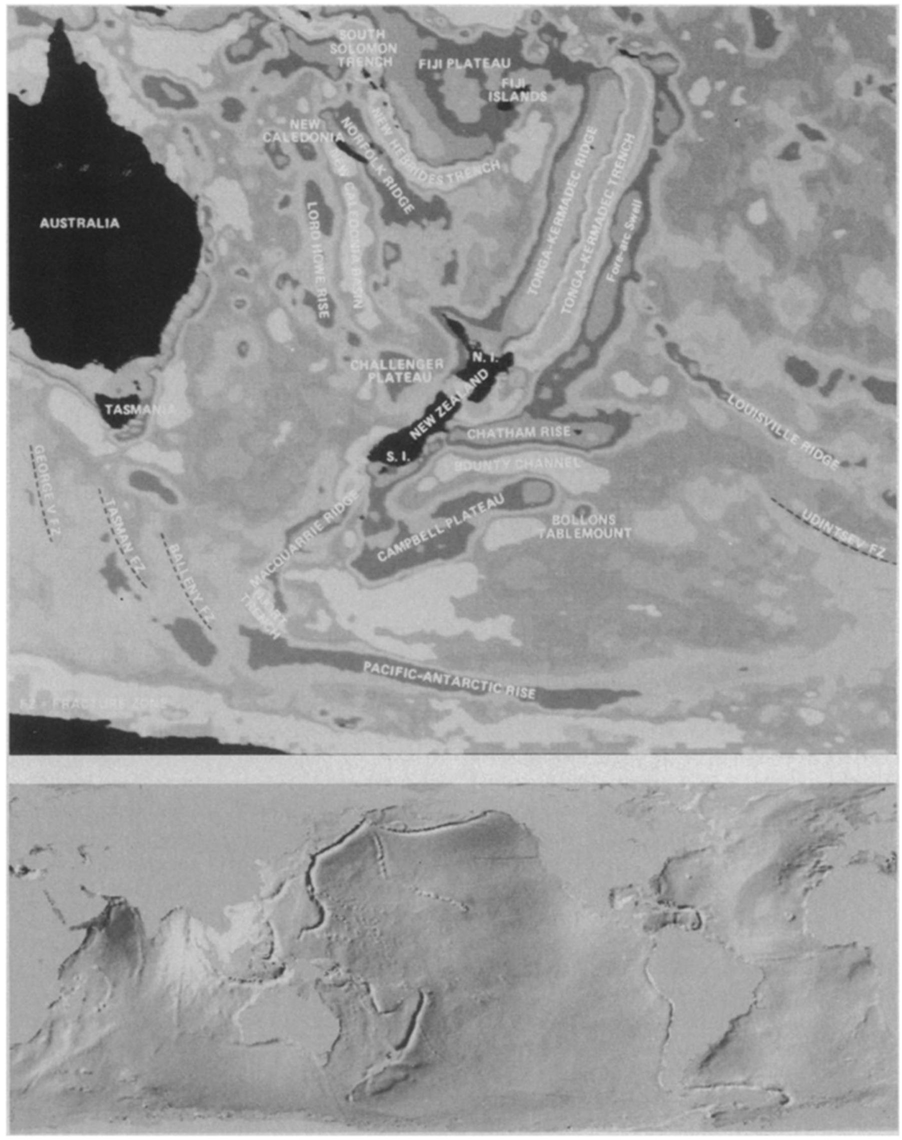
The Globe in Sharper Focus

World maps compiled from satellite readings of the ocean surface reveal and clarify deep ocean features

By CHERYL SIMON



Jet Propulsion Laboratory

Top: Computer-processed map shows geologic features on the seafloor of the southwest Pacific. The Louisville Ridge, right of center, is seen for the first time as a nearly continuous ridge. Bottom: Trenches, ridges and other features resulting from seafloor spreading are shown on a topographic relief map of the world's ocean surface.

The difference in clarity between previous maps of the world's seafloor and the newest ones is something akin to the fuzziness of a Polaroid snapshot when it comes out of the camera and the distinct image five minutes later. Scientists from the Jet Propulsion Laboratory in Pasadena, Calif., have compiled maps of the ocean floor using sensitive measurements taken of the sea surface by the oceanographic satellite SEASAT during 70 days in 1978. From its orbit 800 kilometers above the earth, the satellite measured the distance between itself and the ocean surface with a precision of 10 centimeters.

The data can be used to map the seafloor because the shape of the ocean surface reflects the gravity of the seafloor as well as features of seafloor topography. Newer areas of crust are less dense and therefore higher than older crust. Thus, the fluid ocean waters undulate with more than the transience of waves. Where the seafloor dips into a trench, the waters far above it also dip, a gradual depression on the ocean surface. Over jagged seamounts the surface rises in a subtle swelling that indicates the obstacle in the ocean depths.

Not all major seafloor features appear on the maps. Where a seamount formed on old crust, the gravity signal is unmistakable, but if a seamount formed on newer crust the signal is less distinct. The more plastic young seafloor deforms in response to the seamount's extra mass and, in effect, cancels out the expected undulation of the sea surface; hence, SEASAT's readings do not reflect the presence of all features. For example, the East Pacific Rise, one of the world's outstanding geological features, is by nature very recent and is marked on the topographic relief map only as a light shadow in the eastern Pacific.

The value of the maps is that they supply detailed information about water depth and highlight steep, small-scale features of seafloor topography. The Louisville Ridge in the southwest Pacific was believed to be a chain of discontinuous mountains, but from SEASAT data it is clearly seen as a nearly continuous mountain chain. Timothy Dixon, a marine geologist at JPL, says one explanation for the ridge is that, like the Hawaii-Emperor chain of seamounts in the Northern Hemisphere, it formed as the seafloor slowly moved over a stationary hotspot in the earth's crust (SN: 9/22/79, p. 202; 12/26/81, p. 388).

The satellite maps also show for the first time a California-sized underwater plateau east of the Louisville Ridge, and hint that a subduction zone may be forming south of Australia, trending west toward India. The idea is appealing but "highly speculative," Dixon says. He and Michael Parke, who collaborated on the mapping project, both stress the dearth of evidence for seismic activity that would be expected in the area if a trench were starting to form.

Dixon and Parke, who conducted the scientific analysis of the images, and Kevin Hussey of JPL's processing laboratory, plan to make transparent overlays of the maps in the same size as the standard oceanographic charts. The maps are particularly useful because the southern oceans have been poorly surveyed. Some of the features exposed on the maps may be included in sites scheduled for exploration through the Deep Sea Drilling Project. "Basically this stuff doesn't give you any radically new interpretations," Dixon says, "but it modifies ideas of how the seafloor evolved in that part of the world." □