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The geointerpretation products for selected geosites in Ho Chi Minh City, Vietnam

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Abstract: *Geotourism can be seen as one of the sustainable tourism options attracting attention from both researchers and tourists. Urban geotourism is a niche of geotourism that mainly focuses on some topic related to the urban area that has a relationship with the geological features. Interpretation products for geosites and geoheritages play an important role in geotourism and urban geotourism development due to their role of explanation about the geological foundation of the destination. It can be viewed as a useful instrument for educating people of all ages about geology. Ho Chi Minh City contains many sites with unique geological features and offers enormous potential for urban geotourism. This sites include Geosite Dam Lay-Rung Sac Can Gio, which has the relationship between geology and archeology, biodiversity, and historical events; Geosite Dat Thep Cu Chi, with the geology foundation for the sustainable existing secret tunnels; and Geosite District 1, displaying iconic geological structures. However, there is a shortage of interpretation products to explain geological knowledge to visitors these days. This research aimed to create the interpretation products for some highlighted geosites in Ho Chi Minh City based on scientific and other value (including historical, ecological, archeological, and aesthetic value) of the selected geosite. The target audience of this interpretation product was tourists who were unaware of geological features and geology experts. It is clear that all the interpretation products belonged to the portable interpretative tools, including 2 types: 1) brochure; 2) booklet. Also, all the interpretations were created based on the concept of abiotic, biotic, and culture of the geosites. Raising geology awareness and developing a variety of geotourism offerings for tourists and geology enthusiasts were the goals of this interpretation proposal.*
Keywords: *geointerpretatio; geoproduct; geotourism; Ho Chi Minh City*

1. Introduction

Geotourism emphasizes the Earth's geological properties, which can foster environmental and cultural awareness, appreciation, and conservation, as well as local community involvement to boost the economy. Geotourism can be seen as sustainable tourism (Dowling, 2014). There are three major elements that are fundamental to geotourism, including geological-based (based on the Earth's geoheritage), sustainable (economically viable, community-enhancing, and geoconservation), and educative (achieved through geo-interpretation) (Dowling, 2014). Urban geotourism is a subset of geotourism that has gained popularity recently (Moradipour et al., 2020). Urban geotourism is a powerful instrument for educating people of all ages about geology in urban areas, particularly students and geology enthusiasts (Dowling et al., 2018; Pica et al., 2018; Reynard et al., 2017). Urban geotourism focuses on certain geological ideas (Pica et al., 2018): the origin of the stone used in the construction of historical monuments; understanding geological and geomorphological features prior to the construction of a city; the connection between geological and cultural heritages, particularly archeological heritage sites; the constraints of the surrounding material environment on urban development and its effect on the region's topography and geomorphology; resource exploitation based on geodiversity, particularly mine quarrying; some urban geological disasters; tourist map creation.

To achieve the purpose of geotourism, the interpretation and products play an important role in acquiring knowledge about the geology and geomorphology among visitors beyond the attraction of the site (Hose et al., 2011). It is clear that interpretive panels and documents (written and digital) about geosites are components of the geotourism-related derived offer. The purpose of interpretation is creating or strengthening the connection between the public and the geology sites to enhance the destination, interest, and pleasure of the visit (Bussard et al., 2022). Earth education and geointerpretation are essential factors for an enjoyable and meaningful geotourism experience (Dowling, 2014). Interpretation is also seen as a

vital factor for contributing to the survival or strengthening of the human connection to the Earth (Pásková et al., 2021). There are some major categories into which the interpretation can be divided (Dowling, 2018; Nuray, 2016): (1) permanent on-site interpretive facilities, like information panels; (2) portable interpretative tools, like brochures, guidebooks, and smartphone applications; (3) off-site facilities, like visitor centers, museums, and exhibitions, as well as specialized websites, that can be used and consulted before or after a geotourist trip; and (4) face-to-face interactions with an expert or guide, usually during a guided outdoor walk.

