

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

**Marie Curie Mobility Actions
Initial Training Networks(ITN)**

A1

Proposal Number

000000

Proposal Acronym

THROUGHFLOW

General Information on the Proposal

Proposal Title

Cenozoic evolution of the Indonesian Throughflow and the origins of Indo-Pacific marine biodiversity:
Mapping the biotic response to environmental change

Marie Curie action-code

Initial Training Networks (ITN)

Scientific Panel

Environment and geosciences

Duration in months

48

Call identifier

FP7-PEOPLE-ITN-2008

Keywords (up to 200 characters)

Biodiversity inventory: systematics phylogeny
taxonomy, Paleontology, Stratigraphy, Marine ecosystems (Climate change), Paleoclimate
(Climate change), Paleooceanography

Abstract (up to 2000 characters)

A critical agenda for earth and life sciences is to determine how diverse tropical marine ecosystems such as coral reefs will respond to global environmental change. This will require long-term environmental and ecological data that rarely exist for living coral reefs. In contrast, the fossil record provides abundant examples that can be mined to predict future outcomes. The THROUGHFLOW network will train a cohort of eleven ESRs to enable them to reconstruct past environments and patterns of biotic change using up-to-date technologies within a collaborative interdisciplinary framework. The training program will explore the past record of change on coral reefs in SE Asia in response to reorganization of ocean currents during the Cenozoic. This region contains both the Indo-West Pacific Center of Biodiversity (the most diverse shallow marine ecosystems on Earth) and the Indonesian Throughflow (a primary control of global climate). THROUGHFLOW will reconstruct the history of these two features and develop a model for how coral reefs respond to regional environmental change. Practical training will include eleven integrated research projects and a series of joint training activities to facilitate collaboration and provide access to a variety of expertise. THROUGHFLOW will bring important new data to bear on long-standing scientific controversies, and the results will be relevant to a broad audience including industry and policy makers working to predict and plan for the effects of ongoing anthropogenic environmental change. By providing rigorous training in a range of applied techniques in geology and biodiversity, THROUGHFLOW will produce researchers able to pursue successful careers in academia or industry and will enhance the power of the European research community to tackle pressing issues related to the effects of ongoing environmental change on the biosphere.

Has a similar proposal been submitted to a Marie Curie Action under this or previous RTD Framework Programmes?

yes

IF YES

Programme name(s) and year

Proposal number(s)

ITN 2007	214557-2
-	-
-	-

Does this proposal include any of the sensitive ethical issues detailed in the Research Ethical Issues table of Part B?

yes

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

**Marie Curie Mobility Actions
Initial Training Networks(ITN)**

A2

Proposal Number Proposal Acronym Participant Number

INFORMATION ON ORGANISATIONS

If your organisation has already registered for FP7,
enter your Participant Identification Code

Legal name

Organisation short name

Administrative Data

Legal address

Street name Number

Town Postal Code/Cedex

Country

Internet homepage

Status of your Organisation

Certain types of organisations benefit from special conditions under the FP7 participation rules.
The Commission also collects data for statistical purposes.

The guidance notes will help you complete this section.

Please 'tick' the relevant box(es) if your organisation falls
into one or more of the following categories

Non-profit organisation	<input type="text" value="yes"/>
Public body	<input type="text" value="yes"/>
Research organisation	<input type="text" value="no"/>
Higher or secondary education establishment	<input type="text" value="no"/>
International organisation	<input type="text" value="no"/>
International organisation of European Interest	<input type="text" value="no"/>
Joint Research Center of the European Commission	<input type="text" value="no"/>
Entities composed of one or more legal entities [European Economic Interest Group (Unité mixte de recherche) / Enterprise groupings]	<input type="text" value="no"/>
Commercial Enterprise	<input type="text" value="no"/>

Main area of activity (NACE code)

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

**Marie Curie Mobility Actions
Initial Training Networks(ITN)**

A2

1. Is your number of employees smaller than 250? (full time equivalent)

2. Is your annual turnover smaller than € 50 million?

3. Is your annual balance sheet total smaller than € 43 million?

4. Are you an autonomous legal entity?

You are NOT an SME if your answer to question 1 is "NO"
and/or your answer to both questions 2 and 3 is "NO".

In all other cases, you might conform to the Commission's definition of an SME.

Following this check, do you conform to the Commission's definition of an SME

Dependencies with (an)other participant(s)

Are there dependencies between your organisation and (an)other participant(s) in this proposal?

if Yes:

Participant Number

Organisation Short Name

Character of dependence

0
0
0

-
-
-

-
-
-

Contact Points

Person in charge (For the co-ordinator (participant number 1) this person
is the one who the Commission will contact in the first instance)

Family name

First name(s)

Title

Sex

Position in the organisation

Department/Faculty/Institute/Laboratory name/...

Is the address different from the legal address?

Street name

Number

Town

Postal Code/Cedex

Country

Phone 1

Phone 2

Fax

E-mail

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

**Marie Curie Mobility Actions
Initial Training Networks(ITN)**

A2

Proposal Number Proposal Acronym Participant Number

INFORMATION ON ORGANISATIONS

If your organisation has already registered for FP7,
enter your Participant Identification Code

Legal name

Organisation short name

Administrative Data

Legal address

Street name Number

Town Postal Code/Cedex

Country

Internet homepage

Status of your Organisation

Certain types of organisations benefit from special conditions under the FP7 participation rules.
The Commission also collects data for statistical purposes.

The guidance notes will help you complete this section.

Please 'tick' the relevant box(es) if your organisation falls
into one or more of the following categories

Non-profit organisation	<input type="text" value="yes"/>
Public body	<input type="text" value="yes"/>
Research organisation	<input type="text" value="yes"/>
Higher or secondary education establishment	<input type="text" value="yes"/>
International organisation	<input type="text" value="no"/>
International organisation of European Interest	<input type="text" value="no"/>
Joint Research Center of the European Commission	<input type="text" value="no"/>
Entities composed of one or more legal entities [European Economic Interest Group (Unité mixte de recherche) / Enterprise groupings]	<input type="text" value="no"/>
Commercial Enterprise	<input type="text" value="no"/>

Main area of activity (NACE code)

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

**Marie Curie Mobility Actions
Initial Training Networks(ITN)**

A2

1. Is your number of employees smaller than 250? (full time equivalent)

2. Is your annual turnover smaller than € 50 million?

3. Is your annual balance sheet total smaller than € 43 million?

4. Are you an autonomous legal entity?

You are NOT an SME if your answer to question 1 is "NO"
and/or your answer to both questions 2 and 3 is "NO".

In all other cases, you might conform to the Commission's definition of an SME.

Following this check, do you conform to the Commission's definition of an SME

Dependencies with (an)other participant(s)

Are there dependencies between your organisation and (an)other participant(s) in this proposal?

if Yes:

Participant Number

Organisation Short Name

Character of dependence

0
0
0

-
-
-

-
-
-

Contact Points

Person in charge (For the co-ordinator (participant number 1) this person
is the one who the Commission will contact in the first instance)

Family name

First name(s)

Title

Sex

Position in the organisation

Department/Faculty/Institute/Laboratory name/...

Is the address different from the legal address?

Street name

Number

Town

Postal Code/Cedex

Country

Phone 1

Phone 2

Fax

E-mail

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

Marie Curie Mobility Actions
Initial Training Networks(ITN)

A2

Proposal Number Proposal Acronym Participant Number

INFORMATION ON ORGANISATIONS

If your organisation has already registered for FP7,
enter your Participant Identification Code

Legal name

Organisation short name

Administrative Data

Legal address

Street name Number

Town Postal Code/Cedex

Country

Internet homepage

Status of your Organisation

Certain types of organisations benefit from special conditions under the FP7 participation rules.

The Commission also collects data for statistical purposes.

The guidance notes will help you complete this section.

Please 'tick' the relevant box(es) if your organisation falls
into one or more of the following categories

Non-profit organisation	<input type="text" value="yes"/>
Public body	<input type="text" value="no"/>
Research organisation	<input type="text" value="yes"/>
Higher or secondary education establishment	<input type="text" value="no"/>
International organisation	<input type="text" value="no"/>
International organisation of European Interest	<input type="text" value="no"/>
Joint Research Center of the European Commission	<input type="text" value="no"/>
Entities composed of one or more legal entities [European Economic Interest Group (Unité mixte de recherche) / Enterprise groupings]	<input type="text" value="no"/>
Commercial Enterprise	<input type="text" value="no"/>

Main area of activity (NACE code)

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

Marie Curie Mobility Actions
Initial Training Networks(ITN)

A2

1. Is your number of employees smaller than 250? (full time equivalent)

2. Is your annual turnover smaller than €50 million?

3. Is your annual balance sheet total smaller than €43 million?

4. Are you an autonomous legal entity?

You are NOT an SME if your answer to question 1 is "NO"
and/or your answer to both questions 2 and 3 is "NO".

In all other cases, you might conform to the Commission's definition of an SME.

Following this check, do you conform to the Commission's definition of an SME

Dependencies with (an)other participant(s)

Are there dependencies between your organisation and (an)other participant(s) in this proposal?

if Yes:

Participant Number

Organisation Short Name

Character of dependence

0
0
0

-
-
-

-
-
-

Contact Points

Person in charge (For the co-ordinator (participant number 1) this person
is the one who the Commission will contact in the first instance)

Family name

First name(s)

Title

Sex

Position in the organisation

Department/Faculty/Institute/Laboratory name/...

Is the address different from the legal address?

Street name

Number

Town

Postal Code/Cedex

Country

Phone 1

Phone 2

Fax

E-mail

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

Marie Curie Mobility Actions
Initial Training Networks(ITN)

A2

Proposal Number Proposal Acronym Participant Number

INFORMATION ON ORGANISATIONS

If your organisation has already registered for FP7,
enter your Participant Identification Code

Legal name

Organisation short name

Administrative Data

Legal address

Street name Number

Town Postal Code/Cedex

Country

Internet homepage

Status of your Organisation

Certain types of organisations benefit from special conditions under the FP7 participation rules.

The Commission also collects data for statistical purposes.

The guidance notes will help you complete this section.

Please 'tick' the relevant box(es) if your organisation falls
into one or more of the following categories

Non-profit organisation	<input type="text" value="yes"/>
Public body	<input type="text" value="yes"/>
Research organisation	<input type="text" value="no"/>
Higher or secondary education establishment	<input type="text" value="yes"/>
International organisation	<input type="text" value="no"/>
International organisation of European Interest	<input type="text" value="no"/>
Joint Research Center of the European Commission	<input type="text" value="no"/>
Entities composed of one or more legal entities [European Economic Interest Group (Unité mixte de recherche) / Enterprise groupings]	<input type="text" value="no"/>
Commercial Enterprise	<input type="text" value="no"/>

Main area of activity (NACE code)

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

Marie Curie Mobility Actions
Initial Training Networks(ITN)

A2

1. Is your number of employees smaller than 250? (full time equivalent)

2. Is your annual turnover smaller than €50 million?

3. Is your annual balance sheet total smaller than €43 million?

4. Are you an autonomous legal entity?

You are NOT an SME if your answer to question 1 is "NO"
and/or your answer to both questions 2 and 3 is "NO".

In all other cases, you might conform to the Commission's definition of an SME.

Following this check, do you conform to the Commission's definition of an SME

Dependencies with (an)other participant(s)

Are there dependencies between your organisation and (an)other participant(s) in this proposal?

if Yes:

Participant Number

Organisation Short Name

Character of dependence

0
0
0

-
-
-

-
-
-

Contact Points

Person in charge (For the co-ordinator (participant number 1) this person
is the one who the Commission will contact in the first instance)

Family name

First name(s)

Title

Sex

Position in the organisation

Department/Faculty/Institute/Laboratory name/...

Is the address different from the legal address?

Street name

Number

Town

Postal Code/Cedex

Country

Phone 1

Phone 2

Fax

E-mail

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

Marie Curie Mobility Actions
Initial Training Networks(ITN)

A2

Proposal Number Proposal Acronym Participant Number

INFORMATION ON ORGANISATIONS

If your organisation has already registered for FP7,
enter your Participant Identification Code

Legal name

Organisation short name

Administrative Data

Legal address

Street name Number

Town Postal Code/Cedex

Country

Internet homepage

Status of your Organisation

Certain types of organisations benefit from special conditions under the FP7 participation rules.

The Commission also collects data for statistical purposes.

The guidance notes will help you complete this section.

Please 'tick' the relevant box(es) if your organisation falls
into one or more of the following categories

Non-profit organisation	<input type="text" value="yes"/>
Public body	<input type="text" value="no"/>
Research organisation	<input type="text" value="yes"/>
Higher or secondary education establishment	<input type="text" value="yes"/>
International organisation	<input type="text" value="no"/>
International organisation of European Interest	<input type="text" value="no"/>
Joint Research Center of the European Commission	<input type="text" value="no"/>
Entities composed of one or more legal entities [European Economic Interest Group (Unité mixte de recherche) / Enterprise groupings]	<input type="text" value="no"/>
Commercial Enterprise	<input type="text" value="no"/>

Main area of activity (NACE code)

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

**Marie Curie Mobility Actions
Initial Training Networks(ITN)**

A2

1. Is your number of employees smaller than 250? (full time equivalent)

2. Is your annual turnover smaller than €50 million?

3. Is your annual balance sheet total smaller than €43 million?

4. Are you an autonomous legal entity?

You are NOT an SME if your answer to question 1 is "NO"
and/or your answer to both questions 2 and 3 is "NO".

In all other cases, you might conform to the Commission's definition of an SME.

Following this check, do you conform to the Commission's definition of an SME

Dependencies with (an)other participant(s)

Are there dependencies between your organisation and (an)other participant(s) in this proposal?

if Yes:

Participant Number

Organisation Short Name

Character of dependence

0
0
0

-
-
-

-
-
-

Contact Points

Person in charge (For the co-ordinator (participant number 1) this person
is the one who the Commission will contact in the first instance)

Family name

First name(s)

Title

Sex

Position in the organisation

Department/Faculty/Institute/Laboratory name/...

Is the address different from the legal address?

Street name

Number

Town

Postal Code/Cedex

Country

Phone 1

Phone 2

Fax

E-mail

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

Marie Curie Mobility Actions
Initial Training Networks(ITN)

A2

Proposal Number Proposal Acronym Participant Number

INFORMATION ON ORGANISATIONS

If your organisation has already registered for FP7,
enter your Participant Identification Code

Legal name

Organisation short name

Administrative Data

Legal address

Street name Number

Town Postal Code/Cedex

Country

Internet homepage

Status of your Organisation

Certain types of organisations benefit from special conditions under the FP7 participation rules.

The Commission also collects data for statistical purposes.

The guidance notes will help you complete this section.

Please 'tick' the relevant box(es) if your organisation falls
into one or more of the following categories

Non-profit organisation	<input type="text" value="yes"/>
Public body	<input type="text" value="yes"/>
Research organisation	<input type="text" value="no"/>
Higher or secondary education establishment	<input type="text" value="yes"/>
International organisation	<input type="text" value="no"/>
International organisation of European Interest	<input type="text" value="no"/>
Joint Research Center of the European Commission	<input type="text" value="no"/>
Entities composed of one or more legal entities [European Economic Interest Group (Unité mixte de recherche) / Enterprise groupings]	<input type="text" value="no"/>
Commercial Enterprise	<input type="text" value="no"/>

Main area of activity (NACE code)

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

Marie Curie Mobility Actions
Initial Training Networks(ITN)

A2

1. Is your number of employees smaller than 250? (full time equivalent)

2. Is your annual turnover smaller than €50 million?

3. Is your annual balance sheet total smaller than €43 million?

4. Are you an autonomous legal entity?

You are NOT an SME if your answer to question 1 is "NO"
and/or your answer to both questions 2 and 3 is "NO".

In all other cases, you might conform to the Commission's definition of an SME.

Following this check, do you conform to the Commission's definition of an SME

Dependencies with (an)other participant(s)

Are there dependencies between your organisation and (an)other participant(s) in this proposal?

if Yes:

Participant Number

Organisation Short Name

Character of dependence

0
0
0

-
-
-

-
-
-

Contact Points

Person in charge (For the co-ordinator (participant number 1) this person
is the one who the Commission will contact in the first instance)

Family name

First name(s)

Title

Sex

Position in the organisation

Department/Faculty/Institute/Laboratory name/...

Is the address different from the legal address?

