

INTERNATIONAL GEOSCIENCE PROGRAMME (IGCP)

Annual Report of IGCP Project No. 497 for 2006



IGCP Project short title: "IGCP 497 - The Rheic Ocean: Its Origin, Evolution and Correlatives"

Duration: **2004-2008**

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Date of submission of report: December, 5, 2005

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Short introduction to the Rheic Ocean

The Rheic Ocean was the dominant ocean during Palaeozoic times. Its initial development can be traced back to the plate tectonic situation in the Late Neoproterozoic due to Cadomian orogenic processes culminating around the Precambrian-Cambrian boundary (Fig. 1). The opening of a proto-Rheic ocean between northern continents such as Baltica and Avalonia is assumed to have occurred in Cambro-Ordovician times (Fig. 2). The Rheic Ocean was widest during the Silurian, whereas the Iapetus Ocean finally closed (Fig. 3). The closure of the Rheic Ocean started in the Lower Devonian (Fig. 4) and was completed in the Carboniferous (Fig. 5). The result was the formation of the supercontinent Pangaea (Fig. 5).

Continental blocks such as North and South America, Africa, Baltica and numerous peri-Gondwanan terranes were involved in the development of the Rheic Ocean. The birth, life and death of the Rheic Ocean was a chain of worldwide events that resulted in many orogenic processes like the Ouachita-Alleghanian-Variscan orogen ranging from the Appalachians in North America to the easternmost outcrops in the Dobrogea (Romania) and in Turkey. The history of the Rheic Ocean also affected strongly the history of life, the palaeoclimate, the formation of different sedimentary basins and the environmental conditions on the planet.

The fields of research therefore include stratigraphy, sedimentology, palaeontology, palaeogeography, palaeoceanography, igneous and metamorphic petrology, tectonics, structural geology, geochemistry, geochronology and geophysics (especially palaeomagnetism).

The thematic frame around the Rheic Ocean is therefore worldwide and international and covers nearly all aspects of the geosciences.

1. Website address related to the project

<http://www.snsd.de/igcp497/>

2. Summary of major past achievements of the project (2004/2005)

Opening meeting in Prague (2004): The first meeting and field workshop of the IGCP 497 entitled “*Gondwanan margin of the Rheic Ocean in the Bohemian Massif*” was held in Prague on September, 20, 2004. The meeting was organized by Petr Kraft from the Department of Palaeontology and Geology of the Charles University of Prague (see abstract volume and excursion guides in the attachment of this report). The pre-conference fieldtrip (September 16-19, 2004) to the Sudetes was organized by Stanislaw Mazur, Richard Kryza and Pawel Alexandrowski (Geological Institute, Wroclaw University). The post-conference fieldtrip to the Barrandian and the Saxothuringian in the Bohemian Massif (September 21-25, 2004) was guided and organized by Petr Kraft, Vaclav Kachlik (Department of Palaeontology and Geology of the Charles University of Prague), Uwe Kroner (Department of Geology, Mining Academy of Freiberg) and Ulf Linnemann (Staatliche Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie). 30 scientists from Poland, Czech Republic,

Spain, France, U.S.A., UK and Germany participated at the meeting. All the presentations and the fieldtrips were relevant to the topic of the project.

Session at the IGC in Florence (2004): During the International Geological Congress in Florence, the special symposium “T31.03: Neoproterozoic to Early Paleozoic orogenic processes at the northern margin of Gondwana (Avalonian-Cadomian Orogenic Belt)” was organized by Ulf Linnemann (Staatliche Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie) and Gernold Zulauf (Geologisches Institut der Universität Frankfurt/M.). The meeting was held on August, 28, 2004 and sponsored by IGCP 497 and the International Association of Gondwana Research (IAGR). The keynote address was given by Damian Nance (USA). In the session 9 oral presentations and 12 posters were involved. The IGCP 497 project was introduced to the international audience and the geological community in Florence.

(iii) **Symposium in Mexico (2004):** J. Duncan Keppie and R. Damian Nance organized a special symposium in Mexico that was linked to IGCP 497. The symposium was involved in the conference “IV. REUNIÓN NACIONAL DE CIENCIAS DE LA TIERRA” (31 October – 5 November de 2004, home page: <http://geminis.geociencias.unam.mx/IVRNCT.htm>, title of the symposium: S 01 Acatlan Complex, southern Mexico: part of the Iapetus, Rheic or paleo-Pacific Ocean?, Chairmen: J. Duncan Keppie (duncan@servidor.unam.mx) - Instituto de Geología, UNAM, R.D. Nance (nance@ohio.edu) - Ohio University). The Symposium is sponsored by: IGCP 497 "The Rheic Ocean: its origin, evolution and correlatives" (The Acatlan Complex has previously been attributed to both the Iapetus and Rheic Oceans. This symposium concentrated on new data on the geological history of the Acatlan Complex and its relevance to global reconstructions).

