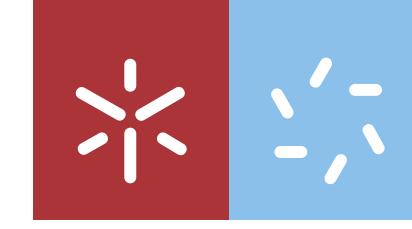




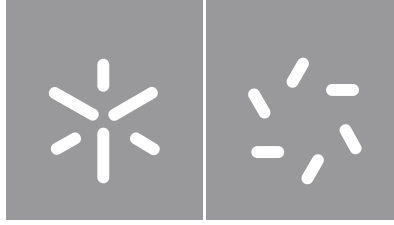
Bahareh Bahrami Samani

**Geoproducts in UNESCO Global Geoparks:  
a study applied to Platåbergens Aspiring  
Geopark (Sweden)**

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Dissertação de Mestrado  
Mestrado em Geociências  
Património Geológico e Geoconservação

Trabalho efetuado sob a orientação do  
**Professor Doutor José Brilha**  
**Mestre Anna Josefina Bergengren**

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# **Geoproducts in UNESCO Global Geoparks: a study applied to Platåbergens Aspiring Geopark (Sweden)**

## **Abstract**

With the arrival of geoparks around 20 years ago, the geoproducts topic was introduced due to its close connection with local communities' sustainable development through geotourism. Geoparks are territories with sites with international geological significance and with a development strategy to promote the whole heritage of the area and better living conditions to local communities. Since 2015 that geoparks are recognized by UNESCO with the Global Geopark label. Geotourism is an approach to attract visitors to geoparks, offering them the possibility to buy geoproducts that has the potential to generate income for local communities. However, this is not the only benefit that people and geoparks receive of the selling of geoproducts. Geoproducts also have educational and conservation benefits as they can contribute to raise public awareness for all geopark assets. Geoproducts are not limited to geology, they can be related with any type of heritage of the territory and have different types of usages.

Although there are some studies about geoproducts, its definition is still unclear and varied. This dissertation proposes a clear definition of geoproducts and of their different types based on their tangible, intangible or service character. The main purpose of this study is to propose some ideas of geoproducts for Platåbergens Aspiring Geopark in Sweden. This is the first geopark in Sweden and this situation provides it the opportunity to be followed later as a model by new future aspiring geoparks in the country. After a literature review about this Geopark, some local features with the potential to inspire geoproducts were selected. The proposed geoproducts for Platåbergens Geopark were based on local natural and cultural features, and also on the profile of visitors and their interests. Some geoproducts proposed for Platåbergens Geopark can be adapted to other geoparks, using other local materials.

The effective implementation of geoproducts in a geopark should be made in a dialogue with the local community in order to assess their capacity and interest to implement and sell these geoproducts. Their involvement can contribute to strength the community's commitment with the geopark project in their territory.

Keywords: UGGp, geoparks, geotourism, geoproducts, sustainable development

## **Geoprodutos em Geoparques Mundiais da UNESCO: um estudo aplicado ao Platåbergens Geoparque Aspirante (Suécia)**

### **Resumo**

Com a chegada dos geoparques há cerca de 20 anos, foi também introduzido o novo conceito de geoprodutos devido à sua estreita ligação com o desenvolvimento sustentável das comunidades locais através do geoturismo. Os geoparques são territórios com sítios de importância geológica internacional e com uma estratégia de desenvolvimento para promover todo o património da área e melhores condições de vida para as comunidades locais. Desde 2015 que os geoparques são reconhecidos pela UNESCO com a designação Geoparque Mundial. O geoturismo é uma abordagem para atrair visitantes aos geoparques, oferecendo-lhes a possibilidade de comprar geoprodutos com potencial para gerar rendimentos para as comunidades locais. Contudo, este não é o único benefício que as pessoas e os geoparques recebem da venda de geoprodutos. Os geoprodutos também têm benefícios educacionais e de conservação, uma vez que podem contribuir para a sensibilização do público para todo o património do geoparque. Os geoprodutos não estão limitados à geologia, podem estar relacionados com qualquer tipo de património do território e têm diferentes tipos de utilizações.

Embora existam alguns estudos sobre geoprodutos, a sua definição é ainda pouco clara e variada. Esta dissertação propõe uma definição clara de geoproduto e dos seus diferentes tipos com base no seu carácter tangível, intangível ou de serviço. O principal objectivo deste estudo é o de propor algumas ideias de geoprodutos para o Platåbergens Aspiring Geopark na Suécia. Este é o primeiro geoparque na Suécia e esta situação constitui uma oportunidade de ser seguido, mais tarde, como modelo por futuros geoparques aspirantes no país. Após uma revisão bibliográfica sobre este geoparque, foram seleccionadas algumas características locais com potencial para servir de inspiração para criar geoprodutos. Os geoprodutos propostos para o Geoparque Platåbergens basearam-se em características naturais e culturais locais, e também no perfil dos visitantes e nos seus interesses. Alguns geoprodutos propostos para o Geoparque Platåbergens podem ser adaptados a outros geoparques, utilizando outros materiais locais.

A implementação efetiva de geoprodutos num geoparque deve ser feita em diálogo com a comunidade local, a fim de avaliar a sua capacidade e interesse em implementar e vender estes geoprodutos. O seu envolvimento pode contribuir para reforçar o compromisso da comunidade com o projeto do geoparque no seu território.

Palavras-chave: UGGp, geoparques, geoturismo, geoprodutos, desenvolvimento sustentável



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## 1. Introduction

The history of geoparks started more than 20 years ago. However, only in 2015 UNESCO adopted the International Geoscience and Geoparks Programme and the UNESCO Global Geopark label (UGGp). A UGGp is not only about geology although it should have geological heritage with international significance in which the whole geopark strategy should be based<sup>1</sup>. A geopark is a place where people can discover the history of our mother Earth. It is like an open book where local communities and visitors can discover and experience geological features like caves, fossils, or volcanoes and to learn more about nature and how its changes can influence their lives.

Local people are an essential part of geoparks as their lifestyle, food, and culture are related with the geodiversity of the area.<sup>2</sup> Geoparks, in addition to protect the natural and cultural heritage of the territory, should encourage local communities to preserve and promote their traditions, agricultural products, and crafts, and help to increase awareness of visitors about the heritage of the area.<sup>1</sup>

The number of UGGp is consistently increasing in all continents, there are 169 geoparks distributed by 44 countries as of December 2021. In December 2021 the UNESCO Global Geoparks Council proposed to forward to the Executive Board of UNESCO (for its endorsement during the 2022 Spring session) the nomination of 8 new UNESCO Global Geoparks, welcoming geoparks in two new Member States: Mëllerdall (Luxembourg) and Platåbergen, in Sweden.<sup>3</sup> China is the country with more UGGp (41) followed by Spain (15), Italy (11) and Japan (9). However, the geographical distribution of UGGp in the world is still very distinct with a clear dominance of European and Asian countries (figure 1.1).



Figure 1.1 – Distribution of UGGp in the world (as of December 2021).<sup>4</sup>

<sup>1</sup> <https://en.unesco.org/global-geoparks>

<sup>2</sup> <https://www.visitgeoparks.org/geopark-cultural-heritage>

<sup>3</sup> <https://en.unesco.org/news/unesco-global-geoparks-council-proposes-8-new-unesco-global-geoparks>

<sup>4</sup> <http://www.globalgeopark.org/GeoparkMap/index.html>

One of the aims of UGGp is to promote the sustainable development of the territory and the improvement of living conditions of local communities. Geoparks tend to create conditions to stimulate jobs creation and the establishment of small businesses related with the expected increase of visitors in the geopark. The term "geoproduct" started to be used in the geoparks community to designate, in general, local products that visitors can buy and take home as souvenirs (UNESCO, 1999). The production and selling of geoproducts is one of the mechanisms to involve local communities in the geopark's strategies and to generate income for their own benefit. Geoproducts should be inspired in the heritage of the area and is not restricted to geology. Geoproducts can have not only an entertainment or utility character but also an informal educational objective.

### **1.1.Aims of this dissertation**

This dissertation aims to promote the development of aspiring and recent geoparks through the identification of the potentials of the territory to produce geoproducts which represent a part of their heritage, and to enhance the involvement of local communities with their geopark. In addition, this work intends to increase local communities' understanding of what they have as heritage in their territories, and how it can be used to attract tourists and generate revenues.

Considering that Sweden is one of the few European countries still with no UGGp, this dissertation uses the Platåbergens aspiring Geopark as a case study. This geopark presented its application to UNESCO and expects a final decision by the first semester of 2022. As the geoproducts sector is still incipient in this geopark, this work aims to present some proposals of geoproducts to be eventually considered by the geopark's managers.

### **1.2.Methods**

In order to reach the objectives mentioned above, different steps were taken. Firstly, recent literature about geoparks, geotourism and geoproducts has been reviewed. Taking into account that there is no global definition of geoproducts, a comprehensive characterisation of geoproducts and a proposal for their definition was presented.

Secondly, it was done a literature review about Platåbergens aspiring Geopark. The application dossier submitted to UNESCO was determinant because unfortunately it was not possible to do fieldwork due to restrictions related with Covid-19 pandemics. Online meetings with the geopark staff were essential to clarify certain aspects and to better assess which characteristics of the geopark have potential to inspire geoproducts.

The third step was the conceptualization of ideas for geoproducts based on specific features of Platåbergens Geopark. It was taken into account not only some specific features of the geopark but also the general profile of visitors to this territory, based on information provided by the geopark staff.

Finally, the last step was the writing of this dissertation. The dissertation is divided in five main chapters: the first three present a review on the main concepts related with geoparks, geotourism and geoproducts. The fourth chapter describes the main characteristics of Platåbergens Geopark and the fifth presents proposals that might be used to develop geoproducts adapted to this case study.

## **2. General principles on geoparks**

The label of 'UNESCO Global Geopark' (UGGp) was approved by UNESCO<sup>5</sup>'s General Conference on 17 November 2015 (UNESCO, 2021) and is awarded to “single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education, and sustainable development“. A UGGp must have geological heritage with international significance<sup>6</sup> but a geopark is not only about geology. Whatever is important for that territory, it is important for the geopark, including its cultural, biological, and archaeological heritage. UNESCO does not play a specific role on the management of a UGGp, because in principle it is managed with the strong involvement of the local community.

Local communities play a very important role in geoparks because their sustainable economic development is an important aim for geoparks, strongly supported on geotourism. The raise of awareness of locals and visitors about the high importance of natural and cultural values inside the geopark is always a top priority for geopark managers. Hence, several information and interpretation resources should be made available, including websites, maps, brochures and publications, workshops, and festivals, adapted to different types of public. “Celebrating Earth Heritage, Sustaining Local Communities” is one of the UGGp's motto because geoparks are not only about people and exploring the connections between people and the Earth (figure 2.1).

Networking is another important keyword for the geopark community. UNESCO Global Geoparks must cooperate through the Global Geoparks Network (GGN) and within one of the regional networks in order to raise the potential of learning from each other, exchange ideas and experiences which contribute for the quality improvement of the UGGp label. In addition, working with international partners brings a better understanding of different communities and helps peace-building all over the world.

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<sup>5</sup> The United Nations Educational, Scientific and Cultural Organization

<sup>6</sup> <https://en.unesco.org/global-geoparks/focus>



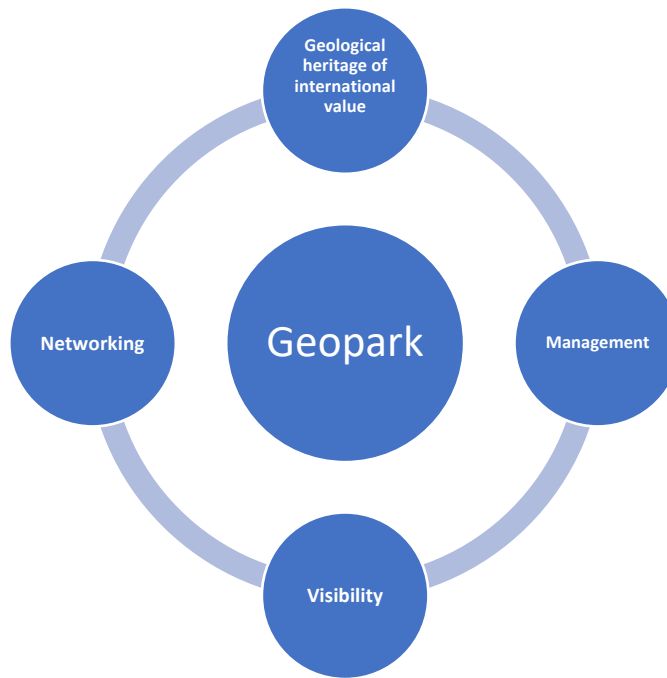


Figure 2.1 – The four features that are fundamental to a UNESCO Global Geopark.

UGGp are also committed to raise the awareness of the society in what concerns several key topics, explained below<sup>4</sup>. For instance, that our dependence on geological non-renewable resources to meet our needs is inevitable. Therefore, people must learn how to use natural resources sustainably, which is important for the continued future well-being of society. Geological hazards are a very important subject in some UGGp and consequently educational activities addressed to locals and visitors about prevention and disaster mitigation strategies are offered in a regular way.

Climate change is also one of the hot topics in UGGp. For instance, people in Iran face many challenges regarding water scarcity due to changes in precipitation patterns. Many UGGp have projects and activities to promote awareness of climate change and its effects on the environment.

All UGGp need to offer educational activities particularly designed for kids and adults, locals and visitors. For example, in Iran, Queshm UGGp organizes workshops with the communities about how the local landscape and nature can inspire new products and also how small businesses and job opportunities can be created (Amrikazemi, 2012).

