

RECOMMENDATIONS FOR FUTURE RESEARCH ON THE GEODYNAMICS OF RIFTING IN ANTARCTICA

Transects Initiative

The workshop recommended that a primary focus of future research consist of integrated geological and geophysical transects (~50-100 km in width) to cross the key tectonic elements and boundaries across the breadth of the rift system. Within the selected corridors, a coordinated program should include the suites of studies outlined below and detailed in the Other Initiatives section that follows. In conjunction with geological and geophysical mapping, priorities for the transects should include obtaining as much age and kinematic information as possible.

- Geologic program:
 - surface geologic and structural mapping
 - systematic geochemical studies, isotopic dating, and thermochronology
 - sub-ice sampling (hot water drilling & bedrock sampling) to shallow depths
 - drilling program to sample deeper features

- Geophysical program:
 - aerogeophysics: magnetism, gravity, radio-echo sounding
 - heat flow data from sub-ice drilling programs
 - targeted, coordinated passive and active seismic experiments
 - magnetotelluric data along proposed seismic profiles

One principal goal of the proposed transect program is to obtain data across Marie Byrd Land, the Ross embayment, the Transantarctic Mountains, the Wilkes/Pensacola basins, and across as much of the East Antarctic craton as feasible. It is important to complete more than one transect in order to document any differences in structural style, age of the events and other variations within the rift system. The second principal goal of the transect program is to target major tectonic boundaries within the rift system in more detail. This will require additional corridor 'legs' oriented along the strike of key boundaries (i.e. branching from the transects), and/or spot investigations at selected sites along their length. The transects

should be sited to incorporate as much existing information as possible. The recommended candidate transect locations include:

- Approximately the site of the proposed ANTALITH transect: Marie Byrd Land - interior Ross embayment - TAM/Queen Maud Mountains - Pensacola Basin- Gamburtzev Subglacial Mountains. This area is extremely important because it contains key tectonic elements of the rift system, yet little is known about their nature.
- Ross Sea – TAM/Victoria Land – Wilkes Basin – Dome C area, either across the TAM in Southern Victoria Land in the McMurdo area or across the TAM in northern Victoria Land north of the Terra Nova Bay area. This appears to be the best area in terms of building upon existing data and planned experiments. It seems feasible to complete a geological/geophysical corridor in this region relatively soon and therefore to develop a comprehensive view of the crustal structure and composition across the rift system.

Other Initiatives

The following research programs were recommended by one or more of the working groups. Each describes research that should be a component of the transect initiative and that can be carried out independently by individuals or groups of investigators. More details about these proposed programs can be found in the working group reports that follow.

- Regional geologic mapping, with particular focus on major tectonic boundaries and structural kinematics. Mapping must be targeted on key exposed geologic provinces and coordinated with geophysical transects.
- A drilling program to establish a detailed chronology for rifting, uplift, basin subsidence, and rift-related magmatism. This drilling program should include:
 - Land/ice-based drilling and ODP ship-based drilling to penetrate major portions of rift-basin fill (1,000 m + penetration).

- Ship-based drilling from the Palmer and Polar Duke to sample shallow targets (100- 200 m penetration).
- Sub-ice bedrock sampling using hot water drilling through ice cover and then remote drilling system to obtain bedrock samples. This program should include:
 - Utilization of “holes of opportunity”, e.g., from astrophysics and glaciology research programs, whenever and wherever possible.
 - Dedicated holes to sample targets identified from geophysical surveys.
- Establish a teleseismic station network, consisting of a continent-wide array utilizing permanent research stations and remote geophysical observatories , in order to:
 - Map the continent-wide internal velocity structure of the lithosphere. This is needed to provide a framework for the TAM/WAR system. It is also very desirable because Antarctica is so poorly known in comparison to most other continents.
 - Compile an earthquake catalog for the Antarctic continent. This is needed to determine the neotectonic setting of the TAM/WAR system, as well as to evaluate the level of seismic activity and the lithospheric structure of the rest of the continent.
- Programs to correlate onshore and offshore structural and geophysical mapping:
 - Reconcile structural and magmatic records in the Transantarctic Mountains and the Ross Sea /embayment region.
 - Link geological and geophysical studies of the major rifted boundaries around the Antarctic continent, for example, the rifted margins with the South Pacific and African edges of the continent.
- Regional geochemical studies designed to:
 - Use the wide age and compositional range of igneous suites in the Transantarctic Mountains to obtain model ages, inheritance ages, and isotopic compositions of source materials, in order to map the compositional and age domains of the crust and mantle.

- Systematically characterize the geochemistry and age of Cenozoic magmatism across the rift system to help document mantle dynamics during rifting and related uplift/subsidence.
- A systematic isotopic dating program in part in association with the initiatives for transects, drilling, neotectonic mapping, and geochemical mapping. The dating program *must* be linked with careful structural control from field and geophysical mapping in order to evaluate the significance of ages for the rift history. The goals of the dating program include:
 - Regional mapping of model and inherited ages from granitoids (here of interest in the context of petrogenetic implications for rift-related magmatism).
 - Obtaining regional age data on rift-related alteration events.
 - Obtaining systematic regional age data on rift-related magmatic rocks.
 - Thermochronology to obtain a thermal history and, by inference, an uplift and denudation history.
- An initiative to determine uplift history of the Transantarctic Mountains, with emphasis on separation of signals arising from glacial and tectonic activity and identifying any synergism between glaciation and uplift. This program should include:
 - Thermochronologic mapping using fission track and higher temperature methods.
 - GPS measurements of uplift.
 - Documentation of the landscape evolution record, by mapping and dating exposed landscape features and by mapping subglacial ‘landscape’ by radio-echo sounding.
- A suite of studies to ascertain the extent of neotectonic activity occurring within Antarctica, including:
 - Establishing a GPS network to measure crustal motions.
 - Establishing a seismic network, if possible co-located with the GPS array, to catalog microseismic activity. A primary target should be the TAM Front.
 - Program to obtain heat flow data from “holes of opportunity” (as above) and from dedicated land- and ship-based programs.

- Structural mapping program to examine the geometry and kinematics of faults and late Cenozoic intrusions, including field mapping in the Transantarctic Mountains and gridded seismic profiling in adjacent sectors of the Ross Sea.
- Systematic mapping of landscape records to document neotectonic uplift patterns.