



p-ISSN 0854-1418

e-ISSN 2503-426X

Accreditation by the Directorate General of Higher Education,
Research and Technology No. 158/E/KPT/2021

EKSPLORIUM

Buletin Pusat Pengembangan Bahan Galian Nuklir
Bulletin of the Center for Nuclear Minerals Development

Volume 44 No. 1, May 2023



DIRECTORATE OF REPOSITORIES, MULTIMEDIA, AND SCIENTIFIC PUBLICATION
NATIONAL RESEARCH AND INNOVATION AGENCY

EKSPLORIUM	Volume 44	No. 1	Pages 1-48	Jakarta May 2023	p-ISSN 0854- 1418 e-ISSN 2503-426X	Accreditation No. 158/E/KPT/2021
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p-ISSN 0854-1418

e-ISSN 2503-426X

Accreditation by the Directorate General of Higher Education,
Research and Technology No. 158/E/KPT/2021

EKSPLORIUM

Buletin Pusat Pengembangan Bahan Galian Nuklir
Bulletin of the Center for Nuclear Minerals Development

Volume 44 No. 1, Mei 2023

Eksplorium, the Bulletin of the Center for Nuclear Minerals Development, is a scientific journal which contains the results of studies, research, and development of nuclear geology with the scope of geology, exploration, mining, processing of nuclear minerals, and environmental safety as well as the development of nuclear technology for people's welfare. **Eksplorium** published 2 (two) times a year, in May and November.

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Photo caption: Tortoise shell joints on phonolitic lava of Adang Volcanics
observed by Professor Sutikno Bronto (Contributor: Frederikus Dian Indrastomo)

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DIRECTORATE OF REPOSITORIES, MULTIMEDIA, AND SCIENTIFIC PUBLICATION
NATIONAL RESEARCH AND INNOVATION AGENCY

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Telp. 081 110 646 830, E-mail: eksplorium@brin.go.id

Website: <http://jurnal.batan.go.id/index.php/eksplorium>

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Buletin Pusat Pengembangan Bahan Galian Nuklir
Bulletin of the Center for Nuclear Minerals Development
Volume 44, No. 1, May 2023

FOREWORD

Dear Readers,

This edition of **Eksplorium** contains five (5) research articles from various fields. The first paper describes northern Sumatra's regional tectonic with titled "Tectonic Structures of Northern Sumatra Region Based on Seismic Tomography of P and S Wave Velocity." The second paper is about the magmatic evolution of special volcanic features titled "Magmatic Evolution of Dago Volcano, West Java, Indonesia". The third paper discusses groundwater pollution, titled "Characteristics of Nitrate Pollution in Shallow Groundwater on the South Slope of Mount Merapi, Yogyakarta, Indonesia". The fourth paper is about the environmental impact of mining activities with titled "Prediction of Potential Acid Mine Drainage Formation in High Sulphidation Epithermal Deposit Using Geochemical and Mineralogy Approaches." The last paper is about the laboratory research on fly ash for acid mine drainage, with titled "The Effect of Fly Ash Ratio Addition as Layering Material Using Free Draining Column Leach Test Method in Laboratory Scale."

We believe that **Eksplorium** can benefit readers, especially in developing insights into nuclear minerals technology, including geology, mining, processing, and the environment.

Editor in Chief

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Tectonic Structures of Northern Sumatra Region Based on Seismic Tomography of P and S Wave Velocity

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Article received: 11 January 2023, revised: 25 May 2023, accepted: 30 May 2023

DOI: [10.55981/eksplorium.2023.6784](https://doi.org/10.55981/eksplorium.2023.6784)

ABSTRACT

The tectonic setting of Sumatra Island is strongly influenced by the oblique subduction of the Indo-Australian Plate, which subducts the Eurasian Plate at a speed of 52–60 mm/year. The movement of these plates resulted in the Northern Sumatra region having seismic sources from tectonic and volcanic activity. The data used in this study is in the form of seismic wave travel-time recorded by numerous seismic stations in the research area from January 2012 to December 2020. The data comes from 5,003 earthquakes recorded by the BMKG seismic network. The inversion is a simultaneous inversion between seismic velocity models (V_p and V_s) and hypocenter parameters by applying a double-difference seismic tomography algorithm. Tomogram results in parts of Aceh (Singkil and Subulussalam) and North Sumatra (Pakpak Bharat and Dairi) at a depth of 0 km show negative perturbations in V_p and V_s values and high V_p/V_s values. The anomaly is most likely related to cracks in fluid-saturated rocks. The tomograms in the south of Lake Toba at depths of 30 km and 40 km have high V_p and V_s perturbation values and low V_p/V_s values. This anomaly indicates a magma supply line that is no longer active or has cooled for a long time. Based on the seismic tomography modeling results, the subducted Indo-Australian Plate to the Eurasian Plate is visible in the study area.

Keywords: Northern Sumatera, seismic tomography, double difference, V_p , V_s , V_p/V_s .

