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Original Article

Volcanic Monument of Western Anatolia: Kula-Salihli UNESCO Global Geopark

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Abstract

The Kula-Salihli UNESCO Global Geopark includes evidence of geological history spanning 600 million years, from Palaeozoic metamorphic rocks to late prehistoric volcanic eruptions. It can function as a field laboratory for geosciences, demonstrating a variety of graben and fault structures and fluvial, volcanic, and karstic landscapes, in addition to rocks from various geological eras, evidence of fluvial processes, and topographic inversions caused by differential erosion. The topography and landscape elements also exhibit the qualities of a natural monument. The majority of the most recent basaltic lava eruptions, linked to the development of scoria cones, took place in the western Anatolian Kula-Salihli UNESCO Geopark during the Pleistocene and Holocene epochs. In this unique volcanic province, there is also much earlier volcanism, such as a few older lavas that overlie mesa-style uplands, conserving underneath them sediments that are loosely bound but otherwise would have been lost to erosion. Because of its rich and diverse geoheritage value, the geopark is emerging as a location for academic studies, teaching, and investigation of natural events. This study aims to introduce the volcanism-related geosites of the Kula Salihli UNESCO Global Geopark. In this context, we present the results of geomorphological research that we have been conducting in the region with an international team for many years, as well as field observations and relevant literature.

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Introduction

Geoparks are conservation areas that aim to protect the geological, natural and cultural heritage while supporting sustainable economic and cultural development of the society. This means that geoparks are the only locations where ordinary people can participate in both economic activity and natural protection processes at the same time. Geoparks are significant instruments of growth and nature protection in the twenty-first century.

Kula-Salihli Geopark is the only UNESCO registered Global geopark of Türkiye and Turkish speaking states in Middle Asia (Aytaç and Demir 2019a). The geopark consists of two main geographical sections, The Kula Volcanic Area and the Gediz Graben. Most geosites connected to volcanoes are located in the Kula area of the geopark and in areas of Salihli (Adala) that are close to Kula. The sites formed from volcanism in the Geopark area are mainly lava flows, volcanic cones, parasite cones, maars and base surge structures, dykes, volcanic lava caves and contact metamorphism zones formed through volcanism. Kula volcanic region is one of the youngest and most popular volcanic fields of Türkiye. In this area, volcanism initiated approximately 1.7 Ma and continued until prehistoric times. During the entire Pleistocene, volcanism took place in three separate phases and lava flows emerging from cones buried most of the paleotopography so that the evidence of older rocks has been preserved extensively. The Kula Volcanic Region, which hosts the majority of the geosites within the Geopark area is an area of international geological significance.

Since ancient times, the Kula Volcanic area has been a popular destination. Strabo (63 BC–24 AD), the renowned Greek geographer, compared the Italian volcanics to Kula. He noted that the volcanic field of Kula is comparable to areas where volcanoes once existed in Italy. As a result, Kula Volcanic Province appears to be the first location in history where the concept of an "extinct volcano" was documented. Due to the coal-black lava, Kula was referred to by Strabo as "Katakekaumene" (Burnt-Country) in his magnificent book "Geographica" (Gümüş 2014). In ancient times, this region was considered to be one of the entry points to the underworld.

The importance of geology in addition to Kula's unique cultural heritage was described in detail by the renowned French historian Charles Texier (1862). Scientific research on the Kula volcanoes region began around the beginning of the nineteenth century and has continued to the present. Hamilton and Strickland (1841) and Philippson (1913) conducted studies on the geology and geomorphology of the Kula volcanic field and stressed the importance of this volcanic region (e.g., Jones 1954). The geochemistry of the lava flows in the area was first studied later that century, when Washington (1894, 1900) named the lava at Kula "Kulaite." According to Canet and Jaoul (1946), the volcanic cones are approximately situated on a pair of straight lines whose strikes are sub-parallel to the Gediz Graben margin in the area. Later researchers Erinç (1970) and Ozaner (1992) focused on the geomorphology while Ercan (1981) and Bunbury (1992) focused on the petrology and tectonic of the Kula volcanites. Up to now more than five PhDs and a MSc thesis have been submitted on Kula volcanism, and there are more than 100 scientific papers.

Kula-Salihli Geopark, where geodiversity is very high, geological heritage elements can be classified into five groups: stratigraphic, structural, volcanic landforms, landform, and geoarchaeological. The volcanic geosites are probably the most important, and here we describe the volcanic richness of the Kula- Salihli Geopark and emphasize the region's significance in terms of geotourism, geoprotection, and sustainable development.

Location

The Kula-Salihli UNESCO Geopark, located in the western Turkish province of Manisa, spans the northern section of the Gediz graben over the administrative-territorial boundaries of the Kula and Salihli municipalities (Fig. 1). The 2320 km2 geopark, which is geographically divided into the Gediz graben and the Kula Volcanic Province, includes 73 unique geosites. The Kula Volcanic Province is located on the northern uplifted shoulder (Horst block) of the graben (Fig. 2).

