

Greek Macedonia

The Greek province of Macedonia is bounded on the south by Mt Olympus and the Cambunian mountains; on the west by the Pindos range; on the east, for our purposes, by the river Strymon (formerly Struma), which separates it from Thrace; and on the north by a mountain barrier, broken only by the Axios (Vardar) and Strymon rivers. The climate is more continental than Mediterranean.

Macedonia is divided geographically into two parts: Western Macedonia is composed of mountains and high plateaux and is largely pastoral; Lower Macedonia, on the east, comprises the coastal plain, where the Axios and Aliakmon rivers flow into the Thermaikos Gulf. It is a fertile district, producing cereals, fruit (other than olives and figs), livestock and timber. Macedonia was also blessed with rich sources of gold.

Parts of Macedonia were inhabited from Early Neolithic times (about 6000 BC), but little is known of it before the seventh century BC. At this time the inhabitants were of mixed origin, Greek, Illyrian and Thracian. The first recorded king was a Greek, Perdiccas I, who reigned about 640 BC and ruled Lower Macedonia from his capital at Aegae, on the site of the modern Vergina on the Macedonian Plain. About 400 BC the capital was transferred to Pella, some 30 km north-east.

Macedonia was of little political importance until about 350 BC, when Philip II incorporated western Macedonia and Chalkidiki in his kingdom, exploited the newly-acquired gold mines of Mt Pangaion and created the most powerful state in Greece. His son, Alexander the Great, who succeeded him in 336 BC, used the Macedonian kingdom as a springboard for his world-wide conquests. On his death in 323 BC

Macedonia passed, often violently, from ruler to ruler until the Roman conquest of 146 BC. Under the Roman Empire Macedonia regained much of its former importance. Christianity came early, thanks to the efforts of St Paul; but Byzantine Macedonia was constantly harried by barbarians. In 1375 it fell to the Turks, and did not become part of the modern state of Greece until 1912.

Macedonia encompasses a wide range of different rocks from many different isopic zones and massifs (Fig. 11.1). The core is the mountainous Serbo-Macedonian massif; to the east, across the Strymon river in Thrace, lies the rather similar Rhodope massif; to the west the Circum-Rhodope belt is separated from the mountains of the Vardar (Axios) and Pelagonian zones by Neogene sediments in the broad valley of the Axios and Aliakmon rivers.

The Serbo-Macedonian massif is a band of ancient metamorphic and igneous rocks south-west of the Rhodope massif, which extends down into the Athos peninsula (Figs. 11.1, 12.1). The western part is dominated by schists, amphibolites and marbles, whereas the eastern part is composed of gneiss and marble. These rocks have been metamorphosed and deformed many times, finally during the Alpine orogeny, when they were thrust over the Rhodope massif to the east and the Circum-Rhodope belt to the west.⁶³

The Circum-Rhodope belt is a band of Mesozoic metamorphosed sedimentary rocks and ophiolites that lies between the Serbo-Macedonian massif and the Vardar zone, with which they are sometimes included. The chain of ophiolites along its south-western edge indicates that an ocean originally lay there which was consumed during the Alpine compression.