The concept of abiotic, biotic, and cultural interconnections of geotourism, also known as the ABC Concept, was introduced by Dowling (Dowling, 2014). Additionally, when interpreting a geosite and developing a geopark product, it is appropriate to use various time scales (geological, ecosystem, and psychological) within the time context or individual services for visitors. What is more, individual geopark products should be linked to the extensive thematic geopark product for spatial context (Pásková et al., 2021). When designing geotourism interpretation, four elements should be considered carefully, which are: location and the objects, content and message, media, and geotourists. The location and objects focus on the visited sites, while the content and message should be clear and limited to a small number of specific messages. Also, when creating interpretation products, a variety of media, including texts, maps, and multimedia tools, should be used to present scientific information to audiences. Last but not least, scientific messages can be simplified as there are many different age groups of geotourists, including children, families, scientists, etc. (Pica et al., 2018). This is done not only to improve the experience of the former but also to raise awareness of geoheritage and the need for its conservation; however, when the interpretations are designed as the geotourism products, it should not focus only as an educational activity (Watson, 2010; Dowling, 2011; Hurtado, 2014; Pica et al., 2018).

There are many potential geosites in Ho Chi Minh City that can contribute to urban geotourism development, such as Geosite Dam Lay-Rung Sac Can Gio, which not only contains the geological feature, but it also has the historical, ecological, and archeological value based on the geological foundation; Geosite Dat Thep Cu Chi has the specific geology which is the main element for the sustainable existing of Cu Chi Tunnels (Vy et al., 2023; Khanh et al., 2024). These sites contain geological value and are also known as popular destinations for tourists when visiting Ho Chi Minh City; however, there is a shortage of interpretation products for explaining the geological foundation for others value. This leads to the misunderstanding of Earth's geoheritage by tourists while visiting the sites.

2. Geological background

2.1 Study area

Ho Chi Minh City, also known as Saigon, is located in the Southeast region in Vietnam. According to the People's Committee of Ho Chi Minh City (2024), this city has a total area of 2095.5 km² and is made up of 1 municipal city, 16 urban districts, and 5 rural districts. Ho Chi Minh City ranked 14th in the Winner list of World's Best Awards 2023 as the favorite city in Asia, voted by Travel + Leisure's readers, so it can be said that this city is the popular destination among visitors, both national and foreign tourists (Vietnam National Authority of Tourism, 2023).

For this study, the selected geosites included Geosite Dat Thep Cu Chi (Cu Chi District); Geosite Dam Lay-Rung Sac Can Gio (Can Gio District); and Geosite District 1 (District 1).

2.2 Geological background

The geology of Ho Chi Minh City has a transition from the ancient alluvial sediments belonging to the Pleistocene age in the Southeast region (where creates terraces 10 – 100m high) to the low plains in the Southwest region where the sediments belong to the Holocene age. Furthermore, Ho Chi Minh City is home to a wide variety of minerals that are representative of the Southeast Vietnam (Hai, 1996).

Tab. 1. The brief geological background of these formations (Hai, 1996).

Geosite	Geological discription of geosite
Geosite Dat Thep Cu Chi	• Age: Middle-Late Pleistocene • Stratigraphic unit: Thu Duc formation (Q_1^{2-3} *tđ*) • Lithology: yellow gravel sand interspersed with gray-white kaolin clay sets, red gravel-containing quartz sand • Geomorphology: Ferrite crust-type weathering crust on a 30m-high ancient alluvial shelf (structured by the Thu Duc formation), including the laterite zone that is roughly 5–12 m deep.
Geosite Dam Lay-Rung Sac Can Gio	• Age: late Holocene - early Holocene • Stratigraphic unit: Can Gio formation (Q_2^{2-3}). • Lithology: blue-gray and brown-gray clay, and the upper layer is often covered with peat. Along the coast, the sediments are mainly fine sand. • Geomorphology: a brackish swamp with an average height of 0.6 - 0.7 m, often tidal flooding. The estuaries are funnel-shaped, which is the only funnel-shaped estuary found in Southern Vietnam
Geosite District 1	• Age: Middle-Late Pleistocene • Stratigraphic unit: Cu Chi formation (Q_1^3*cc*) • Lithology: gravel, gray sand, and gray silty sand. • Geomorphology: 5m high ancient alluvial terrace with arched form

