



International Conference “Marine Geology: Marginal Seas - Past and Future”

December 14-17, 2021

Conference Summary



Guangzhou Marine Geological Survey,

China Geological Survey,

Guangzhou, P.R. China

Summary Report

International Conference

“Marine Geology: Marginal Seas - Past and Future”

hosted by Guangzhou Marine Geological Survey,

China Geological Survey

Guangzhou, December 14-17, 2021

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1. Introduction

To contribute to the progress in marine geosciences, and to foster a new stage of international cooperation a scientific research initiative “Eurasian Marginal Seas: Past and Future” (EMS initiative) was launched in 2019 promoted by the International Association for Mathematical Geosciences (IAMG). On 28th November, 2019, the “1st Marginal Seas Expert Meeting” was held in Guangzhou, China, hosted by the Guangzhou Marine Geological Survey (GMGS), China Geological Survey (CGS). 18 overseas experts from 7 countries, together with 50 Chinese colleagues joined this meeting and elaborated the basic concept for the establishment of a marginal seas research network. An online conference “Marginal Seas – Past and Future” (2nd Marginal Seas Expert Meeting) with 190 participants from 21 countries hosted by the University of Szczecin, Poland, 16-17th December, 2020, served as a base line study for a DDE Marginal Seas Task Group established by the Executive Committee of the Deep-time Digital Earth Big Sciences Program of the IUGS in January 2021. A first research project “Morphological Evolution of Coastal Seas – Past and Future” of the Marginal Seas Task Group supported by DDE, IAMG and project partners and was launched in October 2021.

The “Marine Geology: Marginal Seas – Past and Future” conference hosted by the Guangzhou Marine Geological Survey, China Geological Survey, 14-17th December 2021 (“3rd Marginal Seas Expert Meeting”) represents another milestone supporting the marginal seas research initiative.

Four main targets of the conference are to be mentioned:

- Extension of the international Marginal Seas Research Network,
- The targeted further development of scientific fundamentals and applied fields of marginal sea research,
- Scientific support of the current DDE Marginal Seas research project,
- Definition of the grand challenges of marginal seas research as basis for the preparation of future research projects.

This report was compiled by the conveners of the conference.

2. About the conference

The main venue was set in GMGS Headquarter in Guangzhou. The four branch venues

set in the Ministry of Natural Resources of PRC, Beijing, Academy of Geological Sciences, CGS in Beijing, and GMGS Nansha Base in Guangzhou, GMGS Sanya Base in Hainan Island.

The Scientific Committee of the conference, which included scientists from 10 countries, was chaired by Prof. Guangsheng Yan, China Geological Survey, China.

After several months' preparation, the conference did receive 58 abstracts, from 28 different countries and 5 different continents, covering about 100 organizations.

The conference was held in a hybrid face-to-face and online mode.

During the opening session the participants of the conference were welcomed by Guangsheng Yan, chief geoscientist of CGS; Jianliang Ye, director general of GMGS; Oleg Petov, director general of Russian Geological Research Institute; Piotr Shrek, vice director of Polish Geological Institute / National Research Institute; and Andrzej Skrendo, vice rector of University of Szczecin who attended the opening ceremony and delivered speeches. Jinpeng Zhang, GMGS, chaired the opening ceremony on behalf of local organizing committee and sponsors.

The scientific part of the conference was introduced by 4 plenary key note lectures. During the topical sessions, 10 keynotes lectures and 33 regular lectures were presented. Finally, the participants of the conference debated the general outcomes before the results were summarized by the conveners. More than 120 participants from 18 countries attended the conference.

3. Key note lectures

Qiuming Cheng, IUGS (International Union of Geological Sciences) Executive Committee councilor and Past President (2016-2020) introduced in his lecture “Deep-time Digital Earth and Mineral Resources assessments in South China Sea and Surrounding Area” the IUGS initiatives facilitating data driven earth science, frontiers of earth sciences and DDE- Mineral resources (DDE-Resourcing Future Generations). He also gave more detailed introduction to mineral resources study and potential collaboration along the Tethys and around South China Sea region.

Roland Oberhänsli, Potsdam University, Germany, president of the DDE Sciences Committee and past president of the IUGS (2012-2016), gave a keynote lecture, titled “Deep-time Digital Earth (DDE) an IUGS science program aimed for data driven

discoveries in Geosciences”. He introduced mission, vision and international programs/plans of DDE Big Science Program of IUGS, and emphasized big data science for the current geoscience revolution.

