

# [TAMU]<sup>2</sup> and related geophysical studies of the East Pacific Rise

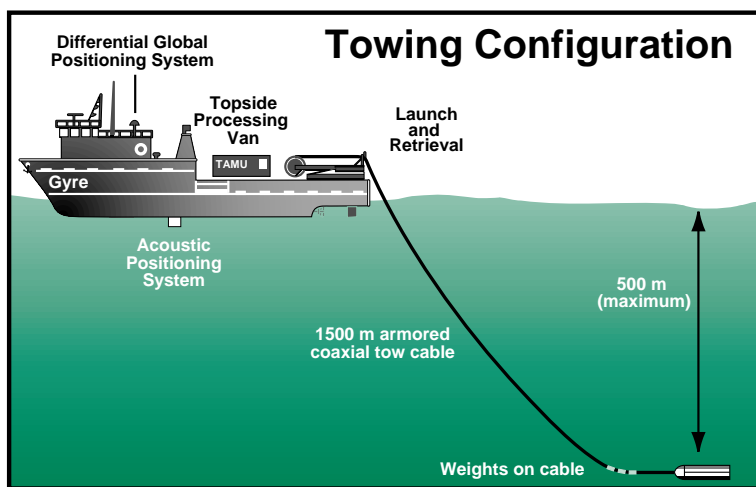
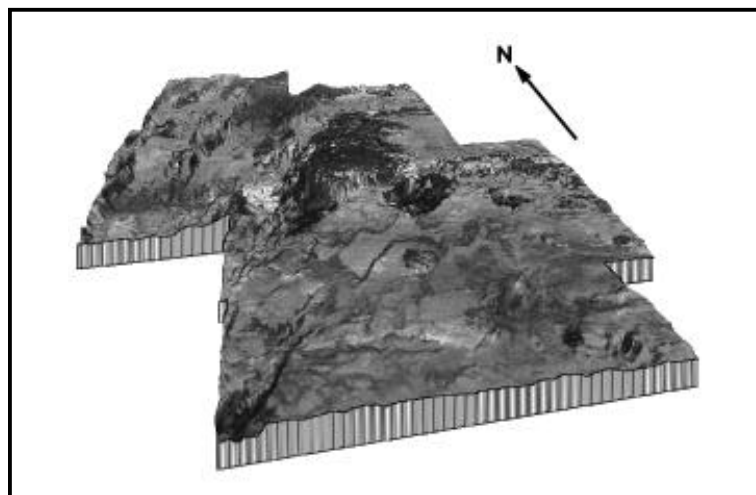
Thomas W. Hilde

The Geodynamics Research Institute (GRI) of Texas A&M University and the Geological Survey of Japan (GSI) are, as this is being written, aboard R/V *Gyre* and nearing completion of a joint [TAMU]<sup>2</sup>\* high-resolution seafloor swath mapping and related geophysical investigations of the super-fast spreading segment of the East Pacific Rise (EPR). We have named this investigation FAST (Flux And Spreading Tectonics) Ridge Expedition. The ridge segment being studied lies between 12°-20°S and is a major focus of U.S. and International Ridge programs. The objective of FAST Ridge Expedition is to determine the relationship between micro-, meso-, and macro-scale topographic and structural variations along the ridge and variations in stages of ridge magmatic and tectonic activity. This investigation is in support of the goals of the Japan Ridge-Flux, International Inter-Ridge and U.S. Ridge Projects, and is funded by the Science and Technology Agency (STA) of Japan. FAST Ridge Expedition is also endorsed by NSF as a U.S.-Japan Science Cooperation Program. Our investigation complements previous Ridge Flux Project studies of the region of the EPR carried out aboard R/V *Melville* (1993) and R/V *Yokosuka* (1994), during which extensive CTD/TN tow-yo surveying and extensive diving observations by *Shinkai 6500* were accomplished, respectively. Our studies also complement other recent investigations of the region such as the French *Naudur* cruise of 1993, previous United States, French and German surveys and the planned U.S. Mantle Electromagnetic and Tomographic (MELT) experiment. *Gyre* departed Galveston on October 19th and we will complete our studies and disembark *Gyre* on December 5th in the Galapagos Islands. *Gyre* should arrive back in Galveston on December 16th.