Street name

Number

Town

Postal Code/Cedex

Country

Phone 1

Phone 2

Fax

E-mail

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

Marie Curie Mobility Actions
Initial Training Networks(ITN)

A2

Proposal Number Proposal Acronym Participant Number

INFORMATION ON ORGANISATIONS

If your organisation has already registered for FP7,
enter your Participant Identification Code

Legal name

Organisation short name

Administrative Data

Legal address

Street name Number

Town Postal Code/Cedex

Country

Internet homepage

Status of your Organisation

Certain types of organisations benefit from special conditions under the FP7 participation rules.

The Commission also collects data for statistical purposes.

The guidance notes will help you complete this section.

Please 'tick' the relevant box(es) if your organisation falls
into one or more of the following categories

Non-profit organisation	<input type="text" value="yes"/>
Public body	<input type="text" value="yes"/>
Research organisation	<input type="text" value="yes"/>
Higher or secondary education establishment	<input type="text" value="yes"/>
International organisation	<input type="text" value="no"/>
International organisation of European Interest	<input type="text" value="no"/>
Joint Research Center of the European Commission	<input type="text" value="no"/>
Entities composed of one or more legal entities [European Economic Interest Group (Unité mixte de recherche) / Enterprise groupings]	<input type="text" value="no"/>
Commercial Enterprise	<input type="text" value="no"/>

Main area of activity (NACE code)

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

Marie Curie Mobility Actions
Initial Training Networks(ITN)

A2

1. Is your number of employees smaller than 250? (full time equivalent)

2. Is your annual turnover smaller than €50 million?

3. Is your annual balance sheet total smaller than €43 million?

4. Are you an autonomous legal entity?

You are NOT an SME if your answer to question 1 is "NO"
and/or your answer to both questions 2 and 3 is "NO".

In all other cases, you might conform to the Commission's definition of an SME.

Following this check, do you conform to the Commission's definition of an SME

Dependencies with (an)other participant(s)

Are there dependencies between your organisation and (an)other participant(s) in this proposal?

if Yes:

Participant Number

Organisation Short Name

Character of dependence

0
0
0

-
-
-

-
-
-

Contact Points

Person in charge (For the co-ordinator (participant number 1) this person
is the one who the Commission will contact in the first instance)

Family name

First name(s)

Title

Sex

Position in the organisation

Department/Faculty/Institute/Laboratory name/...

Is the address different from the legal address?

Street name

Number

Town

Postal Code/Cedex

Country

Phone 1

Phone 2

Fax

E-mail

Proposal Submission Form



EUROPEAN COMMISSION
7th Framework Programme on
Research, Technological
Development and Demonstration

**Marie Curie Mobility Actions
Initial Training Networks(ITN)**

A4

Proposal Number

000000

Proposal Acronym

THROUGHFLOW

REQUESTED FELLOWS

Part n°	Initial Training 0-5 years			Visiting Scientists				Training events		
	Early-Stage Researchers	Experienced Researchers		Visiting Scientists (<10 years)	Visiting Scientists (>10 years)			Number of researcher days for researchers from outside the network	Number of events	
	Fellow Months	Number of researchers	Fellow Months	Number of researchers	Person Months	Number of scientists	Person Months	Number of scientists		
1	72	2	0	0	0	0	0	0	215	3
2	72	2	0	0	0	0	6	1	0	1
3	72	2	0	0	0	0	0	0	192	2
4	36	1	0	0	0	0	0	0	12	2
5	36	1	0	0	0	0	0	0	0	0
6	72	2	0	0	0	0	0	0	50	1
7	36	1	0	0	0	0	0	0	0	0
Total	396	11	0	0	0	0	6	1	469	9

Total

STARTPAGE

PEOPLE
MARIE CURIE ACTIONS

Marie Curie Initial Training Networks (ITN)
Call: FP7-PEOPLE-ITN-2008

PART B

THROUGHFLOW

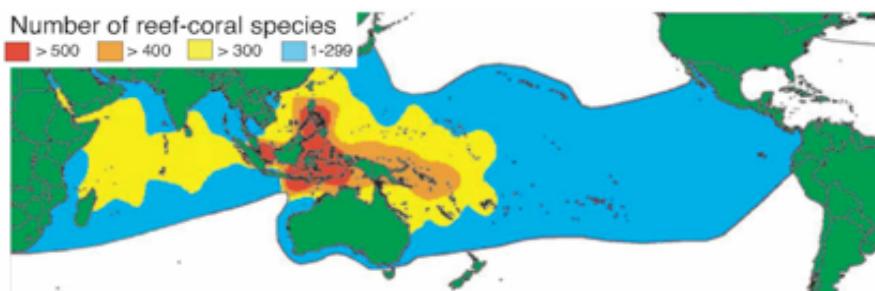
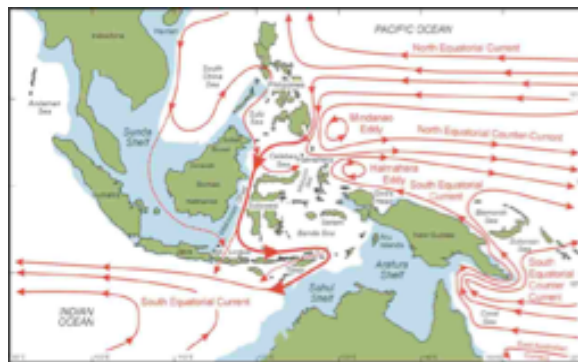


TABLE OF CONTENTS

B.1 LIST OF PARTICIPANTS	4
B.2 PROJECT OVERVIEW AND OBJECTIVES	4
B.3 S&T QUALITY	5
B.3.1. Research Topic and Project Objectives	5
Project B1. Reef building and coral diversity	7
Project B2. Origins of the Pacific reef algal flora	8
Project B3. Diversity and taxonomic turnover of molluscs	8
Project B4. Cenozoic history of Bryozoan diversity	8
Project E1. Shallow marine palaeoenvironments and the ITF	8
Project G1. High-resolution environmental proxies	9
Project P1. Impact of the ITF on global climate	9
Project P2. Neogene circulation patterns biogeography of foraminifera	9
Project P3. Quaternary of the Makassar Strait	10
Project S1. A chronostratigraphic framework	10
Project S2. Variation in large benthic foraminifera	10
B.3.2 Scientific Originality	11
B.3.2.1 Synergies amongst Work Areas and Associates	12
B.3.3 Research Method	12
B.4 TRAINING	14
B.4.1 Content and Quality of the Training	14
B.4.1.1 Local Training: Research Training Projects	14
B.4.1.2 Secondments	16
B.4.1.3 Network Training Activities (NTAs)	16
NTA-1. Introduction to the Geology of SE Asia	17
NTA-2. High-resolution chronostratigraphy	17
NTA-3. Bioinformatics and geoinformatics	18
NTA-4. Palaeoecology and geological analysis	19
NTA-5. Palaeoceanographic proxies and biogeochemical modelling	20
NTA-6. Sedimentology, biostratigraphy, and palaeoecology at a seismic scale	20
B.4.1.4 International Symposia	21
SYM-1. SE Asian Gateway Evolution	21
SYM-2. Geological, Environmental, and biotic history of SE Asia	21
B.4.1.5 Training in Complementary Skills	21
B.4.2 Importance and Timeliness of Training	22
B.4.3 Size of Training and Balance Between Categories of Researchers	22
B.5 IMPLEMENTATION	23
B.5.1 Institutional Capacities	23
Natural History Museum (NHM)	23
Christian-Albrechts Universität Kiel (CAU)	23
Nationaal Natuurhistorisch Museum Naturalis (NNM)	23
Royal Holloway University of London (RHUL)	24

THROUGHFLOW

Universität Bremen (UB)	24
Universidad de Granada (UG)	25
Universiteit Utrecht (UU)	25
Curtin University of Technology (CU)	25
Pusat Survei Geologi (PSG)	25
Smithsonian Tropical Research Institute (STRI)	26
University of Queensland (UQ)	26
Palynova (PN)	26
Murphy Sarawak Oil Co. Ltd (MO)	26
B.5.2 Work Plan	26
B.5.3 Industrial Participation	27
B.5.4 Financial Management	27
B.5.4.1 Track Record of Host and Partner Institutions	28
B.5.5 Complementarity Among Nodes	28
B.5.6 Organization and Management Structure	28
B.5.7 Dissemination of Results and Intellectual Property	29
B.5.8 Recruitment Strategy	30
B.6 IMPACT	31
B.6.1 Individual Researchers	31
B.6.2 Network Institutions	32
B.6.3 European Research	32
EC-Policy Related Issues	32
Public Awareness	32
Synergies with Education at all Levels	33
Gender	33
Safety Issues	33
References Cited	33
B.7 ETHICAL ASPECTS	33
Ethical Issues Table	34
APPENDICES	
Letter of Intent -- Palynova	35
Letter of Intent -- Murphy Oil	36
TABLES	
Table 1. List of Participants	4
Table 2. Research Training Projects	7
Table 3. List of Network Training Activities and Symposia	13
Table 4. Participation of out-of-network researchers in network activities	17
Table 5. Project Work Plan	27
FIGURES	
Figure 1. Recent and paleogeography of SE Asia	6
Figure 2. Information flow among work areas	12
Figure 3. Management structure	28

THROUGHFLOW

B.1 LIST OF PARTICIPANTS

Table 1. A list of participants in THROUGHFLOW, including the requested number of Early Stage Researchers (ESR) and Visiting Scientists (VS) in each institution over the 48 month duration of the project. No support for experienced Researchers is requested. Both industrial partners are committed to intermediate level of network participation. Asterisks indicate the coordinating institution responsible for the contribution of each work area.

Short Name	Full Network Partner	Country	Scientist-in-charge	Work Area	ESR	VS	Sum
CAU	Christian-Albrechts-Universität zu Kiel	Germany	Prof. Wolfgang Kuhnt	P*	72	6	78
NHM	Natural History Museum	UK	Dr. Kenneth Johnson	B*	72	-	72
NNM	Nationaal Natuurhistorisch Museum Naturalis	Netherlands	Dr. Willem Renema	S*	72	-	72
RHUL	Royal Holloway University of London	UK	Dr. Wolfgang Müller	G*	36	-	36
UB	Universität Bremen	Germany	Prof. Michael Schulz	P	36	-	36
UG	Universidad de Granada	Spain	Prof. Juan Carlos Braga	E*	72	-	72
UU	Universiteit Utrecht	Netherlands	Dr. Wout Krijgsman	S	36	-	36

Name	Associated Partner	Country	Primary Colleague	W.A.
CU	Curtin University of Technology	Australia	Dr. Moyra Wilson	G
PSG	Pusat Survei Geologi, Bandung	Indonesia	Dr. Jajang Sukarna	G
STRI	Smithsonian Tropical Research Institution	Panama	Dr. Aaron O'Dea	E
UQ	University of Queensland	Australia	Dr. John Pandolfi	B

Name	Level	Industrial Partner	Country	Primary Colleague	W.A.
MO	2	Murphy Sarawak Oil Co. Ltd.	Malaysia	Mr. Peter Lunt	S
PN	2	Palynova	UK	Dr. Robert Morley	S, P

B.2 PROJECT OVERVIEW AND OBJECTIVES

THROUGHFLOW is a network of earth and life scientists including geologists, palaeoceanographers, palaeontologists, sedimentologists, systematists, ecologists, and geochemists from academic institutions and industry (Table 1). This ITN brings together a novel association of expertise but this is based on some well-established collaborations between team members, represented by joint publications including one published in *Science* in August, 2008 (Renema *et al.* 2008). The network will collaborate in the shared field work, co-supervision of ESRs, and in industrial consultancy. THROUGHFLOW includes premier biodiversity and geological institutions in four European states, and first-class collaborating partners in the field of consulting for the petroleum industry. The network nodes and associated members have been selected to provide world-class experience to the ESRs in the fields related to the project. We are aiming to **combine leading researchers with unique experiences of field and laboratory research on the geology, stratigraphy, and palaeontology of SE Asia with experts in global change research**. The resulting team will be able to provide an excellent research training programme.

THROUGHFLOW has four primary objectives.

- (1) **To provide a unique training experience for eleven early stage researchers (ESR) in field, laboratory, and transferable skills combining the highest level of specialist skills development with the ability to work productively in a multi-disciplinary environment, as is increasingly essential to pursue high-level careers in industry or academia.**
- (2) **To develop a new integrated methodology for collecting, analyzing, and synthesizing the disparate range of information needed to document the geological record of environmental and biotic change in coral reefs and other highly diverse tropical marine ecosystems.**

(3) To improve awareness in the broad scientific and general community of the value of ancient biotic response to environmental change to aid the prediction of outcomes of ongoing anthropogenic global environmental change on coral reefs.

(4) To provide a cohort of European researchers with a strong professional network that will allow Europe to take the lead in studies of the geologic history of diverse tropical ecosystems.

The EU-based institutions will coordinate research training activities in collaboration with several world-class partner organisations and two industrial partners (Table 1). **Associates will participate in network activities using alternative funding sources**, in particular taking advantage of the Australian International Science Linkages Competitive Grants Scheme that is aimed at supporting Australian researchers in collaboration EU FPVII projects. **The industrial participation will provide additional scientific and complementary skills training. The ESRs will also gain insights into the application of geology, stratigraphy, and palaeontology in the oil and gas exploration industry.**

B.3 S&T QUALITY

B.3.1 Research Topic and Project Objectives

The research aim of THROUGHFLOW is to establish a greater understanding of key processes in the biotic response of coral reefs to long-term environmental changes resulting from closure of the Indonesian Throughflow during the Oligocene-Miocene transition (~25 Million years ago). This will establish important baseline data on which researchers can model the impact of predicted environmental change on present reef ecosystems.

Coral reefs and associated shallow-water habitats support the most diverse and productive marine ecosystems on Earth and are of enormous socio-economic value. However, coral reef systems are under increasing threat from a range of natural and man-made disturbances, including both localised impacts from pollution, eutrophication, and fisheries and global environmental changes resulting from the activities of humans (Donner *et al.* 2007; Bruno & Selig 2007). These global environmental changes have both direct and indirect impacts on coral reef ecosystems, and include rise of sea level and changes in ocean circulation that may alter the temperature, salinity, or surface productivity of sea water surrounding reef ecosystems. Associated climate change might also result in more frequent and intense tropical storms with consequences for coastal ecosystems. Finally, higher concentrations of atmospheric CO₂ may lead to ocean acidification.

