THE ROLE OF LITHOSPHERIC INHERITANCE ON SUBDUCTION INITIATION ON A PASSIVE MARGIN

(RELICT)

REPORT OF THE RELICT MAGELLANPLUS WORKSHOP

The RELICT Magellan workshop was successfully held at the Instituto Português do Mar e da Atmosfera (IPMA, I.P.) headquarters in Lisbon, 12th, 13th September, 2019.

Workshop website: http://relict-magellanplus.ipma.pt/

The program and list of participants were the following:

Program

DAY 1 12 September 2019			
9:00-9:30	Administrative	Registration	
9:30-9:40	Administrative	Welcome and introduction	
TIME	**SESSION TYPE**	**TITLE / AUTHOR**	**CHAIRMAN**
9:30-09:45	Oral presentation	***Towards a RELICT Pre-IODP proposal*** Pedro Terrinha (IPMA, Portugal)	César Ranero
9:45-10:00	Oral presentation	***Overview of IODP and Technology of the JOIDES Resolution*** Leah Levay (IODP, USA)	
10:00-10:15	Oral presentation	***Geological setting of SW Iberia – an overview from rifting-drifting through Alpine orogeny to Present Margin reactivation*** Marc-André Gutscher (UBO, France), Nevio Zitellini (ISMAR, Italy)	
10:15-10:30	Oral presentation	***Crustal and upper lithospheric mantle nature in SW Iberia*** Sara Martínez (ICM, Spain)	
10:30-11:00	Keynote Speaker	***Exhumation of partially serpentinized mantle by detachment faults at mid-ocean ridges and continent-ocean transitions*** Mathilde Cannat (IPGP, France)	
11:00-11:20	Discussion 1	• **Gorringe Bank drilling across the Moho and OCT. How does it improve our understanding on serpentinized mantle and OCT rheology ?**	
11:20-11:50	Coffee break / Posters		
11:50-12:20	Keynote Speaker	***Various modes of subduction initiation with special emphasis on the SW Iberia margin case*** Serge Lallemand (Univ. Montpellier, France)	
12:30-13:00	Keynote Speaker	***Subduction dynamics and overriding plate deformation*** Wouter Schellart (Vrije Universiteit Amsterdam)	
13:10-14:10	Lunch break		
14:10-14:30	Oral presentation	***Fluid flow in transform faults*** Paola Vannucchi (RHUL, UK)	Marc-André Gutscher
14:40-15:10	Keynote Speaker	***Delamination of oceanic lithosphere: a key for subduction initiation?*** João Duarte (Univ. Lisbon, Portugal)	
15:20-15:50	Keynote Speaker	***Porous fluid flow controls subduction initiation and seismicity*** Taras Gerya (ETH, Switzerland)	
16:00-16:30	Coffee break / Posters		
16:30-16:50	Keynote Speaker	***Subduction initiation in SE China: perspectives for projects*** Chun-Feng Li (Zhejiang Univ., China)	
17:00-17:20	Oral presentation	***Seismicity and seafloor deformation along a strike-slip Africa-Eurasia plate boundary segment*** Eulália Gràcia (ICM, Spain)	
17:20-18:00	Discussion 2	• **Gorringe Bank drilling across serpentinized mantle. How does it help understanding subduction initiation?**	
19:00	Dinner downtown		

DAY 2 13 September 2019			
TIME	**SESSION TYPE**	**TITLE / AUTHOR**	**CHAIRMAN**
9:00-9:20	Oral presentation	***Tsunami hazard in Southwest Iberia*** Rachid Omira (Univ. Lisbon, Portugal)	Paola Vannucchi
9:30-9:50	Oral Presentation	***Potential hotspots of life in marine fracture zones with active fluid seepage from the lithosphere*** Clemens Glombitza (ETH, Switzerland)	
10:00-10:30	Keynote Speaker	***Drilling the ocean basement: what can and cannot realistically be achieved*** Christopher MacLeod (Univ. Cardiff, UK)	
10:40-11:10	Coffee break		
11:10-12:10	Discussion 3	• **Monitoring the SWIM Faults: improving knowledge & mitigation of Transform Plate Boundary Hazards?** Introduction by Achim Kopf (MARUM, Bremen University)	
12:10-13:30	Lunch break		
13:30-15:30	Discussion 4	• **Split up sessions**	Nevio Zitellini
15:30-16:00	Coffee break		
16:00-17:00	Discussion 5	• **Wrap up/conclusions from split up sessions**	Pedro Terrinha
17:00	Closure		

