A Billion Years Of History In Our Rivers

the waterways of geopark Grevena-Kozani

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Geopark Grevena-Kozani

Venetikos River

an unstable environment that can change within hours

Top photos: Bridge of Portitsa
Bottom photos: Bridge of Aziz Aga

Portitsa Gorge, Spelion Canyon

rivers

remove

sort

carve

transport

accumulate

build

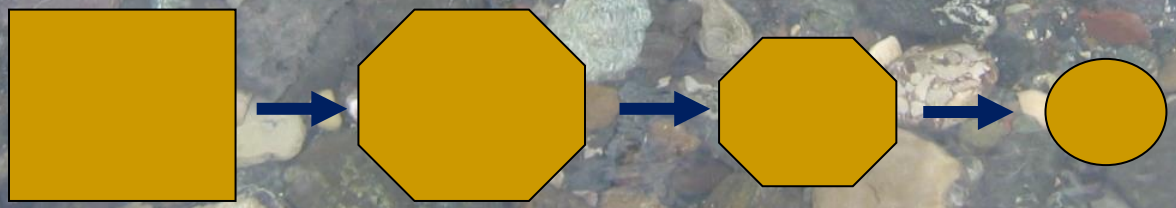
recycle

they shape the Earth's surface

we can read the history of
tectonic movements and climate change
in the rocks formed by rivers

How To Form A Cobble

rocks are cut
tumbled
and
scoured
until they are
nearly spherical



Venetikos River

Agapi

rounding means

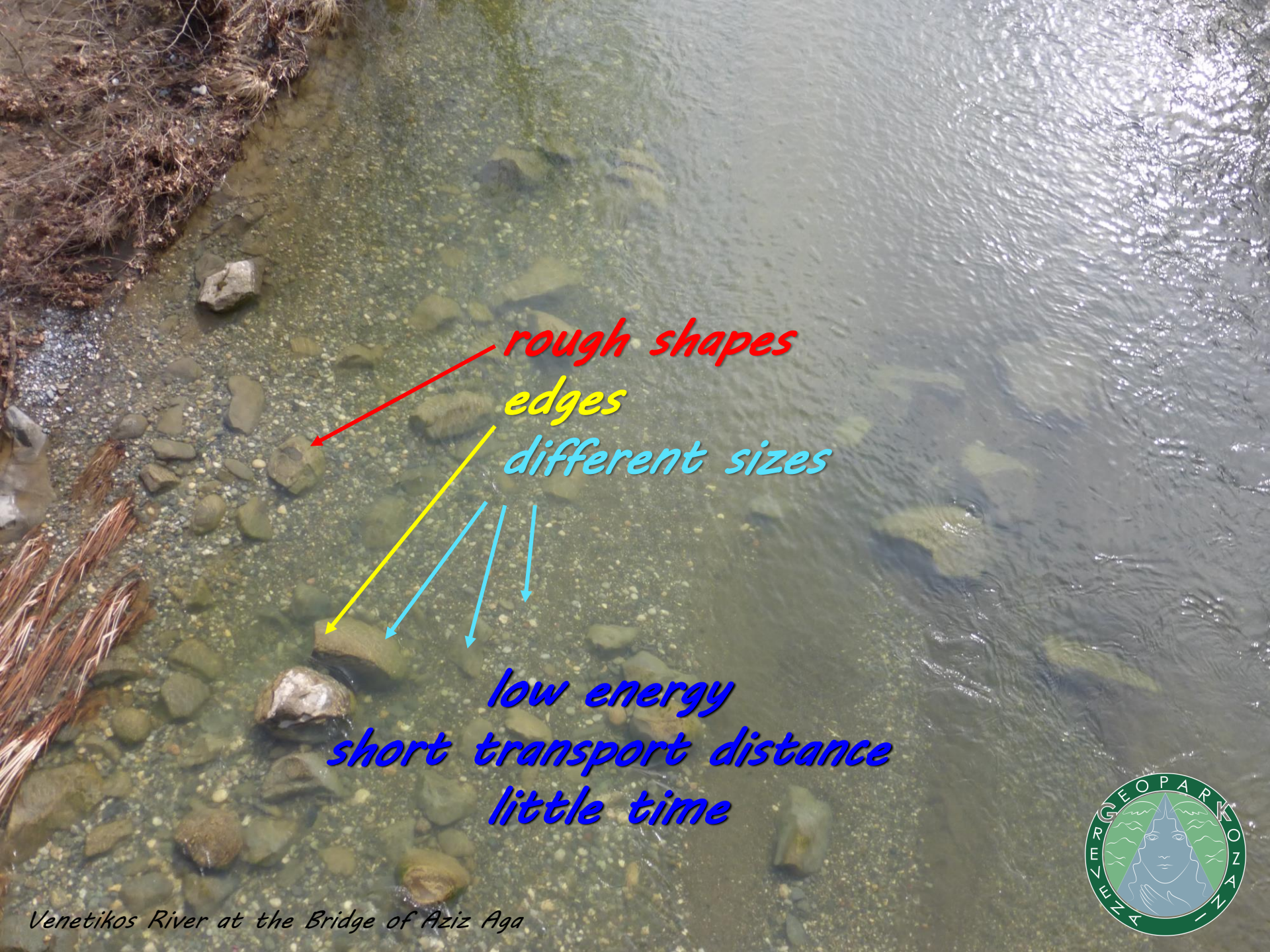
high energy

and...or

long distance

and...or

long time



Venetikos River at the Bridge of Aziz Aga


high energy
torrent
very low energy
slow, meandering stream
Ilarionas
GEOPARK KOZANI
REVENIA

recycling

a cobble may be plucked or
eroded from a formation
picked up by moving water
and deposited elsewhere
as part of a new formation


recycling and reworking
leaves only
the toughest cobbles
Agapi
GEOPARK KOZANI
REVEZA

EON	ERA	PERIOD		EPOCH		Ma
Phanerozoic	Cenozoic	Quaternary		Holocene		0.011
				Pleistocene	Late	0.8
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					Early	34.0
				Eocene	Late	41.3
					Middle	49.0
					Early	55.8
				Paleocene	Late	61.0
					Early	65.5
	Mesozoic	Cretaceous		Late		99.6
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		Jurassic		Late		161
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		Triassic		Late		228
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		Cambrian		Late		501
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				Early		542
Precambrian	Proterozoic	Late	Neoproterozoic (Z)			1000
		Middle	Mesoproterozoic (Y)			1600
		Early	Paleoproterozoic (X)			2500
	Archean	Late				3200
		Early				4000
	Haydean					

★ periods of cobble formation in the geopark area (that we know of)