Determining the response of marine ecosystems to anthropogenic environmental change is a critical research priority for both Life and Earth Scientists. Ecologists studying modern reefs are faced with the dilemma that they have no baseline data to model the impact of predicted environmental change. Key problems associated with the absence of such baseline data include (1) the difficulty of distinguishing 'natural variability' from anthropogenic change, (2) the likelihood that the response may be non-linear, *i.e.* that they are likely to be resistant to change until some threshold is reached and then to show rapid and surprising change, (3) the possibility that responses may be contingent on regional or global history because past events may have enabled reef systems to be buffered to ongoing changes. For all of these reasons, long-term data extracted from the fossil record are required to understand the complex dynamics of coral reef ecosystems. Environmental change is a pervasive part of earth history, and modern reef-building corals have survived repeated and varied episodes of past environmental change. **Documenting the ancient dynamics is essential to the understanding of tropical ecosystems and requires a large-scale interdisciplinary approach.** Palaeontologists are increasingly studying rapid extinction events and other abrupt biotic changes in the fossil record. The most successful projects have come from study of deep-sea sediments, and especially from the **Integrated Ocean Drilling Program** and its predecessors. This programme has provided both access to extensive sedimentary records from the deep sea and the interdisciplinary framework essential for its interpretation, with cruise work

THROUGHFLOW

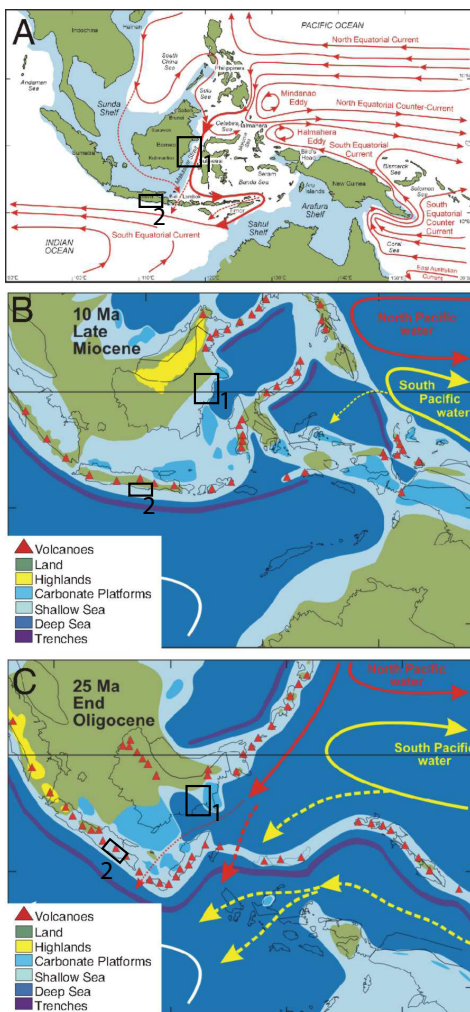


Figure 1 (A) Recent geography of SE Asia showing main ocean currents, including the highly constricted flow along the ITF. (B) and (C) show reconstructed palaeogeography and position of the ITF during Miocene (B) and Oligocene (C). The positions of study sites in Kalimantan (1) and Java (2) are shown.

focusing large teams of diverse specialists on common sample sets. By contrast, study of the response of shallow marine environments to past global change has been conducted on a small-scale, *ad-hoc* basis, despite the fact that such environments are intrinsically more complex to study, and of much greater direct relevance to humanity. The THROUGHFLOW model provides **an ideal basis to carry out a pioneering large-scale integrated study in a key location, and to train a new generation of researchers to develop this approach as a research model for 21st century palaeoenvironmental science.**

SE Asia contains the most diverse terrestrial and shallow marine biota on Earth, yet the factors responsible for the origins and maintenance of this diverse biota remain unknown. Molecular phylogenetic studies suggest that most extant taxa evolved during the Miocene (Meyer 2003; Williams & Duda 2008). However, the fossil evidence currently available to document this pattern and its geographic context is extraordinarily sparse, and primarily consists of small collections of fossils and publications from the late nineteenth and early twentieth centuries. **The existing data demand taxonomic and stratigraphic revision to accommodate advances in these fields over the past century, but most importantly there is a crucial need to collect new data.**

SE Asia contains the modern-day Indonesian Throughflow (ITF). The ITF is the last remaining equatorial oceanic gateway, allowing heat transfer as water flows from the Pacific into the Indian Ocean (Fig. 1A). Today, the highly constrained ITF is regarded as a major component of the modern thermohaline circulation, influencing global climate on short and long timescales (Gordon *et al.* 2003; Kuhnt *et al.* 2004). **The long-term history of the ITF is controlled by the complex plate tectonic history of the region.** Throughout the Cenozoic era, SE Asia has been characterized by convergence

of the Indo-Australian and Philippine-Pacific Plates with the stable Asian Craton, all interacting with many smaller microcontinental and oceanic fragments (Hall 2002). During the early Cenozoic, new basin formation and tectonic convergence constrained and narrowed the pathway for the ITF (Fig. 1B, C). At around the Oligocene-Miocene transition (~25 Ma) the Australian Plate impacted on the Philippine Sea Plate and the resulting formation of bathymetric barriers in the Philippines restricted deep throughflow. It is likely that from this time only shallow and intermediate water of Pacific origin comprised the ITF, as at the present day.

Is it a coincidence that the most diverse biota on earth occurs in a geologically dynamic region that also contains a major control of the global climate? There is evidence that these phenomena are related via long-term changes in coral reef ecosystems in the region. Modern shallow marine diversity is largely associated with coral reefs (Bouchet *et al.* 2002), but extensive reef building has not always existed in the region. Before the Miocene, shallow water carbonates are dominated by larger benthic foraminifera, and are widely distributed around the margins of basins on the eastern edge of Sundaland and on microcontinental blocks in eastern Indonesia. Corals are present before the Oligocene-Miocene transition, but are mostly confined to shallow shelf environments and do not

THROUGHFLOW

Table 2. List of research training projects and primary, secondary, and associated institutions that will provide expertise or facilities.

	Project concerning the Oligocene/Miocene history of the ITF	Primary	Secondary	Assoc.
B1	The effects of increasing reef on development coral diversity .	NHM	UB	UQ
B2	The origins and evolution of the modern Pacific reef algal flora.	UG	RHUL	UQ
B3	Diversity and Taxonomic turnover of mollusks	NNM	NHM	PSG
B4	Cenozoic history of bryozoan diversity in the Indo-West Pacific	NHM	UG	STRI
E1	Shallow marine palaeoenvironments and the ITF.	UG	NNM	CU
G1	High-resolution environmental proxies of microsampled corals and foraminifera	RHUL	CAU	CU
P1	Impact of changes in the ITF on global climate evolution – a modelling approach	UB	RHUL	PN
P2	Neogene circulation patterns and biogeography of foraminifera	CAU	NNM	MO
P3	Quaternary of the Makassar Strait: Base-line for Cenozoic reconstructions.	CAU	UG	PN
S1	Building a chronostratigraphic framework	UU	NNM	PSG
S2	Inter- and intra specific variation in large benthic foraminifera	NNM	NHM	MO

form extensive reefs. From around the Oligocene-Miocene transition and throughout the Miocene, coral reefs are extensive and widespread, forming over tectonic highs, along basin margins, and in newly flooded marine areas (Wilson 2002). These results suggest that three important changes occurred near the Oligocene-Miocene transition in SE Asia, including (1) constriction of deep-water flow through the ITF, (2) onset of extensive coral reef development, and (3) formation of the ancestral centre of diversity by increased speciation or immigration.

The overall aim of the THROUGHFLOW research programme is to determine the precise relationship among these three events using a multidisciplinary approach.

To facilitate management and implementation of the research programme, THROUGHFLOW has been divided into five work areas. Activities will be fully collaborative with team members contributing to several work areas, but five coordinating institutions will assume responsibility for one work area in collaboration with a key associate partner (Table 1). All network partners are currently involved in directly relevant research projects and will share the results of these separately funded projects with the network-funded partners in addition to hosting the 11 ESRs directly funded by the THROUGHFLOW project (Table 2).

The following list of projects will provide the 11 ESRs to be recruited with a range of PhD topics to choose from. The specific topics will be adapted to their individual experience and training needs. The training objectives of each of the projects is set out in 4.1.1 below.

Biodiversity WORK AREA B - (coordinated by NHM) will produce a quantitative description of the pattern of biotic change through the study of sections that can be compared with independent environmental proxies. Specific objectives include: (1) Produce an explicit operational taxonomic framework for the key shallow marine taxa in the region, (2) document the stratigraphic distribution of key taxa in the region to highlight temporal intervals of accelerated extinction or diversification in the shallow water biota, (3) determine how changes in the diversity of local communities combine to produce regional patterns of diversity change, and (4) compare the diversity and composition of assemblages in reef and non-reef deposits.

Project B1. The effects of increasing reef development on coral diversity (NHM/UB/UQ). The aim is to document in detail the distribution and abundance of reef coral species to determine the rate and mode of biodiversity change in reef-coral communities across the Oligocene-Miocene transition in the region. Ecological survey techniques will be used to estimate the relative abundances of constituent corals using a taxonomic framework derived from study of collections at the NNM and NHM and literature review. Replicate samples will be collected of all putative taxa encountered, with larger samples of morphologically diverse taxa. The resulting distribution data will be integrated within palaeoenvironmental and stratigraphic frameworks and combined with

THROUGHFLOW

records from existing museum collections. **Quantitative analyses of this occurrence data set will allow the extraction of regional diversity dynamics in the reef-coral biota** while controlling for artifacts imposed by uneven sampling or uneven distribution of palaeoenvironments.

Project B2. The origins and evolution of the modern Pacific reef algal flora (UG/RHUL/UQ).

The aim is to document the timing and patterns of the diversification of Indo-Pacific reef-building coralline algae, the second most important builders in modern Indo-Pacific reefs. This group appeared in Late Oligocene-Early Miocene times in the IWP area. Sedimentary and palaeoceanographic signals will be used to correlate algal origination (and extinction) events to variations in reef fossil assemblages and regional/global palaeoenvironmental changes. **This project will provide insight into the possible environmental/global context responsible for the origins and maintenance of modern-day diversity.**

Project B3. Diversity and taxonomic turnover of molluscs (NNM/NHM/PSG). Reef-associated mollusc communities in the Indonesian area are the most diverse in the world. Shallow parts of reefs include a diverse set of microenvironments such as reef flats, sea grass meadows, shingle ramparts, and mangroves characterised by very specific mollusc communities that can also be recognised in the fossil record. **This project aims to study development and resilience of these communities from the Oligocene and Miocene and to compare these with the architecture of and spatial variability within modern shallow reef molluscan communities in order to provide a baseline for further work on their response to human-induced pressure.** Samples will be linked to specific habitats resulting from mapping (modern systems) or facies analyses (fossil settings). Replicate samples will be taken in each of the habitats in order to study within and between habitat variability. Mollusc community data will be integrated with biodiversity data from other projects in work area B.

Project B4. Cenozoic history of bryozoan diversity in the Indo-West Pacific (NHM/UG/STRI).

Almost nothing is known about the fossil bryozoans from the Cenozoic of the IWP although they are occasionally recorded in the literature. **This project will pioneer the study of Cenozoic bryozoans, adding these colonial animals to the range of organisms from which biotic responses to changing environments through time can be assessed.** The main objectives will be (1) to identify bryozoan taxa present in sampled sections from the Late Oligocene-Early Miocene of SE Asia, (2) in collaboration with work area E, to track changes in bryozoan diversity and taxonomic composition and correlate these with facies changes, (3) to estimate mean annual range in temperature values from within-colony variations in zooid size, and (4) to apply variations in branch diameter of erect bryozoans to reconstruct palaeobathymetry.

Environments - WORK AREA E - (coordinated by UG) will provide a quantitative description of palaeoenvironments and their temporal and spatial patterns from local to regional scales. Specific objectives include: (1) Identify the major shallow-water marine palaeoenvironments by their physical (sedimentological-geochemical) and palaeobiological characteristics, (2) document the spatial patterns of major palaeoenvironments at a local ('subregional') scale at the highest stratigraphic resolution available, (4) document the temporal changes of the spatial patterns and interpret them in a sequence stratigraphic framework.

Project E1. Shallow marine palaeoenvironments and the ITF (UG/NNM/CU). This project aims to characterize shallow-water non-reefal carbonate palaeoenvironments during the Oligocene-Miocene transition and to understand how these environments responded to the initial constriction of the ITF reducing deep-water circulation. Research methods to be applied include identification of lithostratigraphic units, carbonate lithofacies, and major taphonomic attributes and biotic components in each site/section. Results will be compared with those from other work areas to correlate palaeoenvironmental variations with available data indicative of local to global environmental changes. **The project will contribute important new knowledge about the**

environmental context of formation of non-reefal carbonates in SE Asia, which are volumetrically very significant deposits.

Geology and Geochemistry - WORK AREA G - (coordinated by RHUL) will document the tectonic, geological, and sedimentological context. Specific research objectives include (1) Produce a tectonic and sedimentological framework to evaluate regional geological changes including (2) palaeogeographic maps, and (3) Determine the controls on spatiotemporal sedimentological (facies) variations in shallow marine deposits. (4) Detailed geochemical analysis of environmental proxies to investigate key factors likely to be influenced by the ITF, such as sea surface temperature, nutrients, sea surface salinity, seasonality, and isotopic and trace element studies fingerprinting different water masses.

Project G1. High-resolution environmental proxies from microsampled corals and foraminifera (RHUL/CAU/CU). Coral and foraminifera are widely used in (geo)chemical palaeoceanography as recorders of past conditions including sea-surface temperatures (SST), sea-surface salinity (SSS), palaeo-pH, temperature variation in the upper ocean surface waters, or nutrient chemistry. Using high-spatial resolution sampling, by laser-ablation mass spectrometric analysis (LA-ICPMS) the continuous archives contained in coral skeletons can be sampled at approximately *weekly* resolution, allowing the reconstruction of past seasonal variability in key palaeoceanographic parameters. For instance, Sr/Ca ratios as SST proxy combined with conventionally microsampled oxygen isotope records from coral time series allows to disentangle effects of SST and rainfall. The Mg/Ca composition of foraminiferal shells varies exponentially with temperature, which thus can be utilized to constrain the temperatures of either top or bottom ocean waters (planktonic or benthic foraminifera). High-spatial resolution analysis by LA-ICPMS allows measuring individual chambers, and thus reconstructing environmental conditions through their life cycle. This is a huge improvement over conventional Mg/Ca analysis of bulk foraminifera samples.

Palaeoceanography and Climate -WORK AREA P - (coordinated by CAU) will provide records of palaeoceanographic change on orbital timescales that allow integration of biotic evolution, ocean chemistry and circulation changes. Specific objectives include: (1) Correlation of newly obtained isotope records from shallow marine sites in the ITF pathways with existing high resolution records from Indian Ocean and West Pacific ODP sites to provide a chronologic framework on orbital time scales. (2) Document the stratigraphic distribution of foraminiferal key taxa in order to improve the biostratigraphic framework and recognize intervals of accelerated extinction or speciation. (3) Characterize local water masses (salinity, surface temperatures) with geochemical (stable isotopes, Mg/Ca) and micropalaeontological proxies. (4) Integrate proxy data with biogeochemical box models and global and regional circulation models.

Project P1. Impact on changes in the ITF for global climate evolution – a modelling approach (UB/RHUL/CAU/PN). Our aim is to improve understanding of the role of Indonesian Throughflow (ITF) changes in shaping Cenozoic climate evolution focusing on tectonism as a major driver. The ESR will explore the influence of Oligocene-Miocene local tectonic changes on the ITF and global scale. We will study global ocean circulation and its influence on climate using the comprehensive Community Climate System Model ver.3 (CCSM3). CCSM3 consists of four interactively coupled components representing atmosphere, ocean, land surface, and sea ice. The climate model will be set up with palaeogeographic configurations based on plate tectonic reconstructions (provided by work area G) for three time slices: 30 My, 20 My, and 10 My before present. **This provides essential palaeoenvironmental context to interpret local biotic change.**

Project P2. Neogene circulation patterns and biogeography of foraminifera (CAU/NNM/MO). Our aim is to reconstruct the palaeoceanographic impact of initial closure of the ITF deep-water connection between the Pacific and Indian Ocean. The ESR will estimate the volume and hy-

drography of interoceanic water mass exchange since the Early Oligocene to assess the impact of major Oligocene-Miocene climatic and sea-level events. We will use a combination of foraminiferal biogeography, Mg/Ca-thermometry, stable carbon and oxygen isotopes and Nd isotopes as indicators of Pacific/Indian Ocean water mass mixing. Use of Nd isotopes in palaeoceanography is a novel development with especially high potential in the mixing area of water masses with strongly radiogenic (Pacific) and non-radiogenic (Indian Ocean) isotopic signatures.

Project P3. Quaternary of the Makassar Strait: Base-line for Cenozoic reconstructions.

(CAU/UG/PN). The aim is to calibrate palaeoceanographical, palaeontological and sedimentological proxy records of intensity and hydrologic structure of the ITF within the Makassar Strait. Following two major hydrocarbon exploration programmes in 2003 and 2007, many gravity cores are available for study from the N, S, and central areas of the Makassar Strait (Morley *et al.* 2004). In combination with existing oceanographic data the ESR will calibrate the palaeo-circulation and -hydrography proxies used in Project P2 together with (pollen/spores, sortable silt and other sedimentological current indicators) with observed and modelled modern and glacial surface, thermocline and deep-water circulation patterns (Gordon 2005; Kuhnt *et al.* 2004). **The ESR will produce a model showing the impact of the Indonesian Throughflow on modern and glacial sedimentation through the Makassar Straits. The model will be directly applicable to the interpretation of Cenozoic candidate Throughflow-related features.**

Stratigraphy and Time - WORK AREA S (coordinated by NNM) will develop the stratigraphical framework and age models underlying the entire project that will allow the precise correlation of patterns and events on local, regional, and global scales. Specific research objectives include: (1) Sample sections and produce biostratigraphic zonations for stratigraphically significant microfossils (larger benthic and planktonic foraminifera, calcareous nannoplankton, pollen), (2) Produce a solid geochronologic framework by using magnetostratigraphy and Sr-isotope dating methods, (3) Incorporate the new zonations into the regional schemes based on (a) existing information held in European research institutions and (b) sources in the Petroleum industry to produce a rigorous stratigraphical framework that allows high resolution correlation between sections, and to published regional and global schemes.

