JENNY ANSWERS YOUR QUESTIONS ABOUT ULURU (AYERS ROCK)

Why is the Rock red?

The first thing about the Rock that surprised me when I saw it was that it ISN'T red! – or rather, that it's only red in a thin skin on the outside, like a coat of rusty scales. The inside is a grey and white, kind of stripey, sandstone.

It shows the patterns you would see if you cut through some river sands – I saw exactly the same patterns when I looked at a hole dug in the dry bed of the Murchison River near Kalbarri. They're produced by the sorting effect of the flowing water on minerals of different weights or shapes. These patterns can be seen particularly well in one of the caves at the base of the Rock where the rusty scales have been removed by weathering.

The outside coat is stained red by iron oxides that have been produced from the iron-bearing minerals in the sandstone when it weathered, by a combination of water and oxygen from the atmosphere.

Exactly what kind of rock is the Rock made from?

Well, we've just said it's a sandstone, but it's a very special kind of sandstone called an ARKOSE. Most sandstones are largely composed of quartz grains bound together. This is because quartz is a very resistant mineral: it's hard and it doesn't break down easily, although the grains usually get rounded off by bouncing against each other as they are transported. River sands, like the ones they use in Perth on playgrounds and so on, are mostly quartz – that's why they are so white.

This sandstone is made up of grains of minerals you would find in a granite – it's virtually a reconstituted granite rock. It has lots of cream or white feldspars, and black biotite crystals, and even black iron oxide grains. These would normally break down into clay minerals and so on during weathering and transport of the sediment. However, in this case, weathering and deposition were so rapid that they didn't have time to change hardly at all.

This is why when William Gosse saw it in 1873 he was convinced it was a granite, and even after a second visit a year later he was still calling it an igneous rock. For this reason, he thought it had to be older than the Olgas, which are obviously made out of sedimentary rock.

How old is the Rock then?

You have to imagine a big thickness of sedimentary rocks of all kinds, which has been uplifted into a mountain range by Earth movements. These rocks were squeezed, and crumpled into folds, and partially melted, and faulted and intruded by igneous rock, and pushed up above sea level.

This happened between 590 and 550 MILLION years ago. Rocks high above sea level

have a tendency to be worn down by weathering, so as the rocks were pushed up they were weathered down by all the processes of wind and rain and so on.
Now all this went on rather more rapidly than might happen nowadays, partly because of the fact that there were no proper land plants around at this time, so instead of having a cover of soil and vegetation protecting parts of these mountains, it was all bare, and any grains weathered off got immediately whisked away.

At the base of the mountain ranges great rivers would have poured out, loaded with sediment which immediately got dumped because the slope had changed from a steep one to a gently-sloping plain. There would have been flash floods carrying almost a slurry of sediment, so quite quickly huge alluvial fans would be built up. As the sediment was laid down, that part of the crust would sag a bit, so that more layers could be dumped on top.

The Rock is made from a section of one of these alluvial fans, (which came from a part of the mountain range that was mostly granite) so we can say that it's around 550 million years old, or perhaps a little older.

Why are the layers of sediment in the Rock vertical, not horizontal?

Basically, because they've been turned round 90 degrees by Earth movements. After the mountain range had been worn down, the sea invaded the area again and there were more marine deposits of sand, mud and limestone burying our alluvial fans. Then the sea retreated and there were thick deposits of wind-blown sand – the kind of fossil sand dunes you see at King's Canyon. All these sediments turned into rocks.

At around 400 million years ago, and continuing for about 100 million years, there was ANOTHER episode of mountain building affecting this area. This time our alluvial fan rocks, and the rocks above them, and the older crumpled rocks beneath them, got squeezed and crumpled and faulted and fractured and generally mucked about.

The alluvial fan sandstone deposit that would become the Rock was bent round in big curves or folds, so that in some parts the sedimentary layers were actually vertical. Many millions of years later, after huge thicknesses of rock had been weathered away, part of one of these vertical fold arms appeared at the surface. This is our Rock! The "ribs" are just where some of the more resistant layers of sandstone stand out against the less resistant layers on either side.

How long has the Rock had its present shape?

We dont know quite when the Rock took the shape it has today, but it's possible it looked similar in Cretaceous times (about 70 million years ago, when there were dinosaurs running around Australia) because there are brown coal deposits buried under the present-day surface between the Rock and the Olgas. At this time there was a broad shallow valley between them, with streams and marshes, and the plant fossils prove that the climate must have been much wetter. One of the plants growing then has modern representatives which grow in rainforests in New Guinea and South America.

After being formed, the Rock was buried by soil and other deposits, and has been largely re-exhumed since then. There are rows of caves and breaks in slope half-way up the sides which show one of the stages in the exhumation: a lot of the more marked erosion of the Rock is thought to happen where water running off it pools around the base, and soaks the soil. The rock rots, forming undercuts, and the overhanging lumps break off.

That is why there are piles of huge boulders in some areas.

Why does the Rock have the shape it does – why is it a "rock"?

The long southern side of the Rock is actually bounded by a big fault. This is a crack in the rocks along which movement has taken place. In this case, some older PreCambrian sedimentary rocks have been moved into place next to the Cambrian ones of Ayers Rock. On the northeastern side, similar PreCambrian rocks are present as part of the sedimentary succession. These older rocks are not as resistant to weathering so have been worn away.

The same argument applies to the southwestern face, where there are younger rocks present as part of the sedimentary succession. However, on the northwestern side, the rocks are a continuation of the sandstone forming the Rock itself. It is probable that this represents a zone of cracked jointed or faulted rock which would crumble much more readily because water can penetrate. The Rock itself has no major cracks in it at all, so it can be really resistant to attack.

We've already mentioned weathering processes which break off grains and blocks, but there is another one I should mention. There are some great slabs and sheets which have broken off fairly cleanly. These are probably due to pressure-release. You can imagine that a rock deep in the Earth forms under pressure, especially if it has been involved in a mountain-building episode! As the overlying rocks are weathered off and it comes to the surface, it is put in a situation of different pressure. The surface layers try to expand and the stresses set up cause a big crack. In this way, rock outcrops get rounded off, just like the Rock has been.

How deep down does the Rock go?

Many people imagine the Rock to be like a huge boulder, somehow stuck in the middle of the desert. In fact, we are just seeing the tip of a big bed of sandstone which has been bent round 90 degrees when the rocks were folded, so that it extends downwards as an integral part of the Earth's Crust, possibly for several kilometres.

If you want to know more, there is an excellent booklet called "Uluru and Kata Tjuta: a geological history" by I.P. Sweet and I.H. Crick published by Geoscience Australia (1996 edn) with more details and good illustrations. I can show it to you at the Museum and tell you how to purchase a copy.