Cretaceous rudistid fossil in a limestone cobble, bridge of Aziz Aga

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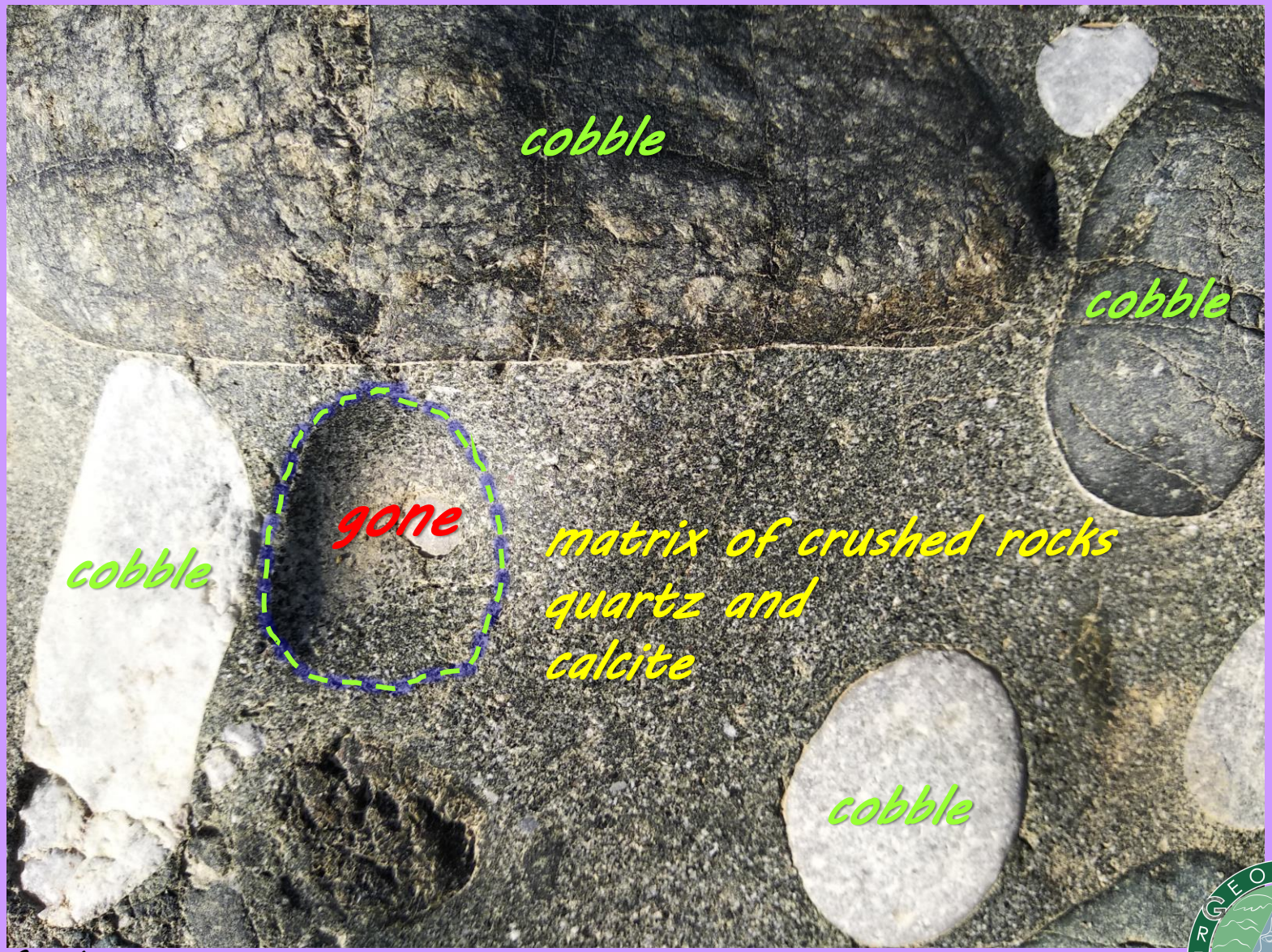
some of the cobbles in this area
have been recycled
up to five times

