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Sibel Kaygili, Derya Sinanoglu,
Ercan Aksoy, Ahmet Sasmaz

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Геотуризм: деякі приклади з Туреччини

Сібель Кейгилі¹, Дерія Сініноглу², Еркан Аксой¹, Ахмет Шашмаз¹.

¹Фіратський університет, факультет інженерної геології, 23119, Елазіг, Туреччина, e-mail: skaygili@firat.edu.tr; eksoy@firat.edu.tr; asasmaz@firat.edu.tr

²Університет Батман, факультет нафти та природного газу, 72060, Батман, Туреччина, derya.sinanoglu@batman.edu.tr

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Анотація. Геотуризм - це одна з найважливіших галузей туризму, яка швидко розвивається і стає значно поширеною останнім часом. Геотуризм визначається як туризм, який підтримує або підсилює особливий географічний характер місця, його оточення, спадщину, естетику, культуру та добробут мешканців. Мета геотуризму - визнання та захист цих природних структур громадсь-

кістю, а також сприяння місцевому та регіональному розвитку через виникаючі різновиди. Надходження від геотуризму починають зростати у загальних доходах від туризму країн. У Туреччині багато місць, які можна вважати можливими районами геотуризму. Серед них досліджені: Каппадокійські казкові димари, вулканічні райони Маніса Кула, Травертини Денізли Памуккале та Кальдера Бітліс Немрут.

Ключові слова: геотуризм, Туреччина, Каппадокія, Кула Геопарк, Памуккале, Немрут Кальдера

Geotourism: Some Examples from Turkey

Sibel Kaygili¹, Derya Sinanoglu², Ercan Aksoy¹, Ahmet Sasmaz¹

¹Firat University, Department of Geological Engineering 23119 Elazığ, Turkey
skaygili@firat.edu.tr; eksoy@firat.edu.tr; asasmaz@firat.edu.tr

²Batman University Department of Petroleum and Natural Gas Engineering 72060 Batman, Turkey
derya.sinanoglu@batman.edu.tr

Abstract. Geotourism is one of the most important tourism sectors that has rapidly developed and become widespread in recent years. Geotourism is defined as tourism that sustains or enhances the distinctive geographical character of a place—its environment, heritage, aesthetics, culture, and the well-being of its residents. The purpose of geotourism is to recognize and protect these natural structures of public, as well as contributing to local and regional development through the emerging species. Geotourism incomes have begun to increase in the total tourism incomes of the countries. There are many places in Turkey that can be considered as possible areas of geotourism. In this scope; Cappadocia fairy chimneys, Manisa Kula volcanic area, Denizli Pamukkale travertines and Bitlis Nemrut Caldera were studied.

Keywords: Geotourism, Turkey, Cappadocia, Kula Geopark, Pamukkale, Nemrut Caldera

1. Introduction. Geotourism is a form of sustainable tourism based on visiting the geosites and geological heritage of an area by local and / or foreign people. In this way, people get acquainted with the Earth sciences and become closer; so that not only the concept of preservation of geological heritage can be understood and spread, but also contribution to local / regional development can be secured. Nature and culture are the common heritages of humanity and

should be respected, maintained, and protected for the future generations (Anonim, 2000; Kazanci et al., 2004; Kazanci, 2006; Mercan, 2009). In this study, the Cappadocia towering cones named “Fairy Chimneys” in Nevsehir province, Kula Geopark in Manisa province, Nemrut Caldera in Bitlis province and Pamukkale travertine area in Denizli province are chosen as examples of geotourism potential (Figure 1).

