Application

to Extend the area of
the LESVOS PETRIFIED FOREST
EUROPEAN and GLOBAL GEOPARK
and the recognition of the LESVOS ISLAND GEOPARK
for membership in the **European Geoparks Network**

PART B. GEOLOGY

LESVOS – GREECE
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Geological Heritage of Lesvos Island

Abstract

Lesvos island belongs to the Pelagonian geotectonic zone of Greece. The geological structure of Lesvos Island comprises:

- The Permo-Triassic metamorphic basement, including schists, quartzites, metasandstones, phyllites, marbles and crystalline carbonates.
- An ophiolitic sequence (basic and ultrabasic rocks, deep-sea sediments and metamorphic rocks of the sole), overthrusted the metamorphic basement.
- Tertiary volcanic rocks and Neogene marine and lacustrine deposits, as well as Quaternary deposits.

The Neogene volcanic rocks, dominate the Central and Western part of the island and are associated with the presence of remains of fossil plants, which form the famous «Petrified forest of Lesvos», declared as Protected Natural Monument. It was developed during Late Oligocene to Lower - Middle Miocene, due to the intense volcanic activity in the area which created impressive volcanic geosites. Neotectonic activity also contributed to the morphology of the island forming significant tectonic fault scarps associated with strong earthquakes.

B. Geological Heritage

1. Location of the proposed Lesvos Geopark

The island of Lesvos is located in the NE Aegean Sea. During Cenozoic, Lesvos took its present impressive shape which the Nobel prize poet Elytis likened to the leaf of a plane tree. On the extreme Western edge of the island on an area of incomparable wild beauty, appear large accumulations of fossilised tree trunks comprising the well known «Petrified Forest of Lesvos», The glossiness and the chromatic variety of the petrified pieces is fascinating. On Megalonisi, the island which protects the bay of Sigri, lie some marvellous trunks of petrified trees.

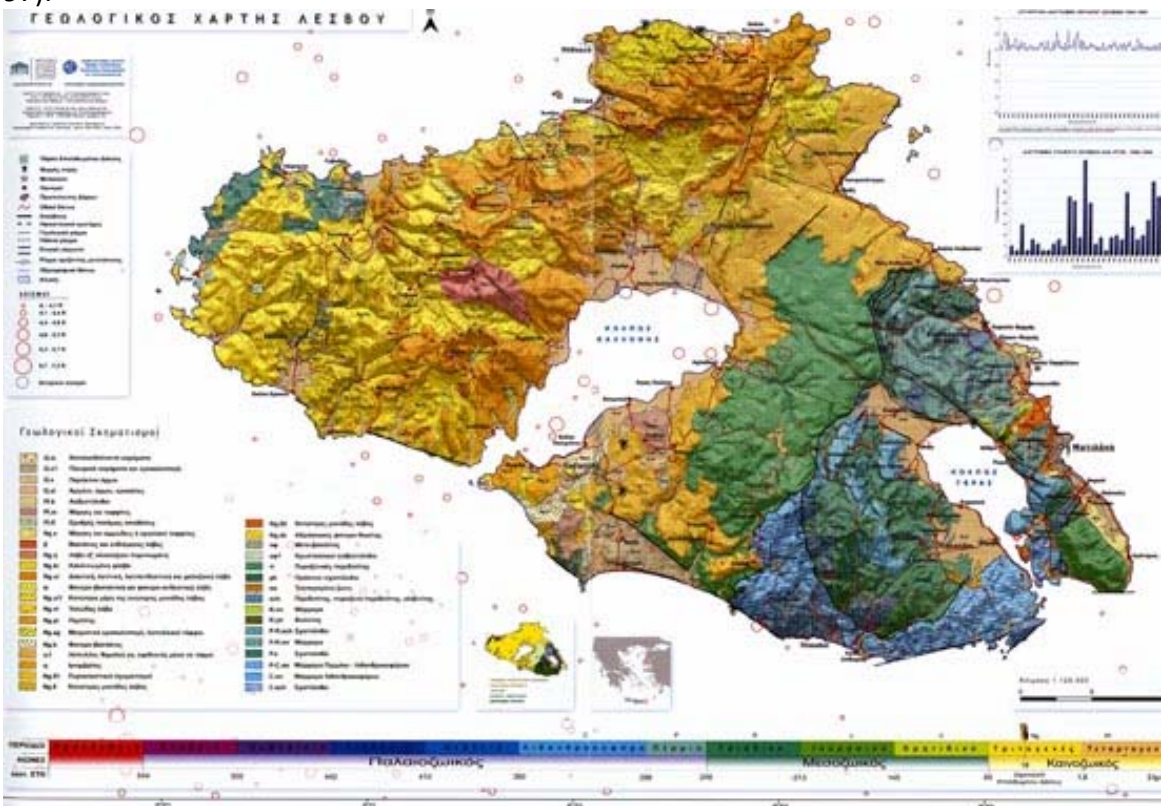
The protected area of the Petrified Forest (15.000 ha) declared as Protected Natural Monument, is a founder member of the European Geoparks Network (2000) and is included in the Global Geoparks Network in 2004.