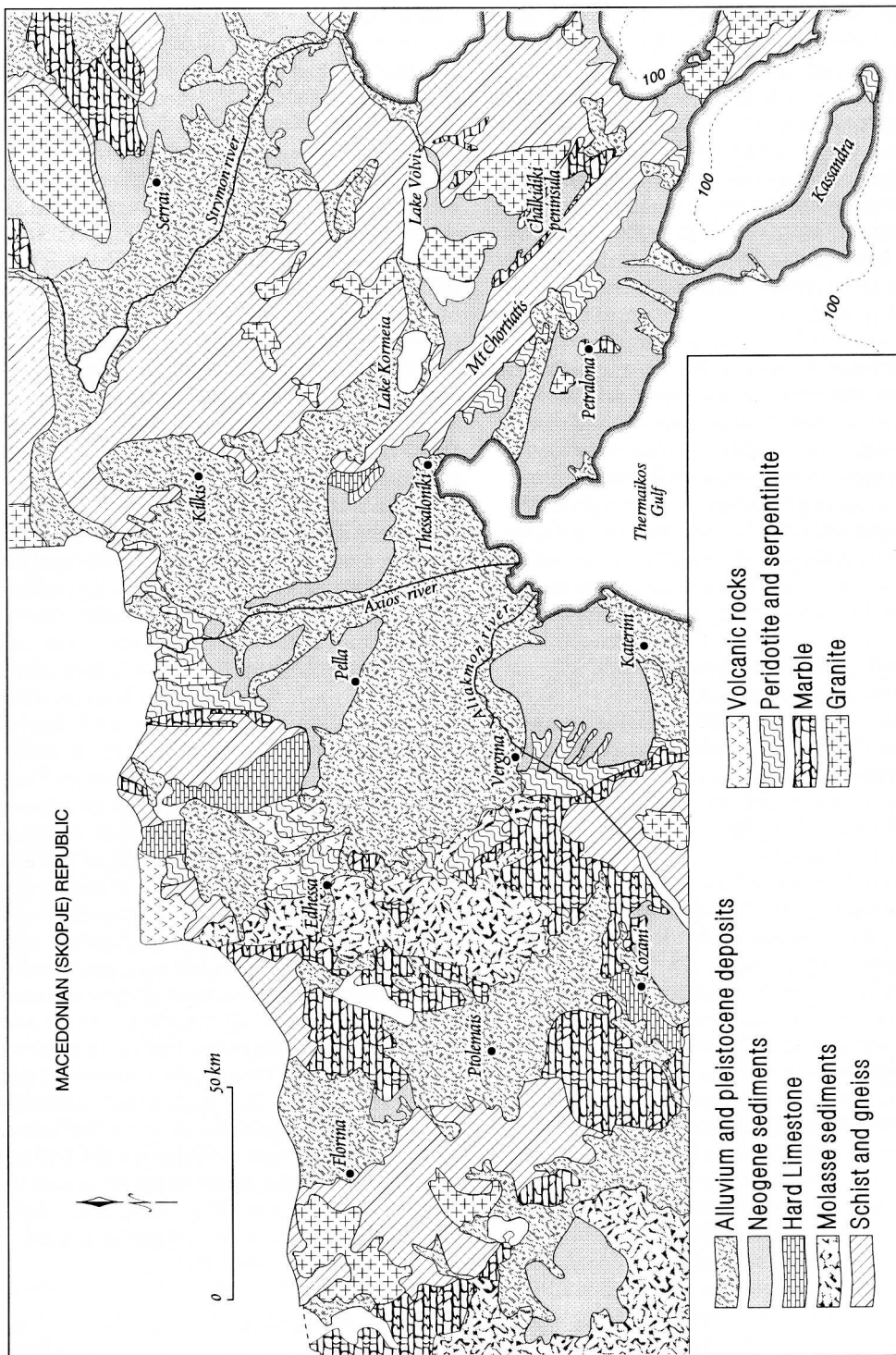


Fig. 11.1. Greek Macedonia.

sions. The Sithonia peninsula is part of this belt, but is dominated by younger granite plutons (see Fig. 12.1).

The metamorphic rocks of the Serbo-Macedonian massif and Circum-Rhodope belt may have been lifted up rapidly during a period of crustal extension: by this mechanism overlying rocks were removed by movements along flat-lying normal faults rather than by erosion. A similar process has been proposed for the occurrence of metamorphic rocks in Thessaly and the Cyclades.¹⁶³

The Vardar (Axios) zone is the central root of the former Tethys ocean from which the main compressional events were driven. It is almost completely concealed by the sediments of the Thermaikos graben, but is exposed to the north-west, where Triassic-Jurassic limestones and ophiolites are overlain by Cretaceous limestones and Eocene molasse sediments. Although the hills to the south of Thessaloniki and the Cassandra peninsula are undoubtedly also underlain by these rocks, most of what are seen on the surface are Miocene and Pliocene sedimentary rocks.

