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Booklet of Abstracts

GetIn-CICERO CONFERENCE 2022

German-Indonesian Talk on Research for Society

Discussions, Meetings and Workshops
for Experts from Science, Politics, and Industry
Together for Future Collaboration

Yogyakarta, 25-26 July 2022
Hyatt Regency Hotel

Preface

GetIn-CICERO Conference

German–Indonesian Talk on Research for Society

organized by RWTH Aachen University and Universitas Gadjah Mada

In this two-day conference with top-class participants, experts and scientists will discuss the important challenges for the future with representatives from business and politics.

Leading questions are:

Where are the intersections of research fields and economic interests and which political framework conditions can promote these synergies?

Where are the strategically important projects for Indonesia's sustainable development and which urgently needed measures are on the agenda to prepare Indonesia for the changing environmental conditions?

Which common research areas between Germany and Indonesia are relevant to make scientific cooperation purposeful and planned in terms of common global interests?

How can the guidelines of Indonesia's National Research Master Plan and the national research priorities be integrated in international research collaborations and thus incorporate national German and Indonesian as well as global goals?

The current pandemic has highlighted how vulnerable the global supply chains have become, the transformation of carbon-based energy production and industrial processes is gathering pace, and climate change has begun to redistribute favourable and unfavourable living zones on our planet. Currently, it is once again necessary to think along the chain of causes and effects and to identify challenges and opportunities for the society.

Germany and Indonesia have set ambitious goals. This year, the German phase-out of electricity from nuclear power will be completed. The tight timelines for ending energy production from hard coals and lignites will influence many industries. Indonesia intents making its marine resources, the agriculture sector, and the mining sector to important pillars of its economic growth and will expand its industrial sector. At the same time, conservation of valuable water resources is compulsory for a sustainable and climate-resilient water supply.

Scientists are called upon to make their essential contribution with expertise and prudent consideration of the opportunities and risks for the successful solution of the tasks ahead. We invite you to come to Yogyakarta in July 2022 to get involved in the expert discussions and networking with scientists, representatives from industry, politics, and society.

The goals of the conference are high level exchange, discussions, and networking. The aim is to outline the challenges in specific fields of **common interest**, possible realizations, applications, and implementations of research into practice. It aims to form an up-to-date international research network, which takes the needs of sustainable development of the urban areas and the rural regions into consideration, and to sketch a **roadmap of future collaboration**.

Leveraging this commitment of shared spirit, activities, and partnerships will be established to tackle further needs of joined research. Sharing knowledge, exchange of best practice in research and education and creating a common spirit in cooperation will strengthen the scientific success.

Greetings from the Organizing Team from UGM & RWTH!

Scientific Steering Committee		
	RWTH (Germany)	UGM (Indonesia)
Coordinators	Prof. Thomas R. Rüde	Assoc. Prof. Dr. Doni Prakasa Eka Putra
Cluster 1 Making Water Supply Resilient for Future	Prof. Jan Schwarzbauer	Assoc. Prof. Heru Hendrayana
Cluster 2 Managing Geohazards	Prof. Klaus Reicherter	Assoc. Prof. Wahyu Wilopo Dr. Gayatri Indah Dr. Esti Handini
Cluster 3 Sustainable Use of Georesources, Mining and Geothermal Energy	Prof. Peter Kukla Prof. Axel Preuße	Assoc. Prof. Arifudin Idrus Assoc. Prof. D. Hendra Amijaya
Cluster 4 Circular Economy of Metals	Prof. Bernd Friedrich Dr. Alexander Birich	Assoc. Prof. Dr. Sugeng Sapto Surjono Assoc. Prof. Dr. Indra Perdana

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German Academic Exchange Service (DAAD)
• Ms. Annisa Fitria
German Embassy
• Prof. Thomas R. Rüde
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• Assoc. Prof. Supriyadi
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Dean Fakultas Teknik (UGM)
• Prof. A. Preuße
Vice Dean Faculty 5 (RWTH)
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Abstracts Accepted for Oral Presentation

Mineralogical and Geochemical Characteristics of Clays at Gunung Patuk and Gunung Wungkal, Godean, DIY - Indonesia

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Keywords: CIW; CIA; geochemical; igneous; soil profile; weathered.

1. Extended Abstract

Indonesia is an archipelagic country with a tropical climate with 2 seasons, which are dry and rainy seasons. This condition causes the weathering process occurring intensely. The intense weathering process is able to change the source rock into soil gradually as indicated by the layers of the soil profile starting from the source rock, horizon C, horizon B, and horizon A [1] with horizon A being the outermost layer and the highest level of weathering. The phenomenon of weathering causes minerals of the parent rock altering into clay minerals. Clay minerals can be also product of hydrothermal alteration process. This process is generally associated with conditions that have high temperatures and hot fluids. This condition can be found in relation with ancient volcanic activity, such as in Java volcanic arc.

Gunung Patuk and Gunung Wungkal which are located at Godean Yogyakarta and a part of Java volcanic arc, are intrusion hills that are abundance of clays. Based on the Regional Geological Map of Yogyakarta [2] Gunung Patuk is a diorite intrusion and Gunung Wungkal is an andesite porphyry – micro diorite intrusion [3]. However, [4] suggests that at Gunung Wungkal has occurred hydrothermal alteration process. Therefore, it is necessary to conduct research on the mineralogical and geochemical characteristics based on the soil profile which is divided into source rock, horizon C, horizon B, and horizon A. The mineralogical characteristic was identified using the XRD (X Ray Diffraction) method and the geochemical characteristic are shown by values of the CIW (Chemical Index Weathering) and CIA (Chemical Index Alteration) that were calculated based on the major elements data from the ICP-AES (Inductively Coupled Plasma Atomic Emission Spectroscopy) analysis.

This study shows that the soil profiles of horizons C to horizons A are dominated by illite, kaolinite, and smectite, where presence of the illite indicates that the mineral formed at relatively high temperatures. Values of CIW and CIA shows getting higher from the source rock to the outermost horizon. Therefore, it can be suggested that genesis of clay minerals at Gunung Patuk and Gunung Wungkal were product of overprinting of hydrothermal alteration and weathering processes.

2. Methodology

Measurement sections of outcrop at Gunung Patuk and Gunung Wungkal was carried out to determine the layers of the soil profile. Rock sampling was collected at several points which represents the horizons in the study area. Laboratory analysis was conducted for petrographical observations, XRD analysis and geochemical analysis. The thin-section analysis was conducted to determine the mineral content of the source rock. XRD analysis was carried out to identify clay mineral content in the C horizon, B horizon, and A horizon in the study area. The XRD analysis using clay treatment method which are air dried, ethylene glycol, and heating 550^o C for 1 hour [5]. ICP – AES analysis was carried out to be used to determine concentrations of major elements in the samples of Gunung Patuk and Gunung Wungkal in units of wt%. This ICP – AES analysis data is used to calculate the CIW and CIA.

3. Results

Observation results on thin sections of the source rock of the study area (samples of 22BI, A227BI and B227 BI at Gunung Patuk) show that the source rock is andesite, based on Streckeisen's classsification [6]. The appearance of thin section on PPL (Parallel Polarized Light) and XPL (Cross Polarized Light) of the sample 22BI showing porphyritic texture with plagioclase (Pl) as phenocryst are set in groundmass of plagioclase micro-crystalline and opaque minerals (Figure 1).

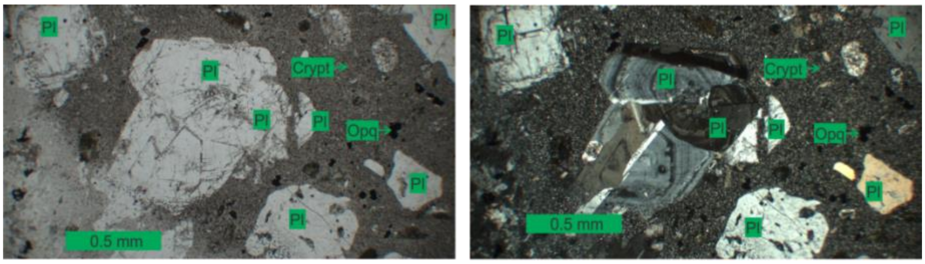

Figure 1. (a) Photomicrograph of sample 22BI (PPL); (b) Photomicrograph of sample 22BI (XPL)

Calculation of Chemical Index Weathering (CIW) and CIA (Chemical Index Alteration) is carried out based on the concentrations of major elements data obtained from the results of the ICP-AES analysis according to equation 1 and 2 [7].

$$CIW = \left[\frac{Al_2O_3}{(Al_2O_3+CaO+Na_2O)}\right] \times 100 \quad (1)$$

$$CIA = \left[\frac{Al_2O_3}{(Al_2O_3+CaO+Na_2O+K_2O)}\right] \times 100 \quad (2)$$

The results of identification of clay minerals, calculation of Chemical Index Weathering (CIW), and calculation of Chemical Index Alteration (CIA) of Gunung Patuk and Gunung Wungkal are shown in Table 1.

Table 1. The results of identification of clay minerals, calculation of CIW, and calculation of CIA of Gunung Patuk and Gunung Wungkal

Location	Stop Site Code	Soil Profile	Minerals Identification	Calculation of CIW	Calculation of CIA
Gunung Patuk	18A	Horizon A	Illite, Kaolinite, and Smectite	85,19 %	78,16 %
	13B1	Horizon B	Illite and Smectite	82,70 %	75,56 %
	16B2	Horizon B	Illite, Kaolinite, and Smectite	82,48 %	69,74 %
	14C	Horizon C	Illite, Kaolinite, and Smectite	73,69 %	68,88 %
	227Bi	Source Rock	-	67,43 %	63,09 %
	27Bi	Source Rock	-	56,22 %	54,23 %
Gunung Wungkal	60A	Horizon A	Illite, Kaolinite, and Smectite	95,91 %	83,33 %
	47B	Horizon B	Illite, Kaolinite, and Smectite	82,17 %	78,18 %
	9C	Horizon C	Kaolinite and Smectite	72,45 %	66,09 %

4. Discussion

Andesite is suggested as source rock of the soil horizons in the study area. Texture of the andesite that showing porphyritic texture (large crystals of plagioclase are set in a finer-grained of plagioclase micro crystalline) and no indicating the trachytic texture (flow lines), so that this andesite is interpreted as part of a shallow intrusion in the study area. This interpretation supports [2] and [3] which reported that the igneous rocks of Gunung Patuk and Gunung Wungkal are the intrusions. While the results of XRD analysis show that horizons C to horizons A in the study area are dominated by clay minerals which are illite, kaolinite, and smectite, excepting horizon C of Gunung Wungkal that shows no presence of the illite (Table 1). The values of the CIW and CIA calculation show the similar trend of Gunung Patuk and Gunung Wungkal that is getting higher from the source rock up to horizon A. The interesting thing is the presence of illite on the both horizon A which are the closest horizon to the earth's surface (characterized by the highest value of the CIW and CIA), even though the illite indicates the mineral forming at the relatively high temperatures. For that reason, it can be suggested that clay minerals at Gunung Patuk and Gunung Wungkal were formed by overprinting of processes of hydrothermal alteration and weathering.

5. Conclusion

The least altered igneous rock in study area is andesite which is the source rocks of the soil horizons. Horizons C to horizons A in Gunung Patuk and Gunung Wungkal which have been changed, are dominated by clay minerals such as illite, kaolinite, and smectite. Geochemical characteristics of the horizons at Gunung Patuk and Gunung Wungkal that shown by values of CIW and CIA reveals getting higher from the source rock up to horizon A. The presence of the illite on both horizon A and having the highest value of the CIW and CIA, suggests that genesis of clay minerals at Gunung Patuk and Gunung Wungkal were product of overprinting of hydrothermal alteration and weathering processes.

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Macro Debris and Microplastic Problem in Indonesian Waters

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Keywords: marine debris; plastic waste; microplastic.

Abstract

The problem of marine pollution (marine debris) especially plastic waste is an issue of concern not only for Indonesia but also other countries. Geographically, Indonesian territory is very vulnerable to the accumulation of marine debris from various sources. Earlier studies showed that marine waste that enters Indonesian waters may come from land, water bodies, coasts that flow into the sea, which are predominantly composed by various kinds of plastic waste. Furthermore, degradation product of microplastic, namely microplastic, may enter the aquatic food chain and harmful the different aquatic compartments and human health. The present review reveals the distribution of marine debris and microplastic, especially in Indonesian waters.

1. Introduction

As the largest archipelago in the world that sits between two continents and two oceans, the territory of Indonesia is naturally very vulnerable to the accumulation of marine debris from various sources. Marine waste that enters Indonesian waters can come from land, water bodies, coasts that flow into the sea, as well as garbage that comes from activities in the sea. To protect marine ecosystems from marine debris, the Indonesian government has worked with several programs. One such program is to adopt a 2017-2025 plan to combat marine debris, and targets a 70% reduction in plastic waste by 2025 (Presidential Regulation No. 83 of 2018). This paper outlines the problem of marine waste, especially plastic waste and its derivative products (microplastics) in Indonesia's aquatic environment. Analysis is also carried out on the potential negative impacts caused and mitigation measures needed to reduce the accumulation of marine waste and microplastics in the future.

2. Marine Debris Distribution in Indonesia Waters

A number of studies have been conducted to identify the accumulation and spread of waste in the high seas, coasts and also its relation to its source in rivers and land. Study on marine debris in Indonesia was started by Willoughby (1986) and followed by Uneputty and Evans (1997) on plastic litter of macroplastic pollution was focused on surface water and seafloor in Ambon Bay. Afterward, several studies on marine litter were conducted in different regions of Indonesian waters (Table 1). Research on waste accumulation has also been conducted in several rivers in Indonesia, namely in Pulau Java, Bali, Sumatra, Kalimantan, Sulawesi, Maluku and Papua (Table 2).

