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Coastal Geoscience Research Cooperation and Opportunity in Myanmar

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Contents

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Abstract

Myanmar's coastal regions possess diverse opportunities for blue economy development and coastal geoscience research. This study aims to emphasize and showcase the growing significance of coastal geoscience opportunities for Myanmar in the coming years. Coastal geoscience integrates geology, geomorphology, oceanography, geophysics, and climate science, providing essential tools for understanding coastal processes, natural hazards, and resource potential. The Department of Geological Survey and Mineral Exploration (DGSE) is strengthening research cooperation with international organizations in coastal and seabed geosciences through data collection, capacity building, and the application of modern techniques. These collaborative efforts focus on seabed mineral potential, coastal erosion processes, mitigation strategies, and broader marine science activities. A key objective is to expand mineral exploration activities and national capacity by engaging a new generation of geologists and promoting applied research. The study area is located in the Gulf of Martaban coastal area, where erosion and accretion processes are closely associated with storm surge events—a major natural hazard in the region. Myanmar's significant coastal mineral potential, combined with increasing international research cooperation, presents important opportunities for advancing coastal geoscience, supporting the blue economy, and contributing to sustainable national economic development.

Keywords: *Coastal Geoscience, Blue Economy, Gulf of Martaban, research opportunities, mineral potential*

မြန်မာ့ကမ်းရိုးတန်းဘူမိသိပ္ပံဆိုင်ရာ သုတေသနပူးပေါင်းဆောင်ရွက်မှုနှင့် အခွင့်အလမ်းများ

အိသဉ္ဇာခိုင်[၁]၊ စုမွန်အောင်[၁]၊ ဇော်ဇော်သိန်း [၁]၊ သက်တင်ညွန့်[၁]၊ မြင့်စိုး[၁]၊ အောင်ကျော်မိုး[၁]၊ အောင်မင်း[၁]

