

North-west Greece and the Ionian Islands

Epeirus comprises the bulk of the mainland of north-west Greece. It is a land of precipitous mountains, large rivers, and a few maritime plains and lagoons. The mountains are rich in pasture and timber; cereals and olives are grown in the plains. The name Epeirus, which goes back to antiquity, means 'The Mainland', as seen from the island of Kerkira (Corfu). There is good evidence for occupation in the Neolithic and Bronze Ages, 6000-1100 BC, and from 1600 BC Epeirus was gradually penetrated from the coast by Mycenaean Greeks. In historic times the Epeirotes were regarded by the Greeks as barbarians, because of their Illyrian heritage. They did, however, possess two famous oracles, much patronised by the Greeks: the Oracle of Zeus at Dodona and the Oracle of the Dead at the mouth of the river Acheron, east of Paxos.

The Epeirotes do not appear on the stage of history until the fourth century BC, when they benefited from the victories of Philip II of Macedon. But in 167 BC Rome took control of the country after a bloody victory. Emperor Augustus founded the town of Nikopolis ('Victoryville') to commemorate his victory over Antony and Cleopatra at the Battle of Actium in 31 BC. Afterwards the importance of Epeirus declined rapidly, until the rule of the notorious Ali Pasha in the nineteenth century AD. It did not become Greek territory until 1913.

The Ionian Islands (alternatively the Epitanesa, or 'Seven Islands') are situated for the most part in the Adriatic Sea, along the west coast of Greece. The name is comparatively recent, but is taken from an ancient name for the Adriatic, 'The Ionian Sea' (not to be confused with the district of Ionia in western Turkey). The principal islands are, from north

to south (Fig. 10.1): Kerkira (Corfu), Paxos, Levkas, Kephallinia, Ithaca and Zakynthos (Zante). The seventh, Kythera, from its situation south of Laconia, is commonly excluded, and we will follow this example.

The islands, with three times the average rainfall of the Aegean, are by far the greenest and most fertile of the Greek islands, though they are also for the most part mountainous. Their early history will be considered below, under the individual islands. They gradually came under the control of Venice in the fifteenth century, and so remained until captured by Napoleon in 1797, who considered them 'more important than the whole of Italy'. After various vicissitudes, in 1815 the Seven Islands became a protectorate of Great Britain and in 1864 they were ceded to Greece.

North-west Greece contains all the westerly elements of the Hellenic collision zone, now stacked upon each other by thrust faults. However, before the compression, which still continues now, the rocks were stretched out over a much greater distance and made up a continent, its margin and the adjacent ocean basin.

The remains of the ocean basin are seen today in the chert, limestone and ophiolite suite rocks of the Pindos zone, cropping out in the eastern part of the region, from the Pindos mountains past Naupaktos into the Peloponnese. This basin formed by spreading along a mid-ocean ridge during the Triassic period. Shortly afterwards, during the Jurassic, regional compression started and the basin closed. The ophiolites of the Pindos zone were thrust eastwards over the Pelagonian zone. They soon rose above sea-level and shed sediments onto the adjacent areas.

