A special session will be dedicated to the Pannonian-Carpathian and it promises to be very well-attended and will afford a unique opportunity for the IGCP 430 community to meet and interact with the broader Geoscience community, thereby showcasing our accomplishments to date and plans for the future.

The 2004 Annual meeting will be held in China (Yunnan province) in May 2004, in compensations for the 2003 cancellation due to SARS. A second annual meeting for the year 2004 is scheduled in Turkey: which is considered highly important to reassemble the working groups from Eastern Europe and Southeast Asia in this new (to them) geologic context. IGCP 430 is making a special effort to ensure continued dialogue between geographically disparate scientists who are addressing the same geodynamic questions – hitherto in relative isolation. Furthermore, the meeting in Turkey will afford the opportunity to introduce a large and active group of Turkish scientists to IGCP 430, including specialists with very recent experience in seismic disaster mitigation.

IGCP 430 is also sponsoring a Penrose Conference to be held at the University of Esfahan, Iran, in September 2004. This meeting will afford a rare opportunity to visit a region of the Tethyan belt inaccessible in the last two decades to much of the Geoscience community. Embodying the Arabia-Eurasia collision suture, the region offers a complete transect of Palaeo- and Neotethyan collisional structures, the scientific focus of the meeting and its attendant field studies.

**No. 433 – Caribbean Plate Tectonics (2000-2004)**

M. A. Iturralde-Vinent, Museo Nacional de Historia Natural, Obispo no. 61, Plaza de Armas, La Habana 10100, Cuba, Tel.: (+537) 63 25 89, Fax: (537) 62 0353, e-mail: iturralde@mnhnc.inf.cu

E. G. Lidiak, Department of Geology and Planetary Science, University of Pittsburgh, Pittsburgh, Pa., United States, e-mail: egl@pitt.edu

**Description:** The scope of this project is to construct a concise, multi-disciplinary geotectonic model for the Caribbean realm. The Caribbean is a tectonically complex region of interaction between several plates (continental and oceanic) and is important for the global understanding of active tectonic settings in narrow zones between major continent-bearing plates. The present contradiction between existing plate tectonic models and palaeogeographic reconstructions of the Caribbean motivated the launching of this project. Contradictions that raise questions are, for example: Is the Caribbean plate allochthonous or autochthonous? Has the subduction in the volcanic arcs changed its polarity? When would the alleged jump in polarity have occurred? First of all, an evaluation of the existing Plate Tectonic Models and palaeogeographic reconstruction of the Caribbean realm will be made in order to encourage a critical review of the models and reach agreement on the basic facts. This should serve as a framework for the formulation of a properly substantiated model of the origin and evolution of the Caribbean Plate, as well as the palaeogeography of the area. The project gives the authors of those models the opportunity to exchange ideas and visit key areas of the region.

**Website of the project**

[www.ig.utexas.edu/CaribPlate/CaribPlate.html](http://www.ig.utexas.edu/CaribPlate/CaribPlate.html)

The website displays the information concerning the project, including project logo, project description, past events and reports, future meetings, Caribbean bibliography, Caribbean models comparison, interesting information, and forum. The FORUM section contains important papers and ppt presentations about the Caribbean Plate Tectonics. The site is regularly updated in order to keep the scientific community informed about the progress of the project.

**Participating countries**

(* countries active this year)

- Argentina*
- Barbados, Canada, Costa Rica*
- Colombia*
- Cuba*
- Dominican Republic*
- France*
- Germany*
- Guatemala, Hungary, Italy*
- Jamaica*
- Japan, Mexico*
- New Zealand*
- Nicaragua, Poland, Panama, Peru, Puerto Rico*, Spain*, Trinidad & Tobago, United Kingdom*
- Venezuela*, United States.

**Achievements of the project in 2003**

**General scientific achievements**

This year IGCP 433 held scientific workshops and presentations and provided extra time for debates, with great success in terms of clarification of individual opinions and interpretations. The project enhanced largely the communication among Caribbean scientists who have exchanged ideas, information and begun new projects. The project was able to incorporate a group of PhD students to investigate subjects related to Caribbean Plate tectonics.

Working groups were active as before. The working group of Petrology and Geochronology were very active both in meetings and carrying out the following research projects: two Cuban-Spain projects, one Dominican Republic-Spain-France project, one US-Virgin Islands project, etc.). The working group of Stratigraphy and Palaeontology presented and debated important papers in Havana (2003), and previously also in Havana (2001) and Barbados (2002); field research was carried out on Jurassic marine and terrestrial reptiles in Argentina and
Cuba, supported by National Geographic Society. The working group on Plate Tectonics Interpretation is very active. The group meets every year, and during 2003 they met in Havana, Freiberg and Barcelona. 3 new plate models of the Caribbean were added during 2003 which are presented on the website of the project.