3. Methodology

3.1 Choosing significant geosites

These geosites were selected based on previous study results, additional field trips, and consulting experts. As a result, 3 essential geosites were chosen based on the geological scientific value, other additional values (such as historical value, ecological value, and archeological value), potential access for tourists, education possibility, and the degradation risks.

3.2 Creating interpretation products

Interpretation products were created based on ABC concept, including abiotic, biotic and culture of the geosites. The ABC (abiotic, biotic, cultural interconnections) paradigm, according to Pásková (2018), provides the best means of clarifying the connections between the biotic, cultural, and abiotic elements of the geopark legacy, allowing for a comprehensive understanding of the region.

4. Results and Discussion

4.1 Abiotic (A), Biotic (B), and Culture (C) of the geosite

4.1.1 Geosite Dam lay - Rung Sac Can Gio

Geosite Dam lay – Rung Sac Can Gio, located in Can Gio District. This geosite is well-known with many ecotourism activities for national and foreign tourists. The relationship between geological and other values (including historical, ecological, and archeological value) played the significant role for the geointerpretation of this geosite.

The description about Abiotic, Biotic, and Culture component (ABC component) of this geosite:

- Abiotic (A): Can Gio formation (Q_2^{2-3}) is the youngest formation in the Southeast region, forming during the regression period after the Flandrian transgression. The geology features are the significant factors contributing to other values of this geosite, including archaeological, historical, and ecological value. By the time the Dong Nai river gradually encroached on the East Sea, ancient people immigrated to this area, which then left many value artifacts (Hai, 1996; Hau, 2022; UNESCO, 2024).

- Biotic (B): High precipitation, a high density of rivers encircling the area, and the geological foundation are necessary factors for the growth of the mangrove forest in Can Gio. In this mangrove forest, there is the greatest diversity of mangrove plant species, mangrove-dwelling invertebrates, and mangrove-

associated fish and shellfish species. This site was recognized by UNESCO as the world's biosphere reserve in 2000 (UNESCO, 2024).

- Cuture (C): The cultural factor of this geosite is contained in archaeological and historical value. Since the Giong Ca Vo archaeology site has been recognized, many artifacts were found, such as two-headed animal earrings, three-pronged earrings, stone beads, bronze objects, and pottery of all types (Fig. 1). All the artifacts belonged to the Sa Huynh archaeological culture. These discoveries allow archaeologists to have initially outlined the history of Can Gio from 3,000 to about 2,000 years ago (Hau, 2022). Another geosite's value is historical value. This site used to be a guerrilla base during the Vietnam War. It is clear that about 400 major and minor battles occurred to contribute to many impressive achievements of Unit 10—Special Forces Can Gio (Fig. 2).

Fig. 1. Three-pronged earrings and bracelets found in Giong Ca Vo archeology site

Fig. 2. Simulated image of Sac Forest Special Forces soldiers

4.1.2 Geosite Dat Thep Cu Chi

Geosite Dat Thep Cu Chi, located in Cu Chi District. This geosite is also known as Cu Chi Tunnels – one of the most special historical relic in Vietnam.

The description about Abiotic, Biotic, and Culture component (ABC component) of this geosite:

- Abiotic (A): The Thu Duc formation (Q_1^{2-3} *td*) and the 30m-high ancient alluvial shelf develop infiltrated weathered crust, including 3 zones with the laterite zone located about 5-12m deep, contributing to the sustainable tunnels. The features of laterite: when wet, laterite is frequently soft and easily excavated with a shovel or hoe. However, when exposed to air and dry conditions, laterite becomes red, brown, and quite solid (Fig. 3).