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စာတမ်းအကျဉ်း

မြန်မာနိုင်ငံ၏ ကမ်းရိုးတန်းဒေသများသည် Blue Economy ဖွံ့ဖြိုးတိုးတက်မှုနှင့် ကမ်းရိုးတန်းဘူမိသိပ္ပံသုတေသနများအတွက် အလားအလာကောင်းများစွာ ပိုင်ဆိုင်ထားပါသည်။ ဤလေ့လာမှုသည် နောင်လာမည့်နှစ်များတွင် နိုင်ငံတော်အတွက် ပိုမိုအရေးပါလာမည့် ကမ်းရိုးတန်းဘူမိသိပ္ပံ ဆိုင်ရာအခွင့်အလမ်းများကို အလေးပေးဖော်ထုတ်ရန်ရည်ရွယ်ပါသည်။ ကမ်းရိုးတန်းဘူမိသိပ္ပံသည် ဘူမိဗေဒ၊ မြေမျက်နှာသွင်ပြင်ဗေဒ၊ သမုဒ္ဒရာဗေဒ၊ ဘူမိရူပဗေဒနှင့် ရာသီဥတုသိပ္ပံတို့ကို ပေါင်းစပ် ထားသည့် ဘာသာရပ်တစ်ခုဖြစ်ပြီး ၎င်းသည်ကမ်းရိုးတန်းဖြစ်စဉ်များ၊ သဘာဝဘေးအန္တရာယ်များနှင့် သယံဇာတအလားအလာများကို ဆန်းစစ်နားလည်နိုင်ရန်အတွက် မရှိမဖြစ်လိုအပ်သောနည်းလမ်းများကို ထောက်ပံ့ပေးပါသည်။ ဘူမိဗေဒလေ့လာရေးနှင့် ဓာတ်သတ္တုရှာဖွေရေးဦးစီးဌာနအနေဖြင့် ဒေတာစုဆောင်းခြင်း၊ စွမ်းဆောင်ရည်မြှင့်တင်ခြင်းနှင့် ခေတ်မီနည်းပညာများ အသုံးပြုခြင်းတို့မှတစ်ဆင့် နိုင်ငံတကာအဖွဲ့အစည်းများနှင့် ကမ်းရိုးတန်းနှင့်ပင်လယ်ကြမ်းပြင် ဘူမိသိပ္ပံဆိုင်ရာသုတေသနပူးပေါင်းဆောင်ရွက်မှုများကို တိုးမြှင့်ဆောင်ရွက်လျက်ရှိပါသည်။ ဤပူးပေါင်းဆောင်ရွက်မှုများသည် ပင်လယ်ကြမ်းပြင် သတ္တုသယံဇာတ အလားအလာများ၊ ကမ်းခြေတိုက်စားမှုဖြစ်စဉ်များ၊ ဘေးအန္တရာယ်လျှော့ချရေးဗျူဟာများနှင့် ပိုမိုကျယ်ပြန့်သော အဏ္ဏဝါသိပ္ပံဆိုင်ရာလုပ်ဆောင်ချက်များအပေါ် အဓိကထားပါသည်။ အဓိကရည်ရွယ်ချက်မှာ မျိုးဆက်သစ် ဘူမိဗေဒပညာရှင်များကို လေ့ကျင့်ပျိုးထောင်ပေးခြင်းနှင့် လက်တွေ့အသုံးချသုတေသန များကို အားပေးခြင်းဖြင့် သယံဇာတရှာဖွေရေးလုပ်ငန်းများနှင့် အမျိုးသားအဆင့်စွမ်းဆောင်ရည်ကို မြှင့်တင်ရန်ဖြစ်ပါသည်။ ဤလေ့လာမှုကို မုတ္တမပင်လယ်ကွေ့ ကမ်းရိုးတန်းဒေသတွင် အခြေပြုထားပြီး အဆိုပါဒေသရှိ ကမ်းခြေတိုက်စားခြင်းနှင့် မြေနုကျွန်းပေါ်ထွန်းခြင်း ဖြစ်စဉ်များသည် ဒေသတွင်း အဓိကသဘာဝဘေးအန္တရာယ်ဖြစ်သောမုန်တိုင်း ဒီရေတက်ခြင်းဖြစ်ရပ်များနှင့် တိုက်ရိုက်ဆက်စပ်နေကြောင်း တွေ့ရှိရပါသည်။ မြန်မာနိုင်ငံ၏ ကမ်းရိုးတန်းဒေသရှိ ထူးခြားသောသတ္တုဖြစ်ထွန်းမှု အလားအလာများနှင့် တိုးတက်လာသော နိုင်ငံတကာသုတေသနပူးပေါင်းဆောင်ရွက်မှုများသည် ကမ်းရိုးတန်းဘူမိသိပ္ပံကို မြှင့်တင်ရန်၊ အပြာရောင်စီးပွားရေးကို အထောက်အကူပြုရန်နှင့် နိုင်ငံတော်၏ ရေရှည်တည်တံ့သော စီးပွားရေးဖွံ့ဖြိုးတိုးတက်မှုကို အကျိုးပြုရန်အတွက် အရေးကြီး သော အခွင့်အလမ်းများ ဖြစ်ပါသည်။

Coastal Geoscience Research Cooperation and Opportunity in Myanmar

1. Introduction

Myanmar has a coastline of nearly 2,300 km, divided into three regions: the Rakhine Coastal Area, bordering the Bay of Bengal; the Tanintharyi Coastal Area, bordering the Andaman Sea; and the Ayeyarwady Deltaic and Gulf of Martaban Coastal Area, between them. These regions offer diverse opportunities for blue economy and coastal geoscience research, including fisheries, agriculture, tourism sites, mineral occurrences, and oil and gas fields. Myanmar's coastal region, characterized by its dynamic interactions and vulnerabilities, is of enormous environmental and socio-economic significance. The study area is highlighted in the Gulf of Martaban; the respective coastlines of Myanmar are described in Figure 1.

