



Methane Fluxes and their Impact on Climate and Ecosystem in the Indo-Pacific Region

Nadezha Syrbu, POI FEB RAS, Russia

WESTPAC Co-PIs

Renat Shakirov, co-leader, POI FEB RAS, Russia

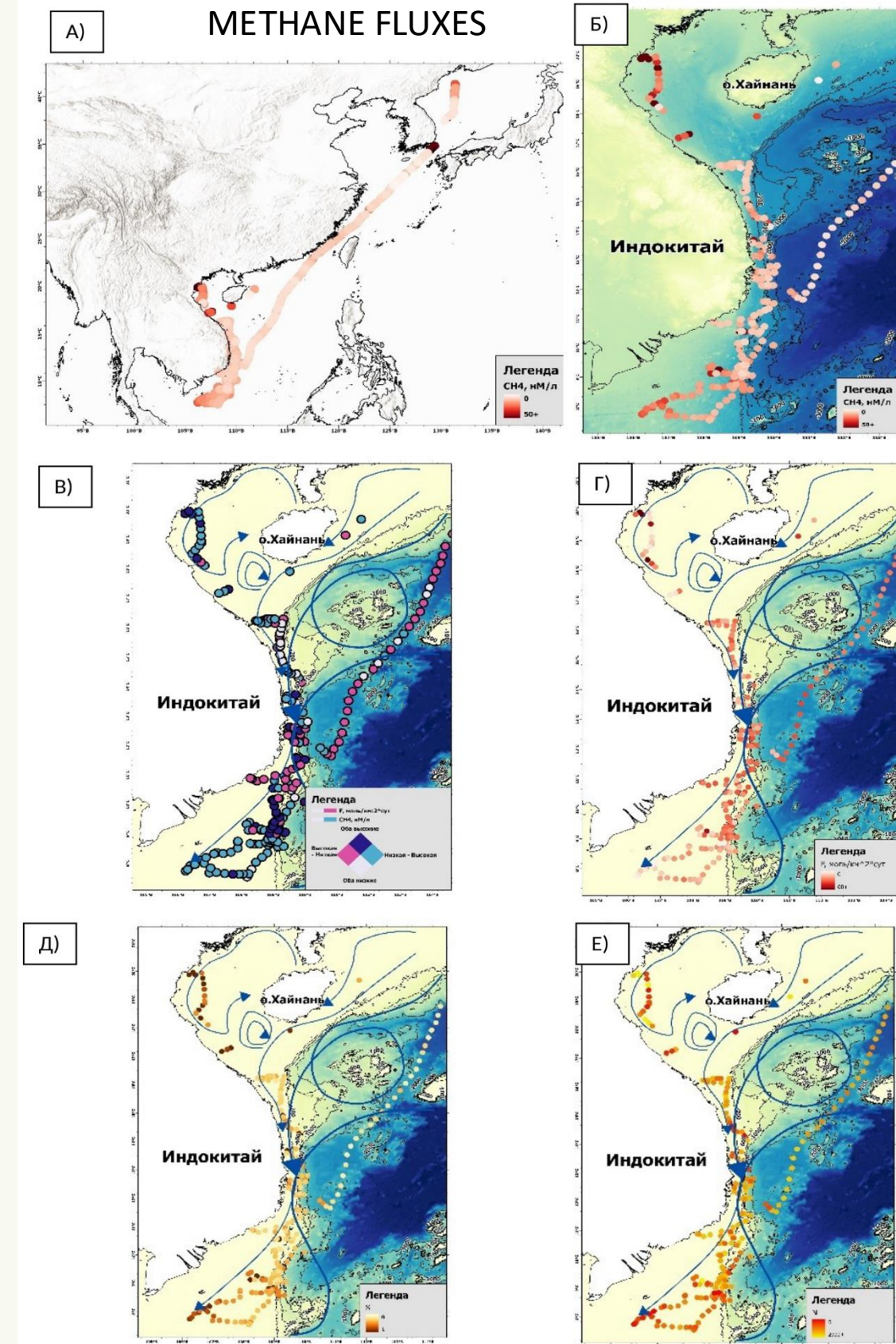
Nengyou Wu, co-leader, Laoshan Laboratory, China

Sixteenth Intergovernmental Session of the
IOC Sub-Commission for the Western Pacific (WESTPAC-XVI)
Hangzhou, China, 10-12 November 2026