Fig. 3. Outcrop of the weathering crust belonging to Thu Duc formation (Q_1^{2-3} *td*) (Hai, 1996)

- Biotic (B): Apart from these secret tunnels, there are some small southern villages that are tucked away next to a verdant bamboo forest (Fig. 4). Also, cassava is a herbaceous plant that is cultivated near this geosite. During the war, boiled cassava became the traditional dish for Cu Chi residents and Vietnamese soldiers. Today, this is a local specialty for visitors when coming to Cu Chi District.

Fig. 4. Battle village reenactment area near Cu Chi tunnels

Fig. 5. Tourists visiting Cu Chi tunnels (Source: http://diadaocuchi.com.vn/)

- Culture (C): Cu Chi Tunnels, or Geosite Dat Thep Cu Chi can be seen as one of the most inventive military structures commemorating significant historical moments during the Vietnam War.

4.1.3 Geosite District 1

District 1 is the central district of Ho Chi Minh City. Back in 1859, when the French colonization of Vietnam began, French planners and architects focused on developing urban areas in District 1 and District 3. Today, many iconic buildings with a hundred years of old history still exist and have become famous tourist attractions, including Notre Dame Cathedral, Central Post Office, City Theater, and Museum of Fine Arts.

The abiotic, biotic, and culture component (ABC component) of this geosite:

- Abiotic (A): The lithology and the geomorphology of the Cu Chi formation ($Q_I^3 cc$) are suitable for structural buildings.

- Biotic (B): Betraux's Saigon planning project in 1890 was proved to be very excellent, and its value lasted to 1954. For the first time, the elements of terrain, geomorphology, geology, climate, and hydrology were receiving proper attention. Also, French planners and architects created a green belt with the Notre Dame Cathedral as the focal point. Houses in this area were no more than two stories high, with trees, lawns, and flower gardens everywhere (Hoa, 2017).

- Cuture (C): Based on the suitable geomorphology for construction, there are many century-old architectural structures of the French classic style for more than 100 years in District 1.

Fig. 6. By design, French planners have created a green belt with the Notre Dame Cathedral as its focal point (Hoa, 2017)

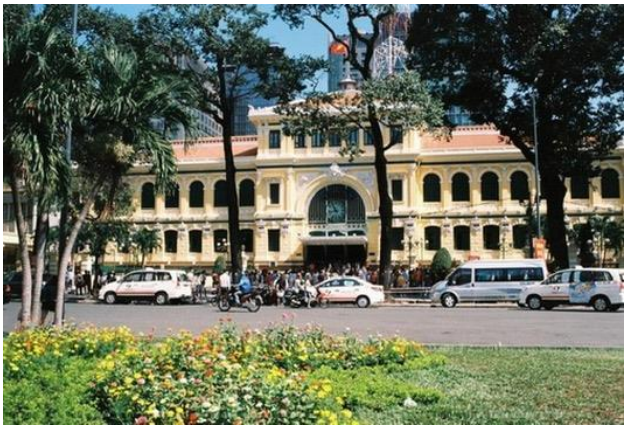

Fig. 7. Post Central Office—one of the iconic tourist destinations in District 1 with more than 100 years

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4.2 The proposal of interpretation products

4.2.1 Brochure

Based on the abiotic, biotic, and cultural factors of Geosite Dat Thep Cu Chi, a brochure with the size 29.7 x 21 cm was designed as a portable product. This geointerpretation brochure was divided into 3 main parts, including the general information (Fig. 8), the geomorphology explanation, the historical value, and the specialty (Fig. 9). The geomorphology explanation focused on the importance of the laterite zone, which contributed to the major historical achievements in Cu Chi. The geology academic words were reduced to the minimum for the understanding of target geo-tourists, including general tourists who are unaware of geological features and the geology experts. This geointerpretation product helped to enhance the understanding of the relationship between the interaction of the geological value and the historical value of the geosite Dat Thep Cu Chi among geo-tourists. Understanding the role of geological value could be seen as the foundation for urban geosite conservation in the future.