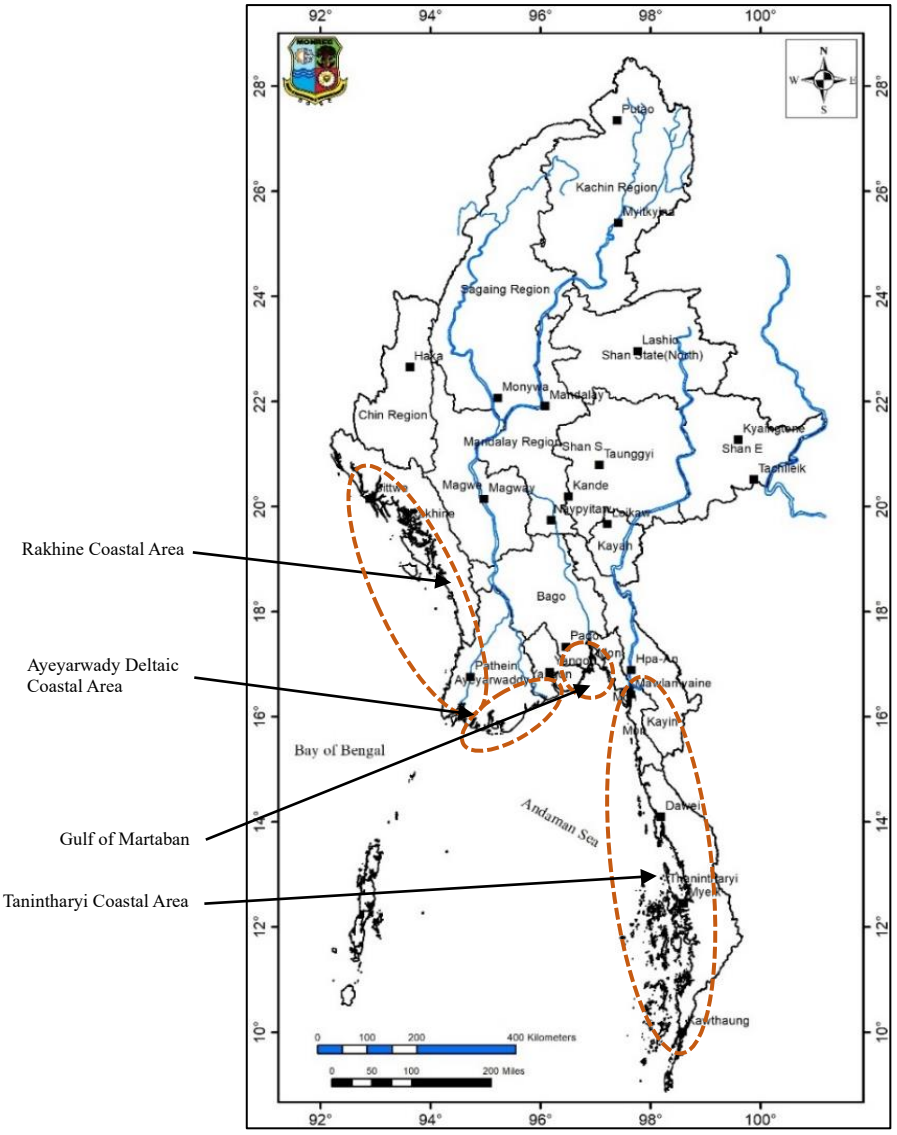

Figure 1. The respective coastlines of Myanmar (DGSE, 2021)

2. Objective

Coastal Geoscience, which integrates geology, geomorphology, oceanography, geophysics, and climate science, offers essential tools for assessing these challenges. Strengthening research and cooperation is therefore vital for environmental management and disaster risk reduction. The Government of Myanmar seeks to enhance regional and global collaboration through strategic partnerships in order to leverage existing opportunities and overcome emerging challenges in coastal geoscience. The Department of Geological Survey and Mineral Exploration (DGSE) is actively strengthening cooperation with international organizations in geosciences, particularly in coastal and seabed research related to mineral potential, erosion processes, mitigation strategies, and broader marine science activities. A primary objective is to expand national capacity in coastal geoscience by engaging a new generation of geologists and promoting applied research.

3. Materials and Methods

Prior to conducting this study, a review of relevant literature and previous studies was carried out. Based on the available data and information, a conceptual understanding was developed by building upon earlier research by Yee Yee Win et al. (2021). This study utilizes GIS techniques and multi-temporal Landsat and Google Earth imagery to analyze contemporary coastal erosion and deposition patterns along the Gulf of Martaban. Polygon-based GIS analysis was applied to calculate erosion and deposition areas. Temporal comparisons were conducted at five-year intervals.

