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MUSEUM REPORT

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ACKNOWLEDGEMENT

We would like to express our sincere gratitude to MSc. Dong Uyen Thanh for her guidance and support during our study at the Ho Chi Minh City Geological Museum. Through her lectures and explanations, we gained not only theoretical knowledge but also practical insights into rocks, minerals, and the broader concepts of geology. The detailed stories and real-life examples she shared helped us better understand the subject and connect classroom knowledge with real-world applications.

The experience at the museum has provided us with valuable resources for future projects and strengthened our awareness of the Earth, encouraging us to care for and protect it. In this report, we have done our best to apply the lessons and knowledge received from Ms. Thanh, along with additional reference materials. Despite our efforts, some minor errors in grammar or understanding may remain.

Once again, we sincerely thank MSc. Dong Uyen Thanh for giving us the opportunity to learn through such a meaningful and practical experience.

1 INTRODUCTION

1.1 The urgency and objective of the topic

In the distant past, meteorites of enormous size flew through the Earth's atmosphere and crashed into our planet; these collisions vaporized mineral fragments from the ground and sent them into the sky. The molten minerals floated in the air like sparkling raindrops, each one traveling thousands of kilometers before falling back to the ground. Even further back, the collision of two hot celestial bodies caused the formation of the Earth and the Moon as we know them today, with the Earth carrying a multitude of minerals within it. After millions of years buried under layers of rock, these shiny mineral fragments occasionally rose to the surface to tell of the vastness of the Earth and the immensity of time.

Geology is the study and combination of knowledge about how rocks form over thousands of years, how fascinating gemstones can be created under pressure and temperature, how minerals are formed, and also about fossils and geological heritage. The Earth was formed about 4.6 billion years ago, so there must be beautiful formations of rare rocks, or even gemstones hidden somewhere within the Earth. Therefore, learning about the theory of rocks and minerals through books will only get us halfway through the actual knowledge of Earth geology. As President Ho Chi Minh taught us: "Learning must go hand in hand with practice. It is useless to study without practice; if you don't learn, you won't be fluent."

Therefore, we went on a trip to visit the Ho Chi Minh City Geological Museum as part of a learning activity, to practice observing and understanding the geological history of Vietnam, with the formation of rocks, ores, minerals, and even gemstones.

1.2 Objectives of the museum visit

Figure 1.1: Ho Chi Minh City Geological Museum

The visit to the Ho Chi Minh City Geological Museum provided us with a valuable chance to connect the theories we learned in class with real-world examples. While books and lectures give us the foundation of geological knowledge, nothing compares to directly observing the specimens that reflect millions, even billions, of years of Earth's history. At the museum, we could see how rocks, ores, minerals, and gemstones are preserved and displayed, each telling a story about the planet's formation and transformation over time.

This experience not only strengthened our understanding of the processes that shape the Earth but also gave us a clearer view of Vietnam's own geological heritage. By exploring these collections, we were able to develop a deeper appreciation of geology as both a science and a record of natural history. More importantly, the museum visit allowed us to practice critical observation, linking theory with practice, and to better prepare for future studies and projects related to Earth sciences.

2 General history about Ho Chi Minh City Geological Museum

The Geological Museum has a long history closely tied to the development of geological research in Vietnam since the colonial period. In 1898, the French colonial government established the Indochina Geological Service (Service Géologique de l'Indochine) and initiated the construction of a museum dedicated to geological research and education. By 1914, the museum's first building was completed in Hanoi. After the Geneva Agreement in 1954, part of the collection was moved to Saigon, where it was initially displayed in a temporary villa before being relocated to its current building in 1973. Following national reunification, the museum was managed by the Southern Geological Mapping Federation and continued to expand within the national geological system.

In 2001, it became one of the first museums in Vietnam to be recognized by the International Council of Museums (ICOM). In 2003, the Geological Museum system was restructured under the Department of Geology and Minerals, and in 2008, the Ho Chi Minh City branch was officially integrated as the southern division. Today, the Geological Museum stands as Vietnam's national geological museum, operating under the Department of Geology and Minerals of the Ministry of Natural Resources and Environment.