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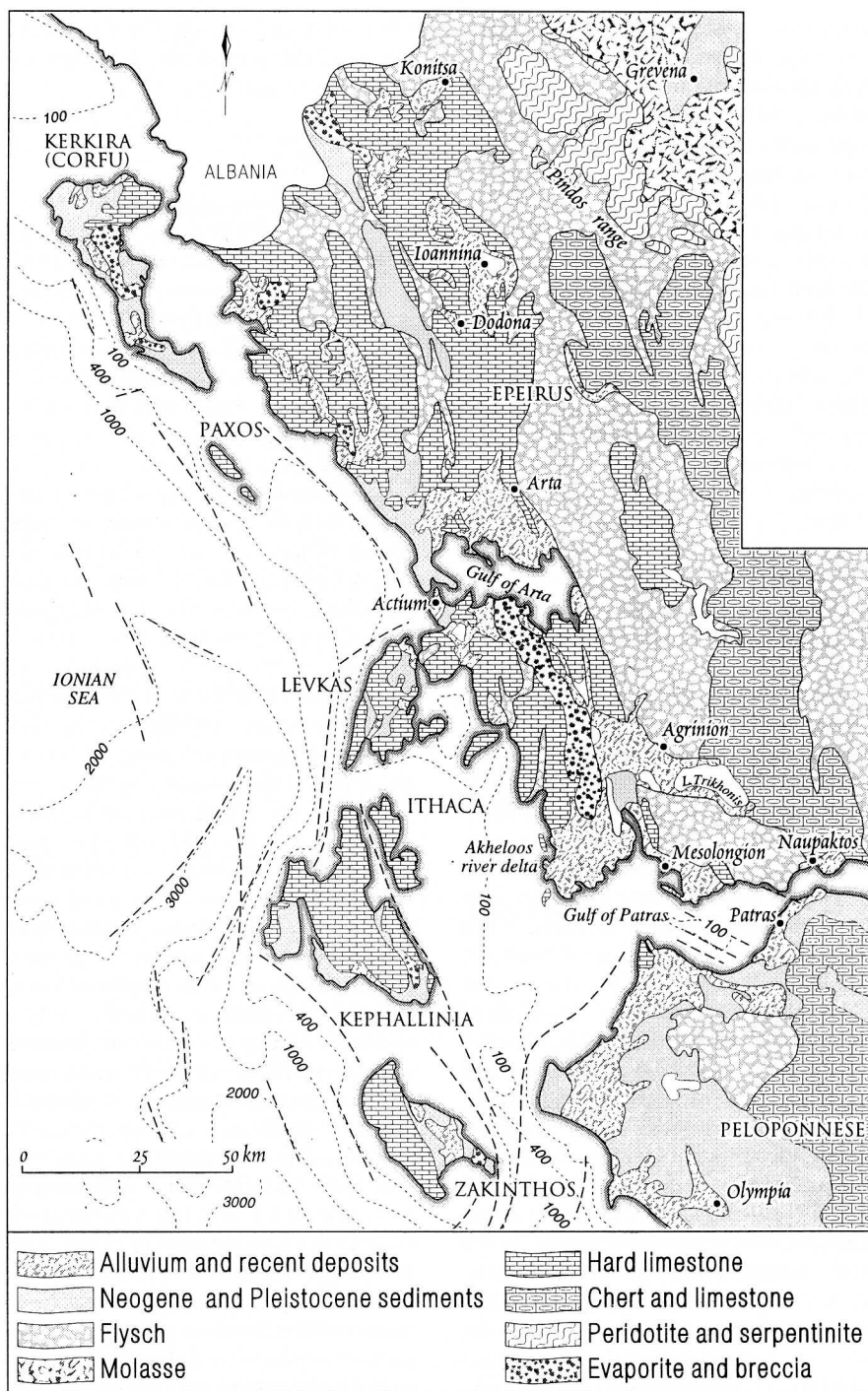


Fig. 10.1. North-west Greece and the Ionian islands.

The Gavrovo zone was originally part of the continental shelf. It now crops out in a narrow belt west of the Pindos zone. The oldest rocks are limestones, rocks typical of shallow seas, far from mountains. This situation changed later when stacking of thrust sheets of rock produced mountains in the Pindos zone to the east. The weight of these mountains bowed down the crust and formed a basin in front. Sediments shed from the mountains accumulated in the basin as flysch.⁴⁰ Further west still the Ionian zone was a deep-water trough, but not a true ocean basin. It crops out throughout much of the western part of this region and is dominated by deep-water limestones. Finally, rocks of these zones were thrust westwards onto the continent during Early Miocene and Pliocene times.²⁶⁸

The remains of the stable continental platform are seen today as the Pre-Apulian zone, which crops out on the western parts of the Kephallinia, Levkas and Zakynthos. This zone is almost part of Italy: continental crust continues north-west from the Ionian islands to the south-eastern peninsula of Italy, Apulia. Deformation associated with regional compression in Greece is slowly spreading west, and has now started, in a rather limited way, in this zone.²⁶⁸

The interior parts of this region were stretched in a north-north-east direction during the Neogene, as elsewhere in most of the Aegean region, forming a series of basins.³⁵ One such basin contains Lake Trikhonis, and may be a western extension of the Gulf of Corinth, with which it is co-linear. The Gulfs of Patras and Arta (Amvrakikos) are other basins oriented in a similar direction. These gulfs are linked by a north-north-west strike-slip fault with leftward movement.⁴⁰ Undulations in the fault direction have produced a series of small basins, now filled by lakes.

The high incidence of earthquakes in the central and southern parts of the region testifies to the presence of a plate boundary just to the west: the Apulian plate is descending to the east below the Aegean plate. Some of these earthquakes have caused rapid changes in the height of the land. For instance, the peninsulas north and south of the mouth of the Gulf of Arta

were produced recently by such uplift: hence, the battle of Actium may have been fought on what is now dry land.

Ioannina

Ioannina was founded in around the eleventh century AD, and took its name from a nearby monastery of St John. Its importance dates from 1205, when it received refugees from Constantinople and the Peloponnese. In 1431 it fell to the Turks. In the early nineteenth century it was the capital of the notorious Ali Pasha, an Albanian adventurer who made himself master of nearly all Greece. Today it is the principal town of Epeirus.

