as 1,839 meters at the southern end of the underwater Aves Ridge. They range in size from pebbles to boulders weighing 2,000 kilograms.

Granite had never been found on the sea floor in such quantities or as part of the crustal structure. The question that puzzles geologists now is how it got there.

One possibility, says Lamont geologist Paul J. Fox, is that the samples are simply from the northernmost extension of the South American continental platform. The Aves Ridge is tied topographically to Venezuela. But, he says, the speed at which seismic waves travel through the granite samples is very close to the velocity recorded for a crustal layer underlying the entire ridge. This is much farther than the continent could extend.

Furthermore, the age of the oldest sample tested was found to be 79 million years, much younger than continents.

Several geologists have advanced the theory that the floor of the Caribbean is actually a segment of subsided continental crust. They postulate that North and South America were once joined by a continental plate composed of the Greater Antilles and unfoundered Caribbean basin. When the continents drifted apart, the basin would have become separated and subsided. The dredged granite samples do exhibit chemical and wave-velocity properties similar to those of continental granites. But, the Lamont scientists point out, if the generally accepted pre-drift fit of the continents is correct, there is only enough room for the Antilles, not for an entire raised Caribbean basin.

Furthermore, a Michigan State geologist who is studying some of the samples, Dr. Thomas A. Vogel, says that although they are similar to continental granites, there are some differences in composition, and the layer of granite found in the Caribbean is shallower than continental granite layers.

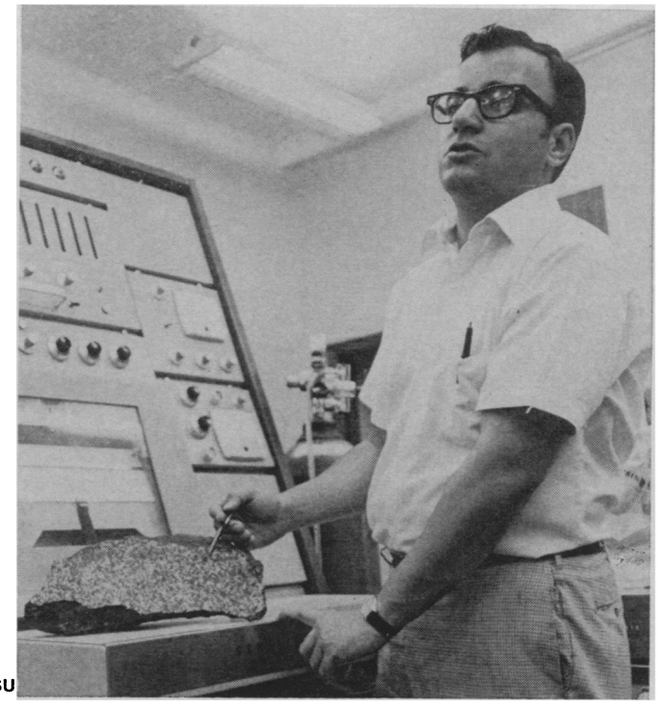
This evidence all suggests that the Caribbean basin was a zone of crustal genesis some time in the Middle Mesozoic, roughly 150 million years ago, the Lamont researchers conclude. But if so, the process must have been different from that occurring along the Mid-Oceanic Ridge today. The thickness of the crust of the Caribbean basin is two-and-a-half times that of normal ocean basins, and the crustal structure is unique.

Seismic surveys reveal that the entire basin is underlain by a layer of rock with the same wave velocity as granite, and last January another Lamont voyage dredged up more granite, this time, from the Cayman Trough in the western part of the Caribbean. Beneath that layer is a 5- to 10-kilometer layer whose seismic velocity is higher than would normally be expected. All other places where a layer with this velocity has been discovered, such as the Mid-Oceanic Ridge and the Colorado Plateau, have been regions of recent vertical uplift.

Furthermore, they point out, there is no evidence of a central ridge where the crust could have been generated, and the Caribbean basin is magnetically quieter than the ocean basins, with none of the magnetic anomaly lineations normally associated with ridges and trenches.

Dr. Vogel believes that a solution to the problem of the origin of the Caribbean granite may cast light on greater mysteries.

"We are still quite in the dark about how fundamental drift happens and how continents form," he says. "We don't know what we will find from these samples. We hope to at least be able to ask more intelligent questions about how continents began." □



MSU

Dr. Vogel: Granite has never been found before as part of an ocean floor.