Fig.1. Location map showing some geotourism locations of Turkey

2. Cappadocia Fairy Chimneys. The Cappadocia is a place where nature and history come together creating one of the most beautiful sceneries of the world and it is an important tourism centre of the central Anatolia of Turkey, which is visited by hundred thousands of tourists every year. Geologically, Paleozoic-Mesozoic aged metamorphic rocks of Kırşehir block consist of basement of the region, and overthrust late Cretaceous ophiolitic rocks of middle Anatolia. All of these are cut by plutonic rocks. The Eocene period is characterized by marine limestone and this unit is unconformably covered by Oligo-Miocene terrestrial detritics (Göncüoğlu et al., 1991). Intensive terrestrial volcanic products which were composed of almost horizontally layered acidic volcanic tuffs and lavas covered all these units from Erciyes, Melendiz and Hasandağ volcanoes whose eruption began in the middle-late Miocene and continued during the Quaternary (Aydın, 2009).

Landforms in the Cappadocia region, which have the most characteristic examples of the world, have evolved as a common product of volcanism, tectonism and mechanical/chemical weathering (Toprak, 1998; Aydın, 2009; Dirik, 2009). Cappadocia

has been a member of UNESCO World Heritage List since 1984.

The Cappadocian volcanic units are generally in the colour of broken white, grey and pink and have clastic character. They show an alternation from the fine grained to coarse types with enclosed large and small lumps of pumice and obsidian, and at some places interbedded with welded tuffs and tuffs in different duration. Intriguing fairy chimneys were created by resistance difference between tuff and ignimbrite layers. The tuff layers are eroded by water and wind easily, and ignimbrites with higher weathering resistance formed the top of fairy chimneys (Figure 2). Cappadocia is a famous and popular tourist destination of Turkey and makes a significant contribution to the development of region through geotourism.

Göreme open-air museum is 10 km away from the centre of Nevşehir and near the Göreme town of Nevşehir province. The area created by volcanic rocks is famous with the chimney rocks which resulted from the erosion caused by the natural factors and contribute to the historical richness.

Fig. 2. Fairy chimneys of Cappadocia volcanic area

3. Kula Geopark. The Kula geopark is located in the Aegean region of Turkey, and 97 km away from the center of Manisa. It has a unique geodiversity where the oldest (Paleozoic) and youngest (Quaternary) rock units of Anatolia are found together. The Kula Geopark area is the youngest volcanic region of Turkey where the volcanic activity continued up to prehistoric times, and volcanic products cover 300 km² area. The outstanding volcanic structures of Kula Geopark area have been well known at least for two thousand years. Strabon, the famous historian, named this region 'KATAKEKAUMENE', which means 'burnt land', because of volcanic activity (Gümüs and Zourus, 2014).

The Menderes massif covers a large area of western Anatolia, and consists of quartz-muscovite schist, biotite-quartz schist, garnet mica schist and augen gneiss (biotite gneiss and pegmatitic gneiss). The basement of the Kula region is composed of these metamorphic rocks and Permo-Triassic dolomitic marbles overlying them. The Mesozoic period is characterized by grey-bluish-white dolomitic limestones and ophiolitic melange called Vezirler Melange, and this melange is overlain by Tertiary units unconformably. The Pliocene period in the region is represented by the alternations of conglomerate,

sandstone, claystone, marl, limestone and tuffite. The products of the volcanism that had been active in the region toward the end of Late Pliocene were called Kula volcanics (Ercan et al., 1980). Kula Geopark area is awarded with high geodiversity representing 200 million years of earth history from Palaeozoic to Holocene including maars, monogenic cinder cones, successive lava flow plains, lava caves and tubes, craters, basalt columns, xenoliths, contact metamorphism, ash deposits, waterfalls in volcanic canyons, active karstic caves, badlands and fairy chimneys, mesa structures and schist tor, as old as 15 thousand years of fossil human footprints preserved in volcanic ash (Gümüs and Zourus, 2014) (Figures 3 and 4). In September 2013, the Kula Geopark was certified as the first and the only Turkish member of the European Geoparks Network and the Global Geoparks Network of UNESCO. As a result of the Kula Geopark Project, Turkey's first Geopark Visitor Centre, the "Katakekaumene", and the first thematic geotrail equipped with custom designed information sign and panels were established within Kula Geopark that offers regular indoor and outdoor geo-educational programs and activities.