Project S1. Building a chronostratigraphic framework (UU/NNM/PSG). This project aims to establish a **detailed chronologic framework for the Oligocene-Miocene transition interval on Java and Kalimantan** by the integration of a wide range of dating tools including biostratigraphy, magnetostratigraphy, isotope (strontium) stratigraphy in combination with radiometric ($^{40}\text{Ar}/^{39}\text{Ar}$) dating techniques. A magnetostratigraphic time frame for the Oligocene-Miocene interval will be constructed by combining marginal shallow marine sequences to the basinal deep water successions that are exposed along several river incisions. Additionally, initial Sr-isotope dating in the region provides promising results for increasing the number of well-dated events, and can thus be used as controls on datum planes in magnetostratigraphy and biostratigraphy.

Project S2. Inter and intra-specific variation in large benthic foraminifera (NNM/NHM/MO).

The aims of this project are (1) Quantify the changes in large benthic foraminifera (LBF) assemblage composition with time, and (2) produce a detailed map of external and internal morphospace occupied by LBF. Secondary goals, in cooperation with other projects, will be to place these in a highly resolved chronostratigraphic (with project S1) and environmental framework (with node E). This will allow us to determine whether observed changes in LBF fauna composition are environmentally or evolutionary driven. The interplay between evolutionary and environmental change is a limiting factor for the use of LBF in biostratigraphy. LBF are very abundant in tropical carbonate deposits, and field geologists rely on them as a primary source for biostratigraphic age assignments.

B.3.2 Scientific Originality

THROUGHFLOW will focus the efforts of a team of outstanding experienced researchers and a group of 11 ESRs working on a series of inter-related projects to document the Oligocene/Miocene evolution of the Indonesian Throughflow and resulting regional environmental changes and biotic response using independent lines of evidence drawn from disparate fields. **This level of collaborative research was long ago shown to be extremely productive in fields such as oceanography, physics, and astronomy, but has rarely been applied to developing large-scale projects combining results from the earth and life sciences.** One successful model is the *Panama Paleontology Project (PPP)* - an interdisciplinary research programme designed to document the environmental and biotic effects of the emergence of the Central American Isthmus during the Neogene (Johnson *et al.* 2007, 2008; O'Dea *et al.* 2007). This project has operated successfully for over 20 years and has resulted in over 100 research articles in general and specialist high-profile journals. Several members of THROUGHFLOW have been closely associated with the PPP and will apply this operational experience in developing an even more successful programme in SE Asia.

Although some formation-scale sedimentological work has been undertaken in the region, to date there have been no integrated sedimentological, geochemical, and biotic studies to evaluate regional-scale trends. The **Geology and Geochemistry Work Area** will coordinate the collection of independent sedimentological data to provide independent environmental proxy data. When combined with the biotic and geochemical data this will allow accurate reconstruction of past environments and evaluation of possible controls. Geochemical analysis is now widely used as a powerful tool in environmental research, but in SE Asia, geochemical studies are still in their infancy, probably because the sedimentology of many formations is only just being elucidated. Geochemical sampling will be on a micro-(e.g. skeletal growth bands) to formational-scale to investigate annual to millennial-scale influences.

Although litho- and biostratigraphic frameworks for the region are well established in the petroleum industry, limited data are publicly available. There have been extensive discussions on the stratigraphic schemes, and there is a long history of adjusting boundaries, and differences in interpretation of biozones. By introducing reference sections in which we will measure palaeomagnetic reversals, the **Stratigraphy and Time Work Area** will develop a **state-of-the-art chronostratigraphy** that will be tested with Sr isotopic dates from key parts of the section. The challenge will be to produce **this new stratigraphic framework** for relatively shallow basins characterised by poor lateral continuity and in which hiatuses are common, so the use of sequence stratigraphical approaches will be essential.

The **Environments Work Area** will implement the **first systematic approach to understanding Cenozoic tropical Indo-Pacific shallow marine environments** from a multidisciplinary multi-proxy approach, providing new insights on the environmental framework leading to the development of the modern day biodiversity hotspot.

We expect **that at least two-thirds of the species discovered by the Biodiversity Work Area will not have been previously described**, but a complete formal taxonomic revision of the groups is neither required nor desirable to meet the objectives of the project. Instead we will develop an operational taxonomic framework that will enable us to rapidly document primary biotic patterns. We will ensure the consistent usage of names and taxon codes within this project by producing on-line reference collections and lists of diagnostic characters for each taxon. This will facilitate the future work of specialist taxonomists to produce formal revisions for each of the study groups. In addition, we will **take advantage of recent advances in the field of analytical palaeobiology** to detect potential artifacts in resulting patterns imposed by the nature of the record or by incomplete

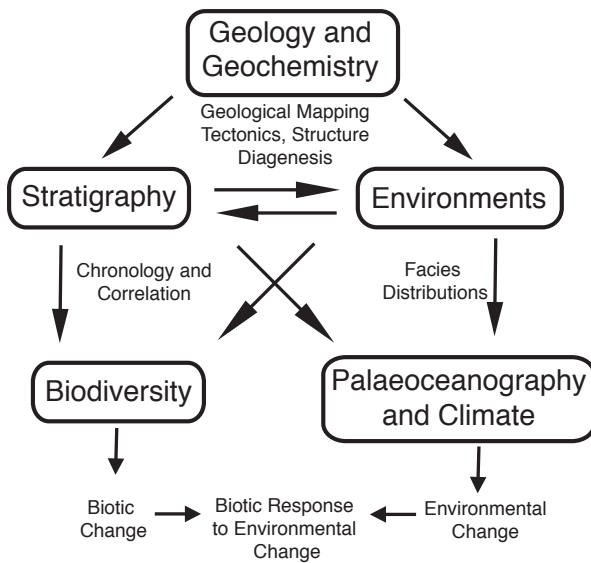


Figure 2. Illustration of information flow among work areas required to address the primary objectives of THROUGHFLOW.

sampling. **We will use new bioinformatics approaches particularly including web-based collaboration.**

The **Palaeoceanography and Climate Work Area** will directly link the main studies focused on shallow marine sections with the much better studied deep-sea record of global climate change provided by the **Ocean Drilling Program**. The ITF area is one of the world's most critical areas to understand early Neogene global ocean circulation, sea level history, climate and biotic evolution. It is a prime target of future IODP drilling to explore the linkage of climate and tectonic evolution and is one of the most promising areas in hydrocarbon exploration. **The Oligocene-Miocene time interval is pivotal in the plate tectonic and biogeographic evolution of this area**, since this is the time when the Australian continent first collided with SE Asia and restricted the previous broad deep oceanic connection between the Pacific and Indian Oceans.

B3.2.1 Synergies amongst Work Areas and Associates.

The five work areas will each contribute to the overall objectives of the training programme (Fig. 2). There will be a strong emphasis on communication between ESRs to ensure that they appreciate the significance of both their own contributions and those of their colleagues. The geological and sedimentological studies require rigorous underpinning by the stratigraphic team to date key sections and events. A solid stratigraphic framework is also required to study the temporal distribution of fossils, and palaeoenvironmental data are needed for the interpretation of ecological results. Sharing of common high-resolution sample sets in common field campaigns will be a pre-requisite for the establishment of a stable carbon isotope stratigraphy, directly correlated to the biostratigraphy and magnetostratigraphy. Ecological interpretations of fossil assemblages will benefit from palaeotemperature and palaeosalinity estimates. Samples processed for fossils will also be used to estimate carbonate grain composition to document regional variation in carbonate production. Many of the statistical and modelling techniques used to document ecological and evolutionary changes in fossil biota are based solely on the fossil distributions (including ecological techniques such as rarefaction, recapture stats, etc.), but other methods can apply information from palaeoenvironmental reconstructions or sequence stratigraphic interpretations to provide new models that can be used to dissect meaningful biological signals from the noise imposed by preservation bias or incomplete sampling. We will take full advantage of these interdisciplinary methods in the implementation of this project.

B.3.3 Research Method

Research material will be collected in the field during two field-based network training activities (NTA) (Table 3). Previous field study by our team confirms availability of suitable exposures and well-preserved fossil material in two particular areas (Fig. 1): (1) The Southern and Menoreh Mountains near Yogyakarta (Java, Indonesia). These sites are selected as the target for the first NTA based on the logistically less complex location. (2) East Kalimantan. Sections containing numerous fossils in the targeted environments and age range are readily accessible from Samarinda, in the Indonesian province Kalimantan Timur.

THROUGHFLOW

Table 3. List of Network Training Activities and Symposiums, including a draft timetable, the name of the coordinating institution and venue.

Code	Date	Co-ordinator	Venue	Short Course/Practical Training	Complementary/Transferrable Skills
SYM-1	Month 2 (Sept. 2009)	RHUL/NHM	Egham, UK	SAGE: SE Asian Gateway Evolution.	
NTA-1	Month 6 (Jan. 2010)	RHUL	Egham, UK	An introduction to the Geology of SE Asia.	GIS and the visualisation of spatial data.
NTA-2	Month 10 (May 2010)	NNM/PN	Yogyakarta, Java, Indonesia	High-resolution chronostratigraphy in clastic and carbonate settings.	Live from the field: communicating Science to wider audiences.
NTA-3	Month 14 (Sept. 2010)	NHM	London, UK	Bioinformatics and geoinformatics: new approaches to integrating research data using the WWW.	IPR: Practices and implications for research in the Natural Sciences.
NTA-4	Month 22 (May 2011)	PN/NHM	Samarinda, Kalimantan, Indonesia	Palaeoecology, geological analysis, and interpretation of past environments.	Life on the other side: Research careers in the petroleum industry
NTA-5	Month 26 (Sept. 2011)	CAU	Kiel Germany	Palaeoceanographic proxies and biogeochemical modelling.	Marine Resources and Risks: Options for regional ocean management
NTA-6	Month 34 (May 2012)	UG/PN	Almería, Spain	Sedimentology, biostratigraphy, and palaeoecology at a seismic scale	Geotourism: Sustainable tourism activities focused on geoheritage.
SYM-2	Month 47 (June 2013)	NNM	Leiden, Netherlands	International Symposium on the geological, environmental, and biotic history of Southeast Asia.	

All sampling will be undertaken in the field after logging and facies mapping of measured sections. Material will be described, partially processed (washed and sorted into taxonomic groups), curated as required, and given unique sample tracking numbers on site. All collections will be shipped to London for additional sorting and dispatch to the network nodes for further processing, curation, and accession into appropriate partner laboratories and museum collections.

Sedimentological and diagenetic analysis of samples by the **Geology and Geochemistry Work Area** will include microscopic analysis of hand samples, petrographic analysis of thin sections, cathodoluminescence and scanning electron microscopy. Geochemical analysis will include X-ray diffraction, isotopic and elemental analysis after micro-drilling key components or through high resolution probe and/or EDAX analysis.

Samples of microfossils will be collected and processed by the **Stratigraphy and Time Work Area** using standard techniques. High-level expertise in all the key groups exists within the network. The most frequently used biostratigraphic system used in the Cenozoic deposits of SE Asia is the letter classification based on the large benthic foraminifera. Most progress will be made by intercalating zonations based on multiple groups including planktonic foraminifera, calcareous nannoplankton (both more abundant in deeper habitats) and pollen and spores (in more coastal settings). For these taxa standardised biozonations are available. We will attempt **to resolve the levels of ecophenotypic and geographic variation by defining the best characters to distinguish biostratigraphically useful taxa**, ideally at a species instead of genus/species-group level. Well preserved material in the reference sections will allow use of Sr-isotope dating. Palaeomagnetic signature will be measured in all sections following standard techniques.

The **Environments Work Area** will proceed by field mapping and sampling of study sections for quantitative taphonomic and palaeoecological analyses. **This will include quantitative identification of major palaeoenvironments by means of sedimentology, taphonomic attributes, and the use of index taxa and palaeoecological ordination of fossil assemblages.** In collaboration with the Biodiversity Work Area, all interpretations will be based following

well-defined criteria documented in a data and image library of diagnostic features of the identified major palaeoenvironments in their stratigraphic framework.

The **Palaeoceanography and Climate Work Area** will analyse bulk and foraminiferal specific isotopes and Mg/Ca Analyses (LA-ICPMS and ICP-OES) to reconstruct palaeo-temperatures and salinities. In addition, Nd-isotopes in ferromanganese incrustations of foraminifera will be tested as tracers of Pacific and Indian Ocean water masses. In collaboration with Work Area S, they will **develop a new orbital stratigraphy for the region using carbon-isotope curves as a high-resolution correlation tool to tuned deep-water records.**

Sampling of biodiversity data in study sections will allow the **Biodiversity Work Area** to apply newly developed palaeontological and ecological techniques to document the temporal pattern of biotic change. We will use bulk sediment samples collected from unconsolidated sediments supplemented by time-normalized visual collection of macrofossils or ecological survey methods as required. After shipping to a sorting centre based at NHM, splits of samples will be distributed among taxonomic experts for further study using standard fossil preparation and taxonomic techniques appropriate to each group (thin sectioning, visualization and morphometric data acquisition using CT scanners or 2D imaging facilities).

As data and analyses accumulate from each work area, information will be loaded onto a project-wide data repository that is part of the *European Distributed Institute of Taxonomy (EDIT)*, a collective of 27 biodiversity institutions funded by the European Commission (<http://www.e-taxonomy.eu/>).

B.4 TRAINING

B.4.1 Content and Quality of the Training

THROUGHFLOW will have multiple mechanisms for providing training in research, transferable and complementary skills based on a combination of local specialist training with network-wide training activities coordinated via the five work areas. **Local Training** in each network node will take advantage of specific expertise and facilities in each institute to provide high-level training in a particular specialist area, in each of the 11 projects to be completed by ESRs (Table 2). In addition, each ESR will participate in **secondments** at another node or associated institution. This additional mobility will provide ESRs with access to extra specialised resources and encourage collaboration among network nodes that is essential to providing interdisciplinary training. Institutional training will be supplemented with a series of six **Network Training Activities (NTAs)** (Table 3). Finally, **two international symposiums** on the geological, environmental, and biotic history of SE Asia will be held that will provide venues for ESRs to obtain broad overview of current research topics in the region as well as encouraging the development of professional networks between the ESRs and experts from industry and academia in specialist research areas.

In collaboration with their local supervisors, each ESR will develop a **personal training plan** at the start of their employment. Progress and updates to these plans will be presented annually to the Supervisory Board. One member of the Management Board will act as a **special training and career development advisor** to ESRs to help solve any issues that might arise within particular training projects and in arranging any additional training elements.

B.4.1.1 Local Training: Research Training Projects

Specific training for each work area will be centered on practical experience available at the host institutions (Table 2). For the **Geology and Geochemistry Work Area**, ESRs will receive training in sedimentology, basin analysis, palaeogeographic reconstructions, facies analysis, and petrography. For the diagenetic and geochemical research full training will be given in different types of microscopy (petrographic, cathodoluminescence and scanning electron), XRD, isotopic and elemental analysis. Training will be given in the analysis, integration, interpretation and

THROUGHFLOW

presentation of these complex data sets. For the **Stratigraphy and Time Work Area** training will include familiarisation with the full range of methods applied including biostratigraphy, chemostratigraphy, magnetostratigraphy, and cyclostratigraphy and methods of integrating and communication diverse stratigraphic data such as graphic correlation and age-depth modelling. The **Environments Work Area** will provide training in quantitative taphonomic and palaeoecological analysis with a focus on environmentally-informative taxonomic groups including calcareous algae. Researchers will receive field and laboratory training in analysis and interpretation of geometries and sedimentary variability of shallow water carbonates. The **Biodiversity Work Area** is capable of providing taxonomic training in a broad range of fossil biota (molluscs, corals, echinoderms, bryozoans, and calcareous nannofossils). Researchers will be trained in modern taxonomic practice including fossil preparation and curation, quantitative morphology, and analytical palaeoecology. Advanced use of bioinformatics is an important part of the training that will be provided.

The chief mechanism for providing local training is a series of research training projects that will be completed by ESRs within each of the work areas. The objectives, general methodology, and anticipated outcome for these projects have been summarised in Section B.2.1 of this proposal. The following is an outline of the specific training to be provided;

Project B1: The ESR will receive training required to document the abundance and distribution of reef-corals in carbonate and siliciclastic settings. This will require expertise in the taxonomy of corals and training in the description of skeletal morphology using quantitative methods. The ESR will also assemble species-occurrence data and learn advanced methods to document palaeobiodiversity dynamics using specimen-based occurrence data.