Yan Qiu, GMGS, titled her keynote lecture “Crust structure and tectonic evolution of the southwest sub-basin and its conjugate margins, in the South China Sea”. She introduced the geological and tectonic setting of SCS, crust structure and tectonic evolution of the conjugate margins of SW sea basin, Pengxi micro-block and Zhenghe micro-block, particularly about the breakup, opening and seafloor spreading of SW sea basin.

Sabin Zahirovic, University of Sydney, Australia, is leader of DDE Paleogeography Working Group. In his keynote lecture titled “The tectonic, geodynamic, and paleogeographic evolution of the elusive Proto South China Sea marginal basin” he argued that the existence of a Proto South China Sea is a necessity for reconciling multiple and independent geological constraints. The author’s interpretation of partly divergent model results explained convincingly the improvement of our understanding of paleogeography, basin evolution, sedimentary provenance, and regional geodynamics of the predecessor marginal basin to the South China SCS.

4. Topical Sessions

The conference was structured into four topical sessions. The first session focussed on **advances in marginal sea research** continuing the discussion of methodologies, societal demands and future regional target areas. The second session on **coastal morphodynamics**, was aiming to foster the discussion related to the research project of the DDE Marginal Seas Task Group focused on the comparison of coastal seas’ morphodynamics. The third session on **ecosystem dynamics** should contribute to integrate environmental data into the general concept of interdisciplinary marginal seas research. The fourth session on **methodological approaches and geodata management** was devoted mainly to formatting, harmonizing, processing and mapping marginal sea data to manage geodata and to make the spatial database FAIR (Findable, Accessible, Interoperable and Reusable) through the implementation of dedicated Marine Spatial Data Infrastructure at different spatial scales.

Session 1. Advances in marginal sea research

(conveners: Peter Clift, Jan Harff, Jennifer McKinley, Susan Nash, Qiuming Cheng)

Topics:

16 lectures were held including 6 key note presentations. The topics were related to the mission of the DDE Marginal Seas Task Group to describe the processes taking place in marginal seas holistically as an interaction between geo-, ecosystem, climate and socioeconomic systems based on big data analysis, functional numerical models and AI approaches. These topics included:

advanced model approaches, natural vs. anthropogenic drivers, sedimentological source-to-sink conceptions, and the formation of an international marginal seas research network.

Keynote lectures:

Susan Nash gave an introduction into Artificial Intelligence (AI) and Machine Learning (ML) in geosciences. The lecture opened the discussion about the value of AI and ML in marginal sea research in particular for advanced sedimentary basin analysis.

Pawel Rekant and **Oleg Petrov** presented the first time a tectonic reconstruction of the Eurasian Basin (Arctic Ocean) along the entire seismic dataset, including both Russian and international seismic lines. The hypothesis of the tectonic 4-stage model (Cretaceous to Quaternary) for the Eurasian Basin is supported by a correlation with the Norwegian–Greenland Basin. **Peter Clift** presented a new compilation of data sets describing the source-to-sink relation between southern China, the Indochina peninsula and Borneo (source) and the South China Sea (sink). He emphasized that synthesizing the existing big data sets using AI methods is critical for modelling the performance of the continental shelves in the near future, especially in the context of sea-level rise driven by global warming over the next century. **Marcus Reckermann** et al. described that the Baltic Sea region as an example of heavily populated semi-enclosed marginal sea is strongly affected by various human activities which are interrelated to different degrees. Impacts on the environment and the human sphere can be roughly allocated to anthropogenic drivers such as food production, energy production, transport, industry and economy. The authors concluded that a management of human activities must keep balance the human needs, which exert tremendous pressures on the systems. Findings from this inventory in the Baltic Sea region can largely be transferred to other comparable marginal and coastal seas in the world.

John R. Delaney et al. explained that extreme anthropogenic impact on natural marine environment is recorded in areas where coastal embayment or estuaries are hosting major densely populated port-cities – the so-called “Urban Seas”. Bold steps toward insightful long-term management of these urbanized ocean systems will require in-depth, sustained studies of the complex interactions among human society and natural marine/terrestrial ecosystems. A focused, but enduring Urban Seas Initiative (USI) could meet many challenges advocated by the *U.N. Decade of Ocean Science for*

Sustainable Development (2021-2032). Studies of this type offer an excellent focus for integrated international collaboration. Real-time delivery of all information to accessible data hubs could rapidly change the efficiencies of modelers crafting highly reliable ‘Digital Twins’ of key ecosystems within Urban Seas systems.