Granite plutons occur throughout this area. In the Vardar zone they are Jurassic in age and related to subduction of oceanic crust. Those on the Sithonia peninsula are Eocene, again related to subduction, but are not probably related to the widespread Miocene volcanism further east and south.

Western Macedonia is underlain by rocks of the Pelagonian zone. The characteristic Triassic-Jurassic limestones and marbles, seen so commonly further south, are here accompanied by gneiss, the basement (foundation) on which these rocks were originally deposited.

Volcanism occurred during the Pliocene, 5-1.8 million years ago, in the north-western part of the Thermaikos graben, north-east of Edhessa and on into former Yugoslavia.⁹² This volcanism is unusual in that it is much younger than that in Thrace, western Turkey and the eastern Aegean islands and is contemporary with that of the South Aegean volcanic belt.

Neogene crustal extension produced a series of north-west/south-east grabens. The largest of these is the broad Thermaikos graben, which extends from the Thermaikos Gulf

up the valley of the Axios river. Further west, the position of the Strymon graben has been partly controlled by the important thrust fault that divides the Serbo-Macedonian and Rhodope massifs. This graben appears to have hinged down from a line parallel to the thrust, so that subsidence is much greater in the south-east. The Drama-Philippi graben is another of these Neogene grabens (Fig. 12.1). It is diamond-shaped and completely enclosed within the Rhodope massif. Yet another series of Neogene grabens occur within the Pelagonian zone of western Macedonia. Most of these basins are partly filled with locally derived sedimentary rocks, including seams of lignite, some of which is mined for electricity generation.⁸⁷ Lakes Koroneia (Langada) and Volvi occupy the east-west Mygdonian graben, location of a number of earthquakes, including a major one in 1978. This graben is probably younger than the Thermaikos graben and has opened up in response to very recent north/south stretching of the crust.¹⁰⁹

Gold has been mined in Macedonia and neighbouring Thrace for about 5,000 years. The primary gold deposits are in the metamorphic rocks of the Rhodope and Serbo-Macedonian massifs. Gold occurs in quartz veins as well as associated with iron and copper sulphides.¹⁶⁶ Weathering of these primary deposits liberates the gold, which is transported in the rivers as tiny grains of metallic gold. These sink to the bottom of the stream and form placer deposits. Gold placer deposits may be 'fossilised' if the river migrates elsewhere and may be reworked by a new river at a later time, further increasing the concentration of gold. Almost all the rivers in this area had some placer deposits, but most were exhausted in antiquity. About 300 tonnes of gold were extracted in this region, and in neighbouring Thrace, from 1200 BC to AD 50,¹⁷² much of it during the reign of Philip II (359-336 BC). In recent times the major Axios river and the smaller Gallikos river (Fig. 11.2), to the north of Thessaloniki, have yielded the most gold.

Thessaloniki and the plains

In 316 BC the Macedonian king Cassander founded a city at the head of the Thermaikos Gulf, by enlarging the unimportant town of Therma and filling it with the inhabitants of 25 other towns; he named it Thessaloniki, after his wife. Its growth was assured by its position at the head of the Gulf. In 146 BC, when Macedonia became a Roman province, it became the capital and later the eastern terminus of the Via Egnatia, the road which connected the Adriatic sea with Byzantium (Istanbul). Under the Byzantines it became the second city of the Eastern Empire, and resisted many attacks by the barbarians who overran most of Macedonia. It fell to the Franks in 1204 and to the Turks in 1430, and in 1912 it was ceded to Greece. Today, known also as Salonika, it is the capital of northern Greece and the second city of the country.

The plains of Thessaloniki are the floor of a graben extending from the Thermaikos Gulf to

the south, north-westwards into former Yugoslavia (Fig. 11.1). The Pieria mountains to the west of the graben are dominated by ophiolite suite rocks and Cretaceous limestones. Similar rocks occur to the north. To the east rocks of the Circum-Rhodope zone lie in front of the gneisses of the Serbo-Macedonian massif. The low hills within the graben, including the western part of Chalkidiki and Kassandra peninsulas, are made of Miocene-Pliocene marine and terrestrial sedimentary rocks.