In addition to the potentiality of geotourism, Kula has well-preserved Ottoman city architecture and a rich historical and cultural heritage.

Fig. 3. One of the volcanic cone erupted volcanic material forming Kula Geopark (URL-1).

Fig. 4. Fossil human footprints preserved in volcanic ash (URL_1)

4. Pamukkale Travertines. The travertine at Pamukkale (Cotton Castle), which is one of the best-known travertine sites of the world, is located in the Denizli Basin, about 17 km from the town of Denizli in western Anatolia. The Denizli Basin is a 70 km long and 50 km wide fault bounded Neogene–Quaternary depression located in the Western Anatolian Extensional Province (Koçyigit, 1984; Şaroglu et al., 1987; Westaway, 1990; 1993; Altunel and Karabacak, 2005). This extensional basin is one of the most

important regions in view of travertine precipitation in the world. The basement rocks of the basin consist of pre-Oligocene mica schists, quartzite, and marbles of the Menderes massif and the tectonically overlain rocks of Mesozoic limestones of the Lycian nappes, which tectonically overlie the massif (Altunel, 1996).

Travertine deposition at Pamukkale, one of Turkey's most important tourist destinations, has been in progress for, at least, the last 400 000 years,

and has partially overwhelmed the Roman city and necropolis of Hierapolis. The travertine originates from hot water that emerges at 35–56°C from the open fissures and at least one fault zone. The five principal morphological varieties of travertine mass are: (1) terraced-mound travertines; (2) fissure-ridge travertines; (3) range-front travertines; (4) eroded-sheet travertines; and (5) self-built channel travertines. The first two varieties are similar to those reported from well-known travertines at Tivoli, east of Rome, and Mammoth Hot Springs, Wyoming, but the last three varieties have not previously been reported.

The orientations of fissure-ridge travertines directly reflect neotectonic directions of stretching that are north-south in the south and north-east-south-west in the north of the Pamukkale plateau.

The Pamukkale travertine area is a 3 km wide terrace with an area of approximately 7.5 km² located in the northern margin of the Denizli basin and bounded by the Pamukkale normal fault segment. The travertine originates from hot waters that emerge at 35–56°C from open fissures and at least one fault zone. The five principal morphological varieties of travertine mass are: terraced-mound travertines; fissure-ridge travertines; range-front travertines; eroded-sheet travertines; and self-built channel travertines. The deposition of travertines is attributed to the presence beneath Pamukkale of carbonate bedrocks and an anastomosing network of fissures intersecting at numerous nodes that provide conduits for the escape of water. Some of the travertines have scarce vertebrate fossil. These fossils are usually found during the slicing of large travertine blocks in the factories for commercial purpose. The fossils are embedded within strongly consolidated travertines and therefore almost impossible to release from the travertine. Pamukkale travertine area is one of the most important tourist destination of Turkey (Polat, 2011).

The Denizli Basin contains many geological heritage items, including hydrogeological, sedimentary, tectonic and paleontological origin, most of which are related to travertine deposits (Figures 5 and 6). Pamukkale, which was previously listed on the UNESCO World Heritage List, includes archaeological and cultural elements, and is home to many features that make it a geopark. In the Pamukkale region, many geological features can be observed such as hot springs, Quaternary travertine accumulations, extensional cracks, travertine ridges and seismic activity produced by active faults bounded the Denizli basin.

With the geological item and attractiveness, Pamukkale is modern travertine accumulations re-

lated to hydrothermal fluids (Polat, 2011). In addition, it must be protected in order to bequeath to future generations because of its rare natural formations.