Basic step to the effective modelling is the interdisciplinary co-operation between geoscientists, modelers and experts in AI and ML. **Jennifer McKinley** mentioned the excellent environment for this networking provided by the link between the DDE Marginal Seas Initiative and the IAMG (International Association for Mathematical Geosciences). As DDE Founding Member the IAMG supports research innovation through deep data learning, spatial data analysis, numerical modelling and informatics in marine geo- and environmental sciences with the goal of developing sustainable strategies in marginal sea research.

Regular presentations:

Advanced results have been presented from two regional research areas:

- South Asian Marginal Seas:

Xianying Wang et al. reported about a coupled thermo-mechanical-surface-process model and its application to the northern passive continental margin of the South China Sea. For model parameterization new sea-level data are available from the Straits of Malacca (**Abdullah Sulaiman et al.**), beach placer data compilation from Guangdong Province, China (**Hai Lin**), and paleomagnetic data from the northern SCS (**Guanhua Li**). An advanced global generalization of sea-level data was presented by **Nicole S. Khan**. **Yulong Xue** described the anthropogenic impact in the northern SCS.

- Arctic Ocean:

Daria Ryabchuk et al. provided the first time a lithological, morphological and genetic interpretation of submerged ridges located on the East Siberian Sea bottom around the New Siberia Island and near Kolyma River based on new research data. **Diana Prishchepenko** have used isotopic-geochemical data of carbonate bedrock fragments from the Mendeleev Rise for the discussion of possible source areas.

Session 2, Coastal morphodynamics

(Conveners: Wenyan Zhang, Tarmo Soomere, Xinong Xie)

Topics:

8 presentations have been scheduled including one keynote talk. The topics cover estuarine, coastal, shelf and continental slope morphodynamics, from short-term processes to long-term evolution.

Keynote lecture:

A hypothesis - the 2021 physics Nobel prize significant for understanding the variability of marginal sea morphology? (**Hans von Storch**). Inspired by the 2021 Nobel prize winner Klaus Hasselmann's work, Prof. von Storch extended the concept to marginal sea studies. According to Hasselmann's theory, that "Brownian motion"-ansatz, short-term, unprovoked fluctuations may cause long-term variations. Thus, any long-term change reflects a mixing of forced and unforced variability. The South China Sea was used as an example. It was shown that in such seas considerable small-scale variations, for instance related to eddies, internal tides, fronts and other phenomena, take place. It is hypothesized that these small-scale (and short term) processes act upon morphology dynamics, which will integrate these variations in the spirit of the "stochastic climate model" so that slow and regional-scale morphological changes emerge.

Regular presentations

The seven regular presentations cover morphodynamics of estuaries (Pear River Estuary, by **Junjie Deng**), barrier islands and sandy coasts (Southern Baltic Sea, by **Pawel Sydor** and **Grzegorz Uścińowicz**), coastal shelf (northern South China Sea, by **Yufeng Wang** and **Ping Xiong**), and continental slope (South China Sea, by **Hui Chen** and **Shan Liu**). Time scale spans a broad range from annual, decadal, millennial (Holocene) to even longer period (last glacial cycle).

Session 3, Ecosystem dynamics (conveners: Andrzej Witkowski, Jinpeng Zhang, Yenny Risjani, Yahui Gao, Hung Duc Nguyen, Jean-Luc Mouget)**Topics:**

15 presentations have been delivered as oral presentations. The topics of the session covered a widespread scale of ecosystem dynamics including anthropogenic impacts on ecosystems as assessed with various proxies including diatoms and foraminiferans. Additionally, aspects of applied diatomology have been discussed.

Keynote lectures:

Harmful algae – global phenomenon (**Gustaaf Hallegraeff et al.**). The quality of data largely depends on the monitoring. In areas with long monitoring there is no significant increase in development of harmful blooms and vice versa in shortly monitored areas the data are not clear. Many microalgae contribute to this phenomenon. In the past numerous human deaths have been recorded. Blue biotechnology – choosing diatom species for applied use, blue diatoms from genus *Haslea* (**Jean-Luc Mouget**). The

genus *Haslea* has been presented in a broad context including history of research, impact on society, and importance of blue diatoms for an applied aspect of diatomology.