At the peak of the last glaciation, some 20,000 years ago, the sea-level was about 120 m lower and the coastline was about 80 km to the south, almost due west of the tip of the Kassandra peninsula.¹⁵¹ Initially, rising sea-levels produced a major marine embayment, up to 40 km inland from the present coast. Since then sediments deposited by the major rivers that flow into this gulf, particularly the Axios and Aliakmon, have partly filled in the estuary and forced the coastline to the south (Fig. 11.2). Most sediments were deposited in

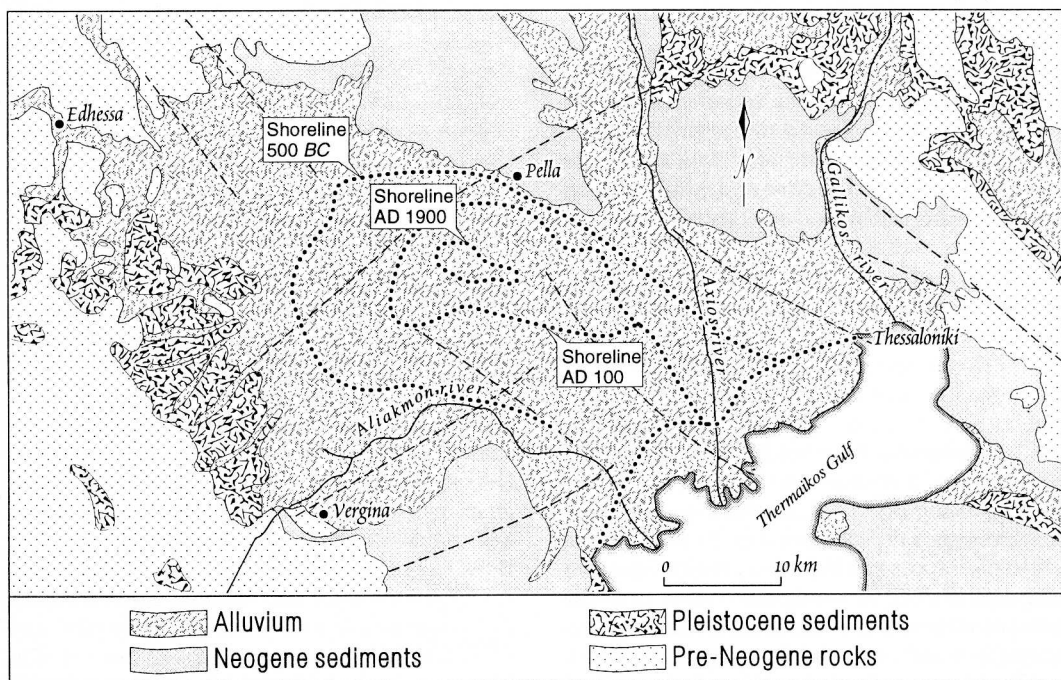


Fig. 11.2. The Plains of Thessaloniki. The positions of ancient coastlines are approximate (after 151 and other sources).

the northern and southern parts of the bay, eventually isolating part of the sea to form a lagoon and finally a lake (see below). This was drained in 1936, and now almost all the plains are under cultivation.

The comparative paucity of earthquakes in the Thermaikos graben indicates that, unlike the Corinth graben, the floor of this graben is no longer sinking at a significant rate. However, there is significant seismic activity within the active Mygdonian graben (containing lakes Kormeia and Volvi) 20 km north-east of Thessaloniki, and these earthquakes have caused much destruction in the region.¹⁰⁹

Thessaloniki

The city of Thessaloniki lies on the eastern edge of the plains, just within the graben, and extends towards the north-east onto the foothills of Mt Choriatis (Fig. 11.1). Most of the city was constructed on recent alluvium and Miocene-Pliocene sandstones, marls and clays (Fig. 11.3). The eastern suburbs lie on a low hill of gneiss, part of the Serbo-Macedonian massif, which continues in the north-east. To the north, across the north-west/south-east graben fault, lie Triassic-Jurassic sedimentary rocks and gabbro, parts of an ophiolite suite.