In recent years, the gender question has also been covered by UGGp, with a strong emphasis on empowering women. Once more, an example from Iran where in areas where the traditional values are very strong, women always stay at home and rarely are seen outside. Queshm UGGp offered some

opportunities addressed to women in order to present their handicrafts to visitors and encourage them to be more active in society and bringing some income into their families (Amrikazemi, 2012).

The last but not least topic that all UGGp need to follow is geoconservation. For Gordon et al. (2018) geoconservation is “the practicing of conserving, enhancing and promoting awareness of those features and underlying processes of geodiversity that have significant scientific, educational, cultural, aesthetic or ecological value.” Considering that UGGp must present geological heritage of international significance, it became obvious that geoparks must be fully engaged on the proper management of geological sites.

In summary, a geopark is not a new category of a protected area nor a geological park, and it does not only deal with geology. It is a territory that uses its geological heritage and connects it with the cultural and natural heritage of the area fostering the sustainable development of local communities.

### **3. Geotourism: basic concepts**

Geotourism is a relatively new type of tourism and is a strategic tool in all geoparks because it is a way to attract visitors to these territories. Despite the different definitions of this term (Newsome & Dowling, 2018), in general it is focused on the geology and landscape of an area as a base to foster sustainable tourism. The definitions of geotourism may vary, in case we would consider a more 'geological' or 'geographical' character (Dowling, 2013).

Under the geological point of view, the main focus of geotourism is on geological and geomorphological aspects of an area. The first definition of geotourism was proposed by Hose (1995) where geotourism was considered "the provision of interpretive and service facilities to enable tourists to acquire knowledge and understanding of the geology and geomorphology of a site (including its contribution to the development of the Earth sciences) beyond the level of mere aesthetic appreciation".

Later, Dowling & Newsome (2006) declares that while the "geo" part of the word geotourism is related to geology and geomorphology and to natural resources like landforms, fossils, and also to processes that have created those features, the "tourism" part is related to visits made to a geosite for different purposes, such as recreation or education (figure 3.1). In addition, geotourism can also involve accommodation and planning, and the necessary management of geosites. Dowling & Newsome (2006) believes that geotourism is a distinct subsection of natural areas tourism and not a form of it that also includes the cultural and heritage components. In comparison with ecotourism, which is related to natural areas in general, geotourists can visit natural areas or human-changed areas where there are geological attractions (Dowling, 2013).

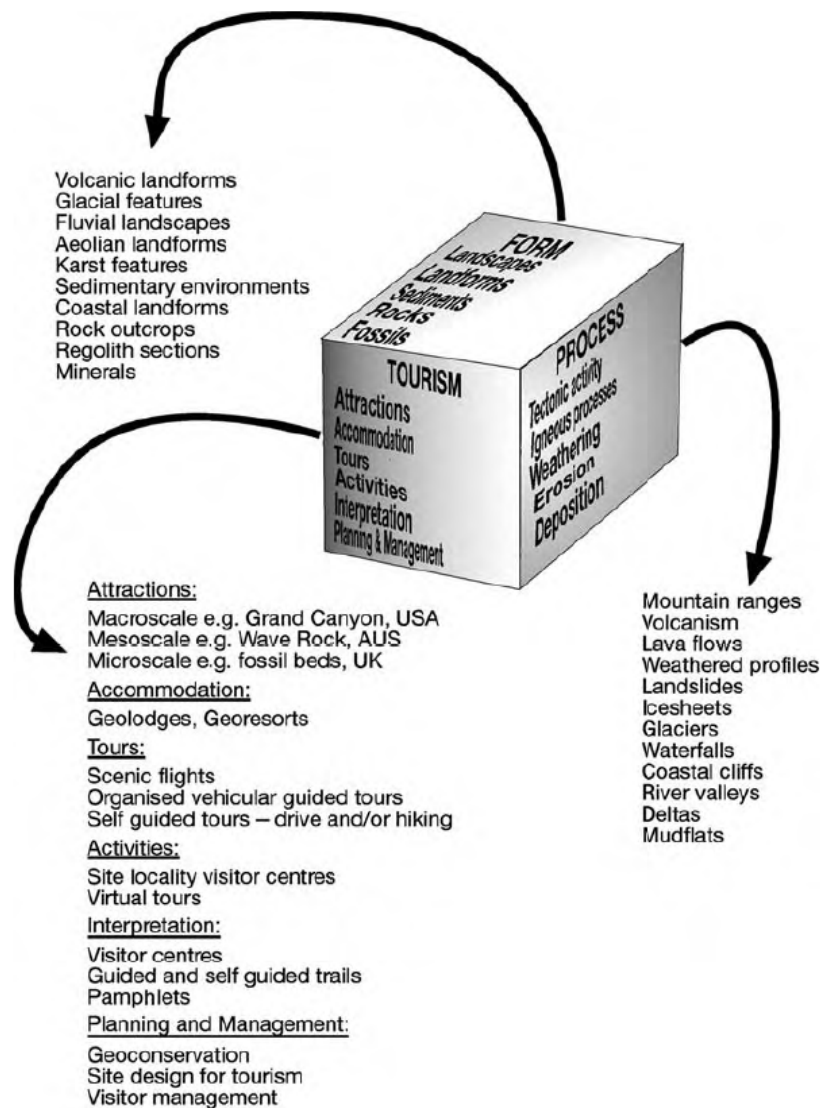


Figure 3.1 – Conceptualization of the nature and scope of geotourism (Dowling & Newsome, 2006).

After the first definition of geotourism presented by Hose (1995), Stueve (2002) gave a more geographical perspective to geotourism referring that it can encompass both cultural and environmental aspects. The U.S. National Geographic Society defined tourism as geographical geotourism: "Geotourism is defined as tourism that sustains or enhances the geographical character of a place – its environment, heritage, aesthetics, culture, and the well-being of residents"<sup>7</sup>. This definition emphasizes regional uniqueness and identity and has a weaker focus on geology and landscapes as the object of tourism (Stoffelen & Vanneste, 2015). About this dualism between the 'geological' and 'geographical' perspectives of the geotourism concept, Dowling (2013) refers that the former definition focuses on

<sup>7</sup> <https://www.nationalgeographic.com/maps/topic/geotourism>

geotourism as a 'form' of tourism, while the later considers geotourism as an 'approach' to tourism, which is similar to sustainable tourism. The understanding of the identity of a region is essential to develop geotourism as it is based on what the environment is built up: Abiotic, Biotic, and Cultural components. This 'ABC' approach contains the abiotic elements of geology and climate, the biotic elements of fauna and flora, and the cultural or human components, both past and present (figure 3.2).

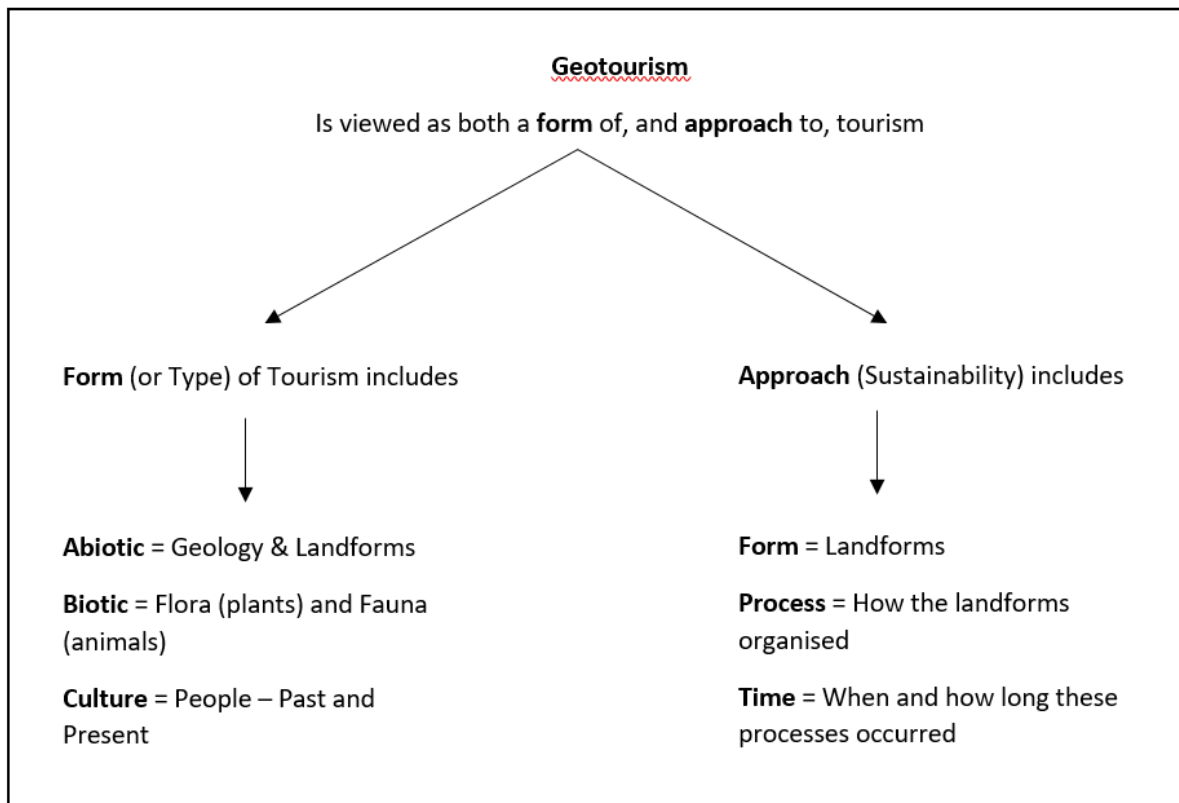


Figure 3.2 – Geotourism is best viewed as both a form of tourism as well as an approach to it. It is made up of Abiotic, Biotic and Cultural (ABC) components. When describing geotourism it is important to include the components of Form (landforms and landscape), Process (how the landforms originated) and Time (when and how long these processes occurred) (Dowling, 2013).

The connection between geographical and geological perspective is obvious. For instance, a monument with high cultural value built with rocks is connected to geology. Persepolis in Shiraz, Iran, is a cultural heritage carved in Cretaceous limestone but the cultural and historical value is more significant than the geological value.

Nevertheless, the concept of geotourism gained different meanings in different countries. For instance, in Malaysia geotourism is considered as “the utilization of geological heritage resources for education-based tourism”, while these resources are based on intrinsic values such as scientific, aesthetic, recreational, and cultural values (Tongkul, 2006). In Iran, geotourism is not only about geology

but also considers archaeological, cultural, and natural attractions (Amrikazemi & Mehrpooya, 2006). In South Africa (Reimold, 2006; Knight, 2015), Australia (James, 2006), USA (Gates, 2006), and Spain (Calaforra & Fernández-Cortés, 2006) geotourism is considered under the geological perspective. In Italy, Garofano (2006) defines geotourism as “the discovery and understanding of the geological beauties visited directly where they are located.” In Southwest Germany is beyond “just geological tourism (e.g., fossicking or visiting caves), and embraces the identification of geo-objects, landscape marketing and interpretation of the geological heritage of a region in a sustainable manner” (Pforr & Megerle, 2006). More recently, Chen (2015) wrote that “geotourism has been interpreted as geological tourism with a focus on geology and its interaction with ecology and culture”.

An International Congress on Geotourism was held in 2011 at Arouca UNESCO Global Geopark (Portugal) to clarify the concept of geotourism. By the end of this congress, a declaration<sup>8</sup> was approved where geotourism: “should be defined as tourism which sustains and enhances the identity of a territory, taking into consideration its geology, environment, culture, aesthetics, heritage, and the well-being of its residents. Geological tourism is one of the multiple components of geotourism”. This geotourism definition was adopted for whole dissertation and today is the more common definition in the geoparks community.

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<sup>8</sup> [http://www.aroucageopark.pt/documents/78/Declaration\\_Arouca\\_EN.pdf](http://www.aroucageopark.pt/documents/78/Declaration_Arouca_EN.pdf)

#### **4. Geoproducts: concept and purposes**

Considering that geotourism is a tool to attract visitors to geoparks, it is important that geopark managers and their partners promote the development and selling of geoproducts, which is the main focus of this dissertation. The definition of geoproducts in the literature still is unclear and varied, and different authors use different terms. For instance, Rodrigues et al. (2021) and Dryglas & Miśkiewicz (2014) consider geoproducts as a geotourism resource. The aim of this chapter is to try to clarify the definition of geoproduct.

##### **4.1. Background**

There are some discussions regarding tourist products and what do tourists consume during their trips since the early 1970s (Koutoulas, 2004). Middleton (1987) cited in Torabi Farsani et al. (2012) stated that all service elements which a visitor or tourist consumes while outside his/her home is a tourist product. The origin of the term geoproduct goes back to 1999 when UNESCO announced that geoproducts are “the sustainable manufacturing of innovation handicraft which have a geological connotation” (Torabi Farsani et al., 2012). Xun (2002) cited in Torabi Farsani et al. (2012) declared that “geoproducts are new orientations in trades and crafts” and Eder & Patzak (2004) refers that geotourism and geoproducts in geoparks provide complementary income for locals and can attract private capital.

Geoproducts incorporate traditional products and crafts with a new vision, which raises awareness of geodiversity and develop the local economy (Rodrigues & Carvalho, 2009). Frey et al. (2006) cited in Torabi Farsani et al. (2012) stated that geoproducts are also pedagogical tools. Torabi Farsani et al. (2012) explained that geoproducts are based on geological features of the territory, not only represent local crafts and goods to tourists but it also increases public knowledge on the geology and geomorphology of the geopark. These authors also consider that all resources related to education can be a geoproduct, such as geotourism maps, geo-museums, or interpretive panels.