lithification
turning loose stones
into a
rock formation
with natural cement

Agapi


cobble
cobble
gone
matrix of crushed rocks
quartz and
calcite
cobble
cobble

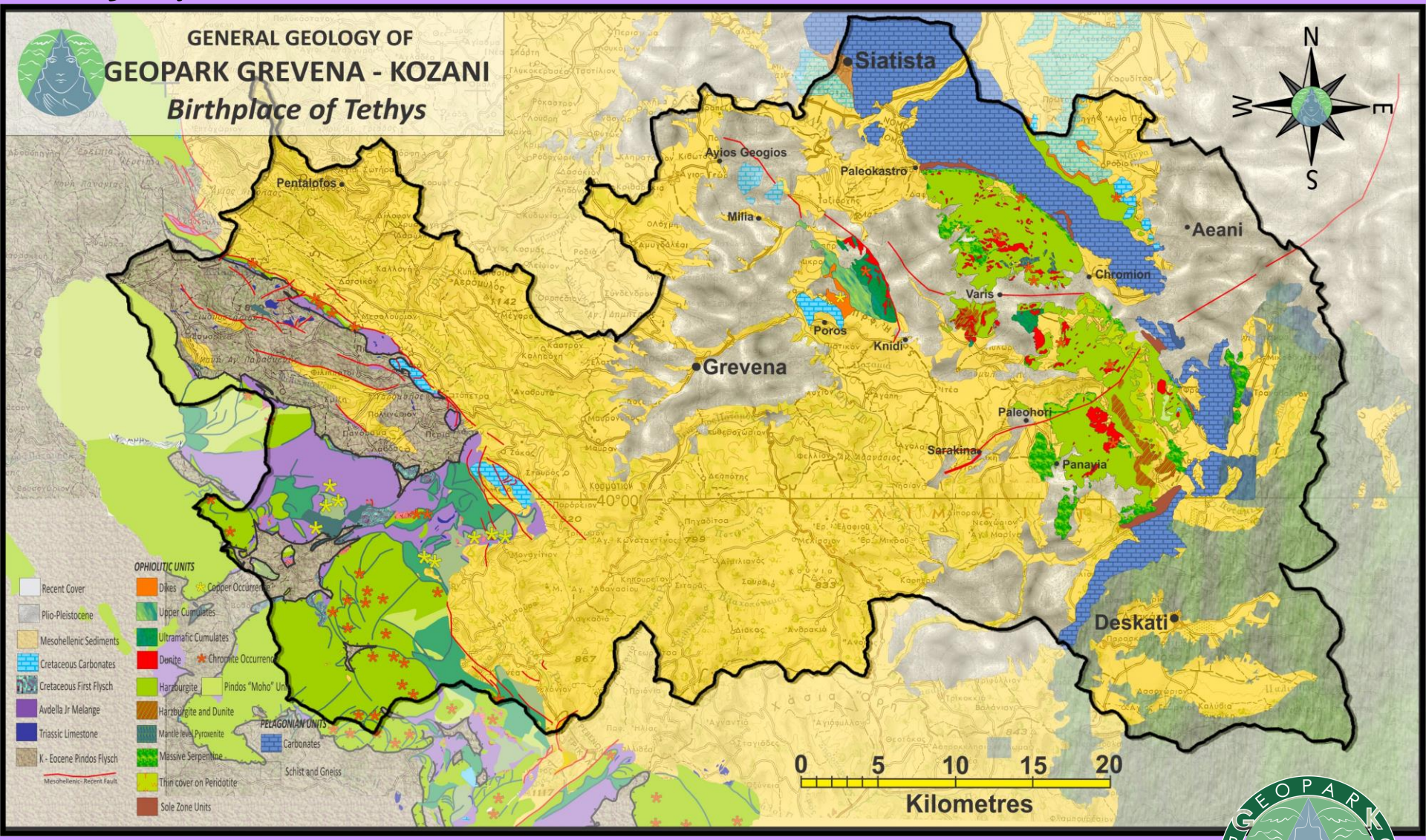
Agapi

cobbles

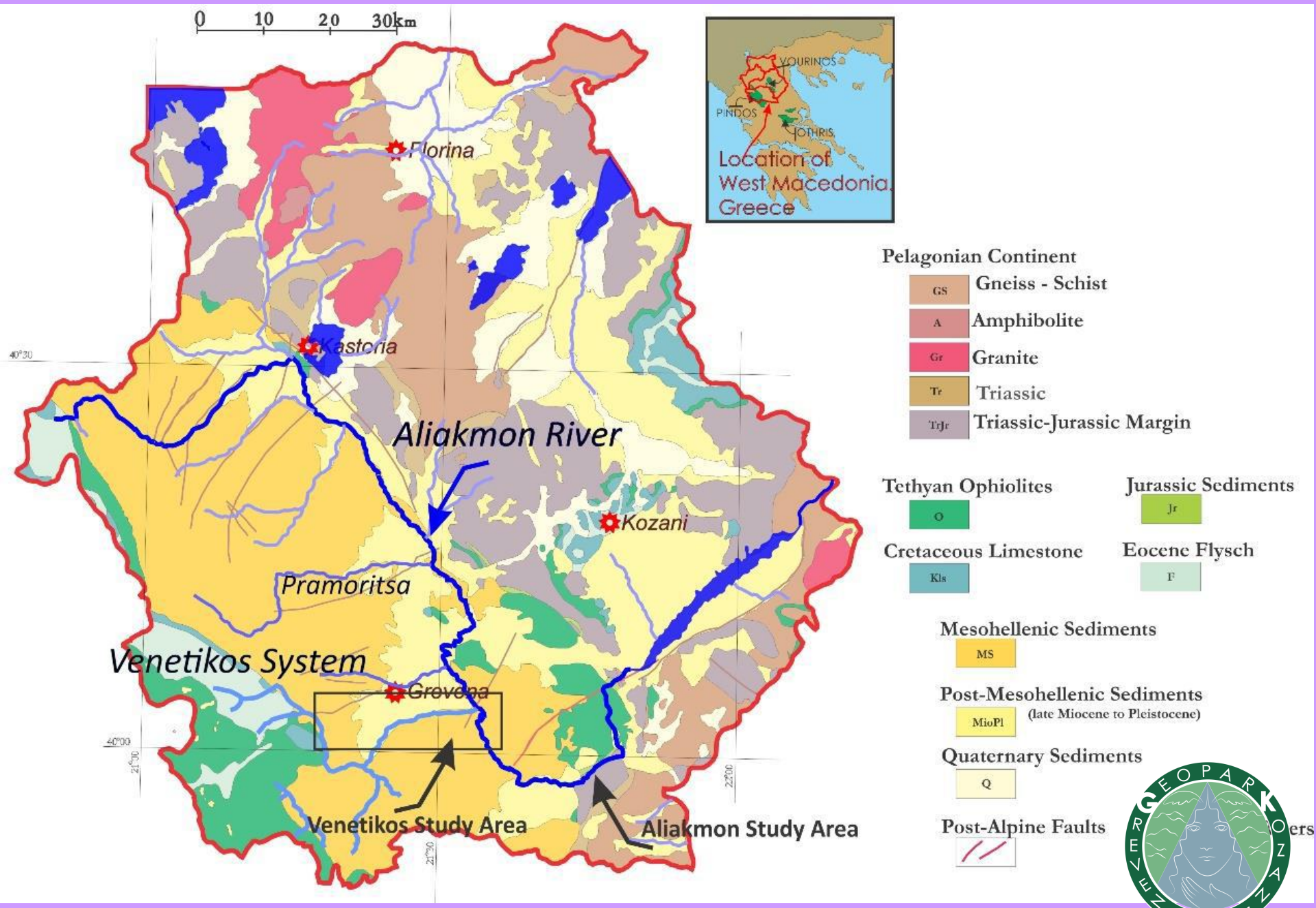
made of conglomerate

Agapi

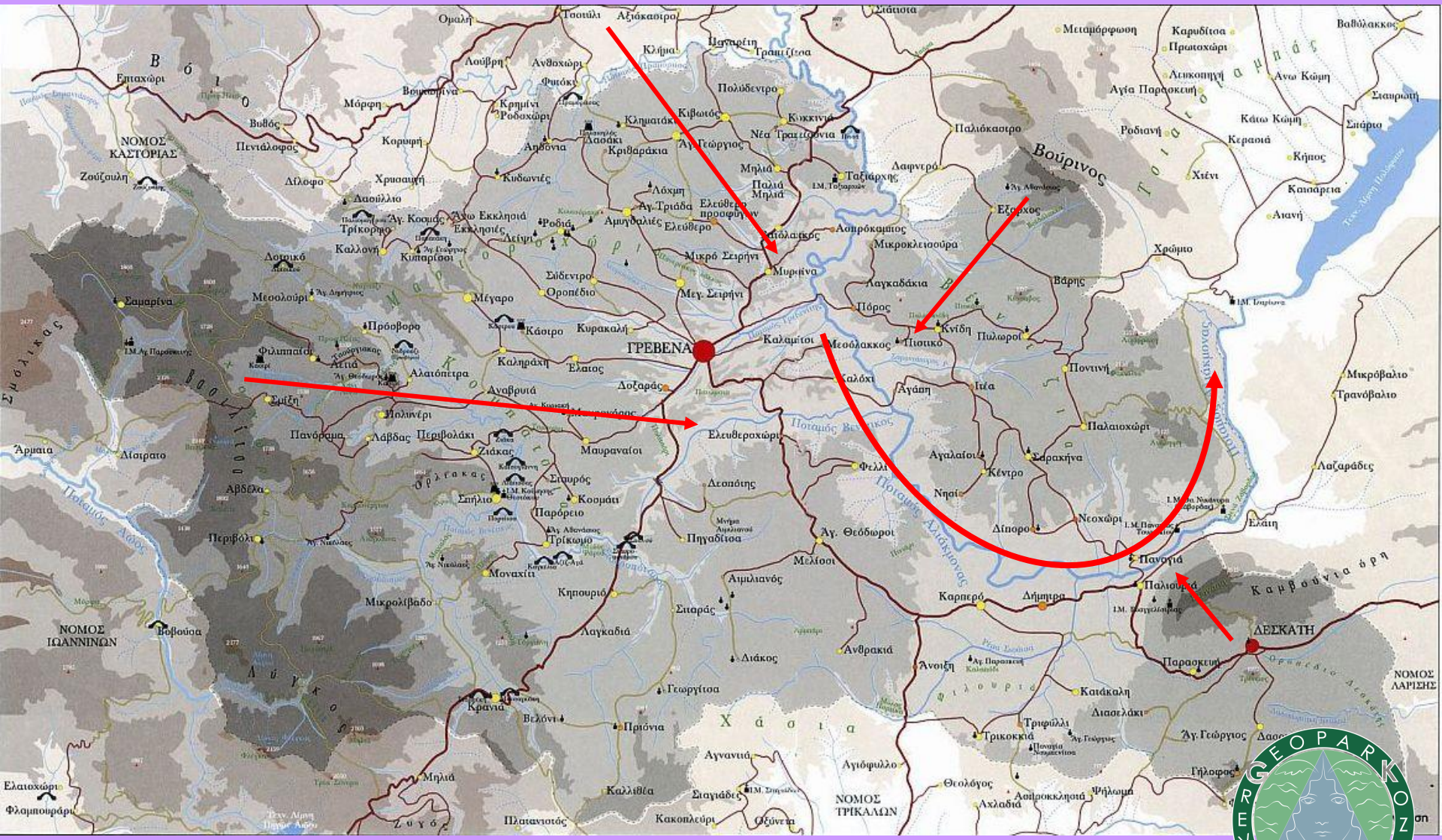
the geopark and the Mesohellenic Basin of the Aliakmon River