Thessaloniki has continued as a port since antiquity because the Axios and Aliakmon rivers debouche in the western part of the gulf, hence little sediment has accumulated in the east. However, the Axios river delta continues to advance and will eventually cut Thessaloniki off from the sea.

Pella

Pella is presently situated in the centre of the Thermaikos graben (Figs. 11.1, 11.2). To the south lie the alluvial plains of the Axios and Aliakmon rivers; to the north lie low hills of Miocene-Pliocene sedimentary rocks deposited long ago in the graben by predecessors of the present rivers. These have been lifted up tectonically and then eroded by the present rivers.

The geographical situation of the site in antiquity was rather different; from Neolithic to Early Roman times Pella was on the coast of

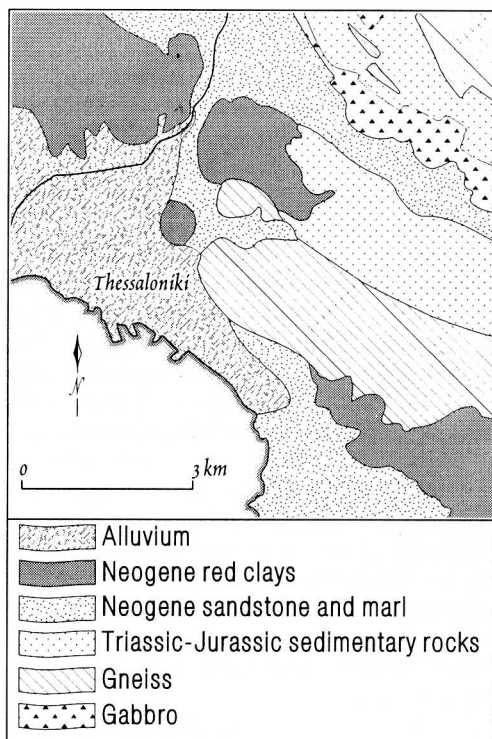


Fig. 11.3. Thessaloniki.

the Thermaikos Gulf, and latterly a port. The low hills to the north provided a site for an acropolis and its position commanded access to the plains. A low island, Phakos, existed just south of the acropolis. A major spring, now known as the Baths of Alexander, issues from the base of the hills, 2 km west of the acropolis, near Nea Pella.

Since antiquity river-transported sediments have filled in the estuary, and forced the coastline to the south: by Late Roman times the city stood on a shallow, but navigable lagoon, Lake Loudias, that was connected to the sea. Later on this lagoon became a lake, isolated from the sea, and was recently drained.

Vergina

The ancient site of Vergina is situated on the south-western side of the Thermaikos graben, at the foot of the Pieria mountains (Figs. 11.1,

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11.2). To the west is the valley of the Aliakmon river, and to the south-east the coastal plain narrows southwards between Mt Olympus and the Thermaikos Gulf. The location was important strategically, but Vergina was never a port.

The Pieria mountains are dominated by ophiolites, and descend via Cretaceous limestones and flysch to the plains. The ancient city was constructed on the lower slopes of the hills and the palace stood on the edge of the plain. The tombs were excavated out of the alluvium – here red clays with boulders of serpentinite.

Edhessa

The town of Edhessa is situated on the top of a steep bluff, facing south-east, over which the River Vodas (Edhesseos) falls 24 m to the Plain of Thessaloniki (Figs. 11.1, 11.4). The surrounding hills to the north and west are made of Jurassic to Cretaceous sedimentary rocks, with many fragments of volcanic materials. Elsewhere serpentinite and marble are parts of an ancient sea-floor (ophiolite), now much disrupted and metamorphosed, but essentially similar in age. Much younger Pliocene volcanic rocks, latite and trachyte tuffs, crop out 3 km east of the town, but volcanic activity ceased 2.5 million years ago. The town was constructed on alluvium that has accumulated behind a natural dam of travertine.

The travertine is a freshwater limestone that forms by direct crystallisation of calcite from the river water as it passes over the falls. The travertine started to form in the early Pleistocene and deposition continues today. It is not connected with the nearby volcanism.