The Ioannina area is a large arch-like fold, dominated by Late Jurassic to Eocene limestones (Figs. 10.1, 10.2). The city of Ioannina lies on the shores of Lake Pamvotis which occupies the core of this fold where erosion has been deepest. It partly fed from karstic springs, discharging from fissures and cave systems in the surrounding hills. The presence of such springs is revealed by the density of vegetation along the north-east shore. One spring discharges into the lake on the shore opposite Nisi island. In the nineteenth century the lake extended more than 10 km the north and to Kastritsa in the south, where it drained into sink-holes.⁴³ The construction of a storm drain and tunnel to the Thiami basin to the north, in 1944, changed the extent of the lake. At present it is up to 10 m deep and partly drains through sink-holes in its bed.

Three blocks of Late Cretaceous limestone poke through the valley floor: the peninsula of the Kastro of Ioannina, the island of Nisi in Lake Pamvotis and Mt Goritsa, beside Perama. The abundance of limestone breccia in this unit has increased its permeability for groundwater, and made it particularly susceptible to the development of caves. A cave below part of the Kastro (currently the local museum) was first used by Ali Pasha for the storage of ammunition. Some caves and fissures are also present on the island of Nisi. However, the best cave in the region, the Perama Cave, was developed beneath Mt Goritsa.

The Perama cave was discovered in the

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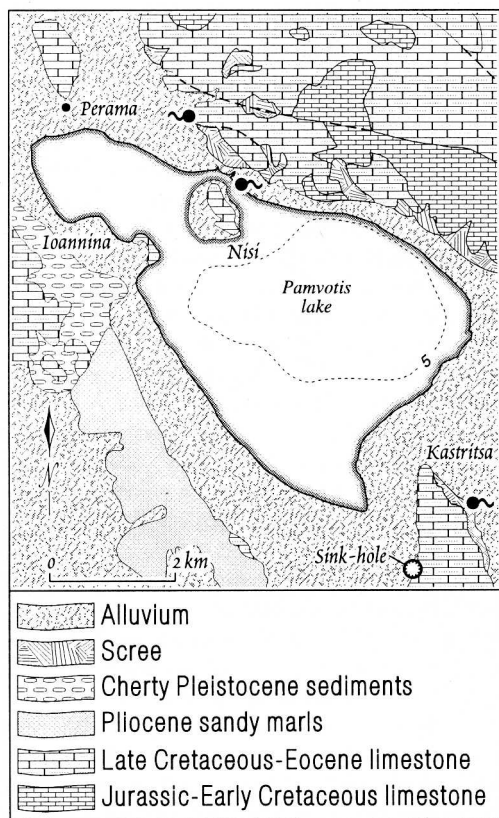


Fig. 10.2. Ioannina and Lake Pamvotis.

1940s and is open to the public.²¹⁶ It was part of an underground river system that formed about 1.5 million years ago and is very rich in different types of cave formations, including stalagmites, stalactites, flowstone, curtains and pool-rims. Very little new material is forming now as climatic change has drastically reduced the flow of water into the cave. Unfortunately, high levels of artificial lighting have caused the growth of much algae on the formations.

Dodona

Dodona was celebrated in antiquity for the Oracle of Zeus, which was regarded as the oldest in Greece. There was a sanctuary here, probably in honour of a fertility goddess, as early as 2200 BC. About 1400 BC the Sanctuary, by now sacred to Zeus, was visited by Myce-

naean Greeks. The Oracle was probably functioning at this time, if not earlier. Legend has it that Odysseus consulted the Oracle, situated in an oak tree, on his return from the Trojan War. By the sixth century BC Dodona had been overtaken by its more accessible rival at Delphi, but it continued to exist until the closing of the pagan sanctuaries in AD 393 by the Christian Emperor Theodosius I. It was finally destroyed by the invasion of the Goths, followed by a terrible earthquake.

The site is at the bottom of a narrow valley, enclosed on almost all sides (Fig. 10.1). There is no river at the bottom of this valley at this point as the drainage from the surrounding hills disappears into sink-holes. Mt Tomeros rises over the site to the south-west and is made of Jurassic limestone. Small valleys on the upper slopes have shed huge, steep cones of scree, that now cover much of the lower slopes.

The acropolis was constructed on a platform of Palaeocene-Eocene limestone, which crops out below the theatre. This rock was itself used to construct many of the buildings, including the theatre. This limestone contains veins of chert, typically 1 cm thick, which were used on the upper surfaces of the seats, either for decoration or because they withstood wear much better than the limestone.

Mesolongion

Although an ancient site, the town of Mesolongion does not really enter history till the Greek War of Independence (1821-32), when Prince Mavrogordato made it his headquarters. Here in 1824 the philhellene Lord Byron died of fever while organizing the Greek resistance.