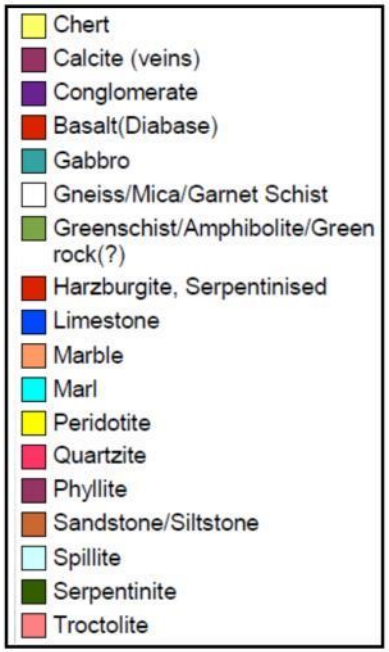
a great variety of rock types within this river basin

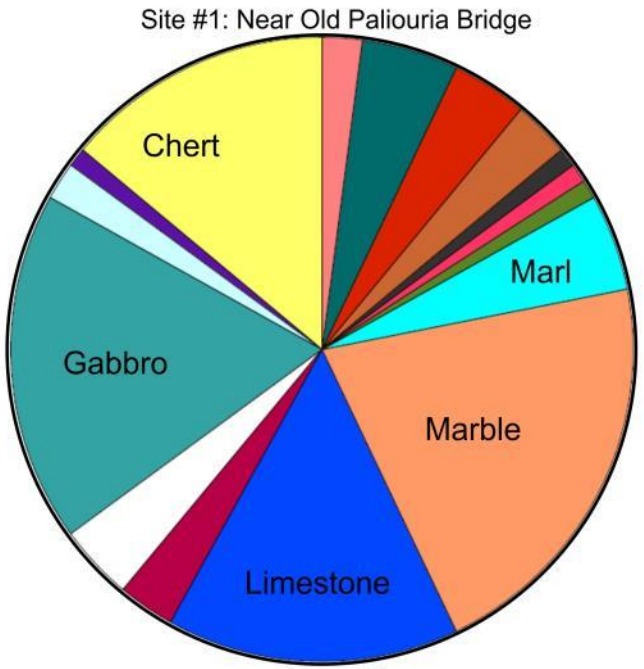

0 10 20 30km
VOURINOS
PINDOS
OTHRIS
Location of West Macedonia, Greece
Florina
Kastoria
Kozani
Aliakmon River
Pramoritsa
Venetikos System
Grevena
Venetikos Study Area
Aliakmon Study Area
40°30
40°00
21°30
22°00
Pelagonian Continent
GS Gneiss - Schist
A Amphibolite
Gr Granite
Tr Triassic
TrJr Triassic-Jurassic Margin
Tethyan Ophiolites
O
Jurassic Sediments
Jr
Cretaceous Limestone
Kls
Eocene Flysch
F
Mesohellenic Sediments
MS
Post-Mesohellenic Sediments
MioPl
(late Miocene to Pleistocene)
Quaternary Sediments
Q
Post-Alpine Faults

the Aliakmon River network collects rocks from the whole basin

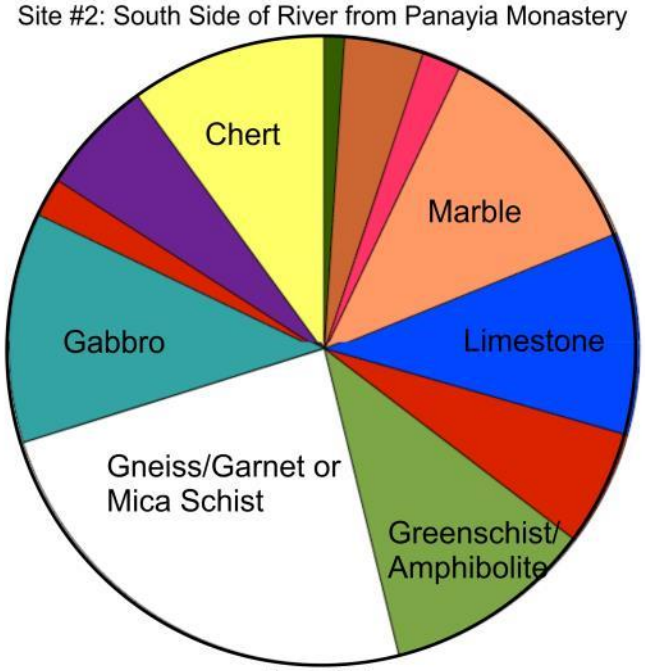


→ direction of stream flow (sediment transport)





Base Point:
USR 82958 25426 | N39°58.780´ E21°45.422' Elevation 342m



Base Point:
USR 87648 28855 | N40°00.640' E21°48.720' Elevation 345m

students conduct cobble counts along the Aliakmon river and its tributary, the Venetikos river

analysis of cobbles indicates what rocks occur in the area, even if we cannot see them· we can also infer past regional tectonic activity


what do you see?
GEOPARK KOZANI
REVEZA

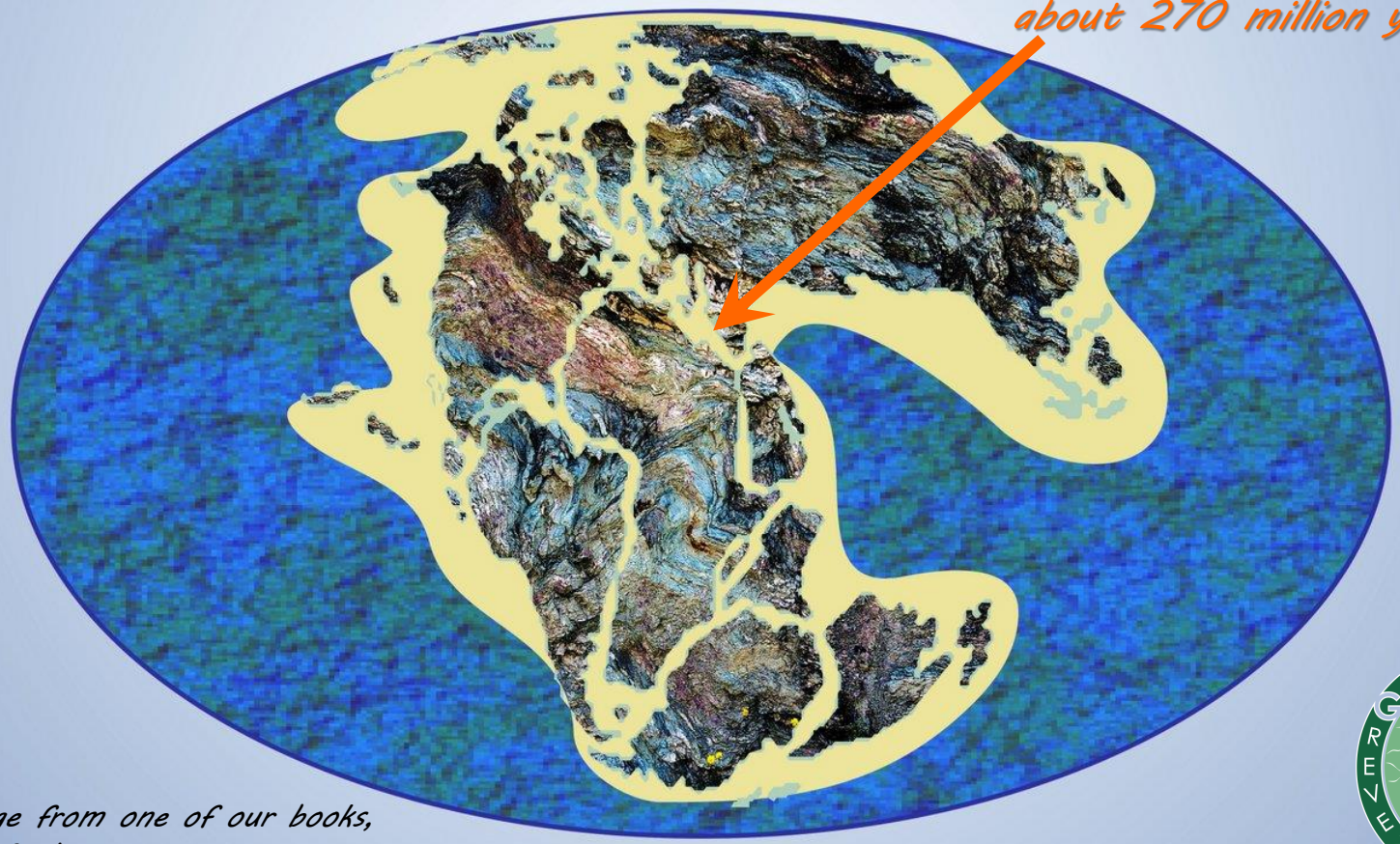
what does a geologist see?

