The Geological record of environmental change

Glaciation: Diamictites

Voice Over

The diamictites and sandstones are so different that the two rock types are easily distinguished. Even away from the shoreline where plentiful inland exposures are lichen-covered it is easy to tell them apart by the distinctive textures. The Gravellachs like most of the western isles are not difficult to map in great detail. Diamictite units forming around two-thirds of the outcrops are shown in green, and the sandstones are mapped as orange. Exposures on the south west shore of the island are not the only ones to reveal an alternation between possibly glaciogenic and ice-free tidal conditions. Most of the Gravellachs are made up of diamictite sandstone repetitions. The stratigraphic log starting at the top of the local succession shows average grain size increasing to the right. There are many more than just two repetitions and thicknesses of the units are variable. Each of the two distinct units contains a variety of sedimentary structures, deducing their environmental significance is not simple, and depends on detailed analysis of these structures and the shoreline offers the best chance of finding them. Following the shoreline north-eastwards successively older cycles of diamictite sandstone repetitions are exposed. The youngest diamictites contain clasts of many different kinds, many much older metamorphic rocks and granites. They may have been derived from exposures of basement and transported from far off. The clast composition changes in successively older diamictites. There is an increasing proportion of sedimentary rocks. These formed clasts are likely metamorphosed carbonate sediments. Strata very like them are common lower in the Dalradian. There is also an unusual rock type associated with the diamictites. Instead of being a jumbled mass, this unit is finally laminated. Small-scale recent erosion has created a complex micro landscape picked out by different colour bands. In cross-section the laminae are perfectly parallel alternations of fine and slightly coarser silts. They suggest low energy conditions and the innumerable repetitions perhaps signify a seasonal control on sediment supply, greater melting of floating ice in summer than in winter. But these beds are controversial and might have formed from turbidity flows. The sandstones frequently show contortions but since they occur only in a single stratum, they are not tectonic folds. They could be the result of slumping of unconsolidated sands, triggered to move down a gentle slope by earthquakes. Structures nearby, however, suggest dewatering of saturated sediments, loading of sands with different porosities, and therefore different densities, encourages the more porous layers to rise under gravity; this results in bulges. Upward escape water during loading is an alternative means of producing the fold-like structures. The diamictite sandstone repetitions contain many ambiguities. Deposition of diamictites and sandstones built up about 900 metres of sediment on the Gravellachs. The thirty-eight repetitions must have spanned between hundreds of thousands and a few million years. However there is an abrupt change in the oldest part of the Gravellachs' sections through the Dalradian. The diamictites are underlain by completely different sediments, marked out in mauve.

M.E. Andrews Deller

This is a very fine-grained rock. It's soft and well-bedded, and it fizzes with acid so it's calcium carbonate, a limestone.

Steve Drury

A limestone, it's a low energy environment; there's no sign of any quartz in that. Now look at these, just here in the bedding: there's some land shapes in cross-section, and they could be discs; those look very like one of the stromatolites which are formed from carbonate secretions by blue-green bacteria. Now that tells us something else. Blue-green bacteria need light to photosynthesise so it's low energy and probably very shallow water, but distant from land though, there's no quartz in it.