

MARGINS WORKSHOP ON THE RUPTURING OF CONTINENTAL LITHOSPHERE IN THE GULF OF CALIFORNIA/SALTON TROUGH REGION

NSF Proposal

PROJECT SUMMARY

We seek funding for a workshop of US and Mexican scientists who are interested in studying processes of RUPTURE OF THE CONTINENTAL LITHOSPHERE in the Gulf of California/Salton Trough region. The Gulf of California/Salton Trough is one of two focus sites chosen for this part of the MARGINS initiative. We propose to have a two and one-half day meeting in Puerto Vallarta, Mexico, in late October, 2000. The workshop will be convened by Joann Stock, Arturo Martín-Barajas, and Michael Steckler. The goal is to familiarize scientists from each nation with what research initiatives are being undertaken, or have recently been completed, related to this topic, by groups who work in the Gulf of California area. This should facilitate the design of future proposals by teams of international collaborators who wish to join forces on the study of this topic under the MARGINS umbrella.

The meeting will start with a brief review of the geology and tectonics of the Gulf of California and of the major unanswered questions about rifting processes. There will then be a series of thematic sessions in which the participants can describe, in brief, the work they have in progress, or the work they hope to accomplish related to this topic. Finally there will be a general discussion of what types of modeling experiments and field observations are necessary to really advance our understanding of the composite picture.

RESULTS FROM PRIOR NSF SUPPORT

Garry D. Karner

Award Number OCE92-17519 Amount \$326,799 (LDEO only)
Dates 2/1/94 - 1/31/98
Title of Project Transform & subduction tectonics along the Macquarie Ridge: Side-scan, seismic reflection, and gravity studies

Summary of results: The Macquarie Ridge Complex (MRC) south of New Zealand forms a segment of the Pacific/Indo-Australian plate boundary. During 1994, R/V Rig Seismic collected multichannel seismics, gravity, sidescan and bathymetry data along the MRC to define the pattern of along-strike alternation of ridge and trench segments of the complex. The research emphasis has focussed on: 1) the factors controlling the observed polarity variations in the sense of subduction/overthrusting along the MRC, and 2) the apparent relationship between overthrust block deformation and the structural fabric of the underthrust plate. We note the following behavior of the bathymetry: 1) the northern propagation of the Macquarie Ridge begins to subside by as much as 1800 m, 2) a corresponding increase in the width of the Puysegur trench, 3) intense positive free-air gravity anomalies associated with the subsiding ridge, 4) a large increase in the width and amplitude of the free-air gravity anomaly associated with the Puysegur trench, and 5) the development of a major strike-slip fault zone along the "backbone" of the ridge. We explain these observations as being the result of differential coupling between the under and over-riding plates. The degree of coupling appears to be strongly influenced by the spacing of Cenozoic fracture zones that occur on both the Pacific and Indo-Australian plates that asymptotically approach the MRC and controls the degree of partitioning between thrust and strike-slip earthquakes.

The fracture zones appear to represent mechanical weaknesses. For example, extreme variations in topographic relief along the MRC correlate with large variations of the free-air gravity anomaly, indicative of a flexural support for the topography. However, the overthrust block that contains Macquarie Island has a surprising abrupt change in slope immediately to the west of the island. Such changes in slope are inconsistent with a flexural origin. We believe that the various fracture zones represent a sequence of potential mechanical weaknesses within the interacting Pacific and Indo-Australian plates. The relative spacing and orientation of the fracture zones control how bending stresses generated during overthrusting will be redistributed. Qualitatively, we would expect that breaking either the over- or under-thrust plate with a vertical fault (such as fracture zone) will decouple the crustal loads on either side of the break. Such is the case for Macquarie Island in which the vertical crack on the west side of the ridge has relieved the bending stresses induced by overthrusting. Macquarie Island is now part of a detached block or "crustal lozenge" caught between two major fault systems: the high angle fracture zone "crack" in the west and a major thrust fault in the east.