Mesolongion is situated on the northern shore of a large lagoon, part of the delta of the Evinos river, north of the Gulf of Patras (Fig. 10.1). West of Mesolongion, across the bay, is another large delta, that of the Akhelos river. Both these rivers drain large areas of Tertiary flysch sediments to the north and east, seen as the hills behind Mesolongion. As in many deltas in the Aegean region, deposition of sediments has been extremely rapid, resulting in similarly rapid changes in geography.²¹⁹

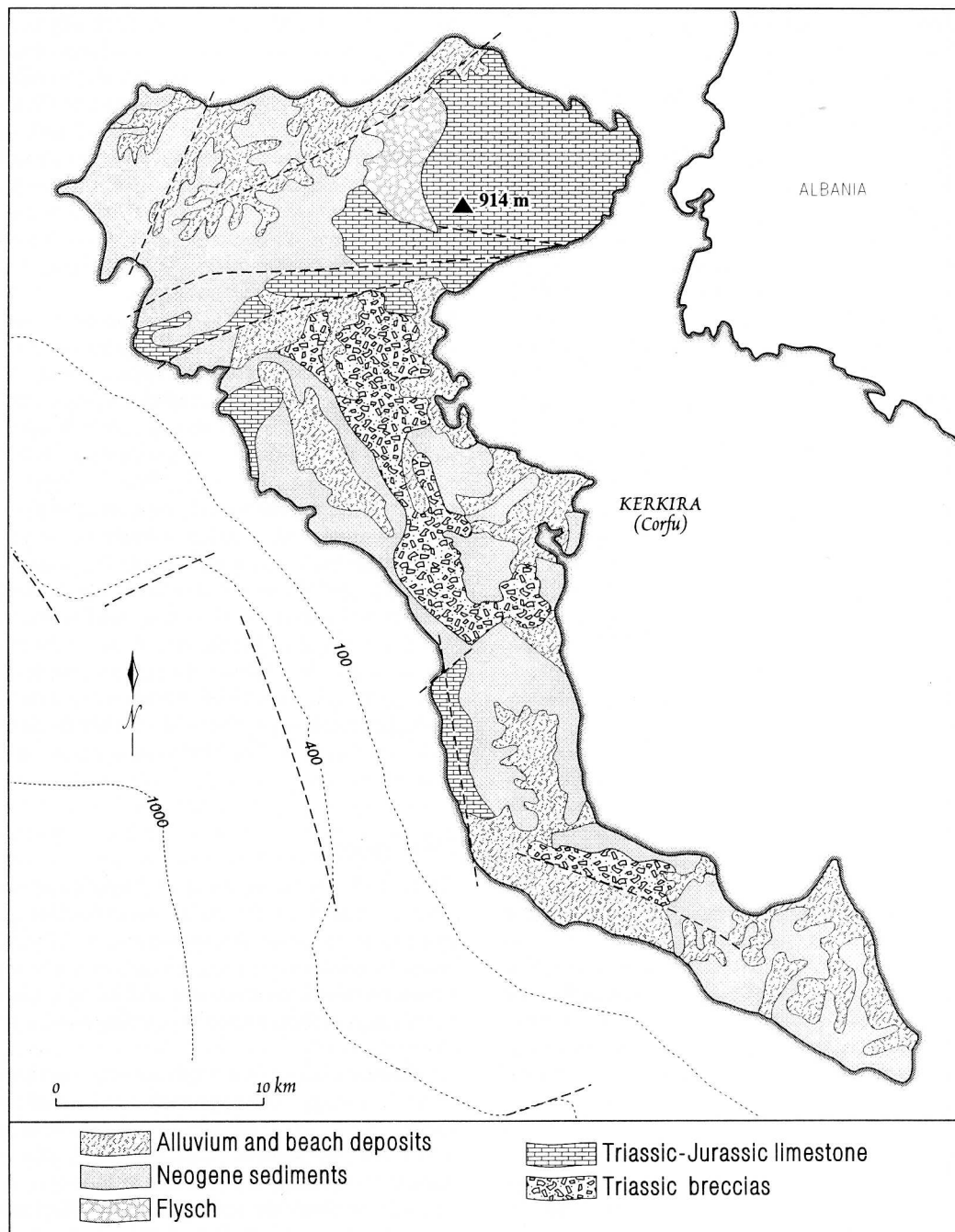


Fig. 10.3. Kerkira (Corfu).