During the meetings held this year in Cuba, Freiberg, Barcelona, and Granada, IGPC 433 concentrated the discussions on major problems selected previously that needed to be addressed during 2003 (see report for 2002). They are:

- Modeling the Caribbean Plate Tectonic history: The autochthonous vs allochthonous origin of the Caribbean
- The problem of space and time in the reconstruction of terranes
- The nature of the ophiolites and their historic positions
- The conception of single vs multiple arc
- The Central American Arc
- Volcanic activity and possible volcanic hazards.

The debate and discussion concerning these issues are briefly summarized below.

**Modeling the Caribbean Plate Tectonic History. The autochthonous vs allochthonous origin of the Caribbean**

One would like to believe that such a fundamental question as “did the Caribbean crust form in situ, or within the Pacific ocean” should have been resolved after many prior years of research. However, the truth is that there is not yet an agreement reached on this topic among scientists. It is true that the majority follow the allochthonous model as originally posted by Malfait and Dinkelmann in 1971, but at the same time, well known scientists such as Frists, Meschede, James and others, do not accept this idea. They have some good arguments against the allochthonous model, points that have been discussed in previous reports. This problem was strongly debated in Brazil (2000), Barbados (2002) and Barcelona (2003). It is necessary to continue the analysis of hard data and interpretations, until a consensus is reached. This year IGCP 433 presented the allochthonous model of Pindell and Kenna, as well as those of K. James and Giunta (visit [www.ig.utexas.edu/CaribPlate/forum.htm](http://www.ig.utexas.edu/CaribPlate/forum.htm))

**The problem of space and time in the reconstruction of terranes. Their palinspastic reconstruction**

This is another topic that may seem to have been previously well established and evident, and should not be a matter of much disagreement; however, the opposite is true. Further consideration makes it obvious that a complex terrane, formed by an amalgamation of distinct geologic units, representing various different palaeogeographic scenarios, can not be interpreted in a simplistic manner. For example, the present tectonic reconstructions of complex terranes such as Escambray, Pinos or Guaniguanico in Cuba, are redraw for 20, 60 or 120 millions years ago, with the same shape and size as today. Any of these terranes, as for example the Escambray, contain fragments of continental margin, mafic-ultramafic bodies and volcanic arc. In any palinspastic reconstruction, for any time before the present, today’s outline of the terrane has no meaning at all, mostly because the exposed area is only a fraction of the actual size of the deformed and amalgamated metamorphic terrane. This matter was debated in Boston (2001), Freiberg (2003), Granada (2003), and unfortunately, has not yet had sufficient impact in current plate models. Continued work will be needed in this direction.

**The nature of the ophiolites and their historic position**

The natural association of ultramafic and mafic rock, usually interpreted as fragments of ocean crust, have been investigated during the project. Field and laboratory research is being done by the Italian-Latin-American group, two Cuban-Spanish groups, and local Cuban researchers. We now understand that the various outcrops of mafic-ultramafic bodies cropping out in the foldbelts around the Caribbean, have very different composition and tectonic position, and the more this topic is being investigated, the more complex the situation is found to be. Many of the so-called “ophiolites” of Cuba are of suprasubduction origin, formed in conditions of arc and back arc environments. In addition, representatives of oceanic plateau basalts and subduction complexes have also been found. The main problem now is to identify the age of the protoliths, because the age of the metamorphism is generally understood. During the meeting in Granada IGCP 433 participants evaluated the degree of complexity in the Greater Antilles mafic-ultramafic complexes, and as is outlined in the meeting’s report, the tectonic and compositional diversity is evident. Another problem now is to classify which mafic-ultramafic complexes are of true Caribbean origin, and which are of Pacific origin. It is clear that those mafic-ultramafic bodies older than the age of the Caribbean, such as Pliensbachian (Duarte Complex of Hispaniola) and Bathonian (Siquisique basalts in Venezuela), are the best candidates to be identified as Pacific crust. In other crustal sections the age of the protoliths is not yet well understood. The use of petrological technics will surely help in this undertaking, as several recent papers demonstrate.