The new application includes the already recognized Lesvos Petrified Forest Geopark and the remaining 148.000 ha of the total surface of the island.

2. General geological description of the proposed Lesvos Geopark

Lesvos island belongs to the Pelagonian geotectonic zone of Greece which represents fragment of the Cimmerian Continent (Mountrakis 1983; 1992).

The geology of Lesvos has been described by Hecht (1971; 1974; 1975), Pe-Piper (1978), Katsikatsos et al. (1982, 1986). Hecht (1971;1974) presented the geological map of the island (1: 50.000 scale). Chemical analyses of the volcanic rocks have been carried out by Georgalas (1949), Borsi et. al. (1972), Pe-Piper (1978; 1980; 1984) and Pe-Piper and Piper (1980; 1989; 1997).



Geological Map of Lesvos Island

According to the published data the geological structure of Lesvos Island comprises the following rock-units.

- An autochthonous unit of Permo-Triassic age, including schists, quartzites, metasandstones, phyllites with intercalation of marbles and crystalline carbonates. These rocks are widely extended on the Southeast part of the island, while in the Northwest part they have a rather small extension.
- The allochthonous units that represent remnants of an ophiolitic sequence, comprising basic and ultrabasic rocks and associated deep-sea fine-grained sediments, as well as metamorphic rocks, amphibolites and amphibole schists, metabasites and metasediments, parts of the sole, overthrusted the metamorphic basement. These alpine and pre-alpine rocks were later covered by Tertiary volcanic rocks and Neogene marine and lacustrine deposits, as well as Quaternary deposits. The Neogene volcanic rocks, dominate the Central and Western part of the island.

The Metamorphic basement

The autochthonous unit, according to Katsikatsos et al. (1982,1986), is a series of formations ranging from Neopaleozoic to Upper Triassic age. It has no strati-graphic unconformities and it consists entirely of metaclastic rocks, crystalline limestones and dolomites. It is characterised by a very low grade metamorphism.

These rocks dominate on the Southeast part of the island, where the visible thickness, in places, is more than 1.000 m. In the Northwest part of the Island they have relatively small extension (areas of Sigri, Gavathas, Eressos) and they are exposed under the postalpine volcanic rocks and lacustrine deposits.

The metamorphic rocks consist of schists (mainly micaceous, sericitic and chlo-ritic) alternating with metasandstones (mainly arkoses), and quartzites as well as lenses and intercalations of crystalline limestones and dolomites. Generally the extension and the thickness of the carbonate rocks are always limited, except in the upper parts of certain areas, where the carbonates dominate.

Mount Olympos

In these rocks and in several localities and different stratigraphic horizons, a rich fauna of Carboniferous-Permian age was found (Hecht 1972; 1974; 1975, Katsikatsos et al. 1982) consisting of foraminifers, algae, lamellinbranches, gastropods, echinoderms, crinoids and corals.

The Triassic formations represent the upwards normal transition of the Neopa-leozoic formations and they are found only in the Southeast part of Lesvos. They consist mainly of schists and metasandstones. Within these formations very thick intercalations of crystalline carbonates usually occur, where fossils of Megalodon have been found by Katsikatsos (Migiros 1994). They are characterised by the presence of breccia and big carbonate blocks, mainly within their upper horizons.