Kerkira (Corfu)

The island of Kerkira (formerly Corcyra), commonly known today by its Venetian name of Corfu, is the most fertile of the Ionian Islands. It was first inhabited about 50,000 years ago, during the Palaeolithic Age. Surprisingly, the Mycenaean Greeks never settled here. Nevertheless, the Classical Greeks claimed this island as Homer's Scheria, land of the Phaeacians, where Odysseus was washed ashore, met the Princess Nausicaa, and was entertained by her father King Alcinous. In fact, the city of Kerkira was founded by Greek colonists from Euboea about 760 BC, but soon passed to the Corinthians, who used the city as a staging point on the way to their colonies in South Italy and Sicily. In 1204 Corcyra passed to the Venetians who ruled it for most of the next 500 years as a vast olive plantation.

Kerkira lies on the shallow continental shelf west of Epeirus and Albania (Fig. 10.1). The channel between Kerkira, the mainland and islands to north was a land bridge prior to 6000 BC.²⁵⁰ Much of the steep western coast of the island follows a fault, along which the island has been uplifted recently. This sharp relief continues to the west of the island, where the sea-floor drops rapidly to a depth over 1,000 m along a series of normal faults. This region has a low incidence of earthquakes, especially compared to the Ionian islands to the south.

The island lies entirely in the Ionian zone, a former deep basin in the continental margin (Fig. 10.3). The oldest rocks on the island are Triassic-Jurassic limestones which are exposed on Mt Pantokrator (914 m) in the north. The southern margin of this massif is a major east-west left-moving strike-slip fault. Further south there is a series of Triassic breccias formed by the dissolution of gypsum and the collapse of the overlying rocks into the holes. Much of the rest of the island is covered with Pliocene-Miocene marine sediments, including gypsum. A two-metre thick bed of hard shelly limestone (coquina or 'panchina') rests on the Pliocene sediments in the western part of the island. In former times it was quarried extensively for construction. The coquina and other recent marine sediments are commonly cov-

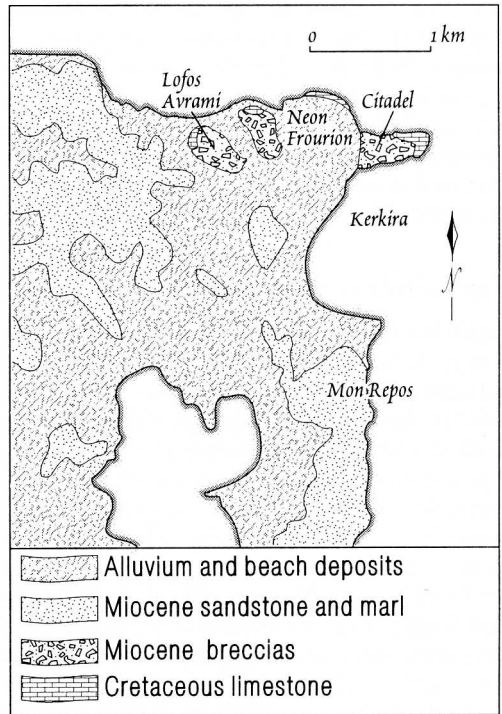


Fig. 10.4. Kerkira (Corfu) town.

ered by terra rossa soils, up to 30 m thick. Many Palaeolithic implements have been found within this soil, suggesting that it continued to form until recently.²⁵⁰

The town of Kerkira lies in the east, on alluvium and low hills of Miocene sandstone and marl (Fig. 10.4). Within the town lie three low hills, the Citadel, Neon Frouirion and Lofos Avrami, which are made of pale Late Cretaceous limestone, covered with Miocene breccias. The low hill to the south, under the ancient acropolis and Mon Repos, is made of Miocene sandstone.

Levkas

The island of Levkas was first inhabited from Early Neolithic times (6000 BC) and there was a particularly rich settlement there toward the end of the Early Bronze Age, 2500-2200 BC. It was colonised by the Corinthians in 640 BC.

Most of the island is in the Ionian zone and

comprises Triassic to Cretaceous limestones (Fig. 10.1). The south-western peninsula is made of rocks of the Pre-Apulian zone, including the 60-metre high white cliff of Cretaceous limestone after which the island is named. It is almost joined to the mainland by a spit of sand that encloses a shallow lagoon around the modern town of Levkas.

Kephallinia (Cephalonia)

Kephallinia (or Cephalonia), the largest of the Ionian Islands, is rugged and mountainous, culminating in Mt Aenos (1,628 m), the highest point in the Ionian Islands. The mountains are clothed with the Kephallinian pine; in the valleys and on the plains are grown olives, citrus, currants and cotton. The island was inhabited from about 3000 BC, and was very prosperous in later Mycenaean times, from 1300 to 1100 BC. From here the Mycenaeans set out for Sicily and South Italy. Kephallinia and Ithaca are among the few remaining habitats of the Mediterranean monk seal.

