S100 Isostasy

Clip: S100_24_clip1

Transcript:

Professor Ian Gass:

It's strange – but it's seemingly true – that mountains grow, to replace in part at least the debris that's eroded from their surfaces, from their summits. And also basins where this debris is accumulating, that's laid down, don't just fill in. They seem to sink, to make way for more and more debris. All this has to do with isostasy.

But isostasy's rather complicated, can we simplify it? Here I have a model. It's just a tank of water, with a block of wood floating in it. Imagine that this block of wood is part of the Earth's crust. As long as there's no force within the Earth upsetting it, that crust will stay in balance.

But if a force comes along – just as my fingers are coming along and depressing that block, depressing the crust, it will stay depressed only so long as the force is there keeping it pressed down. Remove the fingers, remove the force, it comes back to its position of balance: to isostatic equilibrium. And the converse applies if some force within the Earth pushes up the block, pushes up the crust, it will remain up only so long as that force is there – take it away, isostatic re-adjustment comes into its own and back comes the Earth's crust to a position of balance.

Now of course, you can't see the fingers on top of the Earth pushing them down, how can you measure whether the Earth's crust is in balance or out of balance? We do this by actually measuring the gravitational attraction over the surface of the Earth.

Let's take a case.

Here then we have 3 columns through the Earth with the light-weight, the low-density mantle sitting on top of the heavy, more dense mantle. The little dials on top indicate what the gravity will be. In the centre, we have the position of isostatic equilibrium: neither a positive nor a negative gravity anomaly. Now let's look at the left-hand column, and push the surface of the Earth up – something inside the Earth is pushing it higher than it ought to be. We're getting an excess of the heavy, the dense mantle underneath that particular station. And so the gravitational attraction will be greater than it ought to be. We will have a positive gravity anomaly. On the right-hand column, we're going to push the surface of the Earth down, push the crust of the Earth down. In this case, the amount of the dense mantle will be less than it ought to be, the gravitational attraction of that part of the Earth under that station will be less than it should be. We will therefore have a negative gravity anomaly.