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Science news

Kashmir's thermal connection with Tibet found

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Hot water springs and steam gushing out of the ground are familiar sights and tourist attractions in the Ladakh region of Jammu and Kashmir in northwest India. But what is the source of the heat and can it be exploited to generate power?

A team of earth scientists from India, the United States and Israel had launched a study four years ago to find answers. They now report[1] that the heat source actually lies as deep as 50-100 kilometres in a tectonically active mantle below neighbouring Tibet.

The research scene: The Karakoram fault lies underneath the central bed. On either side of the bed are the Ladakh batholith (left) and the Karakoram batholith (right).© *Siva Sastry*

The scientists made this discovery after analysing the isotopic composition of Helium (He) in the hot springs along a 500-km segment of a crack in the Earth's crust called Karakoram Fault (KKF) that separates the western Himalayas from the Tibetan Plateau.

They found He^3/He^4 ratios in the hot springs along KKF to be 3 to 100 times the ratio elsewhere in continental crust. "Such a high helium ratio exists only in the mantle," T. Harinarayana, director of the Gujarat Energy Research & Management Institute in Gandhinagar and one of the authors told *Nature India*. "This further supports evidence that He^3 found in the hot springs is derived from the tectonically active Tibetan mantle," he said.

Although there are different geological fault structures in the Himalayas, it is the KKF that extended all the way to the mantle depths, they concluded. The team estimates that the KKF accessed the Tibetan mantle some 3.5 million years ago. However, their geochemical data cannot show whether the KKF is still acting as a crust-penetrating fault.

According to the authors, the KKF reaching up to mantle depths acts as a vertical conduit for the hot fluids in the mantle to reach the Earth surface manifesting as hot springs and geysers. The researchers also observed that the He^3 enrichment in hot springs decreased rapidly away from the KKF, suggesting that the mantle fluids flow only within the KKF as if it were a vertical pipe.

Harinarayana said geothermal power plants exploiting the heat flow from the sub-surface rocks along this fault, if built, could theoretically have a long term life cycle of 50-100 years.

Currently, some countries including Italy, New Zealand, USA, Japan, Mexico, Philippines and Indonesia are using geothermal energy for electricity generation and thermal applications. Although the Geological Survey of India has identified 350 geothermal energy locations in the country, power is not commercially produced from this source yet, says Siva Sastry, a former geophysicist at the National Geophysical Research Institute in Hyderabad and another co-author of the report.

According to Sastry the study area is characterized by thermal springs where people take bath because of the water's medicinal value and even cook rice in it. "But with temperatures of discharges being only about 85-87°C, it may not be a good source of geothermal energy to generate power."

Simon Klemperer at a hot spring site.© *S Klemperer*

Geophysicist Simon Klemperer of Stanford University and corresponding author of the paper agrees. "I don't think our results change any of the prospects for geothermal power in Jammu-Kashmir," he told *Nature India* adding he "is not quite optimistic of possible commercial exploitation of geothermal energy in that region."

The geothermal locations are in remote places where not many people live. So the cost of developing building a power plant and electricity transmission lines will be too high for economic development. Klemperer points out that the results of this study are academic and help understand the architecture of the Himalayan mountain belt and the nature of KKF. "This is a new method of finding the source using helium ratios," he said.

The measurements of He^3/He^4 ratio in geothermal springs allowed the researchers "map the configuration of mantle lithospheric types beneath the Tibet Plateau in the geologically recent past", he said. The study thus sheds light on the deep crustal processes in a region of the Earth that is the site of the largest collision between tectonic plates.

Despite the relatively few hot springs sampled during the study, "we see the close association of the KKF with a mantle component of geothermal fluids that requires the KKF to access tectonically active Tibetan mantle," the report said leading to the conclusion that the KKF "is a dominant pathway for mantle fluids to reach the Earth's surface."

- **References**

1. Klemperer, S. L. *et al*. Mantle fluids in the Karakoram fault: Helium isotope evidence. *Earth Planet. Sc. Lett.* (2013), doi: 10.1016/j.epsl.2013.01.013