Kephallinia is situated on the edge of the continental margin, but is surrounded by deeper water than Kerkira or Levkas (Fig. 10.1). Thrust faults on either side, and within, the island are related to regional compression and subduction of crust beneath the sea just south-west of the island (Fig. 10.5). Kephallinia is close to the northern end of the Hellenic subduction zone, and it is offset by north-east/south-west strike-slip faults to the north. The combined effect of these two active fault systems ensures that the island is regularly rocked by earthquakes, one of the most destructive in recent times being in 1953. During that earthquake the central part of the island was raised 30 to 70 cm.²⁵⁷ Such events must be geologically relatively frequent: a sea-level stand 1.2 m above present sea-level around the central part of the island must have been produced by movements associated with one or more earthquakes during the fourth to sixth centuries AD.

The island is dominated by limestone (Fig. 10.5). The oldest rocks are exposed in the east as a series of Triassic to Cretaceous limestones of the Ionian zone. These have been thrust

westwards along the Ionian Fault and other faults onto Cretaceous limestones and minor Tertiary limestones and sediments of the Pre-Apulian zone that make up most of the island. The western margin of the zone of Alpine compression has moved progressively westward, and thrusting has occurred recently in the previously stable western parts of the island.¹⁸⁸

The strong relief of the island is partly due to the resistance to erosion of the limestone, and partly to the recent thickening of the sedimentary sequence by thrust faulting.

Katavothres of Argostoli

Near Argostoli there is a very unusual karstic phenomenon (Fig. 10.5): the sea drains into sink-holes (katavothres) in the land with sufficient flow (0.3 cubic metres per second) that it was once used to generate electricity.²¹⁶ This water appears, mixed with freshwater, 14 km away on the other side of the island in springs near Sami at Karavomilos, Frydi and the cave-lake of Melissani, and at Ayia Euphenia 4 km to the north.⁶⁸

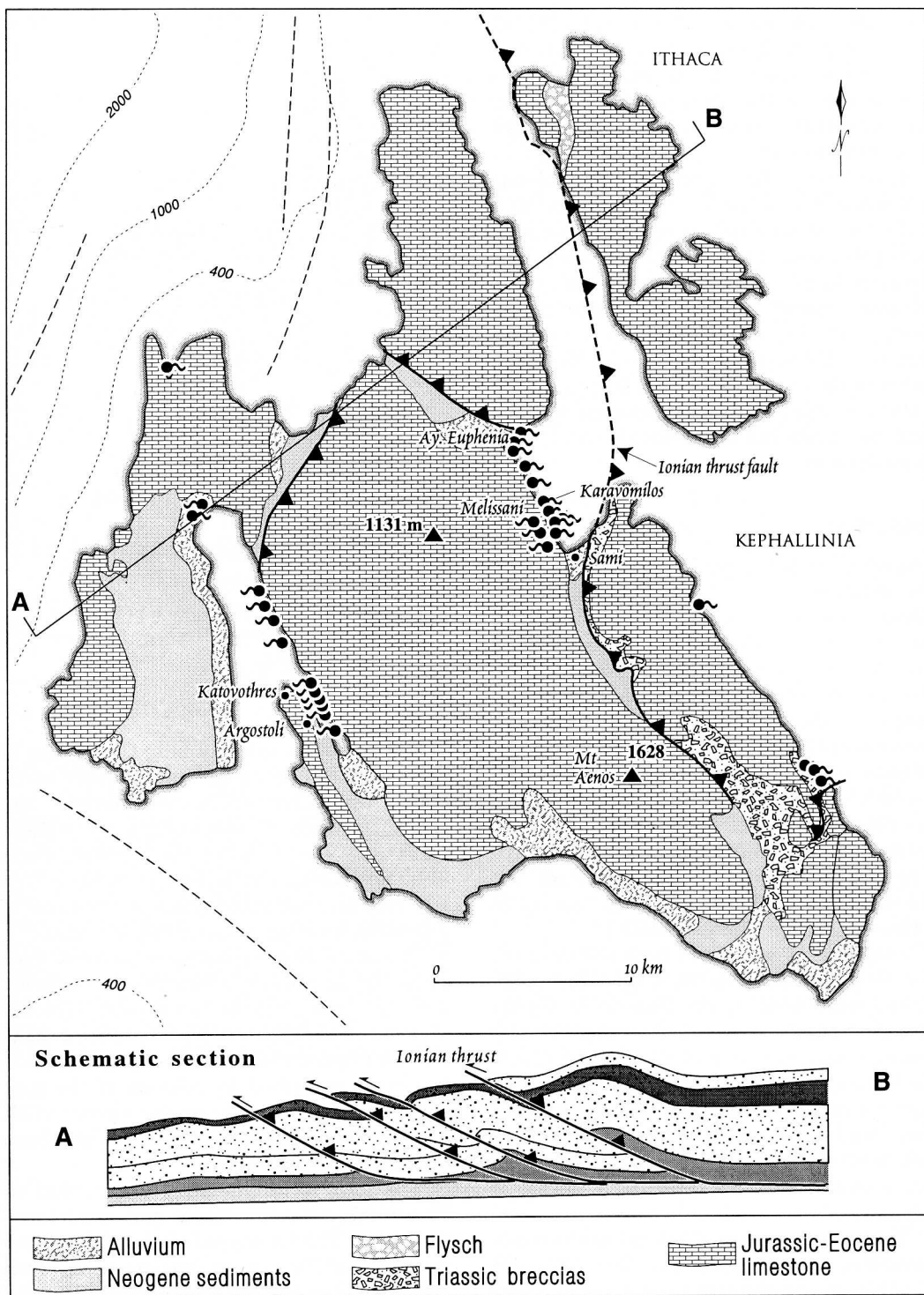
This strange phenomenon is largely driven by the energy derived from the dilution of the seawater by freshwater. The caves or fissures that connect the sink-holes with the outlets descend below sea-level, and were formed when the sea was far below its present level. The dense seawater descends into the cave, where it mixes with lighter fresh water. The brackish water is lighter than the seawater and, therefore, floats at a higher level, finally discharging about one metre above sea-level.⁶⁸ In total there are about 40 springs around the coast of Kephallinia, many of which discharge brackish water. The other sink-holes that feed these springs must be in the sea-bed.