Publications:

- Karner, G.D., J. Fang, M. Coffin, C. Frohlich, P. Mann, C. Massell, L. Shuur, C. Helsley, D. Falvey, and J. Lebrun, Transpressional deformation of the Macquarie Ridge Complex and its flexural and topographic implications,.. J. Geophys. Res. Submitted.
- Lebrun J.F., G.D. Karner, and J.Y. Collot, Flexural coupling between the over- and under-riding plates of the Puysegur subduction system, J. Geophys.Res., 103, 7293-7314, 1998.
- Coffin, M.F., G.D. Karner, and D.A. Falvey, Research cruise yields new details of Macquarie Ridge Complex, EOS, 75, 561, 1994,
- Schuur, C.L., M.F. Coffin, C. Frohlich, C.G. Massell, G.D. Karner, D. Ramsay, and D.W. Caress, Sedimentary regimes at the Macquarie Ridge Complex: Interaction of Southern Ocean circulation and plate boundary bathymetry, Paleooceanography, 13, 646-670, 1998.,
- Massell, C., M.F. Coffin, P. Mann, S. Mosher, C. Frohlich, C.L. Schuur, G.D. Karner, D. Ramsay, and J.F. Lebrun, Neotectonics of the Macquarie Ridge Complex, Australia-Pacific plate boundary, J. Geophys. Res., submitted.

Michael S. Steckler

PIs	M.S. Steckler, J.B. Diebold, G.S. Mountain (LDEO) J.M. Stock (Caltech) A. Martín-Barajas, A. Gonzalez-Fernandez (CICESE)
Award Number	OCE-97-30569 Amount \$429,993 (LDEO only)
Dates	1/1/99 - 12/31/01
Title of Project	High Resolution Multichannel Seismic Imaging of Active Tectonics Northwest Gulf of California

In order to investigate the the tectonic and sedimentary history of the northern Gulf of California, region we undertook a 21-day cruise in May-June 1999 aboard the B/O Ulloa, the 28-m research vessel of CICESE using LDEO's portable high-resolution MCS system with DGPS navigation. The field area extended from the Wagner basin in the north to Isla Angel de la Guarda in the south and from the Baja coast east past the Consag transform. This region straddles the transition from the diffuse "continental"-type transform domain of southern California to the narrow "oceanic"-type transform domain of the southern Gulf of California. Within the northern Gulf of California the broad continental zone of the San Andreas transtensional system merges with the transpeninsular faults and the Gulf Extensional Province. However, details of the plate boundary are not well known.

During the cruise, we collected a grid of nearly 3500 km of high-resolution MCS data and ~4000 km of 12.5 and 208 kHz echosounder data. The MCS system uses GI guns tethered on floats at 2-m depth fired every 5 s. Seismic data were recorded for 2-3 seconds with a 1 msec sample rate using a 48-channel, 600-m streamer to provide detailed

images of the upper kilometer of sediments. In addition, 48 sonobuoys were deployed and recorded to 7 secs to provide refraction velocities to greater depths.

Processing and interpretation of the seismic line are still ongoing. Initial processing provides unprecedented images of active faulting and recent sedimentation. In general, these new data indicate that the faulting in the NW Gulf of California is spread over a broad zone of deformation with multiple rift zones rather than a narrow rift-transform system. The bathymetric data refines the surface expression of the rift zones. Fault-bounded basins such as the Wagner, Upper and Lower Delfin basins are clearly imaged by the seismic data. The oblique rift zone of the Wagner Basin is imaged as a sag in the northern part of the survey area. The Delfin Basin is a rectangular depression that incorporates several individual rifts. Both active and inactive faults can be seen. Active deformation is marked by extensive growth faulting. In the central part of the northern Gulf, faults are very closely spaced, often as little as 600 m and constant changes in their sense of dip may have resulted from strike-slip offset. Strike-slip faults are associated with abrupt changes in the strata to either side of near-vertical fault planes. Northeast of Isla Angel de la Guarda, profiles show a broad expanse of listric faults. Basement is well imaged between San Felipe and San Luis Gonzaga Bay and deepens to the SE from ~600 ms to 1800 ms TWTT. Both young (exposed) and inactive (buried) volcanoes are present near the coast of Baja California. Acoustic diffractions interpreted as volcanic sills and buried flows are particularly common in sections to the north of Volcan Prieto. Gas wipeouts and narrow gas columns, which appear to mark some of the numerous fault planes, generally populate the shelf to the west of the rift basins. Complex stratigraphy related to faulting and volcanism interacting with sedimentation influenced by the Colorado River is evident.