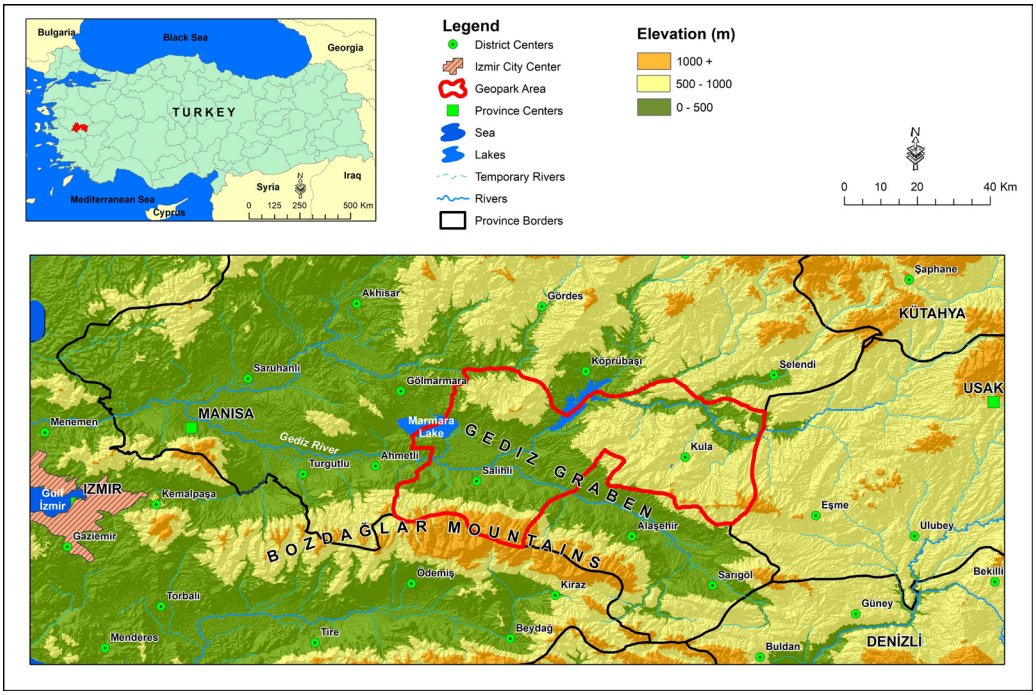

Figure 1. Location map of The Kula Salihli UNESCO Global Geopark

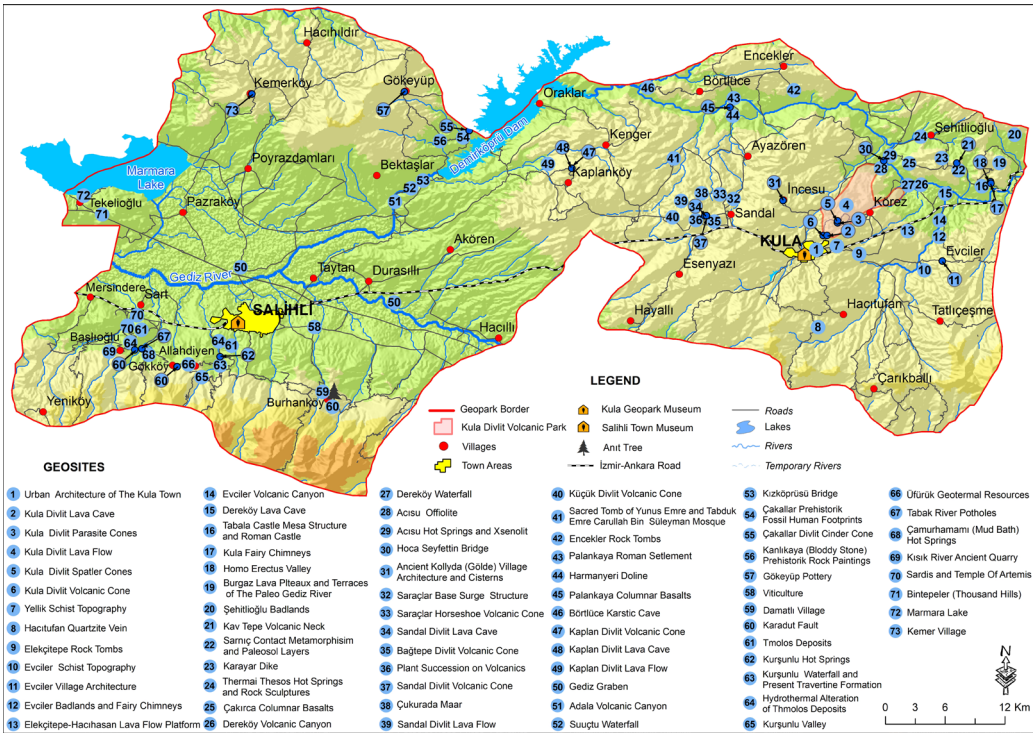

Figure 2. Geosite map of The Kula Salihli UNESCO Global Geopark

Methods

In this study, topographic maps of 1/100000 and 1/25000 scales, geological maps at 1/100000 scale from the MTA General Directorate, SRTM DEM data, and literature on the study area and its surrounds were all used. The results of our geological-geomorphological carried out in the area with an international research team for many years, as well as the relevant literature, have been used to determine the geosites associated with volcanism, which are practically natural monuments in the area.

General Information About Kula-Salihli Geopark (History and Management Structure of the Geopark)

Protection of geoheritage in the Kula region started with the protection of the Sandal Divlit and Kula Divlit volcanic cones and the lava flows arising from them. These volcanic geosites are under strict protection, within the framework of the legislation numbered 2863 and dated 23.07.1983, of the Republic of Türkiye Ministry of Culture and Tourism, concerning the protection of natural and cultural sites. These areas, which were taken under protection long before the geopark was established, also host the most important geosites of the geopark.

The effort to designate the Kula region as a geopark has a ten-year history, beginning with a European Union (EU) project of the 2007–2008 program (Aytaç and Demir 2019a). The first official proposal to the Global Geoparks Network (GGN) was submitted in November 2012 after several years of work to designate the region as a geopark under UNESCO requirements. As a result, in March 2013, the Kula Volcanic Geopark became Turkiye's first candidate for a Global Geopark.

In June 2013, experts affiliated with the Global Geoparks Network reviewed the geopark and approved it as Turkiye's first geopark, which was officially recognized by the network in September 2013. According to a 2017 revalidation, Kula Geopark could not fulfill several of the UNESCO requirements. As a result, the geopark management body was restructured, and a modernized structure was established in accordance with UNESCO requirements (Aytaç and Demir 2019b). In this circumstance, the territories of the geopark and all its geosites were reevaluated; the territory of the geopark expanded from 302 km2 to 2321 km2; its name was changed to Kula-Salihli Geopark, and a comprehensive extension proposal was submitted to UNESCO. The geopark thus received new approval in July 2019 and was reregistered with UNESCO in 2020.

Having been accepted as a Global Geopark in 2013, the Kula Geopark had to adopt the UNESCO strategy on the construction and maintenance of Global Geoparks. In 2018, Kula Geopark was expanded to establish the Kula-Salihli Geopark to preserve the long-term sustainability of the entire region, improve its management, and preserve the Salihli District's unique geological, historical, and culturally significant areas.

To comply with European Geoparks Network and UNESCO Global Geopark regulations, the three muicipalities (Manisa Metropolitan Municipality and the municipalities of Kula and Salihli) established a partially autonomous organization in 2016 to operate the Kula-Salihli Geopark. As a result, the Geopark Municipalities Union was recognized as a legislative body of the Republic of Türkiye. The geopark administrative office always makes decisions on the geopark, which are then approved by the Geopark Municipalities Union Council following consideration of recommendations from a scientific committee and, where necessary, consultation with other stakeholders (Aytaç et al. 2022). Funding of Kula Salihli Geopark (sponsorship) is made by the Union of Municipalities of the Geopark. The geopark has its own management plan and the development of the Geopark takes place within the framework of the action plan in

the management plan. The Geopark Municipalities Union is an officially recognized organization in the Republic of Türkiye. As a result, decisions about the geopark are governed by approved regulations and laws.