Ithaca

Ithaca has been inhabited from about 6000 BC, and was believed by the ancients to have been the home of the Homeric hero Odysseus (Ulysses to the Romans). His date, insofar as he was

Fig. 10.5. Kephallinia (Cephalonia) and Ithaca.

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a historical person, would be about 1200 BC. His palace has not yet been found, but plentiful Mycenaean remains, of the right date, have come to light on the Isthmus, at Aetos, and in the north, at Pelikata, so there is still hope that it might be located.

In contrast to Kephallinia, Ithaca is almost completely within the Ionian zone (Figs. 10.1, 10.5). The island largely consists of a series of folded Jurassic to Eocene limestones. The strong relief of the island is probably related to relatively recent uplift on the Ionian thrust fault, which lies just to the west, under the Straits of Ithaca. As on Kephallinia, the dominance of limestone has led to a lack of surface water, and this, coupled with the scarcity of flat land, has made the island agriculturally very unproductive.

Zakinthos

The island of Zakynthos (alternatively Zante), the southernmost of the four central Ionian Islands, lies off the coast of the Peloponnese west of Olympia. The eastern half is low-lying and fertile, growing currants and olives, whereas the western half is mountainous and barren. There was a small Mycenaean presence here between 1600 and 1100 BC, but the island was not properly settled until about the seventh century BC, by Greeks from Achaea in the Peloponnese. The island is celebrated for its springtime flora (hence its other name 'Di Fliori de Levant'), for the loggerhead sea turtles which nest here, and for its springs of bitumen at Limni Keri (see below).

Zakinthos is separated from the Peloponnese by a channel up to 600 m deep (Fig. 10.1). To the south-west the sea-floor drops rapidly into the Hellenic trough. The general tectonic setting is similar to that of Kephallinia: beside the Hellenic subduction zone and in a zone of regional compression. Also, like Kephallinia, this island is situated in a zone of high seismic risk. Most of the local earthquakes occur along faults east of Zakynthos town and in the bay of Lagana.

The bedrock geology of Zakynthos also much resembles that of Kephallinia (Fig. 10.6): Mt Yiri (756 m) and the ridge in the western part

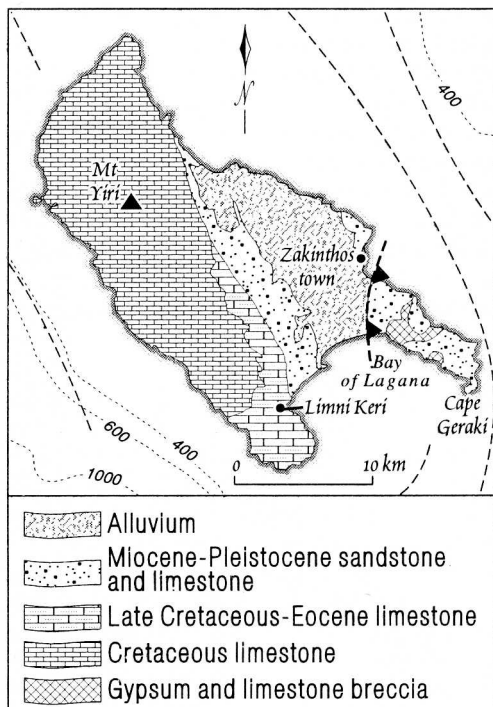


Fig. 10.6. Zakynthos (Zante).