**The conception of a single vs multiple arc**

The debate of a single (Great Arc) vs. multiple arc evolution of the Caribbean has been active almost since the beginning of the project, and still goes on. This problem was addressed this year, as planned, at the scientific meetings in Havana, Freiberg, and Granada, and at the field trip to eastern Cuba. In Granada it was concluded that the concept of a single arc evolving all the way from the mid Cretaceous to the Recent was not possible anymore. Especially during the workshop in Granada, new geochemical and geological data were presented in support of this interpretation.
The Central American Arc
This year the age and duration of the Central American arc was back in debate. Within the e-group and person-to-person mail there was an exchange of papers and opinions related with the Albian to Santonian arc activity. The very existence of the arc was questioned during the workshop in Stuttgart, but facts piled up in favor of this possibility. Next year there will be a field workshop in Costa Rica (March 1-7, 2004) in order to visit the Nicoya Peninsula and the igneous and sedimentary complexes related to the crust and arc sections.

Volcanic activity and possible volcanic hazards in the Caribbean
This year the project added to the web site a section dedicated to the volcanic activity in the Caribbean, with a list of the active volcanoes in the region, as well as a forecast about the year that it is possible that others may become active. This reflects the project’s involvement in matters of direct interest to society (visit the web page of the project — forum and search for Trombley, R.B., 2003: “Holocene Volcanic Activity in the Caribbean Plate Margins: Forecast and Risk Assessment.”)

Meetings
La Habana, Cuba, March 24-28, 2003: The subject of the field workshop was: A single vs multiple arc representation of the Caribbean. The Field trip was organized to the Ophiolites, and to the Cretaceous and Paleogene arc terranes in eastern Cuba, in order to make detailed observations of the relationships between the ophiolites and the volcanic-arc rocks, as well as between the Cretaceous and Paleogene-Eocene volcanic arc sections. The meeting, held in Havana, also was concerned mainly in debating these issues. The report and abstracts of the presentations are available at http://www.ig.utexas.edu/CaribPlate/reports/cuba_2003.htm

Freiberg, Germany, April, 2003: During this scientific meeting there were presented key papers concerning the geology of the Caribbean. This was an important opportunity to exchange with geologists working in Central and South America. Several presentations by non-members of the project were extremely interesting, especially a series of reports about the study of the interactions between the Pacific plates and the SOAM-CARI1B plates. New evidence was presented concerning infraplate erosion taking place in several portions of the subduction zone in Central and South American trenches. These data additionally support the contention, by several authors, that the Nicoya complex of Costa Rica contains fragments of the Caribbean Plate. Abstracts of these presentations are available from Terra Nostra 2: 2003: 1-93. They may be found at: http://www.geo.tu-freiberg.de/dynamo/LAK_18/Tagungsband-gesamt24-3-03-final.pdf and the IGCP report at: http://www.ig.utexas.edu/CaribPlate/reports/freiberg_lak.htm

Participants: Walter Maresch and Peter K. Stanek (Germany), Manuel Ilurralde Vincent, Kenya Nuñez Cambra (Cuba), and many non-members from Central and South America. Some of them became members of the project after this meeting.

Barcelona, Spain, September, 2003: This was a meeting of the working group of Regional Tectonics. During the meeting were presented examples of both the allochthonous and autochthonous Caribbean plate models. The session on the Caribbean comprised seven papers. They include regional papers on the Caribbean and Gulf of Mexico and progress to local focus on hydrocarbon aspects of Cuba and Trinidad. The oral session was complemented by a poster session with nine contributions. Extended abstracts of papers and posters are available on the conference CD, issued by the AAPG. In the opening address James noted that geologically the Caribbean remains one of the world’s most highly debated areas. There are abundant models of plate migrations, hotspot and mantle plume activity, island arc development and disappearance, subduction reversals, opening of young oceanic basins, major block rotations and major plate migration.

Granada, Spain, September, 2003: This was a meeting of the working group on Petrology and Geochemistry, and was celebrated with great success, including a field trip to outcrops of the Bethic subcontinental peridotites.

Educational, training or capacity building activities
PhD students have been accomplishing associated research in this project, in regions as Sierra Maestra of Cuba (G. Kyzar), Sierra del Convento and Guira de Jauco of Cuba (K. Núñez), Sierra del Convento of Cuba (C. Lázaro), Cuban rudist-bearing rocks (R. Rojas), Ophiolites of northeastern Cuba (Claudio Marchesi), Ophiolites of Northern Venezuela (Elisa Padoa), Southwestern Puerto Rico (M. Martínez, D. Lao Davilla).