5. Nemrut Caldera. Nemrut is a dormant polygenic strato-volcano in Eastern Turkey, located 10 km northwest of the city Tatvan which is in the western shore of Lake Van. Nemrut caldera is located in the collision zone of the Arabian and Eurasian tectonic plates, which determines the seismic and volcanic activity in the region (Ercan et al., 1990; Yılmaz et al., 1998; Aksoy et al., 2007). The volcano is named after King Nimrod who is said to have ruled this area in about 2100 BC. The most powerful eruptions of Nemrut occurred in the Pleistocene. Many small eruptions occurred during the Holocene and different dates have been suggested for the last eruption. Some authors (Aydar et al., 2003; Ozdemir et al., 2006; Cubukcu et al., 2007; Ulusoy et al., 2008; Cubukcu et al., 2012) claimed that this eruption occurred in 1441 and some (Ulusoy et al., 2008) in 1692. In the late Pleistocene, about 250,000 years ago, a major eruption formed a lava flow over 60 km long, which blocked the water discharge from the Van basin and formed Lake Van, the world's largest alkali endorheic lake. In the same period, the conical top of the volcano collapsed inward, forming an 8.3×7 km caldera. Afterwards, the freshwater that Lake Nemrut formed inside the caldera, became the world's second largest caldera lake. Subsequent eruptions separated a small lake from Lake Nemrut, which is called small lake. Grand lake, located in the western part of caldera, is 2247 m above sea level and has an average depth of 140 m and a maximum depth of 176 m.

Nemrut volcano exhibits many features of a volcanic activity such as maar, domes, fumeroles, hot water springs and lakes in the vicinity of the caldera (Figures 7 and 8).

Consequently, Nemrut caldera and its environs have an important potential for geotourism with its natural beauty and geological features. Nemrut ignimbrite is the most voluminous product of the volcano. Blocks of ignimbrite are used as raw material for construction purposes for thousands of years. Regionally, Nemrut ignimbrite constitutes the main construction material of Urartian, Seljukian, Armenian and Ottoman architecture. This tradition continues today, especially Ahlat town and old Bitlis city are constructed by using Nemrut ignimbrite, as named “Ahlat stone”. It is expected that the Nemrut Volcanic Geopark Project carried out under the leadership of the Governorship of Bitlis will play a very important role in terms of geotourism (Kaygılı and Aksoy, 2014).

Fig. 5. Travertine terraces and pools of Pamukkale.

Fig. 6. Close view of travertine terraces and pools of Pamukkale.

Fig. 7. Three-dimensional image of Nemrut Caldera and its vicinity

Fig. 8. Grand Lake in the Nemrut Caldera

6. Conclusions. Geotourism will primarily develop and manage the geological or geomorphological features of a region by protecting it from adverse impacts of tourism. In this sense, geotourism provides an opportunity to recognize geological environments and geological characteristics. Geotourism is defined from different perspectives. In details, Newsome and

Dowling, 2006, explain Geotourism in two parts; first part of the term ‘geo’ refers ‘geology and geomorphology and the natural resources of landscape, landforms, fossil beds, rocks and minerals, with an emphasis on appreciating the processes that are creating and created such features’. The latter part,

‘tourism’ includes ‘visitation to geosites for the purposes of passive recreation, engaging a sense of wonder, appreciation and learning’. According to Bahram, 2009, “Geotourism is a knowledge-based tourism, an interdisciplinary integration of the tourism industry with conservation and interpretation of abiotic nature attributes, besides considering related cultural issues, within the geosites for the general public”. Geoparks are the integral parts of the geotourism of a country, and for this reason, it is important to create geoparks. The creation of geoparks is one of the ways of solving a global problem on which the international community is focused - protection of the geological heritage (Geoheritage) (Yaholnyk and Manyuk, 2017).

Fairy chimneys in Cappadocia region are one of the important natural and cultural richness of Turkey's geotourism potential. Kula Geopark area has a wide geodiversity representing 200 million years of earth history from Palaeozoic to Holocene including maars, monogenic cinder cones, successive lava flow plains, lava caves and tubes, craters, basalt columns, xenoliths, contact metamorphism, ash deposits, waterfalls in volcanic canyons, active karstic caves, badlands and fairy chimneys, mesa structures and schist top, as old as 15 thousand years of fossil human foot prints preserved in volcanic ash. Another geotourism potential of Turkey is Pamukkale travertine terraces and pools, which is in the UNESCO's world heritage list. Nemrut volcano and its environs have an important potential for geotourism because of volcanic features such as caldera, maar, domes, fumaroles, hot water springs and lakes.