The museum currently holds about 13,000 precious geological specimens, of which about 3,000 are on permanent display. Including geological drill cores and archived samples, the total number of specimens here is more than 20,000. The highlight on the ground floor (General Geology) is the 1:500,000 scale geological map of Vietnam completed in 1988. This large map shows the geological structure of the entire territory of Vietnam clearly annotated, very useful for visitors to learn about the diversity of resources and stratigraphy.

2.1 Report objectives and breakdown

This report will illustrate our visit to the Ho Chi Minh City Geological Museum, particularly focusing on Floor 1 and Floor 2. The first floor of the Museum will briefly introduce the geological evolution of Vietnam with the geological processes. On the second floor, we will demonstrate the fuel, metallic and non-metallic minerals, gemstones, mineral water and the concept of geological heritage. Throughout this report, we will organize the geological knowledge and our own experience to make this report more informative and easier to comprehend.

3 GENERAL GEOLOGY (The 1st Floor Room)

4 Geological evolution

The Earth has experienced a vast and dynamic history of about 4 billion years. This journey is divided into major geological eons and eras, each defined by important events such as the formation of the crust, shifts in the atmosphere, the rise of life, and tectonic movements. These processes become clearer when explored alongside physical specimens and visual displays, such as those presented at the Ho Chi Minh City Geological Museum.

4.1 Precambrian: 4 billion to 570 million years ago (600 million years)

4.1.1 Archean Eon (4.0–2.6 billion years ago)

It is one of the earliest chapters in Earth's history, when the crust stabilized, continents and oceans first formed, and simple life such as stromatolite-building cyanobacteria appeared, slowly altering the planet's atmosphere.

In Vietnam, Archean rocks are found in the Kon Tum geoblock, mainly within the Kan Nack Group. These 3,000-meter-thick metamorphic rocks show complex changes, from granulite facies to amphibolite and greenschist facies, revealing the intense geological processes that shaped the ancient Earth.

Figure 4.1: Sample of rock in Archean Eon

4.1.2 Proterozoic Eon (2.6 billion to 570 million years ago)

It saw the Great Oxidation Event, global ice ages called "Snowball Earth," and the rise of the first multicellular life, including the Ediacaran biota. These changes prepared the planet for the Cambrian explosion of life.

In Vietnam, rocks from the Proterozoic are found in areas like Red River, Fansipan, Chay River, Ma River, Phu Hoat, and Kon Tum. These include crystalline and metamorphic rocks as well as younger layers that lead into the Cambrian period. Some of these rocks contain fossils of tiny early life forms.

Figure 4.2: Sample of rock in Proterozoic Eon

4.2 Paleozoic Era (541 – 252 million years ago)

This era began with the Cambrian Explosion, a massive diversification of marine life. It is divided into six periods: Cambrian, Ordovician, Silurian, Devonian, Carboniferous, and Permian. During this time, ocean life expanded rapidly with animals like trilobites, corals, crinoids, brachiopods, graptolites, and cephalopods. Later, plants and amphibians colonized land. The era ended with the Permian-Triassic extinction, the largest known mass extinction, wiping out over 90% of marine species.

In Vietnam, marine sedimentary rocks with abundant fossils (e.g., corals, brachiopods, trilobites) are found in Northeast Vietnam, such as in Cao Bang and Ha Long Bay. The Truong Son (Annamite) Range began forming due to Caledonian and Hercynian orogenies. Many rocks from the Paleozoic Era can still be found today in regions like North Vietnam, Northwest Vietnam, Northeast Vietnam, and Central Vietnam, where the rocks are made of limestone and other sediments that contain fossils of trilobites, brachiopods, and corals.

At the museum, fossils of corals, mollusks, and petrified wood from areas like Truong Sa (Spratly Islands) and northern Vietnam are exhibited. Geological maps display Paleozoic strata across northern and central Vietnam.

