Snowdon comes to Essex

Collecting pebbles from a large sand and gravel quarry near Chelmsford in mid Essex, I noticed several with a pale grey-green colour amongst the more common flints, quartzites and vein quartz. They were rough on the surface and rather mottled in appearance. What were they and where had they come from? You need to be a "rock detective" to find out!

First, they were given the "hand lens" treatment: lots of sharply broken fragments, some curiously shaped black bits, one with lots of wavy lines and another with spherical shapes joining together. Where had I seen these features before? In volcanic ash was the answer, the sort from nasty explosive eruptions. But what are they doing here in Essex?

The grey-green colour provided another clue – many rocks from North Wales are greenish in colour due to low grade metamorphism which turns clay minerals into the green mineral chlorite.

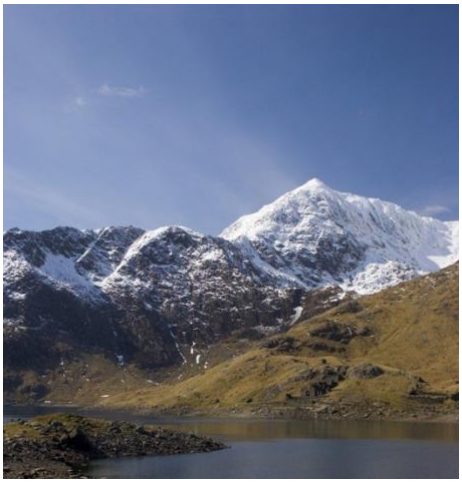
So, do we have lumps of volcanic ash from North Wales?

I searched for some samples that I had collected from the rocks around Snowdon when I had been on a field trip there many years ago. Did they match? Well, yes. I could see similar wavy lines and strange-shaped dark fragments.

Pebbles and cobbles of volcanic ash collected from Bull's Lodge Quarry.

Specimen of Ignimbrite collected from Bull's Lodge Quarry

Specimen of Ignimbrite collected in North Wales



Snow covered Snowdon
https://i.pinimg.com/originals/e2/9b/3f/e29b3f00d2e9dcd2fb85ac6be9c6d1b2.jpg

The rocks of Snowdonia are Ordovician in age; that is about 450 million years old. There are no volcanoes in Britain now, but there must have been all that time ago – and they were the nasty sort too. The lecturer who took us on that field trip had just come back from New Zealand where he had seen similar features in the texture of rocks from the violent volcanic eruption that formed Lake Taupo on North Island in the recent geological past. These had not been squashed and metamorphosed like those in North Wales and were much easier to understand.

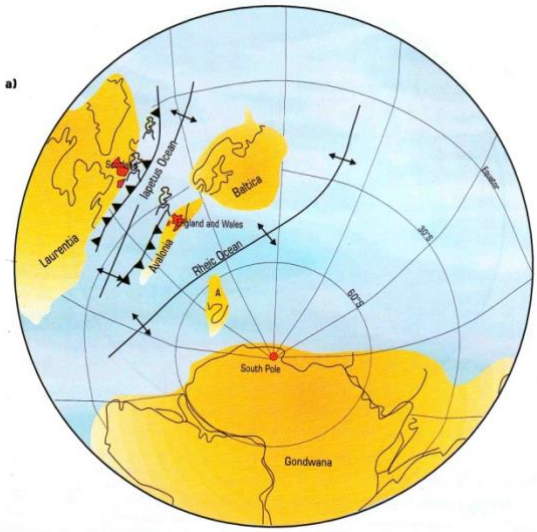
www.space.com/raikoke-volcano-eruption-seen-from-space.html.jpg

Lake Taupo today. Photo RMM

Lake Taupo is in a caldera created by a supervolcanic eruption which occurred approximately 26,500 years ago. According to geological records, the volcano has erupted 28 times in the last 27,000 years. It has ejected mostly sticky rhyolitic lava covering the surrounding land with ash and pumice several hundreds of feet thick. The eruptions emptied the magma chamber and the overlying material collapsed into the void, which was then filled with water.

Lake Taupo today, the second largest freshwater lake in Oceania.

