# Investigation of the shallow geo-electrical resistivity distribution at a fault zone in Sub-Himalayan region in Uttarakhand (India) using Radio-Magnetotellurics

**30. Schmucker-Weidelt-Kolloquium**

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## OUTLINE

- *Geology of Survey Area*
  *Motivation*
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  *Basic Conceptual*
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- *Raw, Obs. Data Plots*
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## Geology of Survey Area:

- The Himalayan Frontal Thrust (HFT) defines the orogen's southernmost margin across an entire ~2500 km-long arc.
- Lithologically, the Siwaliks are composed mainly of detrital rocks, such as coarsely bedded sand- stones, sandrock, clays and conglomerates.

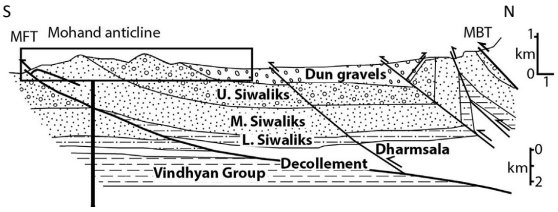



**Figure 2:** Geological setting of the Mohand anticline structure (Thakur and Pandey, 2004).

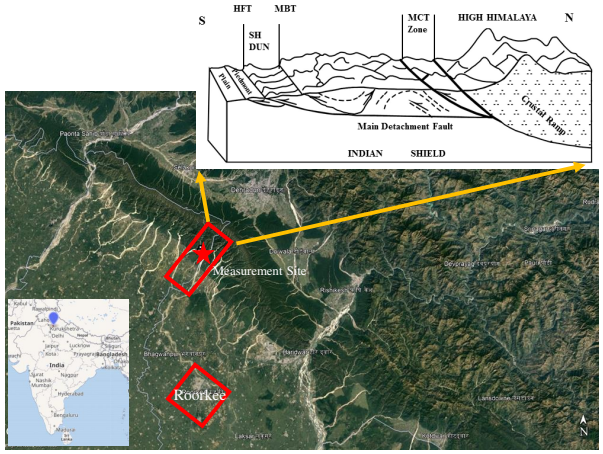
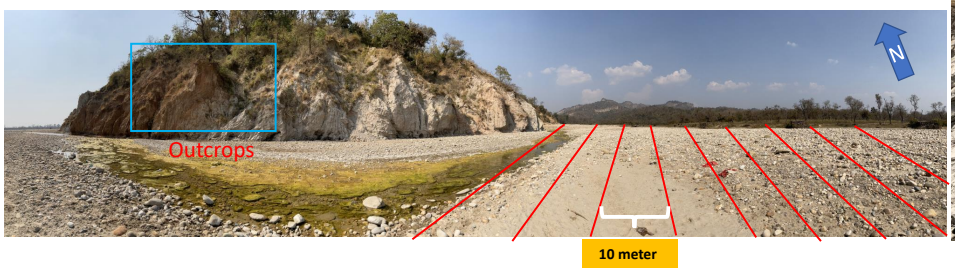


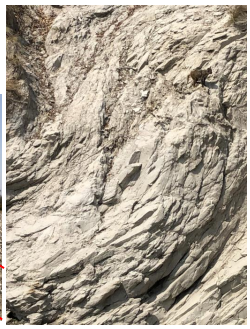

**Figure 1:** The location, block diagram, and schematic cross-section across the Uttarakhand Himalayan region (Robert and Thakur, 2008).



## Motivation:

- Specifying the shallow geo-electric distribution near the Mohand range in Sub-Himalayan region,
- Making a contribution to near-surface geology in the Himalayan Frontal Trust (HFT) zone,
- Determining the fault plane or separation,
- 3D RMT scalar and tensor inversion using ModEM.



## Survey Plan:


- Total number of RMT stations: 326.
- Profile spacing is 10 m.
- Station distance is 10 m.