On the UNESCO Global Geoparks Network Guidelines (2010) geoproducts are considered as protection tools for georesources, like fossils. Meanwhile, Complova (2010) mentioned that most geoproducts are identified as geological attractions but very often are also related with high cultural value.

Dryglas & Miśkiewicz (2014) stresses that organisations like museums, events like conferences, services like geo-medical services, trails, and also places can be considered as geoproducts. Krishna et al. (2019) agrees with this perspective as restaurants and coffee shops are also considered a geoproduct.

## **4.2. Definition and types of geoproducts**

The previous paragraphs showed that several authors have different perspectives about geoproducts. During this dissertation, it will be considered that a geoproduct is a product unique for each geopark, directly related to its territory, and produced as much as possible with local products and locally. The uniqueness of geoproducts in each geopark can be due to a specific feature that the geoproduct represents, the type of material used that is related to that area, local traditions, and history and stories related to the area. Therefore, a geoproduct is a consumer product used as a promotion resource of a geopark, frequently with a profit aim, and:

- Directly related to the territory;
- Inspired in a specific element of the geological, biological or cultural heritage of the territory;
- Preferably unique to that territory;
- Ideally made, as much as possible, inside the territory using local or, at least, national materials;
- Made under environmental-friendly conditions and following ethical principles.

In order to better understand the geoproduct concept, some authors have defined different types of geoproducts. Torabi Farsani et al. (2012) described that geoparks have quite innovative approaches in what concerns decorative and edible products to introduce the geoheritage of the territory and refers to (i) decorative or ornamental and (ii) edible geoproducts. Geoproducts can be decorative, ornamental, educational, or functional (e.g. toys, clothes, furniture etc.) made of different materials like wood, rock etc, which represent a symbol of a geopark. Local handicrafts already being made in the geopark can be adapted to a geoproduct, which can help to preserve the cultural heritage and to improve local economy. Regarding edible geoproducts, there are already many examples in UGGp, such as cookies with the shape of a trilobite or pizza representing tectonic plates.

Drygłaś & Miśkiewicz (2014) divided geoproducts in two main categories: basic and complex (table 4.1). These authors consider any product that is related to geology and that can fulfil the tourists' needs.



Table 4.1- The hierarchical structure of material and immaterial categories of geoproducts (Dryglas & Miśkiewicz, 2014).

<b>Geo-products</b>		
<b>Types</b>	<b>Categories</b>	<b>Examples from Poland</b>
Basic	Object	<ul style="list-style-type: none"> <li>Printed materials: geotourist and geological guides, catalogues of geotourist objects, geotourists/ tourist-geological maps, geoteaching aids, albums, magazines, brochures, postcards, etc.</li> <li>Virtual materials/ multimedia: geo-information websites, geotourist virtual tours, geo-applications, CD, DVD etc.</li> <li>Geo-interpretative panels</li> <li>Collections of rocks, minerals and fossils</li> <li>Handicrafts e.g. jewellery, geo-cosmetics, geo-decoration, bottled water, glassware, metalwork</li> </ul>
	Entity	Permanent exhibition e.g.: <ul style="list-style-type: none"> <li>Geological and paleontological museums</li> <li>Geo-centres</li> <li>Stone in architecture</li> <li>Mining facilities</li> <li>Erratic boulder park</li> </ul>
	Event	<ul style="list-style-type: none"> <li>Temporary exhibitions such exhibitions and markets of minerals and jewellery products</li> <li>Geological picnics</li> <li>Geological festivals</li> <li>Competitions geological knowledge</li> <li>Geo-presentations: lectures, broadcasts movies, etc.</li> <li>Geo-conferences</li> </ul>
	Service	<ul style="list-style-type: none"> <li>Geo-guide services</li> <li>Geo-training services</li> <li>Geo-education services</li> <li>Geo-information services</li> <li>Geo-sales services</li> <li>Geo-medical services e.g. balneotherapy, halotherapy, lithotherapy</li> </ul>
Complex	Tourism package	<ul style="list-style-type: none"> <li>Package geo-tours</li> <li>Geo-school camps</li> <li>Outdoor geo-games e.g. questing</li> </ul>
	Trail	<ul style="list-style-type: none"> <li>Geotourist trail</li> <li>Geostrada</li> <li>Educational trails</li> <li>Underground mining tour</li> </ul>
	Place	<ul style="list-style-type: none"> <li>UNESCO geopark</li> <li>National geoparks</li> <li>Geological parks</li> <li>Dino-parks</li> <li>Spas</li> <li>Geo-regions</li> </ul>

More recently, Rodrigues et al. (2021) proposed four main geoproducts categories:

1. Handicraft and merchandising;
2. Food, cosmetics and others;
3. Tourism facilities (restaurants and accommodation);
4. Tourism related services.

Based on previous proposals, three main geoproducts categories will be presented here: tangible geoproducts, intangible geoproducts, and services (table 4.2, figure 4.1).

Table 4.2 – New proposal for geoproducts classification. Figures 4.2 – 4.6 illustrate some potential examples.

<b>Categories</b>	<b>Subcategory</b>	<b>Examples</b>
<b>Tangible geoproducts</b>	<b>Durable goods</b>	<ul style="list-style-type: none"> <li>▪ Jewellery               <ul style="list-style-type: none"> <li>○ Neckless; Bracelet; Earing; Hairgrip;</li> </ul> </li>   <li>▪ Health and beauty products               <ul style="list-style-type: none"> <li>○ Hair comb;</li> </ul> </li>   <li>▪ Entertainment               <ul style="list-style-type: none"> <li>○ Puzzles; Cards;</li> <li>○ Dolls;</li> <li>○ Games; Apps;</li> </ul> </li>   <li>▪ Decorative               <ul style="list-style-type: none"> <li>○ Candles and candle holder;</li> <li>○ Handicrafts; Souvenirs;</li> <li>○ Textiles;</li> <li>○ Clocks;</li> <li>○ Lamp shades;</li> <li>○ Coasters;</li> <li>○ Posters;</li> <li>○ Decorative magnets;</li> <li>○ Fossil replicas (can also be a teaching resource);</li> </ul> </li>   <li>▪ Clothes               <ul style="list-style-type: none"> <li>○ T-shirts; Caps; Hats;</li> <li>○ Jumpers; Raincoats;</li> </ul> </li>   <li>▪ Teaching resources               <ul style="list-style-type: none"> <li>○ Ready-to-paint fossil plaster casts;</li> <li>○ Silicone moulds to make fossils;</li> <li>○ Kits to make crystals;</li> <li>○ Publications;</li> </ul> </li>   <li>▪ Functional objects               <ul style="list-style-type: none"> <li>○ Backpacks;</li> <li>○ Keyholders;</li> <li>○ Pencils;</li> <li>○ USB pens and rubbers with a specific shape (fossil, mineral, etc.);</li> </ul> </li> </ul>

	<b>Non-durable goods</b>	<ul style="list-style-type: none"> <li>▪ Edible <ul style="list-style-type: none"> <li>○ Bread; Cookies; Cakes;</li> <li>○ Honey; Chocolates; Cheese;</li> <li>○ Wine &amp; liquors; Olive oil;</li> <li>○ Mineral water;</li> </ul> </li> <li>▪ Health and beauty products <ul style="list-style-type: none"> <li>○ Soaps;</li> <li>○ Volcanic thermal muds;</li> </ul> </li> <li>▪ Plants <ul style="list-style-type: none"> <li>○ Seeds; Agriculture kit;</li> </ul> </li> </ul>
<b>Intangible geoproducts</b>		<ul style="list-style-type: none"> <li>▪ Music, literature</li> <li>▪ Videos <ul style="list-style-type: none"> <li>○ Educational</li> <li>○ Video of about any intangible heritage of the geopark</li> </ul> </li> <li>▪ Stories and history</li> </ul>
<b>Services</b>		<ul style="list-style-type: none"> <li>▪ Guided tours;</li> <li>▪ Souvenir photos; <ul style="list-style-type: none"> <li>○ Visitors wearing traditional clothes;</li> </ul> </li> <li>▪ Recreational bathing in thermal water;</li> <li>▪ Hosting visitors in settings specific to each geopark <ul style="list-style-type: none"> <li>○ Meals and accommodation with local families;</li> <li>○ Accommodation in special locations (caves, old mines, etc.);</li> </ul> </li> <li>▪ Experiencing traditional activities (making homemade bread, etc.).</li> </ul>

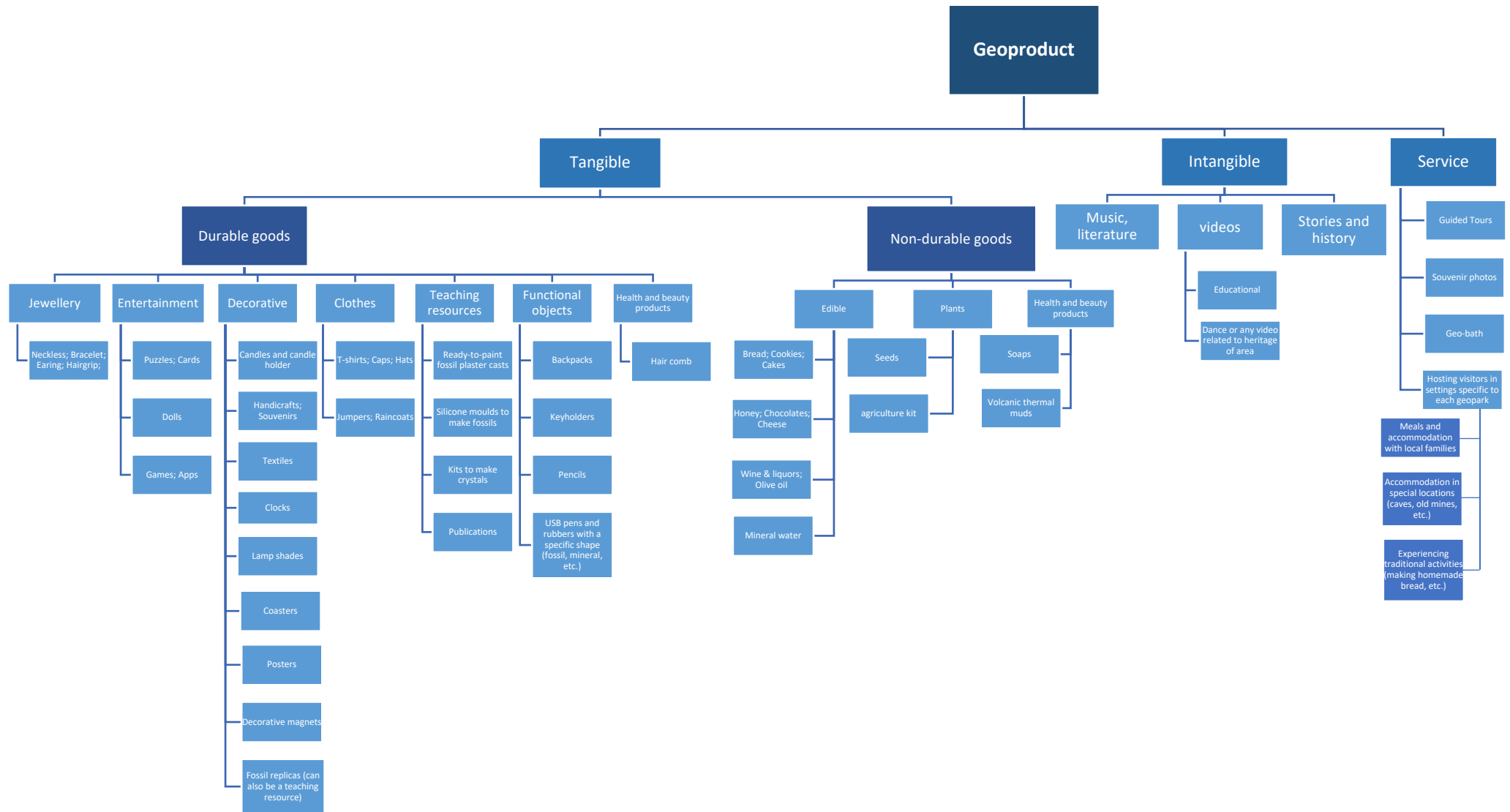


Figure 4.1 – Proposal of geoproducts classification and examples

Tangible geoproducts are physical goods somehow connected with the area, they can represent a specific feature or be made by specific materials, be a local agriculture product or a local wild plant (for instance, juice made by a particular local fruit). Tangible geoproducts can be divided into durable and non-durable products. Durable products are the ones that people can use for a long time, non-durable products are the ones that have a short usage lifetime. According with UGGp principles, tangible geoproducts should not be manufactured using materials considered as geoheritage, neither from the geopark nor from any other UGGp.

Intangible geoproducts are those that preserve/record culture, tradition, or heritage of the geopark and, for this reason, they should not be forgotten.

The service category is related to providing a specific experience to visitors that is related with a particular feature of the geopark. For example, many regions in the world have their own costumes, which usually are expensive and bulky, making unreasonable for tourists to buy them. Therefore, visitors may enjoy the opportunity to rent one of these costumes, take a souvenir photo in a particular location of the geopark and live this particular experience (figure 4.2). Other examples are given in table 4.2.



Figure 4.2 – Visitor wearing a local costume in Abyaneh, Iran (photo by Fereidoon Bahrami Samani).



Figure 4.3 – Andi is a mascot inspired on the andesitic rocks of Hațeg UGGp, Romania (A), Playing cards with illustrations of dinosaurs, one of the most popular fossils in Yanqing UGGp (China) (B).