4. Geologic Settings of Coastal Areas

Myanmar's coastline can be divided into three principal geomorphological provinces: the Rakhine Active Margin, the Ayeyarwady Deltaic System, and the Tanintharyi Granitoid–Island Arc Province.

4.1 The Rakhine Coastal Area

It is a collision coast, recognized as one of Myanmar's active continental margins. Extending approximately 740 km across Rakhine State in the western region, the coastal zone follows the collision boundary between the Indian and Burma plates. This boundary drives active tectonic processes, rapid sediment accumulation, and localized uplift. The offshore basins host thick sedimentary sequences that provide valuable opportunities for geological investigation. The area is characterized by Miocene-age folded sedimentary formations, accompanied by mud volcanoes and isolated unusual limestone masses. It offers significant potential for hydrocarbon deposits as well as related mineral resources. Cyclonic storms occurring in the Bay of Bengal exert significant impacts on coastal environments and constitute one of the major factors contributing to coastal erosion and expansion.

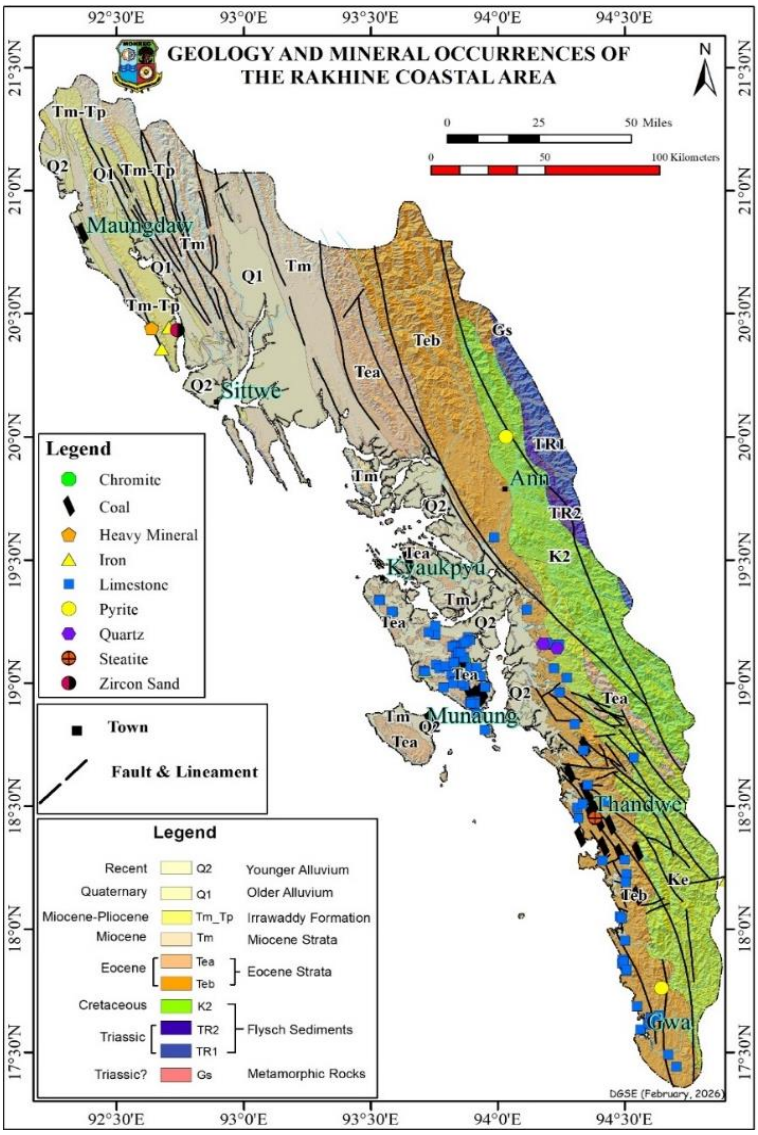

Figure 2. Geology and mineral occurrences of Rakhine Coastal Area (DGSE, 2021)