The geotourism activities in these regions, which have a rich geological diversity, provide an important contribution to the tourism mobility as well as the regional development through the active participation of the local governments and local people, as well as protecting the geological heritage. Geotourism is a segment of tourism that has been developed worldwide and emerging as a new global phenomenon in recent years. It is a form of special interest tourism and focuses on geological features and the types of landscapes. To make visitable as soon as possible the regions with high geotourism potential in Turkey and similar countries has a great importance in terms of tourism income of them.

References

- Aksoy E., Inceöz, M., Kocyigit, A., 2007. Lake Hazar Basin: A negative flower structure on the East Anatolian Fault System (EAFS), SE Turkey. *Turkish Journal of Earth Sciences* 16, 319-338.
- Altunel, E., 1996. Morphological characteristics, ages and neotectonic significance of Pamukkale Travertines. Mineral Research and Exploration Institute (MTA) of Turkey Bulletin 118, 47-64 [in Turkish with English abstract].
- Altunel, E., Karabacak, V., 2005. Determination of horizontal extension from fissure-ridge travertines: a case study from the Denizli Basin, southwestern Turkey. *Geodinamica Acta* 18, 333-342.
- Anonym, 2000. Website www.jemirko.org.tr. Date of access to website: 17/10/2017.
- Aydar, E., Gourgaud, A., Ulusoy, I., Digonnet, F., Labazuy, P., Sen, E., Bayhan, H., Kurttaş, T., Tolluoglu, A. U., 2003. Morphological analysis of active Mount Nemrut Stratovolcano, Eastern Turkey: Evidences and possible impact areas of future eruption. *Journal of Volcanology and Geothermal Research* 123 (3), 301-312.
- Aydin, F., 2009. The Development of the Cappadocia volcanic complex and the effects of volcanism on the region. Abstracts Book of I. Medical Geology Workshop, 30 October–1 November 2009, Ürgüp Municipality Culture Center, Ürgüp/Nevşehir, Turkey, 3-5, [in Turkish with English abstract].
- Bahram, S. N., 2009. Fundamentals of geotourism: With emphasis on Iran. Tehran-Iran: Samt Organization Publishing.
- Cubukcu, H.E., Aydar, E., Gourgaud, A., 2007. Comment on “volcanostratigraphy and petrogenesis of the Nemrut stratovolcano (East Anatolian High Plateau): The most recent post-collisional volcanism in Turkey” by 189–211. *Chemical Geology* 245, 120–129.
- Cubukcu, H. E., Ulusoy, İ., Aydar, E., Ersoy, O., Şen, E., Gourgaud, A., Guillou, H., 2012. Mt. Nemrut volcano (Eastern Turkey): temporal petrological evolution. *Journal of Volcanology and Geothermal Research* 209, 33-60.
- Dirik, K., 2009. Geology, geomorphology of Kapadokya region and their effect on the civilizations of the region. Abstracts Book of I. Medical Geology Workshop, 30 October–1 November 2009, Ürgüp Municipality Culture Center, Ürgüp/Nevşehir, 6-9, [in Turkish with English abstract].
- Ercan, T., Günay, E., Dinçel, A., Türkecan, A., Küçükayman A. 1980. Geology of the Kula-Selendi region, and petrology of the volcanics of this area. Report of Mineral Research and Exploration Institute (MTA) of Turkey, Report No: 6801 [in Turkish with English abstract].
- Ercan, T., Fujitami, T., Madsuda, J. L., Notsu, K., Ui, T., 1990. Interpretation of new geochemical, radiometric and isotopic data on Neogene-Quaternary volcanics in Eastern and Southeastern Anatolia. Mineral Research and Exploration Institute (MTA) of Turkey Bulletin 110, 143-164 [in Turkish with English abstract].
- Göncüoğlu, M.C., Toprak, V., Kusu, I., Erler, A., Olgun, E., 1991. The geology of the western part of the Central Anatolian massif. Chapter 1: Southern Section, Turkish Petroleum Company Report No: 3155, Ankara, 140 pp [in Turkish with English abstract].