General Geology of the Kula-Salihli Geopark

The Kula-Salihli Geopark lies on the eastern section of Aegean Extensional Province, where the African plate subducts beneath its southern boundary and forces the continental crust in this area to extend. This subduction appears to be responsible for pulling a block of continental crust southwestward, which creates the minor Turkish plate (e.g., Meijer and Wortel 1997). The geopark area, bordered to the north and south by the WNW-trending Simav and Alaşehir grabens respectively (Seyitoğlu 1997; Bozkurt and Sözbilir 2004), is mainly located on a block of crystalline rocks of the Menderes Massif (e.g., Bozkurt 2001; Bozkurt & Oberhänsli 2001; Erdoğan & Güngör 2004), which is delimited by a southward-tilted footwall block of the Simav Graben or a southward-tilted hanging-wall block of the Alaşehir graben (Koralay *et al.* 2004; Seyitoğlu *et al.* 1997, 2004). In this province, crustal thickening brought about by earlier orogenic contraction has resulted in the extension of the continental lithosphere in a N–S orientation (Ercan *et al.* 1983; Bozkurt and Sözbilir 2004; Ersoy *et al.* 2010). The extension, which lasted from the late Oligocene to the Early Miocene, was triggered by dextral slide on the North Anatolian Fault System and collision of the African Plate below the southern margin (limit) of Anatolian Plate across the Aegean-Cyprean subduction zone (Ersoy *et al.* 2010).

Kula Volcanic Region, which also comprises the geopark's eastern side, stands in the southern half of the the Neogene Selendi Basin, which has been filled with thick Miocene Basin fill sediments. Much of the sediment in this basin is unlithified and erodes easily, resulting in a deeply incised badland landscape. A series of Quaternary basalt flows from nearly a hundred small volcanic necks have locally flowed on this incised topography, capping and thus conserving the underlying Miocene age fluvial deposits, or 'fossilising' them. The Salihli portion of the geopark, on the other hand, is located on the Gediz Graben, an E–W-trending structure which is one of western Türkiye's most notable structural components. This graben is an active asymmetric graben, with active normal faults mostly on the southern margin (Fig. 3).

Earth Science Interests

The Kula-Salihli Geopark hosts important geological records encompassing more than 600 million years of earth history, from Palaeozoic metamorphic rocks to late prehistoric volcanic activity. It functions like an outdoor laboratory for the earth and natural science researchers, with a variety of fault and graben forms, various forms of fluvial, karstic, and volcanic landforms, rocks spanning different geological eras, indications of fluvial erosional and depositional processes, and topographic inversions owing to differential erosion. A tangible record of history of the earth is presented here, disclosing proof of significant geological and geomorphological evolutionary processes. The geopark is developing as an area for scientific research, teaching, and the exploration of natural events because of its geoheritage significance, which is to be of global scientific and aesthetic relevance.

The major geosites within the Geopark can be classified into three categories: the first category reflects the geological evolution of the region, including the various volcanic landforms and structures (21), stratigraphic units (2), faults, joints (4); the second category includes regional geomorphological features and processes, and hydrological geoheritage (fluvial 5 and karstic landforms 2, erosion processes 4, and others 15); and the third category represents the geoarcheological sites (5), hosting evidence of the geological and human history of the area. In addition, the geopark area

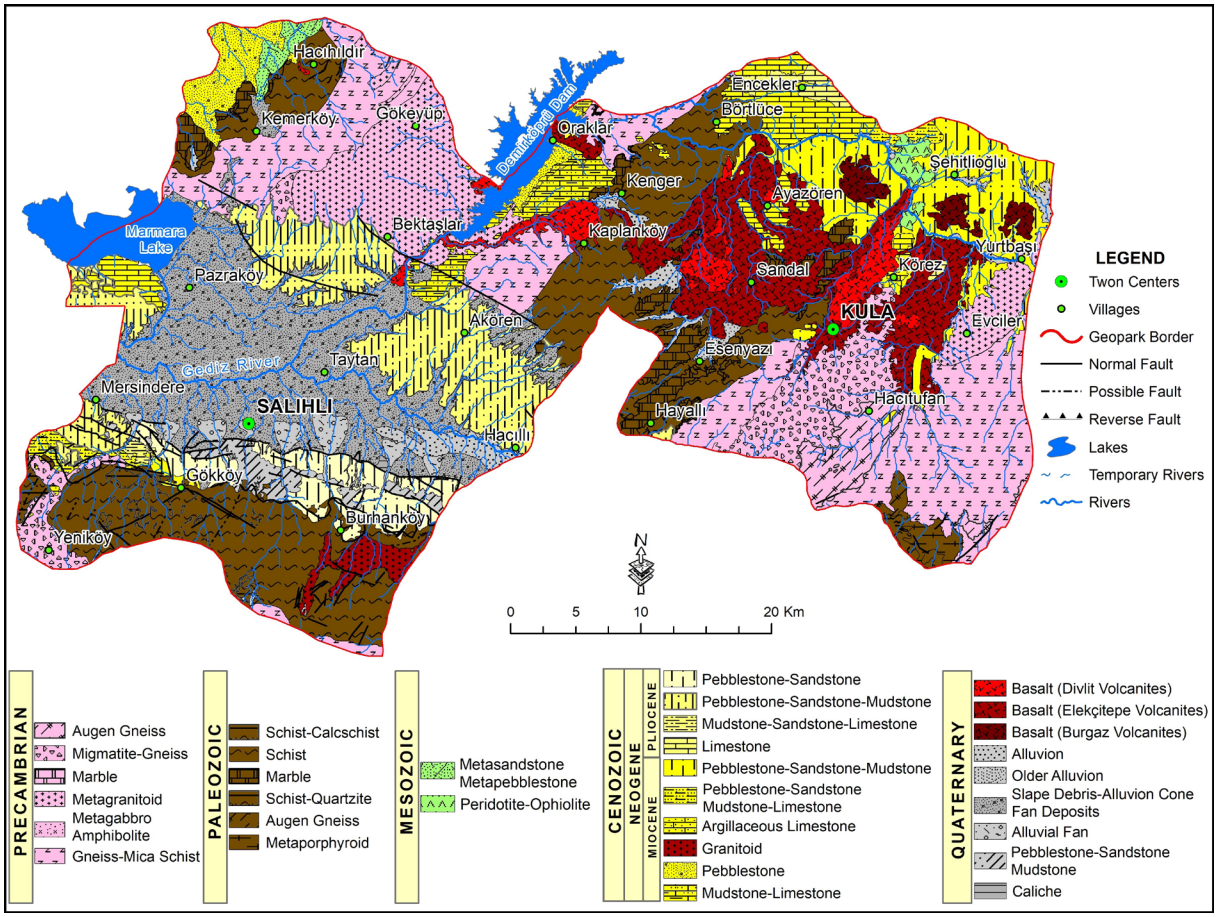

Figure 3. Geological map of the Geopark

is very rich in terms of its historical and cultural heritage as this area has been an important area of human activities since prehistoric times. This is the reason why there are 15 archaeological, historical and cultural sites within the geopark.

The geopark is a result of the impressive volcanic topography in the Kula region, which has been active since the early Pleistocene and extends to the Holocene for the most recent volcanic eruptions (2.7 ka) (van Gorp *et al.* 2013). There is also an excellent sedimentary (early Pleistocene river-terrace deposits) and geomorphological record of landscape and drainage evolution in addition to the Quaternary volcanism. Much of this record has barely remained due to the emplacement of long-lasting lavas and tuffs that have preserved the softer unconsolidated river sediments from erosion.