4.2 The Ayeyarwady Deltaic Coastal Area

It is a marginal sea coast about 700 km long, together with the Ayeyarwady Delta and the Gulf of Martaban, composed mainly of Quaternary and recent alluvial deposits. It is developed by the Ayeyarwady Delta, which discharges directly into the Gulf of Martaban, supplying vast quantities of fine sediments that create one of the world's largest muddy tidal systems. The region is undergoing marked coastal erosion and gradual land subsidence, which collectively contribute to persistent shoreline retreat and heightened susceptibility to a range of coastal hazards. However, this delta and gulf complex remains a socio-economically vital landscape, sustaining major fisheries and functioning as one of Myanmar's foremost centers of rice cultivation and agricultural production.

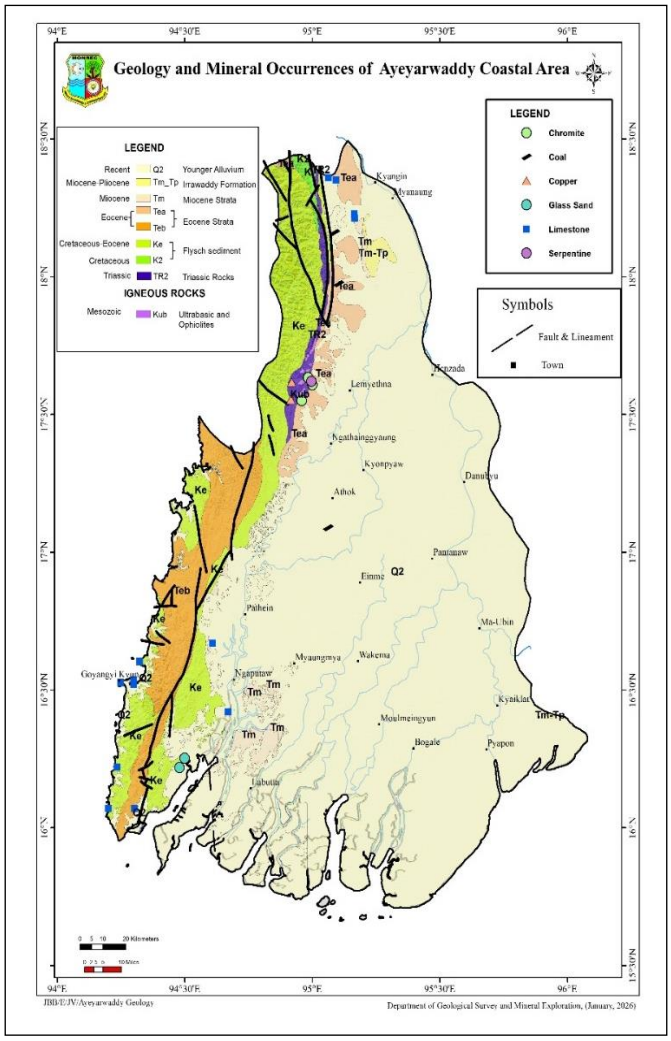

Figure 3. Geology and mineral occurrences of Ayeyarwady Deltaic Coastal Area (DGSE, 2021)

4.3 The Tanintharyi Coastal Area

It is also a marginal sea coast located in southern Myanmar. The coastline extends for about 1,200 km and is bordered on the west by the Andaman Sea. It has the longest coastline from the Gulf of Martaban to the Pakchan River. The geology consists mainly of Paleozoic (Carboniferous) metamorphic rocks (slate, phyllite, quartzite), and Mesozoic to early Tertiary granite. The mineral occurrences identified within the coastal region are mainly Tin - Tungsten, Zircon Sand, Antimony, Oil shale, Glass sand, Gold, Molybdenum and Heavy minerals. It is a dynamic coastal region vulnerable to hazards such as coastal erosion, flooding, saltwater intrusion, and ecosystem degradation that are primarily controlled by wave and current dynamics, storm conditions, coastal morphology, mangrove vegetation, and human activities.