Publications

- Steckler, M.S., A. Martín-Barajas, J.M. Stock, P. Persaud, A. González-Fernández, J.B. Diebold, G.S. Mountain, *Transtensional Tectonics of NW Gulf of California revealed by high-resolution multichannel seismic imaging*, EOS, 80, F1004, 1999.
- Persaud, P., A. González-Fernández, M.S. Steckler, J.M. Stock, A. Martín-Barajas, G.S. Mountain, J.B. Diebold, *Multichannel seismic imaging of active tectonics, NW Gulf of California*, submitted for Fall AGU Meeting, EOS, 80, F1003-F1004, 1999.
- González, A., Stock, J.M., Steckler, M.S., Martín-Barajas, A., Persaud, P., Diebold, J.B., Mountain, G.S., *Sísmica de reflexión multicanal en el Alto Golfo de California*. Geos, Unión Geofísica Mexicana, Reunión Anual, 19, 244, 1999.
- Martín-Barajas, A., Stock, J. M. Steckler, M.S., Diebold, J. Buhl, P, González-Fernández, A., Persaud, P., García-Puga, J. L. y Paz, S., *Estratigrafía sísmica y tectónica activa en el Alto Golfo de California. Rasgos morfológicos del fondo marino utilizando perfiles de ecosonda y GPS diferencial*. Geos, Unión Geofísica Mexicana, Reunión Anual, 19, 219, 1999.
- Steckler, M.S., A. Martín-Barajas, J.M. Stock, P. Persaud, A. González-Fernández, J.B. Diebold, *Multichannel seismic imaging of active tectonics, NW Gulf of California*, 1st Stephan Mueller Conference, Eur. Geophys. Soc., Dead Sea, Israel, June 11-16, 2000.

MARGINS Workshop on the Rupturing of Continental Lithosphere in the Gulf of California/Salton Trough region

Convened by Joann Stock, Arturo Martín-Barajas and Michael Steckler

Written by Joann Stock, Michael Steckler, and Arturo Martín-Barajas

1.0 INTRODUCTION

RUPTURING OF THE CONTINENTAL LITHOSPHERE (RCL) was chosen as one of the Margins science initiatives because of an awareness that our kinematic understanding of continental rifting has progressed a great deal in the last two decades, but the physics of this deformation is not well understood. Furthermore, the mechanisms and patterns of strain partitioning and magma distribution during rifting are also not well known. In January of 2000, a MARGINS theoretical institute and workshop on “RUPTURING OF THE CONTINENTAL LITHOSPHERE” were held in Snowbird, Utah. The purpose of the workshop was to formulate a science plan for the focused investigation of faulting, strain partitioning, and magma emplacement at sites of active continental rifting where there is a transition to initial seafloor spreading. This science plan (now in draft form) discusses the multidisciplinary studies needed in order to better understand the continental rupturing process. This includes: the mechanisms that allow continental lithosphere to be deformed; that enable deformation to be partitioned horizontally, vertically, and temporally; that cause magma to be produced and distributed; and that control the consequent stratigraphic evolution and fluid fluxes. Because these mechanisms fundamentally control the architecture of the margin, they control the distribution of resources and also the extent and magnitude of geological hazards.

