The Geological record of environmental change

Glaciation: Limestones

Voice Over
These lower limestones contain several distinct fashes all of which are fine grained micrites. Evidence for clear water and quiet conditions. Some limestones are massive and thickly-bedded but there are others that are extremely thin-bedded. The micritic carbonate in them probably came from stromatolite growth.

M.E. Andrews Deller
This is the most intricate-looking rock we've seen. It's got elephant skin red ring which is typical of limestones. The grey is calcium carbonate and it should fizz with the acid. Yes, it is. The fawny-coloured stuff shouldn't fizz and it doesn't, so that's calcium magnesium carbonate, or dolomite. Studying the surface we can see iron sulphide, or pyrite. The other thing to notice is that it's low down and very fine laminations. A dolomite, then calcium carbonate, followed by a dolomite, etcetera.

Steve Drury
The colour bands, and there's lots of them, they signify chemical changes. The grey calcite represents calciums being precipitated, the fawn dolomite layers represent calcium and magnesium being precipitated, and then the little pyrite grains suggest that irons of sulphur and iron somehow reacted together and were precipitated.

Voice Over
Alternations between calcite and dolomite reflect changes in magnesium concentration in seawater. Magnesium ions are more soluble than those of calcium, so precipitation requires an increase in their concentration, probably by evaporation. The fawn dolomite layers suggest extremely shallow water. Precipitating iron sulphide is difficult by inorganic means. Some bacteria use the energy released by reducing sulphate to sulphide ions, and live today in oxygen-free muds. Sulphide ions generated by them immediately combine with iron to form insoluble iron sulphide. The final evidence for shallow water conditions are cracks, very like those that form when muds are sun-dried. The bottom 35 metres of the carbonates formed in a warm, shall, tropical sea, occasionally disturbed by current action. The upper carbonates are very different.

Steve Drury
All the carbonates higher up are this orange and fawny colour, and they don't fizz, they're dolomites, they're very, very coarse. In fact there's some other grains in there that are standing out. Let's see how hard they are. Yeah, they've scratched the knife – they're quartz grains - so this looks like a much higher in the environment where quartz clasts are being brought in by currents from nearby exposed basement.

M.E. Andrews Deller
Look at these. They're funny little star shapes, they look as though they were crystals that have filled up cavities, and subsequently been filled with sand. Could they be ice crystals?

Steve Drury
They might be, they do look very like crystals. There is another one, there's a hydrated form of calcium carbonate called ikiate, which also forms under cold conditions.

M.E. Andrews Deller
Look, here's a dyke.

Steve Drury
Is it igneous?

M.E. Andrews Deller

No, it's a sandstone, quartz arenite.

Steve Drury
How very odd; it's vertical and it's cutting across the bedding in the carbonates, and the grains in it but they must have fallen from above, they can't have come up from below. There must have been some sort of a crack here.

M.E. Andrews Deller
Possibly an ice wedge?

Steve Drury
Yeah, possibly.

Voice Over
Evidence for high energy near-shore conditions occurs throughout the upper carbonates. The relics of crystals, perhaps ice or low temperature calcium carbonate, might reflect freezing conditions but there are other minerals such as gypsum that can form by evaporation.