About 450 million years ago, England and Wales were part of the continent of Avalonia, which had just broken away from the large continent of Gondwana that consisted of Africa, South America and Antarctica all joined together. This was near the south pole. As the Rheic Ocean widened south of Avalonia, a subduction zone formed to the north on the edge of the Iapetus Ocean. At the subduction zone, oceanic rocks plunged down beneath continental rocks producing sticky silica-rich magma that rose to the surface to produce explosive volcanoes.



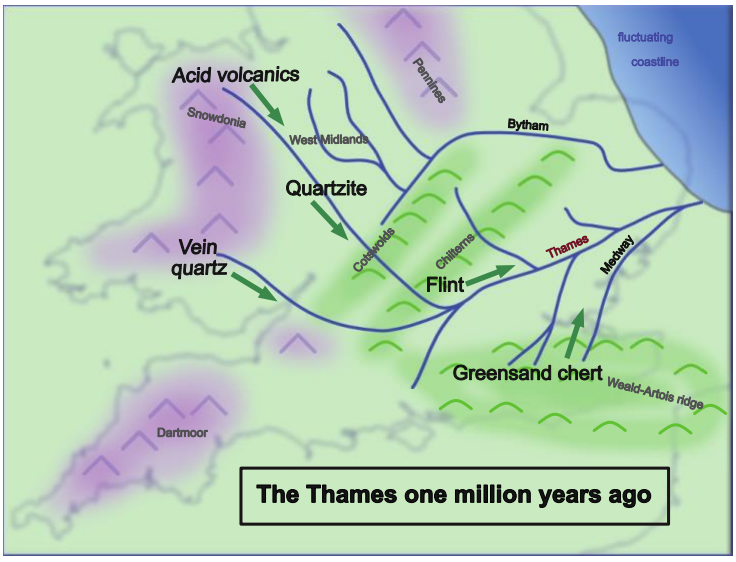
Shards of glass from around burst gas bubbles in the lava. Modern example from Italy. http://www.alexstrekeisen.it/immagini/vulc/shard2017(13).jpg.

The ash clouds from these volcanoes contained fragments of molten rock, solid rock and partly formed crystals. Ash was blown high into the air and it rained down forming layers if it landed in water. Some rolled down the sides of the volcano in heavy very fast-moving clouds of hot ash and gas called nuées ardentes - French for "glowing clouds". When they came to rest, the molten volcanic glass squashed out to form flame-shaped structures – *fiamme*, from the Italian for "flame", within the rock. The particles stuck together as the rock cooled to form an ignimbrite or welded tuff or ash. Other strange-shaped fragments were from volcanic glass surrounding gas bubbles that had burst. They are often "C" or "Y" shaped and I saw these in one of the pebbles I found.

The continent of Avalonia then crashed into Baltica and Laurentia causing the folding and metamorphism of the North Wales rocks.

How then did these volcanic rocks from North Wales get to Essex? That is another story that occurred millions of years later. The next important event for our story began some 66 million years ago (just as the dinosaurs became extinct) when Europe began to split away from America. This produced a rift zone (as in East Africa today) and caused a great uplift of the western parts of Britain and as the land was lifted above sea level, rivers began to establish themselves, flowing from west to east.

One such river was the ancestral Thames, which became the most important river in southern Britain. Little is known of its early history during the Tertiary period, as much has been obliterated and reworked by the subsequent rises and falls in sea level. As the Ice Age began to have a greater effect on the landscape from about 1 million years ago, there is more evidence in the form of spreads of sand and gravel to plot its course. Looking at the rocks making up the pebbles provides evidence of where the river flowed from. Volcanic rocks from North Wales are part of this evidence. Some of the Snowdonia rocks may have been eroded by valley glaciers such as those that finally formed the Snowdon itself and carried eastwards to be swept away by the Thames and its tributaries in full spate following snow-melt.



Before the most extensive glaciation when ice sheets blocked the middle reaches of the Thames and diverted it southwards, the river swept north eastwards after it had crossed the Chiltern Hills and flowed right across north and mid Essex, leaving thick beds of sand and gravel that are now the basis of the huge aggregate extraction industry, such as at the very quarry where I found these interesting pebbles.