At this workshop, the overarching issues that were discussed, related to rupturing of the continental lithosphere, included the following: the driving forces of rift initiation and continuation; the thermo-mechanical behavior of rifts; the evolution of the rift architecture; the nature of transitional crust; and the processes that dictate the transition from continental rifting to seafloor spreading. These issues were expanded to form a more detailed list of questions to be addressed. Summarized here from the draft RCL science plan, they include the following:

1. What are the driving forces of rift initiation and continuation? How do these forces evolve during rifting? What are the positive and negative feedbacks during rifting that cause some rifts to succeed and others to fail? What controls the locus and conditions of initial rifting in different locations (e.g., intracontinental, intra-arc)?
2. How do rifts behave as thermo-mechanical systems? What mechanisms allow the continental lithosphere to extend and rupture (e.g., what are the specific rheological flow laws, and what is the role of brittle failure, including low-angle normal faults)? How do upper mantle thermo-mechanical processes interact with rifting of the continental

lithosphere? What is the scale of deformation of the lower crust during the rifting process? How is heat transferred into and within the lithosphere during rifting? How is the extensional strain partitioned, both in depth and in map view? What controls the amount, location, and episodicity of strain and magmatism?

3. How does the rift architecture evolve? What processes control the location of the initial rifting site? How do fluids, including magma and volatiles, affect the lithosphere during rifting and in the transition to sea-floor spreading? What controls the basin geometry, including segmentation, asymmetry, and its evolution during rifting? What is the interaction between erosion and sedimentation processes and the tectonics?

4. What processes are important in the transition from rifting to initial sea-floor spreading? How are these processes reflected in the structures and geology that characterize the continent/ocean transition zone? What controls the width of rifting and allows it to focus into a narrower zone to produce seafloor spreading? What controls the position of the continent-ocean boundary, and the stage in the rifting process (and kinematic history) at which this boundary develops? What is the composition and origin of transitional crust formed in the rift? What controls the timing and kinematics of the transition along strike from continental extension to mid-ocean ridge spreading?

The group discussed the necessary characteristics of study areas where these questions could be addressed, and came up with the following list of essential aspects:

- Active continental rifting that culminates laterally in seafloor spreading
- Identifiable conjugate margin segments
- Syn-rift stratal and associated fault geometry can be imaged, and the sediments sampled
- Pre-rift surfaces/strata can be imaged at 100-m scales and sampled
- The entire crustal structure can be imaged at kilometer scales
- Pre-rift continental basement is accessible to sampling
- Transitional crust is accessible to sampling
- Oceanic basement is accessible to sampling
- Plate-tectonic kinematic framework can be well resolved

The following were considered to be desirable aspects:

- The presence of an identifiable active low-angle normal fault
- Post-rift strata can be imaged and sampled
- Basement and stratal geometry are not obscured by post-depositional deformation (e.g., minimal salt and shale tectonics; minimal gas)
- Crustal-scale deformation structure can be imaged
- Signature of continental rifting should be distinguishable from that of other active plate boundaries in the vicinity
- Syn-rift magmatism

Logistical aspects that were considered important:

- Access to geological and geophysical data (reflection and refraction seismics, potential field data, drilling and logging data, and field observations)
- Accessibility (logistically, politically, and culturally)
- Ability to leverage resources with other programs and nations

After a discussion of all of these criteria for five possible focus site locations, the participants at the January meeting chose two of the focus areas for this part of the MARGINS initiative: the Gulf of California/Salton Trough area, and the Red Sea. The Gulf of California/Salton trough area met nearly all of the criteria mentioned above, with the exception of a documented active low-angle normal fault (there is a young one in the Laguna Salada area which may be active; it has scarps but no known seismicity).

As a followup to the January meeting, we propose to hold a 2 1/2-day meeting (two full days and the previous evening) dealing with the Gulf of California focus area, in late October of 2000. (A separate meeting in March 2001, most likely to take place in Egypt, is expected to deal with the Red Sea focus site.)

The Mexican meeting will be open to all US and Mexican scientists interested in the Gulf of California/Salton Trough area. The meeting will provide brief summaries of the goals of the MARGINS RUPTURING CONTINENTAL LITHOSPHERE initiative, and the current and past investigations related to this topic in the Gulf of California area. The workshop will allow interested parties from both the USA and Mexico to meet and interact with each other so that they can develop plans for future proposals. Some of the focus area is within the USA (Salton Trough region) and discussions of research in this area will also be included in the meeting.