Figure 4.3: Sample of rock in Paleozoic Era

4.3 Mesozoic Era (252 – 66 million years ago)

Known as the "Age of Dinosaurs," the Mesozoic saw the rise of reptiles, the breakup of Pangaea, and generally warm climates. It is divided into three periods: Triassic, Jurassic, and Cretaceous. This era is famous as the "Age of Reptiles," when dinosaurs, ammonites, and many other creatures lived, along with early plants and marine animals like bivalves and brachiopods. The era ended with the Cretaceous–Paleogene (K–Pg) extinction caused by the Chicxulub impact and Deccan volcanism.

In Vietnam, the Indosinian Orogeny uplifted the Truong Son Range and created sedimentary basins. Volcanic and sedimentary activity occurred in areas like Kon Tum, Son La, and Thanh Hoa. Fossil evidence of dinosaurs and ancient flora has been found in some localities. Mesozoic rocks are found in places such as An Chau, Da River, Hien River, and Southwest. Triassic rocks here contain fossils of ammonites, gastropods, plants, and bivalves. Later, during the Jurassic and Cretaceous, red continental rocks and coal-bearing formations appeared, especially in the North, while volcanic rocks developed in areas like Tam Lang and Tu Le. These layers preserve fossils that show how both land and sea environments changed during this era.

At the museum, basalt and volcanic sediment from this era are displayed in the "Magmatism" section. Fossils and stratigraphic profiles reflect the Mesozoic biosphere and tectonic events.

Figure 4.4: Sample of rock in Mesozoic Era

4.4 Cenozoic Era (66 million years ago to present)

This era features the evolution and dominance of mammals, birds, and eventually humans. Tectonic faulting, glaciations, and sedimentation shaped modern landforms and ecosystems. It is divided into three periods: Paleogene (66–23 million years ago), Neogene (23–2.6 million years ago), and the Quaternary (2.6 million years ago to today). This era is marked by great diversification of life, with many plants, mollusks, diatoms, ostracods, foraminifers, and vertebrates flourishing.

In Vietnam, major faults like the Red River and Song Ca faults influenced the formation of the Cuu Long (Mekong) and Red River basins, rich in oil and gas. The Quaternary Period (2.58 Ma - present) witnessed alternating glaciations and interglacials, forming the Mekong and Red River deltas through alluvial deposition. Cenozoic rocks are found in regions such as Northwest (Pu Tra, Nam Bay), South Central Coast, and coastal basins. Paleogene rocks are rare, but Neogene sediments are widespread, often containing coal, kaolin, bentonite, and diatomite. These layers also include volcanic rocks, lagoon and delta deposits, and shallow marine formations, preserving fossils that show the rich environments of Vietnam during this era.

At the museum, core samples of crude oil from the Cuu Long basin (collected in the

1980s) are on display. Sediment cores and alluvial rock samples reflect recent geological processes, showcased in the "Fuel Group" and sedimentary sections.