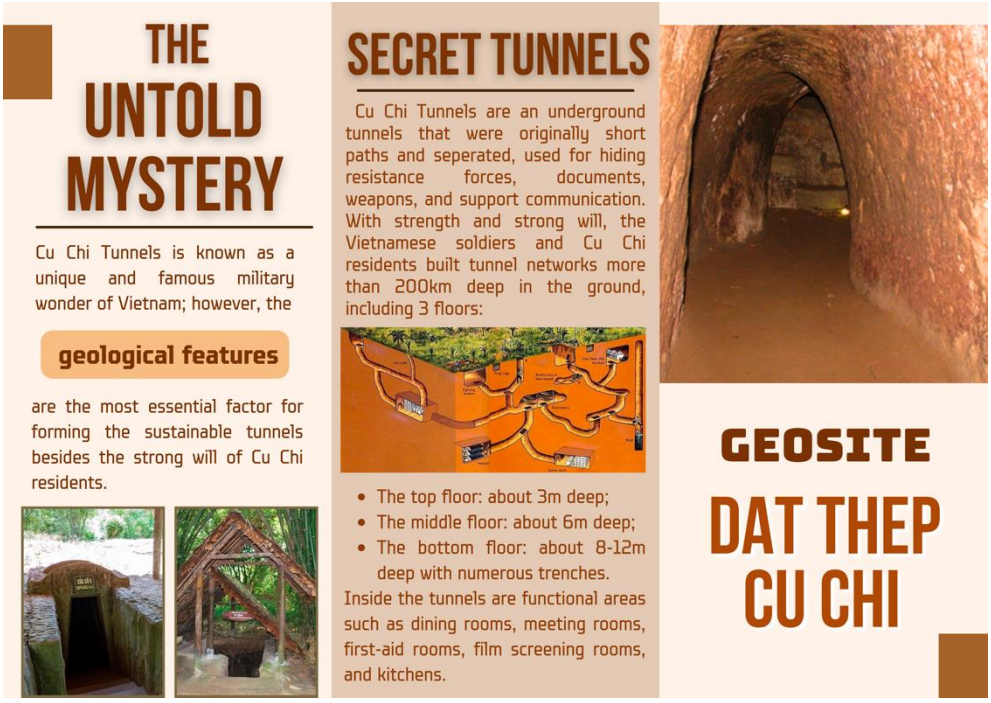

Fig. 8. Front page of the Brochure of geosite Dat Thep Cu Chi describing the general information of this geosite