Much of the proposed focus area lies south of the international border. Therefore, it is very important that any proposals to NSF involving studies within the boundaries of the Mexican republic are designed in collaboration with Mexican scientists who can be equal participants in the project. However, it is not always easy for these collaborations to be established, because the scientific meetings of the two nations are usually separate and in many cases there are language difficulties. We hope that this meeting will be a useful vehicle for investigators to surmount these difficulties and recognize the ways in which they can contribute to collaborative efforts on this umbrella topic.

2.0 GOALS

At the proposed workshop, we will bring together scientists from the USA and Mexico, who have an interest in working on projects related to the RUPTURING OF CONTINENTAL LITHOSPHERE in the Gulf of California region. We will review the major ideas regarding continental rifting and the fundamental questions on this topic as outlined in the MARGINS RCL science plan. The participants will summarize past and present

research on rifting in the Gulf of California. The participants will thus have the opportunity to find out what the other participants are working on, and what they might be interested in working on in the future, so that they can work out how best to propose collaborative research efforts. We hope that it will also give the participants a broader view of what can be accomplished by a community focus on this problem in this region, leading to a more coordinated set of proposals for investigations here.

We hope that this workshop will enable a broader community of scientists to be informed about the Gulf of California, how research there can fulfill the goals of the MARGINS program, and to meet others with similar interests. In this manner, we hope to ‘level the playing field’ so that all interested US scientists can participate equally in conducting MARGINS program research on the Gulf of California.

3.0 STRUCTURE OF MEETING

Participants will need to arrive in Puerto Vallarta on Friday, October 27th, and we will have a welcoming party and two initial introductory sessions that evening. The meeting will take place all day Saturday and Sunday, October 28 and 29th. It will end October 29th by 5 PM in order for participants to attend the icebreaker party of the 2nd National Earth Sciences Congress, if they are staying for that meeting. Participants who are not staying for that meeting may need to wait until Monday Oct. 30 to fly out, as there are not very many flights from Puerto Vallarta to the USA that leave in the evenings.

During the evening session on the 27th, we will have some explanatory remarks. If NSF is able to send a representative to the meeting, they would be welcome to make a few opening remarks. We will briefly explain the overall goals and structure of the Margin initiative so that participants understand how the Rupturing of the Continental Lithosphere fits into the larger program. We will describe how the community has chosen the focus sites for the four parts of the program.

The scientific portion of the meeting will begin with two overview sessions: one on the Gulf of California, and one discussing where we are in understanding the rifting process. This will provide basic background for investigators who haven’t worked in this area before and/or who did not attend the MARGINS workshop on Rupture of Continental Lithosphere in January, 2000.

We will ask each participant to bring a poster or a few overheads to illustrate the work they have been doing that they consider relevant to the problem at hand, and/or describing what they would like to do. The amount of time each person will speak, and the division into poster vs. oral sessions, will be decided when we know what the total number of participants will be. These will be for use in sessions on thematic topics, following the overviews. The exact details of the thematic sessions will not be finalized until we know the number of participants in the meeting and their research interests. However, a

tentative list of thematic topics is as follows:

On-land geological investigations around the Gulf of California/Salton Trough region
On-land geophysical investigations around the Gulf of California/Salton Trough region
Marine geophysical studies in the Gulf of California
Cross-disciplinary studies
Theoretical studies

This will allow us to have three sessions on the first full day, and two sessions plus a wrap-up discussion on the second day of the meeting. The length of the sessions and their order will be finalized based on the list of participants. We plan to have all of these sessions include keynote talks and poster sessions, with a 2-minute poster introduction by each author. We will ask that participants provide short abstracts ahead of time, in both Spanish and English, if possible. If they can only provide them in one language then we will have them translated before the meeting so that they can be provided in both languages to all of the participants. This is not intended to be a refereed publication but rather for the use of the workshop participants, to facilitate their understanding of the goals and interests of each scientist present.

We assume that not all the participants will be bilingual. We have included in the budget the cost of simultaneous translation of all Spanish talks and commentaries into English and all English talks and commentaries into Spanish. We will poll the participants (at the time they sign up for the workshop) to establish how many need each kind of translation, in order to determine the level at which this translation service should be offered.