here are some of the stories of our river stones

Precambrian to Paleozoic

The Rocks of Pangaea

The super-continent of Pangaea once covered about a third of the Earth's surface. Its geology was certainly as complex as that of our world today, maybe more so. Pangaea was itself constructed of older continents, landmasses that included the ancient parts of the Earth. The oldest of the rocks of Greece are included within the Pangaean rocks: these are islets of granodiorite that date to ~700 million years in age, rocks that were ancient when Pangaea was born. These were welded together about 300 – 270 million years ago through plate tectonic processes that created even more rocks, volcanic and metamorphic, to the gigantic landmass.



here's a page from one of our books, the Birth of Olympus

Precambrian to Paleozoic

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		Silurian	Late	419
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		Middle	Mesoproterozoic (Y)	1600
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		Early		4000
	Hadean			

Africa and Europe collide

birth of the Tethys Ocean

Pangea united

the oldest rocks in Greece --part of our geopark

granitic and gneissic rocks
some nearly a billion years old
became part of the supercontinent Pangea
in the Paleozoic era

Precambrian to Paleozoic

the cobble originated in one of these areas

Pelagonian Continent
- GS Gneiss - Schist
- A Amphibolite
- Gr Granite
- Tr Triassic
- TrJr Triassic-Jurassic Margin

Tethyan Ophiolites: O

Jurassic Sediments: Jr

Cretaceous Limestone: Kls

Eocene Flysch: F

Mesohellenic Sediments: MS

Post-Mesohellenic Sediments (late Miocene to Pleistocene): MioPl

Quaternary Sediments: Q

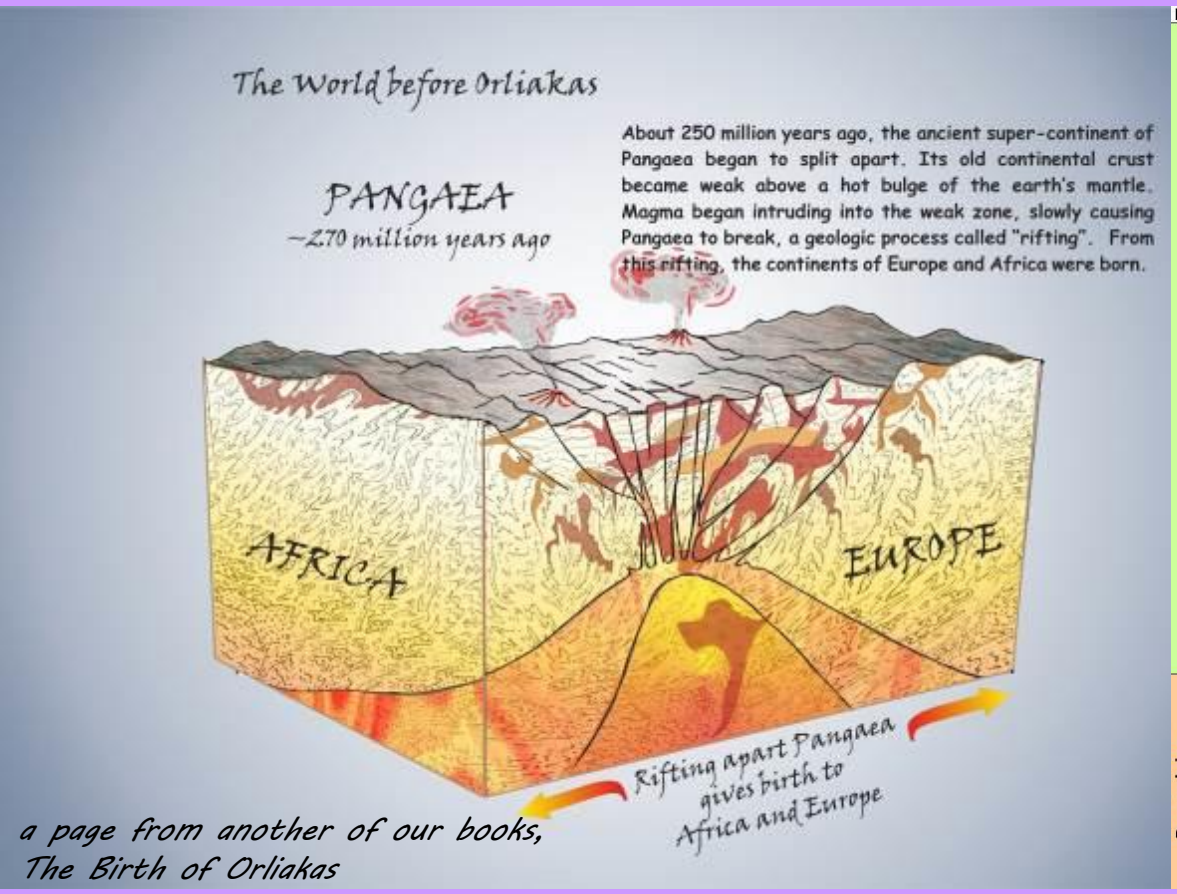
Post-Alpine Faults

Rivers

*the cobble is here

this cobble is older than the Aliakmon river system as we know it. It was first carried by a river flowing westward, before the rise of the Pindus Mountain range.