(iv) **Joint meeting of IGCP 497 with IGCP 453 (2004):** A joint meeting of IGCP 453 “Ancient and Modern Orogens” (Brendan Murphy and Duncan Keppie) and IGCP 497 was held in the Urals (August 3-12, 2004) organized by Dennis Brown (Spain) and Victor Puchkov (Russia).

(v) **First IGCP 497 book-project “Das Saxothuringikum” (2004):** The first book project of IGCP 497 was finished in the spring of 2004 in German with with a synthesis and figure captions in English (“Das Saxothuringikum”, edited by Ulf Linnemann, 159 p., ISBN: 3-

910006-28-0). The book is focused on the history of the Rheic Ocean preserved in the Saxothuringian Zone at the NW unit of the Bohemian Massif and is written for a German audience (students of geosciences, teachers, scientists and all people interested in geology). The book contains an English summary and subchapters of headings, figure captions, diagrams and tables to make it readable also to the international audience. An English version is in preparation and planned for late 2006 or early 2008 at the publisher E. Schweizerbart'sche Verlagsbuchhandlung (Stuttgart, Germany).

(vi) **Compiling the second IGCP 497 book project: GSA-Book (planned for 2007):** The presentations of the opening meeting in Prague, of the session in Florence and of the symposium in Mexico will be published by the Geological Society of America in 2006 (GSA Special Publications, working title: "The Geology of Peri-Gondwana: Avalonian-Cadomian terranes, adjoining Cratons, and the Rheic Ocean", edited by Ulf Linnemann, Petr Kraft, Damian Nance and Gernold Zulauf).

(vii) **Co-operation and planned joint meeting with IGCP 485 (planned for 2007):** Participation of Ulf Linnemann on the annual meeting and the field trip of IGCP 485 "Boundaries of the West African Craton" in December 2004 in Nouakchott (Mauritania). Planning of a big joint meeting by Jean-Paul Liégeois (IGCP 485), Nasser Ennih (IGCP 485) and Ulf Linnemann (IGCP 497) in El Jadida (Morocco) in 2007. This joint meeting is extremely important for the IGCP 497, because most of the peri-Gondwanan terranes in Europe are related to the periphery of the West African Craton.

3. Achievements of the project in this year (2006)

3.1. List of countries involved in the project

Austria, Brazil, Canada, China, Columbia, Czech Republic, France, Georgia, Germany, Ireland, Italy, Kazakhstan, Mexico, Morocco, Mauritania, Poland, Portugal, Romania, Russia, South Africa, Spain, Slovakia, Switzerland, Turkey, U.K., Ukraine, U.S.A., Venezuela.

3.2. General scientific achievements (including societal benefits)

(i) The opening of the Rheic Ocean in the Late Cambrian/Early Ordovician (stage 1-"Birth"),

the evolution of the Rheic Ocean during the Mid-Ordovician/Mid-Devonian (stage 2-"lifetime"=drift of Avalonia and the closure of the Iapetus Ocean) and the closure of the Rheic Ocean (stage 3-"death") accompanied by the formation of Pangea in the Late Devonian/Carboniferous are the general topics of our IGCP (see also chapter "Short introduction to the Rheic Ocean).

Each have shown aspects of all three stages. Our aim is to combine a new data set to all three stages from all significant plates which were involved in the geological history of the Rheic Ocean.

(ii) In our meetings a lot of young geologists and students are involved.

(iii) Our conferences and field workshops take place mostly in developing countries.

3.3. List of meetings with approximate attendance and number of countries

2006-I:

IGCP 497 conference and field workshop in Ankara, Turkey: “Neoproterozoic and Palaeozoic Terranes in Northwest Turkije” (organised by Erdin Bozkurt, Ali Kocyigit, Erdinc Yigitbas (Middle East Technical University, Ankara, Turkey) and Aral Okay (Istanbul Technical University, Turkey)

The meeting was organized by Erdin Bozkurt, Ali Kocyigit, Erdinc Yigitbas and Aral Okay and their colleagues. The very successful conference was held at the campus of the Middle East Technical University in Ankara on June , 23 followed by a marvelous and very informative field trip June, 24-30th 2006. The field trip was guided by the organizers. We had 14 registered participants at the meeting with 7 oral presentations and 1 poster. The meeting and the field trip was co-sponsored by the TUPRAG METAL MADENCILIK SAN. TIC. LTD. The aims of this IGCP 497 meeting and the fieldworkshop were:

- the presentation of new data concerning the remnants of the Rheic Ocean in Turkey
- the introduction into the geological history of the Neoproterozoic ophiolites and adjoining crustal units especially consideration of the of the opening and the closure mechanisms and the tectonothermal events of the Rheic Ocean
- the planning of the next meetings and the strategy concerning data processing and publications (especially book projects and a third special volume)
- introduction of the next meetings in late 2006 and 2007 by Ulf Linnemann Germany).