Project B2: The specific training includes (1) procedures for data retrieval at outcrops: lithostratigraphy and facies recognition, identification of major fossil reef components, recognition of spatial relationships between fossils, especially corallines, and their biotic or abiotic substrate; (2) taxonomic practice applied to a major group of fossils; and (3) use of palaeontological data to interpret ancient environments and their variations throughout time.

Project B3: The ESR will be trained in marine ecology, palaeoecology, numerical community analyses, stratigraphy, and molluscan systematics.

Project B4: Training will be provided in bryozoan morphology and taxonomy as well as collection of bryozoans in the field and sample sorting.

Project E1: Training includes (1) procedures for relevant data retrieval at outcrops such as lithostratigraphy and facies recognition, identification of major fossil components; (2) Field-based taphonomic analyses, recognition of spatial relationships between fossils, and their biotic or abiotic substrate; (3) analyses of sedimentological, geochemical, and palaeobiological data; and (4) use of sedimentary and palaeontological data to interpret ancient environments.

Project G1: The ESR will receive an introduction to the theory and practice of geochemical analysis of carbonates in fossils and carbonate rocks, with specific emphasis on methods for high-spatial resolution sampling, as available by excimer laser-ablation mass spectrometric analysis, or micro-milling. Additional training will consist of theory and application of radiogenic isotopic techniques (Sr, Nd, Pb) such as thermal ionization mass spectrometry and multi-collector inductively-coupled-plasma mass spectrometry.

Project P1: The ESR will gain experience with climate modelling and scientific computing in a parallel supercomputing environment including statistical analysis of large (model-generated) data sets. Global climate models are the prime tools for projections of future (anthropogenic) climate change. CCSM3 is one of the models that have been used in the recently published IPCC Fourth Assessment Report. The ESR will learn how to work with such a comprehensive numerical model and how to analyse its output.

THROUGHFLOW

Project P2: Specific training includes foraminiferal taxonomy and palaeoecology (in cooperation with the NHM), stable isotope, and Mg/Ca analyses. The ESR will also apply leaching techniques (established at IfM-GEOMAR) for analysis of Nd-isotopes in authigenic ferromanganese oxide coatings and planktonic foraminiferal tests. In addition, the ESR will undertake modelling of water mixing relationships via box models.

Project P3: Specific training includes techniques of retrieval, handling, and correlation of marine sediment cores (box cores, multicores and, piston cores), non-destructive analyses (magnetic susceptibility, color reflectance and XRF scanning), core sampling, palynological and micropalaeontological sample processing and analysis of spores and pollen, stable isotopes, Mg/Ca-palaeotemperature and sedimentological current intensity proxies.

Project S1: Specific training objectives involve application of magnetostratigraphic sample protocols, measuring and interpreting magnetic polarity of sedimentary rocks, as well as integrating the results of different stratigraphic schemes or methods with a rigorous assessment of levels of uncertainty involved. Finally, training will involve sampling, analysis, and interpretation of Sr-isotope age measurements.

Project S2: The ESR will apply morphometrics for species identification, use of multivariate statistics to separate random variation from change over time or space in both assemblage composition and evolutionary change in selected lineages of LBF. Apart from these (technical) skills the ESR will be taught how to discriminate between intrinsic or extrinsic driving forces responsible for the distribution of LBF.

B.4.1.2 Secondments. ESRs will be expected to participate in secondments to the secondary or associated institution designated for each project (Table 2). These secondments will last from six months to one year and will broaden exposure of ESRs to a diverse range of expertise and research facilities and increase the level of integration across the network. These secondments will be planned in discussion with each ESR and will take account of their individual backgrounds and training needs.

In most cases, research training projects within a particular work area will be based at the coordinating institution for that work area, but in other cases local expertise appropriate is at other institutions. For these projects, the secondment is critical to building strong relationships between the ESR and the other members of the team within their work area. All of the ESRs will be working in peer groups and will be encouraged to make active links with other research areas.

B.4.1.3 Network Training Activities (NTAs). We plan to organise a set of six NTAs (Table 3). Each of the THROUGHFLOW NTAs will include a combination of three components including:-

(1) A short course (2-4 days) to ensure that all network participants have a firm grounding in fundamental concepts required to produce integrated studies. (2) Practical field or laboratory-based training. (3) Complementary and transferable skills training. Four of the NTAs will take place at selected network nodes, two others will be hosted in Indonesia. **Transferable and complementary skills training will be provided both by local hosts using existing institutional staff development programmes and through a series of special network workshops mounted during the NTA.**

The Earth and Environmental Sciences are laboratory and field-based disciplines and the most efficient approach to developing excellent researchers is by exposing them as ESRs to as much field experience as possible. THROUGHFLOW will provide this field training during three field-based NTAs. Collaborative field training has the additional benefit of encouraging ESRs to work outside of their own specialist expertise and this cross-fertilization is a vital outcome of a well-designed interdisciplinary training programme. Currently, there is an alarming trend away from providing practical field-based training for European ESRs in the Earth Sciences, and **our contacts in the industrial sector indicate that lack of adequate field skills is a common weakness among**

THROUGHFLOW

Table 4. Participation of out-of-network researchers in network activities (*includes members of the Scientific Advisory Board)

Event	Days	Resear- chers
SYM-1 Symposium SAB only (UK)*	3	4
NTA-1 Geology of SE Asia (UK)	5	0
NTA-2 Chronostratigraphy (Java)	25	6
NTA-3 Geo- and Bioinformatics (UK)	5	5
NTA-4 Palaeoecology (E. Kalimantan)	25	6
NTA-4 SAB Mid-term report (E. Kalimantan)*	10	4
NTA-5 Palaeoceanography (Germany)	7	0
NTA-6 Seismic stratigraphy (Spain)	5	10
SYM-2 Symposium (Netherlands)*	3	14

applicants for positions in the environmental consultancy and petroleum industries.

THROUGHFLOW will benefit from a multidisciplinary approach to training in both the field and laboratory. Field work is required to collect the large volume of new information essential for documenting environmental and biotic change during the Late Oligocene to Early Miocene in the region. The entire network will participate in each NTA, and the **field-based NTAs will be**

organised as 'onshore research cruises' modelled on the highly successful Integrated Ocean Drilling Program (IODP). During the field-based NTAs, the THROUGHFLOW team will live and work together and participate in practical training. Besides encouraging interaction among network researchers, working together in the field is efficient because it simplifies logistics associated with supporting field training and reduces overall cost of the training activities. The THROUGHFLOW project will manage travel and research permits, food and lodging, field access with appropriate health and safety measures, vehicles and drivers, and specimen shipping for the entire team. All collections and associated data will be curated and archived in the field to ensure that nothing is lost and to maximize the sharing of data among team members.

Out-of-network researchers will be invited to participate in selected NTAs (Table 4).

NTA-1. An introduction to the Geology of SE Asia (Work Area G / RHUL) Month 6

Theoretical Training (2 days): ESRs will be introduced to the regional tectonic setting, including the definition of key tectonic units, an introduction to the structural geology, a brief stratigraphic outline, and the distribution of main facies in key basins. The overall aim is to develop a dynamic synthesis establishing the geologic history of the region, including plate movements and the shifting distribution of plate boundaries, with special attention to the Oligocene-Miocene transition. In addition, the training will include an introduction to the methods used to reconstruct the palaeogeography of the region, including pole positions, magnetic anomalies on the ocean crust, and the position of terranes relative to the pole and each other.

Applied Training/Complementary/Transferable Skills (3 days): "*Geographical Information Systems and the visualisation of spatial data in the Earth Sciences*". GIS is an essential tool for geologists. The ESRs will be introduced to the use of remote sensing data to visualize digital cartographic techniques and to map rock types and structures, and the visualization of structure and facies distribution. practical exercises will be based on the regional geology of SE Asia.

External Participants: This is the first meeting of the ITN, and it has the additional important goal of allowing the ESRs and other team members to meet each other and exchange their roles in the network. Therefore, out-of-network researchers will not participate in NTA-1.

NTA-2. High-resolution Chronostratigraphy in clastic and carbonate settings (Work Area S / NNM and PN) Month 10

Theoretical Training (4 1/2 days): This short course will introduce the full range of approaches to stratigraphy, their possibilities and their limitations. For the success of the research it is essential that all ESR's are aware of the different correlations, including bio-, magneto-, isotope- and seis-

mostratigraphy. Special attention will be given to the interaction of observed faunal ranges and changing depositional environments.

Complementary/Transferable Skills (1/2 day): "*Life on the other side: Opportunities and pitfalls for research careers in the petroleum industry*". The petroleum industry will continue to offer a wide range of job opportunities, and as easily extractable reserves become exhausted, emphasis is shifting to deeper and more complex fields. These will need more comprehensive geological appraisals using state of the art multidisciplinary approaches before development. Currently, there are several petroleum-related disciplines, especially in stratigraphy, where, with retirement of senior researchers, global gaps will form unless ESR's are adequately trained during the coming decade. The workshop will address the requirements for new researchers both within Hydrocarbon exploration companies and also in the service industry.

Field Training (20 days): The ESRs will gain practical experience in advanced field techniques appropriate to their area of specialty. Specific objectives include measuring and describing the study sections, collection and proper documentation of samples, and the curation of material. We have selected the Cenozoic deposits of Central Java for this field training because it provides **an ideal setting to address the overall objectives** of the THROUGHFLOW project in a relatively well-known region that offers few logistic obstacles. Fossil-rich deposits in the field area are appropriate to study Late Oligocene to Early Miocene faunal change. All units are known to be rich in LBF, corals, and coralline algae. The combined presence of a chronologically-expanded section, a variety of different facies types, and several accessible sections covering the time span of interest make this **an excellent place for field training in basic correlation, mapping and sampling skills**.

During the first part of the NTA we will be based in Bandung, where the theoretical training will be hosted by PSG. From there we will travel to Jogjakarta, the closest major city to the research area (~25 km). Six junior and senior staff of the PSG in Bandung will join in this fieldwork, partly to participate in the training, partly for support on logistics and local knowledge of the area.

NTA-3. Bioinformatics and geoinformatics: new approaches to integrating research data using the world wide web.(work Area B/ NHM) Month 14

Theoretical Training (2 days): Advances in information sciences and the wide availability of networked computers have caused a revolution in the management, integration, and analysis of large volumes of diverse data in the Earth and Life Sciences. The THROUGHFLOW project will leverage these emerging technologies to produce data catalogs for internal use that will be integrated into international federated databases at the close of the project. NTA-3 workshop participants will receive an introduction to the conceptual issues, architectures, and basic approach that will facilitate their participation in distributed data networks that exist within the European Research Community. We will cover topics including web services architectures, evaluating standards for interoperability, scalability, data exchange, security, reliability, and sustainability. ESRs will be introduced to a selection of existing systems and digital repositories, particularly those funded via various EU actions, for example EDIT (the European Distributed Institute of Taxonomy).

Applied Training (2 days): ESRs will be invited to load their own research data into an appropriate online data repository. For taxonomic data, we will use the 'biodiversity scratchpad' system under development by the EDIT WP6 based at the NHM. We will also offer data analysis clinics to help implement quantitative analysis of research data sets.

Complementary/Transferable Skills (1 day): "*IPR policies and practices for research scientists*". All researchers need to understand the implications of IPR in their work, especially in areas with considerable overlap with industrial applications. In collaboration with the NHM IPR team, we will run a half-day workshop to introduce IPR as related to academic and industrial research in the Earth Sciences.

External Participants: Geoinformatics and Bioinformatics are rapidly advancing fields critical to the future development of a European research infrastructure. We know of no comparable workshops for European ESRs with palaeontological emphasis, and will open NTA-3 to 5 outside researchers.

NTA-4. Palaeoecology, geological analysis, and the interpretation of past environments (Work Area B / PN) Month 22

Theoretical Training (5 days): This workshop will emphasize the interpretation of palaeoenvironments in clastic and carbonate rocks from the perspective of both lithofacies and ichnofacies, through sedimentological study and biofacies, using a combination of marine and terrestrially derived microfossils (foraminifera, nannofossils, pollen, spores, algal palynomorphs). The biofacies part of the course will place particular emphasis on the benefits of understanding modern faunal and floral ecology and biogeography in interpreting biofacies data in terms of past environments. **It will also concentrate on methods which are employed in the petroleum industry.**

Applied Training (20 days): Applied training will be provided through field-based research on deposits of the Kutei Basin, East Kalimantan. Late Oligocene reorganization of plate boundaries resulted in uplift in central Kalimantan and the deposition of large sets of prograding deltaic sediments in the Kutei basin, in which the field base of NTA-3, Samarinda, is situated. Framework reefs also deposited in the distal part of this deltaic system, and very similar environments are thus available for study from the proximal to distal part of the basin. Oligocene sections are available in the Balikpapan area and on the Mankalihat peninsula, while Early Miocene to Late Miocene sections, deposited in a variety of environments, are available to study to the north of Samarinda and into the Sangkuliran Bay.

The exposed units contain numerous well-preserved fossils, and some classic publications on coral, mollusc, echinoid, and larger benthic foraminifera faunas are based on material from this region. All these studies were based on limited sample sets collected during pioneering geological mapping of the area because of the hydrocarbon potential of the area. The material studied was characterized by small sample sizes, but fine quality, and came from many localities, thus demonstrating the high potential for palaeontological research in the area.

Samarinda is the capital of East-Kalimantan and provides excellent facilities as a field base for NTA-3. A large number of high quality, easily accessible exposures regularly became available in this area mainly through road building programmes. At Samarinda the Mahakkam river can be crossed, thus allowing access to areas on both sides of the river. Samarinda is positioned proximal in the Mahakkam delta, a major oil and gas-producing area. Links with the local companies will also be developed during this NTA.

Complementary/Transferable Skills (throughout the NTA): "*Live from the field- communicating science to wider audiences*": The effective and meaningful communication of science beyond academic peers is imperative. Members of the NHM Science Communication team will lead a workshop to provide ESRs experience with public engagement. This will include understanding diverse audiences and their needs as well as highlighting the scope of formats and media for science communication. This will culminate in a series of live events linking visitors to the NHM to field sites.

External Participants: Six junior and senior staff of the PSG in Bandung will join in this fieldwork, partly to participate in the training, partly for support on logistics and local knowledge of the area. East Kalimantan is one of the target areas in the current research plan of PSG. Research permits will be arranged via PSG as well.

NTA-5. Palaeoceanographic proxies and biogeochemical modelling (Work Area P / CAU) Month 26

Theoretical Training (2 days): We will present a short lecture series on the use of palaeoceanographic proxies and an introduction to biogeochemical modelling. The goal of the workshop will be to introduce the fundamentals of palaeoceanographic proxies and biogeochemical modelling to ESRs. Topics include data-analysis and data-assimilation methods as applied to biogeochemical oceanography, and the synthesis of observational and modelling aspects of oceanography so that the ESRs will be able to synergistically exploit both.

Applied Training (4 days): A Baltic Sea Cruise on the R/V Alkor or Littorina including an introduction to oceanographic sampling methods such as box core and multiple core sampling of marine sediments in the Kiel Bight and in-situ oxygen measurements. Initial sample preparation will be completed onboard the research vessel, followed by post-cruise laboratory training including sampling techniques of marine cores, non-invasive core analysis (X-Ray, magnetic susceptibility, colour scanning), sample processing, micropalaeontological analyses (microscopy), and data analysis (calculation of accumulation rates, multivariate statistics).

Complementary/Transferable Skills Training (1 day): "*Marine Resources and Risks: the development, implementation, and assessment of global and regional ocean management options*". The Kiel Excellence Cluster "Future Ocean" includes researchers at CAU and the participating Leibniz Institutes to investigate past, present, and future ocean change, explore marine resources, develop strategies for their sustainable use and study hazards arising from the seas. Experts in marine policy and sustainable use of marine resources will present an overview of key issues in these areas.

External Participants: Due to the limited number of participants that can be accommodated on the R/V Alkor and Littorina, we will be unable to invite out-of-network researchers to join NTA-5.

NTA-6. Sedimentology, biostratigraphy, and palaeoecology at a seismic scale (Work Area E / UG) Month 34

Theoretical Training (2 days): Sequence stratigraphy offers the best theoretical framework to integrate data and interpretations from different fields into a single scheme of temporal-spatial relationships of sedimentary rocks. Signals from regional to global scale can be decoded to understand the spatiotemporal distribution of local depositional environments and correlate these signals among different areas in the world.