Table 2. Marine debris in different regions of Indonesian waters

No	Location	Ecosystem	Concentration	Dominant	Reference
1	Banda Aceh	Beach & surface water	0.6-2.8 g/m^2	Plastic	Ondara & Dhiauddin (2020)
2	Panjang Bay	Beach	1-11 items/m^2	Wood, plastic	Johan et al (2019)
3	Jakarta Bay	Mangrove	20-246 items/m^2	Plastic	Hastuti et al (2014)
4	Jakarta Bay	River	6.6-7.9 tons/day	Plastic, glass	Cordova & Nurhati (2019)
5	Jakarta Bay	River	0.5-1.5 tons/day	Plastic, glass	Van Emmerik et al (2019)

6	Jakarta Bay	Surface Water	0.1-1.0 items/m^2	Packaging	Dwiyitno et al (2020)
7	Seribu Island	Beach	1-75 items/m	Plastic, rubber, foam	Willoughby (1986)
8	Seribu Island	Beach	0.1-0.3 kg/m^2	Plastic bag	Faizal et al (2022)
9	Untung Jawa	Mangrove	0-10 items/m^2	Plastic pack	Maharani et al (2017)
10	Banten	Beach	0.1-0.2 kg/m^2	Plastic bag	Faizal et al (2022)
11	Tunda Island	Beach	0.75 items/m^2	Packaging, cig. but	Maharani et al (2018)
12	Biawak Island	Mangrove	0.03-0.3 kg/m	Foam, plastic	Purba et al (2017)
14	Biawak Island	Beach	0.1-0.2 kg/m^2	Plastic bag	Faizal et al (2022)
15	Pangandaran	Beach	0.05-0.35 kg/m	Cig. butts, Fishnet, Packaging	Purba et al (2018a)
16	Pangandaran	Beach	0.1-0.2 kg/m^2	Plastic bag	Faizal et al (2022)
17	Pelabuhan Ratu	Beach	0.1-0.2 kg/m^2	Plastic bag	Faizal et al (2022)
18	Parangtritis	Beach	2-700 items/m^2	Wood, plastic	Mardiatno & Wiratama (2021)
19	Kuta	Beach	5,400-8,400 m^3/season	Wood	Attamimi et al (2015)
20	Bali Coast	Seabed, surface water	0-0.5 items/m^2	Plastic	Husrin 2017
21	Sawu Nat. Park	Beach	4.4$\pm$1.1 kg/m^2	Plastic	Purba et al (2018)
22	Tasikria, Minahasa	Beach	118.6 g/m^2	Plastic	Bangun et al (2019)
23	Minahasa	Beach	0-0.05 items/m^2	Plastic & rubber	Moningka et al (2021)
24	Malalayang	Beach, Bay	2.3-5.1 kg/m^2	Plastic	Schaduw et al (2021)
25	East Nusa	Beach	0-0.4 kg/m^2	Plastic bag	Faizal et al (2022)
26	Ambon Bay	Surface water, seafloor	0.4-8.6 items/m^2	Plastic pack, foam	Uneputty and Evans (1997)
27	West Papua	Beach	0.05-0.1 kg/m^2	Plastic bag	Faizal et al (2022)

3. Microplastic Distribution in Indonesian Waters

Rachman et al. (2015) reported the first study of microplastic in Indonesian water based on the exposure in 11 fish species collected from fish market in Makassar. They found that plastic debris (0.1-4.5 mm) was identified in the gut of 21 out of 76 (28%) fish samples at concentration of up to 21 particles/individual. Afterward, several studies were conducted in different regions of Indonesian waters either in water, sediment or seafood species as presented in Table 2.

Table 3. Microplastic in different regions of Indonesian waters

No	Location	Sample	Concentration	Reference
1	Makassar	Pelagic fish Demersal fish	0-21 parts/individual 0-14 parts/individual	Rochman et al. (2015)
2	Muara Badak, Kaltim	Sediment	57-91 parts/kg dw	Dewi et al. (2015)
3	Lampung	Sediment	0-14 parts/cm^3	Cordova & Wahyudi (2016)
4	Surabaya	Water	0.38-0.61 part/L	Cordova et al. (2019)
5	Banten	Sediment	101-431 parts/ kg dw	Falahudin et al. (2017)
6	Cilacap coast	Water	0.27-0.54 part/m^3	Syakti et al. (2017)
7	Sumba, NTT	Water	70-120 parts/m^3	Cordova & Hermawan (2018)
8	Kupang, NTT	Surface water	0-0.05 part/m^3	Hiwari et al. (2019)
9	Pangandaran Bay	Sediment	26-68 parts/kg	Septian et al. (2018)
10	Pangandaran Bay	Benthopelagic fish Demersal fish	4-28 parts/indv 2-14 part/indv	Ismail et al (2019)
11	Benoa Bay	Water Sediment	0.43-0.58 part/m^3 0-113 parts/kg	Nugroho et al. (2018)
12	Lamongan	Sediment	144-353 parts/kg	Asadi et al. (2019)
13	Madura	Seasalt	12,326-14,932 parts/kg	Kim et al (2018)
14	Makassar	Seasalt	6.7-58.33 parts/kg	Tahir et al (2019)
15	North Java	Seasalt	55-273 parts/kg	Dwiyitno et al. (2021)

4. Potential Harmful to the Ecosystem and Future Concern

Based on the size, marine debris can be divided into several categories, namely (1) mega-debris (>1 m), which can be found in the open water, (2) macro-debris (2.5 cm - 1 m), generally found at the bottom and surface of the waters, (3) meso-debris (5 mm - < 2.5 cm),can be carried on the surface of the water or mixed with sediment, (4) micro-debris (0.33 - 5.0 mm), easily carried by currents and dangerous because it can enter the organs of marine organisms, (5) nano-debris (<0.33 mm), It is very dangerous because it can easily enter the organs of the organism. Sampah that enters the sea generally contains a lot of plastics and metals that undergo a long weathering and decomposition process of 50-400 years.

Various efforts have been made, to overcome marine pollution through a comprehensive system. Joint collaboration between the community, government and relevant stakeholders is needed in efforts to reduce, manage and utilize materials that have the potential to become marine pollutants in everyday life. Considering, there is a wealth of marine natural resources that need to be considered for its sustainability in the Republic of Indonesia which is one of the largest maritime countries in the world.

5. Conclusion

Earlier studies showed that marine waste that enters Indonesian waters may come from land, water bodies, coasts that flow into the sea, which are predominantly composed by various kinds of plastic waste. Furthermore, degradation product of microplastic, namely microplastic, may enter the aquatic food chain and harmful the different aquatic compartments and human health. Many of literatures have revealed adverse effects of microplastic exposure, to aquatic ecosystem, seafood species as well as the possibility to human health. However, this fact is not sufficient yet to generate general regulation for microplastic guidelines in those different compartments. Established global and national legislation and action plans need to be implemented practically to protect Indonesian waters from massively marine debris and microplastic pollution, as well as developing social responsibilities.

Engineering geophysics – a toolbox to improve the safety of constructions

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Keywords: Engineering geophysics; geotechnical engineering; civil engineering; inspection; monitoring.

Abstract

Engineering geophysics is mainly defined as the use of geophysical methods in geotechnical engineering (such as site characterization before constructions are designed and made). The associated methods are well established in earthquake engineering and geotechnical site characterization. Recently, methods such as radar (GPR) have revolutionized detection methods for rebar and other metal objects in quality assurance of concrete constructions and technologies from seismology and exploration seismics are making their way to investigate and monitor the ageing concrete traffic infrastructure of many countries.

1. Introduction

In terms of application, the two main foundations of geophysics have been seismology (including the exploration of the earth's deep interior) and since the 1920ies the exploration of resources such as oil and gas, coal, ores, and increasingly groundwater and geothermal energy. Since the late 1980ies engineering geophysics has made its way forward in science and towards commercial application. Here, the author aims to give a few examples form his and his group's work to demonstrate the use of geophysical methods in various aspects of civil engineering

2. Geophysics in geotechnical engineering

Geophysical methods to explore natural or human-made soil before construction or to prevent geohazards are used commercially since the end of the 1980ies [1]. Methods used include resistivity, electromagnetic, refraction seismic, active and passive surface wave based methods plus a variety of borehole base methodologies. Earthquake risk assessment based on seismic evaluation of average wave speed in the subsurface (Vs30) has made it into building codes [3]. Details about the practical use of seismic methods are given e.g. in [4]. Other applications focus on foundation engineering, e.g. verifying the length of foundation piles.

Figure 1 shows an application from flood protection. Old river embankments in Germany were surveyed by resistivity imaging and other methods to map weak spots to prioritize repair and upgrade.

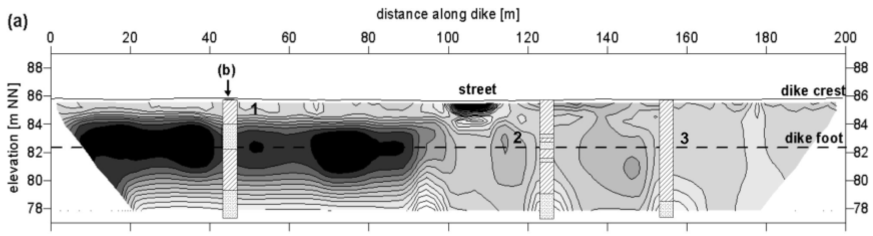


Figure 1. Resistivity image of a river embankment, showing sandy parts (weak spots by high resistivities (dark).

3. Geophysics in civil engineering

During the last three decades, several geophysical methods and technologies have paved their way into non-destructive testing in civil engineering (NDT-CE) applications. The by far most advanced are specialized ground penetrating radar (GPR) devices dedicated to localizing rebar and other metal objects as well as other features in concrete constructions. Due to their superior depth of penetration and 3D imaging capabilities, they are replacing the conventional inductive rebar locator in many cases.

Recently methods from seismology and exploration geophysics have also found their way into NDT-CE. Two examples are given below, both described e. g. in [6] with references to other authors.

3.1. *Imaging ultrasonic echo data by reverse time migration*

Ultrasonic and radar echo data acquired concrete structures are converted into images mainly using the SAFT method which is very similar to geophysical Kirchhoff migration. Inherent limitations include the inability to map vertical boundaries or the backside of objects. Recent experiments Reverse Time Migration (RTM), which is a standard tool in oil exploration, shows the huge potential of its application in NDT-CE, albeit at the cost of more intensive computing time (Figure 2).

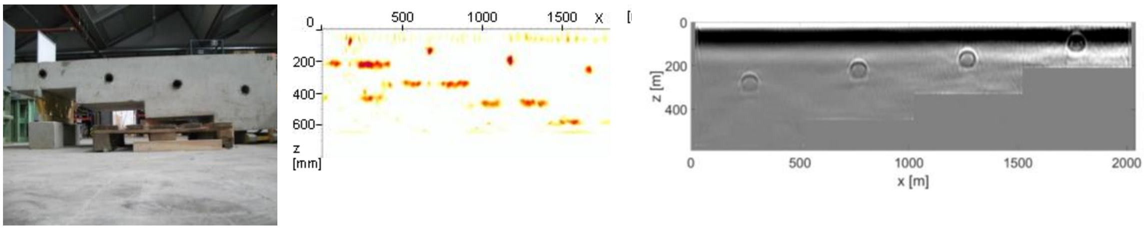
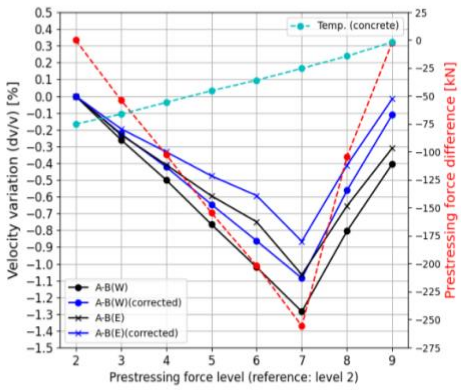


Figure 2. (left) concrete model in BAM lab; (center) conventional ultrasonic image, measured data (SAFT), RTM image (flipped, simulated data)

3.2. *Monitoring constructions by ultrasound and coda wave interferometry*

Coda wave interferometry (CWI) is used in seismology to detect and quantify small changes in seismic waveforms. CWI can also be applied to ultrasonic monitoring data acquired by embedded transducers in concrete constructions. Figure 3 shows the results of ultrasonic monitoring at a model bridge on BAM's test site. The velocity change clearly follows the simulated damage (change of prestress). The method is now experimentally applied at structures in Germany to monitor deterioration and failure pre-warning.

Figure 3. (top) BLEIB model bridge at BAM's test site TTS in Horstwalde, Germany; (right) Monitored velocity changes at various positions (blue, black) during simulated damage (change of prestress, red)



4. Conclusion and Outlook

Geophysical methods have found their way as indispensable tools into various fields of engineering. This includes but is not limited to the characterization of natural and human-made soil before construction, the assessment of earthquake (and other hazard) risks to human lives and constructions as well as the investigation of the quality and the condition of constructions. However, there are still some gaps to fill. In addition as the continuous improvement of the measurement and data processing technologies (including items such as data fusion, machine learning and general digitalization) the author thinks emphasis should be out an a) quantitative interpretation of geophysical results including uncertainties, b) standardization to provide guidance for service providers and clients and c) full integration of geophysical and other non-destructive testing into monitoring and assessment procedures to ensure the full benefit of the data gathered.