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Programm

22 June - Arrival to Ankara

23 June - Conference (Middle East Technical University Ankara)

9h00m- *Reception and documentation delivery*

10h00m- *Opening of the Conference*

10h-13h30m- *Oral presentations session*

10h00m- LINNEMANN

INTRODUCTION

10h15m- WINCHESTER

CONTINENTAL AFFINITIES OF THE ISTANBUL BLOCK BASEMENT

10h45m- LINNEMANN, GERDES, DROST & BUSCHMANN

CADOMIAN OROGENIC PROCESSES - THE ULTIMATE CAUSE FOR THE OPENING OF THE RHEIC OCEAN: CONSTRAINTS FROM U/Pb ZIRCON DATING AND ANALYSES OF THE GEOTECTONIC SETTING (SAXO-THURINGIAN ZONE, BOHEMIAN MASSIF, GERMANY)

11h15m-11h45m- *Coffee Break and posters*

11h45m- DROST, LINNEMANN & ROMER

NEOPROTEROZOIC - EARLY PALAEOZOIC VOLCANO-SEDIMENTARY RECORD OF THE TEPLÁ-BARRANDIAN (BOHEMIAN MASSIF) AND ITS RELATION TO THE OPENING OF THE RHEIC OCEAN

12h15m- BISKE

PALEOZOIC TIAN-SHAN AS A TRANSITIONAL REGION OF THE RHEIC TO URAL-TURKESTAN OCEAN

12h45m- OKAY

CARBONIFEROUS DEFORMATION, METAMORPHISM AND MAGMATISM IN THE PONTIDES - A LINK TO THE VARISCAN OROGEN?

14h00m-IGCP 497 business meeting

Poster presentation

GIL-PEÑA

STRUCTURAL INVERSION OF THE SILURO-DEVONIAN PASSIVE MARGIN OF THE RHEIC OCEAN IN THE VARISCAN PYRENEES

Field Trip Itinerary in Turkey

June 24 Excursion "A Geotraverse through the so-called 'Ankara Mélange' between Elmedağ and Bedesten, Ankara, Turkey"

III.1.A. June 24. Ankara - Hasanoglan - Elmadag - Bedesten - Kirikkale - Ankara
"Ankara Mélange"

June 25 - 30 Excursion "Neoproterozoic and Palaeozoic Terranes in Northwest Turkije"

III.2.A. June 25. Ankara - Ismetpasa - Kapakli - Gerece - Bolu
Ulus-Gerece Segment of the North Anatolian Fault System

III.2.B. June 26. Bolu - Cukurören - Celegölcük - Yedigöller
Neoproterozoic ophiolites and granites and overlying Paleozoic succession in the Istanbul-Zonguldak Unit (Sünnice Mountains)

III.2.C. June 27. Bolu - Ilica - Bektemurlar - Akcaalan - Abdiköy - Izmit
Neoproterozoic ophiolites and granites and overlying Paleozoic succession in the Istanbul-Zonguldak Unit (Almacik Mountain)

III.2.D. June 28. Izmit - Büyükkumla - Narli - Armutlu - Yalova - Izmit
Neoproterozoic ophiolites and granites and overlying Paleozoic succession in the Istanbul-Zonguldak Unit (Armutlu Peninsular)

III.2.E. June 29. Izmit - Gebze - Denizli - Tepeköy - Istanbul
Paleozoic and Triassic of the Istanbul Region

III.2.F. June 30. Istanbul - Ankara

Cultural excursion



Neoproterozoic ophiolite related to the suture along that the Rheic Ocean was opened in Cambro-Ordovician time (NW-Turkey)



Group photograph of participants of the field workshop in NW-Turkey

2006-II:

IGCP 497 conference Evora, Portugal and field workshop in the Ossa-Morena Zone of Portugal and Spain: “Ediacaran to Visean crustal growth processes in the Ossa-Morena Zone (SW Iberia)” (organised by Francisco Pereira , University of Evora, and Cecilio Quesada, Geological Survey of Spain, Madrid)

The meeting was organized by Francisco Pereira, Cecilio Quesada and their colleagues. The very successful conference was held at the campus of the University in Evora on September, 27. The field trip to the Ossa-Morena Zone of Portugal and Spain took place between September, 28 and October, 3, 2006. The field trip was guided by the organizers. The meeting was co-sponsored by the University of Evora (Departamento de Geociências, Centro de Geofísica de Évora, Universidade de Évora, Portugal), the Geological Survey of Spain (Instituto Geologico y Minero de España, Madrid) and the Geological Institute of the University of Salamanca.