\* [TAMU]<sup>2</sup> — Texas A&M University Topography and Acoustic Mapping Undersea System

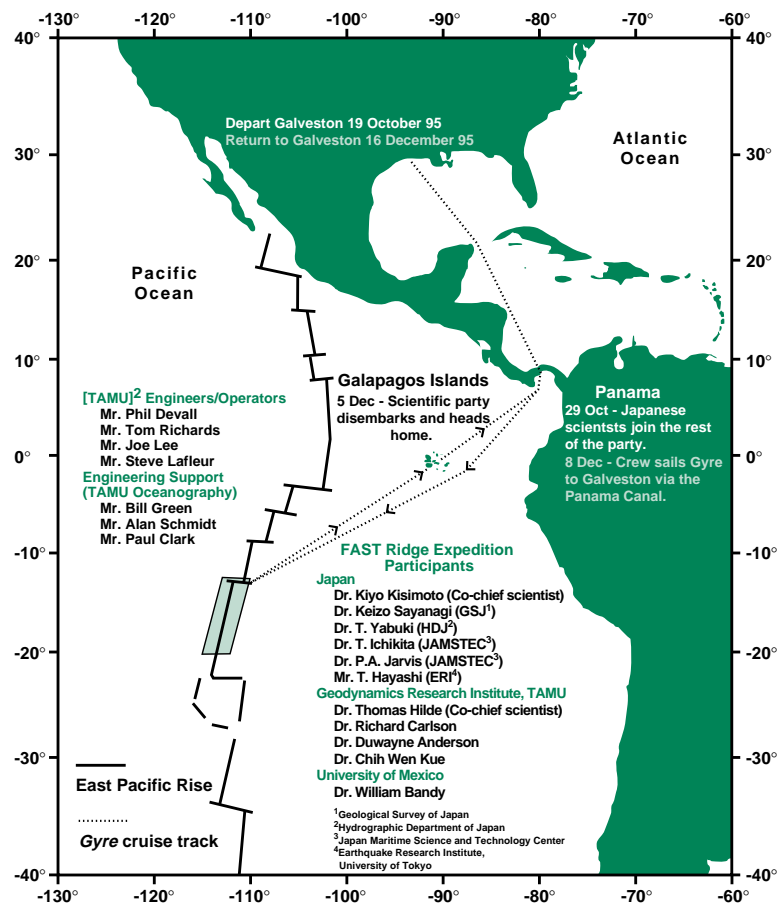
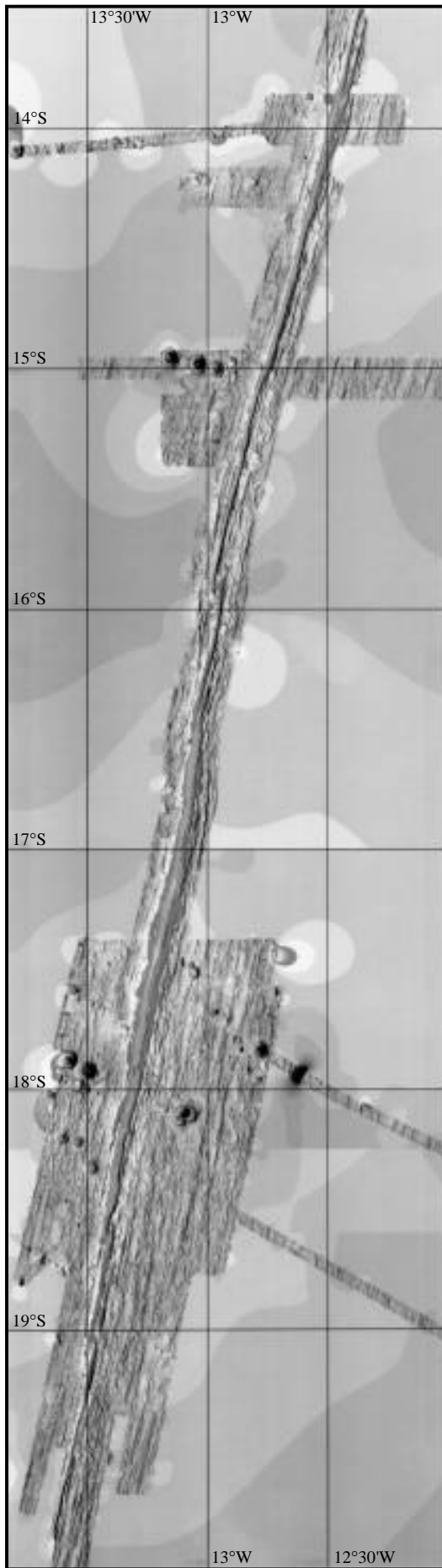
At the conclusion of FAST Ridge Expedition we will have comprehensive coverage of the 13°-19°S ridge crest and immediate flanks with collocated [TAMU]<sup>2</sup> swath imagery and bathymetry. These data are allowing us to map the distribution, in greater resolution than previously achieved, of the volcanic, magmatic, structural and bathymetric features of the ridge. At the same time we are collecting three-component magnetic, total-field magnetic, and gravity data to aid in determining crustal age and sub-surface structure. A special concentration of effort is being made to acquire very detailed imagery and bathymetry on the 17°10'S to 18°40'S region to complement the abundant geologic, volcanic and magmatic activity data previously collected on or near the seafloor by the 1993 R/V *Melville* and 1994 R/V *Yokosuka* cruises. Two ocean bottom heatflow instruments were placed on the ridge crest last year by the submersible *Shinkai 6500*, at 18°26'S and 17°34'S, to measure variations in the heatflow of this volcanically active ridge over an extended period of