Applied Training (3 days): The Neogene Almeria basins in southern Spain provide one of the world's finest 'natural laboratories' for the study of sedimentation at a seismic scale. Exposures of Upper Miocene carbonates allow any sampling/observation site to be placed in a sequence-stratigraphic framework and original 3D physical gradients such as palaeodepth. Sealevel changes observed in shallow water reefs can be correlated with palaeoceanographic signals (temperature and in a lesser degree productivity) at the Milankovich time scale.

Complementary/Transferable Skills Training (1 day): "*Geotourism: Sustainable tourism activities focused on geoheritage*". Geotourism is a rapidly expanding economic activity in many parts of Europe. we will visit the "Cabo de Gata-Níjar Geopark", member of the *European Geoparks Network*, devoted to developing the sustainable use of Europe's geological heritage.

External Participants: We will invite 5 out-of-network researchers to join this NTA and learn about outcrop scale sequence stratigraphic interpretation in a classic field area. Similar courses are popular with oil company geologists, and we intend to encourage participation from that sector.

B.4.1.4 *International Symposiums*

SYM-1. SAGE: SE Asian Gateway Evolution (RHUL/NHM). Month 2 - 3 days

Planning is underway for a three-day multidisciplinary meeting to bring together researchers interested in the geology, tectonics, oceanography, biodiversity, and climate of SE Asia (see <http://www.gl.rhul.ac.uk/searg/sage>). This symposium is jointly organised by RHUL and NHM will be held with the support of various external funding sources. We are seeking scientific contributions on all geological and biological aspects of this region, and anticipate approximately 300 participants. The SAGE symposium will combine with the first official meeting THROUGHFLOW project, and we will invite the members of the THROUGHFLOW Scientific Advisory Board (SAB) to participate (Table 4). This will allow them to present their perspective on the current trends in research that will be used to help guide the priorities of the THROUGHFLOW network. It will have the additional benefit of allowing SAB members to obtain additional overview in areas relevant to THROUGHFLOW but outside of their specific research expertise. We request support for 12 researcher-days to allow the participation of the SAB at the symposium.

SYM-2: International Symposium on the geological, environmental, and biotic history of SE Asia (NNM) Month 47 - 3 days

This international symposium will mark the end of the project and provide an international forum to communicate results of the ITN on the geology, environments, and biotic history of the global center of marine biodiversity and will allow each of the ESRs to present their results to a broad scientific community as well as providing networking opportunities for further career exploration. We especially hope to encourage participation of researchers from our main non-academic user groups, especially those engaged in petroleum exploration and biodiversity conservation agencies. We will encourage selected authors to contribute to a book highlighting recent advances accomplished by THROUGHFLOW. We expect approximately 300 participants. We will invite the Scientific Advisory Board to participate in SYM-2, and we also request support to fund 10 other external researchers to attend (Table 4). Priority will be given to researcher colleagues from Indonesia to allow them to present research results and to continue fostering international collaboration between EU and local host counterparts.

B.4.1.5 *Training in Complementary Skills*

Each ESR will be provided with training in complementary skills including research ethics, presentational skills, project management and team building, IPR management, proposals writing, and contract negotiation. This will include a blend of local training and network wide training, as well as support in attending regional and national seminars and workshops mounted by Research Councils and other relevant agencies. Complementary and transferable skills workshops will be held at each NTA (Table 3).

Presentations at appropriate THROUGHFLOW seminars and workshops will be made by external experts from other research organisations, industrial partners and other external experts from international agencies. The complementary training requirements of the individual ESRs will vary considerably. The average duration will be 8-10 days per year per ESR

We aim to provide a rich training experience of the highest possible quality. All the network nodes include internationally recognized leaders in their fields with long research and training experience. THROUGHFLOW will also benefit from high-profile researchers in associated institutions including SME consultancies working with the petroleum industry. This resource brings considerable added value to the network in the form of **expertise and potential access to unpublished data at no additional cost.** Especially important are the local counterparts in Indonesia and elsewhere in SE Asia. These colleagues bring vital expertise and logistical support to

the project, and we will encourage their participation in collaborative projects as well as NTAs with support from alternative sources.

B.4.2 Importance and Timeliness of Training

Training of the next generation in combined geological and geochemical studies is essential for evaluating earth surface processes and their influence on the evolution of environments and life. This is of **particular importance at this time with development of new, high-resolution geochemical fingerprinting techniques and growing awareness of the application of geochemistry in a range of palaeoenvironmental studies.** With ongoing concern over the future of the global climate, **there is an urgent need to train young scientists to effectively communicate accurate interpretations of past change to the scientific and wider public** with a view to a better informed debate about likely the extent of future changes and the measures required

As well as their academic relevance, basin studies, sedimentology, diagenesis and geochemistry also have **applications in the water resource use and petroleum industry.** **Expertise in palaeoecology can be a powerful tool in interpreting the sedimentary geology of carbonate and mixed carbonate and siliciclastic rocks, which are also of industrial/economic interest as water or hydrocarbon reservoirs.** Expertise in stratigraphy is **an important resource for the global petroleum industry,** yet a recent review indicates an urgent demand from industry to recruit trained geoscientists (Gramling 2008)

Training in palaeontology and palaeoecological interpretations is especially timely because understanding palaeoenvironments and their temporal variations is essential to understand the evolution of life, particularly regarding **the evolutionary processes driven by major regional or global changes.**

Taxonomic training is important, because we need more taxonomists to continue to develop methods to describe the diversity of life. This is particularly important during this time of declining taxonomic expertise, especially expertise in the study of fossils. Modern taxonomy of extant organisms is increasingly focused on molecular techniques, and although these techniques have allowed rapid progress in some fields, **molecular data will never be available to study extinct taxa that comprise the overwhelming majority of the diversity of life that has lived on earth.** New taxonomists are required with the skills to apply modern quantitative techniques to the study of morphology so that extinct taxa can be brought into 21st century systematics.

Throughout the course of the THROUGHFLOW project, we will endeavor to fully share data using a modern geoinformatics and bioinformatics approach. The training provided in these rapidly advancing fields will allow project members **to understand the processes and experimental design decisions necessary to ensure that their future research programmes are connected to emerging data networks in the Earth and Life Sciences.**

B.4.3 Size of Training Programme and Balance Between Categories of Researchers

Training of eleven ESRs will be the prime deliverable of THROUGHFLOW. We also request support to hire Dr. Robert Morley as a Visiting Scientist for six weeks each year. He brings expertise that is not available elsewhere in the network. A summary of the numbers of researcher-hours for EXTs and VS requested for each institution is included in Table 1. No support is requested to hire experienced researchers.

In terms of appointment, we regard three years as an absolute minimum to allow our young researchers to develop new skills and **make a significant contribution to the scientific field.**

The International Symposiums are critical to the success of the network. In order to be attractive on the job market, young scientists must have the opportunity to make their contributions clearly recognizable to scientific peers. In this way THROUGHFLOW will **ensure competitiveness of the**

trained young scientists in the European labour market, allowing them to launch successful scientific careers.

B.5 IMPLEMENTATION

B.5.1 Institutional Capacities

Natural History Museum London (NHM) will provide training in applied taxonomy and systematics of marine invertebrates, analysis of biodiversity dynamics, and reef palaeoecology. NHM will also act as project coordinator. NHM is the premier biodiversity research institute in the UK, employing more than 350 scientists and curators. The NHM includes abundant expertise, collections, and facilities that will be available for ESR research. The Public Engagement Group of NHM will support public dissemination of project results.

Dr. Kenneth Johnson (Project Coordinator) is an expert on taxonomy, and biodiversity dynamics of fossil and living reef-corals. He will devote 50% of his time to the project. **Dr. Paul Taylor** is an international expert on Mesozoic-Recent cyclostome and cheilostome bryozoans. **Dr. Jon Todd** is a molluscan taxonomic expert researching diversification patterns in tropical mollusc groups. **Dr. Jeremy Young** is a leading authority on the biology, palaeobiology and taxonomy of coccolithophores and other calcareous nannoplankton.

Johnson, K.G., Jackson, J.B.C. & Budd, A.F., 2008. Caribbean reef development was independent of coral diversity over 28 million years. *Science* 319: 1521-1522.

Johnson, K.G., J.A. Todd, & J.B.C. Jackson. 2007. Coral reef development drives molluscan diversity increase at local and regional scales in the late Neogene and Quaternary of the southwestern Caribbean, *Paleobiology* 33: 24-52.

Todd, J.A., J.B.C. Jackson, K.G. Johnson, H.M. Fortunato, A. Heitz, M. Alvarez, & P. Jung. 2002. The ecology of extinction: molluscan feeding and faunal turnover in the Caribbean Neogene, *Proc. Royal Society, Series B* 269: 571-577.

Christian-Albrechts-Universität Kiel (CAU) will provide training in marine micropalaeontology, palaeoceanography and palaeoclimate research. Kiel University with the Institute for Geosciences and Leibniz Laboratory for Radiometric Dating and Stable Isotope Research and the Leibniz Institute of Marine Sciences (IfM-GEOMAR) is one of the leading locations for Marine Geosciences in Europe.

Prof. Dr. Wolfgang Kuhnt has expertise in marine micropalaeontology and palaeoceanography with emphasis on deep water benthic foraminifera and their palaeoceanographic application. 50% of his time is dedicated to research on the longterm variability Indonesian Throughflow which includes this project. **Dr. Ann Holbourn** is a leading authority on benthic foraminiferal taxonomy and palaeobiology. **Dr. Marcus Regenberg** is an expert on the application of Mg/Ca and Sr/Ca in foraminiferal tests as palaeotemperature and dissolution proxies. **Dr. Nils Andersen** is head of the research group Stable Isotopes at the Leibniz Laboratory for Radiometric Dating and Stable Isotope Research. **Prof. Dr. Martin Frank** is an authority on Neodymium isotopes and their application in the reconstruction of past circulation patterns.

Kuhnt, W., A. Holbourn, R. Hall, M. Zuvela, & R. Käse. 2004. Neogene History of the Indonesian Throughflow. In: Clift, P., D. Hayes, W. Kuhnt, & P. Wang. 2004. *Continent-Ocean Interactions in the East Asian Marginal Seas*. AGU Monograph 149: 299-320.

Holbourn, A., W. Kuhnt, M. Schulz & H. Erlenkeuser. 2005. Impacts of orbital forcing and atmospheric CO₂ on Miocene ice-sheet expansion. *Nature* 438: 483-487.

Frank, M., N. Whiteley, T. van de Flierdt, B.C. Reynolds, & R.K. O'Nions. 2006. Nd and Pb isotope evolution of deep water masses in the eastern Indian Ocean during the past 33 Myr. *Chemical Geology* 226: 264-279.

Nationaal Natuurhistorisch Museum Naturalis (NNM) will coordinate the stratigraphy node, and design and implement the training programmes concerned with all aspects of stratigraphy. Additionally, NNM will provide training in applied taxonomy and systematics of selected marine invertebrates and reef (palaeo)ecology. SE Asia has been a focus of research for NNM scientists for over 100 years, and currently teams of marine and terrestrial zoologists and palaeontologists still work in

the region. NNM holds significant collections from Indonesia and elsewhere in the region that form the foundation for the pioneering work on fossil diversity in the region.

Dr. Willem Renema has expertise on the morphology, taxonomy, and biodiversity dynamics of fossil and living benthic foraminifera. **Drs. Frank Wesselingh** is an expert on the evolution of marine and freshwater mollusc faunas.

Renema, W., D. Bellwood, J.-C. Braga, K. Bromfield, R. Hall, K.G. Johnson, P. Lunt, C.P. Meyer, L. McMonagle, R.J. Morley, A. O’Dea, J.A. Todd, F.P. Wesselingh, M.E.J. Wilson, & J.M. Pandolfi. 2008. Hopping hotspots: Global shifts in marine biodiversity. *Science* 321:654-657

Renema, W. 2007. Fauna Development of Larger Benthic Foraminifera in the Cenozoic of SE Asia. In Renema, W. (ed.) *Biogeography, Time and Place: Distributions, Barriers and Islands*, Springer, Dordrecht: 179-215.

Wesselingh, F.P. 2006. Miocene long-lived lake Pebas as a stage of mollusc radiations, with implications for landscape evolution in western Amazonia. *Scripta Geologica* 133:1-17

Royal Holloway University of London (RHUL) will provide expertise in Geology and Tectonics of SE Asia, including geochemical analysis, tectonic reconstructions, regional background to biogeography, GIS/Remote Sensing, and by facilitating links with industry to increase their contribution to project. Key research activities at the SE Asia Research Group (SEARG) at RHUL include global environmental change, geochemical techniques in radiogenic and stable isotopes and geodynamics and basin modelling. SEARG is primarily funded by industry. Research facilities include atmospheric monitoring and isotope laboratory, thermal ionization mass spectrometer laboratory, IsoProbe-multi-collector, LA-ICP-MS laboratory, stable isotope laboratories, ICP-AES facility, X-ray fluorescence laboratory, two analogue modelling laboratories, as well as industry-standard seismic and potential field processing, analysis software and a 3-D Visualisation Facility.

Dr Wolfgang Müller: Isotope geochemistry, particularly application of LA-ICP-MS techniques.

Professor Robert Hall: is director of the SEARG and is an expert on all aspects of the geology of SE Asia and the Western Pacific, in particular tectonic reconstructions. **Dr Michael Cottam:** Regional thermochronometry. **Dr Gary J. Nichols:** Clastic sedimentology studies in the Africa, Antarctica, Mediterranean, Pyrenees, Borneo, Eastern Indonesia and ODP.

Hall, R. 2002. Cenozoic geological and plate tectonic evolution of Southeast Asia and the SW Pacific: computer-based reconstructions and animations. *J. Asian Earth Sciences* 20: 353–434.

Müller, W., H Fricke, A.N. Halliday, M.T. McCulloch, & J.-A. Wartho. 2003. Origin and Migration of the Alpine Ice-man. *Science* 302: 862-866, 2003.

van Hattum, M.W.A., R. Hall, A.L. Pickard, & G.J. Nichols. 2007. Southeast Asian sediments not from Asia: Provenance and geochronology of North Borneo sandstones. *Geology* 34: 589-592.

Universität Bremen (UB) will support work area P by providing expertise on earth system modelling. The Faculty of Geosciences (GeoB) and the Center for Marine Environmental Sciences (MARUM) at the University of Bremen are institutions for palaeoenvironmental analyses of marine sediments. GeoB and MARUM host an Earth-system modelling group and a great emphasis is placed on combining real-world data with numerical modelling (coupled climate models, high-resolution ocean-circulation models and ecosystem models). Data-management is provided by the PANGAEA data-bank that has been institutionalised as World Data Center for Marine Environmental Sciences.

Prof. Dr. Michael Schulz is the head of the Earth-system modelling group and is an expert in palaeoceanography and palaeoclimate modelling. **Dr. Matthias Prange** has long expertise in climate modelling using a hierarchy of models ranging from low-order to comprehensive, fully-coupled general circulation models

Prange, M. & M. Schulz. 2004. A coastal upwelling seesaw in the Atlantic Ocean as a result of the closure of the Central American Seaway. *Geophysical Research Letters* 31: L17207.

Holbourn, A., W. Kuhnt, M. Schulz, & H. Erlenkeuser. 2005. Impacts of orbital forcing and atmospheric CO₂ on Miocene ice-sheet expansion. *Nature* 438: 483-487.

Steph, S., R. Tiedemann, M. Prange, J. Groeneveld, D. Nürnberg, L. Reuning, M. Schulz, & G. Haug, 2006, Changes in Caribbean surface hydrography during the Pliocene shoaling of the Central American Seaway. *Paleoceanography* 21: PA4221.

Universidad de Granada (UG) will coordinate the Environment Work Area and will be responsible for training ESRs in quantitative taphonomic and palaeoecological analysis on the Oligocene-Miocene shallow water carbonates. UG will be responsible for training in modern taxonomic practice in calcareous algae. The “Departamento de Estratigrafía y Paleontología” is in charge of the courses in sedimentary geology and palaeontology for undergraduate students of Geology and Biology; and for graduate students in the master and “Programa de Doctorado” on Earth Sciences at the Universidad de Granada. The department has a long tradition of sedimentary geology research mainly focused on the western Mediterranean area.

Prof. Juan C. Braga and **Dr. J. Aguirre** are experts on palaeontology of calcareous algae and its application to sedimentary and regional geology. **Prof. Jose M. Martín** is an expert on carbonate-related sedimentary geology.