Summary Outline



1. Justification and project duration
2. Project objectives
3. Major activities and outputs (particular those accomplished during 2025-2026)
4. Anticipated activities and outputs in 2027
5. Biennial workplan and budget for 2028-2029, structured around the IOC HLOs
6. Strategic recommendations for future development



Members/ Steering group

□ Principal Members/ Steering Group

- **Renat Shakirov**, co-leader, POI FEB RAS, Russia
- **Nengyou Wu**, co-leader, Laoshan Laboratory, China
- **Yi-Zhao Wan**, Qingdao Institute of Marine Geology, China
- **Min Zhang**, First Institute of Oceanography, China
- **Pawan Dewangan**, National Institute of Oceanography, India
- **Susilohadi Susilohadi**, Research Centre for Geological Resources-BRIN, Indonesia
- **Dileka Samaranayake**, National Aquatic Resources Research and Development Agency, Sri Lanka,
- **Nadezhda Syrbu**, POI FEB RAS, Russia
- **Siti Nur Azella Binti Zaine**, Chemical Engineering Department, University Teknologi Petronas, Malaysia
- **Abdus Salam**, Hydrogen Energy Laboratory, Bangladesh Council of Scientific and Industrial Research (BCSIR), Bangladesh

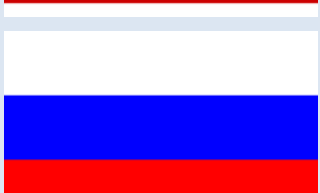
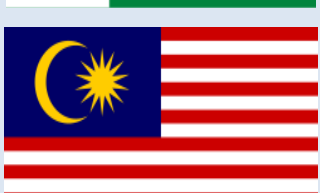
Well represented: 10 countries

Bridge among IOC units: 8 IOC/WESTPAC + 2 IOC/INDIO

Experts of various disciplines: physics, chemistry, geology, biology

□ Associated Members

- **Hitoshi Tomaru**, Chiba University, Japan
- **Le Duc Anh**, Vietnam Academy of Science and Technology, Vietnam
- **Yury Telegin**, POI FEB RAS, Russia
- **Natalia Sokolova**, POI FEB RAS, Russia
- **Vyacheslav Lobanov**, POI FEB RAS, Russia
- **Feisal Dirgantara**, National Research and Innovation Agency of Indonesia (BRIN), Indonesia
- **Norbert Andrianarivelo**, Institute d'Enseignement Supérieur d'Anosy (IESA) de l'Université de Toliara, Madagascar
- **Aina Le Don NOMENISOA**, Institut Halieutique et des Sciences Marines (IH.SM), Madagascar
- **Glen Snyder**, Atmosphere and Ocean Research Institute, University of Tokyo, Japan



1. Justification and project duration



- **Data gap:** comprehensive data on methane fluxes in the Indo-Pacific are lacking, limiting accurate climate modeling and prediction at regional and global scales.
- **Understudied issue:** impacts of methane emissions from Indo-Pacific marginal seas – especially from geological sources and hydrothermal systems in the Asia–Pacific–Indian Ocean transition zone – remain poorly understood.
- **Fragmented research:** many methane-flux sites are studied separately by different countries. Coordinated regional research is needed to understand ecosystem impacts and future responses.
- **Key outcome of WG CoSGas (2021–2024):** the WESTPAC WG on Gas Hydrates and Methane Fluxes established a network of highly specialized experts from WESTPAC countries working on gas hydrate phenomenon. Project will build on this formed expert community to enable collaborative research and generate new knowledge on this important issue.
- **Collaboration:** the project will connect scientists, researchers, and policymakers across the Indo-Pacific, promoting knowledge exchange and joint action on climate challenges.

2. Project objectives



Overall objective:

by 2028, define, estimate and clarify methane fluxes and associated processes in the Indo-Pacific Ocean and their impacts on climate, ecosystems and socio-economic development.

Specific	Focus on methane fluxes in the Indo-Pacific, including geological sources and marginal seas, and their links to climate, marine ecosystems and socio-economic development.
Measurable	4 peer-reviewed open-access papers; 2 specialized training/workshop/course programs; an accessible web-based methane inventory; joint cruise data; intermediate and final reports.
Attainable	Builds on the CoSGas expert network (2021–2024), co-chairs and member institutions; uses planned workshops, conferences, cruises and co-funding.
Relevant	Addresses the regional methane data gap; supports better climate modeling, ecosystem assessment, UN Decade of Ocean Science and WESTPAC priorities.
Duration	4-year project, 2025–2028, with annual milestones: ☐ 2025 launch and website creation; ☐ 2026 workshops/training/intermediate report; ☐ 2027 WESTPAC conference session - 12th WESTPAC International Marine Science Conference & 3rd UN Ocean Decade Regional Conference (on 20–23 April 2027 in Manila, Philippines) ☐ 2028 inventory report/final workshop/papers.