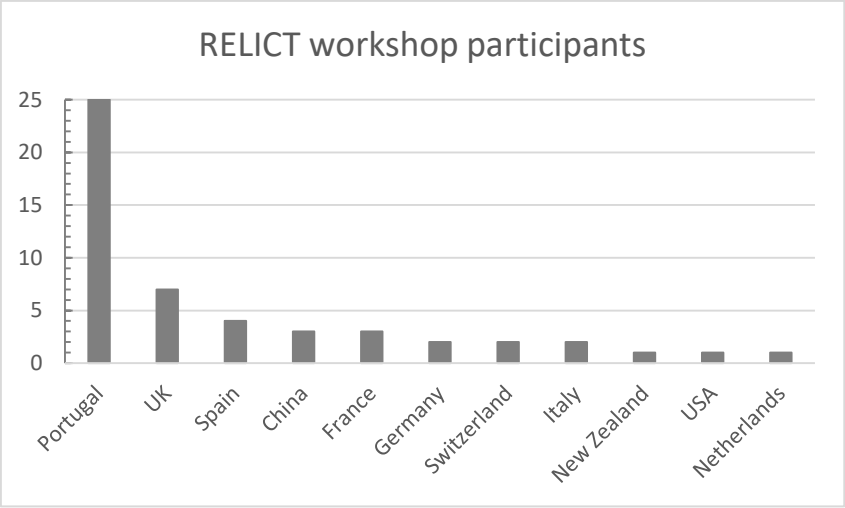
List of participants

Name		**Institution**	**Country**
Afonso Silva Gomes	PGSt	Univ. Lisboa	Portugal
Ana Gomes	PGS	FCUL	Portugal
Andrew Parsons	YRs	University of Oxford	UK
Antonio Ribeiro	SRs	IDL & Geology Department (FCUL)	Portugal
Carlos Ribeiro	SRs	Dep. Geosciences, University of Evora	Portugal
César Ranero	SRs	Institut de Ciències del Mar – CSIC, Barcelona	Spain
Christian Hübscher	SRs	University of Hamburg	Germany
Christopher MacLeod	SRs	Cardiff University	UK
Christopher Schmidt	PhDst	GEOMAR Helmholtz Centre for Ocean Research Kiel	Germany
Chung Feng Li	SRs	Zhejiang University	China
Clemens Glombitza	SRs	ETH Zürich	Switzerland
Cristina Roque	SRs	EMEPC	Portugal
Daniela Henriques	Tech	IPMA	Portugal
Davide Gamboa	SRs	IPMA	Portugal
Débora Duarte	PhDst	IPMA & RHUL	Portugal
Elliot Carter	PhDst	University of Manchester	UK
Eulàlia Gràcia Mont	SRs	Institut de Ciències del Mar – CSIC, Barcelona	Spain
Fernando Ornelas	SRs	Universidade de Lisboa	Portugal

Marques			
Filipe Medeiros Rosas	SRs	IDL-FCUL	Portugal
Francesco Turco	PhDst	University of Otago	New Zealand
Gil Machado	Geologist	Chronosurveys	Portugal
Hector Perea Manera	SRs	Universidad Complutense de Madrid	Spain
Jaime Almeida	PhDst	Univ. Lisboa	Portugal
João Duarte	SRs	IDL-FCUL	Portugal
Johan Lissenberg	SRs	Univ. Cardiff / ECORD	UK
Lallemand Serge	SRs	CNRS – Montpellier University	France
Leah Levay	SRs	IODP	USA
Luis Batista	PhDst	IPMA	Portugal
Luísa Ribeiro	Post Doc	EMEPC	Portugal
Lulu Zhang	PhDst	Zhejiang University	China
Marc-André Gutscher	SRs	Univ. Brest	France
Maria Filomena Loreto	SRs	CNR – ISMAR	Italy
Marta Neres	YRs	IPMA	Portugal
Marta Reis	PGSt	Universidade de Coimbra	Portugal
Mathilde Cannat	SRs	CNRS-Institut de Physique du Globe de Paris	France
Nevio Zitellini	SRs	CNR - ISMAR, Bologna	Italy
Nuno Afonso Dias	SRs	IDL/ISEL	Portugal
Paola Vannucchi	SRs	Royal Holloway, University of London	UK
Pedro Madureira	SRs	EMEPC	Portugal
Pedro Terrinha	SRs	IPMA	Portugal
Rachid Omira	SRs	Univ. Lisboa / IPMA	Portugal
Ricardo Correia	PhDst	Univ. Aveiro	Portugal
Ricardo Pereira	SRs	Partex Oil and Gas / Instituto Dom Luiz	Portugal
Sara Martínez Loriente	YRs	Institut de Ciències del Mar – CSIC	Spain
Taras Gerya	SRs	ETH Zurich	Switzerland
Tiago M. Alves	SRs	3D Seismic Lab – Cardiff University	UK
Uisdean Nicholson	SRs	Heriot-Watt University	UK
Vânia Veloso Lima	PGSt	Instituto Hidrográfico – Marinha	Portugal
Vítor Magalhães	SRs	IPMA	Portugal
Wouter P. Schellart	SRs	Vrije Universiteit Amsterdam	Netherlands
Yaqing Li	PhDst	Zhejiang University	China