Triassic



a page from another of our books, The Birth of Orliakas

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	Hadean					

Africa and Europe collide

birth of the Tethys Ocean

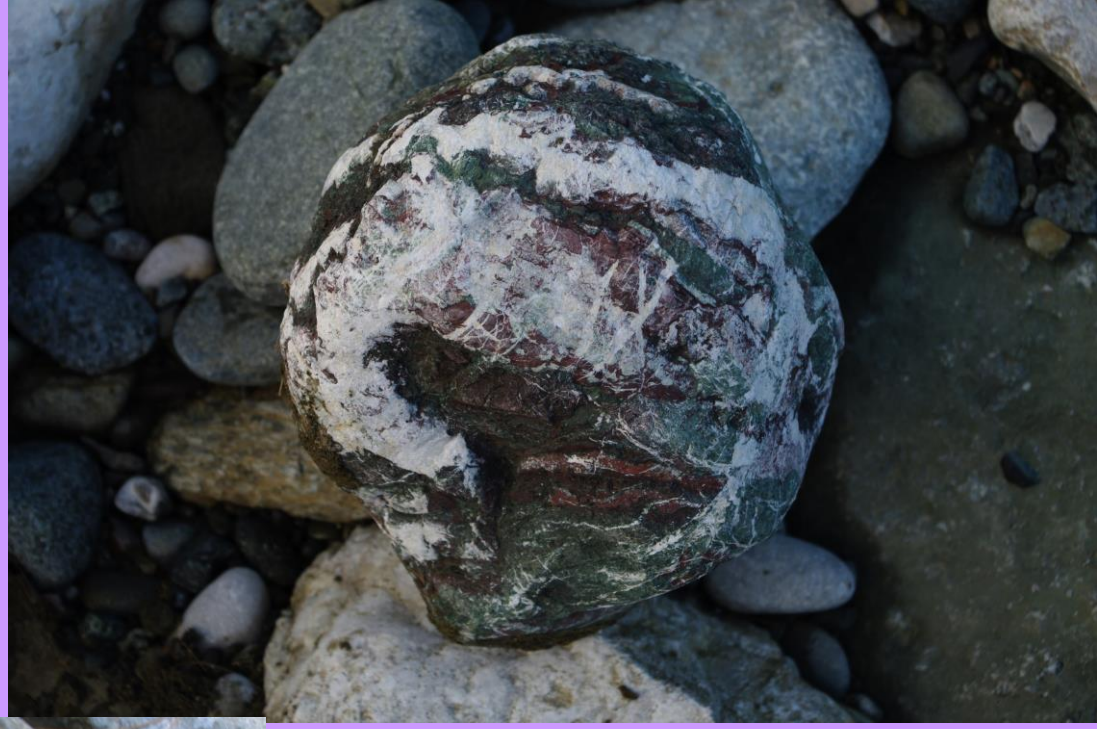
Pangea united

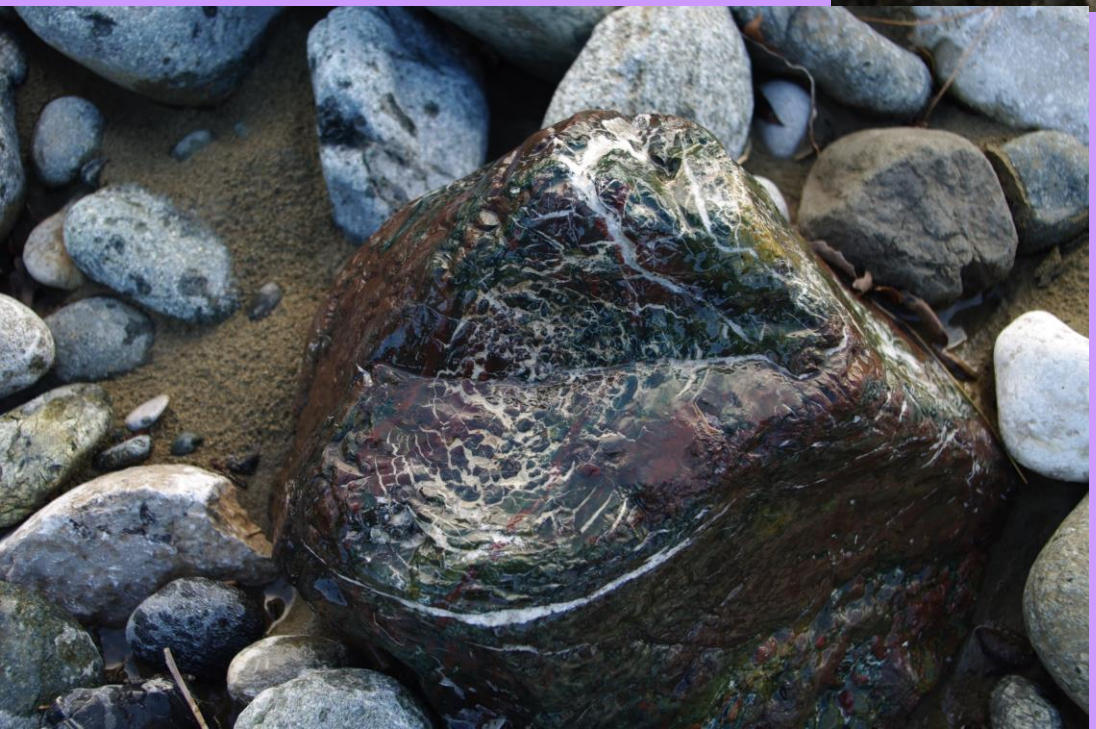
the oldest rocks in Greece --part of our geopark