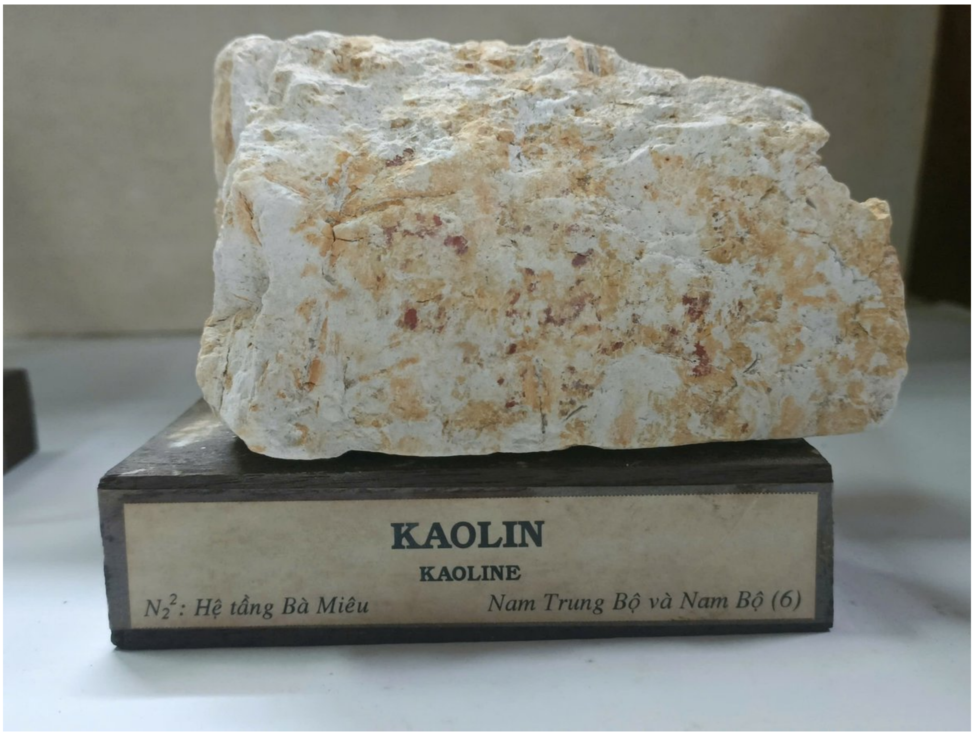

Figure 4.5: Sample of rock in Cenozoic Era

5 Geological Process

Geological processes are natural forces that continuously shape and alter both the Earth's surface and its interior. At the Ho Chi Minh City Geological Museum, visitors were introduced to six key geological processes through rock samples, models, and diagrams. These processes—ranging from extraterrestrial impacts to deep-earth activity and surface transformations—drive the creation, modification, and recycling of Earth's materials. The museum's exhibits illustrated how each process contributes to the formation of various rocks and landforms, highlighting the dynamic and interconnected system of the geological cycle.

5.1 Cosmic process

Although no meteorite samples were displayed during the visit, the cosmic process remains essential in Earth's geological history. It refers to extraterrestrial impacts, especially meteorites, which helped shape the early Earth. These collisions formed craters, altered surface rocks, and delivered elements like iron, nickel, and platinum - key components of Earth's crust and core. Despite the lack of exhibits, this process highlights the planet's cosmic origins and is widely studied through global meteorite discoveries.

5.2 Tectonic process

Tectonic processes involve the movement of the Earth's lithospheric plates. These dynamic movements are responsible for geological phenomena such as earthquakes, volcanic eruptions, mountain formation, and continental drift.

At the museum, this process was illustrated through global tectonic maps and a three-dimensional model of plate boundaries, showing the locations and interactions between major tectonic plates around the world. These materials effectively demonstrate how plates move and interact through different boundary types:

- Divergent boundaries, where plates move apart and new crust forms;
- Convergent boundaries, where plates collide, leading to subduction and mountain building;
- Transform boundaries, where plates slide past each other, often causing earthquakes.

The exhibit helps explain how these boundary interactions drive geological activity and continuously shape the Earth's surface.

5.3 Magmatic process

Magmatic processes are responsible for the formation of igneous rocks through the cooling and solidification of magma. These rocks differ in texture and composition depending on where and how quickly the magma cools.

In the museum exhibit, igneous rocks were organized into two main groups. Extrusive rocks, such as basalt and andesite, are formed from lava that cools quickly at the surface. Because the cooling is rapid, crystals don't have time to grow large, resulting in a fine-grained texture. Intrusive rocks, like granite and diorite, form deep underground where magma cools slowly over extended periods. This slow cooling allows large crystals to develop, giving the rocks a coarse, crystalline texture.

The museum displays showed how different cooling environments produce rocks with distinct characteristics, helping visitors understand the relationship between geological processes and rock formation.