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Monogenetic Volcanoes and their Impacts on Groundwater System at the Pasuruan District, East Java

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Extended Abstract

The Pasuruan district in the northern coastal areas of East Java has a huge groundwater system at the northern flank of the Bromo-Tengger volcanic caldera complex. Recent development is the utilization of the Umbulan spring water for water supply of the Surabaya metropolitan area that becomes a strategic urban project in Indonesia. Therefore, conservation of the Pasuruan groundwater system is a concern for many stakeholders, in which understanding the groundwater system is the first-step effort towards a sustainable groundwater management. In general, Pasuruan groundwater system is considered a volcanic groundwater system, with the recharge area is around the top of Bromo-Tengger caldera around 25 km to the south and discharge area is around the Pasuruan plain at the bottom of the northern flank. However, our study reveals the presence of several monogenetic volcanoes which are genetically having different magma sources from the Bromo-Tengger caldera. The most distinctive volcanic feature is the 1.5 km-wide Grati maar lake. Other volcanic features are found as scattered rock exposures of scoria-rich fall deposits found around Umbulan and Banyubiru springs. Monogenetic volcanoes are probably erupted within an older Lekok volcano, whose volcanic remnant is now forming a 11-km wide half circular feature of hills at coast line. Geological observation at Gunung Sir and Watuprapat beach show the presence of lava and basaltic-andesitic pyroclastic rocks. Representative samples are analyzed for their lithogeochemistry, and supporting evidence of two magma sources, i.e. distant Bromo-Tengger and local Grati-Lekok volcanin complexes. Lavas and pyroclastic rocks originated from Bromo-Tengger caldera complex have medium-K calc-alkaline affinity and mostly mafic composition (i.e. SiO2 less than 53%), while volcanic rocks from Grati-Lekok volcanic complex have high-K calc-alkaline affinity and more evolved compositions (SiO2 more than 53%). It is proposed that the Pasuruan artesian groundwater system is formed due to the cover of lava at the surface and originated from the Bromo-Tengger caldera, and being extruded by several hydroclastic eruption centers at the lowland area to trigger the outflowing of natural springs such as Umbulan.

Geomorphological indicators of on-going uplift in the Southern Mountains (Central Java, Indonesia)

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Keywords: Java Island; subduction; uplift; marine terraces; geomorphology; seismic hazard.

Extended Abstract

The island of Java forms part of the volcanic arc originated from the subduction of the Indo–Australian plate beneath the Sunda Plate, which commenced during the Eocene [1]. Along the Java trench, subduction takes place at a rate of 7 cm/y in N20ºE direction [2], resulting in regional uplift of the overriding plate and controlling Java's current stress field. Large earthquakes have occurred in the Java subduction trench with magnitudes Mw 7.0-7.5. The most significant events include the 1994 Mw 7.8 Kencong and the 2006 Mw 7.7 Singaparna earthquakes (Fig. 1b), which ruptured at shallow depths and generated tsunamis [3]. These tsunamigenic events, together with potential megathrust events along the Java trench with an inferred return period of approximately 500 years [4], denote the need to study regional tectonic uplift in order to contribute to the long-term seismic hazard assessment of the Island of Java. Based on remote sensing and GIS analysis of the 8 m resolution DEMNAS DEM from the Indonesian government [5], we investigated the geomorphological markers associated with the superficial expression of relative uplift in the area of the Southern Mountains, located in the vicinity of the Special Region of Yogyakarta (southern central Java, Indonesia), to study its Quaternary tectonic history.

The study area encompasses the Sewu Karst (Fig. 1c), a karstic plateau consisting of reefal limestone of the Middle Miocene (Wonosari Fm.) [6], intensely weathered due to the tropical climate resulting in a completely dissected landscape with characteristic cockpit karst morphology of the tropics. The hydrogeology of the karst is characterized by an underground river system fed by numerous sinkholes and cave entrances in the North of the Plateau and discharges close or in to the Indian Ocean at the South. [7] We have identified within the plateau several lineations with two main orientations: NW-SE and WNW-ESE. The WNW-ESE striking lineations are sub-parallel to the coast and can be followed along the whole plateau. These lineations coincide with the occurrence of other features: 1) areas with differential incision of river channels where channels are more incised towards the coast, 2) areas with different terrain ruggedness index where the surface of the areas next to the coast is less rugged, 3) aligned knickpoints (which we calculated using LSDTopoTools software [8] based on the DEMNAS DEM [5]), and 4) aligned sinkholes. We interpret these lineations as various stacked levels of marine terraces. Depending on the area, we identify up to 7-9 levels of terraces that are slightly dipping towards the south (see topographical profile in Fig. 1d). Previous studies ([9]; [10]) have already described three major marine terrace levels. Moreover, in the eastern part of the karst, we identify a major and deeply incised river valley (Fig. 1c). This valley is connected to the north to the Baturetno depression and to the south to the Indian Sea. It appears that at some point, an active river was draining towards the north and due to uplift and southern tilting of the Sewu plateau, it changed course (stream piracy) and incised deeply towards the south. As for the other lineations (NW-SE striking), we interpret them as a joint system whose orientation is in agreement with the present-day stress field.

Furthermore, we observe other geomorphological indicators of uplift in the fluvial system further inland. The Opak River (Fig. 1c), which flows at the toe of the Baturagung Range from North to South, is presently incising in the bedrock and its fluvial terraces are degradational, which implies a lowering in the base level. It has to be also taken into account that the course of the Opak river is fault-controlled (Fig. 1c) [11]; consequently, river incision is also influenced by the activity of shallow crustal faults. Similarly, within the Wonosari Basin, the Oyo River is currently deeply incising. Streams drop in waterfalls to drain into the Oyo river, where there are no lithological bedrock changes. Evidence of this incision is also seen in the pattern and course of Oyo; the Oyo river finds its way to the Indian Ocean having to cross the Baturagung Range, which implies high incision and impossibility to cross the Sewu Karst Plateau (Fig. 1). The underground river system, first mapped by Mc Donalds and Partners [7], also shows a tectonic influence in its karstification process.

We presented here geomorphological markers of ongoing uplift in the western edge of the Southern Mountains, including marine terraces and deeply incised rivers, as the first step to study the regional uplift. Further studies are needed to understand the interplay between regional uplift, local uplift related to crustal faults, and sea-level changes to obtain a long-term uplift rate and define recurrence intervals of sudden uplift linked to megathrusts earthquakes. One of the following steps will be to date the marine terraces and relate them to Quaternary sea level changes and tectonic activity. The karstification process will be further studied and compared to the terrace formation process.

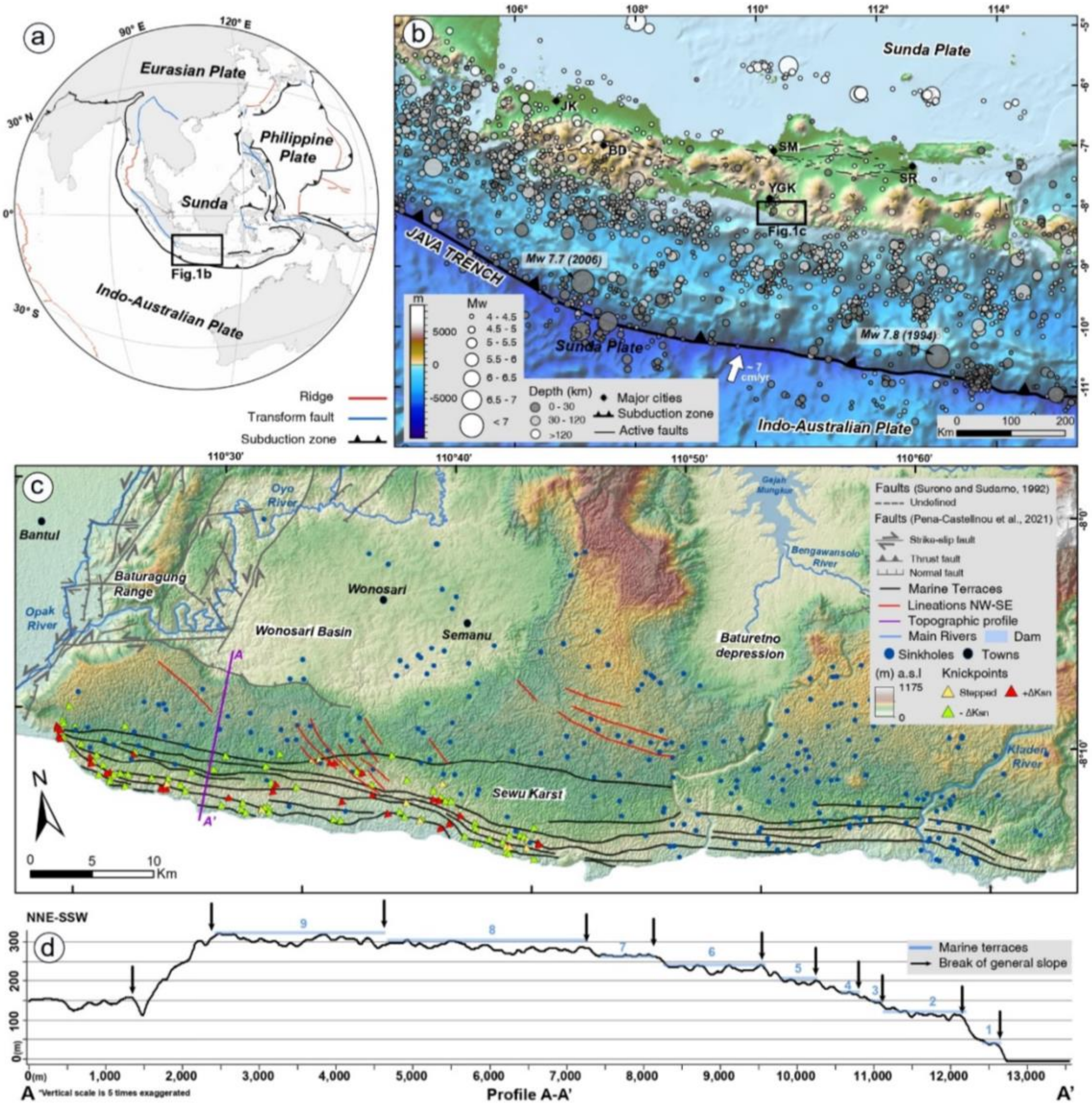

Figure 1. (a) Simplified tectonic setting of the Indonesian archipelago; (b) Instrumental seismicity of the Java Island of the period 1990-2020 (USGS seismic catalog, https://earthquake.usgs.gov). The white arrow and number show the convergence velocity of the Indo-Australian plate relative to the Eurasian plate fixed frame [3]. Black lines [12] indicate active faults. Abbreviations for major cities: JK: Jakarta, B: Bandung, YGK: Yogyakarta, SR: Surabaya, SM: Semarang; (c) Overview of the study area, the province of Yogyakarta. Dashed faults are from Surono and Sudarno [13] and non-dashed from Pena-Castellnou et al. [11]; (d) Topographic profile across the Sewu Karst and the coastline with the inferred marine terraces.

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Risk of Naturally Occurring Radioactive Material (NORM) due to rapid urbanization of Phuket Province, once the biggest tin mining town but now the most popular tourist place of Thailand

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Keywords: Risk; Radioactivity; Radionuclide; NORM; Phuket.

Extended Abstract

Phuket Province is now the most popular tourist place in Thailand. Several millions of people from around the world travel to Phuket each year, leading to rapid urbanization in this area. Phuket was used to be major producer of tin concentrates of the country a few decades ago. With increasing price of tin, old tin mines as well as new tin deposits in Phuket have been revisited in hope to revive tin mining in this region. In addition to tin, there are a number of valuable minerals associated with tin deposits, especially Rare-Earth-Element (REE)-contained minerals, e.g., monazite, xenotime, which could be recovered as by-products. However, these minerals also contain a certain degree of natural radioactivity from some radionuclides, especially from uranium (U) and thorium (Th).

This study demonstrates the characteristics of naturally occurring radioactive material (NORM) in Phuket Island. The results help in evaluation of risk due to expansion of urban area. Samples of soils and rocks were taken from various locations, including tailing and waste from previous processing plants.

The activity concentrations of 226Ra, 232Th and 40K of soils and rocks in non-mining area are low same as typical background values. In addition, the activity concentrations of 226Ra, 232Th and 40K of disturbed soils in former tin mining area are low, almost same as in non-mining area. However, the activity concentrations of 226Ra, 232Th and 40K of soils in the vicinity of old tin processing plant are significantly greater than world average (UNSCEAR (2008)).

Phuket are safe for travel without risk from exposed radioactivity due to NORM either in mining or non-mining area.

Sample Types	Description	^{226}Ra (Bq kg^{-1})	^{232}Th (Bq kg^{-1})	^{40}K (Bq kg^{-1})
Soil (Shallow)	Non-mining area, 0-0.5 m deep	100±50	150±50	500±200
Soil (Deep)	Non-mining area, 0.5-2 m deep	110±20	250±100	700±300
Rock (Granite)	Weathered or fresh rock samples of granite	170±30	375±75	2,000±500
Soil (Mining)	Disturbed soil in mining area (soil, waste, or tailing)	200±100	125±25	750±250
Soil (Processing)	Disturbed soil in processing area (soil, waste, or tailing)	3,000±1,000	7,000±3,000	1,000±500
World average	Reported by UNSCEAR 2008	50	50	500

Constraints on relocation of settlements from Landslides and adaptation with landslides

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Abstract

Long term change of temperature and weather pattern bring about different kinds of hazards. The climate change together with intense rainfall or rainfall pattern challenges landslides in high land areas that threaten to people, infrastructures, and properties. The destruction of this impact becomes more and more augmented within a decade. From the small scale to large scale landslides as well as disastrous ones, disaster management on the pre and post events should be effective for short and long term. This paper presents the effects of relocation of settlement due to huge landsides after five years and compared with adaptation of landslide based on the case studies of different locations. By comparing those case studies, this paper highlights the important of involvement of community in landslide prone area and requirement of the awareness to change their mindsets and to forge more a resilience and inclusive community. Although the vulnerable landslide zonation maps are important for the scientists, authorities, department of disaster management team as well as the local people in affected areas, some constraints arise after focusing only on standardized map after several years.