The Ophiolitic sequence

Basic and ultrabasic rocks, associated deep-sea sediments, as well as basic metamorphic rocks, overthrust the metamorphic basement. All these rocks have an allochthonous origin, they are remnants of an ophiolitic sequence and represent fragments of the Neo-Tethyan oceanic lithosphere, which were emplaced on the Pelagonian margin during Mesozoic (Mountrakis et al. 1992).

According to Katsikatsos et al. (1982; 1986), the allochthonous rocks are divided into two tectonic nappes. The lower nappe, comprising Triassic volcano-sedimentary formations and the upper one, comprising ophiolitic rocks.

The lower nappe, occupies a large area in the Southeast part of the island and its thickness exceeds, in places, 1.000 m. It consists of various types of metabasites, which usually dominate in the upper parts, and metasediments. At the base of the lower tectonic nappe, crystalline limestones and dolomites appear forming lenses and intercalations with schists of various mineralogical composition (chlorite, mica, sericite, e.t.c.) and conglomerates. Characteristic fossils of Lower-Middle Triassic age have been found in the carbonate rocks (Katsikatsos et al. 1982).

The volcano-sedimentary rocks suffered initially a low grade metamorphism in the pumpellyite-actinolite-chlorite zone (Katsikatsos et al. 1982). But in some places the presence of glaucophane, provides a high-pressure metamorphism.

The upper ophiolitic nappe occupies a large area in the Southeast part of Lesvos. Geophysical data indicate that in the central part of the island (Kalloni gulf) the ophiolites are continuous at depth below the Neogene volcanic rocks. The ophiolitic rocks overthrust, in their larger part, the volcano-sedimentary formations and can be divided into two parts, which are in tectonic relation, an upper part which mainly consists of ultramafic rocks (peridotite, pyroxen-peridotite, and olivinite) and a lower part consisting of metamorphic basic ophiolitic rocks. Ultramafic rocks, of various degrees of serpentinization, are intersected by veins of pyroxenites and gabbros. Their thickness exceeds in places 1.000 m. Metamorphic basic ophiolitic rocks, mainly amphibolites and amphibolitic schists, are always tectonically intercalated with the ophiolitic rocks and the underlying volcanosedimentary formations. Their thickness reaches, in places 300 m.

Both these rock - groups which belong to the ophiolitic tectonic nappe have suffered at least one very low grade metamorphism in the pumpellyite-actinolite-chlo-rite zone, similar to the one that suffered the volcano-sedimentary nappe (Katsikatsos et.al. 1986; Katagas & Panagos, 1979).

The Postalpine volcanics

Neogene volcanic rocks dominate the Central and Western part of the island. Lesvos is part of a belt of late Oligocene to middle Miocene calc-alcaline to shoshonitic volcanism of the Northern and Central Aegean Sea and Western Anatolia.

In the central part of the island there is a series of stratovolcanoes, of basalt, andesite, dacite and rhyolite, termed the main volcanic chain, which extends in a SW-NE direction and includes a probable caldera complex near Vatoussa (Pe-Piper 1978; 1980).

The Oligocene-Miocene volcanic rocks of Lesvos are shoshonitic, with only minor interbedded calc-alkaline andesites. There was minor earlier (21.5 M.a.) and later (16.5 M.a.) calc-alkaline volcanism. Several volcanic formations can be distinguished:

- The Eressos Formation is the oldest igneous formation, composed by porphyritic andesites interbedded with agglomerate and volcaniclastic rocks, dated at 21.5 M.a., by Pe-Piper & Piper (1993). These lavas are 3 to 4 M.a., older than the main volcanic sequence of Lesvos.
- The Skoutaros Formation is a normally magnetised sequence of andesite and basalt flow approximately synchronous with Sigri pyroclastics and Polychnitos ingnimbrite. In the upper part of the formation pyroxene andesite lavas interbedded with hornblende-biotite dacite lavas and felsic pyroclastic rocks of Sigri pyroclastic Formation.
- The Sigri pyroclastics, thickest in the west of the island, are connected with the development of the Petrified forest and are overlain by several sheets of the Polichnitos ignimbrite. The Kapi rhyolite domes are of approximately the same age, of about 17.0 M.a.
- The Polychnitos ignimbrites occur in correlable units 5-30 m thick. Each unit has an upward decrease in size of lithic tephra, often poor welding at the base. Commonly an abundance of glass lenticules or obsidian are present near the base, and good columnar jointing exists at the top of the unit. They are believed to be cooling units. The ignimbrites thin out against both metamorphic basement highs, and the main volcanic chain (where they interbed with volcani-clastic conglomerate).
- The Skalochorion Formation lay in-between the lower Skoutaros Formation and the upper Sykaminea lavas, composed by reversely magnetised intermediate lavas and contain feldspar megacrysts, commonly associated with mafic xenoliths.
- The Sykaminea Formation dominates in central Lesvos and comprise a reversely magnetised stratovolcanic sequence of andesites, dacites and rare rhyolitic pyroclastics, dated at 17.3 M.a. (Pe-Piper 1980).
- The Mytilene Formation, was defined by Pe-Piper (1978; 1980) as local basalt flows that Prager (1966) claimed to overlay Pontian marls. New radiometric data indicate that the Mytilene formation is part of the main sequence of the volcanic activity in Lesvos, dated at 16.8 M.a. (Pe-Piper & Piper 1993), (Borsi, et al. 1972.).
- Mesotopos dykes, dated by Pe-Piper (1978) at 16.2 M.a., are widespread in western Lesvos. Volcanic equivalents are rare or absent.

Panagia Gorgona - Volcanic rocks

The impressive in volume and time duration (21.5-16.2 M.a.) volcanic activity in the area left a large number of active surface thermal manifestations and include hydrothermal alterations.

The numerous hot springs, various geothermal fields, etc., should be connected mainly to the recent active tectonic activity.

The Neogene marine and lacustrine deposits

A long period of erosion, with deposition of Pliocene marine and lacustrine deposits, preceded the local basaltic andesitic activity of Eastern Lesvos. The Pliocene deposits consist of white marly limestones, partly concretionary and oolithic, intercalated with sandstones, conglomerates, whitish marls and clays containing several shell beds. The total thickness of these sediments is more than 60 meters. Neogene sediments are overline by Pleistocene and Holocene talus and continental deposits, composed by cemented and unconsolidated conglomerates, gravels, grey and red clays and sands.

The Petrified Forest of Lesvos

Western Lesvos, exposes large accumulations of fossilised tree trunks comprising the Petrified Forest of Lesvos. Isolated plant-fossils have been found in many other places of the island, including the area of Mythimna and Polichnitos (Velitzelos and Zouros 1997).

The formation of the Petrified Forest is directly related to the intense volcanic activity in Lesvos island during late Oligocene - middle Miocene. In particular, it is related to the volcanic ash and pyroclastic materials erupting during the various episodes-phases. These materials covered entirely the vegetation of the area with a great quantity of fine, mainly volcanic, material.

The rapid covering of tree trunks, branches, and leaves lead to isolation from atmospheric conditions. Along with the volcanic activity, hot reach in SiO_2 solutions penetrated and impregnated the volcanic materials that covered completely the tree trunks. Thus the major fossilisation process started with a molecule by molecule exchange of the organic plant by inorganic materials. In the case of the Petrified Forest of Lesvos, the Lesvos was perfect due to favourable conditions. Therefore morphological characteristics of the tree trunks such as the annual rings, barkers, as well as the internal structure of the wood, are all preserved in excellent condition. From the orientation of the trees we can presume also the direction of movement of the pyroclastic flow units (from E to W).

The study of the fossil tree trunks, leaves and seeds gives useful data about the Palaeoflora, the climate and the relative age of the Petrified Forest in Lower Miocene. In addition to the large number of fossilised leaves, the genus or the species of the trees, can also be determined from the micro-analysis of the internal structure of the fossil wood. The erect trunks, the roots and branches of many trees, give evidence that the fossilisation took place in situ.