4.0 PARTICIPANTS

We do not know how many people may want to attend this meeting, and we understand that in order to best serve the community, we must allow all interested people to attend. However we feel that roughly 50-60 participants would be an appropriate size to make this meeting a success, so on that basis we have calculated the requested budget. We hope to have roughly even numbers from the USA and from Mexico. In the event that the community interest exceeds the participant support costs requested here, we will have to decide how to award the funds. Therefore, we will ask each prospective attendee for a statement concerning their research and how it will fit into the goals of the meeting. On the basis of these statements we will attempt to allocate the participant support costs appropriately. We anticipate that not everybody would be awarded the same amount; for example, people from farther away would have higher travel costs and might need to be awarded more travel money. Participants receiving no travel subsidy would still be welcome to attend the meeting as long as they paid their own costs.

We expect that most of the following Mexican scientists will participate in the meeting:

Luca Ferrari, Instituto de Geologia, UNAM (tectonics)
Jorge Aranda, Instituto de Geologia, UNAM (petrology)
Bill Bandy, Instituto de Geofisica, UNAM (tectonics and marine geophysics)
Osvaldo Sanchez, Instituto de Geofisica, UNAM (marine geophysics and GPS)
Krishna Singh, Instituto de Geofisica, UNAM (seismotectonics)
Francisco Paz, UNISON, Hermosillo (petrology)
Thierry Calmus, ERNO-UNAM (tectonics)
Amabel Ortega Rivera, ERNO-UNAM (geochronology)
Max Suter, ERNO-UNAM (neotectonics)
Jaime Roldan, ERNO-UNAM (petrology and stratigraphy)
Enrique Nava, CICIMAR, La Paz, B.C.S. (sedimentology)
Adolfo Molina, Instituto de Geologia, UNAM (micropaleontology)
Arturo Martín-Barajas, CICESE (sedimentation and tectonics; marine geology)
Luis Delgado, CICESE (petrology)
Francisco Suárez Vidal, CICESE (neotectonics)
Raul Castro, CICESE (seismology)
Cecelio Rebollar, CICESE (seismology)
Antonio Gonzalez Fernandez, CICESE (marine geophysics)
Margarita Martinez-Lopez, CICESE (geochronology)
Lance Forsythe, CICESE (petrology)
John Fletcher, CICESE (tectonics)
Ewa Glowacka, CICESE (seismology)
Luis Munguía, CICESE (seismology).
Javier Gonzalez, CICESE (geodesy, neotectonic)
Alejandro Nava, CICESE (seismology)
José Frez, CICESE (seismotectonics)
Enrique Gómez Treviño, CICESE (magnetotellurics, ground-penetrating radar)
José Manuel Romo, CICESE (magnetotellurics)
Juan Manuel Espinoza, CICESE (gravity-magnetics)
Juan Garcia Abdeslem, CICESE (gravity-magnetics)

Additional Mexican participants will certainly be welcome.

The following US participants are likely to have interest in participating in the meeting. This is not intended to be a comprehensive list as we certainly don't know who else might apply to attend.

Gary Axen, UCLA (structural geology)
Rick Bennett, Harvard-Smithsonian Astrophysical Observatory (geodesy)
Ann Blythe, USC (structural geology; fission track geochronology)
W. Roger Buck, LDEO (geophysics)