1. Introduction

The two case studies of landslides are presented here are post disaster condition and preventive condition. The first one, largest landslide, was recorded in Hakha, Chin State and another is in Taunggyi, Shan State, Myanmar. On 27th July 2015, the magnitude of the landslide event had a great impact on infrastructures, residences (more than 500 nos.) and inhabitants at Mt. Rung area, roads & Hakha environs with no fatalities. In order to support the local community and regional planners, the potential landslide hazard zonation map was produced by the collaboration with Myanmar Geosciences Society (MGS) and Department of Geological Survey Enterprise (DGSE). The urgent relocation of settlement had been done based on this map.

Another case study, Taunggyi, Shan State(South) in Myanmar is selected as a river basin area as a project for landslide risk reduction integrating with projection of climate change. This was implemented under ASEAN Committee on Disaster Management (ACDM) through working group of Institute for Global Environmental Strategies (IGES), CTI Engineering International (CTII) and Asian Disaster Preparedness Center (ADPC). This project is aimed to develop technical capacities of targeted nationals, local government officials and institutions on landslide risk assessment and risk mapping with incorporation of climate projection through structured trainings including site survey.

2. Methodology

After five years of Hakha landslide event, in the year 2020, there was an utter among local people who had been demanding to live at their old land due to no recurrence of significant landside even though the area occupied in the very high potential zone. Field survey was done to investigate the symptoms of landslides potential. The tension cracks on the top of Mt. Rung were still observed. As a result, a great change have been observed such as moderate potential zone to high one except low potential zone. The huge anthropogenic activities impact on some previous input parameters mostly in the area of natural vegetation to bare land. Construction of new infrastructures without a proper drainage system and cutting slopes reduce the stability.

In summing up, the parameters in previous landslide potential mapping should be reconsidered due to the change of situation, also giving awareness to the local community.

Figure 2. Activities of case studies 1 in Chin State and 2 in Shan State

In the case study of Taunggyi area, the landslide map integrated with impact of climate change was established indicating the most vulnerable areas with high risk. There were eleven areas for household surveys (200 nos.), from which the capacity of community and the sensitivity of community can be revealed. Due to higher capacity of community, that can reduce vulnerability, the community training had been done. From those training, the community can build up their own capacity, understand well about how the capacity needs by doing feature map. Based on those facts, action plan on risk management including duration plan, resource plan, capacity and policy needs can be adopted for comprehensive implementation.

3. Conclusion

Partly due to the growing populations living in hazard prone-areas, the impacts of climate change cause more severe consequences and intensify the disasters in the region. With this direct effect of climate change on disasters, linking disaster risk reduction and climate change adaptation becomes an urgent necessity. By creating a safer environment through preparedness and mitigation measures, as well as improving response capacity for landslide events can achieved an adaptation with landslide risk.

In summing up, based on two case studies, the advantages and disadvantages of relocation and adaptation of landslides from the point of view of local people and authorities should be discovered. The changes of input parameters in creating zonation map from time to time should be periodically analyzed. And finally, the authorities can cope the right decision for management of community based disaster risk reduction.

Study on saltwater origin and mechanism in aquifers of Danang area and solution for sustainable groundwater development

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Keywords: saltwater intrusion; Danang-Vietnam; numerical modeling; sustainable groundwater development.

Extended Abstract

This article shows the results of saltwater intrusion simulation in aquifers in coastal aquifers in Danang area, centre of Vietnam in the context of climate change and sea level rise. Saltwater intrusion model validated by coupling geophysical and isotopics approaches. Based on the calibrated model, prediction model of saltwater intrusion for the period of 2020-2050 with different scenarios have been simulated to sustainable groundwater development using SEAWAT model. Simulated results from numerical model shows that groundwater in porous aquifers in Danang area is highly affected by tidal in Han, Cu De river and seawater level. To face with the increasing of water demand, a groundwater exploitation wells system could be added with total pumping rate of 12.000m3/day in Hoa Khanh, Lien Chieu and Non Nuoc area.

Abstracts Accepted for Poster Presention

Investigation of Aquifer Using Geoelectrical Methods, Case Study: Gombong District, and Surrounding Areas, Central Java, Indonesia

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Keywords: Aquifer Characteristics; Geoelectric; Gombong; Indonesia.

1. Introduction

Groundwater is one of the biggest endowing providers of clean water sources. In this increasingly progressive era, the demand for clean water increases day by day, and if only leaning on surface water, the target will not be fulfiled. Therefore, groundwater usage is the right choice as a provider of clean water for the survival of living things. The geological conditions surrounding an area will be bonded to groundwater availability.

Geological conditions in an area will affect groundwater availability. Determination of the aquifer, can be done by the geoelectric method. According to the Regional Geological Map of Banyumas and Kebumen [1], Gombong area and its surroundings built by four geological formation, which are the Kalipucang Formation, and Penosogan Formation, Halang Formation, and Alluvium. Based on hydrogeological conditions, Gombong District and its surroundings are divided into four aquifer conditions: medium to high productivity aquifers, medium productivity aquifers with wide distribution, minor local mean productivity aquifers, and rare groundwater areas [2]. Considering geological and hydrogeological conditions that allow the Gombong area and its surroundings to have groundwater sources, this research has an objective to know the aquifer distribution in the researh area.

2. Methodology

The geoelectrical method used on this research is the VES (Vertical Electrical Sounding) method and, this study uses the Schlumberger method for the measurement and evaluation, where the depth achieved from geoelectric measurements using the Schlumberger configuration is 1⁄3 of the total stretch or 1⁄3 of the AB value, usually denoted by (r). This configuration is used if the device has high sensitivity. The distance of the current electrode is quite far from the potential electrode so that the recorded data is the original data from the current injection, not noise [3]. Data analysis was carried out in several stages: data input, filtering and

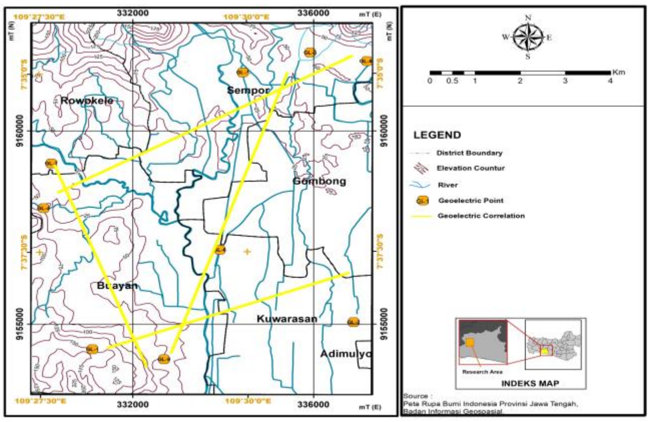

Figure 1. Geoelectric Point

smoothing data, and inversing and forwarding data modelling. Geoelectric measurements using the Schlumberger method at the research site were carried out at as many as nine (9) measurement points with a full stretch of 200 meters (see Figure 1).

3. Result and Discussion

Based on the results of measurement and data evalution, Figure 2(a) shows the distribution of true resistivity value at each measurement point. Based on resistivity value at the nine points, the interpretation of lithology, was obtained as shown in Table 1. According to the interpreted lithology, a fence diagram shows the subsurface conditions in Gombong District and its surroundings can be developed (Figure 2b). In the southern part of the research area, in general, the lithology composed is in the form of limestone that is included in the Kalipucang Formation unit, then heading north is dominated by claystone, sandstone, and breccia lithology where the lithology represents the Penosogan Formation, Halang Formation, and Alluvium. Aquifer is dominantly found on the alluvium deposits representing by the oocurence of silty sand to sandstone.

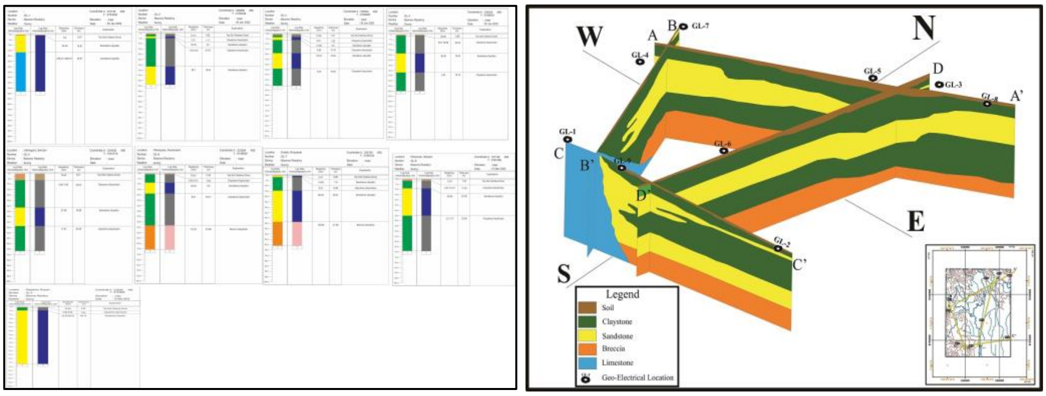

Figure 2. (a) Bore Hole Point 1-9; (b) Fence Diagram of Geoelectrical Field Measurement Result

Table 1. Rock Resistivity Values and Lithology from Field Measurements

No	Resistivity (Ω m)	Lithology
1	0.2 - 10	Clay to claystone
2	17.57 - 86. 25	Silty sand to Sandstone
3	112.21 - 136.94	Boulders to Breccia
4	278.47 - 1382.07	Limestone

4. Conclusion

Geoelectric measurements using the Schlumberger method were carried out at as many as nine (9) points spread across Gombong District and its surroundings. The lithology was obtained in clay to claystone with a resistivity value of 0.2 – 10 Ωm, silty sand to sandstone with a resistivity value of 17.57 – 86.25 Ωm, breccia with a resistivity value of 112.21 – 136.94 Ωm, and limestone with a resistivity value of 278.47 – 1382.07 Ωm. Based on the value of resistivity, aquifer will be find on the layer of silty sand to sandstone lithology.

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Identification of Potential Saltwater Intrusion in Eastern Batang Regency, Central Java based on Geochemical Data

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Keywords: Saltwater intrusion; Shallow groundwater; Batang Regency; Geoindicator.

1. Introduction

Water is one of human's basic needs. Most of the water consumption comes from Groundwater has a vital role in human activities. 97% of the world's available freshwater resources come from groundwater [1]. Most of the water consumption came from groundwater. Groundwater is not only used for drinking water resources but also for domestic and industrial use. So, groundwater should be well managed to preserve water quality and quantity.

Saltwater intrusion has become the main problem in Batang Regency. Excessive water consumption caused groundwater-related subsidence. This condition caused saltwater intrusion in the coastal area and brackish groundwater water. Saltwater intrusion in Batang Regency has reached 5 kilometers from coastal based on PUDAM Batang.

Several assessments could be considered in coastal groundwater management, specifically basic water needs, such as hydrogeochemical analysis in groundwater. This analysis can be a basis for determining freshwater availability, identifying water pollution, or identifying any anomaly caused by specific geological conditions.

Several assessments must be conducted to determine how far saltwater intrusion is in the research area based on this condition.

2. Methods

Several geoindicator was conducted in this research to determine how far saltwater intrusion affected this area. There are several geoindicator, such as:

1. Cl/Br Ratio
   Based on natural conditions of Cl/Br ratio in saltwater is 297. Cl/Br ratio could be classified into hypersaline brine (<297), dissolved or evaporated water (>1,000), anthropogenic source (<800), or agricultural product (low).
2. Simspon Ratio
   This ratio represents seawater contamination levels. This ratio could be classified based on the salination process, not affected (< 0.5), affected (0.6 – 6.6), and strongly affected (> 6.6) [2]
3. Electrical Conductivity vs. Chloride Plot
   This geoindicator shows a correlation between Electrical Conductivity (EC) and Chloride Plot saltwater intrusion in a groundwater sample. Cl^- >200 mg/L with EC ~1,000 μS/cm shows saltwater intrusion, and Cl- 100 - 200 mg/L with EC 600 – 2,000 μS/cm shows mixing process [3]
4. Seawater Mixing Index (SMI)
   This geoindicator index is used to determine the relative mixing degree between saltwater and groundwater based on major ions in saltwater such as Na^+, Mg^{2+}, Cl-, SO_4^{2-} [4]

3. Results

Samples were confirmed by geoindicators but not classified as intrusion due to low electrical conductivity (EC) and low total dissolved solids (TDS) values, and the presence of sampling wells is far from the coast. Samples indicated as intrusion by 2 methods were grouped as low intruded, within three indicated as moderate intruded, and within four indicated as high intruded. Three samples were classified as high intruded, and three samples indicated as intruded, as shown in Table 1.

Table 1. Zone status based on chosen geoindicators

STA	Cl/Br	Cl/HCO3	EC vs Cl	SMI	Description
ARB - GR 1	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - GR 2	Septic Effluent	*Slightly*	Normal	Normal	Normal
ARB - GR 3	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - GR 4	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 5	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 7	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 8	Intrusion	*Moderately*	Intruded	Intruded	High Intruded
ARB - GR 9	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 10	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 11	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 12	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - GR 13	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - GR 14	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - GR 15	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - GR 17	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 18	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - GR 19	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 20	Animal Waste	*Good Quality*	Normal	Normal	Normal
ARB - GR 21	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 22	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 25	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 26	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - GR 27	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - GR Bor 1	Intrusion	*Moderately*	Intruded	Intruded	High Intruded
ARB - GR MA 1	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - BP 1	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - BP 2	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - BP 3	Septic Effluent	*Slightly*	Normal	Normal	Normal
ARB - BP 4	Septic Effluent	*Slightly*	Normal	Normal	Normal
ARB - BP 5	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - BP 6	Animal Waste	*Good Quality*	Mixing	Normal	Low Intruded

ARB - SB 1	Septic Effluent	*Slightly*	Normal	Normal	Normal
ARB - SB 2	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - SB 3	Animal Waste	*Good Quality*	Mixing	Intruded	Low Intruded
ARB - SB 4	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - SB 5	Septic Effluent	*Good Quality*	Normal	Normal	Normal
ARB - SB 6	Animal Waste	*Good Quality*	Intruded	Intruded	Low Intruded
ARB - SB 7	Intrusion	*Injuriously*	Intruded	Intruded	High Intruded
ARB - SB Bor 1	Pristine	*Good Quality*	Normal	Normal	Normal
ARB - SB Bor 2	Pristine	*Good Quality*	Normal	Normal	Normal

4. Conclusions

This study provides significant information on the potential intrusion identification in the Eastern Batang Regency, Central Java. Intrusion zone can be determined based on geoindicator such as Cl/Br, Simpson Ratio (Cl/HCO_3), Chloride vs. Conductivity, and Sea Mixing Index (SMI). Samples indicated as an intrusion by two methods were grouped as low intruded, within three methods indicated as moderate intruded, and within four methods indicated as high intruded Research area is grouped into two groundwater intrusion zones, namely high intrusion dan low intrusion. High intrusion is in Gringsing and Subah District, while low intrusion is in Banyuputih and Subah District.