SRs- Senior Researcher; YRs- Young Researcher; PGSt- Post Graduate Student; PhDSt- PhD student.

Participants per country



MAIN RESULTS

- The main outcome of the discussions was that the central addressed topic: subduction initiation in a passive margin, should be the core topic of a proposal to be submitted to the IODP Science Support Office, to the present proposal submission call that have the deadline on the 1st October, 2019.

- Pre-IODP proposals submission:

a) 1st submitted on 1st October, 2019

b) 2nd submitted on 4th April, 2020.

Cover pages below

Lisbon, IPMA, 27th July, 2020

Pedro Terrinha, pedro.terrinha@ipma.pt

Marta Neres, marta.neres@ipma.pt

Vitor Magalhães, vitor.magalhaes@ipma.pt

(organizing board)

IODP Proposal Cover Sheet

977 - Pre

Subduction initiation off SW Iberia

Received for: 2019-10-01

Title	THE ROLE OF LITHOSPHERIC INHERITANCE AND PASSIVE MARGIN REACTIVATION ON SUBDUCTION INITIATION - RELICT
Proponents	Pedro Terrinha, Nevio Zitellini, Cesar Ranero, Marc-André Gutscher , Marta Neres, Eulàlia Gràcia, Paola Vannucchi, Sara Martínez-Loriente , Christian Hensen, Jason Morgan , Andrew Parsons, João Duarte, Taras Gerya, Serge Lallemand, Wouter Schellart, Clemens Glombitza, Mathilde Cannat, Uisdean Nicholson, Maria Filomena Loreto , Vitor Magalhaes
Keywords	passive margin reactivation, subduction initiation
Area	South West Iberia

Proponent Information

Proponent	Pedro Terrinha
Affiliation	Portuguese Institute for the Sea and Atmosphere
Country	Portugal

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Abstract

Subduction initiation (SI) at passive margins remains a challenge for understanding of the mechanisms of Plate Tectonics. No examples of spontaneous SI along passive margins have been observed. Yet, the geological record tells us that Atlantic-type oceans get reactivated in compression to the point of developing subduction zones. The average life span of passive margins is 136 My, the approximate age of oceanic break up off SW Iberia.

Because the strength of a pristine passive margin exceeds the stresses produced by plate tectonics, SI at passive margins must require lithospheric-scale weak zones that can be ruptured at relatively low stresses. Such weaknesses can be transform fault or oceanic core-complexes. Compressive reactivation is a necessary pre-requisite for SI at a passive margin. Large magnitude earthquakes M~>8 are also characteristic of subduction zones.

The South West Iberia Margin (SWIM) comprehends all these features.

The Gorringe Bank is a 200 km long segment of continental exhumed mantle along a Lower Cretaceous extensional detachment that has been obducted in Miocene times. Drilling >300 m into the mantle will allow inspection of the nature of the mantle, internal anisotropies and present and fluid paths, damage of the original structure, in order to understand whether it can constitute a lithospheric weakness.

The whole West Iberia Margin was submitted to the Alpine compression during Paleogene and Neogene times up to the Late Miocene. In Pliocene times the main compression direction rotated counter-clockwise and compression resumed and concentrated in the SWIM. Strain concentration is required for developing large scale individual faults, i.e. subduction zones. Drilling the Tagus Abyssal Plain, the Gorringe hanging-wall and Horseshoe Abyssal Plain will allow the stratigraphic calibration of thousands of kilometres of seismic lines in order to understand the compressive history of the West Iberia Margin mainly in post-Alpine orogeny times. When and how concentration of compression in the SWIM occurred and how it was transmitted.