WESTPAC-XVI, 10-12 November 2026, Hangzhou, China

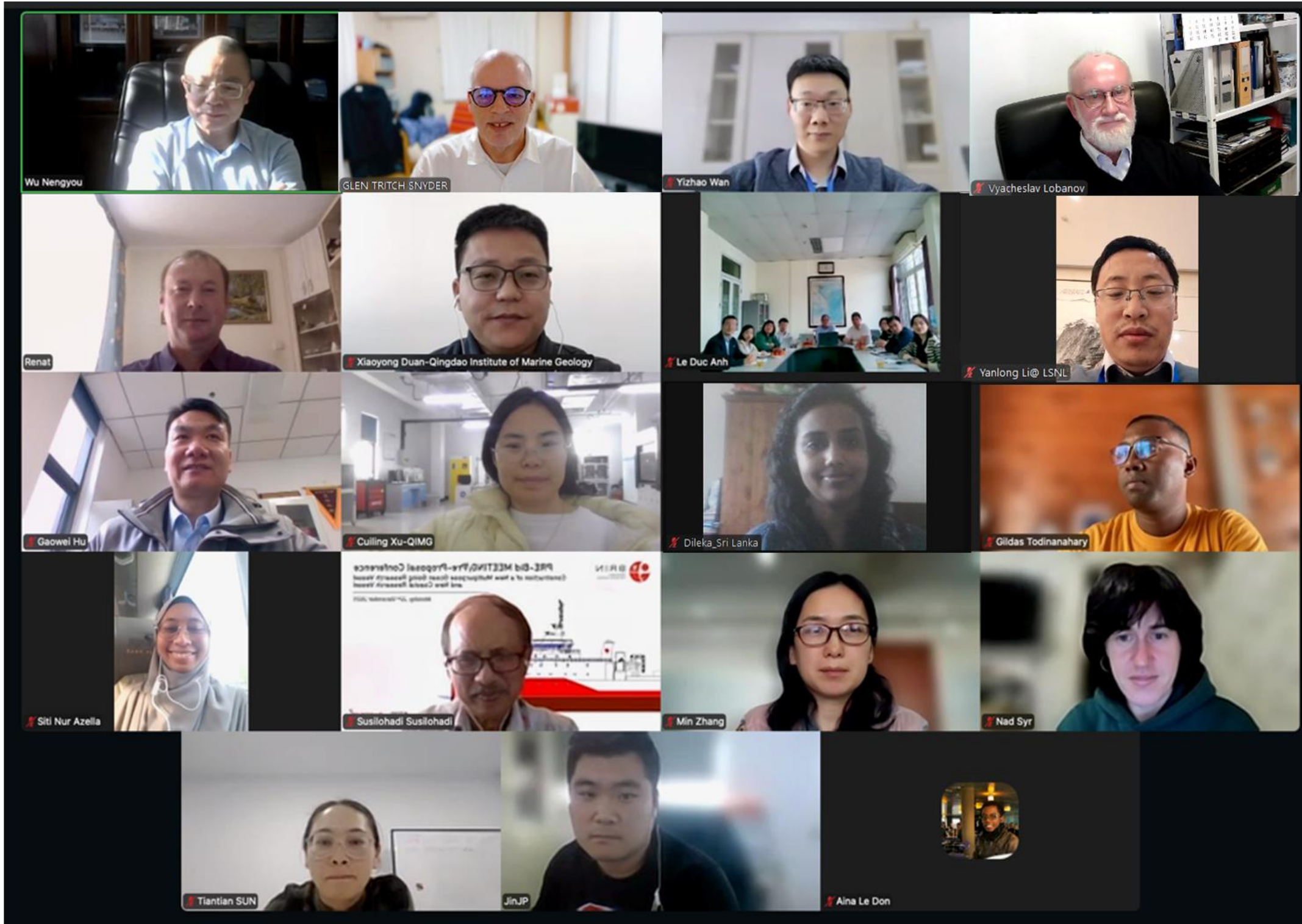
3. Major Activities and Outputs



Activities	Outputs
Meetings - online meeting of project participants to discuss work plan and recent results, Dec.2025 - in-person meeting at WESTPAC-XV in Tokyo (2025) - meeting with Madagascar team on IOCAFRICA REGIONAL WORKSHOP (Mombasa, Kenya, 14 June 2026) - meeting with members on EC IOC (Paris, France, 2026)	Agreed work plan, allocation of tasks among partners, project protocol/roadmap
Joint cruises Two Russian–Vietnamese geological and geophysical expeditions on R/V Akademik M.A. Lavrentyev (Oct.–Dec. 2025 and Oct.–Dec 2026)	New field data on methane fluxes, gas hydrate potential and related processes
Publications Preparation of a special issue of the journal <i>China Geology</i> on gas hydrates and methane fluxes; preparation of joint papers based on project results	Special issue of <i>China Geology</i> (2026)
Outreach Development of the project website; creation of an accessible catalogue/inventory of methane fluxes in the region; preparation of an intermediate repor	Operational website and updatable data catalogue; intermediate progress report (2026); News publication on international platforms

Meeting on Dec. 24, 2025

Methane fluxes and their impact on climate and ecosystem in the Indo-Pacific Region



List of participants (26):

Renat Shakirov, co-leader, POI FEB RAS, Russia
Nengyou Wu, co-leader, Laoshan Laboratory, China
Yi-Zhao Wan, Qingdao Institute of Marine Geology, China
Vyacheslav Lobanov, POI FEB RAS, Russia
Min Zhang, First Institute of Oceanography, China
Susilohadi Susilohadi, BRIN, Indonesia