The Kula-Salihli Geopark provides an excellent opportunity for a diverse range of stakeholders in earth sciences to interact. The geopark is situated in one of the world's most active tectonically expanding zones. This region is a component of the "Aegean Extensional Region," an area of spreading extension that includes parts of Macedonia, Bulgaria, Greece, and Albania. As a result, the area is an excellent place for earth scientists to investigate global and regional tectonics. This area's geology also includes the best and most complete records of environmental changes related to global climate change and also regional tectonism. Lavas emanating from various cones dispersed throughout vast areas of the Kula volcanic province, form large lava plateaux covered by lavas. These lava plateaux stabilize the pre-existing landscape by preventing erosion. Thus, studying geological strata and formations underneath the lava-covered pla-

teaux that contain evidence of paleoenvironmental and paleoclimate conditions will aid scientists in determining the conditions under which they formed. Indications of Quaternary environmental changes connected to both human impact and natural processes can be seen in the geology of the geopark. Numerous badlands in the region are evidence of overgrazing in the recent past, connecting landscape change to modern civilization and culture.

Kula Volcanic Region

The Kula Volcanic Region is located in the southern part of the Neogene Selendi Basin. The volcanic field is roughly 15 km north to south and 40 km east to west. The volcanic rocks in the area are constituted of tephra and lavas ejected by 83 cinder cones (Richardson-Bunbury 1996). Most of the lava flows constitute alkali olivine basalt, phonotephrite, and basanite-classified lava flows (Güleç 1991). Tephra, tuffs, and cinder cones can also be observed. The volcanism which began around Kula 1.7 Ma generates mafic basalts that are commonly connected with active rifting (Ercan 1993; Ercan *et al.* 1983; Richardson-Bunbury 1996).

These volcanic activities and associated basalt flows are categorized into four groups, β1–β4, in ascending order of relative age, as implied by weathering and erosion extents (Canet and Jaoul 1946). Unfortunately, no objective criteria can be used to resolve the β1 category (Richardson-Bunbury 1992; Richardson-Bunbury 1996). Hence, three categories are left. The β2 basalts, commonly referred to as the "Burgaz volcanics" and are undoubtedly the oldest, cap the highest portions of the current fluvial terrain, approximately 150–200 m above the current level of the Gediz River. Their estimated total volume is 0.5 km3 (Bunbury *et al.* 2001). They are frequently seen to cover river deposits at this relative level, suggesting that the contemporary Gediz gorge had not yet started to be carved when they erupted. The β3 basalts, also termed the "Elekçitepe volcanics," which erupted after the commencement of this stage of incision and are now somewhat weathered, stand out above the current river level in the Gediz valley. The β4 basalts, also known as the "Divlit tepe volcanics," are found to be fresher in the field and, where trapped by tributaries of the Gediz, reach the current gorge floor. The combined volume of the β3 and β4 basalts is 2 km3 with most of this amount belonging to the β3 group (Bunbury *et al.* 2001) (Fig.3).

Geographically, each stage of volcanism is linked to an area with various eruption centers. Those in the far north, presently on or near basaltic plateaux, were the earliest, with strongly weathered volcanic cones or volcanic necks. The middle Pleistocene eruption centers were located even farther south, and their flows took place at lower altitudinal levels. Eventually, most of the latest eruption volcanoes are located yet further south, close to the Alaşehir (Gediz) graben, and are supported by the existence of large cones and lava flows with quite fresh, uneven surfaces on which it is difficult to walk. Most of these lava flow patterns make their way to the contemporary Gediz River north of Kula Town.

Some fossilized human footprints were found in 1970 around the Demirköprü Reservoir, adjoining to a neck (β4) yielded an age of 65 ± 7 ka, 49 ka from hornblende crystals scratched from the tephra underlying the footprint, and 26 ± 5 ka from basaltic scoria covering the footprint (e.g., Ozansoy 1969; Barnaby 1975; Göksu 1978). The context, nevertheless, implies that the tuff fall, imprinting of the footprints, and burial took place in rapid succession during the same eruption phase, rather than over tens of thousands of years. The age of the related eruption was assessed by Erinç (1970) to be 10 ka, although Tekkaya (1976) reported that the age of these footprints is approximately 12 ka.

The sites formed by volcanism in the Geopark area include lava flows, volcanic cones, parasite cones, Maar and base surge structures, dykes, volcanic lava caves, basaltic columns and contact metamorphism zones formed through volcanism.

Volcanic Cones: Un-eroded volcanic cones belong to the last stage of volcanic activity in Kula. Their geologically young age means that the morphological structures of the cones are very well preserved. Volcanic cones and structures which belong to different eruptive periods are found next to each other in the Kula area which reveals a perfect comparison for volcanic evolution and related geodynamic processes at the Sandal Divlit, Küçük Divlit and Bağtepe Divlit cinder cones (Figs. 4–5).

Volcanic cones in the geopark consist of Sandal Divlit, Kula Divlit, Küçük Divlit, Kaplan Divlit, Çakallar cinder cone, Saraçlar Horseshoe cones, the most important of which are the Sandal Divlit, Kula Divlit and Cinder cones.

Figure 4. Kula Divlit cinder cone

Figure 5. Sandal Divlit and its lava flow

Spatter Cones and Spatter Ramparts: It is possible to observe several spatter cones or lava flow forms in the Kula Volcanic Province. Spatter cones are small, steep slopes or mounds formed by spatter or welded lava pieces around the fountain of lava erupting from the cone's center and are typically around three and five meters high. They are mainly, mafic, highly fluid lavas, similar to those that formed the Hawaiian Islands. When molten lava spatter is ejected into the air by a lava fountain, and it may not have enough time to cool completely before falling to the ground. In the case of a linear fissure, lava fountaining would then form broad spatter berms, known as spatter ramparts, on both sides of the fissure. Spatter cones are circular and cone-shaped features, whereas spatter ramparts are linear wall-like features (Figs. 6–8).

Lava Flows: Lava flows are one of the most prominent morphologies of the Kula volcanic area. There are five different lava flows in the area, the Kula Divlit Lava Flow, Sandal Divlit Lava Flow, Kaplan Divlit Lava Flow, Elekçitepe and Hacıhasan lava flow platform, and the Burgaz Lava Plate (Figs. 6–7).

Lava Caves: There are many lava caves and lava tubes both inside the volcanic cone crater and around their lava flows. Some of these caves have been modified and used by people, thus having archaeological significance. On the other hand, some of them have been used as barns. The most spectacular lava caves and lava tubes are found on the basaltic canyon walls of the Dereköy Canyon (Gümüş 2014). Plenty of lava caves and lava tubes have been found within lava flows in the Kula, Sandal and Kaplan lava flow (Figs. 8–9).