Figure 4.4 – Silicone moulds with fossil shapes.<sup>9</sup>

<sup>9</sup> <https://juniorgeo.co.uk>



Figure 4.5 – Traditional cooking in the ground using geothermal heat in the Azores UGGp, Portugal (photos by José Brilha).



Figure 4.6 – Frukt and Cider in Magma UGGp, Norway.<sup>10</sup>

<sup>10</sup> <https://magmaopark.no/en/discover-experience/geofood/produser-2>

### **4.3. Why are geoproducts important and how can they be produced?**

The economic impact on local communities is one of the major assets of geoproducts (Eder & Patzak, 2004; Torabi Farsani et al., 2012). In addition, geoproducts contributes to raise awareness of geodiversity as they symbolically represent geoheritage elements of the geopark (Rodrigues et al., 2021). According to what was defined in previous sections, geoproducts can also promote knowledge about the cultural and biological heritage of the territory.

The UNESCO Global Geoparks Network Guidelines (2010) refer that geoproducts are tools for protecting the georesources of the geopark.<sup>11</sup> For instance, producing chocolates, candles, soaps, etc. with the shape of a fossil, can be an effective approach to avoid people to collect fossils and instead of collecting fossils illegally, they can buy some products that represent those fossils, which has a positive local economic impact as well.

The production of geoproducts needs to consider the country 's social and economic setting. In a developing country like Iran or Brazil, the local communities can play the main role as it is easy to show them that their engagement in the production of geoproducts can bring a direct economic benefit. The Queshm UGGp provides an opportunity for local women to offer their handmade handicrafts to tourists, which help them to receive an income and encourage to do more. They also learn general explanations about landforms and sites to visit in the geopark that they share with their customers (Amrikazemi et al., 2012).

In developed countries, like Sweden, where the social welfare covers most of the population that needs an economic aid, it is harder to engage local communities on the design and production of geoproducts. Therefore, perhaps a way to convince local people to be involved on this activity implies a previous effort on the raise of awareness on the richness and uniqueness of local heritage and enhancement of their sense of pride, for instance, with the organisation of annual events and competitions like cooking, knitting, etc. In addition, sometimes younger generations in developed countries that could be interested in making geoproducts are not familiar with old activities/traditions that today are completely forgotten in their communities.

In the Arouca UGGp, the project GeInvolve is a good example to attract the interest of local population on a possible involvement with the production of geoproducts (Sousa et al., 2011). The idea for this project started with the visual similarity of the shape between the homemade maize bread crust and the "maize bread rocks" geosite. It started with some talks in parishes to raise the awareness of the

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<sup>11</sup> [http://www.globalgeopark.org/uploadfiles/2012\\_9\\_6/ggn2010.pdf](http://www.globalgeopark.org/uploadfiles/2012_9_6/ggn2010.pdf)



local community and to try to recover ancient traditions promoting at the same time and inter-generational exchange. This project was integrated in the annual festival of the municipality, with a workshop and a contest related with the production of maize bread.

Torabi Farsani et al. (2012) underline the importance of branding and marketing for the success of geoproducts. Hence, geoparks should provide adequate consultation in order to assure that their geoproducts achieve a good market position. With the agreement of the geopark, a local producer may use the UGGp logo on geoproducts, which is a valuable tool to increment the public visibility and attraction.<sup>12</sup> For instance, GEOfood is an official label recognized by UGGp, which confirms that a certain edible geoproduct is, in fact, produced in a certain geopark.<sup>10</sup>

Finally, it is worth to mention that the involvement of young students might create interesting opportunities. In some countries, students after their graduation from secondary school have the possibility to join technical and vocational training organizations to learn different professions. These students are very good candidates to bring new ideas that might give a "new life" to ancient local products. Also, history and art students are good candidates to recover old stories and tales that could be used on geoproducts.

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<sup>12</sup> <https://magmaopark.no/en/discover-experience/geofood/>

## **5. The Platåbergens aspiring Geopark**

Sweden is one of the few European countries still with no UGGp. However, in order to promote the geopark concept in the country, the Geological Survey of Sweden (SGU) is encouraging the establishment of national geoparks.<sup>13</sup> At this moment, there is one national geopark (Siljan). Platåbergens Geopark is the first aspiring geopark under UNESCO evaluation in 2021.

### **5.1. General characterisation**

Platåbergens Geopark is located in southwest Sweden, in the region of Västra Götaland and is a cooperation between nine municipalities (figure 5.1): Trollhättan, Vänersborg, Grästorp, Lidköping, Götene, Mariestad, Skara, Skövde, and Falköping. The whole characterisation of the geopark here presented was mainly based on the UGGp application dossier (Bergengren et al., 2019).

The geopark partially borders the southern part of Vänern lake, the largest lake in Sweden (5650 km<sup>2</sup>) and the third in Europe. The geopark has an area of 3,690 km<sup>2</sup> and an altitude ranging from about 40 m near the lakeshore to 330 m at Ålleberg in the south sector of the geopark. There about 289 thousand inhabitants, with an estimated annual population growth of 11,200 inhabitants until 2040. On average, there are 78 inhabitants per square kilometre but most population are concentrated in towns. However, the geopark is only about 1-hour drive (80 km) from Gothenburg, the second-largest city in Sweden (about 570,000 inhabitants in the city and 1 million in the metropolitan area).

Västra Götaland, in terms of population, is the second-largest region in Sweden with 1,734,443 inhabitants<sup>14</sup>. In the geopark, the population is mostly concentrated around the major cities of Trollhättan, Vänersborg, and Skövde. The local economy is mostly based on agriculture, manufacturing, and services. The municipalities that have received more immigrants have higher unemployment rate (6.2%).

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<sup>13</sup> <https://www.sgu.se/samhallsplanering/naturvarden/geoturism/geoparker/svensk-geopark/>

<sup>14</sup> <https://www.regionfakta.com/vastra-gotalands-lan/>

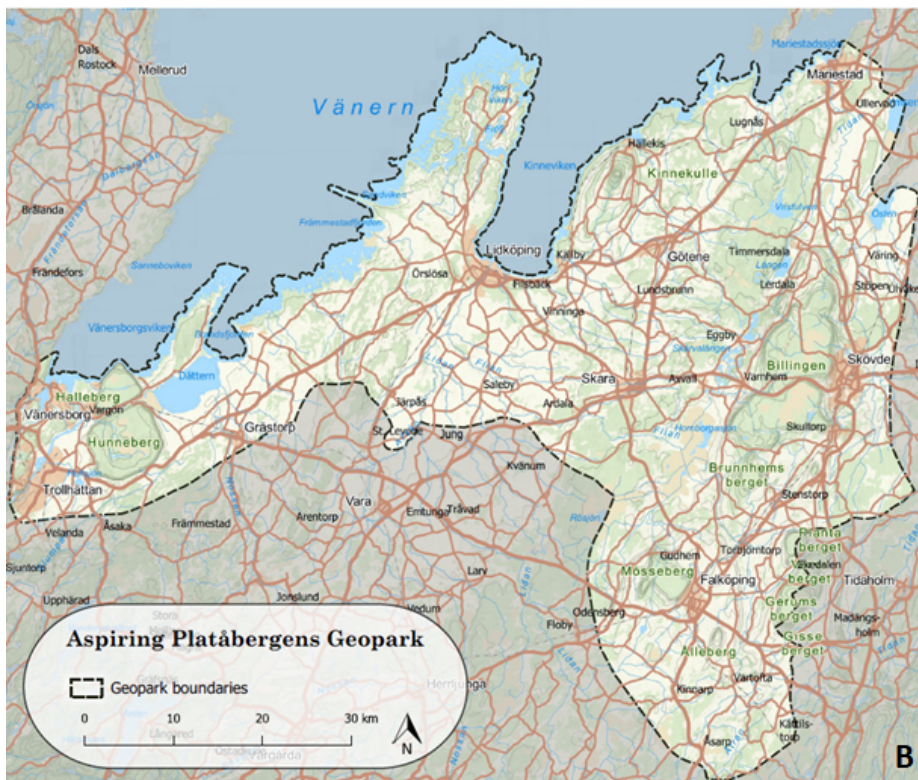
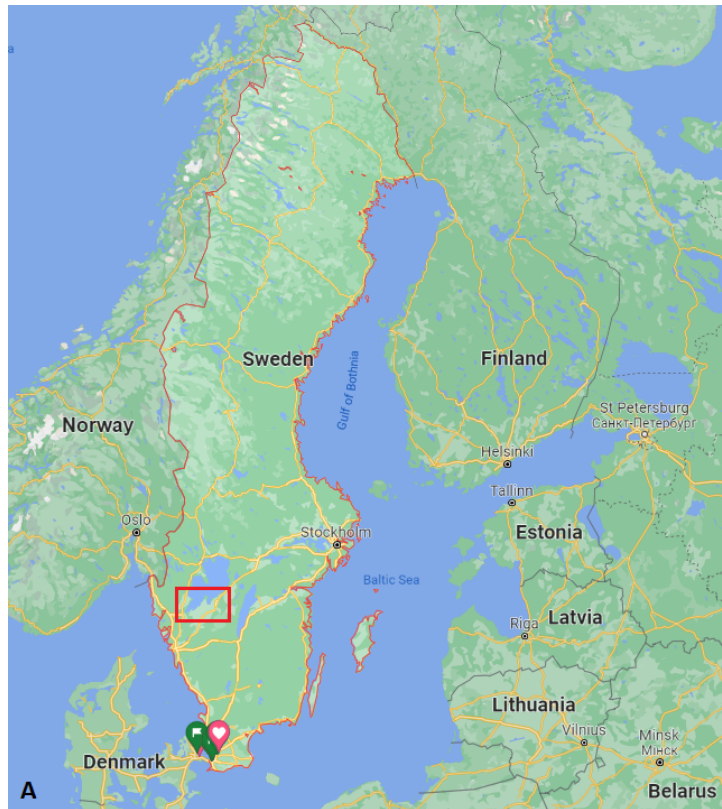


Figure 5.1 – Location of the aspiring Platåbergens Geopark at the regional context (A) and at the local context (B) (Bergengren et al., 2019).

## 5.2. Geodiversity

The geodiversity of Sweden is the result of a long geological history (around 2800 Ma). The bedrock is composed by magmatic and metamorphic rocks that were strongly eroded during the last glaciation, originating the typical landscape of Scandinavia.<sup>15</sup>

In the area of the geopark, the older rocks are magmatic (granitic rocks) and metamorphic rocks (gneisses, migmatites) with about 1700 Ma old (figure 5.2). The bedrock is also composed by Palaeozoic metasedimentary (shales, sandstones, conglomerates, limestones) and intrusive rocks (dolerite) that have intruded as sills about 300 Ma ago. The dolerites are very well represented in the local landscape as they form the upper layer of mesas, flat-topped hills reaching 330m high at Ålleberg (figures 5.3 and 5.4).

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<sup>15</sup> <https://www.sgu.se/en/geology-of-sweden/rocks/the-bedrock-of-sweden/>

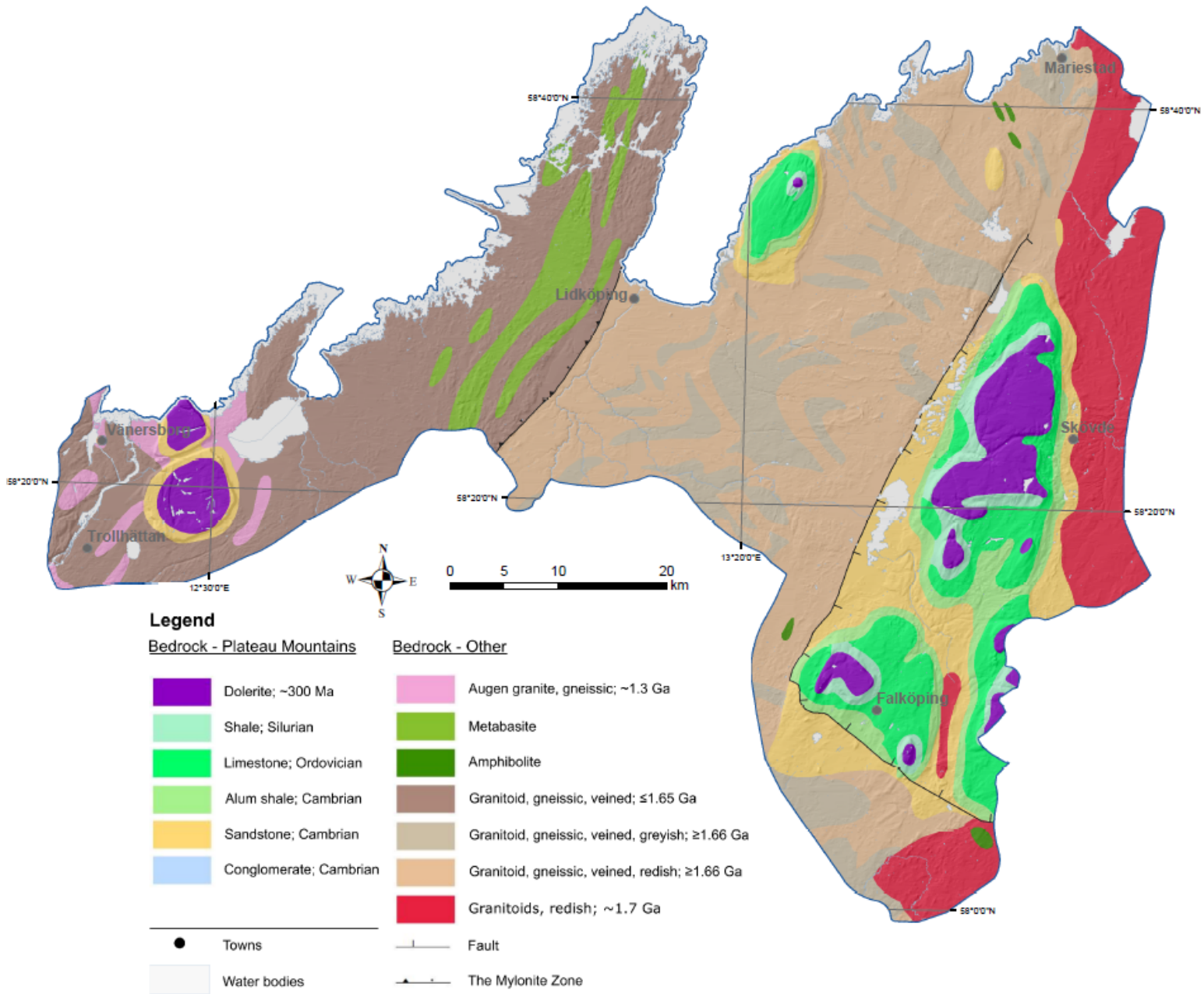


Figure 5.2 – Geological map of the bedrock at Platåbergens Geopark (Bergengren et al., 2019).