Peter Clift, WHOI
Steve Day, UCSD (seismology)
Tim Dixon (geodesy)
Becky Dorsey, University of Oregon (stratigraphy/sedimentology)
Robert Douglas, USC
Ken Farley, Caltech (Th-He geochronology)
Phil Gans, UCSB (geochronology, structural geology)
Donn Gorsline, USC (marine geology)
Jochen Halfar, Stanford University (sedimentology)
Brian Hausback, Cal State Sacramento (volcanology)
Steve Holbrook, U. Wyo. (seismology)
John Holt, University of Texas at Austin (paleomagnetism, tectonics)
Martha House, Caltech (structural geology, geochronology)
Markes Johnson, Williams College (geology)
Graham Kent, SIO (seismology)
Jeff Lee, Central Washington University (tectonics, structural geology)
Peter Lonsdale, SIO (marine geology)
Larry Mayer, Miami Univ. of Ohio (geomorphology)
Tim Melbourne, Central Washington University (geodesy, seismology)
M. Meghan Miller, Central Washington University (geodesy, structural geology)
Elizabeth Nagy, Syracuse University (geochemistry and tectonics)
Dave Okaya, USC (seismology)
Michael Oskin, Caltech (structural geology)
Scott Paterson, USC (structural geology, tectonics, modeling)
Rob Reilinger, MIT (geodesy)
Tom Rockwell, San Diego State University (neotectonics)
Richard Sedlock, San Jose State University (tectonics)
Leonardo Seeber, LDEO (seismology, neotectonics)
Chris Sorlien, UCSB (structural geology)
Paul Umhoefer, Northern Arizona University (structural geology)
Frank Vernon, UCSD (seismology)
Mike Williams, U Mass (Structure, metamorphism, tectonics)

5.0 VENUE

We propose to hold the meeting at the Hotel Camino Real in Puerto Vallarta, Mexico. This hotel has meeting rooms and adequate infrastructure to host scientific meetings larger than the one we plan in this proposal. The Hotel Camino Real has been the headquarters hotel for the yearly meeting of the Unión Geofísica Mexicana (Mexican Geophysical Union) for the past few years, and will be the site of Mexico's 2nd National Earth Sciences Congress in the year 2000. This hotel is about 3 km south of the center of the city of Puerto Vallarta, and is on a private beach. The hotel welcomes tourists (both US and Mexican) but it is not in the "hotel strip" with all of the major high-rise hotels that is

north of town. If participants wish to leave the hotel they will have to take a cab as there is not much to do in the immediate vicinity, within walking distance. Thus the hotel is relatively isolated promoting interaction among the participants.

Puerto Vallarta is a port city on Banderas Bay in the state of Jalisco, just south of the mouth of the Gulf of California. The Puerto Vallarta airport has international flights from the USA as it is a popular tourist destination. It also has frequent domestic flights.

We have chosen Puerto Vallarta as the location for the workshop in order to minimize the costs of participation for the Mexican scientists, since most of them will attend the 2nd National Earth Sciences Congress (which starts immediately after our meeting). Thus, they will already be planning to go to this location, and the additional costs for their participation are only food and lodging. An additional rationale is that US participants may choose to stay for the 2nd National Earth Sciences Congress, which would give them even more of a chance to meet Mexican colleagues and find out about the research that is being conducted in Mexico. The 2nd National Earth Sciences Congress is especially large because, in honor of the year 2000, the Mexican geological society (SGM) and the Mexican Geophysical Union (UGM) are having a joint meeting. Normally they meet separately. Four other Mexican scientific societies, the Mexican Association of Petroleum Geologists, the Mexican Union for Quaternary Studies, the Mexican Geothermal Association, and the Mexican Mineralogical Society will be co-sponsoring the meeting and having joint sessions. The information about the 2nd National Earth Sciences Congress is on the web at <http://www.ugm.org.mx/reunion2000i.html>.

6.0 TIMELINE

We realize that there is not much time to get this meeting organized before October. The time of late October was chosen for the workshop because our Mexican colleagues considered it optimal; it is right before the meeting of the Unión Geofísica Mexicana (in late October/early November, in the same location) and it does not conflict with the Geological Society of America national meeting (in mid-November). Also it will allow the more organized participants enough follow-up time to submit proposals for the January 15 margins deadline.

July 2000 - submission and approval of this proposal

July 2000 - announce dates of meeting in both US and Mexican scientific communities, and solicit expressions of interest from scientists who wish to attend. Advertise in EOS, GSA Today, GEOS, and on the various web sites (Margins, UGM). We will also ask email to be disseminated to UGM members, members of the Peninsular Geological Society, and other relevant scientific organizations in both countries.

August 15, 2000 - Deadline for abstract submission to 2nd National Mexican Earth Sciences Congress (the venue for the workshop)

August 30, 2000 - Deadline for participants to indicate their interest in attending.