The calcite of the travertine probably originates in the marble hills to the west: rainwater dissolves the marble and the groundwater becomes saturated in calcite. The water appears at springs and feeds the Vodas river. As the water passes over the waterfalls in the city, it loses carbon dioxide and calcite crystallises out. The resulting limestone is commonly full of holes and fossilised plant material. It may be dissolved again to form caves and reprecipitated to make stalactites. There must have been a waterfall hereabouts to start the whole

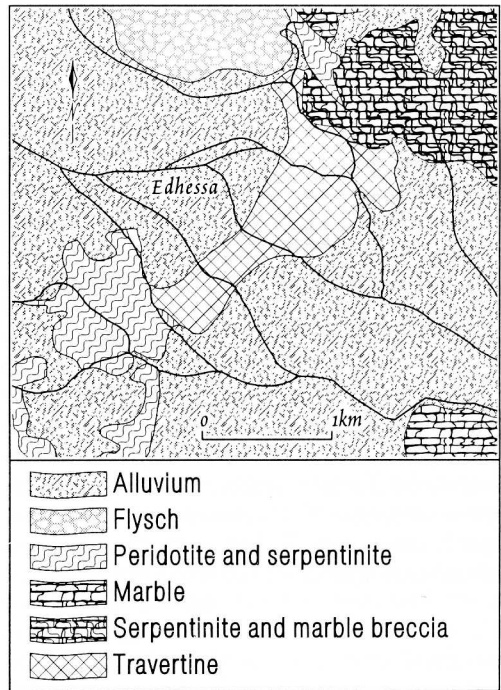


Fig. 11.4. Edhessa.

process – perhaps a scarp of one of the faults that define the Thessaloniki graben. There are travertine terraces 4 km upstream on the Vodas river, and at Flamouria 6 km to the south-west, which probably originated in the same way.

Chalkidiki peninsula

The Chalkidiki peninsula juts out into the Aegean from Macedonia proper (Figs. 11.1, 12.1). In the south-west, near Petralona, is a cave with stalactites, where the skull of a Neanderthal woman was found; she must have lived some 75,000 years ago. From the southern end of Chalkidiki three spurs of land project. From west to east, they are Kassandra (ancient Pallene), Sithonia and Mt Athos. The original inhabitants of this peninsula were not Greeks, but the coastline was thickly colonised by Greeks from the eighth century BC onwards.

The three prongs that terminate the Chalkidiki peninsula each have contrasting

geology: Kassandra is largely made up of Neogene sedimentary rocks, Sithonia is several large granite plutons and Mt Athos contains both granites and metamorphic rocks (Figs. 11.1, 12.1). The form of these peninsulas is controlled by north-west/south-east faulting during the Neogene, but these directions follow older directions of weakness that are parallel to the isopic zones. The ends of the three peninsulas are aligned: they have been cut off by relatively recent movements along the North Aegean Fault zone (see Chapter 12). As a result, the sea-floor plunges rapidly to the south-east of the end of the peninsulas into the North Aegean Trough, a south-east extension of the North Anatolian strike-slip fault which dominates Turkish geology. Although movements along the North Aegean Fault zone are mostly strike-slip, it does have an important component of tension, forming a graben.

An important modern mineral commodity of the Chalkidiki peninsula is magnesite. It is extracted from a series of mines in the serpentinite masses that lie in a line south-east of Thessaloniki, especially near the villages of Vardos and Gerakini.¹⁷² It was formed during the metamorphism of ophiolites, when peridotite was converted into serpentinite. Circulating hot water dissolved magnesium from the rocks and redeposited it as magnesite in veins. Magnesite is used in the manufacture of refractory bricks. Copper is also mined in the region.

Mt Athos

The most famous of the spurs of Chalkidiki is the peninsula of Mt Athos (or Ayion Oros, the Holy Mountain), known in antiquity as Akte. This semi-autonomous theocratic republic is covered with mediaeval monasteries, some dating from the tenth century AD. The area is forbidden to women; consequently the monasteries are seldom visited by tourists, and are usually viewed from the sea.