Despite the fact that the systematic study of the Petrified Forest has not yet been completed, the classification of the fossils allows certain conclusions to be drawn. All of the genera and species determined belong to higher plant groups: Angiospermae and Gymnospermae. Complete development of the flora was achieved in the presence of Angiosperms, the most evolved plants.

From phytogeographical point of view the above mentioned plants can be distinguished into two main groups. The first group contains subtropical plants like Laurus (laurel), Cinnamomum (cinnamon), whose related species are actually developed in the forests of South-Eastern Asia. The second group includes plants which prefer mild temperatures like Alnus (alder), Carpinus (hornbill), Populus (poplar), Querqus (oak), Pinus (pine), Taxodioxylon gypsaceum (sequoia),

etc. Related vegetation flourishes today in the warm continental zones of South-Eastern Asia and North America (Velitzelos 1988; 1993, Velitzelos & Gregor 1990, Suss & Velitzelos 1994).

Standing fossilized tree trunk in the Petrified forest park at «Bali Alonia», West Lesvos. It has 4,50 m high, 3,70 m perimeter and is petrified *in situ* on account of the intense volcanic activity in the area during Lower Miocene. The majority of the tree-trunks in the Petrified Forest Park «Bali Alonia» belong to the species *Taxodioxylon gypsaceum* (GOPPERT) KRAUSEL an ancestor of the present day species *Sequoia sempervirens*.

A comparison of the stratigraphic expanse of the plant fossils with other European flora and with the Palaeoflora of Greece leads to the conclusion that the Palaeoflora of Lesvos developed during Lower Miocene, under subtropical or warm temperate seasonal climatic conditions.
The high proportion of upright petrified tree trunks, with well preserved roots in the fossilised soil, allows us to infer that the petrified forest of Lesvos island represents a complete autochthonous (fossilised in situ) ecosystem.
The Fossilised Forest was developed during the time period from the end of the Late Oligocene to Lower - Middle Miocene (ca. 20-15 million years before present), in contrast to most well known fossilised forests on Earth, which developed in earlier geological periods. According to recent data, the composition of the fossil flora is characterised by a high proportion of angiosperms (flowering plants) and gym-nosperms (conifers), and a low proportion of Pteridophytes (ferns). The silicified tree trunks and their organs - especially the wood - are very well preserved. Furthermore, fossilised leaves, cones and seeds provide the raw data for important scientific studies. Taxonomic study of the flora shows that they do not grow today in

the Mediterranean, but only in tropical to subtropical regions such as Asia and Central America. (Velitzelos 1988; 1993).
All of the above mentioned criteria certify that the Petrified Forest of Lesvos represent an important stage of the earth's evolutionary processes. It is considered a unique natural geological monument offering rare scientific data as no other analogous monument from this time period and stage of plant development exists.
The Greek State recognised the exceptional palaeontological and geological value of this unique natural monument. In order to protect the Petrified Forest and ensure its proper management, five terrestrial and marine areas with fossil accumulations, as well as all the isolated fossils were declared as Protected Natural Monument with a special Presidential Decree (443 /1985).
The need for further research and protection of the fossils led to the establishment of the Natural History Museum of Lesvos' Petrified Forest in 1994. Its scope is to undertake scientific research on the Petrified Forest as well as to preserve and to promote this monument.

The Paleofauna of Vatera

The Natural History Collection of Vrisa houses the fossils that were collected in Vrisa and some characteristic rocks, animals and plants of Lesvos. The Collection was founded in September of 1999. It is part of the Museum of Paleontology and Geology of the University of Athens and it is housed in the building of the old school of Vrisa.