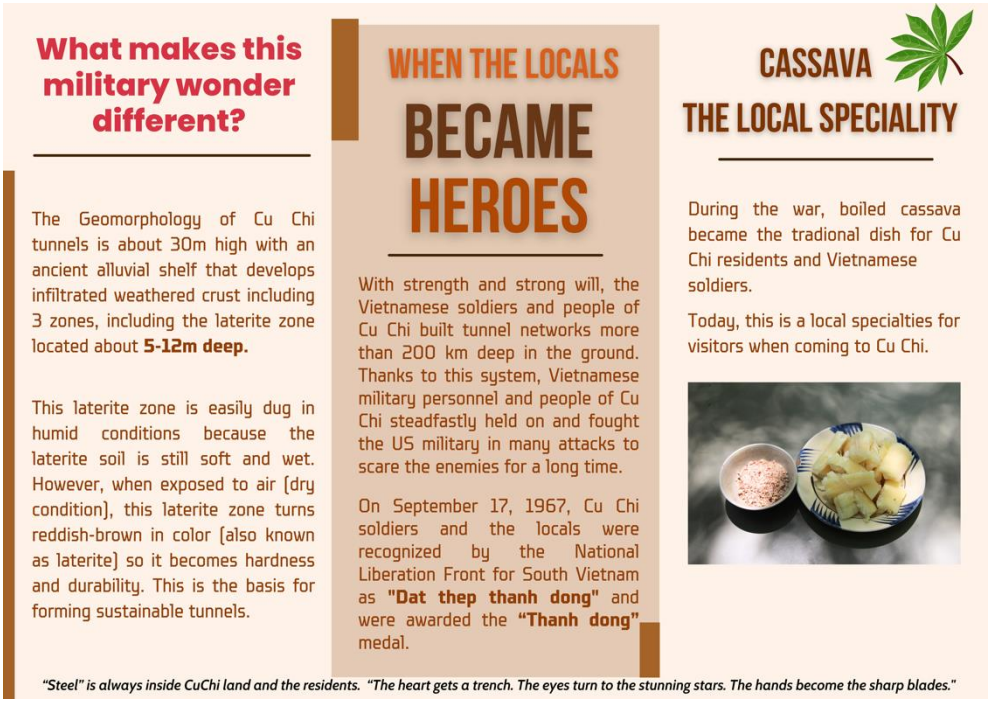

Fig. 9. Back page of the Brochure of geosite Dat Thep Cu Chi describing the geomorphology as well as the local speciality of this geosite in a concise and understanable way

4.2.2 Booklets

4.2.2.1 Geosite Dam Lay – Rung Sac Can Gio

Based on the abiotic, biotic, and cultural components of this geosite, a booklet with 5 pages and the size of A5 (14.8 x 21 cm) was created. This geointerpretation booklet was divided into 5 parts (Appendix A), including general information (Fig. 10), details of geology in Can Gio, archeology, the Can Gio Guerrilla Base, and the Can Gio mangrove forest. The geology information of this geosite was presented in the combination with the archeological value, historical value, and ecological value. By this way, the geological knowledge can be more interesting, as geotourists can clearly understand the role of geology and the relationship between geology and other values of this geosite.

The detailed explanation about the importance of a geological foundation for many historically significant achievements and the history of Can Gio from 3,000 to about 2,000 years ago should also be useful as the learning material for students from high schools to university students whose majors are not geology when they have field trips to this geosite for learning or outdoor activities

Fig. 10. The first page of the booklets about the general information

4.2.2.2 Geosite District 1

A booklet of this geosite was created in A5 size (14.8 x 21 cm) (Appendix B), divided into 3 parts, including 1) Geology knowledge application; 2) Some iconic buildings information; and 3) Recommendation of popular sites and individual notes.

The geological information in this booklet was provided shortly, with the aim of popularizing the importance of geomorphology knowledge when Betraux's Saigon planning project chose District 1 as the center for urban area development. Also, to make this booklet more attractive to geotourists, this booklet also attached general information about some historical structures as well as travelers' notes.