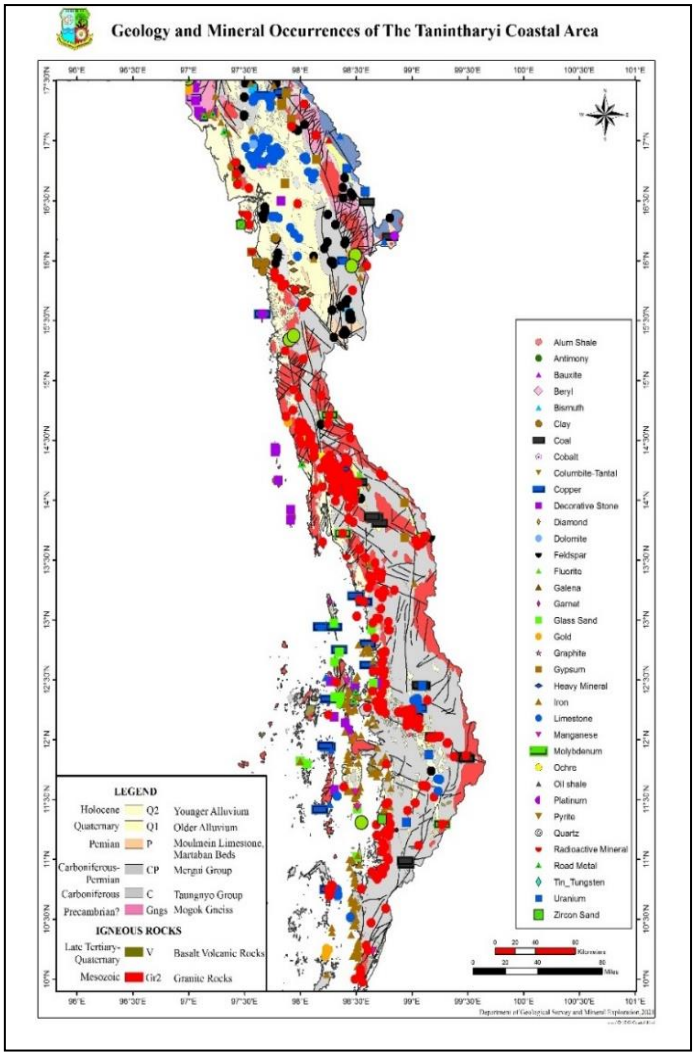

Figure 4. Geology and mineral occurrences of The Tanintharyi Coastal Area (DGSE, 2021)

5. Previous Works

The Department of Geological Survey and Mineral Exploration (DGSE), as a department whose primary mandate centers on geological science, has continually pursued opportunities to engage in collaborative activities at both the national and international levels. These engagements reflect our long-standing commitment to advancing geoscientific knowledge, strengthening technical capacity, and contributing to regional and global scientific networks. Fortunately, DGSE has been actively engaged in coastal and seabed studies. In 2019, Director General, DGSE, Dr. Thet Tin Nyunt, represented Myanmar and participated in discussions at the Workshop on Deep Seabed Resources and the Blue Economy for ASEAN & BIMSTEC Countries, held at Park Royal, Nay Pyi Taw, under the title 'Strengthening National Capacities for Coastal and Seabed Mineral Development, Myanmar's Experiences. In 2021, Assistant Director Yee Yee Win conducted a preliminary assessment of erosions and depositions of the Gulf of Martaban in relation to the Sittaung Estuary and adjacent coastal areas. In 2021, the team of geologists led by Deputy Director, Aung Min, and two members participated in the 4th Training Courses on Capacity Building on Marine Geoscience and Geohazards Reduction and Prevention for ASEAN Member States. In 2023, another team of geologists led by Deputy Director Zaw Htet, and two members contributed with virtual system at the 2nd Workshop on Marine Scientific Research in the South China Sea, and the research work was published in 2023. In 2025, Geologist Assistant-(1), Ei Thinzar Khaing, joined

the “Seminar on China-ASEAN Coastal Earth Observation Technology and Disaster Mitigation and Prevention” held in Nanning, China.

6. Results

This study is grounded in the work of Yee Yee Win et al. (2021), who assessed the spatio-temporal characteristics of shoreline erosion and deposition in the Gulf of Martaban covering the years 2000 to 2020. The depositional area of Martaban Gulf (Sittaung Estuary) is also carried out by the area calculation of polygons used with Remote Sensing, GIS and also Google Earth images. The results showed that depositions were generally dominated over erosion, with an estimated average depositional rate of approximately 8.15 km²/year, although a temporary decline was observed between 2010 and 2015, likely related to climatic and hydrodynamic variability.