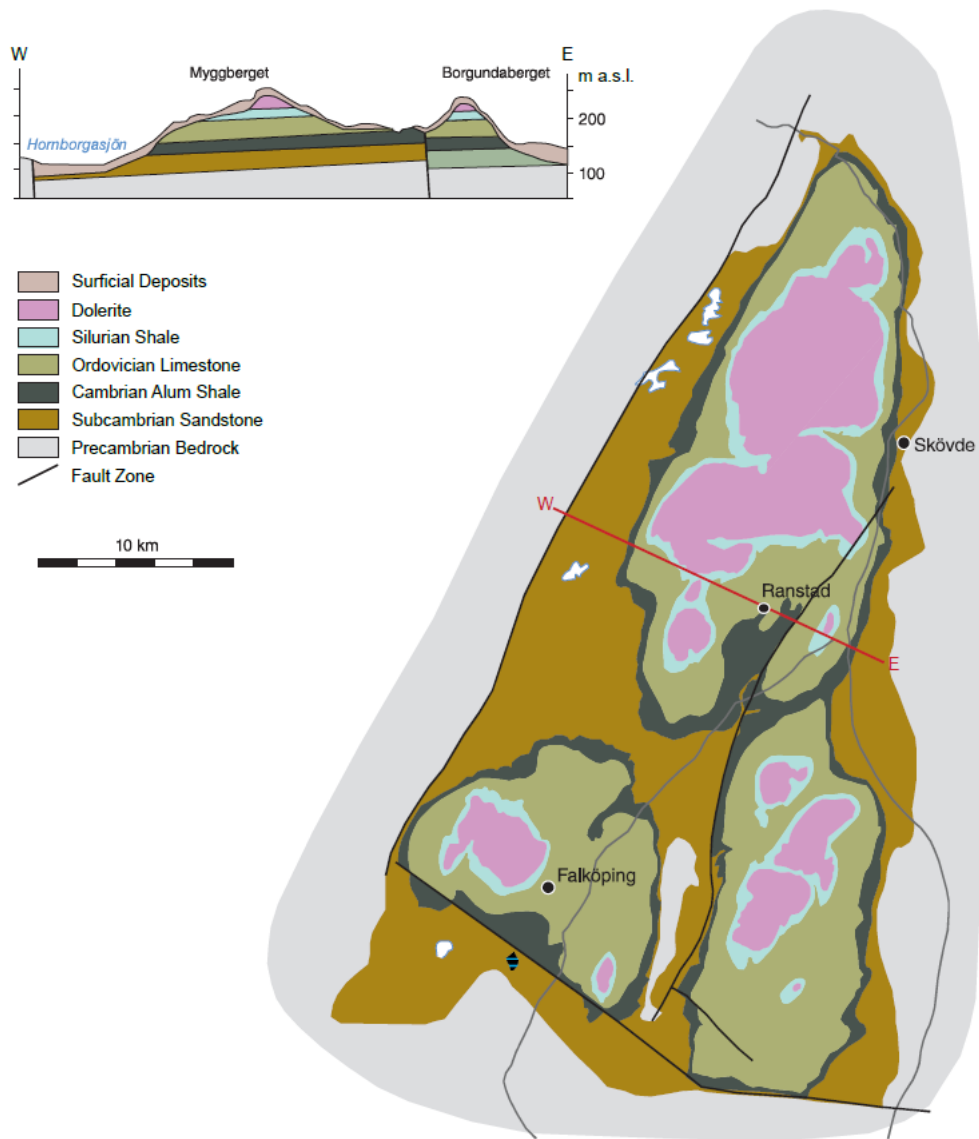


Figure 5.3 – Simplified geological map of table mountains in the Billingen–Falbygden area, modified from Wik et al. (2002) (Bergengren et al., 2019).

The Cambrian metasedimentary rocks have abundant marine trace fossils and a microscopic fauna of early arthropods. The Ordovician limestone shows evidences of the Great Ordovician Biodiversification Event (GOBE), an unprecedented rise in marine biodiversity on the family, genera and species level.

This limestone is also very rich in fossil meteorites, some of them with an odd and rare achondritic composition that is the result of an Ordovician bombardment. The geopark thus houses the largest known archive of fossil meteorites in the world.

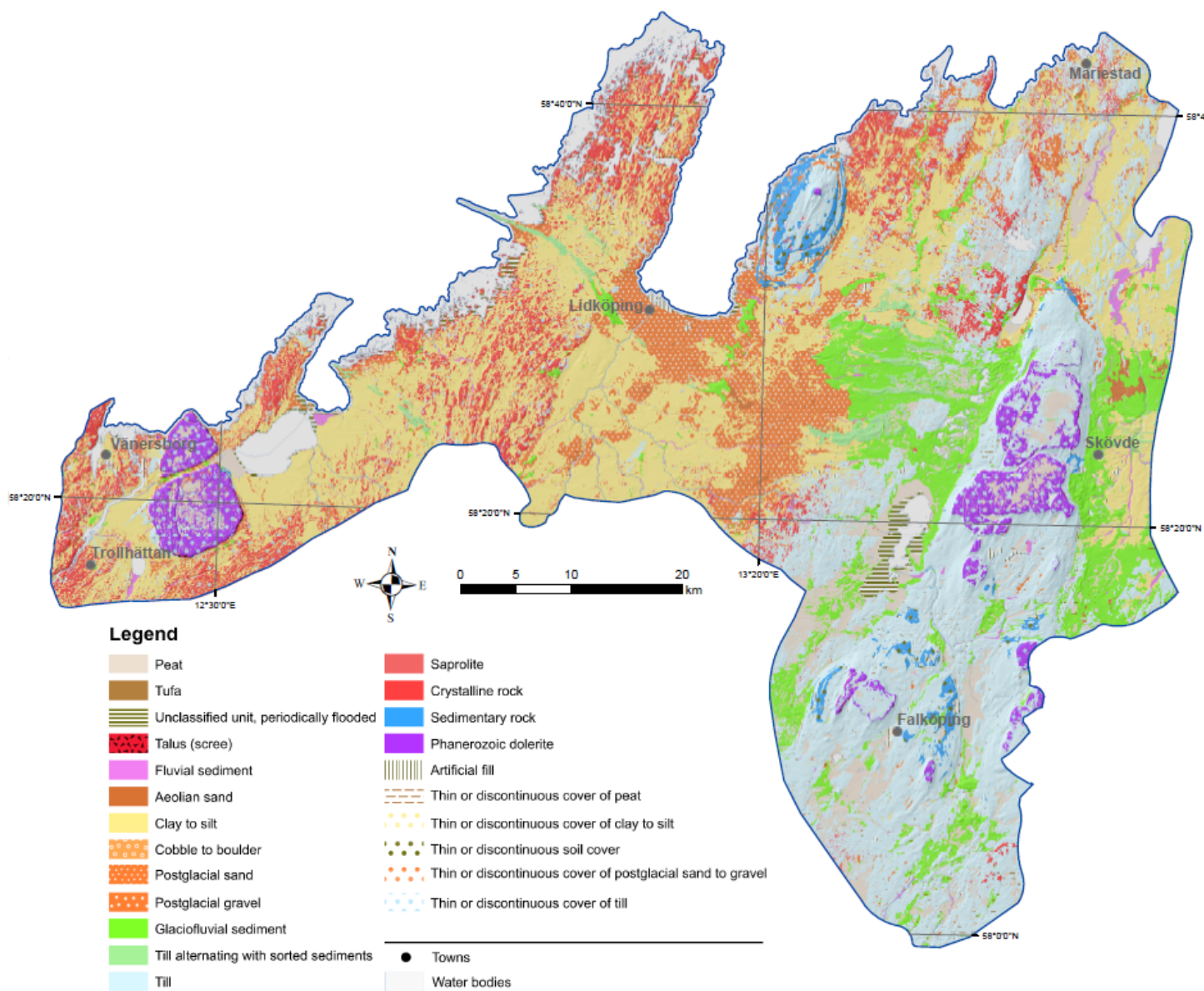


Figure 5.4 – Geological map of the Quaternary deposits at Platåbergens Geopark (Bergengren et al., 2019).

The area of the geopark is a preserved flat land shaped by peneplanation events during the Mesozoic and Cenozoic, modified by later deep-weathering in warm climates and subsequently modified by the Pleistocene glaciations. The current landscape was mostly affected by the last Ice Age, about 115,000 years ago. The whole area of the geopark was covered with a thick ice layer with up to 3.5 kilometers which has caused a high erosion on underlying rocks of the bedrock. This erosion also happened during the “return to Ice Age conditions” episode, referred to as the Younger Dryas (13 to 11,6 ka) that has originated peculiar end moraines composed almost entirely by clay, included in the

Middle Swedish End Moraine Zone (MSEMZ). During the subsequent deglaciation, a catastrophic drainage to the west of the dammed Baltic Ice Lake into the sea has provoked some erosional and sedimentary features that are visible in the geopark area.

### 5.3. Geological heritage

Platåbergens Geopark currently has 106 geological sites but only 52 geosites have been chosen to be integrated in the UGGp application (figure 5.5 and table 5.1).

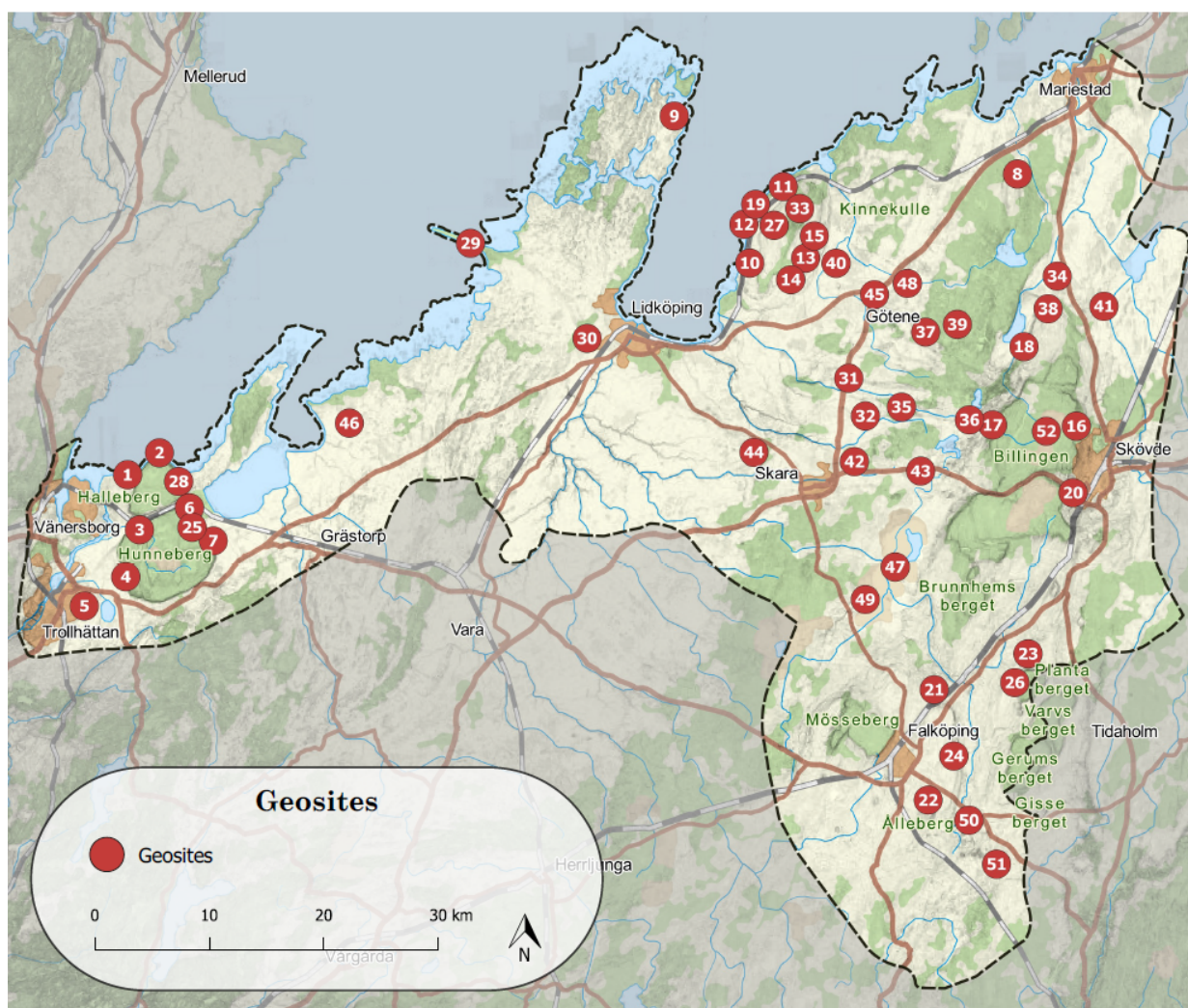






Figure 5.5 – Map of the distribution of 52 geosites in the geopark (Bergengren et al., 2019).



