A hidden drip

John West and colleagues struggled with widely held misconceptions and computer hackers in their attempt to explain mantle processes beneath the Great Basin in the United States.

What was the objective of the work?

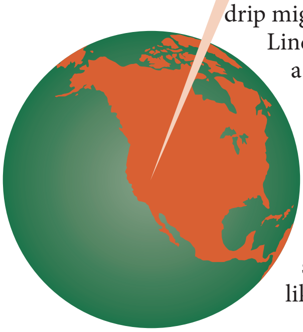
At the beginning of the project, we wanted to determine how forces in the upper mantle influence present-day crustal extension — the stretching of the Earth's crust — in the Great Basin region of the western US. Late in the project we discovered that portions of the lithosphere — the crust and uppermost mantle of the Earth — are sinking into the more fluid upper mantle beneath the Great Basin. This was a very surprising finding, as such 'lithospheric drips' have not previously been detected in regions without major surface changes.

Was there a fieldwork component to the project?

Most of the work was done using data from EarthScope's USArray Transportable Array, which is a network of seismic observation stations designed to provide information on the structure of the lithosphere and mantle below. Most of us have done quite a bit of fieldwork over the years, so it was wonderful to be able to sit back and just request data. We can't say enough good things about the professionalism of the EarthScope team — the data quality is absolutely fantastic.

Did you encounter any difficulties?

Our own preconceptions! Until now it was widely thought that lithospheric drips only occur in areas marked by large changes in surface morphology; that is, in regions where the Earth's crust moves up (uplift) or down (subsidence), or where there is massive magmatic activity. The Great Basin region of the western US does not show any of these features; it is a desert region of parallel small mountain ranges separated by sediment-filled valleys, with very little recent volcanism. Thus we didn't even consider the possibility that a lithospheric drip might be present until Linda Elkins-Tanton, a co-author on the paper, demonstrated with numerical models that drips would have a minimal effect on the Earth's surface in regions like the Great Basin.




JOHN D. WEST

Crossing the Great Basin: the surface topography offers no clues to the lithospheric drip below.

Were there any low points?

The low point of the project was when, over the Christmas holiday break, our servers at school were hacked and all of our early data, including backups, were destroyed. Since then we have all become fanatical about making multiple backups and storing them off-site!

What were the high points?

The two high points on this project both came from finding new results to compliment our existing data. The first was when I realized that Jeff Roth (sitting next to me in the computing lab) had a tomography data set showing mantle structure in the same area where we had anomalous results. We were both excited about the possibilities, and ideas about the probable causes for our observations flew back and forth at a rapid rate. The second high point came when Linda sent us her geodynamic models showing that a lithospheric drip might be present in the Great Basin. The model was the last piece of the puzzle.

Any lessons learnt?

Talk science frequently with your friends and colleagues! Sometimes, as was the case here, the person sitting next to you in the lab will have the key information you need.

Did the project give you any ideas for future research?

We have already started follow-up projects. For instance, we are now working with Bill Holt at SUNY Stony Brook to relate the Great Basin drip to local changes in surface morphology. Although the Great Basin as a whole is extending, GPS data show a region of surface contraction above the drip, which could be caused by traction forces from the mantle as material flows into the drip. Also inspired by this project is a new software system; projects such as the Transportable Array are generating such huge amounts of new seismic data that traditional data processing methods are breaking down. My background in business software development includes working with databases with hundreds of millions of records; on this project I realized that I could use my software experience to help the seismic community improve data handling efficiency, share methods easily, and do science better and faster. Other new project possibilities abound, including a full three-dimensional modelling effort to better characterize the drip and its interaction with the mantle.

This is the Backstory to the work by John D. West and colleagues, published on page 439 of this issue.