Building upon those earlier outcomes, the present investigation extends the assessment to the period 2021–2025 by evaluating and recording coastal erosion and depositional changes. According to the findings of the present study, the total area affected by shoreline erosion and deposition during the five years from 2021 to 2025 is estimated to be approximately 1,195 km^2. The findings indicated that the area of sediment deposition in coastal regions has decreased over the most recent five-year period. This value closely corresponds to the 1,182 km² reported in the previous study (2015). Especially in 2015, the impacts of Cyclone Komen during the study period included intense storm rainfall, extensive flooding, and a high incidence of landslides nationwide. Likewise, over the five years (2021-2025) under review, the impacts of Cyclone Mocha (2023) and Typhoon Yagi (2024) led to widespread flooding and associated landslides nationwide, producing substantial damage within Myanmar. Moreover, the present study found that, compared with the 2015-2020 period, the area affected by erosion within the coastal zone has decreased by approximately 401 km^2. The erosion-affected areas of the coastal zone studied since the year 2000 are presented in Table 1, while the increase and decrease of coastal erosion and accretion are illustrated in Figure 5.

7. Discussion

The coastal dynamics of Myanmar, particularly in the Gulf of Martaban, exhibit a high degree of sensitivity to hydrometeorological events. While depositional processes generally dominated the shoreline between 2000 and 2020, achieving an average accretion rate of 8.15 km^2/year, these gains are frequently offset by extreme weather. The reduction in depositional area to 1,182 km² following Cyclone Komen (2015) and the more recent decline to 1,195 km² during the 2021–2025 period (linked to Cyclone Mocha and Typhoon Yagi) suggest that storm surges are primary drivers of rapid geomorphological change in the region. Furthermore, the study identifies distinct economic and research opportunities across Myanmar’s three coastal provinces. The Rakhine Coastal Area serves as an active margin with high potential for hydrocarbons and related minerals, while the Tanintharyi Coastal Area is a critical source of Tin-Tungsten, Zircon sand, and other heavy minerals. Despite these resources, all regions face escalating hazards, including coastal erosion, land subsidence, and saltwater intrusion. To address these challenges, the Department of Geological Survey and Mineral Exploration (DGSE) is prioritizing international cooperation and capacity building. Transitioning from land-based geology to integrated coastal and seabed research is essential for Myanmar to achieve a sustainable Blue Economy and enhance its national disaster risk reduction strategies.