Table 5.1 – List of geosites within Platåbergens Geopark (Bergengren et al., 2019). The symbol  represents the top five geological sites of the geopark. MSEMZ – Middle Swedish End Moraine Zone.

ID	Name of site municipality and geographical coordinates	Key words	Relevance and potential use (INT: International, NAT: National, Reg: Regional, Sci: Scientific, Edu: Educational, Tour: Touristic)
1	Nordkroken, Vänersborg 58°23'17.3"N   12°24'16.9"E	Bedrock site, sub-Cambrian peneplain, granite, conglomerate	INT  Sci, Edu, Tour
2	Predikstolen, Hallesnipen, Vänersborg 58°24'20.8"N   12°27'05.8"E	Bedrock site, viewpoint, dolerite	REG Tour
3	Geology Trail, Byklev, Vänersborg 58°20'42.5"N   12°25'25.4"E	Bedrock site, stratigraphy, sedimentary bedrocks, geotrail	NAT Edu, Tour
4	Västra Tunhem's caves, Vänersborg 58°18'29.3"N   12°24'15.7"E	Bedrock site, alum shale, dolerite, cultural history	NAT Edu, Tour
5	Slättbergen, Trollhättan 58°17'04.7"N   12°20'35.8"E	Bedrock site, sub-Cambrian peneplain, granite, conglomerate	INT Sci, Edu, Tour
6	Gyllene spiken, Grästorp 58°21'46.6"N   12°29'52.0"E	GSSP, fossil site, Floian age, alum shale	INT  Sci, Edu, Tour
7	Flo viewpoint, Grästorp 58°20'52.6"N   12°31'04.4"E	Viewpoint, dolerite, Västgötaslätten plain	REG Tour, Edu
8	Lugnås millstone quarry, Mariestad 58°37'42.6"N   13°44'08.6"E	Bedrock site, gneiss, conglomerate, sandstone, millstone production	INT Sci, Edu, Tour
9	Källandsö, Lidköping 58°40'25.9"N   13°13'08.8"E	Bedrock site, gneiss, mylonite zone, large area	NAT Sci, Tour
10	Kakeled, Götene 58°33'31.6"N   13°19'19,8"E	Bedrock site, alum shale, fossil site, old quarry	INT Sci, Edu
11	Large quarry at Hällekis, Götene 58°36'39.9"N   13°23'28.7"E	Bedrock site, limestone, old quarry, orthoceratites, fossil site	INT Sci, Edu, Tour
12	Trolmen harbour, Götene 58°35'44,5"N   13°20'16.2"E	Bedrock site, sandstone, sub-Cambrian peneplain, conglomerate	INT Sci, Edu, Tour
13	Österplana hed, Götene 58°34'26.6"N   13°25'33.1"E	Bedrock site, alvar plain, limestone	INT Edu, Tour
14	Kinne-Kleva, Götene 58°32'44.9"N   13°23'41.7"E	Bedrock site, alum shale, limestone, old quarry	NAT Sci, Edu, Tour

15	Thorsberg's quarry, Götene 58°34'44.4"N   13°25'46.9"E	Bedrock site, meteorites, limestone, quarry	INT Sci, Edu
16	Ryds grottor, Skövde 58°25'50.1"N   13°49'20.9"E	Bedrock site, dolerite, viewpoint	NAT  Tour
17	Jättadalen and Öglunda caves, Skara 58°25'54.3"N   13°41'49.9"E	Bedrock site, dolerite, viewpoint	NAT Tour
18	Silverfallet, Skövde 58°29'35.0"N   13°44'40.4"E	Bedrock site, sandstone, alum shale, limestone, old quarry	REG Edu, Tour
19	Råbäck harbour, Götene 58°36'22.1"N   13°20'45.5"E	Bedrock site, sandstone, sub-Cambrian peneplain, conglomerate	INT Sci, Edu, Tour
20	Cementa's south quarry, Skövde 58°22'41.9"N   13°49'00.8"E	Bedrock site, fossil site, limestone, old quarry	NAT Sci, Edu, Tour
21	Tomtens limestone quarry, Falköping 58°13'27.2"N   13°36'32.8"E	Bedrock site, fossil site, limestone, old quarry	REG Sci, Edu, Tour
22	Ålleberg, Falköping 58°08'15.3"N   13°35'59.7"E	Viewpoint, table mountain, sedimentary bedrocks, dolerite, landscape	INT Edu, Tour
23	Djupadalen, Dala, Falköping 58°15'07.8"N   13°44'55.9"E	Geomorphological site, bedrock site, canyon, limestone, ice lake drainage site, alvar	NAT Edu, Tour
24	Djupadalen, Karleby, Falköping 58°10'19.8"N   13°38'17.3"E	Geomorphological site, bedrock site, canyon, stratigraphy	REG Sci, Edu, Tour
25	Dolerite quarry, Hunneberg, Grästorp 58°21'38.2"N   12°30'07.5"E	Bedrock site, dolerite, old quarry	REG Sci, Edu
26	Högstena, Plantaberget, Falköping 58°13'46.8"N   13°43'44.3"E	Bedrock site, shale	REG Sci, Edu
27	Råbäck's limestone quarry, Götene 58°35'48.1"N   13°21'34.3"E	Bedrock site, alum shale, fossil site, old quarry	NAT Edu, Tour
28	Shingle field at Grytet, Vänersborg 58°22'22.8"N   12°29'37.1"E	Geomorphological site, shoreline, rounded rocks	REG Edu, Tour
29	Hindens Rev, Lidköping 58°34'23.1"N   12°54'50.1"E	Geomorphological site, peninsula, end moraine, MSEMZ	INT  Sci, Edu, Tour
30	Rådaåsen, Lidköping 58°29'57.0"N   13°05'23.6"E	Geomorphological site, end moraine, MSEMZ	NAT Sci, Edu, Tour

31	Ledsjö moraine, Götene 58°28'06.7"N   13°28'55.1"E	Geomorphological site, end moraine, MSEMZ	NAT Sci
32	Skåning-Åsaka moraine, Skara 58°26'20.1"N   13°30'24.5"E	Geomorphological site, end moraine, MSEMZ	NAT Sci, Edu
33	Höggkullen – Kinnekulle drumlines, Götene 58°36'06.0"N   13°24'29.1"E	Geomorphological site, drumlines	NAT  Sci
34	Låstad esker, Mariestad 58°32'53.9"N   13°47'41.4"E	Geomorphological site, esker	NAT Sci, Edu
35	Krogstorp esker, Skara 58°26'45.4"N   13°33'39.2"E	Geomorphological site, esker, outwash fan	NAT Sci
36	Valle Härad, Skara, Skövde 58°26'08.8"N   13°39'45.2"E	Geomorphological site, kame landscape, MSEMZ	INT Sci, Edu, Tour
37	Store Mon, Skara 58°30'17.1"N   13°35'49.7"E	Geomorphological site, sedimentary deposits, Baltic Ice, Lake drainage site	INT Sci, Edu
38	Stora Stolan, Skövde 58°31'21.9"N   13°46'51.2"E	Geomorphological site, bedrock site, sedimentary deposits, Baltic Ice, Lake drainage site, alum shale, old quarry	INT Sci, Edu, Tour
39	Klyftamon, Götene, Skövde 58°30'38.5"N   13°38'41.1"E	Geomorphological site, Baltic Ice Lake drainage site	INT Sci, Edu, Tour
40	Kestad De Geer moraines, Götene 58°33'31.5"N   13°27'46.3"E	Geomorphological site, De Geer moraines	NAT Sci, Edu
41	Binneberg DeGeer moraines, Skövde 58°31'28.1"N   13°51'52.6"E	Geomorphological site, De Geer moraines	NAT Sci, Edu
42	Skara moraine, Skara 58°24'11.3"N   13°29'25.7"E	Geomorphological site, end moraine, MSEMZ	INT Sci, Edu, Tour
43	Axevalla hed, Skara 58°23'44.6"N   13°35'21.9"E	Geomorphological site, outwash fan, sedimentary deposits	REG Tour
44	Händene sand dunes, Skara 58°24'37.1"N   13°20'25.0"E	Geomorphological site, sand dunes, aeolian processes	INT Sci
45	Pellagården varved clay, Skara 58°32'03.0"N   13°31'13.8"E	Geomorphological site, varved clay, scientific test site, Baltic Ice Lake drainage site	INT Sci
46	Tun moraine, Lidköping 58°25'51.9"N   12°44'06.2"E	Geomorphological site, end moraine	NAT Sci, Tour

47	Lake Hornborga, Skara, Falköping 58°19'13.7"N   13°33'04.8"E	Geomorphological site, lake	NAT Edu, Tour
48	Holmestad esker, Götene 58°32'34.5"N   13°34'11.6"E	Geomorphological site, esker	NAT Sci, Edu, Tour
49	Ore backar, Skara 58°17'41.9"N   13°30'23.9"E	Geomorphological site, esker	REG Tour
50	Rännefalan delta, Falköping 58°07'18.3"N   13°39'37.2"E	Geomorphological site, outwash plain, Åsle Ice Lake drainage site	REG Sci
51	Nolgården Näs, Falköping 58°05'14.2"N   13°42'03.9"E	Geomorphological site, esker net	INT Sci, Edu, Tour
52	Blängsmossen, Skövde 58°25'36.2"N   13°46'38.7"E	Raised bog, mountain plateau	NAT Sci, Edu, Tour

The geological features of some of these sites briefly presented below were selected in order to inspire ideas for geoproducts that will be described in the next chapter.

- **Site No. 6 Gyllene spiken (golden spike)**

This site is a disused quarry located on the east side of Hunneberg and corresponds to the Global boundary Stratotype Section and Point (GSSP) of the Floian Stage (477.7±1.4 Ma, Lower Ordovician) (figure 5.6). This GSSP is marked by the first appearance of the graptolite *Tetragraptus approximatus* (Bergström et al., 2004) (figure 5.7). The stage name Floian was named after the small village of Flo, located east of Hunneberg.



Figure 5.6 – Golden spike marking the GSSP layer.<sup>16</sup>



Figure 5.7 – Graptolite fossil (Photo by Jonas Lind).

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<sup>16</sup> <https://www.platabergensgeopark.se/en/portfolio/gyllene-spiken-en/>

- **Site No. 10 – Kakeled**

This fossil site in an old quarry is located in the southwest slope of Kinnekulle (figure 5.8). Here, the Cambrian alum shale presents abundant trilobites (figure 5.9).



Figure 5.8 – Kakeled site.<sup>17</sup>

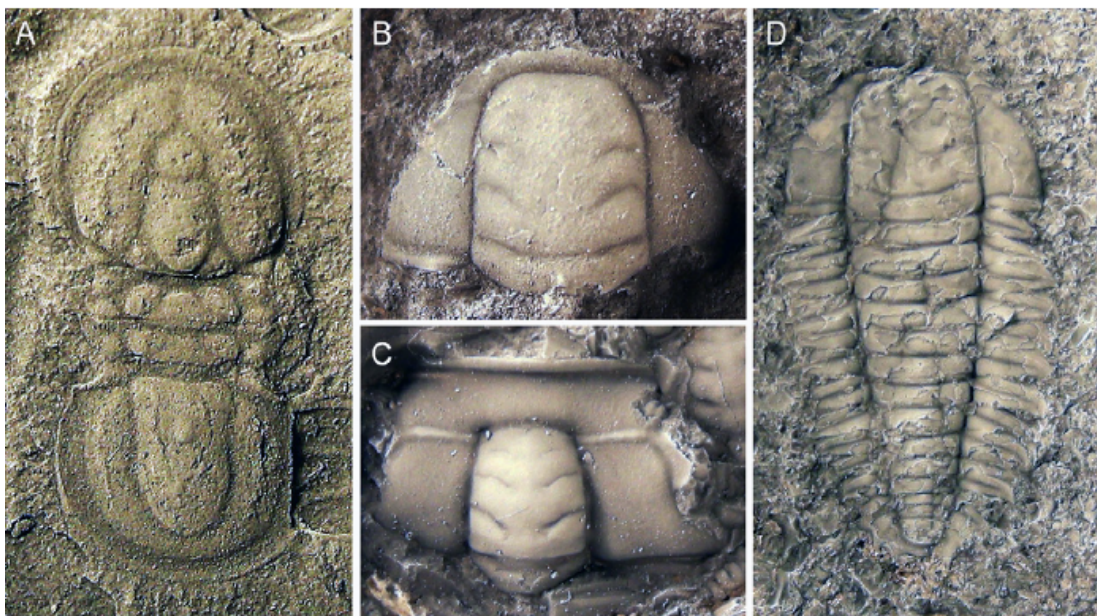


Figure 5.9 – Agnostoids and trilobites from the Kakeled quarry. A – *Agnostus pisiformis*,  $\times 8.6$ . B – *Peltura minor*,  $\times 7.0$ . C – *Olenus gibbosus*,  $\times 6.7$ . D – *Peltura scarabaeoides*,  $\times 4.5$  (Photos by P. Ahlberg) (Calner et al., 2013).