The Mt Athos peninsula is part of the Serbo-Macedonian massif and is dominated by igneous and metamorphic rocks (Figs. 11.5, 12.1). The schist and gneiss of the central part of the peninsula contain bands and masses of

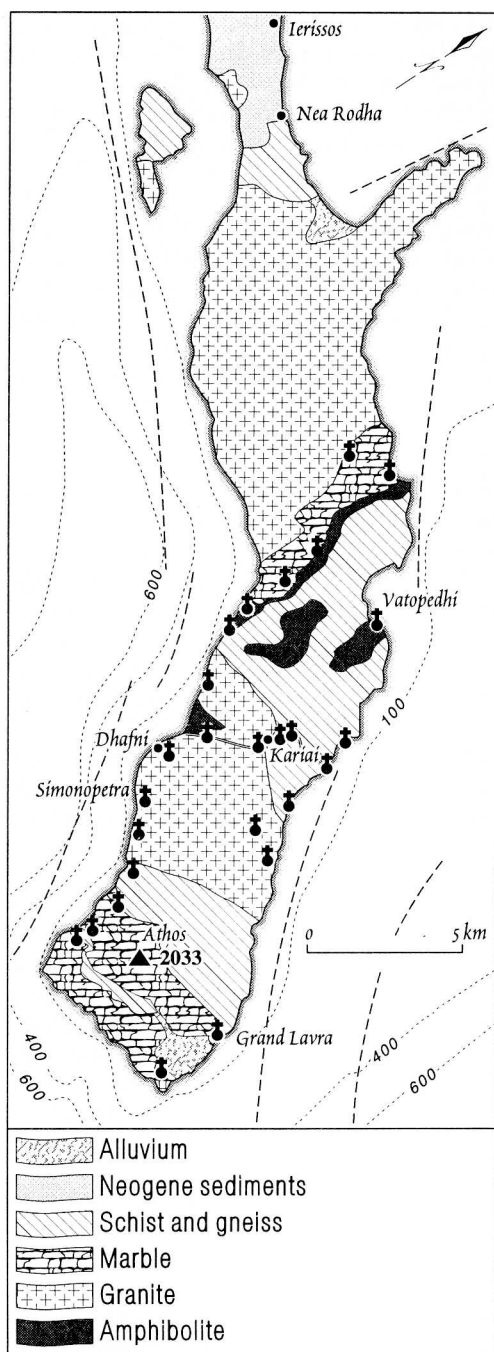


Fig. 11.5. Mt Athos peninsula.

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dark-coloured amphibolites. Schist also occurs in the south, but the summit of Mt Athos (2,033 m) itself is made of pale marble. Two granite plutons were emplaced into these metamorphic rocks; one is about 5 km in diameter and is exposed on the south-west coast just south of Dhafni. The cliff to the north of Simonopetra is made up of this granite. The other pluton comprises most of the plateau in the north-west part of the peninsula and is almost devoid of monasteries.

To the north-west the peninsula narrows to an isthmus 2.5 km wide made of soft Neogene sediments. It was here in 480 BC that Xerxes ordered a canal to be cut across the peninsula, to avoid the perils of the Mt Athos promontory. Little now remains as sediments have been deposited in the canal and the land has risen since that time by some 14 m (see below), but it is believed to have been just west of Nea Rodha (Fig. 11.5).

Evidence of ancient sea-level stands can be clearly seen from the water around the peninsula: These generally consist of notches or ledges about 1 to 3 m above present sea-level; old sea-caves, excavated by storms, can be seen above these ledges. These sea-level stands are frequently very discontinuous; sometimes we can see many, and sometimes very few. Their height varies enormously also, in some cases across a valley. The peninsula is divided up by faults into blocks, each of which has a separate history of movement, and some of these faults run along the river valleys. The rapidity of uplift and the greater overall altitudes of the land towards the south of the peninsula are probably related to its tectonic position: the graben of the North Aegean Trough lies immediately to the south, and frequently the subsidence of the floor of such grabens is balanced by uplift of the land adjacent to the graben.