Maars: Five maars have been diagnosed in the Kula volcanic area, of which Çukurada is the most prominent. The Çukurada Maar measures 110 m in depth and 1000 m in diameter. Çukurada and four others belong to the second stage of volcanism while Divlittepe Maar belongs to the last stage. Çukurada Maar was formed due to a violent ex-

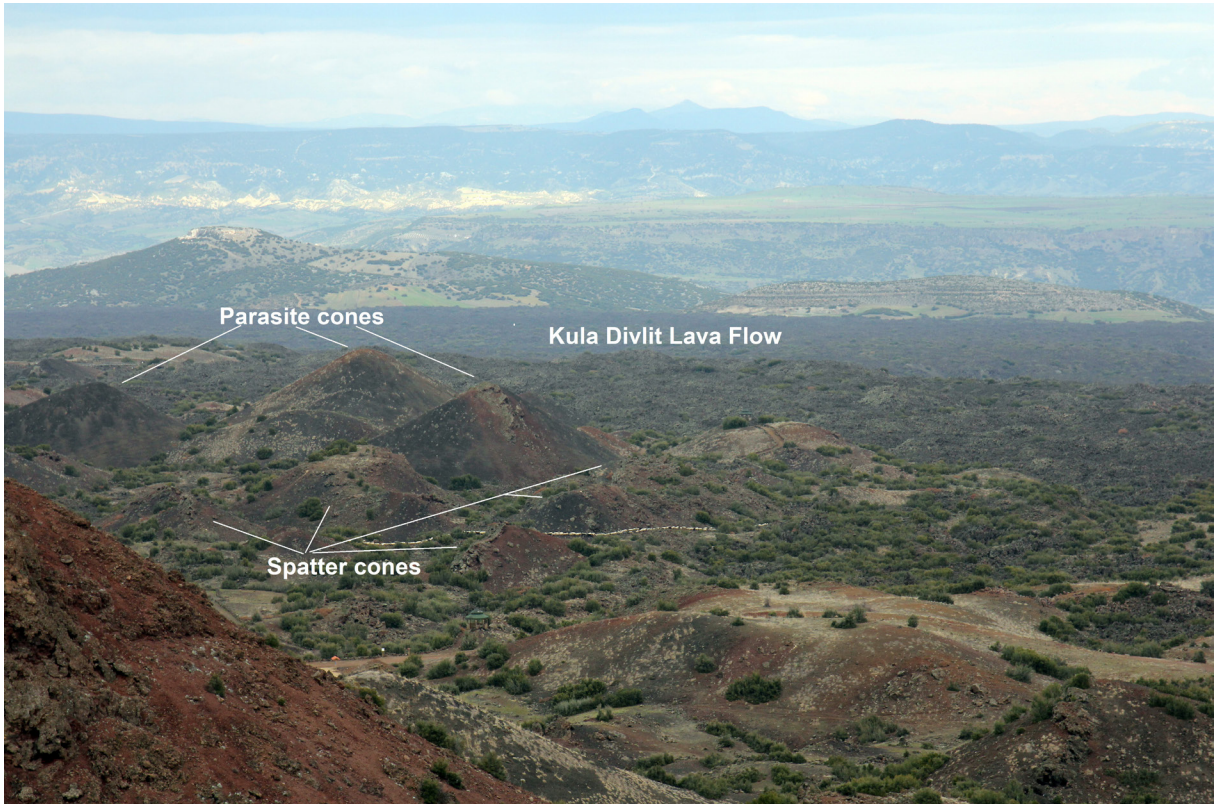

Figure 6. Various forms of parasite cones, spatter cones or spatter ramparts on the lava flow

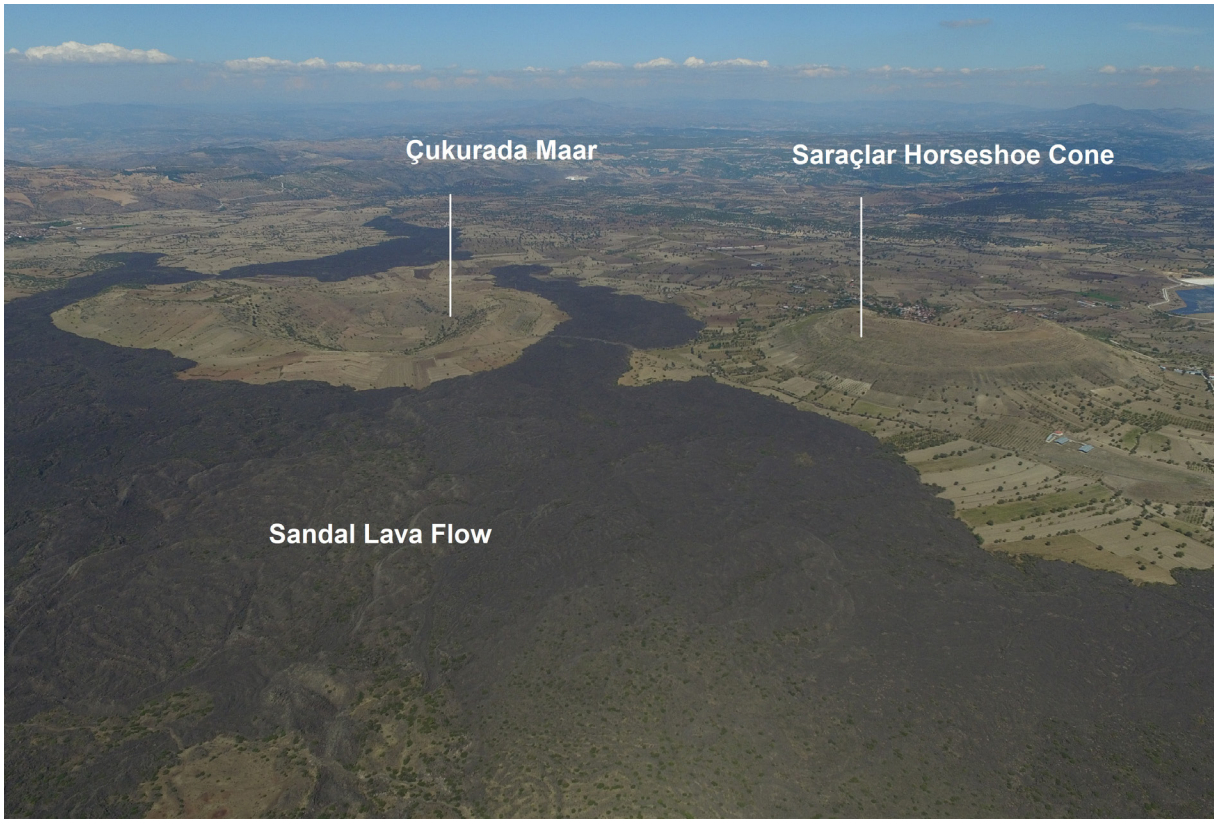

Figure 7. Çukurada Maar surrounded by the Sandal Lava Flow

Figure 8. One of the lava tube on the Kula Lava Flow

Figure 9. The lava caves and lava tubes in the Dereköy Kanyon

plosion while other maars are "tuff ring" style. Because of these explosive activities phreatomagmatic base surge structures are common in the vicinity (Gümüş 2014) (Figs. 7–10).