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Carbonate reservoir characterization, Kujung Formation North East Java Basin

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Keywords: Carbonate Reservoir Characterization; Kujung Formation; Petrophysics.

Abstract

Area of study located at Ramdha Field is a carbonate reservoir from Kujung Formation, North East Java Basin. The reservoir interval consists of carbonate rocks that has high complexity as result of depositional and diagenetical process. Kujung Formation has high variety of carbonate rocks that deposited in 5 depositional environments, such as inner ramp, outer ramp, platform interior, platform margin, and slope. Diagenetical processes happened in meteoric phreatic, marine, mixing, and burial environments. Carbonate characteristics complexity caused variation of petrophysical property of the reservoir. This condition caused the need of a more detailed research to determine the prospect zone than in siliciclastic reservoir. Lack of laboratorium data test causing the use of loss of circulation zone as the basic to determine reservoir prospect zone. Loss of Circulation is used because the zone having high permeability but low porosity. So this study looks for zone that have the same amount of permeability and having high porosity. Based on the result, Ramdha-1's reservoir prospect zone has petrophysical properties of 0-0.12 V/V shale volume, 19,4-26.5% porosity, 6.4-10% water saturation, and 555-1119 mD permeability and formed in a platform margin and platform interior environment., Ramdha-2's reservoir prospect zone has petrophysical properties of 0-0.0031 V/V shale volume, 15.3-30% porosity, 27-53% water saturation, and 395-4300 mD permeability and formed in inner ramp environment. Ramdha-3's reservoir prospect zone has petrophysical properties of 0-0.054 V/V shale volume, 20.5-27.6% porosity, 29.3-34.1% water saturation, and 747-1252 mD permeability and formed in a platform interior environment.

1. Background

North East Java Basin is one of the Giant Field explored in Indonesia (Satyana, 2002). Currenty the exploration target of this basin is the Oligo-Miocene Carbonate Reef Reservoir. This reservoir can be found in Ramdha Field, as part of the Kujung Formation. Kujung Formation is mainly composed by bioclastic limestone with insert of marl and clay. The target of exploration is the bioclastic limestone.

Limestone is a rock that has variety of facies caused by deposition and diagenetics environment. Depositional environment caused various texture and material composition in a limestone. Diagetics environment caused changes in texture and petrophysical component that makes limestone more complicated. Both of these are the factors that makes reservoir characterization in limestone harder. So we need to make several adjustment in determining the petrophysical properties of a carbonate reservoir.

2. Purpose

There are several purposes for this research, such as

1. Determining depositional environment and facies in Kujung Carbonate Reservoir
2. Determining diagenetics zone and process in Kujng Carbonate Reservoir
3. Determining the reservoir characteristics in Kujung Formation

3. Location

The research location is Ramdha Field, North East Java Basin that is located in Bojonegoro Regency, East Java under the jurisdiction of PT. Pertamina EP Cepu.

4. Data and Method

The data used in this research are core and thin section, well log, and 3 dimensional seismics. All these data are taken from 3 different wells in the Ramdha Field.

Core and thin section are used to determine the type of limestone based on the limestone classification by Embry and Klovan (1971) and became the basis in depositional and diagenesis environment determination. Wireline log are used as the basis of petrophysical calculation for shale volume, porosity, water saturation and permeability using the Paradigm Geolog 7. Seismic data are used to obtain the depositional environment of the carbonate reservoir.

Prospect zone is determined by the cut-off of petrophysical properties acquired from loss of circulation zone in each well and plot those cut-off to the part of the wells that didn't have loss of circulation.

5. Result and Discussion

Based on the data available, we can conclude that there are five depositional setting that can be found in Ramdha Field, such as slope, platform interior, platform margin, inner ramp and outer ramp. The diagenetics environment that can be found in Ramdha field are marine, meteoric, mixing, and burial. Marine environments are characterized by massive micritization and fibrous-bladed cement, Meteoric Environment characterized by the appearance of vuggy and moldic porosity, and blocky, equant, isopachus cement. Mixing Environment are characterized by dolomitization, and burial environment in the appearance of sylolites.

The Cut-off obtained from loss of circulation zone for prospect zone characterization are effective porosity > 8.65%, permeability >15 mD, Shale Volume <0.198 V/V and effective water saturation <78%.

6. Conclusion

There are several conclusions that can be taken from each wells, such as

1. Ramdha-1
   There are 13 prospect zone with 1.21-20.75 m in thickness, the petrophysical properties are shale volume 0-0,12 V/V, porosity 19,4-26,5%, water saturation 6,4-10%, and permeability 555-1119 mD. The depositional setting is platform interior on the bottom of the wells and platform margin on the top part. Diagenetics zone that happened in these wells are from the meteoric phreatic zone.
2. Ramdha-2
   There are 4 prospect zone with 1.21-14.9 m in thickness, the petrophysical properties are shale volume 0-0,0031 V/V, porosity 15.3-30%, water saturation 27-53%, and permeability 395-4300 mD. The depositional setting is inner ramp. Diagenetics zone that happened in these wells are from the meteoric phreatic zone.
3. Ramdha-3
   There are 8 prospect zone with 1.21-11.58 m in thickness, the petrophysical properties are shale volume 0-0,054 V/V, porosity 20.5-27.6%, water saturation 29.3-34.1%, and permeability 747-1252 mD. The depositional setting is platform interior and the diagenetics zone that happened in these wells are from the meteoric phreatic zone.

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Conventional pumping remediation modeling in the case of fuel pollution in the groundwater of Tugu station, Yogyakarta, Indonesia.

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Keywords: Pumping remediation; Groundwater Modelling; Groundwater contamination.

1. Introduction

One of the groundwater pollution problems faced by the city of Yogyakarta is groundwater pollution caused by the leaking of the fuel tank belonging to the Indonesian railway company in the city of Yogyakarta which is located in the center of Yogyakarta city in 1997. The results of this groundwater pollution make TOC levels (total organic carbon) in groundwater is increasing and the community around the railway station cannot use groundwater from their dug wells until now.

This study aims to create a remediation model with conventional pumping. This conventional pumping remediation modeling is done by placing pumping wells that aim to contain the spread of pollution and reduce the polluted area with the discharge obtained through the calculation of the plume catchment zone. After that, the configuration for laying the pump well is obtained which is suitable for application in this research area. The pumping remediation configuration using 3 pumping wells can prevent the spread of plumes and reduce the polluted area from 8047 m^2 (green area in Figure 1) to 4776 m^2 (red area in Figure 1) until the next 30 years, namely in 2050.

2. Methodology

To control, restrain the movement of groundwater pollution (Plume) and reduce polluted areas in research area. It takes a pumping remediation modeling approach to get the configuration placement of suitable pump wells in the study area. This conventional pumping remediation approach was chosen because it is simple to apply, easy, inexpensive and can be combined with other technical approaches that are more expensive.

This pumping remediation model is a model developed from the model that has been carried out in previous research in the same research area. The calibration values on the groundwater flow model and the mass transport of TOC contamination models are 8.78% and 9.6% [1].

Because the calibration value of the groundwater flow model and the mass transport model is less than 15%, these two models are considered to have described the actual condition of groundwater flow and mass transport of TOC contamination in the study area so that it can be used as the basis for developing a conventional pumping remediation model. Assumptions are needed to limit and control the pumping remediation model using visual modflow 3.1.0 software. The assumptions made are as follows. Screens on pumping remediation wells are placed along the pumping wells to the bottom of the shallow aquifer, The installed screen is assumed to be able to pump groundwater in polluted areas according to the calculated discharge, Pumping is carried out from early 2021 to 2050 with calculated discharge (Q m^3/day) according to Cohen et al [2], the condition of the ground water level elevation in the research area does not experience significant changes in the next 30 years until 2050 and the simulation was carried out by remediation of 1 pumping well, 3 pumping wells and 7 pumping wells.

3. Results

The pumping remediation model uses 3 pumping wells with a calculated flowrate (Q) of (733.4 m^3/d) at pumping well 1, (889.35 m^3/d) at pumping well 2 and (859.35 m^3/d) at pumping well. pumping well 3 was able to contain pollutants and reduce the plume area from 8047 m^2 to 4776 m^2 (Figure 1). The green area on the map (Figure 1) represents the state of the plume in 2020 prior to the pumping remediation process and significantly reduced to a red area (Figure 1) of 3271 m^2, with a plume reduction of 110 m from the southeast, 81 m from the northwest to the west. and from the south by 60 m towards the center of the plume caused by the pumping configuration using these 3 pumping wells.

The pumping remediation configuration using 3 pumping wells is more efficient than the configuration of 1 pumping well and 7 pumping wells because the configuration of 1 pumping well results in an expansion of the plume to the southeast and south of 8-10 meters in the period 2021 to 2050 during the remediation process pumping. While the pumping configuration using 7 pumping wells will have an impact on a significant decrease in the groundwater level because pumping using 7 remediation wells will reduce the groundwater level in the study area up to 10 m. Therefore, it is not recommended to use 7 pump well remediation in the study area because the research area is a densely populated area that uses shallow wells as access to daily groundwater use.

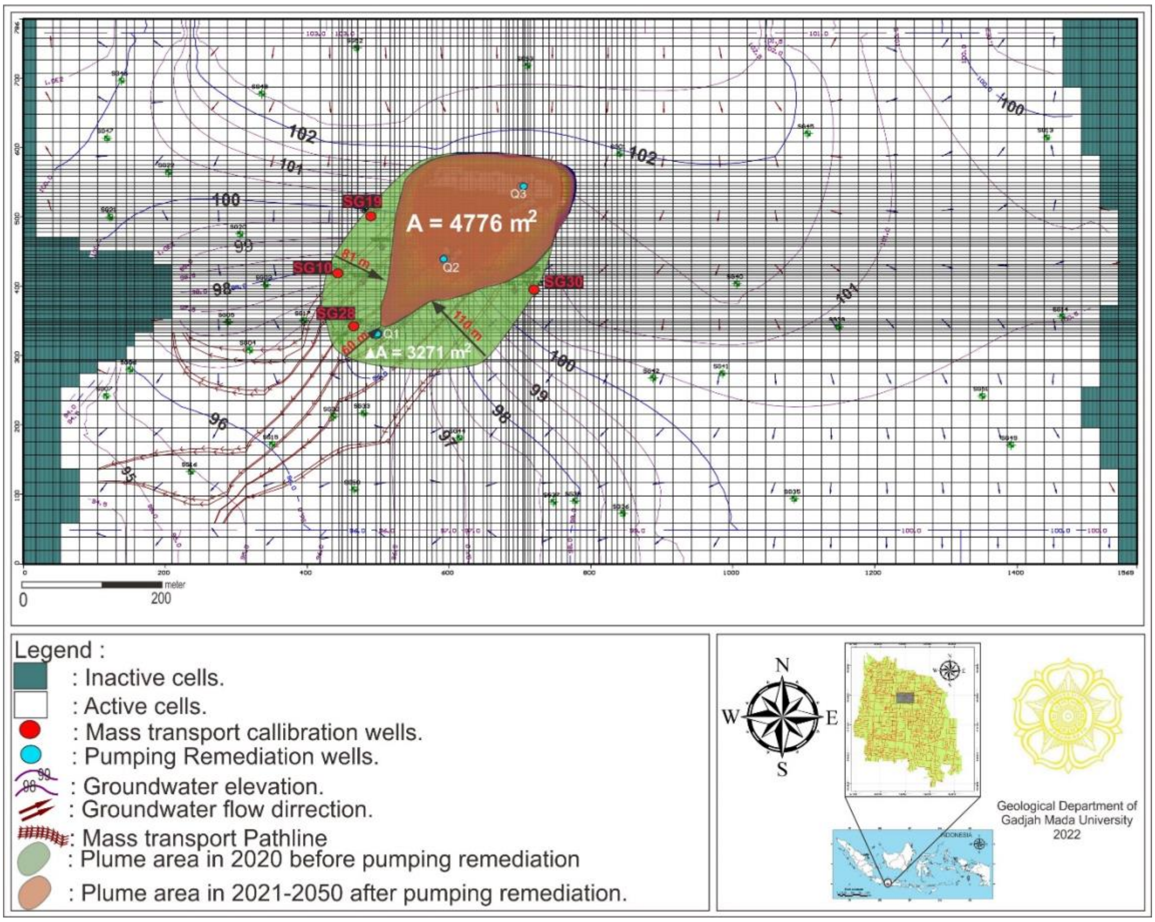

Figure 1. Recommended conventional pumping remediation in study area

4. Conclusion

Conventional pumping remediation uses 3 pumping wells with a calculated flowrate (Q) of (733.4 m^3/d) in pumping well 1, (889.35 m^3/d) in pumping well 2 and (859.35 m^3/d). d) the 3 pumping wells can withstand and reduce the pollution area from a polluted area of 8047 m^2 to 4776 m^2 until 2050 so that remediation using 3 pumping wells becomes a conventional pumping remediation recommendation in the research area.