Regular presentations

In this topic presentation on a green technology of nanogold and nanosilver production on cultured benthic diatoms (**Piya Roychoudhury**) shall be included. Bioindication of environmental hazards in shallow brackish-waters – mercury in the Gulf of Gdańsk sediments (**Dominoka Hetko**), eutrophication and mass mucilage development in the Sea of Marmara (**Latife Köker**). Fossil diatoms and foraminifers – environmental reconstructions (East China Sea and South China Sea in China and Malesia by **Jinpeng Zhang**) Environmental reconstruction based on geochemical and sediment proxies – from Szczecin Lagoon (**Agnieszka Strzelecka**). Biodiversity of diatoms in South China Sea (**Huina Lin**), Mediterranean Seas (**Aydin Kaleli**), high diversity of some marine taxa in Java Sea and SCS (**Mateusz Rybak**) and the phenomenon of massive blooms of blue diatoms in Corsica, Croatia in the Mediterranean and in North Carolina (**Julie Seveno**). Dynamics of the southern Baltic nearshore benthic communities in relation to temporally changing sediment plant material enrichment – (**Teresa Radziejewska**)

Session 4, Methodological approach and Geodata management

(conveners: **Federica Foglini, Joanna Dudzinska-Nowak, Yuanzhi Zhang**)

Topics:

12 presentations have been scheduled including one keynote talk. The topics cover remote sensing applications and sea level changes, spatial data infrastructure and data FAIRness, marine geological mapping.

Keynote lecture

This study (**Yuanzhi Zhang**) presents a very interesting application of remote sensing technique for the estimation of chlorophyll-a (chl-a) and suspended sediments concentrations via a case study in the Pearl River estuary in China. The author showed the algorithms used for estimation of the chl-a concentration in these productive turbid waters, the maximum band ratio (MBR) and near-infrared–red (NIR–red) models are used in this study. Specific focus is placed on (a) comparing the ability of the models to estimate chl-a in the range 1–12 mg m⁻³, which is typical for coastal and estuarine waters, and (b) assessing the potential of the Moderate Resolution Imaging Spectrometer (MODIS) and Medium Resolution Imaging Spectrometer (MERIS) to estimate chl-a concentrations.

Regular presentations

This session presents different subtopics in different geographical contexts showing examples at global and local scale. In particular the session covers: i) Remote sensing and underwater acoustic (backscatter) applications for estimation of chlorophyll and suspended sediments in Pearl River estuary in China (**Yuanzhi Zhang**), mangrove extraction in Shenzhen (Hong Kong) (**Yingying Liu and Yuanzhi Zhang**), and analysis of internal solitary waves in the northern south China (**Yingci Feng**); ii) Marginal seas data base inventories (**Jakub Miluch**), DDE metadata standard (**Minghua Zhang**) and marine spatial data infrastructure to make data FAIR with examples at global scale and at local scale (e.g. the Adriatic Sea) (**Valentina Grande and Federica Fogliani**); iii) Example of marine geological habitat mapping in Malaysia coastal areas showing the evolution of technology and the possible future works (**Alwakhir Shaarani and Iryawan Hamza**); iv) The impact of sea level change in South China (**Yilin Yang**); v) the distribution source and level of pollution in Kelantan river (**Arif Che Abd Rahim**) and vi) the characterization of the various soil types in Peninsula Malaysia (**Halim Abdul**); vii) How estuary evolution impacted on human activities: a case from ancient harbors in Pearl River Estuary (**Pingyuan Li**).

5. Summary

As the third Marginal Seas initiative the meeting supported researchers' communication in geo-marine science and technology among the international partners, including the coastal and marine environmental research, fundamental geology, marginal sea future projections and management for the upcoming decades. It also provided an opportunity for multidisciplinary collaborative research in the field of geosciences, as several actions or plans are expressing the strong demand international cooperation in the coming future.

The scientific lectures and discussions encourage the organizers to continue the tradition of scientific conferences on marginal sea issues. In this way, the relatively new and modern field of marginal sea research can be further developed in a targeted manner.

The initiation of new joint international research projects is emphatically supported.

For advanced research future projects the following challenges have to be considered:

- (1) Marginal sea research in general (Session 1):

- Anthropogenic impact on Marginal seas' environments ("Urban Seas" concept)
- interaction between geo-, ecosystem, climate and socioeconomic systems in polar and subpolar marginal seas.

(2) Coastal morphodynamics (Session 2):

- Coastal protection versus climate change,
- Disequilibrium in coastal morphology driven by human activities and climate change.

(3) Ecosystem dynamics (Session 3):

- Harmful algal blooms – impacting coastal densely populated areas,
- Assessment of anthropogenic impact on shallow water areas.

(4) Methodological approach and Geodata management (Session 4):

- Spatial data integration and harmonization (Data FAIRness),
- New technology for seafloor and habitat mapping, remote sensing challenges for environmental application and sea level change detection.