Glen Snyder, AORI, University of Tokyo, Japan
Yanlong Li, Laoshan Laboratory, China
Tiantian Sun, Laoshan Laboratory, China
Jiapeng Jin, Laoshan Laboratory, China
Gaowei Hu, QIMG, China
Cuiling Xu, QIMG, China
Siti Nur Azella Zaine, Universiti Teknologi PETRONAS, Malaysia
Le Duc Anh and 8 colleagues, VAST, Vietnam
Gildas Todinanahary, de l'Universite de Toliara, Madagascar
Aina Le Don, de l'Universite de Toliara, Madagascar
Nadezhda Syrbu, POI, Russia
Yury Telegin, POI, Russia

Joint papers



Advancing regional cooperation—The IOC WESTPAC project on methane fluxes in the Indo–Pacific region

Renat Shakirov, Neng–you Wu, Nadezhda Syrbu, Vyacheslav Lobanov, Yi–zhao Wan, Wen–xi Zhu

Citation: Renat Shakirov, Neng–you Wu, Nadezhda Syrbu, Vyacheslav Lobanov, Yi–zhao Wan, Wen–xi Zhu, 2026. Advancing regional cooperation—The IOC WESTPAC project on methane fluxes in the Indo–Pacific region, *China Geology*, 9, 1–2. doi: [10.31035/cg2026030](https://doi.org/10.31035/cg2026030).

View online: <https://doi.org/10.31035/cg2026030>

Upper boundary variation of the gas hydrate stability zone in the Sea of Okhotsk: Error assessment and climate change scenarios based on 131286 oceanographic stations (19292020)

Renat Shakirov, Vladimir Luchin, Evgeniya Petrova, Nengyou Wu, Tiantian Sun, Yizhao Wan

Citation: Renat Shakirov, Vladimir Luchin, Evgeniya Petrova, Nengyou Wu, Tiantian Sun, Yizhao Wan, 2026. Upper boundary variation of the gas hydrate stability zone in the Sea of Okhotsk: Error assessment and climate change scenarios based on 131286 oceanographic stations (19292020), *China Geology*, 9, 1–11. doi: [10.31035/cg2025305](https://doi.org/10.31035/cg2025305).