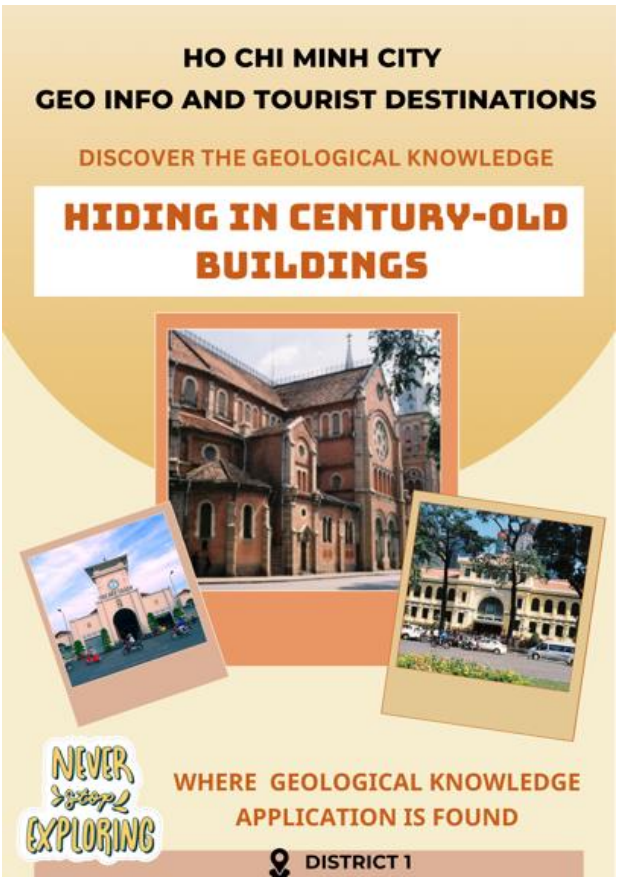

Fig. 11. A booklets cover of the geosite District 1

5. Conclusion

Ho Chi Minh City has a huge potential for developing urban geotourism with many popular tourist destinations; however, this topic has not been developed. It leads to the shortage of geointerpretation products in these geosites, so the geology knowledge has not been promoted to tourists yet. Based on previous research about urban geotourism in Ho Chi Minh City, three geosites were selected for this study to create geointerpretation products, including Geosite Dam Lay – Rung Sac Can Gio, Geosite Dat Thep Cu Chi, and Geosite District 1. The geointerpretation products belonged to the portable products, including: 1) brochure and 2) booklets. Moreover, these products could be seen as essential materials for promoting geoknowledge to geotourists, from geoexperts to unaware geology visitors.

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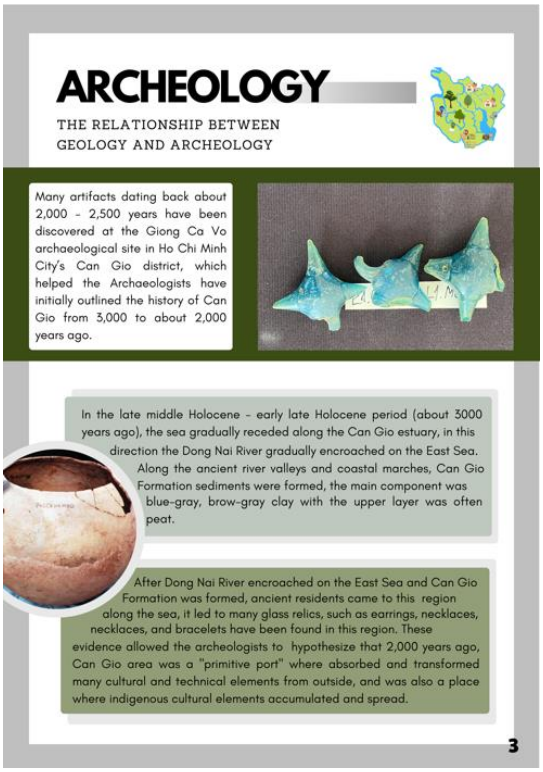
Appendix A – Booklet of geosite Dam Lay – Rung Sac Can Gio



Appendix B – Booklet of geosite District 1

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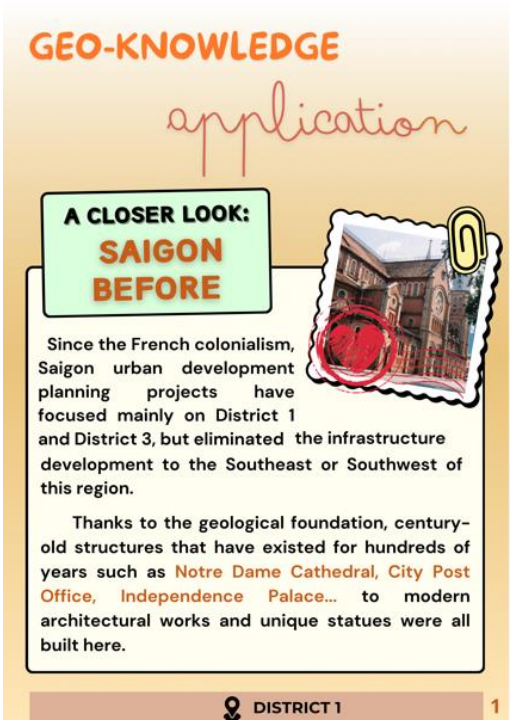