Base Surge Structures: Base surge bedforms have been observed around maars in Kula related to the second stage volcanism between Saraçlar and Sandal craters. Base surge deposits are rare volcanic deposits of pyroclostastic materials characterized by undulated cross beddings (Ercan and Öztunalı 1982). The base surge deposits were created by

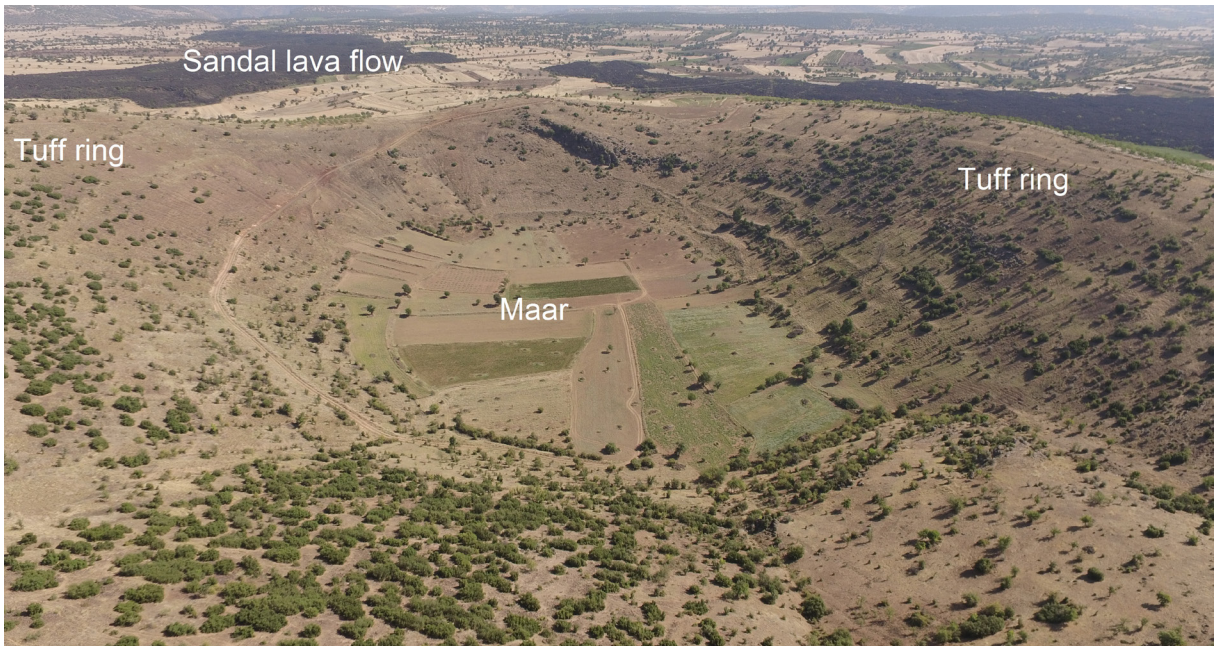

Figure 10. A view from Çukurada Maar.

shallow, explosive steam eruptions, which are turbulent mixtures of steam, and solid ejecta that originate from the crater and sweep outward with high velocities (Gümüş 2014) (Fig. 11).

Dikes: Spectacular dikes are found in Sarnıç Village. One of the most important is the Karayar dike in the Karayar area, where basaltic magma was injected into overlying lacustrine sediments. In this area, there is also a very nice volcanic feeder. In the Karayar area, basaltic dikes stand more than 100 m vertically above the land surface because

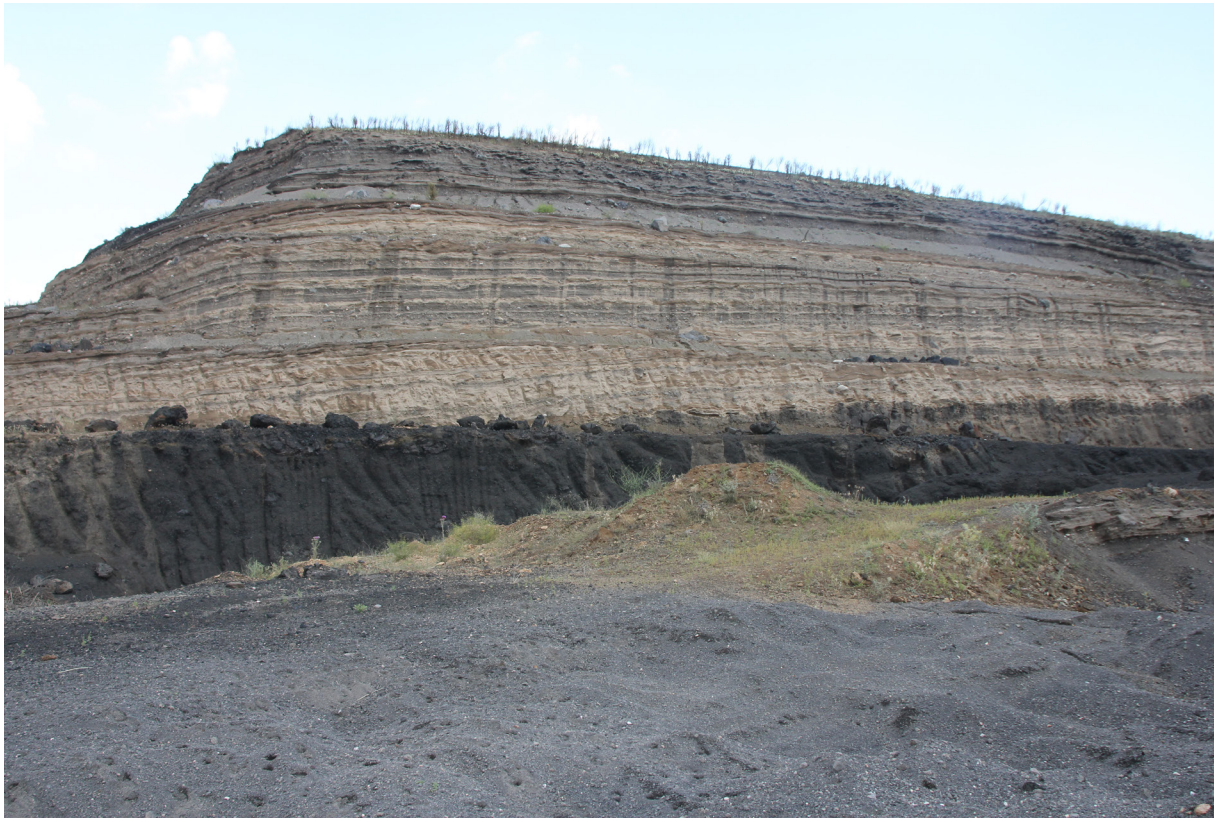

Figure 11. Base surge deposits near Saraçlar Village.

of their resistance to erosion. Dikes are layers of volcanic rock intrusions that shoulder aside other pre-existing layers or bodies of rock in an existing rock body or a crosscutting fissure, meaning that a dike is always younger than the rocks it crosscuts (Gümüş 2014) (Fig. 12–14).