We had 37 registered participants at the meeting with 15 oral presentations and 7 posters. The aims of this IGCP 497 meeting and the fieldworkshop were:

- the presentation of new data concerning the remnants of the Rheic Ocean in the Ossa-Morena Zone of Portugal and Spain
- Correlation between the Portuguese and Spanish parts of the Ossa-Morena Zone
- the planning of the next meetings and the strategy concerning data processing and publications (especially book projects and a third special volume)
- introduction of the next meetings in and 2007 by Ricardo Arenas, Jose Ramon Martinez Catalan and Jacobo Abati (Spain) and Ulf Linnemann (Germany)

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Programm

27 September- Arrival to Évora (overnight in Portugal)

28 September- Conference (University of Évora; overnight in Portugal)

9h00m- *Reception and documentation delivery*

9h30m- *Opening of the Conference*

10h-13h- *Oral presentations session I (see Part III for Conference Abstracts)*

9h40m – LINNEMANN, GERDES, DROST & BUSCHMANN

THE CADOMIAN OROGENY IN THE BOHEMIAN MASSIF AND CONSEQUENCES FOR THE RECONSTRUCTION OF THE ORIGIN OF THE RHEIC OCEAN

10h00m- MURPHY & DOSTAL

CONTINENTAL MAFIC MAGMATISM OF DIFFERENT AGES IN THE SAME TERRANE: CONSTRAINTS ON THE EVOLUTION OF AN ENRICHED MANTLE SOURCE

10h20m- KEPPIE, RAMOS-ARIAS, MORALES-GÁMEZ, NANCE, MILLER, MURPHY & DOSTAL

THE ACATLÁN COMPLEX, SOUTHERN MEXICO: ODEYSSEY FROM RHEIC SOUTHERN MARGIN TO PACIFIC EASTERN MARGIN

10h40m- DROST, LINNEMANN & ROMER

EARLY PALAEOZOIC VOLCANO-SEDIMENTARY RECORD OF THE TEPLÁ-BARRANDIAN (BOHEMIAN MASSIF) WITHIN THE SCOPE OF THE OPENING OF THE RHEIC OCEAN

11h00m-11h40m- *Coffee Break and poster session I (see Part III for Conference Abstracts)*

11h40m- PEREIRA, CHICHORRO & PIN

SM-ND ISOTOPE CHARACTERIZATION OF THE CAMBRIAN-ORDOVICIAN(?) AMPHIBOLITES FROM THE ÉVORA MASSIF: AN ENSIALIC RIFT DEVELOPING INTO A PROTO-OCEANIC BASIN WITH MOR INITIATION?

12h00m- CHICHORRO, PEREIRA, WILLIAMS & SILVA

SHRIMP U-Pb ZIRCON GEOCHRONOLOGY OF FELSIC ORTHOGNEISSES FROM THE ÉVORA MASSIF: LOWER-MIDDLE CAMBRIAN CONTINENTAL RIFT-RELATED MAGMATISM

12h20m- SÁNCHEZ-MARTÍNEZ , JEFFRIES, ARENAS, FERNÁNDEZ-SUÁREZ & GARCÍA-SÁNCHEZ
U-PB DATING OF THE PURRIDO MAFIC UNIT (CABO ORTEGAL COMPLEX, NW SPAIN)

13h-14.40h- Lunch

14h40m-18h- Oral presentations session II (see Part III for Conference Abstracts)

14h40m- PISAREVSKY, MURPHY, NANCE & KEPPIE
NEOPROTEROZOIC-EARLY PALEOZOIC CONFIGURATION OF PERI-GONDWANAN TERRANES AT THE ONSET OF PALEOZOIC OCEAN DEVELOPMENT: IMPLICATIONS FOR LAURENTIA-GONDWANA CONNECTIONS AND THE EARLY EVOLUTION OF THE RHEIC OCEAN

15h00m- ARMENDÁRIZ, LÓPEZ-GUIJARRO, PIN, BELLIDO & QUESADA
SEDIMENTARY PROVENANCE AND INFILLING HISTORY OF THE PEDROCHES SYN-OROGENIC BASIN (MISSISSIPPIAN, SW IBERIAN MASSIF) INFERRED FROM GEOCHEMISTRY AND Nd ISOTOPES

15h20m- LÓPEZ-GUIJARRO, ARMENDÁRIZ, PIN, FERNÁNDEZ-SUÁREZ, BELLIDO & QUESADA
NEOPROTEROZOIC-PALAEOZOIC TECTONIC EVOLUTION OF THE OSSA-MORENA AND CENTRAL IBERIAN ZONES AS REVEALED BY SM-ND SYSTEMATICS OF METASEDIMENTS

15h40m-16h20m- Coffee Break and poster session II(see Part III for Conference Abstracts)

16h20m- GOROZHANINA, PUCHKOV & GOROZHANIN
THE COMPARISON OF THE RHEIC AND THE URALIAN OCEANS DEVELOPMENT: SIMILARITIES AND DIFFERENCES

16h40m- ABATI, WHITEHOUSE, ARENAS & FERNÁNDEZ-SUÁREZ
U-Pb - SIMS DATING OF ECLOGITES FROM THE BASAL ALLOCHTHON OF THE NW IBERIAN MASSIF (SPAIN): IS SUBDUCTION YOUNGER THAN PREVIOUSLY THOUGHT?