<sup>17</sup> <https://www.platabergensgeopark.se/en/portfolio/kakeled-en/>

- **Site No. 15 -- Thorsberg's quarry**

This fossil site is the only quarry where limestone is still extracted at Kinnekulle. A peculiar occurrence of meteorites is found in this limestone, which makes this site one of with international relevance (figure 5.10).



Figure 5.10 – Meteorite included in the Cambrian limestone (Photo by Eva Lena Tullborg).

- **Table mountains**

In the Västergötland province, there are fifteen table mountains (figure 5.11): Halleberg, Hunneberg, Kinnekulle, Lugnåsberget, Billingen, Mösseberg, Ålleberg, Brunnhemsberget, Tovaberget, Myggeberget, Borgundaberget, Plantaberget, Gerumsberget, Varvsberget, and Gisseberget, the last one located outside the geopark boundaries.

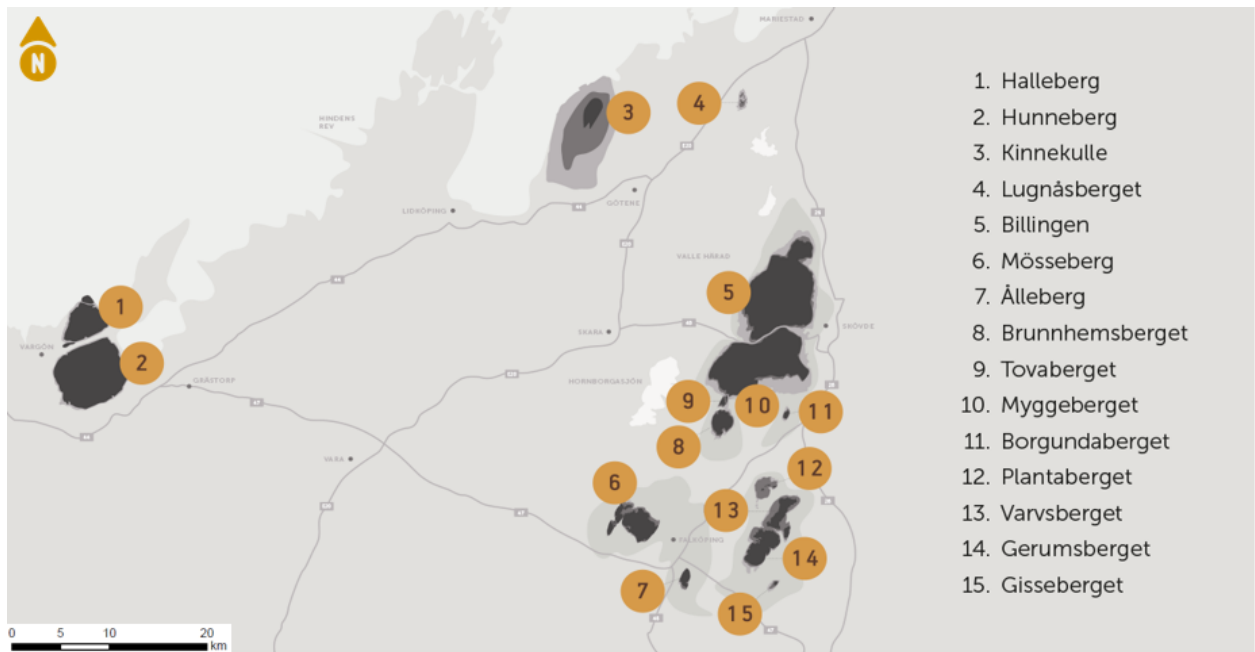


Figure 5.11 – Map with the location of table mountains.<sup>18</sup>

Table mountains in the geopark have all a similar structure, defined by a succession of horizontal rock formations (figure 5.12). The flat-topped layer is constituted by dolerite, a rock that easily resist to weathering under this climate (figure 5.13).

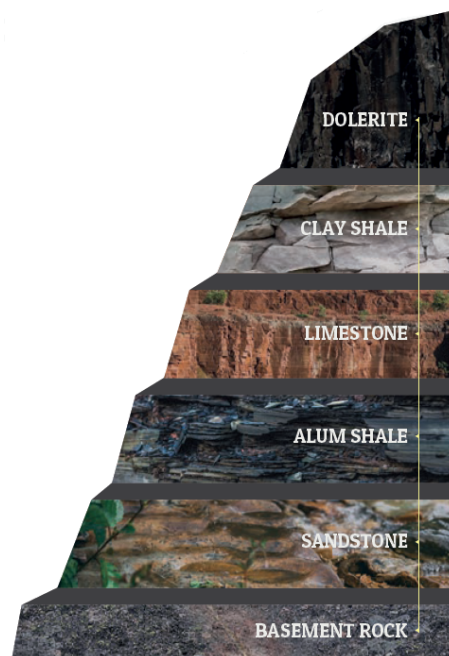


Figure 5.12 – Typical structure of table mountains in the geopark (Stenström, 2021).

<sup>18</sup> <https://www.platabergsgeopark.se/en/15-table-mountains/>





Figure 5.13 – Ålleberg table mountain, the highest point of the geopark. Mt Kinnekulle and Mt Billingen by the horizon (photo by Anna Bergengren).

- **Martorpsfallet**

This site is a waterfall on the Cambrian limestones, which presents *Orthoceras* fossils, among other marine species (figure 5.14). Martorpsfallet is part of the so-called limestone cleft, a distinct step in the limestone that runs all the way around Kinnekulle mountain. The cleft was created after the last Ice Age, when the sea level was higher due to the subsidence of the land by the weight of the ice. This site has national relevance and presents touristic and educational significance. This site is not listed in the above geosites' table but the geopark will include it in a next revision (personal communication by the geopark staff).



Figure 5.14 – Martorpsfallet waterfall over the limestone cleft<sup>19</sup>

In addition to natural features presented above, one element of the geopark's cultural heritage was selected in order to inspire ideas for geoproducts. The tree of life slabs were carved in medieval times on sandstone and limestone and used essentially in graves (figure 5.15). These artefacts are unique in the Västergötland region, especially Kinnekulle mountain, and can for example be seen at the small Forshem's stone museum. These slabs have national relevance, cultural and touristic significance and are one of top five cultural features in the geopark.

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<sup>19</sup> [https://www.platabergensgeopark.se/wp-content/uploads/2021/01/Platabergen\\_Annex2\\_Geological\\_heritage.pdf](https://www.platabergensgeopark.se/wp-content/uploads/2021/01/Platabergen_Annex2_Geological_heritage.pdf)



Figure 5.15 – Tree of life slabs in Forshem's stone museum .<sup>20</sup>

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<sup>20</sup> <https://www.platabergensgeopark.se/en/portfolio/forshems-stenmuseum-en/>

## 6. Conceptualization of geoproducts for the Platåbergens aspiring Geopark

The Platåbergens aspiring Geopark has not yet developed any strategy regarding geoproducts. The ideas here proposed resulted from the analysis of the specific characteristics of natural and cultural sites of the geopark and also from some discussions and meetings with the geopark 's staff which helped to know more about the area and local communities' interests. During these meetings, it was mentioned that Swedish people is more interested in edible and useful products rather than decorative products, a preference that was taken into account during the conceptualization of geoproducts.

### Tangible geoproducts – Durable goods

#### Jewellery (neckless; bracelet; earring; hairgrip)

The idea is to use a part of the tree of life pattern and make jewellery with steel, silver, gold, or even wood. This pattern can be applied to necklaces, bracelets or any other accessories (figure 6.1).



Figure 6.1 – Tree of life slab pattern (Photo by Robert Bernhoff) (A), Design of necklace from a part of Tree of life pattern (B).

## Entertainment (puzzles)

Orthoceras is one of the fossils found at Platåbergens Geopark and it seems that when kids see this fossil, they mention that it is like an unicorn antler. Geo-Unicorn puzzle is a two-sided product, with a puzzle made of wood cells which move horizontally and vertically to get a complete image of a unicorn on one side, and with an illustration of an Orthoceras and some simple stories, on the other side (figure 6.2).

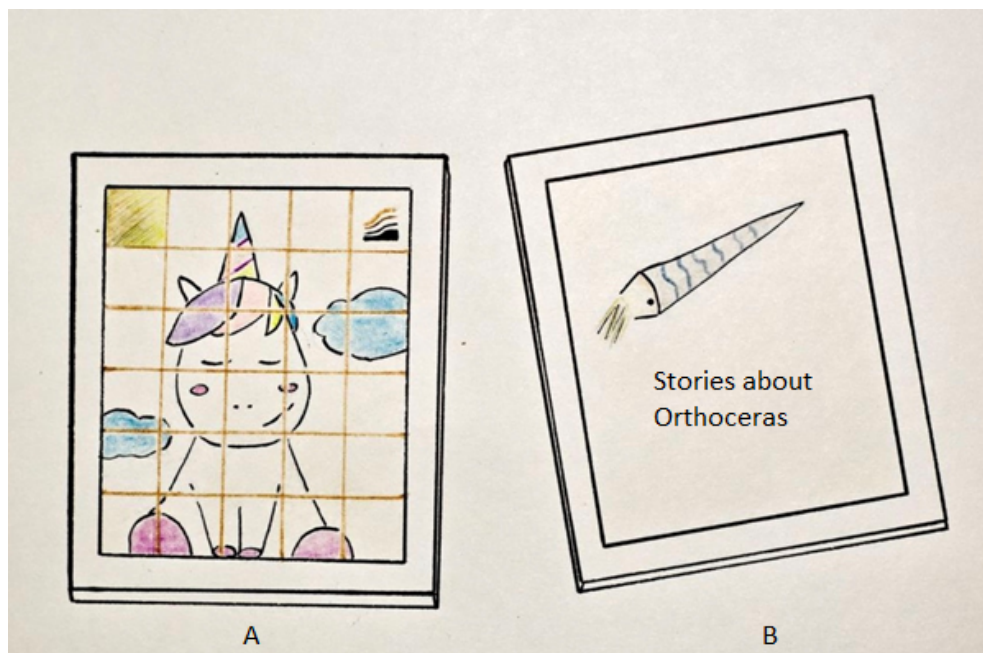


Figure 6.2 – Geo-Unicorn puzzle (A); Orthoceras drawing and some stories (B).

Cube puzzle is a wooden game made of four cubes<sup>21</sup> (figure 6.3), on each side of each cube there is part of a drawing of a specific aspect of the geopark such as a fossil, plant, or bird. Kids need to put four related sides properly to complete the image of the aspect.

<sup>21</sup> <https://choobin.com/product/%D8%AC%D9%88%D8%B1%DA%86%DB%8C%D9%86-2/>

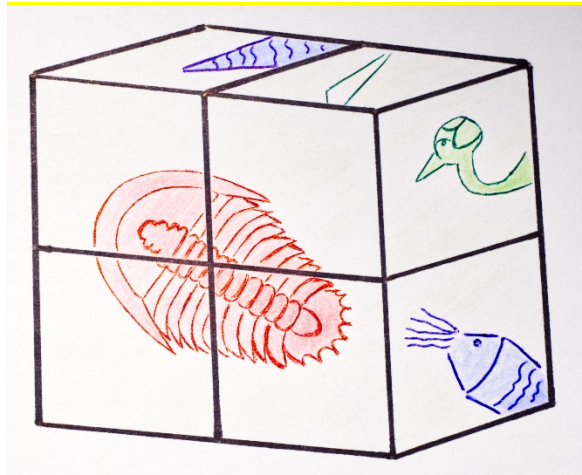


Figure 6.3 – Cube puzzle.

Table mountain cube proposal is based on the well-known "Rubix cube" and on the sub-horizontal rock layers of the table mountains structure in the geopark. This idea is to use the mechanism of the "Rubix cube" but simulate the rock layers on cube's faces (figure 6.4). The more layers are represented the higher is the difficult level. For instance, Halleberg table mountain contains three rock layers: dolerite, alum shale, and sandstone, which can be considered an easy puzzle.

Another possibility, each side of the Rubix cube represents an image of different table mountains and the final result is a complete image of each image on each side.

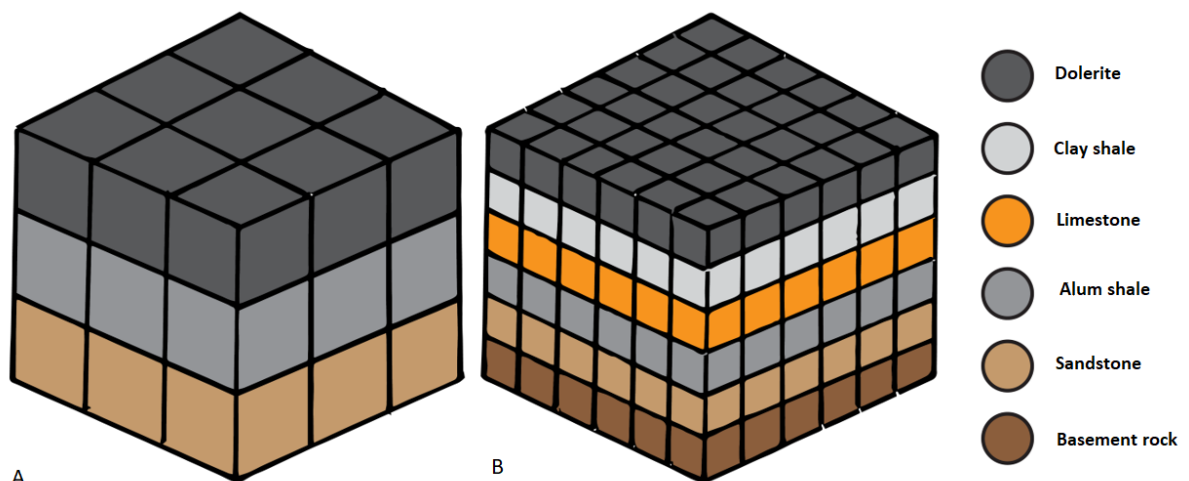


Figure 6.4 – Halleberg table mountain cube (A); Table mountain cube which contains all the layers (B).