Columnar Basalts: Columnar basalts can be seen around the Burgaz, Sarnıç and İbrahiağa plateaus. Spectacular columnar basalts are found near the Çakırca and Palankaya Villages where the rapid cooling of the thick lava flow has created characteristic basalt columns (Fig. 13).

Other Geosites Related to Volcanism

In Kula Salihli Geopark, there is a significant link between the origins of some geosites and volcanism. The most important geosites are mentioned below.

Sarnıç contact metamorphism and paleosoil layers: Contact metamorphism created by the cooking of clay minerals within the Quaternary fluvio-lacustrine sediments by hot lava flow can be witnessed all along the canyons and mesa structures where first (1.1 my) and second (0.3 my) stage lava flow interacted with the fluvio-lacustrine basement. This contact band can be recognized even from far due to its shiny red color (Figs. 12–14).

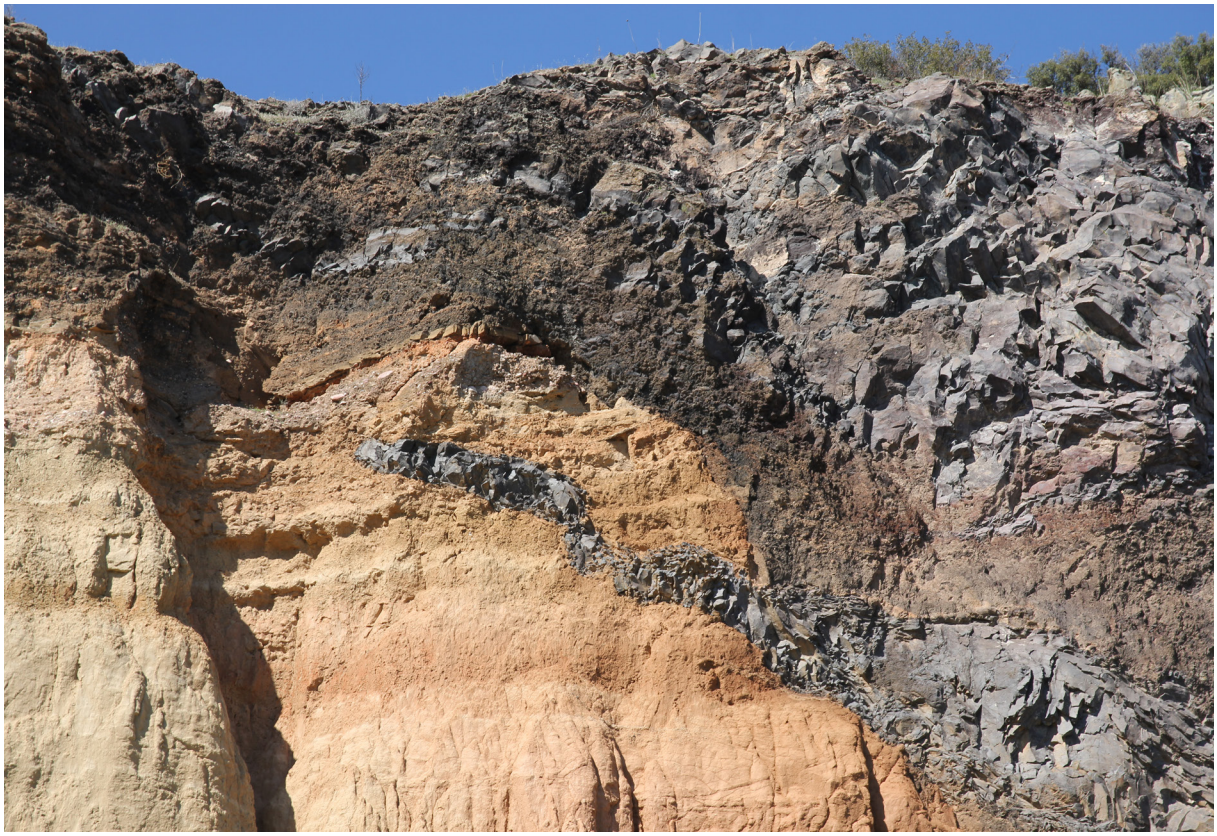

Figure 12. Karayar dike and baking zone on lake sediments

Figure 13. Columnar basalts with geo-tourists near Çakırca Village.

Figure 14. Contact metamorphism along the Sarnıç basalt plateau lava flow, paleosoil layers and Karayar dike

Burgaz Lava Plateaux and Early Pleistocene Terraces of the Paleo-Gediz River: The Palaeo-Gediz terraces have been identified beneath the high-level Burgaz and Sarnç plateaux in the Kula volcanic area, both of which are capped by some of the earliest basaltic lava flows (Maddy *et al.* 2012). These lavas originated in three necks and flowed right across the palaeo-Gediz valley floor and into the current river, smothering the pre-basalt landscape and preserving its terraced deposits (Fig. 15). Palaeo-Gediz sediments can be found in continuous parts across the Burgaz plateau, as well as in more limited outcrops along the Sarnç and İbrahioağa plateaux. Eleven terraces preserved beneath basaltic lava flows on the Burgaz plateau date from 1.67 to 1.245 Ma (MIS 59-37) (Maddy *et al.* 2017). These terraces are of worldwide significance because they formed during the early Pleistocene by the combined effects of localized tectonic uplift and obliquity-driven 41,000-year global climatic cycles. These exceptionally well-preserved terraces contain evidence of global climatic changes that took place on a worldwide scale and had a profound impact on the Mediterranean basin (Maddy *et al.* 2020).

Çakallar prehistoric fossil human footprints: The Çakallar volcanic region has unique prehistoric human footprints. These footprints were discovered by coincidence on a thin tuff layer covering the basement metamorphic bedrock during construction of the Demirköprü Dam in 1954–1960. Around 200 footprints were discovered, with approximately sixty of them being moved to the MTA's Natural History Museum in Ankara (Gümüş 2014; Türe 2018; Aytaç and Demir 2020) (Fig. 16).