**Figure 3:** Survey map near Mohand area.



## Introduction:

***Radio-magnetotellurics (RMT)*** **:**

- The RMT is a passive measurement method in the frequency domain.
- MT approximation is valid for 1-1000 kHz and < 1000 Ωm
- Impedance Tensor: $\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix} \begin{bmatrix} B_x \\ B_y \end{bmatrix}$
- Scalar: $Z_{ij} = \frac{E_i}{B_j}$
- Tensor calculation from cross and auto spectra of all components.

| RMT-F |
|---|
| 10kHz-1MHz |
| Full RMT Z tensors |
| 4 frequency bands |

| Band | Freq. Range (kHz) |
|---|---|
| D1 | 1-10 |
| D2 | 10-100 |
| D3 | 100-300 |
| D4 | 100-1000 |

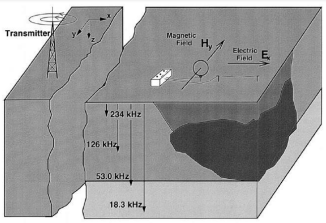



**Figure 4:** The practical field application scheme of the RMT method.(Tezkan,2009).

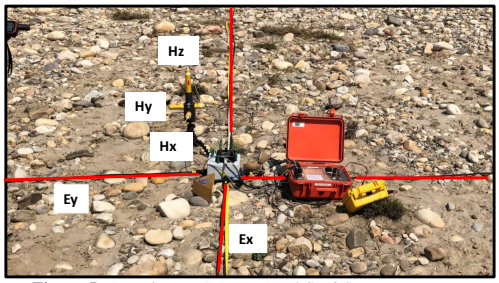



**Figure 5 :** Data logger (RMT, M-K5-SM25), electric antennae and magnetic coils.

## RMT Data Processing:

- Fourier transform of the time-series,
- Window length : D1 ≈ 16000, D2 ≈ 32000, D4 ≈ 65000
- Window Type : Blackman
- Coherency level : 0.7 - 1

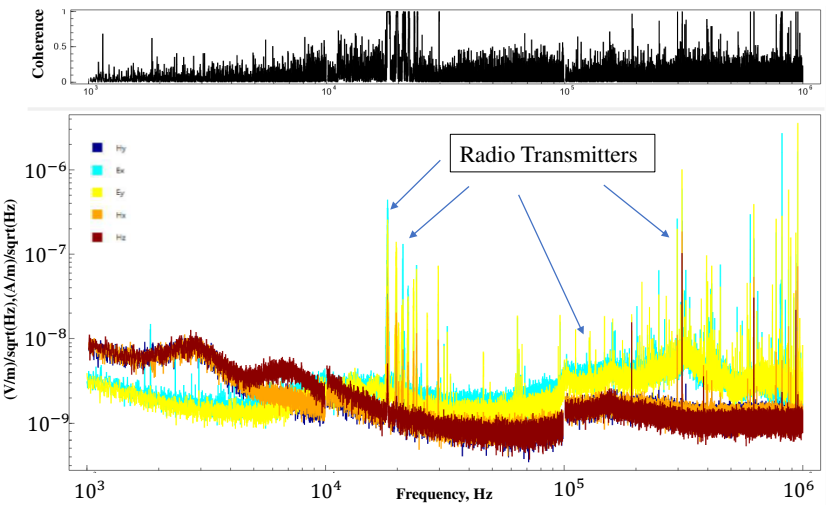
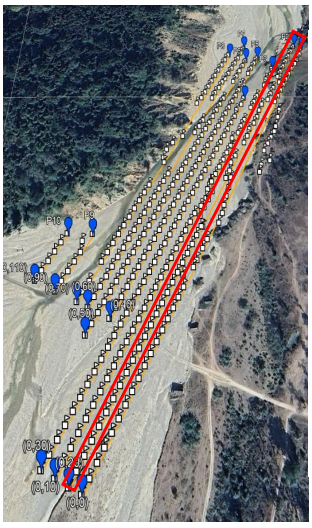



