

# Sand layer plays a key role in protecting the underlying permafrost in the Qinghai-Tibet Plateau

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The effect of sand layer on the ground temperature of permafrost is one of the unsolved scientific problems in the Qinghai-Tibet Plateau, the sand layers were found to play a key role in the protection of the underlying permafrost by the measured data, and this research work was published in *Chinese Science Bulletin*.

The permafrost is degrading, and at the same time, the desertification is also developing at the surface of Qinghai-Tibet Plateau, under the condition of global warming. Sand layer is accelerated permafrost degradation or protecting permafrost? No significant conclusions have been drawn currently. Some studies have shown that ground temperature in regions of windblown sand within the permafrost zone of the Qinghai-Tibet Plateau are higher than in regions not affected by sand, which may accelerate the degradation of permafrost. Other studies have shown the dual nature of the sand layer on the ground temperature: the ground temperature in a zone of thick sand layer coverage is higher than that in a non-sandy zone, thereby accelerating the thawing of permafrost, whereas the ground temperature in a zone of thin sand layer coverage is lower than that in a non-sandy zone, thereby protecting the permafrost. Because of the conditions and technical limitations during that period, the above researches comprise only sporadic observations and simple reasoning. Moreover, lack long-term observations and systematic research; therefore, the conclusions vary, and sometimes even contradict one another.

In order to clarify the scientific problems, Prof. Jianjun Qu and his student Dr. Shengbo Xie of the Key Laboratory of Desert and Desertification, Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, were funded by the National Natural Science Foundation of China and the Knowledge Innovation Project of [Chinese Academy of Sciences](#), an experimental field was set up by them in the hinterland desert permafrost regions of Qinghai-Tibet Plateau, in 2010. Synchronized contrasting observations were made in an open area, and observations of the ground temperature of permafrost below sand layer covering were conducted more than one year. Sand layer was found to play a key role in protecting the underlying permafrost in Qinghai-Tibet Plateau. Their research work, entitled "New discoveries on the effects of desertification on the ground temperature of permafrost and its significance to the Qinghai-Tibet Plateau", was published in *Chinese Science Bulletin*. 2012, Vol 57.

The result shows that, in the desert permafrost regions of Qinghai-Tibet Plateau, the ground temperature below thick sand layer was bounded near the permafrost table, compared to that of the natural ground surface. The ground temperature of the permafrost below this depth decreased during the observation period. Moreover, the ground temperature in the active layer above the depth varied with the seasons. i.e., the ground temperature decreased during the summer half-year (May to September), and increased in negative value, however, the whole permafrost layer below the ground surface was in a frozen state during the winter half-year (November to March), lead to the annual range of ground temperature decreased, with April and October being transitional stages. During the month of April, the soil turned from the frozen state into the thawed state, and the ground temperature of the active layer below the thick sand layer was lower than the temperature of the natural surface. During the month of October, the soil turned from the thawed state into the frozen state, and the ground temperature of the active layer below the thick sand layer was higher than the temperature

of the natural surface. The ground temperature near the permafrost table below the thin sand layer was decreased throughout the year, whereas the ground temperature difference in the upper active layer and underlying permafrost layer gradually decreased. Thus, the sand layer in the Qinghai–[Tibet Plateau](#), in general, preserves the underlying permafrost. The method of sand coverage can be considered in the future practice of permafrost protection; this work could provide a new idea to protect the permafrost in the regions of engineering construction.

The result also shows that, the changes in the ground temperature of the permafrost below sand layer can be attributed mainly to the differences of reflectivity and heat conductivity between the sand layer and natural ground surface in Qinghai-Tibet Plateau. The sand layer causes a stronger blocking effect to the heat exchange of land–atmosphere system because of its high reflectivity and poor heat conductivity, compared to that of the natural ground surface. During the summer half-year, the surface air temperature was positive in value and higher than the ground temperature, the sand layer blocked the downward transfer of surface heat; during the winter half-year, the surface air temperature was negative in value and lower than the ground temperature. Similarly, the sand layer prevented the upward transfer of underground heat.

The scientific significance of the research is not only to present an exploration of the interaction between desertification and permafrost, enriched the theoretical system of geocryology and desert science, but also has the reference value to [permafrost](#) engineering.

**More information:** Xie S B, Qu J J, Zu R P, et al. New discoveries on the effects of desertification on the ground temperature of permafrost and its significance to the Qinghai-Tibet Plateau. Chinese Science Bulletin, 2012, 57:838-842

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