17h00m- GUTIÉRREZ-ALONSO, FERNÁNDEZ-SUÁREZ, WEIL, MURPHY, NANCE, CORFÚ & JOHNSTON
SELF-SUBDUCTION OF A GLOBAL PLATE – THE BEGINNING OF PANGEA’S END?

17h20m- GLEN
THE TASMANIDES OF EASTERN AUSTRALIA: A COLLAGE OF ACCRETIONARY OROGENS

17h40m- BOZKURT, YIĞITBAŞ, WINCHESTER & KOÇYIĞIT
THE STRUCTURE OF THE BOLU MASSIF, NORTHWESTERN TURKEY

18h- IGCP-497 business meeting

Field Trip Itinerary in Portugal and Spain

29 September- 1st Day of the Field Trip (overnight in Spain)

30 September- 2nd Day of the Field Trip (overnight in Spain)

1 October- 3rd Day of the Field Trip (overnight in Portugal)

2 October- 4th Day of the Field Trip (overnight in Portugal)

3 October- 5th Day of the Field Trip (overnight in Portugal)

4 October- Departure from Évora



Group photograph of participants of the field workshop in the Ossa-Morena Zone in front of Early Ordovician sediments related to the opening of the Rheic ocean (SW-Spain)



Group photograph of participants of the field workshop in the Ossa-Morena Zone in front of a Variscan granitoid related to the closure of the Rheic ocean (S-Portugal)

**2006-III:
Special Session:
Northeastern Section—41st Annual Meeting (20–22 March 2006), Harrisburg,
Pennsylvania
Session No. 13 Monday, 20 March 2006**

1:00 PM-4:00 PM, Radisson Penn Harris Hotel and Convention Center: Keystone D/E T13. Time Slices Across the Appalachians: Role of the Rheic Ocean in the Development of the Appalachian Orogen

R. Damian Nance and John Duncan Keppie, Presiding.

1:00 PM Introductory Remarks

13-1 1:05 PM ORIGIN OF THE RHEIC OCEAN: RIFTING ALONG A NEOPROTEROZOIC SUTURE?: MURPHY, J. Brendan, GUTIERREZ-ALONSO, Gabriel, NANCE, R. Damian, FERNANDEZ- SUAREZ, Javier, KEPPIE, J. Duncan, QUESADA, Cecilio, STRACHAN, Rob A., DOSTAL, Jarda

13-2 1:25 PM BIRTH OF THE RHEIC OCEAN, A 2-STAGE PROCESS ON THE SOUTHERN (MEXICAN) MARGIN: KEPPIE, John Duncan, NANCE, R. Damian, MURPHY, James Brendan, DOSTAL, Jarda, MILLER, Brent V.

13-3 1:45 PM LOWER PALEOZOIC OF NORTHWEST GONDWANA—TERMINAL CAMBRIAN AND LOWEST ORDOVICIAN TIÑU FORMATION IN SOUTHERN MEXICO: LANDING, Ed, KEPPIE, J. Duncan, WESTROP, Stephen R.

13-4 2:05 PM THE ACATLÁN COMPLEX, SOUTHERN MEXICO: RECORD OF THE ASSEMBLY, DURATION AND BREAKUP OF PANGAEA: NANCE, R. Damian, MILLER, Brent V., KEPPIE, J. Duncan, MURPHY, J. Brendan, DOSTAL, J.

13-5 2:25 PM ZIRCON RECYCLING FROM THE GONDWANAN MARGIN OF THE RHEIC OCEAN: THE ROLE OF MEGACRYSTIC GRANITOIDS OF THE ACATLÁN COMPLEX, SOUTHERN MEXICO: MILLER, Brent, NANCE, R. Damian, MURPHY, Brendan, KEPPIE, J. Duncan, DOSTAL, Jarda

2:45 PM Break

13-6 3:00 PM TECTONOMAGMATIC AND PALEOZOIC EVOLUTION OF PLUTONIC ROCKS IN THE NORTHERN ACATLÁN COMPLEX, LA NORIA AREA, SOUTHERN MEXICO: HINOJOSA-PRIETO, Hector R., NANCE, R. Damian, KEPPIE, J. Duncan, DOSTAL, Jaroslav V., MILLER, Brent V., MURPHY, J. Brendan

13-7 3:20 PM STRUCTURAL ANALYSIS OF MORB PILLOW BASALTS AND CLASTIC ROCKS OF THE SOUTHWESTERN COSOLTEPEC FORMATION, ACATLÁN COMPLEX, SOUTHERN MEXICO: A REMNANT OF THE RHEIC OCEAN: GRODZICKI, Kathryn R., NANCE, R. Damian, KEPPIE, John Duncan, DOSTAL, Jaroslav, MURPHY, J. Brendan

13-8 3:40 PM DEVONO-CARBONIFEROUS AND PERMIAN TECTONOTHERMAL EVENTS IN THE NORTHERN ACATLÁN COMPLEX, SOUTHERN MEXICO: A RECORD OF CLOSURE OF THE RHEIC OCEAN FOLLOWED BY CONVERGENCE ON THE PACIFIC MARGIN OF PANGEA: BARLEY, Brent, KEPPIE, J. Duncan, NANCE, R. Damian

Attendance on both meetings and the special session(Turkey and Portugal/Spain):

59 scientists

number of countries: 15

3.4. Educational, training or capacity building activities

(i) In our meetings a lot of young geologists and students are involved.

