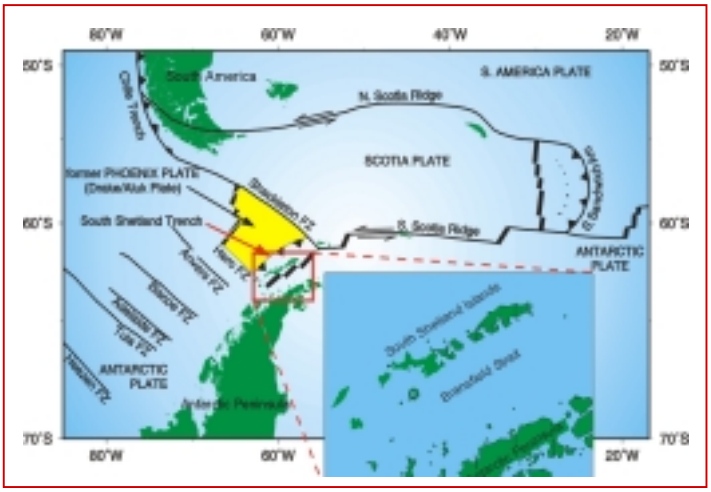
A SMALL PIECE OF THE CRUSTAL JIGSAW PUZZLE

THE DEEP CRUSTAL STRUCTURE OF BRANSFIELD STRAIT, WEST ANTARCTICA: A MODERN ANALOG OF THE PRE-ANDES

TO UNDERSTAND more fully the early evolution of the Andes Mountains, the break-up of the ancient supercontinent known as Gondwanaland, and the diverse processes involved in forming continental margins UTIG scientists have undertaken three marine geophysical cruises to Bransfield Strait, offshore Antarctica.



GEOLOGIC SETTING. Bransfield Strait is a relatively young rift system between the West Antarctic Peninsula and the South Shetland Islands, an inactive volcanic arc. The axial rift of Bransfield Strait appears to lie near a critical transition from intracontinental rifting to seafloor spreading. Widespread crustal extension, accompanied by recent volcanism along the Strait's axis, is associated with slow underthrusting of oceanic crust at the South Shetland Trench. Similar "back-arc" extension occurred along the entire Pacific margin (now western South America/ West Antarctica) of Gondwanaland some 130-200 million years ago. Approximately 100 million years ago, deformation of these basins initiated uplift of the Andes.

FIELD PROGRAMS. The first cruise to study the structure of Bransfield Strait was carried out in 1991 by scientists from UTIG and Lamont-Doherty Earth Observatory aboard the R/V *Maurice Ewing.* Multichannel (MCS) seismic data collected on that NSF-sponsored cruise revealed very important basin-wide characteristics of Bransfield Strait, including faulting associated with extension, the rise of crustal diapirs or domes leading to volcanic eruptions at the seafloor, and a complicated system of fault-bounded segments that is typical of rift basins all over the world.

The *Nathaniel B. Palmer* is an icebreaker operated by Edison Chouest Offshore, Inc. for the National Science Foundation.

In April of 2000, UTIG Senior Scientist Jamie Austin led a team of UTIG researchers on an NSF-sponsored marine geophysical cruise on the Icebreaker R/V *Nathaniel B. Palmer.* The *Palmer*, which is owned and operated by Edison-Chouest of Louisiana, is under long-term contract to the National Science Foundation Office of Polar Programs (OPP) for support of scientific research in Antarctica. The goal of the cruise was to use UTIG's suite of ocean-bottom seismographs (OBSs) in a seismic refraction experiment to investigate the geologic structures in Bransfield Strait that had been previously revealed by the *Ewing's* MCS data. Many of the OBS profiles coincided with the seismic reflection profiles collected previously. Single-channel seismic reflection, magnetic, and bathymetric data were also collected.

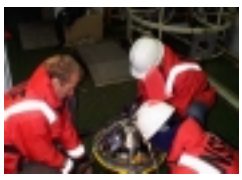
PRELIMINARY RESULTS indicate that the zone of recent volcanism along the axis of the Bransfield Strait is a discrete, localized high-velocity feature in the shallow crust with low-velocity zones beneath. Large fault blocks underlie the margin of the Antarctic Peninsula. As expected along a rift zone, crustal thinning is observed beneath the Strait's axis. Seismic profiles collected parallel to the strike of the basin show clear segmentation into multiple fast and slow blocks that correlate well with volcanic centers along the axis and with horst and graben topography interpreted from MCS data on the Antarctic Peninsula margin. Structural boundaries correlate with volcanic centers, suggesting possible across-strike structural control on initial volcanic emplacement.

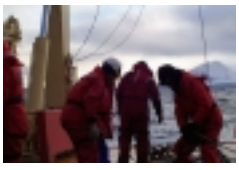
A second geophysical cruise on board the *Palmer* to Bransfield Strait is currently underway (October–November 2000) to complete UTIG's seismic refraction experiment.

EDUCATION AND TRAINING. Daniel H.N. Barker, who received his Ph.D. from The University of Texas at Austin in 1997 for his work on *Ewing* seismic profiles collected in Bransfield Strait, returned from the Lamont-Doherty Earth Observatory to UTIG for a two-year postdoctoral appointment. Barker is currently working as part of the UTIG team of investigators, including James Austin, Jr., Ian Dalziel, Gail Christeson, Yosio Nakamura, James Dolan, and Ben Yates. Stanly Treanor, a high school physics and computer science teacher from Merkel, Texas, participated in the April 2000 *Palmer* expedition to Bransfield Strait.

SIGNIFICANCE. Understanding Bransfield Strait's deep crustal structure is the key to resolving its transitional stage of evolution as a rift basin and a crucial step toward understanding the complex tectonic evolution of this part of the Southern ocean. Such knowledge will provide a foundation for comprehensive models of the origin and evolution of the Andes Mountains, with important implications for similar mountain building processes everywhere. The latest OBS data, integrated with interpretations of the *Ewing* MCS profiles and other high-quality geophysical coverage in Bransfield Strait, will complement other ongoing studies, including the deep seismic analysis of Antarctic Peninsula crust to the southwest (Italy's Project TENAP), and additional OBS monitoring for deep earthquakes by investigators at Washington University (St. Louis) and Scripps Institution of Oceanography.

For more information, please contact James Austin, jamie@utig.ig.utexas.edu.





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