Permafrost and climate change (/news/1035110/permafrost-and-climate-change)

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Research at high altitude can be extremely difficult and after experiencing a snowstorm in mid-June on top of the Deosai plateau, one has greater respect for scientists who camp out in the freezing cold to conduct their meticulous studies. Located at an elevation of slightly more than 4,100m, the Deosai plateau is wedged between the Nanga Parbat massif in the western Himalayas and the eastern end of the Karakoram mountains north of the Indus River. Since Deosai is covered with snow for more than half the year and given its high altitude, it is a good location to study permafrost in Pakistan, and that is exactly what the Italian scientist Renato Colucci was doing for the SHARE (Stations at High Altitude for Research on the Environment) project this summer.

What exactly is permafrost? It is defined as any “subsurface material” (soil, sediments) that remains below or at 0 degrees Celsius continously for at least two years. That means they remain frozen for a minimum of two years. Usually you have the ground surface on top, below it an active layer (that thaws in the summer and freezes in the winter) and then below that is the permafrost layer (below which is un-frozen ground). Around 25pc of the land surface in the Northern Hemisphere is said to be covered by permafrost (including large tracts of Siberia, Central Asia, Alaska, Canada, Norway and the Alps). The thickness of permafrost can be quite variable — from 100m to 800m in high latitude areas, while in the mountains of lower latitude areas it can be between 25m and 100m. According to Colucci,

who is working for the National Research Council in Italy and collaborating with the Ev-K2-CNR scientific committee which is supporting his research, “permanent+frost is permafrost which is directly connected with temperature and climate conditions”.

Not much is known about the role of permafrost in the highest mountains of the world, the Himalaya and Karakoram, although parts of these mountains have now been mapped as permafrost areas (with the help of satellite technology). It is important to study permafrost more closely because its sudden melting can lead to slope instability resulting in large landslides and debris flows and it also has an impact on water supply management. According to the Pakistan Meteorological Department, whose scientists are collaborating with the Italians in Deosai, the thawing of permafrost in the mountains above the Hunza River probably caused the massive landslide that blocked the river and formed the Attabad Lake. This huge lake has cut off the Gojal valley (and the Karakoram Highway leading to China) from the rest of Pakistan. Hence the thawing of permafrost in our high mountains, given warmer temperatures across the globe because of climate change, could have grave implications for us.

Permafrost can also store large amounts of water and if it melts, the water will just flow out. According to Colucci, accurate mapping of permafrost is important for water management because permafrost degradation can cause changes in water quality and chemistry and there is no data about it in Pakistan. He had brought hi-tech equipment with him in Deosai to detect permafrost in the ground and measure its active layer thickness and ice content by using electricity to penetrate the soil (called ERT or Electrical Resistivity Tomography) and measure ground temperatures in shallow boreholes. “It is interesting to research permafrost which doesn’t need much snow like glaciers do — you can study permafrost in a different way” he explained.

No thermal data or any data related to the ice content within permafrost exists in Pakistan and this is the first time that this kind of research is being done in the country. Unfortunately, because of all the snow up in Deosai throughout June, Colucci’s initial research in the area was not very fruitful — “I work with electricity, so with the snow on the ground, I could not take measurements (snow/water/mud all conduct electricity)”. He did get a half a day’s

opportunity, when it stopped snowing for a few hours, to test his ERT equipment in the field in Deosai. Colucci is currently working in the Baltoro glacier area where he hopes he will have better luck with his fieldwork.

His study aims to map permafrost distribution considering the geological and climatological conditions of the Deosai and Baltoro areas. Different types of permafrost modelling, using both satellite and on-ground measurements to determine ice content and permafrost thickness, will be used to give a complete mapping of permafrost in the two areas. This summer’s data collection will hopefully be the first step towards more research on the role that permafrost has to play in our high mountains.