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Magmatic Evolution of Dago Volcano, West Java, Indonesia

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Article received: 29 April 2023, revised: 14 May 2023, accepted: 31 May 2023

DOI: [10.55981/eksplorium.2023.6873](https://doi.org/10.55981/eksplorium.2023.6873)

ABSTRACT

Dago Volcano is a product of Miocene Sunda Arc volcanism located southeast of the capital city of Jakarta. The morphological change from flat lava flows to steeper lava morphology implies a process of magma evolution under Dago Volcano. This research provides an overview of the magma evolution that occurs on this volcano. The methods used include volcanostratigraphy analysis, petrographic analysis, mineral chemistry, and whole-rock geochemistry. The volcanostratigraphy of Dago Volcano is composed of two eruption centers and a flank eruption forming lava and cinder cone products. The mineralogical associations of Dago Volcano products include plagioclase, olivine, and clinopyroxene. The mineral textures of Dago edifices show zoning, sieve, and reaction rims textures. Geochemically, the Dago Volcano product has a magma affinity of med-K calc-alkaline with quite high levels of MgO, Ni, and Cr approaching the characteristics of primitive magma. The magma evolution process of Dago Volcano includes fractional crystallization and magma mixing which originates from the same magma source.

Keywords: Dago Volcano, magmatic evolution, primitive magma, volcanostratigraphy

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Volume 44, No. 1, May 2023

Characteristics of Nitrate Pollution in Shallow Groundwater on the South Slope of Mount Merapi, Yogyakarta, Indonesia

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Article received: 1 May 2023, revised: 25 May 2023, accepted: 31 May 2023

DOI: [10.55981/eksplorium.2023.6876](https://doi.org/10.55981/eksplorium.2023.6876)

ABSTRACT

Groundwater is the primary clean water source for most Indonesian society. The increasing use of groundwater is inevitable due to the rapid development in Indonesia, particularly in Yogyakarta. Shallow aquifers are vulnerable to contamination due to anthropogenic influences. Therefore, this research aims to determine shallow groundwater's physicochemical and chemical characteristics on the southern slope of Mount Merapi, specifically focusing on nitrate and chloride concentrations in groundwater. This research collected monthly data from eighteen dug wells or springs and rainfall data in the study area during the rainy and dry seasons from August 2022 to January 2023. The analyzing sample used argentometry to determine chloride concentration and ultraviolet spectrophotometric to determine nitrate concentration in Yogyakarta Environmental Health and Disease Control Technical Center (BBTKLPP) laboratory. The physicochemical parameters were tested directly in the field using Hanna instruments. The results indicate that a significant portion of shallow groundwater has high nitrate concentrations, corresponding to the growing settlements in the research area. Furthermore, according to the comparison graph between nitrate and chloride, the nitrate source was indicated as anthropogenic. Fecal matter from sanitation practices using septic tanks will likely influence the nitrate increase.

Keywords: Mount Merapi, shallow groundwater, nitrate pollution, anthropogenic.

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Buletin Pusat Pengembangan Bahan Galian Nuklir
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Volume 44, No. 1, May 2023

Prediction of Potential Acid Mine Drainage Formation in High Sulphidation Epithermal Deposit Using Geochemical and Mineralogy Approaches

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Article received: 16 August 2022, revised: 8 December 2022, accepted: 31 May 2023

DOI: [10.55981/eksplorium.2023.6652](https://doi.org/10.55981/eksplorium.2023.6652)

ABSTRACT

Identification of acid mine drainage (AMD) can be predicted using a geochemical and mineralogy characterization approach to identify rocks forming and neutralizing acids. Geochemical characterization was conducted using static and kinetic tests. The static test is the first step to determining the potential for acid formation in rocks by comparing the potential for forming and neutralizing acids, which are characterized by uncertain behavior that causes predictions to be inaccurate. Kinetic tests were carried out to predict the long-term acid-producing potential better. Furthermore, mineralogical characterization is needed to assess the importance of sample mineral content in predicting AMD. Tests were conducted on rock samples from high sulfidation epithermal (HSE) deposits in North Sulawesi, Indonesia. The samples represent the different geological domain conditions found in HSE deposits. The main acid-producing components are pyrite and secondary minerals (alunite) capable of buffering acidity. The results showed a lower change in leachate pH (from day 30 to 180) and were accompanied by the release of species (high dissolved metals).

Keywords: AMD, geochemical, mineralogy, HSE, pyrite, alunite, leachate pH.

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Buletin Pusat Pengembangan Bahan Galian Nuklir
Bulletin of the Center for Nuclear Minerals Development
Volume 44, No. 1, May 2023

The Effect of Fly Ash Ratio Addition as Layering Material Using Free Draining Column Leach Test Method in Laboratory Scale

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Article received: 3 October 2022, revised: 24 December 2022, accepted: 31 May 2023

DOI: [10.55981/eksplorium.2023.6707](https://doi.org/10.55981/eksplorium.2023.6707)

ABSTRACT

Acid mine drainage (AMD) is formed due to the oxidation of sulfide minerals in the presence of water and air. AMD already entering the environment can damage the aquatic ecosystem due to low pH and high dissolved metal concentrations. Efforts to prevent the formation of AMD are by regulating the stockpiling of materials containing sulfide or potential acid forming (PAF) with non-acid forming (NAF) to avoid oxidation reactions of sulfide minerals. The purpose of this study was to simulate the effect of adding fly ash ratio as a PAF rock coating material to the quality characteristics of leachate using the laboratory-scale free draining column leach test (FDCLT) method. Adding fly ash ratio as a layering material significantly affects the quality of the resulting leachate. This is due to the physical condition of the fly ash material, which cannot prevent the meeting of AMD-forming components.

Keywords: Acid Mine Drainage, Fly Ash, Free Draining Column Leach Test.