Triassic

volcanic rocks from the splitting of Pangea and the birth of the Tethys Ocean

chert and limestone from the depths of the new ocean

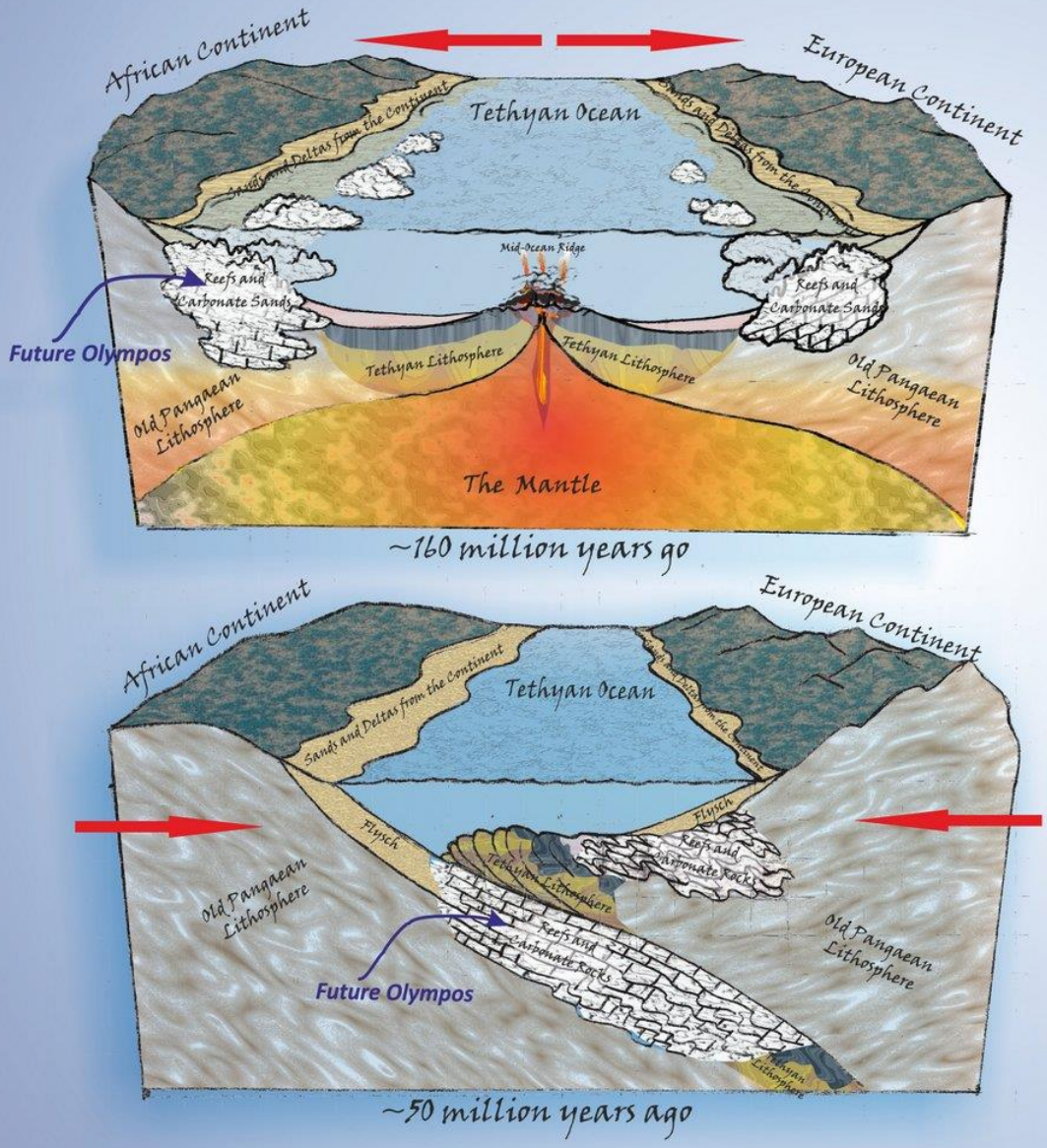




these rocks are tough they resist the destructive power of rivers

Jurassic

Continents in Collision



Tectonic plates never cease their wandering…

Once the Tethyan Ocean was at its maximum size, reaching from Britain to China about 170 million years ago, the continental plates of Africa and Europe began moving towards each other. This was not a peaceful movement; splinters and wedges of the Tethyan Ocean were pried up and slid onto the European continent, leaving trails of rock that were, so to speak, "burnt" by the hot slabs of the fresh Tethyan lithosphere. Even while this early phase of continental collision was going on, the sands and reefs that would make up Mount Olympos were still being deposited along the African margin of Tethys.

At depth, the plates of Europe and Africa themselves collided. Imagine ramming together two bodies of rock, each 25 – 40 km thick, slowly moving but relentless, unstoppable, propelled by the mighty motions of the Earth's mantle, by the source of the heat and ultimately by the life of the Earth itself.

This collision – the continents buckled, and one would be forced to "give into" the other. In this case, it was Africa, and the edge of the African Continent was forced in this collision beneath the European tectonic plate, including at about 40 million years ago, our rocks that would come to form Olym

Jurassic

rocks of the crust and upper mantle under the Tethys Ocean

this sequence of rocks is called an ophiolite

it is all that remains of the Tethys which was consumed when Africa and Europe collided


Zavordas


Agapi


Arkoudorema (Bear Creek)

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Cretaceous
Life in the Cretaceous Reef
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Cretaceous
limestone
formed in warm
shallow seas
from the remains of
mollusks and corals
was later buried and
recrystallized
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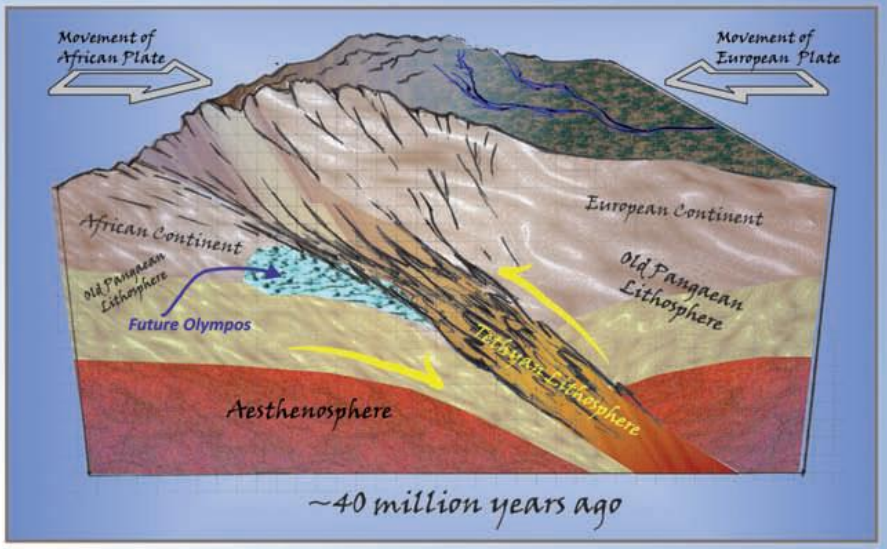
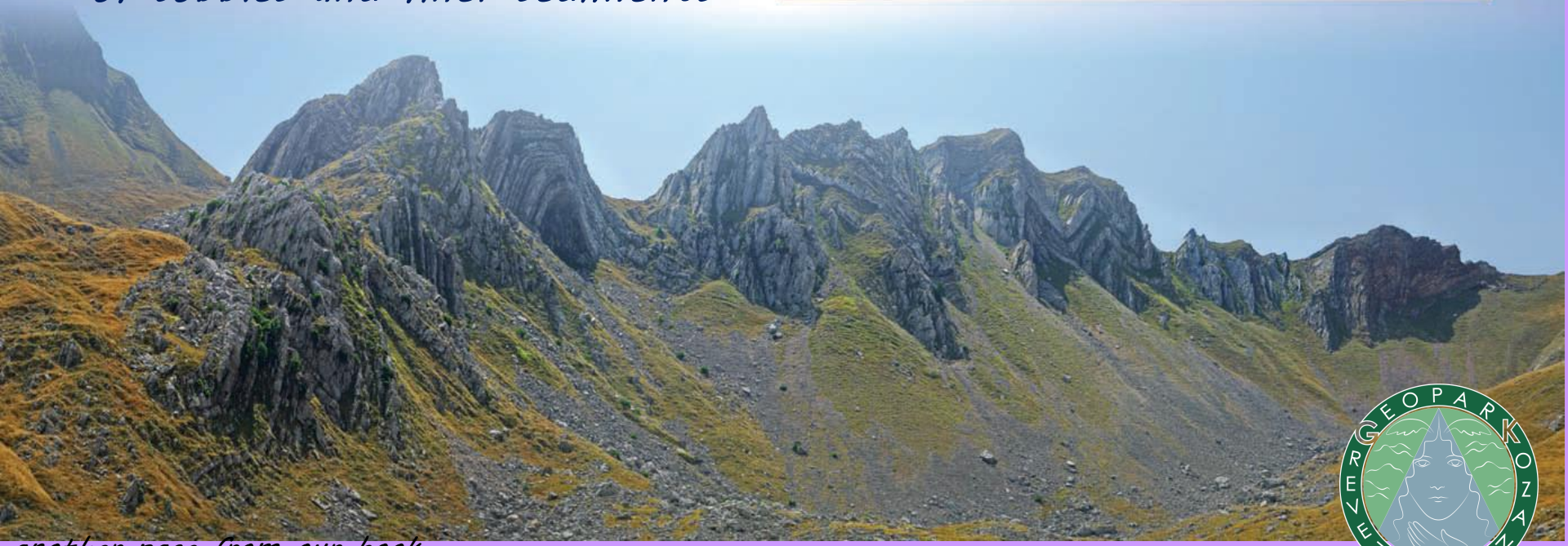
Cretaceous

uplift of the Pindus Mountain range lasted from the Cretaceous to the end of the Tertiary Period

intense erosion produced enormous quantities of cobbles and finer sediments





Cenozoic

sandstones and mudstones
formed in tidal
and deltaic environments

the last vestiges of the sea
receded and rivers took
their place

these rocks are too soft
to form cobbles
instead
they form the matrix
which binds cobbles together
in conglomerates