Publications


Activities planned

General Goals

The last year (2004) of the project is aimed toward the preparation of the SCIENTIFIC RESULTS of the
project, as a memoir, to be published early in 2005 by *Geologica Acta*.

IGCP 433 will also organize a Field meeting in Costa Rica to address in detail the geology of Central America. The final scientific meeting will be held as part of the 32nd International Geological Congress in Florence, Italy.

**Meetings**

**Field workshop in Costa Rica. March 1-7, 2004**
- Geology of the Pacific Margin of the Caribbean Plate.
- Field trip to the Nicoya complex and related units.

**32 International Geological Congress. August 2004**
1. *Origin and Evolution of the Caribbean: The evolution of the ideas and models.* Papers to be included in this section will be concerned with evaluating the history of Caribbean interpretation from Geosynclinal to Plate Tectonics theories.
2. *Second Part: The conflict among data sets and their interpretation, with present-day models.*

**No. 434 – Land-Ocean Interactions During the Cretaceous in Asia (1999-2003, OET in 2004)**

H. Hirano, Department of Earth Sciences, School of Education, Waseda University, Nishiwaseda 1-6-1, Shinjuku, Tokyo 169-8050, Japan, e-mail: hhirano@waseda.jp

_Description:_ This project builds on and continues IGCP project 350, Cretaceous Environmental Change in East and South Asia. It intends to construct a new scale for the correlation between the Cretaceous marine and non-marine deposits by establishing a stable carbon isotope stratigraphy for the Cretaceous, taking notice of the global carbon cycle as a new point of view. The non-marine Cretaceous is widely distributed in Asia, but the age determination is still not so well fixed. IGCP 434 aims to study the Cretaceous plume activities and the associated tectonic movements in East and South Asia on the one hand, with a background of daily developing, higher resolution and more reliable correlation. On the other hand, the project encompasses the genesis of metallic, non-metallic ore deposits, and fossil fuels, sea level changes, carbon cycle, changes of partial pressure of carbon dioxide, climatic changes and floral changes. It also includes the appearance and flourish of angiosperms, turnover of oceanic layered structure comprising the occurrence of up welling and anoxic events, and the response of biotope, elucidating their relation of cause and effect in more details.

Special attention is paid to:
1. Establishment of the stratigraphy of the stable carbon isotope, in marine and non-marine deposits
2. Environmental analyses by various chemical analyses
3. Collection and evaluation of various geological information that affects the global carbon cycle
4. Study of the cause and effect between environmental changes and changes of biodiversity

**Participating countries**
(*countries active this year*)

**Achievements of the project in 2003**

**General scientific achievements and societal benefits**

- The proceedings of the first symposium (Tokyo) were published as the Special Issue of the Journal of Asian Earth Sciences, vol. 21, no. 8, pp. 803-977, June 2003. The proceedings of the second symposium (Yangon) are now in press as a Special Issue of the Journal of the Geological Society of Thailand. It is scheduled to be published during the 5th International Symposium in Thailand.
- Stable carbon isotope stratigraphy was much developed in China, Japan, and Korea. In Japan, many carbon isotope excursions were obtained from many sections in the range from Aptian to Campanian. They have been examined from the framework of biostratigraphy (ammonoid-, inoceramid-, planktonic foraminifer-, radiolarian-, and nanofossil-biozones), radiometrics, and magnetostratigraphy, and brought harmonious results.
- The stable carbon isotope excursions obtained from terrestrial organic matter are well correlated with those from marine carbonate carbon in Europe. The recognition of carbon-isotopic fractionation is deepened. The scientists implied in this work were invited to present their results at the GSA meeting in Seattle, November, 2003.
- Palaeotemperature was studied in detail by using Campanian planktonic foramminifers, nektic amonoids, benthic mollusks, which contributes to the temperature structure of the Campanian Northwestern Pacific. Various temperature data were also obtained from benthic and nektic mollusks and brachiopods from the Alban to Campanian higher latitudes in Far East Russia.
- The Chinese-Japanese joint working group began to determine the exact age of the so-called Lower Cretaceous which yields some unique fossils of feathered dinosaurs in northeast China by using stable carbon isotope stratigraphy.
- Geology of Thailand, Vietnam, and Far East Russia was intensively researched in the tectonic, sedimentologic, and biostratigraphic points of view by some working groups. These results will be discussed in the forthcoming 5th symposium in Thailand in December 2003.