**Figure 6:** Coherence and spectra (EMP, written by Arseny Shleykov).



## Scalar Raw Data (Profile-2):



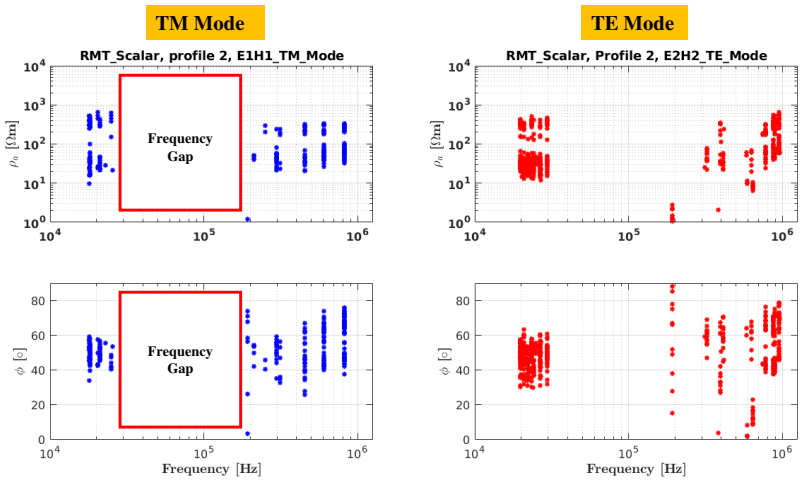



**Figure 7:** Profile-2 raw apparent resistivity and phase plots along the frequency.

## Scalar Observed Data for Two Selected Frequencies (Profile-2):

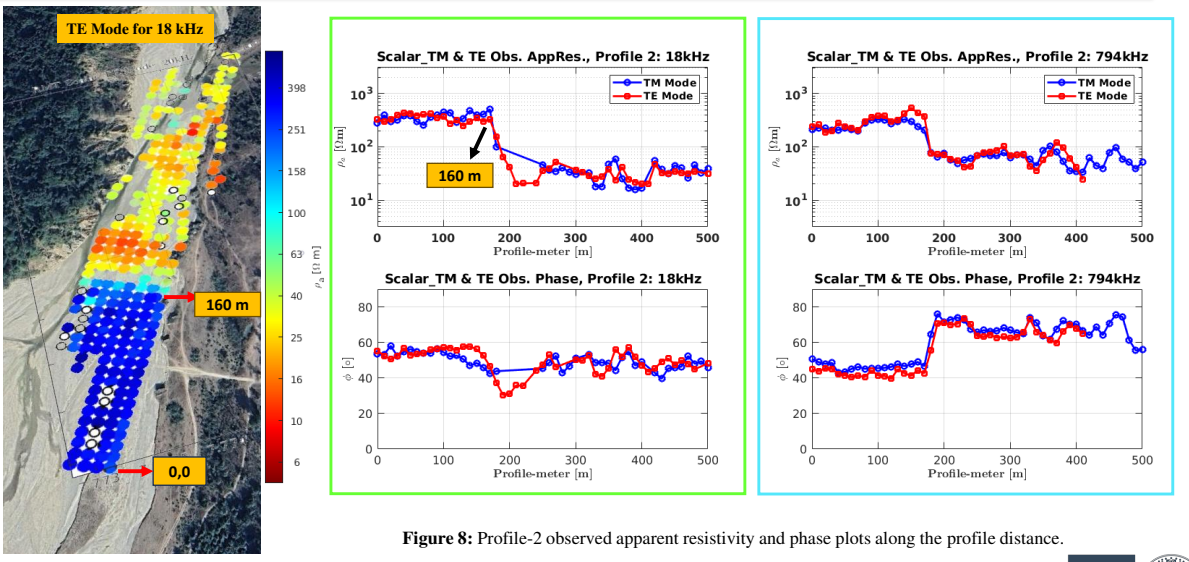



**Figure 8:** Profile-2 observed apparent resistivity and phase plots along the profile distance.



## Inversion Results:

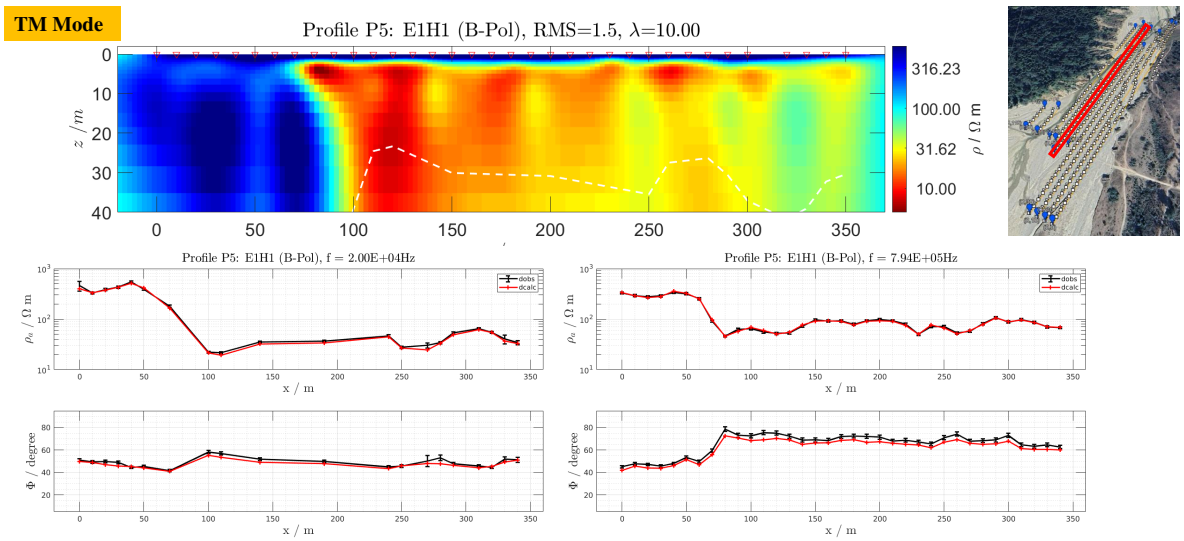