Figure 5.1: Sample of intrusive igneous rock

5.4 Metamorphic process

Metamorphism happens when existing rocks undergo high heat, strong pressure, or interaction with reactive fluids, leading them to change into new rock types. At the museum, specimens like schist, gneiss, slate, quartzite, and marble were displayed, each representing different metamorphic environments.

One highlighted example was marble, which develops from limestone through contact metamorphism. The exhibit also included diagrams of metamorphic facies and processes, illustrating how different conditions drive these rock transformations.

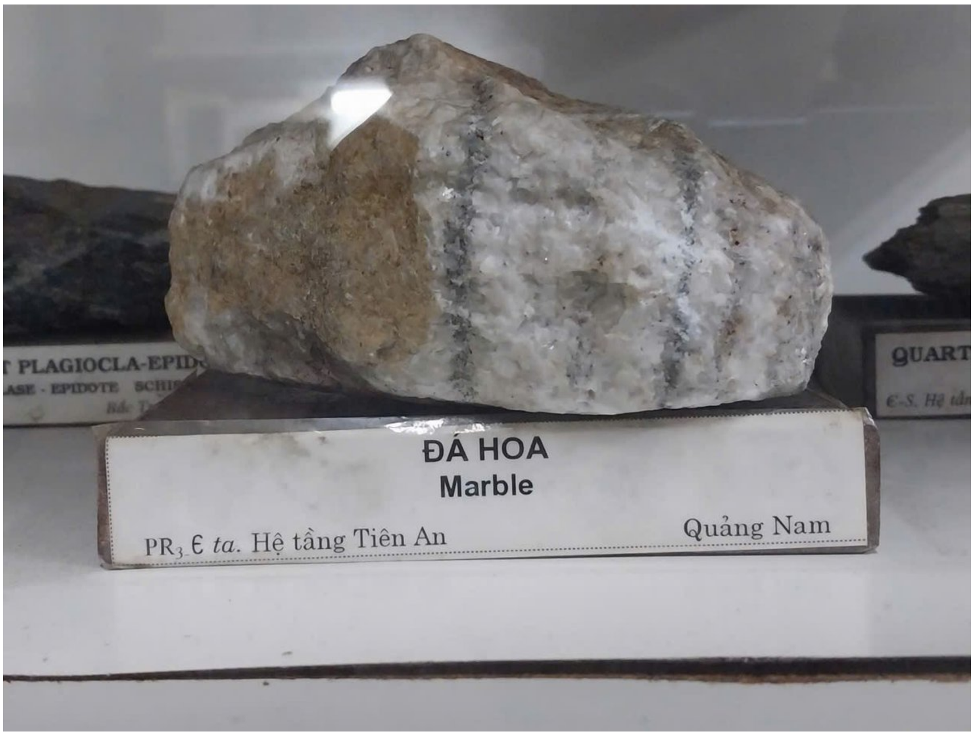

Figure 5.2: Sample of Marble

5.5 Sedimentary process

Sedimentary processes occur when materials from older rocks or biological sources are gathered, compressed, and cemented together, resulting in sedimentary rocks that typically show layered structures.

- Mechanical sedimentation produces rocks such as sandstone and conglomerate, created from the physical breakdown and accumulation of rock fragments.
- Chemical sedimentation is seen in rocks like limestone, which forms when minerals precipitate from water-rich solutions.

Figure 5.3: Sample of Mechanical sedimentation rock

5.6 Weathering process

Weathering is the natural process that breaks down rocks at Earth's surface through the effects of wind, rainfall, temperature changes, and chemical reactions. At the museum, this was demonstrated with diagrams and rock samples that showed how rocks are altered by different types of weathering.

Examples included mechanical weathering, such as rock fragmentation and exfoliation, and chemical weathering, like the oxidation of iron on rock surfaces. These displays highlighted weathering's important role in the rock cycle, as it produces loose sediments that can later compact and cement to form sedimentary rocks.

Figure 5.4: Sample of Bauxite

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