**Decorative** (clock; pin button; badge; fridge magnets)

Fridge magnets are very popular worldwide. It would be very easy to select some local aspects of the geopark (for instance, pattern of tree of life, trilobite, orthoceras, Ordovician clock, etc.) and prepare a magnet made of wood or other available local material.

The idea of Ordovician Clock is based on Gyllene spiken site where a particular age of the geological timescale is represented. The clock's face represents the Ordovician Period and is divided into Lower (0–4h), Middle (4–7h), and Upper (7-12h) Epochs (figures 6.5 and 6.6). The difference of hours representing each Epoch is related with the difference of radiometric ages for each Age. The "golden spike" symbol at 2 o'clock represents the base of the Floian Age (Gyllene spiken geosite). The fossil drawings are according with typical fossils of the Ordovician Period. The clock's hands shape represents graptolite fossils that are found at Gyllene spiken geosite. This design can be used on a real clock, or as a badge or pin button.

System / Period	Series / Epoch	Stage / Age	GSSP
Ordovician	Upper	Hirnantian	▶
		Katian	▶
		Sandbian	▶
	Middle	Darrivilian	▶
		Dapingian	▶
	Lower	Floian	▶
		Tremadocian	▶

Figure 6.5 – Extract of the international chronostratigraphic chart representing the Ordovician Period.<sup>22</sup>

<sup>22</sup> <https://stratigraphy.org/chart>

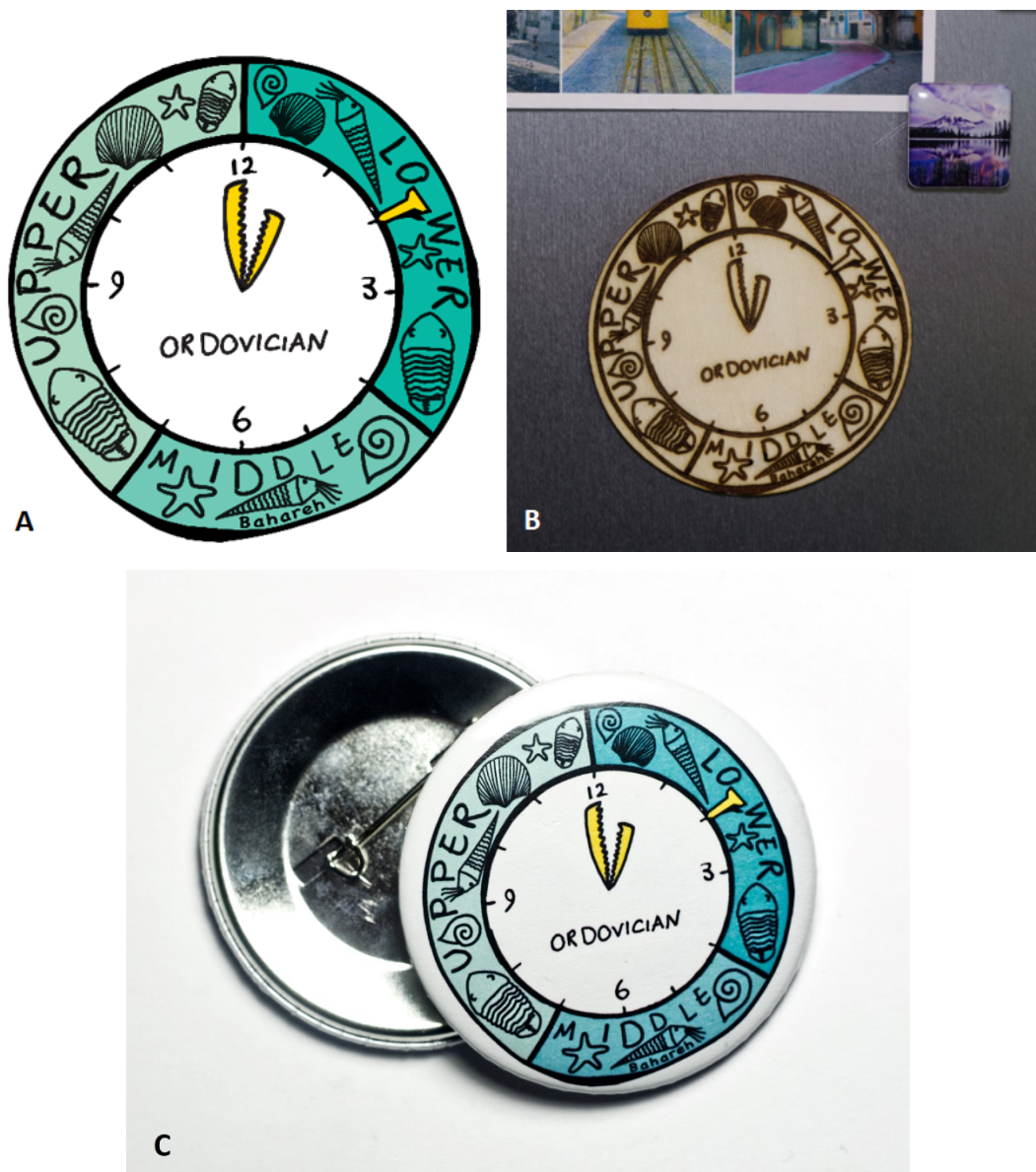


Figure 6.6 – Ordovician clock (A); Wooden Ordovician clock as a fridge magnet (B) Printed Ordovician clock on pin button (C).

**Clothes and other textiles** (T-shirt; fabric backpacks; caps; etc)

Considering that knitting is a popular hobby in this region, the production of knitted hats, headbands, gloves, socks, sweaters, scarfs, and neck gaiter with a pattern of local features that people can use in geopark's outdoor activities, is another idea.

The “textile printing method” can also be used to produce tablecloths, napkins, scarfs, fabric bags, etc. with a pattern of local features like trilobite, tree of life, etc. (figures 6.7 and 6.8). This technique applies colored patterns printed on textiles with wooden stamps or blocks.





Figure 6.7 – Left: tablecloth designed with fossil patterns from the Kolah-Qazi area and Soh village of Isfahan province (Iran). Right: wooden blocks (stamps) with fossil patterns used for printing on textile (Torabi Farsani et al., 2017).



Figure 6.8 – Iranian Qalamkār tablecloth with fossil patterns from the Kolah-Qazi area and Soh village of Isfahan province as an example of geoproduct (Torabi Farsani et al., 2017).

Considering that meteorites is a very interesting feature for many people and attracts their imagination, the existence of ancient meteorites in the geopark can also be used on geoproducts. Printing an image of a meteorite with references to the occurrence of meteorites in the geopark on a T-shirt, fabric backpacks, caps, etc. can be very an interesting motif for the geopark's merchandising (figure 6.9).



Figure 6.9 – A shot of meteorite impacts<sup>23</sup>

**Functional objects** (drink coaster; cutting board; anti-stress ball)

The production of cutting boards, drink coasters, or any other functional objects with some local features carved or painted on is another possibility to enhance the geoproducts offer of the geopark (figure 6.10).

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<sup>23</sup> <https://www.businessinsider.com/nasa-just-found-rare-meteorite-fragments-in-the-ocean-2018-7>



Figure 6.10 – Examples of drink coasters (A)<sup>24</sup> and cutting board (B)<sup>25</sup>.

Some products can be produced inspired on the trilobites of Kakeled geosite, such as erasers or soaps. The shape of the *Agnostus pisiformis* arthropod of the same site can be also inspire the production of anti-stress balls (figure 6.11).

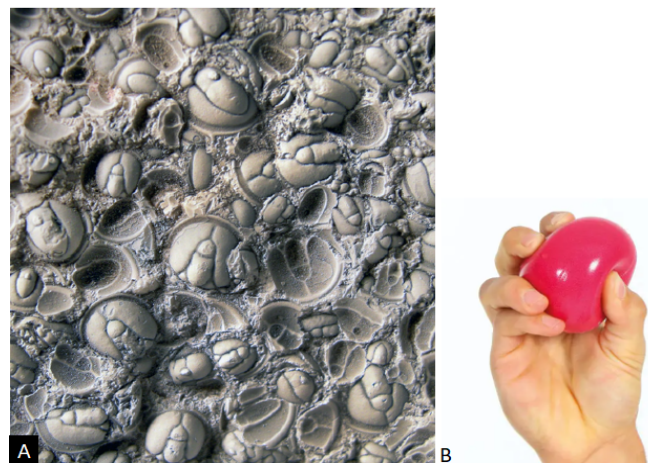


Figure 6.11 – Mass occurrence of *Agnostus pisiformis* in the Kakeled Limestone (Photo by P. Ahlberg) (Calner et al., 2013) (A); Anti-stress ball (B).<sup>26</sup>

<sup>24</sup> <https://www.quora.com/Whats-the-word-for-the-thing-used-to-prevent-tea-or-coffee-cup-rings-on-the-table-on-which-a-cup-is-placed>

<sup>25</sup> <https://www.amazon.com/Authentic-Engraved-Chopping-Vegetables-Multipurpose/dp/B08CTK3V88>

<sup>26</sup> <https://www.medicalexpo.com/prod/togu/product-70340-717613.html>

## Tangible geoproducts – non-durable goods

**Edible** (cake; jelly; pancakes; chocolates)

Cakes or jellies with coloured layers representing the rock layers of the geopark's table mountains might attract young people's attention (figure 6.12).



Figure 6.12 – Examples of layered cake<sup>27</sup> (A) and jelly<sup>28</sup> (B). The colours of these cake layers should be more realistic regarding the real colour of the mountain tables rock layers.

Another possibility is the production of Martorpsfallet pancakes (figure 6.13). The idea is to pill up chocolate pancakes and decorate them with white cream/chocolate, vanilla sauce or sugar glaze to represent the limestone layers and the water falling over the rocks. Local cafes could offer a creative menu with specific terms related with the territory or show photos of the waterfall near the pancakes in order to attract tourists' attention.

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<sup>27</sup> <https://www.tastingtable.com/cook/recipes/italian-rainbow-cookie-recipe>

<sup>28</sup> <https://pengskitchen.blogspot.com/2014/06/rainbow-agar-agar-jelly.html>



Figure 6.13 – Chocolate pancakes representing Martorpsfallet waterfall (Photo by Alar Ainla).

The selling of chocolates with the shape of trilobites or Orthoceras is also an easy solution as a geoproduct.

### **Plants**

Wild garlic (*Allium ursinum*) grows in Platåbergens Geopark on lime-rich soils over the alum shale and in broad leaf woodlands (figure 6.14). They grow and bloom during a short period in spring, and it is for example popular to make soup made with this plant or to use it as a herb to flavour other food. Therefore, seeds of wild garlic or even the plant on small pots could be sold to national visitors, considering that there are some international restrictions to avoid the proliferation of non-endemic species to some countries. Another possibility is to offer an agriculture kit, which can comprise seeds, soil, pot, gloves, some tools, etc.



Figure 6.14 – Photo of *Allium ursinum* in Platåbergens Geopark (Photo by Henrik Theodorsson).

### **Intangible geoproducts**

Considering the existence of evidence of ancient meteorites in the geopark, an educative video to raise awareness of visitors about this topic could be a relevant geoproduct, either to be shown in visitor centres or to be sold as a DVD. Depending on the funding to produce such a video, it can be more or less elaborated, with virtual scenarios, 3D vision, etc.

## **7. Final considerations**

UNESCO Global Geoparks need to attract visitors to their territories in order to stimulate the economic activity with the close participation of local communities. Geoproductions made with local materials, inspired on local features and produced by local people following sustainable and ethical principles can provide visitors with an accomplishment feeling and, consequently, attracting new visitors. Geoproductions may also play a relevant role on informal education and are a good marketing tool of the geopark.

The main purpose of this study was to propose some ideas of geoproductions for the aspiring Platåbergens Geopark in Sweden. This is the first geopark in Sweden and this situation provides it the opportunity to be followed later as a model by new future aspiring geoparks in the country. The proposed geoproductions for Platåbergens Geopark were based on local natural and cultural features, and also on the profile of visitors and their interests.

The next phase is to review the proposed ideas and check the requirements for their effective implementation. It will be very important to open a dialogue with the local community in order to assess their capacity and interest to implement and sell these geoproductions. The production of geoproductions can only be developed with the close involvement of the local community. Their involvement can contribute to strength their commitment with the geopark project in their territory.

Some geoproductions proposed for Platåbergens Geopark can be adapted to other geoparks, using other local materials. It should be emphasized that some natural and cultural features of a geopark might not be very interesting for national visitors but could be really attractable for foreigners. For instance, glacial features are extremely common in Nordic countries and for this reason perhaps some geoproductions inspired on them might not be so appealing for Nordic visitors. However, for foreign visitors from other geographical settings, a simple geoproduct relate with glaciers might be fascinating.

Therefore, it is important to have a comprehensive view and consider products that could be interesting for both national and international tourists, addressed to visitors of different ages, with different purposes, and covering different prices. Each geoproduct could have a simple QR code attached that can be used to promote the geopark and to provide a simple explanation. For instance, a QR code on the Ordovician clock could link to a webpage of the geopark where a simple explanation can be given regarding the international importance of the golden spike geosite. Geoproductions are excellent opportunities to be connected with the informal education strategy of a geopark.

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