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Geological Controls on Acid Rock Drainage Characteristics of the Kali Kuning deposit, Wetar Island, Indonesia

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Keywords: ARD; Kali Kuning deposit; acid-producing potential.

Abstract

The geological properties of mineral deposits influence to a great extent the acid-producing capacity of materials extracted during mining activities. Therefore, is critical to gain a comprehensive knowledge of mined rock units because such information will in turn allow robust environmental planning and mine management decisions. This research examines the Acid Rock Drainage (ARD) characteristics of the Kali Kuning deposit, using a combination of on-site, static and mineralogical tests to establish the relationship between ARD behaviour and geological properties. Results of this study categorise most of the investigated rock units as potential acid-producing materials.

1. Introduction

Indonesia has become a significant player in the global mining industry in recent decades. The Indonesian mining sector has played a vital contribution to national economic growth over many years [1], particularly in developing several remote regions. However, mining of sulfidic ores and coal seams may also be associated with a range of environmental issues, including the formation of Acid Rock Drainage/Acid Mine Drainage (ARD/AMD). To date, there are no superior methods in ARD prediction. The best way to gain a comprehensive understanding is by performing a series of tests to justify and verify the likelihood of ARD development. Several critical reviews have outlined the currently available predictive tests and have documented their strengths and weaknesses [2], [3].

Despite the advantages in the established ARD characterisation tools, there are no comprehensive guidelines to assess the likelihood of ARD development in remote areas. Especially remote Indonesian exploration and mine sites would benefit from national best-practices ARD guidelines that suit local, Indonesian situations. This approach includes having valid field methods that are quick to conduct, be completed on-site, are inexpensive, require only limited measuring equipment and be completed on a large number of samples.

This research aims to understand the ARD characteristics of the Kali Kuning deposit on Wetar Island, using a combination of established and novel on-site testing techniques, recognised static tests as well as conventional mineralogical laboratory analyses. The results can be used as a preliminary information to guide the development of comprehensive environmental management plans for the remote site. In addition, the results also equip the regulator by ensuring appropriate site monitoring and informed assessment of the company’s environmental management plan.

2. Site Description

The Kali Kuning mine is located on Wetar Island, about 2100 km from Jakarta, Indonesia. The site has a tropical savanna type climate, with three-month monsoonal rainfall at an annual intensity between 500 and 1000 mm. The average temperature is 27.2ºC, with a variation of daily temperatures between 24ºC and 30.8ºC.

The Lerokis, Kali Kuning and Meron deposits, located on the north central coast of Wetar Island, comprise precious metal-rich volcanogenic massive (VMS) base metal sulphide and barite deposits, which are hosted by Neogene volcanic rocks and minor oceanic sediments and lie within part of the Inner Banda Arc. The geology of the Kali Kuning deposit comprises of andesitic volcanic breccia, intermediate lava and crystal tuff, which forms the base of the footwall. The volcanic breccia gradually mixes with tuff breccia and shows pervasive quartz and chloritic alteration in clasts and matrix. The alteration intensity gradually increases into clay ± pyrite altered volcanics and continues in the form of pyrite ± silica volcanic breccia and silica ± pyrite breccia at the contact with the sulfidic ore [4]. Alteration in the Kali Kuning deposit is highly intensive and zonal. It is dominated by silicification in the centre of the sulphide ore and gradually shifts to illite–smectite and then to chlorite on the peripheral, outer parts of the deposit.

3. Methodology

The methodology to carry out this research comprises a combination of (1) on-site tests including the application of (a) a thermal infrared (IR) camera to induce and visualise exothermic reactions during the use of H2O2, (b) a pH test (AMIRA, 2022), and (c) the USGS Field Leach Test (FLT) Test; (2) established static ARD characterisation tests provided by commercial laboratories, which include a single NAG and ANC test as well as carbon-sulphur analyses for 54 samples; and (3) geochemical and mineralogical analyses using optical microscopy of thin sections, XRF, XRD and SEM-EDS.

4. Methodology

In the first stage of the assessment process, on-site test data (IR, pH, FLT) were to achieve a preliminary classification of samples into currently acid-forming (CAF), non-currently acid-forming (NCAF) and potential acid forming (PAF) materials. Initially, the IR test categorises the samples into reactive and non-reactive samples. Then, a combination of paste pH and FLT test data with electric conductivity (EC) analyses allows the categorisation of the samples into CAF, NCAF and PAF materials.

In the second stage, samples categorised as PAF are subjected to further assessment. Here, on-site test data are combined with static test analyses provided by commercial laboratories. The results classify the samples into PAF, acid-forming (AF), extremely acid-forming (EAF) and uncertain (UC) materials. Materials are classified as uncertain, when there is an apparent conflict between the NAPP and NAG results (i.e. when the NAPP is positive and NAGpH > 4.5, or when the NAPP is negative and NAGpH = 4.5) [5].

At the third stage, samples, which were classified as PAF, AF, EAF and UC at stage two, were subject to mineralogical and geochemical analyses. Based on the acquired information, samples were categorised according to their ARD as low-, medium and high-risk materials. Materials of medium- to high-risk should be subject to further kinetic testing to understand the samples' long-term acid-producing potential and to predict their water quality in the long term.

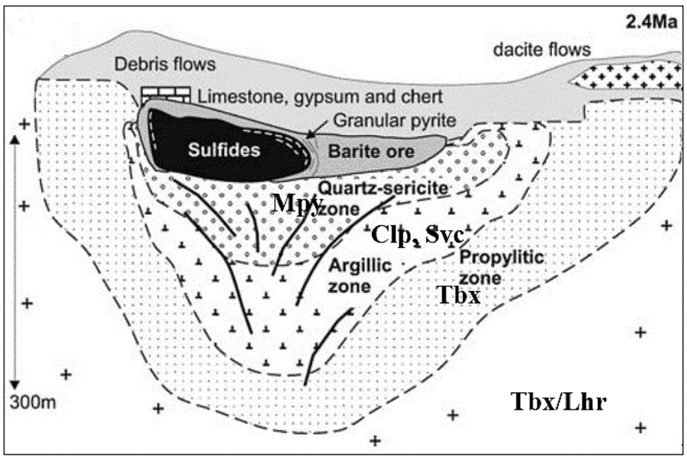

Figure 3. Schematic cross-section of Kali Kuning deposit, showing the various alteration and ore zones (after Scotney et al., 2015)

Results of the completed ARD classification demonstrate that there is a clear spatial distribution of ARD risks (Fig. 1). The most outer alteration lithic tuff/Tbx zone (minor hydrothermally altered) can be classified as NCAF, followed by Tbx tuff breccia (propylitic alteration) categorised as intermediate-low ARD risk. The following clay pyrite (Clp) and silica volcanic (Svc) alteration units are of low to intermediate ARD risk. Finally, materials of the ore zone (Mpy and Ms), rich in pyrite and chalcopyrite and resultant high base metal concentrations, are recognised as high-risk ARD samples. Consequently, the acquired data demonstrate a gradual increase in base metal concentrations and ARD risk from tuff breccia to the massive pyrite unit.

5. Conclusions and future research

This work has been able to recognise different ARD risks in host rocks of the Kali Kuning deposit. The detected distribution of ARD risk mirrors the presence of different geological units in the Kali Kuning deposit,. In general, the ARD risk gradually increases from the alteration zones at the periphery of the deposit to its sulfidic core. Samples with the highest ARD risk are recognised in the ore zone and therefore should be subject to further kinetic testing.

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Characteristic of shallow groundwater level fluctuation in an old residential area and a new residential area of Yogyakarta, Indonesia

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Keywords: Groundwater fluctuation; seasonal rainfall; land use change; impervious area; groundwater recharge

1. Extended Abstract

This study aims to investigate the effects of seasonal rainfall rate on shallow groundwater level fluctuation in an old residential area and a new residential area of Yogyakarta, Indonesia. This study is conducted during a time period of dry season and wet season started from September 2021 to February 2022. Collected data in this study are groundwater level, precipitation, and land use. The result shows that the trend of shallow groundwater level fluctuation and seasonal precipitation is positive which indicates shallow groundwater level is strongly influenced by seasonal rainfall. It clarifies the result of previous studies that urban recharge process has less significant impact towards groundwater level in humid region. Moreover, there is a possibility of localized recharge occured in old residential area covered by impervious area through the existing canals.

2. Introduction

There are several factors that are able to influence groundwater level fluctuation, such as geology, topography, climate, and antrophogenic activities [1]. Understanding groundwater table fluctuation over a period of time is very useful for water management tool [2]. Moreover, it provides information that can be used to determine the magnitude of long-term groundwater recharge changes due to climate or land use change [1]. Thus, this research tries to conduct comparative study of groundwater level fluctuation in two distinct area in Yogyakarta City based on the difference in antrophogenic factors and the similarity in natural factors.

3. Methodology

Criteria selection of study area based on the difference in antrophogenic factors (age of settlement and land use) and the similarity in natural factors (lithology, geomorphology, and 20 years mean rainfall) which the output of this selection are an old residential area and a new residential area. Based on selection, an old residential area is located in Kraton Sub-district, Yogyakarta City and a new one is located in Ngestiharjo Village, Bantul Regency, as shown in Figure 1.(a). Both of study areas have an area of 0.96 km2. The upper shallow aquifer of both study areas are composed of medium sand with clay lenses which has a hydraulic conductivity of 7.8 m/day and a spesific yield of 0.2 [3]. Data collection include groundwater level, precipitation, and land use. Groundwater level data are obtained by conducting 30 groundwater level measurement points in every week for 6 months of dry season and wet season (September 2021 to February 2022) in each of study area. Daily precipitation of 6 months are obtained from Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS) raster data set provided by Climate Hazards Center UC Santa Barbara. CHIRPS data set are clipped by the boundary of study areas using QGIS . For land use change evaluation purpose, it requires two satellite imageries which represent two distinct long term period of time. Google Earth only provides the historical collections of high-resolution satellite imageries started from 2006 to present. Therefore, the last 16 years of land use change evaluation is to be considered. The analysis of land use change pattern and settlement growth is conducted by interpretation of Google images data, both 2006 and 2022 period. Calculation of impervious area is carried out based on the assumption that built area is 100% impermeable whereas open space, agricultural, rangeland are 100% permeable. The evaluation of groundwater level fluctuation data and variation of seasonal precipiation data is visualized by overlaying them in line graph. Line graph is a simple way to show the relationship between items and can be used to compare changes over a period of time [4].

4. Results and Discussion

3.1. *Land use change, settlement growth, and impervious area*

The results of this section are shown in Figure 4(a) and Table 4. There are the differences of land use change pattern, settlement growth, and impervious area between both study areas. An old residential study is mostly covered by the old settlements which has been existed since more than 16 years ago. Moreover, impervious area covers 99.69% of its extent. On the other hand, a new residential study area experienced an enormous tranformation from agricultural, rangeland, and open space towards settlement area between 2006 and 2022. Heterogenity of land use in a new residential study area still can be found. In addition, densification of new residential area occured in less than 16 years in the central part of study area. Due to settlement growth, impervious area increases rapidly from 53.96% to 77.71% for the last 16 years.

3.2. *The influence of rainfall fluctuation on the groundwater level change*

According to Figure 4(b), decreasing of groundwater level until its minimum peak at the end of October occured much faster about 0.5 month later after the absence of rainfall at the middle of October. However, increasing of groundwater level until its maximum peak at the middle of February occured slower about one month later after the increase of rainfall until its maximum peak at the early of January. Thus, it reveals the groundwater level fluctuation is still influenced by the variaton of seasonal rainfall even in an old residential study area. This result confirms that urban recharge process has less significant influence towards cities in humid region, especially in Yogyakarta City [3]. In addition, there is a possibility of localized recharge in an old residential study area through the existing canals.

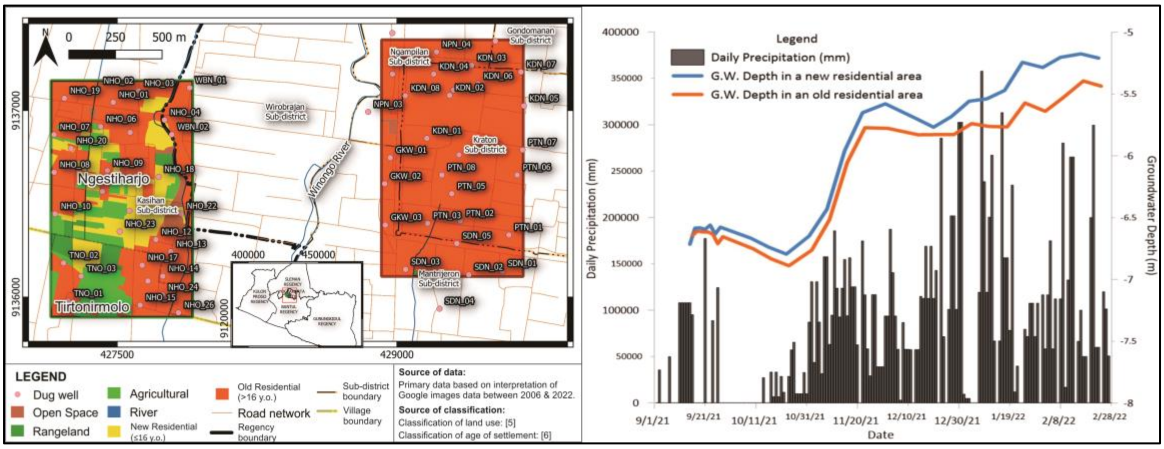

Figure 4. (a) map of area study; (b) groundwater level fluctuation vs precipitation.

Table 4. Land use evaluation of both study areas between 2006 and 2022.