time. We have just recovered the instrument from the 18°26'S site and will attempt recovery of the other instrument tomorrow. The integration of all these various types of data with [TAMU]<sup>2</sup> imagery and bathymetry will allow detailed aerial mapping of volcanic, magmatic, geologic and tectonic features for this entire fast-spreading segment of the EPR.



**Top:** Three-dimensional map of the seafloor created by the [TAMU]<sup>2</sup> system in 1994.

**Bottom:** The [TAMU]<sup>2</sup> apparatus is towed behind the *Gyre*.



*Left: Map showing the Gyre cruise track for the FAST Ridge Expedition and the location of the East Pacific Rise.*

*Far left: Three-dimensional detail map of the section of the East Pacific Rise under study.*

Our goals include relating the observed variations in seafloor geology, structure and bathymetry to evolutionary stages in the processes of magmatism along the ridge, to determine which segments are presently in constructive stages, the time scale for ridge constructive processes and, by comparative analysis of FAST Ridge Expedition data with that data previously collected, whether ridge segments have undergone inflation or deflation in the last few years.

This super-fast spreading segment of EPR offers a great opportunity to study the fundamental aspects of crustal origin at oceanic spreading centers. The full spreading rate along this ridge segment is 150-160 millimeters per year. Previous studies have revealed an extremely narrow, elevated ridge axis, hydrothermal venting temperatures of about 400°C, magma chambers as shallow as about 900 meters and fresh, glassy basalt at many submersible dive locations. [TAMU]<sup>2</sup> is showing us the distribution and variation in tectonic and volcanic activity along the ridge. The data quality has been excellent—the images are like photographs. So far, we have observed that overlapping spreading exists at various scales all along the ridge. We have found numerous axial rifts, extensive volcanic

flows on the ridge flanks and mammoth off-ridge lava flows. Normal faulting is most extensively developed at the base of the elevated two- to four-mile-wide axial ridge. Apparently the axial ridge crest is sufficiently hot and plastic so that brittle faulting does not become the dominant tectonic expression until the newly formed crust has moved a mile or two away from the ridge axis.

In order to guide our mapping and to get started with our data analysis, we are processing the data aboard ship as it is acquired. The [TAMU]<sup>2</sup> system displays both the imagery and bathymetry in real-time as waterfall displays on computer monitors and strip recorders. Additionally, the digital data are recorded to high density tape for archiving, and transferred via network to an off-line Silicon Graphics workstation for post-acquisition processing. By the time we get to the Galapagos Islands, we should have mosaics of the imagery, contour images and three-dimensional images for much of the ridge.

Assuming no equipment failures during the remainder of the expedition we expect return with a data set that will provide new insights into the processes and structure of this super-fast spreading segment of the East Pacific Rise. ☺