



## **The Geological record of environmental change**

*Glaciation: The Garvellachs*

### **Voice Over**

In geology there is no substitute for fieldwork when other scientists' views can be considered against field observations. Ground truth helps support, or refute, the best theoretical models so opportunities for getting out in the field should be taken, whether by seasoned geologists or those new to the discipline.

### **Caption: Steve Drury, Lecturer, Open University**

Well worth the walk up here, it's a fantastic day.

### **Caption: M.E. Andrews Deller, PhD Student, Open University**

Yes, look at that little island; you can see the dip clearly picked out, gently going thirty degrees to the south.

### **Steve Drury**

Yeah and the strike's pretty good as well though, all the little ridges are running roughly east to west, so the older rocks are going to be on the north side of the island, the youngest ones are going to be on the south side of the island. But it's a pity we weren't here 10,000 years ago though because it would have been absolutely fresh, bare rock, glacial debris, but then we've had 10,000 years of Gulf Stream, warmth, humidity and the vegetation's come back with a vengeance.

### **M.E. Andrews Deller**

Exactly, just look at this rock covered with lichen.

### **Steve Drury**

Yeah that's one of the problems. It's best really in the Hebrides to work on the coast where everything's much fresher.

### **Voice Over**

Inland only vertical cliffs are bare of lichen and vegetation. They show large scale structure well but are too inaccessible for detailed examination of rock textures and minor structures.

### **Steve Drury**

Well south side of the island and there's about, it's pretty high up in the sequence but look at this – now that's rounded, it's pretty smooth as well, look at this groove coming through here. Now that's glacial action from the last glaciation that's done that.

### **M.E. Andrews Deller**

And it's beautifully clean, all the soil and vegetation has been washed off by wave action. We should be able to see clearly relationship and texture.

### **Steve Drury**

Yeah let's try and find a really, really good exposure to get started.

### **M.E. Andrews Deller**

At last this is a lovely exposure. There are all different sized class and boulders; you have a granite here with the obvious Pink Feldspar, a gneiss, and amphibolite, more granite, a diorite, and a fine-grained ground mass. The name for this is simply descriptive: it's a diamictite. Here we're showing matrix support and the boulders just sitting in it.

**Steve Drury**

Yeah, diamictite, that's this term that means just a whole range of ground sizes, nothing specific, nothing genetic with it at all. The thing that fascinates me is there's this great range of crystallised igneous and metamorphic rocks, that's one thing; the other thing is they're fantastically fresh, it's as though they've just been quarried. Now what that says to me is that the environment and transport of those boulders wasn't chemically active; but the other thing is that there's such a mixture. Now I happen to have read that some of these have been dated, I mean a billion years older than the Dalradian, about 1800 million years.

**M.E. Andrews Deller**

So what processes do you think could have brought them here?

**Steve Drury**

I don't, that's the problem with something like this, it could be a multitude of different processes and to – I mean it could be, it looks like it could be a tillite, or maybe it isn't, I think we've got to get some more evidence from some other outcrops before we can jump to any conclusions.

**Voice Over**

Along the shoreline diamictites are often perfectly exposed.

**M.E. Andrews Deller**

This is different. The matrix is bedded and it's studded with granites, large fragments and little ones.

**Steve Drury**

Well the bearing suggests current action. The matrix is sanded, there's no silt or clay in there, and the current would winnow out the fines just to leave the sand.

**M.E. Andrews Deller**

So it can't be a tillite?

**Steve Drury**

No, I think the diamictite's been re-worked by flying water.

**Voice Over**

In places the energy of the currents was high enough to remove sand-sized greens as well. The winnowing out left behind only pebbles and cobbles so the diamictites contain examples of lag conglomerates. Yet more evidence for reworking by current action.

**M.E. Andrews Deller**

Here's another granite boulder and it's clearly a dropstone; it's fallen from above and it cuts the bedding.

**Steve Drury**

It's a beauty. It does suggest that the diamictite accumulated from debris falling from floating ice onto the seabed.

**M.E. Andrews Deller**

Yes and the bedding would have subsequently covered it over.

**Steve Drury**

Yeah, and there's lots and lots of these dropstones around.

**Voice Over**

In the upper diamictites the majority of clasts are granites, some up to a metre across. Where bedding is well developed all the clasts cut across it so each of them must be a dropstone.