View online: <http://www.jos.ac.cn/article/shaid/07c052a2528e348ca10ae563c226438353a60277e51bc4a722ab1623366378e0>



Article

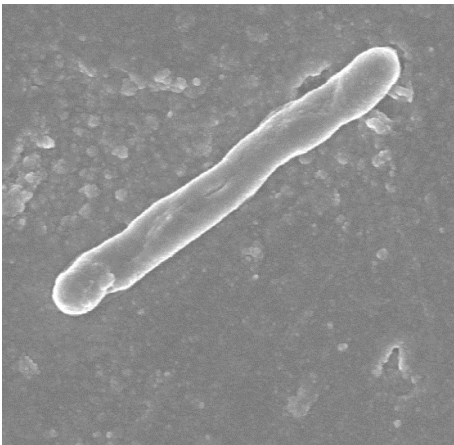
On Tectonic and Hydro Meteorological Conditions of Methane Genesis and Migration in the Offshore Waters of East Vietnam

Andrey Kholmogorov ¹, Ruslan Kulinich ¹, Galina Vlasova ¹, Nadezhda Syrbu ^{1,*}, Nengyou Wu ² and Yizhao Wan ²

¹ V.I. Il'ichev Pacific Oceanological Institute, Far Eastern Branch, Russian Academy of Sciences (POI FEB RAS), Baltiyskaya 43, 690041 Vladivostok, Russia; kholmogorov.ao@poi.dvo.ru (A.K.); kulinich@poi.dvo.ru (R.K.); vlasova@poi.dvo.ru (G.V.)

² Qingdao Institute of Marine Geology, China Geology Survey, 62 Fuzhounan Road, Qingdao 266237, China; wuny@ms.giec.ac.cn (N.W.); yizhao_wan@126.com (Y.W.)

* Correspondence: syrbu@poi.dvo.ru



Mag = 10.75 K X EHT = 5.00 kV Signal A = InLens
WD = 5.8 mm I Probe = 43 pA Photo No. = 68208

WESTPAC-XVI, 10-12 November 2026, Hangzhou, China

4. Anticipated activities and outputs in 2027



1. WESTPAC 12th International Marine Science Conference (20–23 April 2027 in Manila, Philippines)

<u>Description</u>	Scientific Session: “Methane Fluxes and their Impacts on Climate and Ecosystem in the Indo-Pacific Region” — conveners: Renat Shakirov (Russia), Nengyou Wu (China), Susilohadi (Indonesia), Le Duc Anh (Vietnam). The session will summarize and share knowledge on methane fluxes in the Indo-Pacific and is linked to the MeFIE project (2025–2029). It seeks contributions on methane fluxes and their impacts on climate, ecosystems and socio-economic development, and synergies with related initiatives. The session will serve as a platform for a dedicated face-to-face meeting of the Project members.
<u>Outputs</u>	20–30 oral presentations from project members and partners; enhanced regional visibility; new collaborations; synthesis of regional methane-flux knowledge; strengthened science–policy dialogue (20–23 April 2027 in Manila, Philippines)

4. Anticipated activities and outputs in 2027



2. 4th Joint Russian–Vietnamese complex geological and geophysical marine expedition (Vietnam waters)

<u>Description</u>	Continued complex geological and geophysical marine expeditions on R/V Akademik M.A. Lavrentyev
<u>Outputs</u>	New field data on methane fluxes, gas hydrate potential and associated processes; validation of 2025–2026 results; expanded spatial coverage

3. Joint monograph preparation and publications

<u>Description</u>	Initiation of a joint monograph on gas hydrates and methane fluxes in the Indo-Pacific region. Preparation of joint scientific papers.
<u>Outputs</u>	Agreed concept, editorial team and contributor list. Write draft structure and chapter assignments. At least 2 peer-reviewed manuscript submissions

4. Anticipated activities and outputs in 2027



4. Support for young scientists

<u>Description</u>	Involvement of early-career ocean professionals and students in the Manila session, expedition work and data analysis; mentoring and training-through-research
<u>Outputs</u>	Strengthened regional capacity; oral presentations and participation; long-term network development

5. Joint project proposals

<u>Description</u>	Development of new bilateral/multilateral project proposals building on the Project results and partnerships
<u>Outputs</u>	At least 1–2 joint proposals submitted or prepared for funding

6. Online project meetings

<u>Description</u>	Regular online coordination meetings of the project team (every quarter)
<u>Outputs</u>	Progress review, updated work plan for 2028, agreed joint actions, maintained momentum across partners