Figure 15. Early Pleistocene Terraces of The Paleo Gediz River

Kanlıkaya (Bloody Stone) prehistoric rock paintings/ pictograph: The Kanlıkaya is located near the Çakallar volcano. The paintings were drawn in red colors on a gneissic rock boulder known as Kanlıkaya, which translates as "Bloody Stone" (Gümüş 2014; Aytaç and Demir 2020). Because of the strong evidence from the footprints that people observed a volcanic explosion, this pictograph (Fig. 17) stands out among other prehistoric art pieces that depict an erupting volcano (Ulusoy *et al.* 2019).

Figure 16. Çakallar prehistoric fossil human footprint

Geotourısm, Education and Public Awareness

Geotourism is a relatively new concern in Türkiye, and awareness of geo-heritage and geo-tourism is growing gradually. The Kula-Salihli geopark has a high level of geodiversity, and the fact that it is on major transportation routes contributes significantly to this potential. Guided geotourism is the most important tourism activity in the geopark. Approximately 30 geosites inside the geopark region are currently offering geotourism activities. The Kula Salihli UNESCO Global Geopark contains the volcanism-themed Kula Divlit Volcanic Park, which is completely made up of volcanic geosites (Fig. 2). Kula Divlit Volcanic Park is located in the Geopark's Kula Section, northeast of the Kula district. Kula Divlit Volcanic Park has six geosites related to volcanism. This theme park was designed so that visitors can observe lava flows and many types of volcanic cones. A 3-km- long walking path, wooden bridges, and camellias enable passage over fallen lava tunnels (Fig. 18). Kula Divlit Volcanic Park is one of Kula Salihli Geopark's most popular and visited locations.

Correspondingly, until 2014, approximately 10,000 tourists visited the Kula region annually, but that figure increased to 80,000 in 2018 and 92,000 in 2019. The state-imposed weekend restrictions had

Figure 17. Kanlıkaya (Bloody Stone) prehistoric rock paintings

Figure 18. Walking path, wooden bridges, and camellias in Kula Divlit Volcanic Park

a significant impact on geotourism during the pandemic. During this time, our geopark and visitor center were partially accessible through guided tours.

Kula Salihli geopark offers a range of activities focusing on the significance of geoheritage, its preservation, and increasing societal awareness. A variety of educational activities and excursions emphasizing the geological features of the geopark are offered for travel companies to introduce Kula Salihli Geopark and especially Kula. Field training programs are organized, and expeditions are made by the geopark management office for people from colleges and universities requiring detailed academic information on the natural and cultural heritage of the Geopark. In these activities, Kula Divlit volcanic park attracts special attention. This is all done as part of the management team's collaborative efforts with the Public Education Organization. Numerous showcase and explanation panels aid in the promotion of the geopark and its particular geosites. Furthermore, various sorts of electronic showcases advertise and promote the geopark in district centers.

These activities have supported the expansion of the local tourism business and increased the community's awareness of the importance of geoheritage. When certain conditions are fulfilled, businesses inside the geopark territory, such as restaurants, motels, and gift shops, receive designation as certificated geopark partners. Historical Kula houses that were once owned by the Kula Municipality have been designed into business enterprises that offer amenities such as accommodation or restaurants to promote tourism in the area. Additional sporting events such as hiking, cycling and marathon races have been organized in the Geopark (Fig. 19). All of this has been augmented by booklets and other articles promoting the geopark.

By developing infrastructure, the Geopark Municipalities Union intends to encourage the development and expansion of rural tourism within the geopark area, especially in Kula. The building of a Geopark Visitor Center in the Kula Divlit Volcanic Park began in 2021.

Figure 19. Cycling in Adala Volcanic Canyon

The establishment of the geopark has improved the region's attractiveness to researchers, and there is currently a notable rise in the number of projects for scientific investigation. Summer vacation programs for children ranging in age from primary to secondary school have been designed to raise awareness of the geological features of the area among children (Fig. 20). These activities include basic training on subjects like climate change, earthquakes, flooding, the importance of freshwater, and its role in the economy in the schools located in the geopark. As part of the Geopark education plan, a program called 'Geopark education at school' was launched in 2021. Within the scope of this program, students have been taught about natural disasters such as forest fires, floods, and earthquakes, which have occurred frequently in recent years and resulted in significant loss of life and property.

Figure 20. Educational activity at the school

Geoconservation

Although Kula-Salihli Geopark is the first and only UNESCO geopark in Türkiye, geoprotection has only recently been a phenomenon in this country (Aytaç and Demir 2019a). In this regard, the geopark serves as the foundation for the promotion and development of efficient geoprotection throughout the region. Security officers and geopark security personnel assist with safeguarding some geosites while also trying to educate and raise public awareness about conserving cultural and natural resources. Because of their very fresh, diverse and young volcanic forms, the Kula volcanoes are among the most popular destinations for tourists in the geopark. They have indeed fascinated the scientific community and travelers since antiquity, representing a prominent feature of the landscape in the region. However, before the establishment of the geopark, fresh scoria material from the scoria cones in the volcanic field had either been used by private companies as construction and filling material for road construction works or these areas had been used as storage areas for solid wastes by the municipalities. After the establishment of the geopark, some specific and stringent regulations for using the cinder cones came into

effect. Currently, these volcanic landscapes are heavily conserved, and quarrying is allowed only in volcanic cones that are not defined as geosites. The educational activities and rise in tourism have promoted the advantages of these locations in terms of landscape, tourism and ecology.

Conclusion

Kula-Salihli Geopark has a very rich geodiversity and hosts evidence of about 600 Myr of the history of the earth. The geopark works as an open natural laboratory in hosting the best examples of geology, geomorphology and natural sciences features from various geological ages. The most preeminent landscapes of the geopark are the landforms formed by volcanism, including various forms of lava flows, volcanic cones, craters, maars, basalt columns, volcanic canyons, Paleogediz terraces, badlands topography and fairy chimneys (Hodoos), Gediz graben, and geoarchaeological sites. Volcanic geoheritage sites represent naturally occurring events that have intrigued frightened, devastated, and "resourced" mankind with nutrient-rich soil along with additional geological advantages in many different forms. Volcanism is also of significant public interest because eruptions occur on human time scales and yet can have devastating and beneficial outcomes. Hence, geoparks with active volcanoes and in places affected by recent volcanism are becoming more common, with increasing appreciation of the potential given by such geosites for fostering geotourism in regions related to dynamic volcanism (Joyce 2009; Joyce 2010a; 2010b; Migon and Pijet-Migon 2016; Németh *et al.* 2017). Despite the absence of active volcanoes in the area, the volcanic landscapes created by ancient volcanism preserve their originality or appeal, rendering the area an increasingly popular place for tourists. For this reason, Kula Salihli Geopark occupies a very important place as a volcanic monument in western Anatolia.

Conflict of Interest

The authors of this article state that they do not have any known conflicting financial interests or relationships that could appear to have influenced the work stated in this study.

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