Paleofauna of Vatera

Some of the samples of the Collection are exposed, in order to give a general impression of the natural history of the region. The core of this exposition are the fossils of animals, which lived in Lesvos 2 million ye
At that time, the fauna of Vatera was pretty different from the fauna of today. On the open plains, the ungulate herbivores (gazelles, antelopes and wild oxen, horses) and mammoths were grazing, being stalked by sabre-toothed cats.
In the woods, deer, rhinoceroses, mastodonts, raccoon dogs and wild cats lived. This forest was not very dense. Giant macaques were found at the forest edge. Either in the open or in the forest, tortoises walked around, a small one and a giant one, as big as a car. Along the river, badgers and possibly otters made a living. High in the sky, eagles were circling. They are extinct since long, and their story is told only by their fossils.
At the same time, two million years ago, the same animal species were found also in the rest of Europe and in Asia as well. The fauna of Vatera is part of that large ecosystem, ranging from Spain and France in the West to China in the Far East. The geological period of this fauna is the end of the Late Pliocene (MN 17). It is the time of the gradual transition from the warmer Pliocene period to the colder Pleistocene period. The Pleistocene species are very similar to the species of today, but those of the Pliocene are rather different. The climate of Lesvos two million years ago was warm and relatively dry. The landscape of Vatera was mainly an open-canopy woodland, as indicated by the presence of antelopes, gazelles, giraffes, rhinos and horses. But there may have been also a more closed woodland, where the deer and wild ox roamed.

Two mandibles and a humerus from the baboon-like *Paradolichopithecus arvernesis* from Vatera. The mandible on the left belongs to a juvenile male and the mandible on the right to an adult female (G. Lyras and A.A.E. van der Geer 2007).

Typical forest dwellers (pigs, tiny ruminants) are missing; these habitats were not available around Vatera. The climate, the landscape and the fauna of Vatera two million years ago was similar to the subtropical open woodlands and savannas of Africa and India of today.
(www.vrissa.geol.uoa.gr)

Neotectonics

Lesvos island laying in the North-East Aegean area has a key role in understanding the geodynamics of the area.

Major geological faults can be observed in Lesvos. The Larsos fault scarp in the Gera Fault is a spectacular geosite related with the construction of the Roman aqueduct.

The Kalloni Gulf fault zone is related with several strong earthquakes. The 230 BC earthquake is linked to the destruction of the ancient city of Pyra, the ruins and ancient port of which are now beneath the sea in the Gulf of Kalloni. The same fault zone appears to be linked to the 1867 6.8 R earthquake, the most destructive earthquake in Lesvos's recent history. The quake epicentre was the Agia Paraskevi region were some impressive fault scarps with strike slip movement are visible. Many other active faults can be seen in southern and west Lesvos (Vatera, Plomari, Tarti, Mesotopos, Antisa) providing excellent evidence for the active deformation of the island.

Map of active Faults of Lesvos Island

The Agia Paraskevi fault scarp geosite

The northern edge of the Gera gulf is dominated by the steep scarp of the Larsos fault

3. Listing and description of geological sites within the proposed Lesvos Geopark

GEOSITE	ASSESSMENT
Petrified Forest Parks	International significance
1. Petrified Forest Park (Main Park)	Scientific Value (S)
2. Sigri Petrified Forest Park	Educational Value (E)
3. Plaka Petrified Forest Park	Aesthetic Value (A)
4. Chamandroula Petrified Forest Park	Tourism attraction(TA)
5. Skamiouda Petrified Forest Park	
6. Nisiopi Petrified Forest Park	
Fossil sites (plant fossil sites)	National significance
7. Antissa	Scientific Value (S)
8. Gavathas	Educational Value (E)
9. Mesotopos	Aesthetic Value (A)
10. Eresos	Tourism potential (T)
11. Vatousa	
12. Rougada	
13. Lapsarna	
14. Agra	
15. Sarakina	
16. Mythimna	
Fossil sites (mammal fossil sites)	International significance (I)
17. Vatera vertebrate fossil sites	Scientific Value (S)
18. Gavathas Dinotherium fossil site	Educational Value (E)
19. Lapsarna micromammal site	