(ii) The first book project of IGCP 497 “Das Saxothuringikum” (edited by Ulf Linnemann, 159 p., ISBN: 3-910006-28-0) is our large contribution to the educational sector in 2004. The book is focused on the history of the Rheic Ocean preserved in the Saxothuringian Zone at the NW part of the Bohemian Massif and written for the German students of geosciences, teachers, scientists and all people interested in geology.

(iii) Our second volume will come out in early 2007. It will have a remarkable impact concerning the knowledge of the dispersal of Gondwana and the Pangea configuration mirrored in the geodynamic history of the Rheic ocean.

Book title: “The Evolution of the Rheic Ocean: From Avalonian-Cadomian active margin to Alleghenian-Variscan collision” (Special Volume of the Geological Society of America).

(iv) With exception of two days of excursion in Germany our conferences and field workshops take place only in developing countries. This is important for the position of the local geoscientists in their own country and for the exchange of knowledge with young geologists who have no large possibility to travel. Of course the making of contacts for projects in the future is also an important point.

3.5. Participation of scientists from developing countries

In 2005 from developing countries the following geoscientists were sponsored because of active participation at the meetings:

Francisco Pereira (Portugal), Inma Gil-Peña (Spain), Cecilio Quesada Ochoa (Spain), Ricardo Arenas (Spain), Jacobo Abati (Spain), Yelena Gorozhanina (Russia), Gutiérrez-Alonso (Spain), José R. Martínez-Catalan (Spain), Sonia Sánchez Martínez (Spain), Ricardo Arenas (Spain), Erdin Bozkurt (Turkey), Duncan Keppie (Mexico), Ruben Diez (Spain), Erdinc Yigitbas (Turkey).

3.6. List of most important publications (including maps)

The editing of the second IGCP 497-volume is finished and the book will be published by the

Geological Society of America (Special Publication) in early 2007:

Book title:

“The Evolution of the Rheic Ocean: From Avalonian-Cadomian active margin to Alleghenian-Variscan collision”.

Boulder, Colorado, Geological Society of America Special Paper 423.

Editors:

Ulf Linnemann, R. Damian Nance, Petr Kraft & Gernold Zulauf

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2. Geodynamic evolution of the north-western Palaeo-Gondwanan margin in the Moroccan Atlas at the Precambrian-Cambrian boundary

Andre Pouclet, Abdellatif Aarab, Abdelilah Fekkak and Mohammed Benharref

3. The continuum between Cadomian Orogenesis and opening of the Rheic Ocean: Constraints from LA-ICP-MS U-Pb zircon dating and analysis of plate-tectonic setting (Saxo-Thuringian zone, NE Bohemian massif, Germany)

Ulf Linnemann, Axel Gerdes, Kerstin Drost, Bernd Buschmann

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O. Elicki

6. THE VARISCAN OROGENY IN THE SAXO-THURINGIAN ZONE-HETEROGENOUS OVERPRINT OF CADOMIAN / PALEOZOIC PERI-GONDWANA CRUST

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7. Far Eastern Avalonia: its chronostratigraphic structure revealed by SHRIMP zircon ages from Upper Carboniferous to Lower Permian volcanic rocks (drill cores from Germany, Poland and Denmark)

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9. *Structural evolution of the Prague synform (Czech Republic) during Silurian times: An The diversity and geodynamic significance of Late Cambrian (ca. 500 Ma) felsic anorogenic magmatism in the northern part of the Bohemian Massif: a review based on Sm-Nd isotope and geochemical data*

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10. *Sm-Nd isotope and trace element study of Late Proterozoic metabasalts (“spilites”) from the Central Barrandian Domain (Bohemian Massif, Czech Republic)*

Christian Pin and Jarmila Waldhausrová

11. *Structural evolution of the Prague synform (Czech Republic) during Silurian times: An AMS, Rock Magnetism and Paleomagnetic study of the Svatý Jan pod Skalou dykes. Consequences on the napes emplacement.*

Tahar Aïfa, Petr Pruner, Martin Chadima, Petr Štorch and Jean-Pierre Lefort

12. *Cadomian and Variscan metamorphic events in the Léon Domain (Armorican Massif, France): P-T data and EMP monazite dating*

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13. *U-Pb depositional age for the upper Barrios Formation (Armorican Quartzite facies) in the Cantabrian Zone of Iberia: Implications for stratigraphic correlation and paleogeography*

Gabriel Gutiérrez-Alonso, Javier Fernández-Suárez, Juan Carlos Gutiérrez-Marco, Fernando Corfu, Brendan Murphy and Mercedes Suárez