- Gümüş, E., Zourus, N., 2014. Kula Geopark: Turkey's first European and global geopark. EGU General Assembly 2014, held 27 April - 2 May, 2014 in Vienna, Austria.
- Kazancı, N., Saroglu, F., Kirman, E., Uysal, F., 2004. The natural heritage is under great threat. *Blue Planet*, 10, 4-9.
- Kazancı, N., 2006. Geoparks and qualities: the country burned from the past to the future. Kula symposium, (1-3 September 2006), Kula, Abstracts Book, 78-81 [in Turkish with English abstract].
- Kaygılı, S., Aksoy, E., 2014. Nemrut Caldera: An example for Turkey's important geological heritage. Abstracts book of the Third International Ahlat-Eurasia Symposium on Science, Culture and Art, Ahlat, Bitlis, Turkey, 34-45 [in Turkish with English abstract].
- Kocyigit, A., 1984. Intraplate neotectonic development of Southwestern Turkey and adjacent areas. *Geological Society of Turkey Bulletin* 27, 1-16 [in Turkish with English abstract].
- Mercan, N., 2009. Geosites and geological heritage in northern and western areas of Ankara, Turkey, Graduate Thesis, Ankara University [in Turkish with English abstract, unpublished].
- Newsome, D., Dowling R., 2006. *Geotourism: Sustainability, Impacts and Management*, Elsevier Butterworth-Heinemann, Oxford, p. 4-6.
- Ozdemir, Y., Karaoglu, O., Tolluoglu, A. U., Güleç, N., 2006. Volcanostratigraphy and petrogenesis of the Nemrut stratovolcano (East Anatolian High Plateau): the most recent post-collisional volcanism in Turkey. *Chemical Geology*, 226 (3), 189-211.
- Polat, S., 2011. The formation of travertine in Turkey, distribution areas, and their conservation. *Marmara Geographical Review*, 23, 389-428 [in Turkish with English abstract].
- Saroglu, F., Boray, A., Emre, O., 1987. Active faults of Turkey. Mineral Research and Exploration Institute (MTA), Turkey, unpublished report, 8643, 394.
- Toprak, V., 1998. Vent distribution and its relation to regional tectonics, Cappadocian Volcanics, Turkey. *J. Volcanol. Geotherm. Res.* 85, 55-67.
- Ulusoy, I., Labazuy, P., Aydar, E., Ersoy, O., Cubukcu, E. 2008. Structure of the Nemrut caldera (Eastern Anatolia, Turkey) and associated hydrothermal fluid circulation. *Journal of Volcanology and Geothermal research*, 174 (4), 269-283.
- URL-1. <http://www.kulageopark.com>. Date of access to website: 17/12/2016.
- Yaholnyk, O. V., Manyuk, V. V. 2017. Legal aspects of creating geoparks in Ukraine. *Dniprop. Univer. Bulletin, Geology, Geography* 25 (2), 136-145, doi: 10.15421/111729.
- Yilmaz, Y., Güner, Y., Saroglu, F., 1998. Geology of the Quaternary volcanic centres of the East Anatolia. *Journal of volcanology and geothermal research*, 85 (1), 173-210.
- Westaway, R., 1990. Present-day kinematics of the plate boundary zone between Africa and Europe, from the Azores to the Aegean. *Earth and Planetary Science Letters*, 96 (3), 393-406.
- Westaway, R., 1993. Neogene evolution of the Denizli region of western Turkey. *Journal of Structural Geology* 15, 37-53.