Volcanic sites 20. Vatousa Caldera 21. Agra Caldera 22. Anemotia Volcano 23. Lepetymnos Volcano 24. Mesotopos Volcano 25. Petra Volcanic Neck 26. Pithariou Dome 27. Ipsilou Dome - Columnar Lavas 28. Eresos Dome 29. Mythimna Dome – Castle Columnar Lavas 30. Eresos Laccolith 31. Pelopi Columnar Lavas 32. Alifada Dyke 33. Filia Dyke 34. Eresos Dyke 35. Avlaki Dyke (Petra) 36. Volcanic Structure of Panagia Gorgona (Skala Sikamineas) 37. Achladeri Ignimbrite 38. Skamiouda Ignimbrite 39. Parakila Volcanic Rocks Alteration Structures 40. Vatoussa Spheroidal Erosional landforms 41. Pterounda Volcanic Conglomerate 42. Voulgaris Volcanic Conglomerate	National significance Scientific Value (S) Educational Value (E) Aesthetic Value (A) Tourism potential (T)
43. Panagia Islet Columnar Lavas (Tokmakia) 44. Mparmpalias Islet Ignimbrite	Regional significance Scientific Value (S) Educational Value (E)
Thermal Springs 45. Polichnitos 46. Lisvori 47. Argenos 48. Eftalou 49. Thermi 50. Gera – Therma	Regional significance Scientific Value (S) Educational Value (E) Tourism Attraction (TA)
Thermal Springs 51. Panagia Krifti	Regional significance Scientific Value (S) Educational Value (E) Tourism potential (T)
Ancient Quarries – Mines 52. Moria Ancient Quarry 53. Mine galleries of Northern Lesvos 54. Polichnitos Magnesite Mines 55. Ancient quarries of Skala Loutron 56. Lignite Mine galleries (Lapsarna) 57. S. Lesvos Ancient Mines (Tarti, Tsaf) 58. Eressos Ancient quarry	Regional significance Scientific Value (S) Educational Value (E) Tourism potential (T)
Caves & Karstic structures 59. Alifada Cave 60. Agios Vartholomaios Taxiarhis Cave 61. Mihos Cave	Regional significance Scientific Value (S) Educational Value (E) Tourism potential (T)

Caves & Karstic structures 62. Antissa Cave 63. Panagia Krifti (Plomari) 64. Asomatos Cave	Regional significance Scientific Value (S) Educational Value (E) Tourism potential (T)
Waterfall - Gorge 65. Pessa Waterfall 66. Mankatsa Waterfall Mantamados 67. Eresos Waterfall 68. Voulgaris Gorge (Vatousa) 69. Tsiknia Gorge	Local significance Educational Value (E) Tourism potential (T)
Erosional Structures 70. Candles Volcanic Erosional Structures 71. "Dragon's Jump" Volcanic Erosional Structure (Napi) 72. Lapsarna Erosional Structures – Orfikia 73. Fikiotrypa 74. Sigri Tafoni	Regional significance Scientific Value (S) Educational Value (E)
River delta 75. Evergetoula Delta 76. Kalloni Wetlands – Tsiknias Delta	Local significance Educational Value (E) Tourism potential (T)
Springs 77. Agiasos Water Springs	Local significance Educational Value (E) Tourism potential (T)
Tectonic Structures 78. Larsos Fault – Gera Gulf Fault 79. Agia Paraskevi Fault 80. Amali Faults 81. Olympos Tectonic Window 82. Nisiopi Graben 83. Lambou Miloi Nappe 84. Ancient Pyrra Fault 85. Taxiarhis Tectonic Structures 86. Antissa Fault	Regional significance Scientific Value (S) Educational Value (E)
Geological – Geomorphological Structures 87. Ophiolite – Ampeliko 88. Ophiolite - Amali 89. Gera Schists 90. Plomari beach-rock formation 91. Megali Limni	Local significance Scientific Value (S) Educational Value (E)

ANNEX I

4. Details on the interest of these sites in terms of their international, national, regional or local value (for example scientific, educational, aesthetic).

Eighty two Geosites have scientific importance.

Nineteen geosites have significant paleontological value; the most notable are the Petrified Forest Park at Bali Alonia, the Plaka Park, Sigri Park and the Nissiopi Park declared as Natural Monuments.

Thirty one of them are Geosites with valuable geomorphologic features. Specially, they are remarkable the domes of Pitharion (Eresos-Mesotopos road), the dome of Ipsilou and the Geras

fault scarp as well as the Lepetymnos – Mirivili peak and the Olympos peak due to their geological views.

Twenty two sites have also cultural interest, due to their significance for cultural and religious reasons. Fifty seven geosites can be used for education and geotourism.

The Petrified Forest Fossil sites have been declared Natural Monuments since 1985, a designation which has legal protection equivalent to National Parks.

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