MINERALISATION IN MID-WALES

NOTES ON A TALK GIVEN BY BILL BAGLEY .MARCH 16th.1999.

To fully understand why there is mineralisation in Mid-Wales we have to go back a very long time.----Nearly 600 million years ago Wales as we know it did not exist.Wales was a deep sea basin bordered by the Midland Platform on one side,and the Irish Platform on the other, with volcanicaly active land masses to the North,the North East,and the South.

If we take for example one of the larger mines in the area, Dylife,and examine the host rock, we would find that it is mostly a mudstone of grey to rusty brown colouration.The sediments which are the basis of the mudstone were deposited by the action of quite active eroding processes around the margins of the sea.

Obviously,at this time in the Earths history,climatic conditions were very much more violent than they are now,also there would have been frequent earthquakes causing a fairly rapid movement of material into the sea. The same earthquakes triggered underwater avalanches of material which had gradualy piled up around the sloping edges of the sea. The avalanches could be quite violent,propelling vast ammounts of sediment towards the centre of the sea. These movements were what are known as turbidity currents,and we have evidence of these movements by way of what are known as proximal turbidites,which have been preserved in the compressed and hardened mud. The turbidites are quite useful as indicators of the direction of flow into the sea, and also help to determine the extent of the sea.

The Welsh Sea Basin was in existence for aproximately 220 million years during which time it received a vast ammount of sediment from different sources,and was also subjected to various geological stresses and strains which caused the basin floor to raise and lower more than once.

The basin started life in the late Precambrian period just over 600 million years ago,and by the late Cambrian period,about 500 million years ago,the basin had already accumulated a depth of approximately 1.5 kilometers of sediment. Recent thinking suggests that in fact rather than one large basin there were several smaller basins with their floors alternately subsiding and being refilled with sediment.There was such an oversupply of sediment at this time that a lot of the sediment was what is known as"Non-marine sediment". However,there is some fossil evidence of a sea enviroment at Dylife with the occasional graptolite being found.Graptolites are planktonic organisms which would sink to the deep sea floor from their surface enviroment.

The graptolite fossils become more plentiful nearer to the more shallow margins of the sea, for instance they start to be quite commonplace on the Powys-Shropshire border.

The bulk of the sedimentary rocks were deposited between the Early Cambrian period abut 600 million years ago, through the Ordivician period, and continuing on through to the end of the Silurian period ending about 390 million years ago, a time span of over 200 million years.

There were other deposits,before,and after these periods,but not on the same massive scale,and certainly very little after the end of the Silurian period. It would be fair to say that much of Mid-Wales is composed solely of sediment washed into the basin.

It is important at this point to remember that the origin of much of the sediment was derived from volcanic activity around the margins of the Welsh Basin,from erosion deposits coming from the Midland shelf,and from erosion deposits coming from the Irish platform. The origins of these deposits have a direct bearing on the mineralisation of the area because it is from these deposits that mineralisation was born. To understand the massive scale of the sedimentation it is calculated to have in places a depth of almost 5 kilometers (3½ miles),but most commonly a depth of about 3 kilometers(2 miles),and the basin itself was approximately 100 kilometers by 50 kilometers(66 miles by 33 miles)
As the sediments were deposited,buried,deposited,buried,deposited and so on,they retained a proportion of water. Obviously,the deeper the sediment was buried,the greater was the pressure from above,and the water was gradualy sqeezed with ever increasing force to seek an avenue of escape. The only escape availiable was to be forced through the overlying sediments towards the surface of what was now becoming a dried up or closed up sea.

At the same time,about 400 million years ago the material in the basin was further squeezed by a tectonic action known as the Caledonian Orogeny when the sea basin was greatly compressed, causing folding and uplifting of what had by now become hardened sedimentary rock. This tectonic activity was responsible for the formation of the Welsh mountains,the Scottish mountains,and the Lake district mountains.

Further geological activity stretched the now dried up sea basin causing faulting in a South West to North East direction,and it is around these faults that mineralisation is centered.

The scene is now set to explain why there is mineralisation in Mid Wales. The most important ingredient was the masive ammount of sediment. As mentioned before,the sediment contained a residue of water and this water was sqeezed through the sediments with terrific pressure,both from the overlying material and the effects of the continental collision.As the water was squeezed out,it concentrated any mineral content of the sediment and carried it along in what would then be called mineralising fluid.

Another,equaly important ingredient in the mineralisation process,was the heat which allowed the minerals in the sediment to be dissolved into the circulating fluid. The most probable source of heat would have been an igneous intrusion underlying the sediment.Because the faulting extends below the sedimentary layers and into the igneous rocks below there could be as much as,and maybe more than 6 Kilometers in which the fluids could circulate. Using as an example,the geothermal gradient of the North Pennine ore field,which indicates an increase of 30°C for every kilometer of depth we can calculate a temperature at depth of at least about 180°-200° probably higher,which is sufficient to dissolve the minerals as the fluid circulates. As the circulating fluid rises it obviously cools,and it is at this time that the mineralisation of the faults and associated veins takes

place.The minerals carried by the fluid precipitate out in order of temperature,for instance quartz would be the first to be deposited,followed by galena,sphalerite and barite,and then maybe quartz again,all depending on the temperature of the fluid.

The mineralisation occupies every crack,every vein,every nook and cranny,but the most important deposits are in the larger veins and pockets created by the faults,and these deposits can sometimes be measured in thousands of tons,for instance Dylife Mine produced 36,684 tons of lead,1,540 tons of copper,and 390 tons of blende(zinc).That is almost 39,000 tons of ore.If we then consider that there were about 200 mines in Mid and West Wales we can understand that the ammount of mineral extraction was quite substantial.Even so we must remember that it was all precipitated out of the fluids circulating through millions upon millions of tons of sediments which in turn were eroded from land masses all around the Welsh Basin.

Lead isotoping has indicated two episodes of mineralisation,the first 390 million years ago,at the end of the Silurian period,and the second between 360 and 330 million years ago,The second period produced deposits which were more brecciated,because they incorporated some material from the first episode

It is hard to imagine that we are living in,or on what was once a deep sea basin,and perhaps even harder to imagine the intense hydrothermal activity which produced the tremendous ammount of mineralisation in Mid and West Wales.

NOTE.

This is merely a summary of the notes which I used for reference while giving a talk on the subject of mineralisation. The talk was illustrated by slides, and all the information is simply what I managed to glean from various books,and from recently published articles

Bill Bagley. March 1999.