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19. *Crete and the Minoan Terranes: Age constraints from U-Pb dating of detrital zircons*
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20. *Geological evolution of Mid to Late Paleozoic rocks in the Avalon terrane of northern mainland Nova Scotia, Canadian Appalachians: a record of tectonothermal activity along the northern margin of the Rheic Ocean in the Appalachian-Caledonide orogen*
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24. *Ordovician-Devonian oceanic basalts in the Cosoltepec Formation, Acatlán Complex, southern Mexico: vestiges of the Rheic Ocean?*
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25. *P-T-t constraints on exhumation following subduction in the Rheic Ocean from eclogitic rocks in the Acatlan Complex of southern Mexico*
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29. *Aluminum-phosphate in Proterozoic metaquartzites: implications for the Precambrian oceanic P-budget and development of life*
Giulio Morteani, Dietrich Ackermann and Jörg Trappe

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3.7. Activities involving other IGCP projects or the IUGS

Participation of Ulf Linnemann on the annual meeting and field workshop of IGCP 485 “Boundaries of the West African Craton” in Algiers and Tamanrasset (Algeria) for the planning of the joint meeting of IGCP 497 “Rheic Ocean” and IGCP 485 “West African Craton” in El Jadida (Morocco) in 2007.

4. Activities planned

4.1. General goals

The evolution of the Appalachian-Caledonide Orogen is commonly described in terms of the Iapetus Ocean whose opening produced the rifted margin of eastern Laurentia and whose closure resulted in the collision of this margin with Baltica and a variety of peri-Gondwanan

terranes. However, the climactic collision in the Appalachian Orogen and much of Eastern and Central Europe was not that of Iapetus closure but that of its immediate successor, the Rheic Ocean. Closure of the Rheic Ocean produced the vast Ouachita-Alleghanian-Variscan Orogen and was one of the principal events in the Late Palaeozoic assembly of the supercontinent Pangaea.

The Rheic Ocean is generally held to have opened between Gondwana and a number of terranes that rifted from the Amazonian-West African margin of Gondwana. Its growth occurred at the expense of the Iapetus Ocean and its closure brought Gondwana into collision with Laurussia during the assembly of Pangaea. Despite its importance during the Palaeozoic, however, the history of the Rheic Ocean has not received the same attention as that of its better-known forerunner, and much controversy surrounds its origin, palaeogeography and evolution. These controversies result from uncertainties in the identification of its rifted margins, in the timing of its initial rifting and rift-drift transition, in its size and geography, and in the geodynamics of its final closure. Lying behind these uncertainties is the broad geographic area to which regions of Rheic geology were scattered following the breakup of Pangaea, including North and Central America, Western, Central and Eastern Europe (including former “Eastern-Block” countries), and Northwest Africa, and the widely varying disciplines involved in its study. As a result, communication between interested geoscientists is impeded by language and cross-disciplinary barriers. To remedy this, we believe it is timely to bring together geoscientists of varying disciplines from each of these areas in order that a more comprehensive understanding of the evolution of this important ocean can be developed. In particular, scientists from less developed nations and former “Eastern-Block” countries will be invited in order to promote information and technology transfer that will both promote the goals of the project and enhance the development of the geosciences in their own countries. The fields of expertise involved (stratigraphy, sedimentology, palaeontology, igneous and metamorphic petrology, geochronology, geochemistry, structural geology, tectonics, palaeogeography, palaeoceanography, geophysics, etc.) span the entire discipline and, because of the vagaries of Pangaea breakup, are developed to differing degrees amongst the countries in which the story of the Rheic Ocean is recorded. Thus, the Czech Republic, for example, possesses vital expertise on the stratigraphy, sedimentology and palaeontology of the Rheic Ocean because of the superb sedimentary record preserved in the Prague Basin, the palaeoecology of which has been used to trace the radiation and extinction events that chart the ocean’s evolution. Poland, Germany and Slovakia, on the other hand, possess well-

exposed records of the collisional processes that accompanied ocean closure, while Spain and Portugal possess records of its initial rifting, and the United Kingdom preserves vestiges of the ocean itself. The transfer and exchange of this expertise with that from other areas of Rheic geology, for example, the sedimentary records preserved in Morocco and South Africa, the rifting and ophiolitic records preserved in Mexico, and the collisional histories preserved in Turkey, eastern North America and northern South America are central to resolving the ocean's origin and evolution, and its relationship to correlative oceanic tracts, such as proto-Tethys, Tornquist, Aegir and other unnamed seaways in Europe, the Middle East, Kazakhstan, Ukraine, Russia and China, with which it played a collective geodynamic role in the assembly of Pangaea.

