Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

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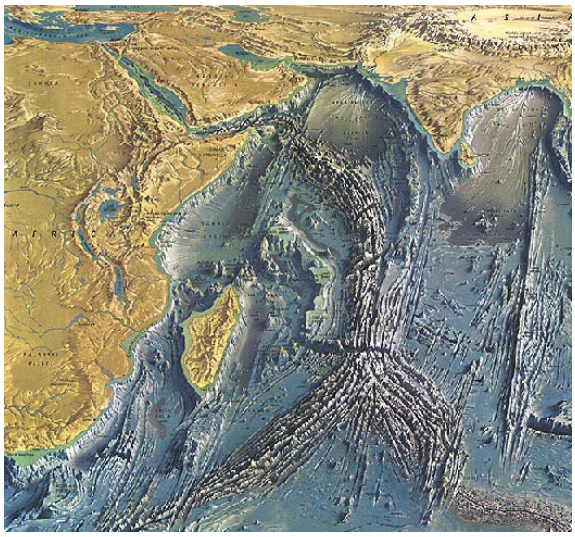
The Birth of the Indian Ocean



The seafloor of the Indian Ocean.

The Indian Ocean was surprisingly calm during our 6-day crossing to the small island of Mauritius, where we stopped to refuel. I saw absolutely nothing around the ship but one bird and a few flying fish on this entire transit. The water is a brilliant deep blue, very clear, and a sure sign that there isn't a lot of life out here. There aren't many nutrients in the middle of the Indian Ocean, so there is nothing to sustain marine life.

While this 2100-mile stretch of ocean appears homogeneous (read monotonous after 6 days of empty ocean) from a ship, the seafloor beneath us presents a totally different picture. It's a complicated jumble of ridges and fracture zones, plateaus and rift valleys, all part of a complex system of tectonic plates that has torn continents apart over the past 160 million years.

Africa, Antarctica, Australia, Madagascar and India were all joined together at that time in a huge supercontinent known as Gondwanaland. As a volcanic ridge opened up under this landmass, large fragments began splitting apart and the Indian Ocean was born. That ridge, or spreading center, appropriately named the

Mid-Indian Ridge, now looks a bit like the stitching on a baseball as it traverses the ocean floor.

In the north, this rift has split the Arabian Peninsula away from Africa by creating the Gulf of Aden and the Red Sea. The seam then bifurcates and heads southwest into Africa where the African Rift Valleys are gradually wrenching East Africa apart.

About 1000 miles east of Madagascar, the Mid-Indian Ridge splits again, with one branch heading southwest, rounding the Cape of Good Hope and continuing into the Atlantic Ocean. Another branch heads southeast, passes between Antarctica and Australia and then veers north into the Pacific.

This 40,000 mile long, global rift went essentially unrecognized until the 1950s when oceanographic institutions began to acquire surplus navy ships and head off on distant expeditions. As ocean bottom sonar records were gradually collected, the fragments of this global system of cracks in the ocean floor were pieced together and revealed the enormity of this feature.

The presence of active volcanoes along this ridge soon led to the concept of sea floor spreading, which provided a mechanism for how continents had drifted apart over geologic time. Hot molten lava from deep within the Earth's mantle surfaces along these fractures, cools to form ocean crust, and then spreads laterally away from the ridges like massive conveyor belts, carrying sea floor as well as continents.

And this is precisely what happened as the Indian Ocean opened up. Madagascar and India broke away from Africa, along with Australia and Antarctica, 150 million years ago. Madagascar didn't move far, but India started on a 2000-mile trek, colliding with Asia 50 million years ago, pushing up the Himalayas, the highest mountains on Earth.

And beneath these empty waters, unseen by any mariner, are topographic features that provide the evidence and record of rifting seafloor, continental breakups and drifting landmasses.