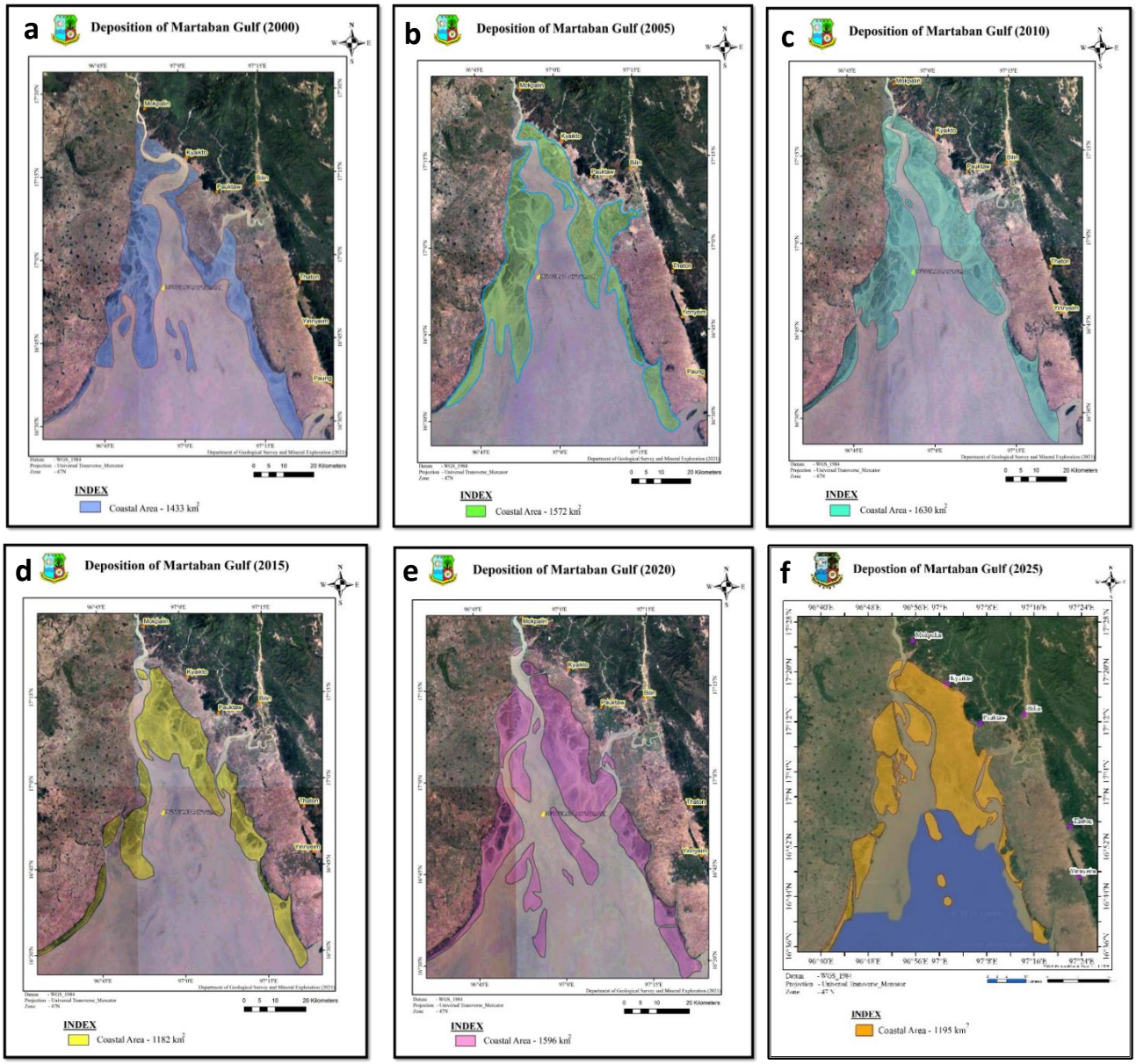

Figure 5. (a-e). Deposition area of Martaban Gulf in the years 2000- 2005- 2010- 2015- 2020, showing increasing and decreasing of depositional condition (Yee Yee Win et al., 2021), (f) Present Study (2025)

Sr.No	Year	Evaluated area (km²)	Different area(km²)	Remarks
1	2000	1433	-	
2	2005	1572	+ 139	Increased
3	2010	1630	+ 58	Increased
4	2015	1182	- 448	Decreased
5	2020	1596	+ 414	Increased
6	2021-2025	1195	- 401	Decreased

Table: Erosion and deposition areas of the Martaban coastal zone (2000–2025)

8. Conclusion

The findings of the present study indicate that the erosion and accretion processes within the Gulf of Martaban coastal zone are directly associated with the impacts of storm surge events, which constitute a major natural hazard. Generally, the coastal zones in Myanmar are increasingly threatened by climate change, and sea-level rise, erosion, cyclones, salinity intrusion, and unplanned development. However, coastal research capacity, technological infrastructure, and regional cooperation remain limited in Myanmar. To ensure effective long-term coastal management, research must expand beyond land-based studies to include integrated coastal zone assessments. Strengthening these scientific capabilities will play a vital role in securing Myanmar's future economic and environmental opportunities. Furthermore, to fully harness the potential of the Blue Economy, it is imperative for Myanmar to transition from onshore-focused geological studies toward Integrated Coastal and Seabed Research. By integrating oceanography, geophysics, and marine geology, Myanmar can better manage its offshore energy resources, deep-sea minerals, and sustainable tourism. Strengthening cooperation with regional and international partners will be the key to unlocking these opportunities while building resilience against the increasing threats of climate change and natural disasters.

9. Acknowledgements

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