MAR-ECO research expedition to the Charlie-Gibbs Fracture Zone

MAR-ECO scientists are the first human beings to ever explore the depths of this deep ocean zone.

Mid-ocean ridges are the largest topographic feature on the planet, stretching almost continuously for 74 000 km. The second group of most prominent features on the planet are the fracture zones. There is currently is no clear definition of what actually constitutes a fracture zone. They are caused by the action of stress relief on a spherical body (the earth) where differential movement is occurring (i.e. plates moving laterally against one another). Fracture zones can be considered as fault zones that connect different segments of the spreading ridges.

The Charlie-Gibbs Fracture Zone (CGFZ) extends about 2000km (from about 18 to 43°W) along an axis that cuts across the mid-Atlantic ridge at about 52°N or between the northern tip of Newfoundland and the southern tip of Ireland.

Igor M. Belkin at the Graduate School of Oceanography at the
University of Rhode Island explains that the CGFZ was first described by *Johnson* [1967] who named it the “Charlie fracture zone” after the U.S. Coast Guard’s Ocean Weather Station “Charlie” located at 52°45’N, 35°30’W. Belkin goes on to explain that the first extensive survey of this area was conducted in July 1968 by the USNS *Josiah Willard Gibbs*, and that therefore *Fleming et al.* [1970] proposed that this fracture zone be named the “Gibbs Fracture Zone.” The double name “Charlie-Gibbs Fracture Zone” was first used by *Garner* [1972], then *Olivet et al.* [1974] and many others. This name is officially recognized by the Intergovernmental Oceanographic Commission and the International Hydrographic Organization.

The CGFZ is characterised by generally rough topography. It is the deepest fracture zone associated with the mid-Atlantic Ridge, descending to around 4500m at its deepest point.

June 2003, MAR-ECO leadership supported by funds from NOAA Ocean Exploration Initiative and the A.P. Sloan Foundation were able to organise a unique opportunity for MAR-ECO scientists aboard the Russian manned submersibles, MIR I & II. They were the first human beings to ever explore this deep ocean zone. The support vessel for the MIR submersibles is the Russian RV, Akademic Mistislav Keldysh. The Keldysh is owned by the Russian Academy and operated by the P.P. Shirshov Institute of Oceanology in Moscow. The MIR submersibles can dive to about 6000 m, and can take aboard 2 passengers / observers in addition to the pilot.

Each of this cruise's double dives involved four scientists: one Russian and one American in each of the submersibles. At each dive site, the two subs performed near-bottom visual/video transects and collected samples. In addition, both subs observed and documented pelagic organisms during their transit downward and upward. Videotapes were recorded continuously throughout dives. Dive parameters and other observations were also recorded manually in dive logs.

The Keldysh left Copenhagen, June 3 and docked in St. John’s Newfoundland June 17, 2003. Despite poor weather, the MIR submersibles were able to engage in two double dives, June 11 and 13.

The goal of the expedition was to observe and document the megafauna of the deep pelagic, near bottom and bottom communities. Therefore the scientists used what bathymetric data is available about the region to select two contrasting dive zones (at around 34°W, an area of high topographic relief, and around 35°W, an area of low topographic relief). The first included some of the roughest topography the bathymetric data indicated. The second was a flatter area, bounded by what looked like an escarpment, on paper at least.

A diverse team of scientific specialists were assembled to participate in the expedition. The team included Mike Vecchione as its chief scientist. Vecchione is a world-renowned

cephalopod specialist based in Washington D.C. where he heads the National Systematics Laboratory of the NOAA National Marine Fisheries Service. His particular interests in the MAR-ECO Project are the virtually unknown cephalopods living below 1000m.

Raymon R. Wilson Jr. is a fish biologist working at California State University, Long Beach, California. His task during the MIR expedition was to try to identify fish in the mid and deep waters. Andrey Gebruk is a specialist on epibenthos (bottom-living fauna), especially sea cucumbers. He comes from the P.P. Shirshov Institute of Oceanology, in Moscow. He has a great deal of experience from diving operations on hydrothermal vents. He is the primary MAR-ECO contact in the Shirshov Institute. Georgii Vinogradov is a planktologist, i.e. studying small mid-water animals. He also comes from the P.P. Shirshov Institute of Oceanology. Vinogradov comes from a family of renowned marine biologists. His father is Akademik Vinogradov, who has written important works on plankton and plankton ecology, and his mother was a specialist on hadal fauna, i.e. fauna of the extreme deep-sea trenches. Elena Krylova also comes from the P.P. Shirshov Institute of Oceanology. She is a benthos specialist. The final team member was John Nicolas from NMFS, NEFSC, and Woods Hole. Nicolas came along to observe and record whales during the cruise period. His observations will serve the MAR-ECO mammals' component, which is investigating whether mammals are particularly concentrated in the mid-Atlantic Ridge area.