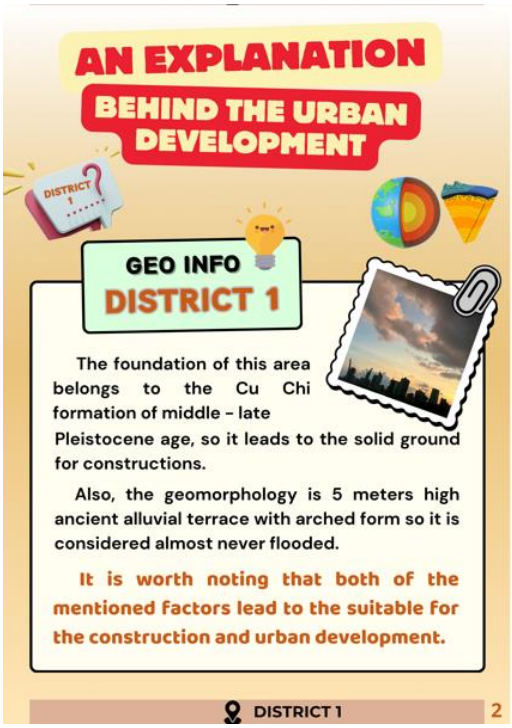

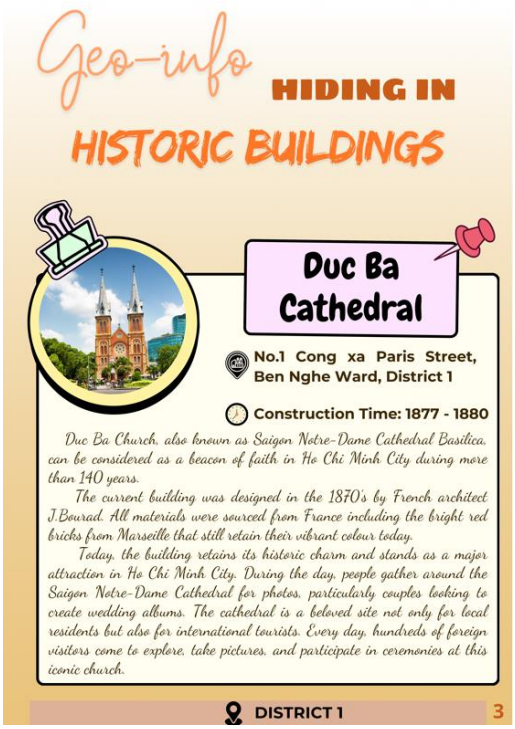

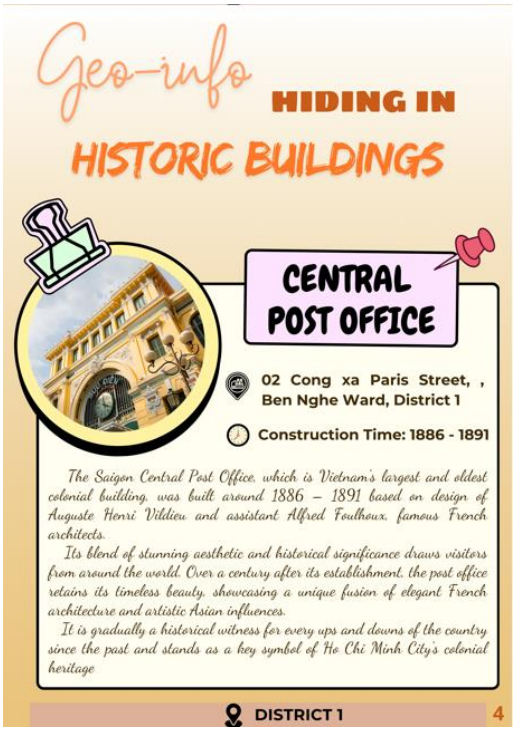

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