Braga, J.C. & D. Bassi. 2007. Neogene history of *Sporolithon* Heydrich (Corallinales, Rhodophyta) in the Mediterranean region. *Palaeogeog., Palaeoclim., Palaeoecol.* 243: 189-203

Sánchez-Almazo, I.M., J.C. Braga, J. Dinarès-Turell, J.M. Martín, & B. Spiro. 2007. Palaeoceanographic controls on reef deposition: the Messinian Cariatiz reef (Sorbas Basin, Almería, SE Spain). *Sedimentology* 54: 637-660.

Webster, J.M., L.M. Wallace, D.A. Clague, & J.C. Braga. 2007. Numerical modeling of the growth and drowning of Hawaiian coral reefs during the last two glacial cycles (0–250 kyr). *Geochem. Geophys. Geosyst.* 8: Q03011

Universiteit Utrecht (UU) will support work area S by provide training, expertise and facilities in magnetostratigraphy. The palaeomagnetic laboratory is equipped with state-of-the-art palaeomagnetic instrumentation: two DC-SQUID magnetometers, two high-sensitivity spinner magnetometers, thermal and alternating field demagnetization equipment, and a magnetically shielded room for dedicated palaeomagnetic measurements in a low-field environment.

Dr. Wout Krijgsman has expertise in dating of geological records and constructing time scales for marine and continental sequences using a wide range of techniques such as palaeomagnetism, astronomical calibration, and radiometric dating.

Kuiper, K.F., A. Deino, F. J. Hilgen, W. Krijgsman, P.R. Renne, & J.R. Wijbrans. 2008. Synchronizing rock clocks of Earth history. *Science* 320: 500-504.

Dupont-Nivet, G., W. Krijgsman, C.G. Langereis, S. Dai, & X. Fang. 2007. Tibetan Plateau aridification linked to global cooling at the Eocene-Oligocene transition. *Nature* 445: 635-638.

Krijgsman, W., F.J. Hilgen, I. Raffi, F.J. Sierro, & D.S. Wilson. 1999. Chronology, causes and progression of the Messinian salinity crisis. *Nature* 400: 652-655.

Associated Institutions

Colleagues at associated institutions (Table 1) are experts in regional geology and palaeontology, and their participation increase the overall quality of the research and training programme.

The Institute for Geoscience Research (TIGer) at **Curtin University of Technology (CU)** will provide training in sedimentology and field geology. The overall rationale of TIGer is to study Earth's dynamic evolution as recorded in the geotectonic, geochronologic, geodetic and geochemical records using new collections and modern analytical facilities. **Dr. Moyra Wilson** is an international expert on the petrology and sedimentology of equatorial carbonates and has worked for more than 20 years on the geology of SE Asia.

The **Pusat Survei Geologi in Bandung (PSG)** is the national geological survey of Indonesia. The Centre is renowned for its mapping and research programme throughout the region, and also houses the national geological museum, including important fossil collections. The centre has ongoing strong collaborative links with international academia, industry and national museums. There is a history spanning 30 years of research exchanges, joint fieldwork, training and joint international quality publications between the proposers of this project and PSG. **Dr. Janang**

Sukarna is the director of PSG, and manages a staff of over 100 specialists including experts in the geology, stratigraphy, and paleontology of Indonesia.

The Centre for Tropical Paleocology and Archeology at the **Smithsonian Tropical Research Institute (STRI)** will provide training in field and laboratory techniques for the reconstruction of paleoenvironments using biological proxies. STRI is at the forefront of palaeontological research in the tropics. **Dr. Aaron O'Dea** is a paleobiologist with experience in field-based tropical palaeoecological surveys and conducts research into the macroevolution, microevolution and ecology of marine invertebrates. Additional funds to support STRI participation will be sought from institutional sources and external grants from the US NSF and SENACYT (Panama).

The Centre for Marine Studies at the **University of Queensland (UQ)** will provide training for the Biodiversity work area, including approaches to evaluate natural ecosystems so that managers can use these as goals for restoration, unveiling processes that contribute to the resilience of coral reefs over long time frames and changing environmental condition. UQ conducts marine research and teaching into present and past diverse tropical marine ecosystems. **Professor John Pandolfi** integrates long-term ecological and environmental time series data over broad spatial scales to discover the major past and predicted future influences of natural variability, human impact, and climate change on coral reef resilience.

Palynova (PN) is a SME established in 1992 that produces research consultancy for the petroleum industry, concentrating on the biostratigraphy of Cenozoic sediments in SE Asia and West Africa, especially on using biostratigraphy as a sequence stratigraphic tool. It has carried out projects for most of the major international and local petroleum companies working in the region and has unique theoretical and practical expertise in the economic geology of SE Asia. **Dr. Robert J. Morley (Director, Palynova)** is a palynologist and stratigrapher with more than 30 years experience in international geological consultancy.

Murphy Sarawak Oil Co. Ltd (MO) is a subsidiary of Murphy Exploration & Production Co. International, a major company involved in oil and gas exploration and production activities worldwide. In Malaysia, Murphy is the Operator of 9 offshore licenses for exploration and production activities. **Mr. Peter Lunt (Senior Geologist)** has twenty years of experience in SE Asian petroleum geology and stratigraphy, with primary interests in the use of foraminifera for biostratigraphic and palaeoenvironmental analysis. He has extensive field experience in the region and for several years has volunteered for PSG to direct an annual course on applied micropaleontology.

B.5.2 Work Plan

The work plan is divided into multiple phases bounded by scheduled network activities that will include our progress meetings. These will act as milestones for completion of individual subprojects within each work area (Table 5).

Most of the duration of the project will be devoted to practical work and research training, including two cycles of field-based training and sample acquisition followed by practical work culminating in progress reports to be presented at annual lab-based NTAs. Dissemination of preliminary results among network participants is a key component of each cycle and will enable coordination of research results among the disparate work areas. To achieve this, a series of preliminary reports from each field season (NTA-2 and NTA-3) modelled on the practice of the IODP will achieve this. These reports will be published on the network website.

We anticipate that each ESR will produce at least 3 research publications based on the results of their projects. They will be provided with full support in doing so. Milestones for these and the reports of the SAB are indicated on Table 5.

THROUGHFLOW

Table 5. Project work plan including key network activities which will act as milestones for project assessment. The number of elapsed months is included in parenthesis in each cell.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
2009	(0) Contract negotiation, project planning, recruitment advertising							(1) Project start	(2) SYM-1	(1-5) Recruitment for ESR target start date month 6.			
2010	(6) ESR Start NTA-1	(7-9) Initial training, background reading, prep. for field season			(10) NTA-2	(11-13) Consolidation of samples, prepare initial results and presentations			(14) NTA-3	(15-21) Analysis of results from NTA-2.			
2011	(15-21) continued: preparation of first research publications				(22) NTA-4 Mid term report	(23-25) Consolidation of new field data, analysis,			(26) NTA-5	(27-29) Laboratory work			
2012	(30-33) Laboratory work, analysis of results, preparation of second set of research publications				(34) NTA-6	(35-41) Complete analyses, integration of results onto online data repository, prepare final reports, complete third research publication.							
2013	(42) ESR End	(43-46) Consolidate results, complete publications.				(47) SYM-2 final review	(48) project end						

B.5.3 Industrial Participation

THROUGHFLOW includes **two highly experienced industrial partners engaged in petroleum exploration**. These partners are contributing invaluable expertise to the project and will ensure that the results of the project are disseminated effectively to the industrial scientific community. Both will serve on the THROUGHFLOW Supervisory Board. **We will also recruit a senior industry-based research manager to serve on our Scientific Advisory Board.**

Dr. Robert J. Morley (Director, Palynova) will work with the THROUGHFLOW network as a Visiting Scientist for six weeks each year, recruited by the NHM. He will participate in the NTAs, including coordinating NTA-3 and co-coordinating NTA-2. He will also act as secondary supervisor for one ESR project P3, serve on the Management Board, and will coordinate liaison with additional industrial participants.

Mr. Peter Lunt (Senior Geologist, Murphy Sarawak Oil Co. Ltd) will contribute to the training in biostratigraphy, complementary skills and regional geology. He will also contribute in supervising ESR projects S1 and S2.

B.5.4 Financial Management

Financial management will be coordinated by the NHM based on a central fund. Prior to the start of each project year (commencing on 1 August), projected budget requests will be submitted to NHM from the partner institutions including requests for funds to support ESR salaries, laboratory costs, funding to deliver planned NTAs, and allocations to support the participation of external researchers at network activities. A dedicated EC grant administration team at NHM assists grant holders with contractual and financial management and reporting. The research training to be provided by THROUGHFLOW includes a large proportion of laboratory and field-based work, and the majority of the contribution to participation expenses will be devoted to supporting this practical training. A small proportion of the research allocation will be used to purchase consumables or minor

THROUGHFLOW

equipment to support project-wide laboratory and field training, and to provide an adequate health and safety environment (for example, GPS receivers, field safety equipment, basic survey equipment, geological field tools).

B.5.4.1 Track Record of Host and Partner Institutions

The Natural History Museum (NHM) has a strong track-record in leading EC-funded research and training. It leads the FPVI €13m EU I3 Infrastructure Programme SYNTHESYS, and this contract has just been granted a FPVII €7.2m extension. NHM hosted 12 Marie Curie European and 2 international fellowships during FPVI and already has 4 IEFs funded under FPVII. It has also led training networks in the last three frameworks and now leads a FPVI RTN and is a partner in FPVII ITN. NHM is also a partner in another 12 live FPVI and FPVII-funded projects. Each of the partner institutions has extensive experience managing EU-funded projects. CAU is currently involved in 42 EU funded projects, including 7 Marie Curie Actions. 9 EU projects are coordinated by CAU. In FPVI, RHUL is involved in one RTH, and four Marie Curie Fellowships. In FPV, RHUL managed three RTNS, 7 Individual fellowships, and one Host Fellowship Training Site. As a participant in SYNTHESYS, EDIT and MARBEF, NNM has an extensive network of European partner organisations and is experienced in working in European research and infrastructure networks. UB is currently managing over 40 EU projects, including one FPVI project in the Earth-system modelling group and 5 FPVI projects in marine sciences. In FPVII, UG is leading 2 projects and is involved in 5 additional actions. In FPVI and FPV UG lead 5 and participated in a total of 67 EU-funded projects.

B.5.5 Complementarity Among Nodes

THROUGHFLOW has been designed as an interdisciplinary project that requires input from all teams. Each work area has particular expertise required to complete a subset of the overall project, but the success of each subproject depends in part on the results of other subprojects (Fig. 2). No single European institution has the capacity to provide the proposed research training program. Understanding of the regional palaeogeographic (work area G) and oceanographic setting (work area P), as well as the timing of events (work area S) is critical to be able to address questions on biotic response (work area B) to environmental change (work area E), the primary research question.

THROUGHFLOW will benefit from the **participation of two associates closely involved in the petroleum exploration industry**. We anticipate the development of strong interactions between academic and industrial researchers that will provide training opportunities to enable ESRs to make informed decisions as they move into successful research careers.

B.5.6 Organization and Management Structure

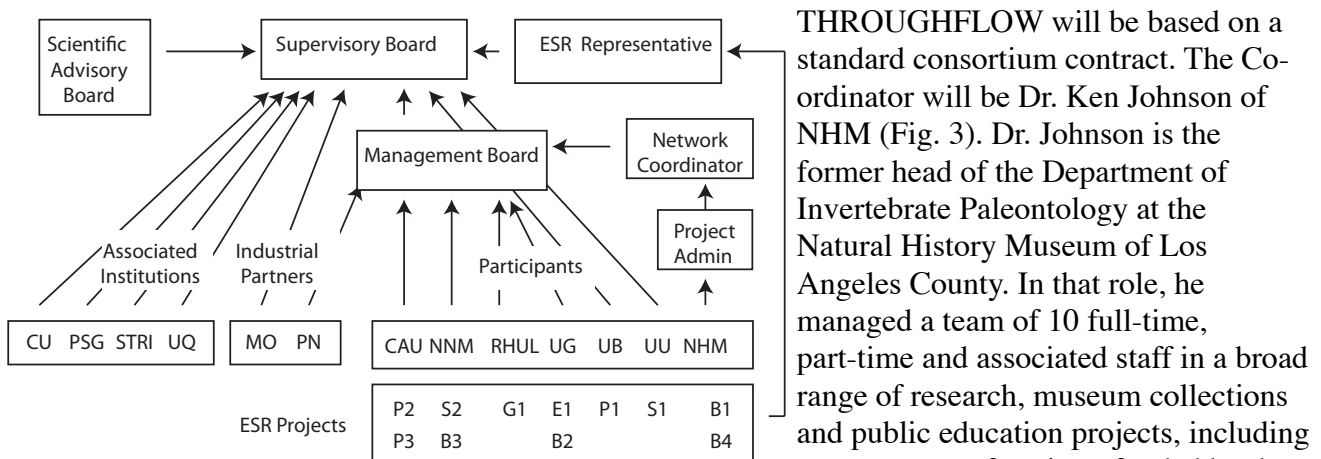


Figure 3. Management structure of Throughflow.

THROUGHFLOW

and laboratory-based postgraduate training courses on the ecology of tropical coastal ecosystems, and new methods in taxonomy and systematics.

Using the management allocation, a part-time **Project Administrator (PA)** will be hired by the co-ordinator to provide key support for the timely production of technical and financial reporting. The PA will also administer the HR contracting process for the ESRs and ensure the proposed training is delivered.

All measures required to achieve our objectives will be approved by a **Supervisory Board (SB)**. The SB will include one representative from each network member including primary nodes, industry participants, and associated institutions. In addition, **an ESR will be elected to the board by their peers** to facilitate effective communication between the researchers and network management. The SB will supervise network activities and ensure adherence to appropriate recruitment and financial policies defined in the consortium agreement as well as defining the skills requirements for the recruited researchers and ensuring full exploitation of network synergies. Planning meetings will be organised at each of the network activities, where network coordinators will be expected to report on the progress of the research training projects and present plans for NTAs in their work area. When necessary electronic conferencing will be used to allow participation in the board meetings. All major planning decisions will be ratified with the consensus of the entire group.

The SB will be too large for agile decision-making required to address administrative and logistical issues that are sure to arise during the course of the project. Therefore, a network **Management Board (MB)** will meet quarterly at a NTA or via teleconferencing. The MB includes lead researchers from the five primary nodes plus one of the industrial participants. Each member of the MB will act as "champion" or coordinator for a key area of operational responsibility: Training (Müller), Recruitment (Kuhnt), NTA logistics (Renema), ESR Advisory (Braga), and Informatics/Intellectual Property (Johnson).

We will appoint an external **Scientific Advisory Board (SAB)** including three eminent research scientists and one highly experienced research manager from the industrial sector. The SAB will be asked to provide general oversight regarding the overall direction of the research training programme and will assist with the midterm review of network progress and a final review. To facilitate these reviews, the SAB will be expected to participate in three NTAs, including the two symposiums and NTA-3 to be held in month 22.

A project website will be produced and maintained by the PA and ESRs with support from the NHM interactive media group both for external dissemination and for the internal publication of agendas, meeting reports, updates and other documents related to the project. This site will include an online 'forum' section to facilitate discussion among ESRs. We are also already experimenting with basic multi-way video conferencing as a mechanism for hosting 'virtual meetings' to discuss issues related to the project.

Work area coordinators will be responsible for the research training projects within their area and will liaise with project supervisors and co-supervisors to produce personal training plans for each ESR. Likewise, planning and management of the NTAs and Symposiums will be the primary responsibility of particular coordinators (Table 3), although we anticipate that there will be network-wide support for the planning and implementation of these activities.

B.5.7 Dissemination of Results, and Intellectual Property

Research results will be published in mainstream scientific journals and presented at leading international conferences, including the two symposiums organised as part of our network activity. Each ESR will be expected to participate as a co-author in at least three publications, and as first or single author on at least one publication. Due to the large volume of work to be published, we

anticipate producing edited volumes including contributions from the symposia (as special publications of the Geological Society of London or the Systematics Association, for example).