of the island are made of Late Cretaceous to Eocene limestones. Oligocene-Pliocene sandstones and other sediments underlie the central lowlands.²⁶⁷ Layers of gypsum in these rocks were formed when the Mediterranean dried out during the 'Messinian Salinity Crisis'. Deposits occurring south of the town of Zakynthos have been extensively quarried.²⁶⁷

The south-eastern peninsula contains older rocks, Triassic in age, which have been thrust over the younger rocks to the west. Gypsum also occurs here, as well as extensive breccias produced by collapse of the overlying rocks into the caves developed by solution of the gypsum.²⁶⁷ Such rocks make up the summit of Mt Skopos (485 m). Pliocene sandstones have been quarried near Cape Geraki.

The town of Zakynthos is constructed on Pliocene-Pleistocene marls and sandstones (Fig. 10.7). The flat-topped castle hill is capped by a layer of Pleistocene conglomerate, which is harder than the underlying Pliocene rocks

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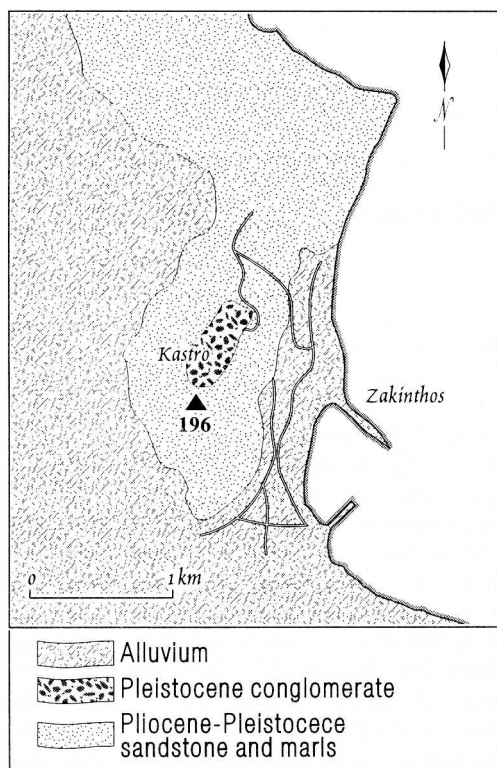


Fig. 10.7. Zakynthos town.

and has protected them from erosion.

In the southern part of the island, near Limni Keri, there are natural springs and pools of bitumen (pitch), mentioned by Herodotus (Fig. 10.8). Bitumen was used in antiquity in the Aegean for caulking ships and making wine-jars waterproof.^{267, 281} It was applied as a protective coating on metals and for magical purposes. It was thought to have great medical qualities and was prescribed for anything from coughs and diarrhoea to lumbago. Bitumen is the residue left where petroleum has seeped up

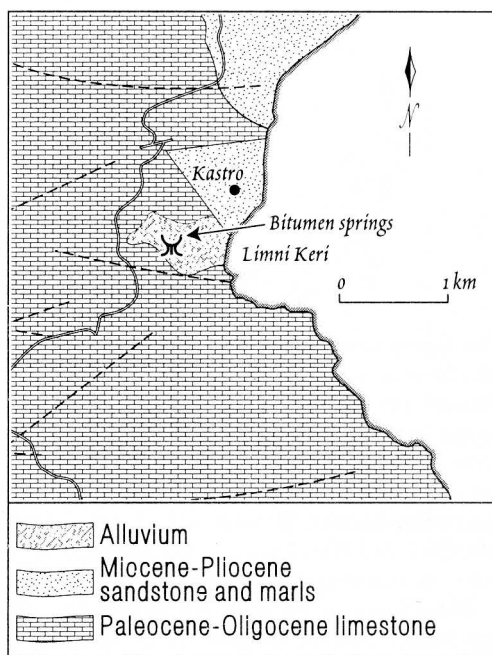


Fig. 10.8. Limni Keri (after 267 and other sources).

to the surface and the lighter, more volatile components (similar to paraffin/kerosene and petrol/gasoline) have been lost by evaporation. The bedrock here is Palaeocene-Oligocene limestone, but the petroleum is probably derived from deeper rocks, perhaps the Cretaceous limestones seen elsewhere in the island. In such sedimentary rocks petroleum forms from plant remains by the action of heat in the absence of oxygen. It is lighter than water and hence tends to migrate upwards through permeable rocks or along faults, unless trapped. Despite the presence of bitumen, economic reserves of oil have not yet been found in the region.