General frame work: The opening of the Rheic Ocean in the Late Cambrian/Early Ordovician (stage 1-"Birth"), the evolution of the Rheic Ocean during the Mid-Ordovician/Mid-Devonian (stage 2-"lifetime"=drift of Avalonia and the closure of the Iapetus Ocean) and the closure of the Rheic Ocean (stage 3-"death") accompanied by the formation of Pangea in the Late Devonian/Carboniferous are the general topics of our IGCP (see also chapter "Short introduction to the Rheic Ocean).

4.2. Specific meetings and field trips (*please indicate participation from developing countries)

2007-I

IGCP 497 conference and field workshop in NW-Spain (*Iberia II*): "The rootless Variscan suture of NW Iberia (Galicia)" in NW-Spain (responsibility: Ricardo Arenas, José Ramon Martinez Catalan, Jacobo Abati).

(*Spain is a developing country)

2007-II:

Joint Meeting of IGCP 485 and IGCP 497 including field workshop in El Jadida, AntiAtlas, Morocco) (IGCP 485-board: Jean-Paul Liégeois & Nasser Ennih, responsibility for IGCP 497: Francisco Pereira, Scott Samson, Richard D`Lemos, Ulf Linnemann).

(*Morocco is a developing country)

2008-I

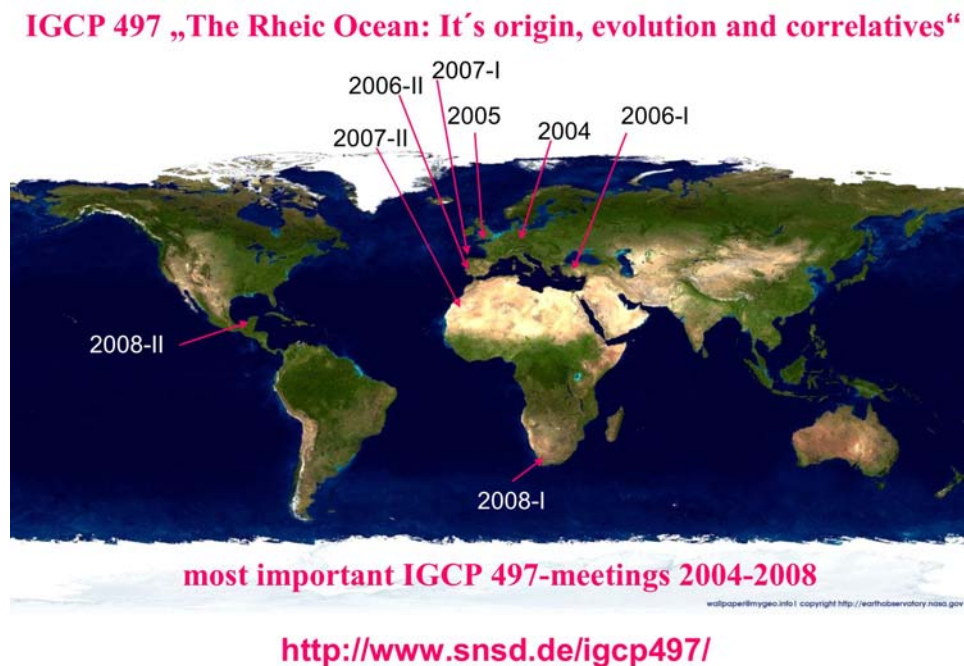
IGCP 497 conference and field workshop in South Africa: "The Rheic Ocean and the Cape Fold Belt" (responsibility: Maarten de Wit et al., South Africa).

(**South Africa is a developing country*)

2008-II

Final IGCP 497 conference and field workshop in Mexico: "The Rheic Ocean and the peri-Gondwanan terranes of Mexico" (responsibility: Duncan Keppie, Mexico, & Damian Nance, USA)

(**Mexico is a developing country*)



5. Project funding requested

The thematic frame around the Rheic Ocean is worldwide and international and covers nearly all geosciences (see introduction). We want to make a real important contribution to the geosciences. We organize two big meetings per year (!). Especially therefore we need higher funding. All future meetings will be held in developing countries (!). The next IGCP (2007) meetings in Spain and Morocco should involve many more young geoscientists from developing countries.

For these reasons we apply for the full funding (“very high”) of our IGCP-Project (ca. 10-12.000,- \$US) because we want to involve more young scientists in the project who have no possibility of funding.

6. Request for extension, on-extended-term-status, or intention to propose successor project

The IGCP 497 board will discuss this on the business meeting in 2007.

ADDITIONAL FUNDING

Additional funding for IGCP 497 was generated by:

- *Turkey*: A major part of the field workshop was funded by the local industrie (TUPRAG METAL MADENCILIK SAN. TIC. LTD).
- *Spain/Portugal*: The Geological Survey of Spain (funding of some Spanish students, Publishing of the abstract volume and the excursion guide, providing of jeeps for the excursion)
- *Spain/Portugal*: The University of Salamanca (providing one car for the field workshop)
- *Spain/Portugal*: Ulf Linnemann was funded by the German National IGCP Committee (570,- EUR) for the participation on the Evora-Meeting