Besides publication of research papers, the **THROUGHFLOW website will serve as an ongoing data repository**. Where journal policy permits, preprints of all publications resulting from the research training will be archived on this website. We will make all non-proprietary data available as part of the EU funded EDIT "scratch pad" facility hosted at NHM. This will facilitate establishing linkages to a wide variety of federated databases and all our data to be published to a large audience in a maximally useful form. **Participation in these data networks will also ensure sustainability of the THROUGHFLOW data repository, as responsibility for its maintenance will be transferred to the NHM at the close of the project.**

Several of the **THROUGHFLOW institutions are renowned centres of excellence in the delivery of research results to the general public**, especially NHM and NNM. In collaboration with the Public Engagement Groups at these institutions, we will produce **a set of informal presentations and teaching aids based on the results of the project** that will provide content for the foundation for museum exhibit units, articles in general interest magazines, traveling road-shows, and new media content to publicise our research results to a diverse non-specialist audience.

All intellectual property rights will be managed according to the policies of host institutions and industrial collaborators as required. Wherever possible, we will negotiate with our institutions for permission to release all results into the **Creative Commons**. This will be coordinated by a designated Informatics/IP Champion.

B.5.8 Recruitment Strategy

The **Recruitment Coordinator** will collaborate closely with the coordinators of each work area to ensure both the **open and timely recruitment of excellent ESRs** and that the recruitment strategy rigorously follows the criteria of competitiveness, internationality and equal opportunity presented in the *European Charter for Researchers* and *Code of Conduct for the Recruitment of Researchers*.

All vacancies within THROUGHFLOW will be advertised through at least six different channels. (1) communal advertisement in two leading journals to reach a world-wide audience; (2) national and international professional networks, including specialist listservers; (3) the Marie Curie Fellowship Association webpage; (4) advertising at high-level international meetings; (5) e-mailing colleagues and contacts in the scientific community; and (6) advertisements on EURAXESS. Full acknowledgement of the support received from the MC programme will be given in all such publicity and any other material produced by THROUGHFLOW. Due to the high scientific novelty and high-profile research team, we do not anticipate any special difficulties in attracting and recruiting high-quality and well motivated ESRs. While liaising with the Recruitment Coordinator, each work area will conduct an independent recruitment process including interviews. The end result will be a ranked list of applicants for each ESR position by the start of the project.

The selection of the young researchers will be based on the following criteria: (1) Scientific excellence and innovativeness, (2) Previous expertise, (inter-disciplinarity will be an important asset), (3) Strength of academic references, and (4) Performance at the interview.

The Supervisory Board will meet and make the final decision on each ESR after consideration of network-wide priorities. Gender balance will be actively promoted via recruitment within the Network. All of the team leaders in THROUGHFLOW are male, but this tends to reflect the existing situation in senior positions in Earth Sciences in Europe. The EU-wide gender balance is healthier at both post doc and PhD level and it is our intention that at least 40% of the PhD trainees recruited should be female. All ESRs should be in place by month 6 as they will be required to attend NTA-1 to gain an overview of their project area.

B.6 IMPACT

B.6.1 Individual Researchers

This ITN provide an integrated training to 11 ESRs in diverse fields including geology, stratigraphy, geochemistry, palaeontology, oceanography, palaeoclimate modelling, taxonomy, and systematics through individual learning and NTAs. At international symposiums, NTAs, and by networking within THROUGHFLOW, the ESRs will have the opportunity to meet and work closely with leading experts from these fields in both academia and industry. **This close interaction with a diverse set of colleagues is one of the intrinsic strengths of network-based research training and will be maximised throughout the THROUGHFLOW project.** In addition, THROUGHFLOW will provide courses in transferable skills including basic GIS, sequence stratigraphy, palaeoenvironmental reconstruction, IPR, and science communication. At the end of the project, each ESR will possess a comprehensive toolset of skills that they will be able to apply to a range of theoretical and applied problems in the Earth and Life Sciences. Critical to their success will be a firm grounding in applied interdisciplinary research.

THROUGHFLOW ESRs will be able to compete in at least three different fields of employment: academia, industry, and government/NGO/policy.

Academic positions are competitive and only the most prepared researchers will succeed in attracting the external funding required to assemble productive research groups. THROUGHFLOW will create researchers able to thrive in competitive university environments. The ESRs will already be embedded in a successful research network that will allow them to make rapid progress and take advantage of new opportunities in interdisciplinary research. They will have the broad overview and mindset required to develop their own research networks to move forward into new research problems. For THROUGHFLOW ESRs, participation in large-scale interdisciplinary research will be a normal experience rather than something to strive for. The end result will be satisfying and productive careers in either university or industrial research.

SE Asia is one of the world's frontier petroleum exploration areas. Deposits of shallow water carbonates, and especially ancient reefs, are important oil and gas reservoirs. With increasing oil prices, reservoirs deeper in the sub-surface will become profitable for exploitation. This will require the employment of skilled geologists and stratigraphers. In most companies, the average age of experts in these fields continues to increase, and the currently dominant cohort trained during the 1960s and 1970s will soon pass into retirement. The result is a high demand for well-trained geoscientists. **THROUGHFLOW, with its roots in both academia and industry will be an ideal launching platform to gain the relevant expertise to lead a successful career in industrial research or consulting.** A key component of our training programme is fieldwork (lithology, facies and carbonate component recognition, relevant data retrieval methods) and in qualitative and quantitative methods of palaeoenvironmental interpretation of carbonate deposits. **This background means that ESRs will be very attractive recruits for the petroleum industry.**

SE Asia contains some of the most diverse ecosystems on the planet. It also contains some of the largest cities and highest population densities of any region on Earth and a number of nations undergoing rapid economic development. These three facts create an inescapable tension that must be addressed by regional, national, and international governments, NGOs, and other stakeholders impacted by the resulting policy decisions. THROUGHFLOW ESRs will have direct experience of these issues and will have the knowledge and skills required to contribute to ongoing debates by contributing data, by stakeholder education, and through analysis. For example, ESRs might be able **to provide significant information to the current debate over the cause of ongoing global decline of coral reef ecosystem function** because of their ability to integrate information about oceanography and climate systems with the results of biotic surveys of ecosystems.

B.6.2 Network Institutions

THROUGHFLOW will both improve existing channels and result in new interactions among its partners and catalyse individual research groups to produce and integrate diverse data streams enabling truly interdisciplinary research. This project is the first major effort to attract research funding by the Indo-Pacific Ancient Ecosystems Group (IPAEG). The IPAEG is a group of earth and life scientists that have gathered to document the relationship between environmental and biotic change on coral reefs and shallow tropical marine ecosystems in the Indo-West Pacific. One of our most significant outputs to date was a joint publication for *Science* (Renema *et al.* 2008). Through studies in the field and laboratory, we will accumulate **a new data set that will be used to establish a far better understanding of the structure and functioning of tropical marine ecosystems** and will be applied to address ongoing issues associated with accelerating anthropogenic environmental change on local to global scales. All members of the THROUGHFLOW network are involved with IPAEG, and the THROUGHFLOW project will result in the development of new communication channels and research links among research groups and act as a model for future large-scale integrated projects to be instituted to achieve the aims of IPAEG.

B.6.3 European Research

There is increasing recognition that rapid advances in our understanding of the Earth System can only be gained through the assembly of large volumes of data that can be analyzed rigorously using state-of-the-art quantitative techniques. This work requires the assembly of multiple research groups into teams that are able to work together and communicate effectively specific research outcomes to groups from other disciplines.

The results should have ramifications for multiple domains of academic enquiry with implications for industrial applications as well as increased understanding of the fate of the biosphere in an epoch of accelerated anthropogenic climate change. The European Research Area can address these large-scale research questions, because it has a long history of contribution to the Earth and Life sciences, and contains abundant expertise, instrumentation, collections, and data banks of existing information. **We propose to utilise an innovative combination of the dormant resources currently housed in European museums with new data that will enable us to make the first detailed description of the environmental effects and biotic consequences of reconfiguration of a tropical ocean gateway.**

This ITN will produce a strong cohort of European research scientists that will have a deep understanding of the importance of both detailed observation at the small scale and large-scale integrative analysis that will allow them to build new international trans-disciplinary teams to address other ambitious research questions relevant to understanding the future of the biosphere. They will also gain extremely valuable experience of working as a team at both a European and an international level, that will lay the basis for their future research careers.

EC-policy Related Issues. By providing new knowledge on the **biotic response of marine ecosystems to global environmental change**, THROUGHFLOW will contribute to key objectives of the Commission Communication on Halting the Loss of Biodiversity by 2010 (COM(2006)216). THROUGHFLOW will also contribute to the objectives of UN Framework Convention on Climate Change (UNFCCC) and the UN Convention in Biological Diversity. The new insights gained into the palaeoecology of coral reef ecosystems and their use as indicators of both past and current climate change will be directly relevant to the work of the Intergovernmental Panel on Climate Change (IPCC) and the European Climate Change Programme.

Public Awareness The ESRs will be encouraged to participate in Science fairs, University Open Days and public lectures. THROUGHFLOW will issue press releases and other news items aimed at the popular media such as local radio and TV. The environmental issues of **climate change and its impacts on biodiversity and sensitive environments** are both of concern to the general public

and will provide excellent opportunities for making the general public aware of the benefits of collaborative research at the European level. The THROUGHFLOW website will have an open section that discusses popular issues and presents the results from the network. The funding support from Marie Curie will be fully acknowledged in all public communications derived from the THROUGHFLOW project.

Synergies with Education at all Levels. The research results and training methods developed by THROUGHFLOW will be incorporated in undergraduate, Masters and PhD courses by the University partners. The project will generate large volumes of research material and we anticipate that all partners will utilise THROUGHFLOW samples in nationally funded research projects resulting in considerable multiplier effect from the initial EU investment in the project. The Partners will also use some of the relevant material in their Professional Development Training offered to SMEs and industrial workshops.

Gender. The partners will promote **Best Employment Practice** with regard to the employment of women researchers and other staff. This will be reinforced by a simple practical survey of best practice across the partners. Women researchers taking part in the project will be actively encouraged to participate in “*Women in Science*” activities.

Safety Issues. There are NO additional safety issues associated with this topic. All the partner laboratories have safety-training programmes and operate to high safety standards. The safety training of each ESR will be checked during the recruitment phase and any additional safety training that they may need will be built into their individual training plans

B.7 ETHICAL ASPECTS

Long experience of field-based research has provided the THROUGHFLOW team with a deep respect and appreciation for the value of meaningful collaboration with colleagues from developing nations. This new research programme is no exception. We will involve colleagues from Indonesia in all aspects of the training programme. Indonesia has a booming petroleum industry and requires increased capacity to manage this activity using local expertise. We intend to attract Indonesian ESRs as excellent candidates for positions within the network, and will invite local host counterparts to participate in the NTAs and Symposiums. We aim to increase local capacity in SE Asia by contributing to the training of researchers that will able to compete within a field of significant economic activity. A key objective of THROUGHFLOW is to better understand the impact of past environmental changes on shallow tropical coastal ecosystems in the region to better understand the future of ecosystems as climates change in the next century. We will work with local research managers to share the implications of our studies that may be relevant to conserving the biodiversity and economic value of ultra-diverse coral reefs of SE Asia.

References Cited

- | | |
|--|---|
| <p>Bouchet, et al. 2002, <i>Biol. Jour. Linn. Soc.</i> 75:421-436.
 Bruno and Selig 2007. <i>PLoS ONE</i> 2(8), e711.
 Donner et al. 2007, <i>Proc. Nat. Acad. Sci.</i> 104, 5483-5488.
 Gordon, 2005, <i>Oceanography</i> 18,14-27.
 Gordon et al. 2003, <i>Nature</i> 425, 824-828.
 Gramling, 2008. <i>Science</i> 856-857.
 Hall 2002, <i>J. Asian Earth Sci.</i>, 20, 353-434.
 Johnson et al. 2007, <i>Paleobiology</i> 33, 24-52.
 Johnson et al. 2008, <i>Science</i>, 319: 1521-1522.</p> | <p>Kuhnt et al. 2004, in Clift, et al. (eds), <i>Continent-Ocean Interactions in the East Asian Marginal Seas</i>.
 Meyer 2003, <i>Biol. Jour. Linn. Soc.</i> 79, 401-459.
 Morley et al. 2004, <i>Deepwater and Frontier Exploration in Asia & Australasia Proceeding</i>, Jakarta.
 O’Dea et al. 2007, <i>Proc. Nat. Acad. Sci.</i> 104, 5501-5506.
 Renema, et al. 2008. <i>Science</i> 321:654-657.
 Williams and Duda 2008 <i>Evolution</i> 62, 1618-1635
 Wilson 2002, <i>Sedimentary Geology</i> 147, 295-428.</p> |
|--|---|

THROUGHFLOW

ETHICAL ISSUES TABLE

	YES	PAGE
Informed Consent		
• Does the proposal involve children?	NO	
• Does the proposal involve patients or persons not able to give consent?	NO	
• Does the proposal involve adult healthy volunteers?	NO	
• Does the proposal involve Human Genetic Material?	NO	
• Does the proposal involve Human biological samples?	NO	
• Does the proposal involve Human data collection?	NO	
Research on Human embryo/foetus		
• Does the proposal involve Human Embryos?	NO	
• Does the proposal involve Human Foetal Tissue / Cells?	NO	
• Does the proposal involve Human Embryonic Stem Cells?	NO	
Privacy		
• Does the proposal involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	NO	
• Does the proposal involve tracking the location or observation of people?	NO	
Research on Animals		
• Does the proposal involve research on animals?	NO	
• Are those animals transgenic small laboratory animals?	NO	
• Are those animals transgenic farm animals?	NO	
• Are those animals cloned farm animals?	NO	
• Are those animals non-human primates?	NO	
Research Involving Developing Countries		
• Use of local resources (genetic, animal, plant etc)	NO	
• Impact on a local community	YES	33
Dual Use and potential for terrorist abuse		
• Research having direct military application	NO	
• Research having the potential for terrorist abuse	NO	
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL		

PALYNOVA Woodstock, 1 Mow Fen Rd, Littleport, Cambs CB6 1PY, UK
Tel. +44 1353862173, email pollenpower@palynova.com

August 23 2008

Attn: Dr Kenneth Johnson
Department of Palaeontology
Natural History Museum
Cromwell Road
London SW7 5BD

Dear Ken

This is to confirm that:

Dr R.J. Morley of *Palynova*, a UK based geological consultancy located in Littleport, Cambs. UK, will perform the following tasks with respect to the proposed 'Hotspots' research proposal:

- 1) Provide a background overview to the geological history of the SE Asian region as required for the project
- 2) Provide training through joint supervision of a PhD student at Kiel, emphasising terrestrial and marine climate and biotic signals from pollen and foraminifera in marine gravity cores.
- 3) Coordinate joint training program in Kalimantan, which will include field-based workshops, visits to clastic and carbonate outcrops, and examination of clastic and carbonate modern analogues (eg to Mahakam Delta, Paternoster),
- 4) Provide advice where applicable to project members regarding field program logistics
- 5) Serve as required on the network steering committee
- 6) Help facilitate links with industry, advise on additional experienced petroleum industry scientists to join the project 'Scientific Advisory Board'.

Yours sincerely

Dr R.J. Morley

THROUGHFLOW



SARAWAK OIL CO., LTD. (Co. No. 993918-P)
SABAH OIL CO., LTD (Co. No. 993919-M)
PENINSULAR MALAYSIA OIL CO., LTD (Co. No 994121-T)

August 21, 2008

To: Dr K. Johnson
Natural History Museum
CROMWELL ROAD
LONDON

Murphy Sarawak Oil Co. Ltd.
Level 26-28, 31 & 36, Tower 2
Petronas Twin Towers KLCC
50088 Kuala Lumpur

To whom it may concern.

Over the next few years I intend to participate in the "THROUGHFLOW" program of joint research and training with several other geologists, palaeontologists and stratigraphers from Universities and Museums, on topics associated with the sedimentary geology of SE Asia and the evolution of faunal diversity. I have volunteered to assist with topics in the field of stratigraphy and biostratigraphy, including assistance to post-graduate students. I will participate in the network Supervisory Board. In addition I will have special interest where research overlaps with commercial interests, and hope to be able to advise on the best ways for both applying research and getting industry support for studies.

A final function will be to support the network with contacts in industry and academia in the region, offer advice and support for the logistics of field programs and location of archived reports in the region.

Sincerely,

A handwritten signature in blue ink, appearing to read "P. Lunt", is written over a faint, light-colored signature line.

Peter Lunt
Senior Geologist

ENDPAGE

PEOPLE
MARIE CURIE ACTIONS

Marie Curie Initial Training Networks (ITN)
Call: FP7-PEOPLE-ITN-2008

PART B

THROUGHFLOW