Land use	Old residential (2006)	Old residential (2022)	New residential (2006)	New residential (2022)
Residential (impervious area)	99.69%	99.69%	53.96%	77.71%
Agricultural, rangeland, open space, river (pervious area)	0.31%	0.31%	46.04%	22.29%

5. Conclusions

Based on results, shallow groundwater level fluctuation in an old residential study area and a new residential study area of Yogyakarta city are strongly influenced by rainfall fluctuation. It confirms that urban recharge process in Yogyakarta city has less significant impact on groundwater level rather than precipitation recharge. In addition, there is a possibility of localized recharge occurs especially in an old residential study area.

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Concentration and spatial distribution of heavy metals in groundwater of Kasihan, Yogyakarta, Indonesia

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Keywords: anthropogenic activities; contamination; spatial distribution; heavy metals

Abstract

Groundwater contamination by heavy metals is a ubiquitous problem, especially in developing countries like Indonesia. Determination of heavy metals content in groundwater is an effective method that provides information about the status of groundwater quality and the level of concentration of potential contaminants. This approach helps in groundwater conservation and quality management. This study determined heavy metals (Cu, Fe, Mn, Cd and Zn) concentration in the Kasihan sub-district in the Special Region of Yogyakarta, Indonesia. Moreover, the spatial distribution of physicochemical properties of water and the concentration of heavy metals were delineated. In addition, secondary land use data were analysed using GIS software to determine major anthropogenic activities in the research area. Laboratory analysis of groundwater showed a low concentration of the heavy metals targeted. However, the evaluation of land use and land cover indicated a rapidly urbanising region. This finding suggests a high probability of contamination in the future. Thus, future researchers should assess other contaminants with different methods because the area investigated is highly susceptible to pollutants.

1. Introduction

Groundwater contamination by heavy metals is widespread among most developing countries due to over-extraction and lack of proper groundwater management implementations. Heavy metals such as Fe, Cu, Cd, Zn and Mn in groundwater are sometimes harmful to humans, even at low concentrations. Groundwater contamination in big cities is due to several contaminant sources and the complexity of recharge pathways at the same time. Unfortunately, except for point source contamination, such as industrial sources, it is challenging to determine dominant sources of contaminants in urban areas, such as domestic and industrial wastewater [2]. Anthropogenic activities such as farming and urbanisation can significantly impact groundwater resources, especially in areas with a large population and agricultural activities. Human activities and land use type could substantially affect groundwater [4].

Previous studies conducted in Pandak and Bambanglipuro, Yogyakarta Special Province, Indonesia, revealed that the two primary sources of nitrate in the research area were chemical fertilisers and leakage of household wastewater from septic tanks (or faecal coliform). Previous studies observed a high pollution source index in the Kasiahn sub-district [5]. Therefore, the quantity and fate of the contaminants released are determinant factors contributing to groundwater contamination in Kasihan, Bantul Regency. However, regarding those scientists' findings, it was observed that the research conducted was not in detail or enough because they only analysed a few groundwater samples in Kasihan. Heavy metals concentration has not been considered in this study area. Therefore, this study conducts a thorough analysis of heavy metals (Fe, Zn, Mn, Cu, P& Cd) concentration in the groundwater of Kasihan. This study is crucial to understanding groundwater quality, and the result of the finding may act as the first step in solving water quality problems in this region.

2. Geology and Hydrogeology of the Study Area

Bantul Regency, which is also the location of the Kasihan sub-district, is in the central portion of the Yogyakarta Special Province. Kasihan sub-district is located in the central portion between the Opak and the

Progo River. The geology of the central part consists of alluvium, young volcanic product and the Sentolo formation, which predominantly consists of fine limestone and marl. Rocks and soils in the Yogyakarta Special Region, including Bantul Regency, were formed during the Tertiary and Quaternary periods [7]. The Sentolo Formation age is the Early Miocene to the Pliocene, and the alluvial deposits are Quaternary age [3].

The eastern and northern parts of the Kasihan district in Bantul Regency could be classified as part of the Merapi Aquifer System (MAS) or the Quaternary alluvial deposits (Qa) [5]. The area comprises a multi-layered aquifer system with relatively homogeneous and related hydraulic properties. The transmissivity of aquifers ranges from 894-1,400 m2/day and specific yields of 22-28.8% [1] [6].

3. Research Methodology

3.1 Sampling and laboratory analysis

A stratified sample grid map was developed to determine the physicochemical properties of groundwater in the field. The distance from sampling points was set at 950m, and the interval was almost constant throughout the study area. The sampling points map was synchronised with the QGIS INPUT tool. This technique made data collection and management very easy by simply recording all samples point with a mobile phone and synchronising them with INPUT int a computer. Initially, for collecting the physicochemical properties of water from various wells, 44 sample points were plotted in the study area with an interval of 950m. The spatial distribution of sample points in the study area was created with GIS.

With the aid of the stratified sample grid map, we carefully measured the depth of groundwater, hydrogen ion concentration(pH), electrical conductivity (EC), total dissolved solids (TDS) and temperature (T) of groundwater in the study area. After determining the spatial distribution of the physicochemical properties of groundwater by kriging interpolation with ArcGIS software, groundwater samples for laboratory analysis were then collected from 31 wells with an interval of approximately 1000m (i.e., 1 km × 1 km).

Thirty-one (31) groundwater samples were analysed for heavy metals concentrations in the Laboratorium Pusat Geologi at the geological engineering department of Gadjah Mada University. The laboratory task lasted for one month. Laboratory equipment, including beaker, Erlenmeyer flask, pipette, dropper, jars, and water test tubes, was used and adequately cleaned during and after each task. The 31 groundwater samples were analysed for five heavy metals, including Fe, Mn, Cu, Zn, and Cd. During the analysis, each sample was run three (3) times to ensure the accuracy of the results. The heavy metals absorbances from the atomic absorption spectrophotometry (AAS) were determined against the standards for each metal. For further analysis, the heavy metals concentrations were then calculated in parts per billion (ppb) and converted to parts per million (ppm).

4. Results and Discussion

Raster land use and land cover maps of the Special Region of Yogyakarta were obtained from the United States Geological Survey and ArcGIS Living Atlas. The data were further processed in QGIS to obtain the land use and land cover maps of Kasihan. Land use and land cover of 2017 and 2021 were analysed to observe the land cover changes over the past five years. This analysis was necessary to see how human activities have impacted the Kasihan district in the past years to infer how the changes can also affect the groundwater system. The land use and land cover results showed a 2% increase in settlement and rice fields. Conversely, bare ground and rangeland observed a 2% decrease in tress or forest cover.

This study analysed six metals, including iron, copper, manganese, zinc, cadmium, and lead. However, no lead (Pb) concentration was detected in all groundwater samples analysed. In wells with sample ID SW1, SW8, and SW39, we recorded 0.165 ppm, 0.115 ppm, and 0.139ppm of manganese concentrations. The highest concentrations of iron noted were 0.146 ppm, 0.050 ppm, and 0.049 ppm on wells with codes SW38, SW9 and SW39, respectively.

Fortunately, all groundwater samples yielded low heavy metals concentrations. No real danger or a higher concentration above the Indonesian standard for drinking water was detected.

5. Conclusion and Recommendations

Land use and land cover analysis results from 2017 to 2021 suggest that Kasihan is rapidly urbanising. As a result, there is an increased loss of trees (2% since 2017), bare ground and rangeland. Meanwhile, we observed increased built area and rice fields (a 2% increase in 2021 for both). So, it is predicted this could add more pollutant load to the area. These findings indicate that the study area will influence groundwater contamination aside from lithology and groundwater depth.

According to the laboratory analysis result of the 31 groundwater samples, the heavy metals' concentration was insignificant. Lead was even below the detectable limits. Overall, the concentrations of heavy metals (Mn, Cu, Zn Fe and Cd) analysed were mainly below the threshold values based on the Indonesian water quality standard.

Human actions may lead to a significant decrease in groundwater recharge from precipitation. Instead, the recharge will be predominantly from the water supply or mains and wastewater from anthropogenic activities. Therefore, groundwater resource protection should be implemented or enforced immediately.

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A Preliminary Volcanological Study of North Eastern Kaba Volcano, Bengkulu Province, Indonesia

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Keywords: Geology; Stratigraphy; Geochemistry; Volcanoes; Mount Kaba.

Abstract

Mount Kaba is an active volcano located in the eastern part of Bengkulu Province. This research was conducted at the Gunung Kaba Complex because the location of the distribution of the last eruption was close to several monogenetic volcanoes and residential areas. This is interesting to study considering that it can become a potential disaster threat. The research methods used include geomorphological, stratigraphic, petrographic, and geochemical analysis. Geomorphological units in the study area consist of 7 units. Geomorphological and stratigraphic analysis of the volcano divides the research area into 2 different khuluk, namely the khuluk of Danau Mas and the khuluk of Kaba. The khuluk of the Danau Mas consists of 3 gumuk while the khuluk Kaba consists of 1 gumuk. Based on petrographic analysis of 10 samples, the names of the rocks in the study area are scoria basalt, basalt, and andesite. The research area in general can be divided into 8 geological units. Based on the geochemical analysis of 15 samples against the TAS (Total Alkali Silica) diagram, it is known that the igneous rocks in the study area consist of andesite, basaltic andesite, trachyandesite, basanite/tephrite, basalt and dacite. Magma in the study area undergoes a differentiation process that changes the composition of magma from basaltic to andesitic-dasitic. This shows the explosive level of magma which tends to increase along with the increase in SiO_2 content. Meanwhile, the increase in the content of K_2O+Na_20 causes the emergence of a new magma series that is different, namely Basanite/Tephrite which also has a higher affinity, namely the alkaline series. The samples from the khuluk kaba tend to belong to the high-K calc-alkaline series while the samples from the khuluk danau mas vary from the calc-alkaline series, high-K calc-alkaline series to the alkaline series.

Application Sentinel 2 Image Data to predict some Water Quality Parameters in Pit Lake, South Sangatta

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Keywords: Partial Least Square Regression, Pit Lake, Sentinel 2, Water Quality Parameters,

1. Extended Abstract

Every mining activity especially those using open pit method will changes the nature appearance massively. The significant change is the forming of pit lake which accommodates surface and groundwater around the mining area. Water quality monitoring from pit lake become a challenging research problem. Apart from monitoring and assessing water quality that required large amount of money and human resources, manual monitoring only covers a small area. This paper aim to evaluate applicability of Sentinel 2 images to detect some water quality parameters from one of pit lake in South Sangatta. Using six samples field measurements which 7/3/2018 [1] and combine with Sentinel 2B multispectral image which acquired of 4/3/2018. The water quality parameters obtained from data used in this study are pH, Conductivity, Dissolved Oxygen (DO) and turbidity. Water quality approach is done by looking for bands of images that have significant correlation with this value. The significance between the reflectance and the field measurement value is known from the p-test, t-test and pearson analysis. Furthermore, those significant bands used to process the regression analysis to build up the equation. The final step of this study is testing accuracy relations between the parameters and the images reading using Root Mean Square Error (RMSE) and determination coefficient (R2).

2. Study Area

This study located in ex-J void Jupiter coal mining PT Kaltim Prima Coal (PT KPC) South Sangatta, East Borneo. This concession is laying between latitudes 0°31′20.52″– 0°52′4.60″ N and longitudes 117°27′7.40″–117°40′43.40″ E extending over area exceeding 84.928 Ha. The pit lake itself has elongated shape about 3500 m, 1500 m in width and depth about 152 m.

3. Data and Methodology

Water Samples taking from 6 locations in pit lake water body (Figure 1). The water quality parameters obtained from data used in this study are pH, Conductivity, Dissolved Oxygen (DO) and turbidity [1]. This data ware used to validate an accuration simple algorithm to retrieve water quality parameters.

This study using Multi-Spectral Instrument (MSI) Sentinel 2B Top-Of-Atmosphere (TOA) Level-1C image were obtained from the European Space Agency (ESA) via US Geological Survey Earth Resources Observation and Science Centre (EROS) site (http://earthexplorer.usgs.gov). Acquisition data of 4/3/2018 with less than 10% cloud coverage. This image has 13 bands that include aerosol band, visible to shortwave infrared spectrum.

3.1. *Preprocessing Image*

To achieve a good result when working with satellite imaginary which using visible to shortwave infrared spectrum to observes the surface of the earth, the important step is atmospheric correction. This correction aim to get the real reflectance value of the surface earth. In this study, atmospheric correction process was executed using plugin Sen2Core 2.10 which downloaded from ESA site (https://step.esa.int/main/snap-supported-plugins/sen2cor/sen2cor-v2-10/).

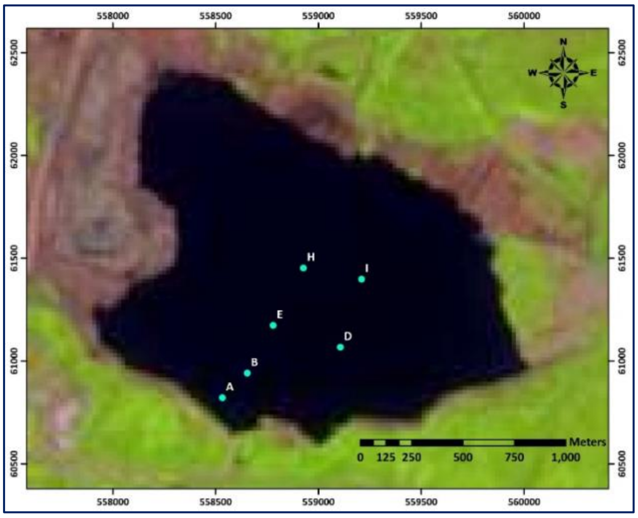

Figure 1. Location map of water samples

3.2. *Extracting Water Body*

Extracting water body of pit lake purpose to get water body boundaries and the statistical analysis can just applied on the water body. In order to this, Normalized Difference Water Index (NDWI) which was developed by McFeeters (1996) [2] was used to get the line. The output was a range -1 to +1. Water has a positive value while non-water (vegetation and soil) gets the negative ones.