Convenors decide on participant list and allocation of travel expenses.

September 2000 - participants provide abstracts of presentations so that these can be translated and provided in both languages to all meeting attendees

October 27 and 28, 2000 - hold the workshop

October 29-Nov. 3, 2000 - 2nd National Mexican Earth Sciences Congress

7.0 OUTCOMES

There will be no formal scientific publication stemming from the meeting. However, we will write up a report of the meeting, which will be placed on the MARGINS web page. This will include a list of attendees, together with their addresses, e-mails, and interests in order to promote continued interaction. We will write up a brief summary of the meeting for GEOS (the newsletter of the Mexican Geophysical Union) and EOS.

The main expected outcome will be a more coordinated community effort for work in the Gulf of California/Salton Trough area, and generation of proposals by individual investigators, or small groups of investigators, for the upcoming 2001 and 2002 MARGINS proposal deadlines. We expect the resulting proposals for the Gulf of California will better address the scientific issues at the heart of the MARGINS RCL initiative.

8.0 EDUCATION AND HUMAN RESOURCES STATEMENT

We will encourage the participation of scientists at all levels who may be submitting proposals to the MARGINS program, or collaborating on these proposals (senior graduate students, postdocs, and researchers, both starting researchers and more senior researchers). We will not exclude anybody from participating but we will attempt to use the funds to achieve a balanced participation. We do not think that the participation of undergraduates or junior graduate students (who have not yet started their thesis research) will be appropriate. We are not expecting any major interest on the part of US industry, US national laboratory, or US Geological Survey geologists but they may attend if they wish. However in allocating the participant support costs, we believe it is advisable to give priority to those researchers who are in a position to write proposals to the NSF Margins program.

9.0 BACKGROUND OF CONVENORS

The three convenors (Stock, Martín-Barajas, and Steckler) all participated in the Jan. 2000 Margins TEI and Workshop about rifting of continental lithosphere, and have ongoing research projects on topics related to rifting in the Gulf of California. They also have all had previous experience at organizing conferences.

Martin-Barajas is a geologist who did his Ph.D. studies in France, in marine geology. He has worked at CICESE, in Ensenada, since 1989, on topics related to sedimentation, tectonics, volcanology, and petrology of the Gulf of California and surrounding regions. He was a co-organizer of the recent IV International Conference on the Geology of NW Mexico which was held in March, 2000 in Hermosillo, Sonora. Stock and Martín-Barajas were co-organizers (with Paul Umhoefer) of a very successful 1996 Penrose Conference on the Gulf of California. This conference was held in Loreto, Baja California Sur and was similar in size to the one proposed here.

Stock has been involved in numerous research projects in the Gulf of California area, starting with her Ph.D. research studies in structural geology and volcanic stratigraphy of the Gulf Extensional Province of Baja California. She helped to organize the Loreto Penrose Conference, mentioned above, and later served on the Penrose Conference Committee of the Geological Society of America, which oversees and approves the proposal for GSA Penrose Conferences. Thus she has a good appreciation for the details that are necessary to get these types of conferences to be successful. Stock also was a co-organizer of a Chapman conference on Plate Motions and Geodynamics, with Mark Richards (UC Berkeley). This conference was held in June 1997 at Marconi station in northern California. Stock has organized special sessions during meetings of the Unión Geofísica Mexicana twice before (1993 and 1994) and regularly attends the UGM meetings in Puerto Vallarta.

Steckler has a background on theoretical aspects of rift development including subsidence and stratigraphy, and has done much research on other rifts, although he is now working on problems of the Gulf of California. He was a co-convenor of the International Workshop on the Gulf of Suez and Red Sea Rifting in Hurghada, Egypt, in 1986. He has been the co-chair of the Stratigraphy Project of the ONR STRATAFORM program since 1994. He is currently proposing to co-convene the MARGINS workshop on the Red Sea and is on the program committee of a Chapman conference on the Formation of Sedimentary Strata on Continental Margins. He has helped lead many meetings, and worked on various scientific white papers.