Subsurface structure beneath the Satluj valley, NW Himalayas and Seismogenesis of swarm activities in peninsular India

Speaker: Dr. Monika Wadhawan, National Center for Seismology, New Delhi
Time: 11 AM, July 9, 2021 (Friday)
WebEx link:
https://iitroorkee.webex.com/iitroorkee/j.php?MTID=m7ce384bddcf17b6f2dc985ddcc9235ad
Meeting number: 159 446 0316
Password: 23yfYj2DjDM

During my PhD, a passive source seismological study was carried out in the Satluj valley, NW Himalaya using teleseismic earthquake data recorded by 18 broad band seismometers were analysed based on P-wave Receiver function method to delineate the geometry of the subsurface structure beneath this region. It was found that the Main Himalayan Thrust (MHT) is gently dipping northward and its depth varies from ~16 km beneath the Sub-Himalaya to ~27 km beneath the Higher Himalaya which further increases to ~38 km beneath the Tethyan Himalaya. These estimates imply a ramp close to the South Tibetan Detachment System (STDS), at a distance of~180 km from the Himalayan Frontal Thrust (HFT). It was also found that the Moho dips gently to the north and the depth increases from ~44 km below the HFT to ~62 km below the Tethyan Himalaya. The seismicity pattern in the Satluj valley region indicated that large and moderate magnitude earthquakes were fewer in this segment in comparison to that in the Kangra-Chamba region and Garhwal Himalaya. This contrasting seismicity pattern along with the corresponding geometry of the MHT, clearly revealed the role of ramp on the MHT in generating clustered seismicity in the HSB.
In my ongoing project, I am studying the seismogenesis of earthquake swarm occurred on the west coast of the Peninsular India which is continuing till date. It was a low magnitude earthquake swarm activity which started on the west coast of central India in November, 2018. These earthquakes were tightly clustered in a region of 10×6 km^2 and occurred through normal slip on the N-S oriented east dipping steep fault(s) having a depth of only 6–7 km. It produced more than 32,000 earthquakes of magnitude -0.5 to 3.8 with an equivalent single earthquake magnitude of 4.5. The InSAR data analysis revealed a subsidence of the ground of ~3 cm between November 2018 to May 2019 in the swarm region and confirmed that the resulting deformation occurred through normal slip on the N-S oriented planes. Focal mechanisms of many earthquakes supported the above conclusions. Considering the analysis of monsoon rainfall, InSAR data and focal mechanisms together, it was found that the monsoonal rainfall and its infiltration at depth along with the pore pressure may have played some role in the initiation of this swarm by inducing aseismic deformation causing subsidence and underground cavity collapse. Thus, it appears that it could be a non-tectonic earthquake swarm purely driven by moderate to heavy precipitation.

About the Speaker
Dr. Monika Wadhawan is currently working as a Project Scientist in the National Center for Seismology (NCS), New Delhi since February, 2018. She did her Bachelors in Computer Science in 2008 and Masters in Applied Geophysics in 2011, both from Kurukshetra University. I joined Institute of Seismological Research (ISR), Gandhinagar as a Project Fellow in October 2011. After that, she moved to Wadia Institute of Himalayan Geology as a Doctoral Research Fellow to pursue her PhD in Earth Sciences on "Shear wave velocity and crustal structure along Satluj valley, northwest Himalaya" and was awarded the degree in 2018. So far, her main research interests have been delineating subsurface structure using receiver function method, seismotectonics and study of seismic anisotropy in the Himalaya. Currently, she is working as a co-leader in a project that involves the detailed study of ongoing earthquake swarm in the Peninsular India.

Understanding the effects of saltwater intrusion on coastal groundwater and aquifer sediments

Speaker: Dr. P. Prusty
Time: 4 PM, July 9, 2021 (Friday)
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https://iitroorkee.webex.com/iitroorkee/j.php?MTID=m72957c392172cb42eccda7d6b5d5c444
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Saltwater intrusion is a major challenge in coastal regions across the globe. Long-term saltwater intrusion leads to loss of agricultural land and shrinkage of freshwater resources, thus have enormous social and societal impact. In view of this, a study was conducted to (i) understand the geochemical processes controlling coastal water chemistry, (ii) identify potential freshwater regions in saltwater-intruded areas, and (iii) evaluate the impact of periodic fluctuation of the freshwater-seawater interface on groundwater chemistry and aquifer sediments. The first two objectives were achieved by the application of integrated geochemical, statistical, and geospatial techniques in the coastal regions of Puri, India. Seasonal groundwater and surface water samples were collected and analyzed for various physicochemical parameters. The water quality parameters show wide spatial variations with limited temporal variations in the area. Geochemical processes such as seawater-freshwater mixing, ion-exchange, and sulfate reduction are found to control the coastal water chemistry. Further, it has been calculated that just 1% mixing of seawater is sufficient to raise the TDS content of groundwater above the WHO permissible limit. Interestingly, it was observed that the saline groundwater is located in inland areas and patches of fresh groundwater were found near the coast. These freshwater patches have shown a strong association with the geomorphic features existing in the areas.

Further, to understand the effect of fluctuation in the seawater-freshwater interface a column-based study was conducted, where the conditions similar to the natural aquifer systems were simulated in the sediment-filled columns by injecting the freshwater and seawater periodically. The experiment was continued for around one year, and pore water samples from the columns were collected at regular intervals. The analysis of pore water samples for major and trace elements suggests that processes such as ion-exchange, mineral precipitation/dissolution, elemental adsorption/desorption and seawater-freshwater mixing play an important role in controlling the pore water chemistry. It has also been identified that some trace elements (barium, boron, bromide, lithium, and strontium) can act as very sensitive indicators of saltwater intrusion. Further, changes in the elemental composition and grain size distribution have been observed in column sediments. Such changes, in turn, affect the vital aquifer properties, including porosity and permeability. These findings are unique and highly appreciated by the scientific community.

About the Speaker

Dr. Prusty is currently working as an Assistant Professor at the Central University of Karnataka. Prior to that he did his PhD in Hydrogeology from IIT Bhubaneshwar in 2020 and Masters in Geology in 2015. He specializes in hydrogeology, water quality, saltwater intrusion and sediment-water interactions.