3.3. *Statistical Analysis*

The first statistical analysis like t-test, p-test and pearson applied to get known strong correlation between reflectance value of bands with water quality parameters. From these tests, will be obtains bands which use to develop the mathematical algorithm to approach of water quality parameters. The mathematical algorithms used is Partial Least Square Regression (PLSR). The final step is validated field data with estimated data from remote sensing analysis before. The validation methods which used in this study are Root Mean Square Error (RMSE) which developed by Nevitt & Hancock (2000) [3] and coefficient determination (R^2). RMSE purpose to measure how far predicted value are from filed data (observed value) in regression analysis, while R^2 explain to how much goodness of fit from model parameters.

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Analysis on Geodynamic History of Aceh Special Province Indonesia based on Igneous Rocks Lithogeochemistry Data

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Keywords: Geodynamic history; lithogeochemistry data; Aceh province.

1. Extended Abstract

Aceh Province is located on the northern tip of Sumatra Island, which has experienced long tectonic history that represents the major part of the formation of Sumatra island. Aceh province is composed of several terrane blocks such as the Sibumasu block in the east, the West Sumatra block in the middle, and the Woyla block in the west [1][2][3]. The existence of the terrane block has contributed to the important information in the tectonic activity that develops in Aceh Province through the distribution of igneous rock [3]. Research on the history of tectonic activity and magmatism in Aceh Province is rare. This is what underlies the researcher to study the geodynamic history of Aceh province by using igneous rocks lithogeochemistry data from various literature sources. This study started with data compilation and building a database from lithogeochemistry data for the entire Aceh Province.

The datasets were managed in a database using a specially designed database schema to simplify the process of storing and processing data [4]. We collected a total of 122 igneous rocks lithogeochemistry data for the entire province of Aceh and after data quality consideration, we used 115 data, including 51 from Pleistocene, 1 from Pliocene-Pleistocene, 42 from Miocene, 5 from Eocene, 1 from Paleocene, 3 from Cretaceous and 11 from Jurassic-Cretaceous. The results show that magmatism activities have taken place since the Jurassic period and are still active today. The spatial distribution of igneous rocks shows a pattern of change from west to the north with the oldest concentration of igneous rock distribution in the west and then the youngest in the north.

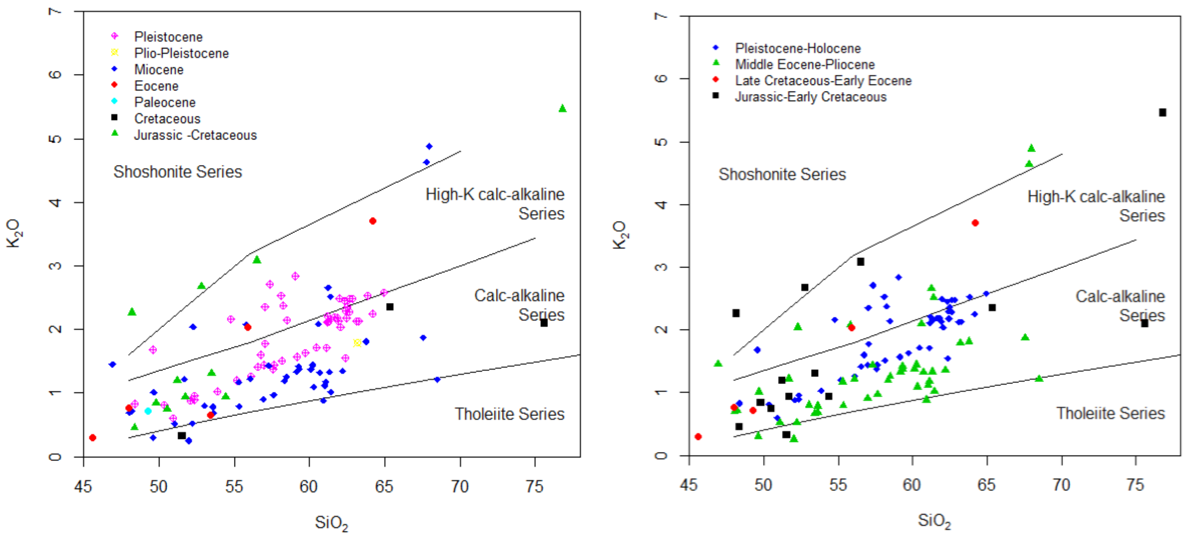

Figure 1. (a) K2O vs SiO2 plot of igneous rocks lithogeochemistry data by epoch (Pecerrillo and Taylor, 1976); (b) K2O vs SiO2 plot of igneous rocks lithogeochemistry data by periods (Pecerrillo and Taylor, 1976)

The results of the analysis of igneous rocks lithogeochemistry data show that igneous rocks in Aceh Province have different characteristics of magma affinities at each epoch but overall show a repetitive pattern of changes in magma composition from low-K tholeiitic to calc-alkaline and high-k calc-alkaline series. This repetition reflects the existence of several cycles of subduction that have occurred in Aceh Province since the Jurassic period. We estimate the periods of subduction cycles that occurred in the Aceh Province as 4 periods such as Jurassic-Early Cretaceous, Late Cretaceous-Early Eocene, Middle Eocene-Pliocene, and Pleistocene-Holocene periods.

From our current study results, we conclude that Aceh Province experienced several cycles of subduction to continental collision events. The last and still going on subduction started in early Tertiary and still active today that produce several Quaternary volcanoes in the northern parts of the study area.

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Contaminants in Groundwater at Jatibarang Landfill of Semarang City

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Keywords: Groundwater; contaminants movement; leachate

Abstract

The Jatibarang Landfill (*TPA Jatibarang*) has been operating since 1993. It functions to store the waste from all regions in Semarang City. Its main issue is related to leachate which may seep into the soil and then contaminate groundwater if it is not managed well and properly. The waste volume is increasing from time to time in a limited area, and the landfill has been more than 20 years. Meanwhile, there is the Kreo River which flows on the east side of the landfill which is used as the source of raw water for drinking. So it is important to study the presence of contaminants in groundwater at the landfill site. This research aims to identify the presence of conservative and non-conservative contaminants in groundwater to evaluate the effectiveness of current landfill management in preventing groundwater contamination. The research uses geological survey, hydrogeological survey, groundwater quality, river water, and leachate testing, as well as analysis of primary and secondary data. This research is expected to know the hydrogeological conditions at the Jatibarang landfill and the concentration of conservative contaminants (Chloride or Cl^-) and non-conservative contaminants (heavy metals (Manganese or Mn and Lead or Pb) and Total Organic Carbon (TOC)). The results show that hydrogeologically in Jatibarang landfill and its surroundings are composed of tuffaceous sandstone and volcanic breccias. The values of Cl^- and Pb in the groundwater in the Jatibarang landfill office area are higher than in zone 4. The Mn and TOC values are higher in zone 4 than in the landfill office area. This means there should be a deeper evaluation of the leachate seepage into groundwater and better landfill management to protect groundwater quality.

1.1. Introduction

The Jatibarang Landfill *(TPA Jatibarang)* is located in Kedungpane Village, the Mijen sub-district of Semarang City. It covers an area of 46.0183 Ha, of which 27.64 Ha is used for waste disposal and processing sites[2]. There are settlements on the north side and the Kreo River on the east.The river is used as raw material for Municipal Waterworks *(PDAM)*. In 2020, the waste management is controlled landfill with the land is covered every two days but it only applies to some parts of, while some other lands still use an open dumping system[5].

Putrantro et al (2008)[4] found that the value of Cl^- in groundwater samples in the Jatibarang landfill area is 1765 mg/l, with a plume movement model ± 600 meters from northwest to southeast based on the direction of groundwater. They also predicted the value of Cl^- of 2500 mg/l in 2018. Purba and Kamil (2015)[3] studied the Pb level. They took five sample points from the north of the Jatibarang landfill. The findings showed that the Pb concentrations range from 0.0005 - 0.0042 mg/l. They predicted that in the next 50 years, the Pb concentrations might pollute groundwater. Meanwhile, there has not been any research that analyzes TOC and Mn movements in groundwater at the Jatibarang landfill. This research aims to identify the presence of conservative (Cl^-) and non-conservative (Mn, Pb, and TOC) contaminants in groundwater at the research site to see the effectiveness of current landfill management in preventing groundwater contamination.

1.2. Methodology

The research uses a geological survey include observations of lithology, morphology, geological structure, porosity and permeability tests; a hydrogeological survey covers the analysis of groundwater samples, and secondary data include climatologi data. The quality of groundwater, river water, and leachate for Chloride paramaters use the Ion Chromatography tool, the Mn and Pb parameters use atomic absorption spectrophotometer (AAS) tool, and the TOC parameters use Elementar Vario TOC tool. The groundwater samples are taken from two sites; the landfill office area and on the south side of zone 4. The river water samples are obtained from two locations, i.e. the sites before the Leachate Treatment Plant *(LTP)* and after the *LTP*. Meanwhile, leachate samples are taken from two sites, namely at the *LTP* inlet and zone 4 leachate puddles.

1.3 Results and Discussion

The results of the geological surveys show that the hydrogeologically in the Jatibarang landfill and its surroundings areas are composed of tuffaceous sandstone and volcanic breccia with the slope of rock layers to the south. Test results of porosity and rock permeability test indicate that the porosity value of volcanic breccias start from 1,279% – 3,181%, tuffaceous sandstone start from 5,172% – 23,706%, the permeability values of volcanic breccias start from 17,883 mD – 31,902 mD, and tuffan sandstone values ranges from 23,239 mD – 43,097mD. Based on the Hydrogeological Map of Semarang City and Surroundings Areas[1], the types of aquifer at the site include flows through fissures and spaces among particles, and productive aquifers with local distribution, which generally have a deeper groundwater levels.

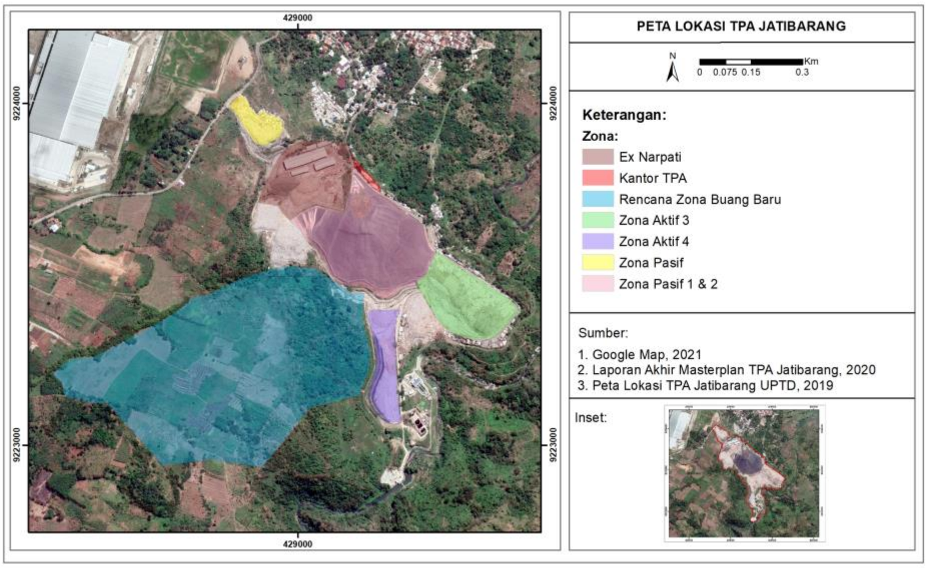

Figure 5. Map of Jatibarang Landfill (Technical Implementing Service Unit (UPTD) of Jatibarang Landfill, 2020)

Based on data in 2018, the waste disposal zone in Jatibarang landfill is divided into 4 zones (see Figure 1). The current active zones are zone 3 and zone 4, while the passive zones are in zone 1 and 2. They are covered with a membrane layer and are used as electrically generators for the Waste Power Plant *(PLTSa)*. Zone 4 (a new exhaust zone built in 2017) already has a geomembrane, covering an area of 1.5 Ha. However, in zone 1, 2, and 3 there is no geomembrane[5]. The results of the groundwater quality test show that the value of Cl^- and Pb at the landfill office area is higher than zone 4. The Mn and TOC values are higher at zone 4 point than at the landfill office area (can be seen in Table 1). The zones that do not yet have geomembrane enable potential leachate to enter groundwater. Although zone 1 and 2 are no longer activated, the accumulation of previous garbage can influence the entry of leachate into groundwater.

Table 1. Results of Analysis Chloride (Cl-), Manganese (Mn), Lead (Pb), and TOC

Parameters	Leachate		Groundwater		River Water	
	LTP inlet	Zone 4	Office area	Zone 4	Before the LTP	After the LTP
Cl^- (mg/l)	1299.20	2251.29	962	122.98	3.97	7.93
Mn (ppm)	0.241	0.323	0.037	0.278	0.007	0.003
Pb (ppm)	0.030	0.027	0.007	0.003	0.003	0.003
TOC (mg/l)	182.2	348.1	9.645	17.64	2.638	4.879

The drainage channel built in the Jatibarang landfill is located on the east side of the landfill parallel to the operational road from the beginning of the landfill office to zones 3 and 4. The drainage around the offices, warehouses and hangar are in good condition, but those lying around zones 3 and 4 filled with garbage and turned into leachate channels. On the southwest side of zones 1 and 2, no channels and barriers which separate them with green areas[5]. Even though zone 4 has been covered with geomembrane, but drainage channels filled with leachate can be a source of seepage of leachate into the groundwater. That is why the Cl^- and TOC values in the groundwater from the south side of zone 4 are still high.

1.3. Conclusion

The results show that hydrogeologically, the Jatibarang landfill and its surroundings were composed of tuffaceous sandstone and volcanic breccias. The contaminants identified in groundwater in the landfill office area and on the south side of zone 4 are affected by the distance from the waste disposal zone, the existence of the geomembrane layer, and the condition of the drainage channel. There must be a better and deeper evaluation of current landfill management to prevent or mitigate contaminants coming into the groundwater.

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