The scientists reported that everything went pretty well in both dives, which took about 12 hours, each, with eight hours bottom time. They underlined, however, the need for better, more detailed bathymetry so that dives could be planned to better optimise the observation and sampling opportunities. They recommended that on future dives, the subs divide tasks so that one undertakes the transect work (filming and counting), while the other is responsible for sampling. In addition, there were some difficulties safely transporting samples, particularly fragile ones, back to the ship. Wilson suggested using covered sample baskets, to avoid possible sedimentation or washing away problems.

The scientists appreciated the great contrast between the life forms seen and the landscape in the two dives, although the two locations were only separated by a distance of around 15 nautical miles. In general, however, they were surprised by how much life, in fact, was present at these great depths. Another very interesting observation was the presence of so much "marine snow". Marine snow is the name given to the aggregations of biological debris that sift slowly down from the upper layers of the ocean.

Dive 1, 11 June, went to a rough area – the roughest the scientists could find according to the available bathymetry data. Veteran of many deep-water cruises, Vecchione stated that it would be impossible to trawl this area, and that direct observation was the only way to see the life forms present. The scientists were able to photo or video document many life forms. They saw at least six different types of fish, including many juveniles. The video enabled them to capture the swimming / walking behaviour of an orange anglerfish. They documented many invertebrate organisms that will provide fodder for months of analysis by invertebrate experts, as well as being able to collect a number of samples.

Dive 2, 13 June, covered a much flatter region. There were ripple marks aligned in a N/S direction in the fluffy sediment material on the bottom attesting to regular water movement patterns. Vecchione reported that the subs actually drifted quite quickly when the motors were completely stopped. In addition there was a great deal of evidence of bio-perturbations of the sea-floor caused by creatures burrowing into the sediments. While there was relatively little fauna in the sediments, any rock surfaces that emerged were covered in invertebrate communities, to the point that in some places the scientists described them as sponge gardens.

Sadly, the researchers also noted the presence of plastic trash in some of the holes or depressions in this area.

After the intense experiences of voyaging to these great unexplored depths, the team takes back a wealth of information that will keep MAR-ECO scientists and scientists at their respective research centres busy for many months. The MIR expedition has whetted our

appetites for the continuing MAR-ECO explorations to come. It demonstrated that there is life in the deep – what is it living on?

Dive 1: 11 June, Station 4540, 52°N 35°W

MIR I
Pilot: Anatoly Sagalevitch
Co-pilot: Viktor Nischeta
Scientific observer: Raymond Wilson
MIR II
Pilot: Zhenia Chernyaev
Co-pilot: Viktor Schadilov
Observer: Mike Vecchione

Dive 2: 13 June, Station 4537, 52°N 34°W

MIR I
Pilot: Viktor Nischeta
Observers: Mike Vecchione, Egor Vinogradov
MIR II
Pilot: Zhenia Chernyaev
Observers: Elena Krylova, Raymond Wilson

Scientific Personnel:

Name	**Responsibility**	**Organization**
Michael Vecchione	Chief Scientist, Cephalopods	NMFS, NSL, Washington, DC, USA
Raymond R. Wilson, Jr	Fishes	CSU, Long Beach, CA , USA
Andrey Gebruk	Epibenthos	PPSI, Moscow, Russia
Georgii Vinogradov	Plankton	PPSI, Moscow, Russia
Elena Krylova	Benthos	PPSI, Moscow, Russia
John Nicolas	Marine Mammals	NMFS, NEFSC, Woods Hole, MA, USA

NMFS = National Marine Fisheries Service
NEFSC = Northeast Fisheries Science Center
NSL = National Systematics Laboratory
CSU = California State University
PPSI = P.P. Shirshov Institute of Oceanology
NOAA = National Oceanic and Atmospheric Administration

Russian RV, Akademic Mistislav Keldysh, details
http://www.titanic-deutschland.de/Wrack/A__Keldysh/a__keldysh.html
http://www.titanic-online.com/titanic/expeditions/keldysh_specs.html
http://www.sio.rssi.ru/