5. Biennial Workplan for 2028-2029



No.	Activity / Output Description	Expected Result / Output	Y1-1st H	Y1-2 nd H	Y2-1st H	Y2-2 nd H	IOC RP Budget (USD)	XB Required (USD)	Lead Responsibility
HLO 1 — HEALTHY OCEAN AND SUSTAINED OCEAN ECOSYSTEM SERVICES									
Expected Result 1.1 (Sub-obj. 1.1): Regional ocean biodiversity and ecosystem observations and FAIR data strengthened									
1.1.1	Finalize the Indo-Pacific Methane Flux Database. Conduct ecosystem impact assessment using 2025–2027 marine and field expedition data	Publicly accessible online Methane Database (maps, flux data); 2 peer-reviewed papers on ecosystem responses to methane seepage	Database compilation	Database launch; paper submission	Database maintenance Data integration	Final data archiving	3,000	5,000	Project Co-Chairs (Russia, China), all members
HLO 2 — EFFECTIVE WARNING SYSTEMS AND PREPAREDNESS FOR TSUNAMIS AND OTHER OCEAN-RELATED HAZARDS									
Expected Result 2.1 (Sub-obj. 2.1+2.3): Regional tsunami and multi-hazard early warning systems maintained and strengthened									
2.1.1	Assess geohazards associated with gas hydrate dissociation and methane fluid seepage (e.g., submarine landslides, seafloor instability)	Joint scientific paper on geohazard risks related to methane fluxes	Data synthesis on geohazards	Manuscript submission	Manuscript submission	Final geohazard report	2,000	5,000	Project Co-Chairs (Russia, China), all members

5. Biennial Workplan for 2028-2029



No.	Activity / Output Description	Expected Result / Output	Y1-1st H	Y1-2 nd H	Y2-1st H	Y2-2 nd H	IOC RP Budget (USD)	XB Required (USD)	Lead Responsibility
HLO 3 — RESILIENCE TO CLIMATE CHANGE AND CONTRIBUTION TO ITS MITIGATION									
Expected Result 3.1 (Sub-obj. 3.1+3.2): Regional ocean-climate observations, data and scientific knowledge enhanced									
3.1.1	Final synthesis of methane flux data and integration into regional climate models. Submission of final project deliverables.	4 peer-reviewed open-access papers (target goal); Final Project Report and Methane/Cold seeps Database (2028); Special issue closure (China Geology)	Joint paper drafting	Final Report	manuscript submitted	Project finalization, legacy planning.	2,000	5,000	Project Co-Chairs (Russia, China), all members
HLO 4 — SCIENTIFICALLY FOUNDED SERVICES FOR THE SUSTAINABLE OCEAN ECONOMY									
Expected Result 4.1 (Sub-obj. 4.1+4.2): Scientific evidence base and knowledge dissemination for the sustainable ocean economy enhanced									
4.1.1	Capacity building and knowledge transfer to Early Career Ocean Professionals	Joint Monograph on Gas Hydrates and Methane Fluxes (draft)	Training Course (Online)	Monograph editing.	Final Workshop	preparation for publication	4,000	12,000	Project Co-Chairs (Russia, China), all members

6. Strategic recommendations for future development

Key Insights & Lessons Learned:

- Network is the key benefit. The established CoSGas expert network proved that coordinated regional efforts are far more effective than fragmented national studies.
- Data gap is still critical. We successfully generated new field data, but long-term, continuous observations are needed to reduce climate model uncertainties.
- Science-to-Economic works. Joint expeditions and international workshops effectively attract political attention and funding.



6. Strategic recommendations for future development



Strategic Recommendations (2029 - future):

- ❑ Transition the Project into a permanent Indo-Pacific Methane Observing Network to ensure continuous monitoring and data sharing beyond the project's lifespan. Strategic roadmap for future methane research in the Indo-Pacific region.
- ❑ Move from seed funding to large-scale international grants (e.g., UN Ocean Decade, bilateral funds) and expand the scope to cover the Indo-Pacific-Arctic linkage.
- ❑ Integrate in-situ field data (from joint cruises) into next-generation digital models (e.g., Digital Twins of the Ocean) to enhance regional climate and ecosystem forecasting.
- ❑ Expand Geographical Scope into the Western Indian Ocean. A proposed multilateral expedition (Vladivostok–Toliara–Vladivostok on R/V Akademik M.A. Lavrentyev, 2028–2029) will bridge the Indo-Pacific and Madagascar sectors, enhancing the regional data inventory.
- ❑ Strengthen Science-Economic Interface. Translate our findings (especially the joint monograph and policy briefs) into actionable recommendations for blue economy and climate mitigation strategies in the region.
- ❑ Formalize the ECOP (Early Career Ocean Professionals) mentorship program to guarantee the continuity of highly specialized expertise in the region.

Uncovering the secrets of methane —
from the Indo-Pacific depths to global climate solutions

