Beneath the surface

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It was the geological collision between India and Asia millions of years ago that created one of the world's most distinctive places: The area around Lake Baikal in Siberia, which contains 20 per cent of the world's fresh water reserves and a unique display of plant- and wildlife.

That is the conclusion reached by two Danish researchers from the University of Copenhagen, Professor Hans Thybo and PhD Christoffer Nielsen, after many seismic examinations, including blowing up tons of dynamite, and five years work of analysing the data.

In the middle of Siberia lies the 2000km long Baikal Rift Zone, where, over the last 35 million years, a gigantic crack in the Earth's crust has developed. In the middle of this rift zone lies the world's deepest lake, Lake Baikal, which is almost 1700m deep. Due to Lake Baikal's isolated location, far from the world's oceans the microbial and animal life found here has undergone a unique evolution over the last 30 million years. The Baikal Rift Zone, or fracture zone, is also special because it is located 3000km away from the nearest tectonic plate boundary. Therefore, it has been difficult, until now, to explain the origin of the Baikal Rift Zone using commonly accepted geological premises and methods.

However, two Danish researchers from the University of Copenhagen in collaboration with Eastern European colleagues, have succeeded in uncovering what happened, and what is still happening, under the surface of one of the most special and distinctive areas on Earth. More than that; the results from the experiment in Siberia have lead to a new understanding of, and model for, the formation of and activity in rift

zones, which are found in locations around the globe, including between the continents.

Lots of dynamite

In Siberia the Danish research team lead a seismic experiment known as BEST (Baikal Explosion Seismic Transects) carried out around Lake Baikal. The experiment included setting off of tons of dynamite so the scientists could follow the sound waves from the explosion as they travelled through the ground, using them to determine the structure of the Earth's crust and the upper mantle and thus gain an understanding of the processes driving the rift zone's development.

The fieldwork at Lake Baikal was carried out in 2003-2004 with financial support from the Carlsberg Foundation and the Danish Natural Science Research Council and in collaboration with geologists and geophysicists from the Russian Academy of Science's Siberian departments and the Polish Academy of Science. Since then the scientists have spent 5 years interpreting the huge amount of data they collected and have ended up with sensational seismic results related to the general formation of, and activity in, rift zones around the world.

The sensational results from Siberia now form the basis for a new model for understanding the formation of rift zones on a global plan. The results from Lake Baikal show that the 40-50km wide crack in the Earth's crust is around 10km deep. All previous models of rift processes have assumed that the bottom of the Earth's crust would have a corresponding bulge. However to the researchers' great surprise it turned out that the bottom of the crust is flat across Lake Baikal. The two scientists explain this phenomenon by a greater thinning of the crust than expected but at the same time also by an intrusion of magma (liquid rock from the Earth's mantle) into the bottom part of the crust layer. The volume of the magma corresponds to the thinning of the crust.

The research group has therefore reinterpreted data from a number of other rift zones around the globe, including from the East African rift in Kenya where Karen Blixen had her African farm and from an older rift zone in the Ukraine. In both places the researchers see the same phenomenon found in Siberia. This is an important reason for the Danish researcher's new results.

Rift zones can divide continents

Rift formation is a fundamental process of plate tectonics, which can, given time, split a continent in two. Up until 60 million years ago, what is currently Europe and North America was one large continent. The northern Atlantic appeared when a rift zone developed between what is now Norway and Greenland. The rifting process continued and ca 55 million years ago a new ocean arose.

Rift zones are also important for oil exploration as many oil rich areas have arisen as a result of rift processes. This is true, for example, of the area around the Central Graben in the North Sea which is a former rift zone whose development halted. The Central Graben is the location where the countries bordering the North Sea obtain most of their oil. It is therefore important to understand the processes that lead to rift formation, as it may give us an opportunity to pump more oil up from underground.

Source: University of Copenhagen