Rivers and Us

Mt. Vounassa and Aliakmon River with Neolithic settlement 2008

Mt. Vounassa and Lake Ilarionas 2014


ancient people found
the raw materials
for their tools
along rivers
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the constant recycling of cobbles
in this area has left
only the toughest of the tough
in huge numbers
all our ancestors had to do
was walk a bank
and choose what they needed

size
shape
hardness
grain size
determined which cobbles
were suited
to each task

A Paleolithic Ophiolite

gabbro
pyroxenite
serpentinite

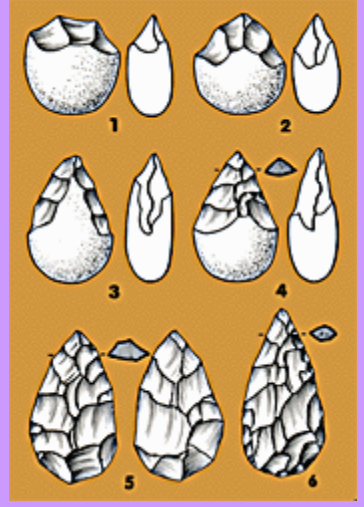
rocks which are regionally

rare

may be found in abundance

as cobbles

if they are durable

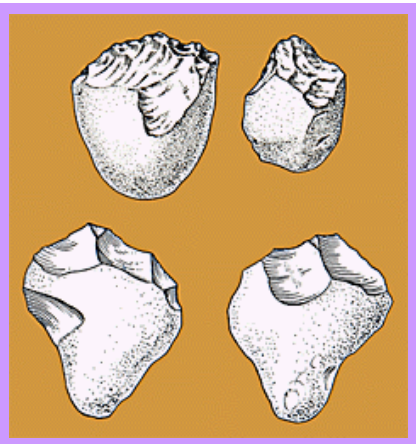


such rocks were often

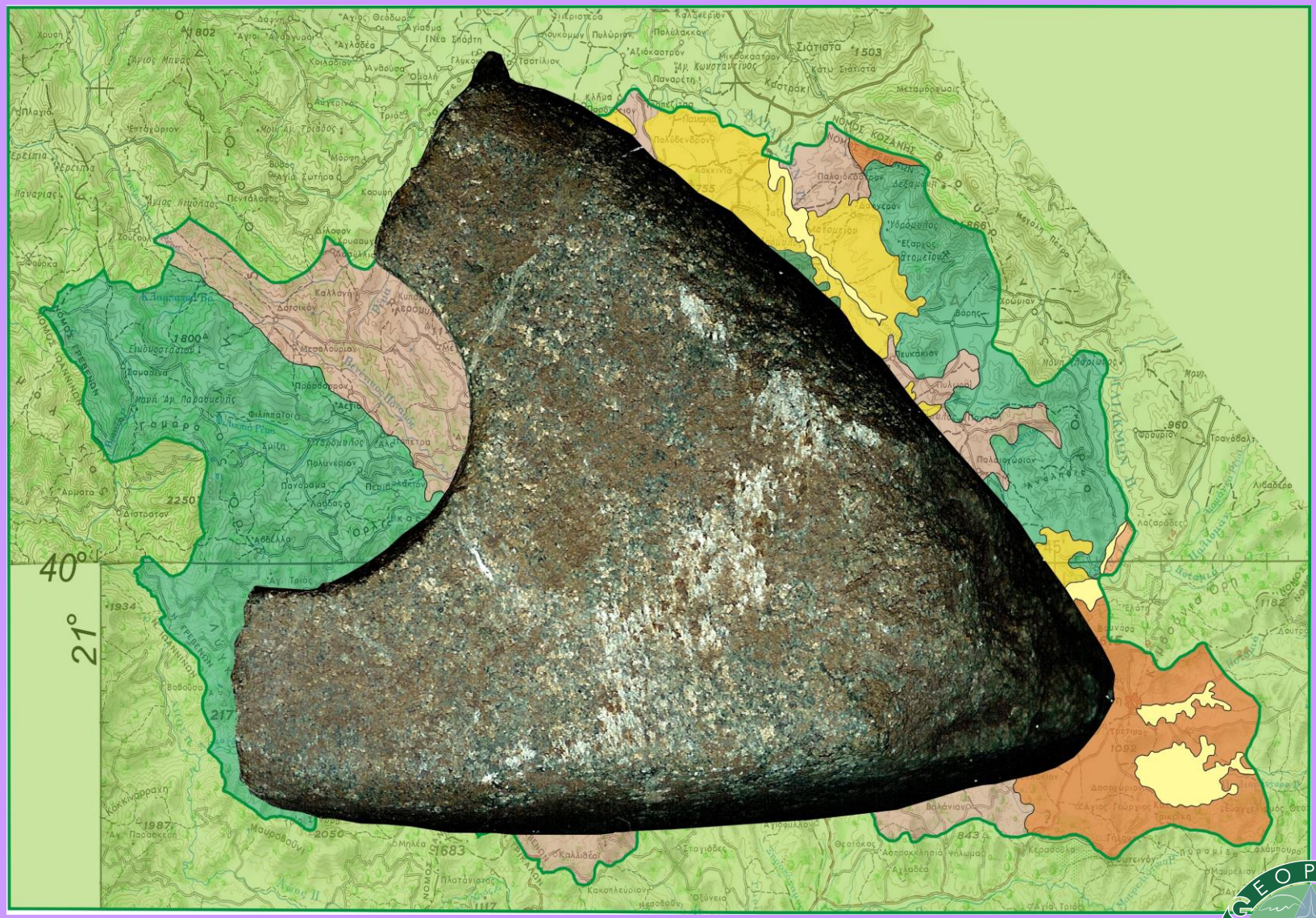
highly prized

and widely traded

by ancient peoples



Neolithic hand axe, made of plagiogranite, found along the Venetikos River



plagiogranite outcrops are small and few
but this rock can easily be found along our rivers
artifacts made from local plagiogranite are found all over Greece


later chapters
in our river story
are told by the bridges
Krania
GEOPARK KOZANI
REVEZA

Bridge of Portitsa

in 1998
the Institute of Geologic and Mineral Exploration (IGME) conducted abrasion tests on the Quaternary cobble deposits along the Venetikos River (LA abrasion and microdeval testing)

the cobbles destroyed the testing apparatus

no wonder
these rocks have passed Nature's abrasion tests for millions of years

learn more about the rivers
and geologic history of
the geopark Grevena-Kozani and
greater West Macedonia

Dina Ghikas, Anne Ewing Rassios (2019), A Billion Years of History within the Grevena-Deskati Watershed· Bulletin of the Geological Society of Greece, 54, 20-33

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(formerly IGME)

members and supporters
of the geopark team

archaeologists from the
Ministry of Antiquities
for Grevena and Kozani
Counties

visiting researchers and
students who have shared
their insights