Two large earthquakes were generated in the SWIM with magnitudes M8.5-8.9 (1755 Lisbon tsunamigenic earthquake), M7.9, 1968, 29th February earthquake. Large magnitude earthquakes are prone to trigger large Mass Transport Deposits, such as landslides and homogenites. Full recovery of sediments from the Tagus and Horseshoe Abyssal Plains will allow the correlation of large mass transport events in these two basins and extrapolation into the Pleistocene (~1.3My) the record of historical and instrumental seismicity.

The answers to these questions will allow understanding how an Atlantic-type continental margin reactivates and subduction initiates.

IODP Proposal Cover Sheet

988 - Pre

Subduction Initiation at a passive Atlantic-Margin

Received for: 2020-04-01

Title	THE ROLE OF LITHOSPHERIC INHERITANCE AND PASSIVE MARGIN REACTIVATION ON SUBDUCTION INITIATION - RELICT
Proponents	Pedro Terrinha, Nevio Zitellini, Cesar Ranero, Marta Neres, Jason Morgan, Andrew Parsons, Paola Vannucchi, Eulàlia Gràcia, Sara Martínez-Loriente, Marc-André Gutscher, Christian Hensen, João Duarte, Uisdean Nicholson, Taras Gerya, Serge Lallemand, Wouter Schellart, Mathilde Cannat, Clemens Glombitza, Maria Filomena Loreto, Vitor Magalhães
Keywords	Subduction Initiation,Atlantic passive margin
Area	Southwest Iberia

Proponent Information

Proponent	Pedro Terrinha
Affiliation	Portuguese Institute for the Sea and Atmosphere
Country	Portugal

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Abstract

Subduction initiation (SI) at passive margins remains a challenge for understanding of the mechanisms of Plate Tectonics. No examples of spontaneous SI along passive margins have been observed. Yet, the geological record tells us that Atlantic-type oceans get reactivated in compression until developing subduction zones. Average life span of passive margins is 136 My, the approximate age of oceanic break up off SW Iberia.

Because the strength of a pristine passive margin exceeds stresses produced by plate tectonics, SI at passive margins must require lithospheric-scale weak zones that can be ruptured at relatively low stresses and concentration of strain to reactivate decollements. Such weaknesses can be transform fault or oceanic core-complexes. Compressive reactivation is a necessary pre-requisite for SI at a passive margin. Large magnitude earthquakes M~>8 are also characteristic of subduction zones.

The South West Iberia Margin (SWIM) comprehends all these features. The Gorringe Bank is a 200 km long segment of continental exhumed mantle along a Lower Cretaceous extensional detachment that has been obducted in Miocene times. Drilling >300 m into the mantle will allow inspection of the nature of the mantle, internal anisotropies and fluid paths, damage of the original structure, in order to understand whether it can constitute a lithospheric weakness.

The whole West Iberia Margin (~1700 km) was submitted to the Alpine compression during Paleogene and Neogene times until Late Miocene when mountain building ceased. In Pliocene times the main compression direction rotated counter-clockwise and compression resumed and concentrated in the SWIM, ~400 km. Strain concentration is required for developing large scale detachments that can evolve to subduction zones.

Drilling the Tagus Abyssal Plain, the Gorringe hanging-wall and Horseshoe Abyssal Plain will allow the stratigraphic calibration of thousands of kilometres of seismic lines in order to understand the compressive history of the West Iberia Margin in post-Alpine orogeny times. When and how concentration of compression in the SWIM occurred and how it was transmitted.

Two large earthquakes were generated in the SWIM with magnitudes M8.5-8.9 (1755 Lisbon tsunamigenic earthquake), M7.9, 1969, 29th February earthquake. Large magnitude earthquakes are prone to trigger large Mass Transport Deposits, such as landslides and homogenites. Full recovery of sediments from the Tagus and Horseshoe Abyssal Plains will allow the correlation of large mass transport events in these two basins and extrapolating into Pleistocene (~1.3My) the record of historical and instrumental seismicity.

Answering these questions will allow understanding how an Atlantic-type continental margin reactivates and subduction initiates.