**Figure 9:** Profile-5, TM Mode 2D inversion model and datafit plots for 20kHz & 794 kHz.

## Inv. Results of Scalar & Tensor :

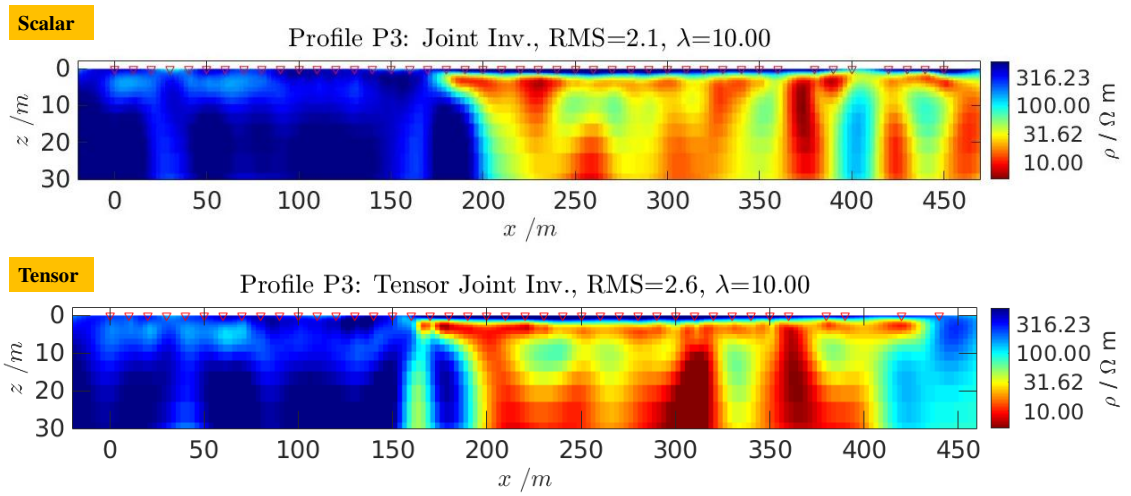



**Figure 10:** Profile-3, 2D Scalar and Tensor joint inversion depth sections. .



## Geological Interpretation of RMT results:

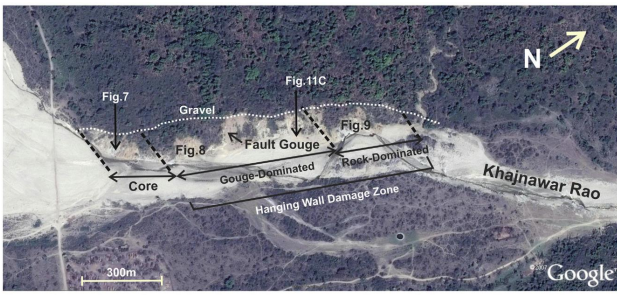



**Figure 11:** Conceptual model for the HFT fault zone in the Mohand Range (Srivastava, 2016).

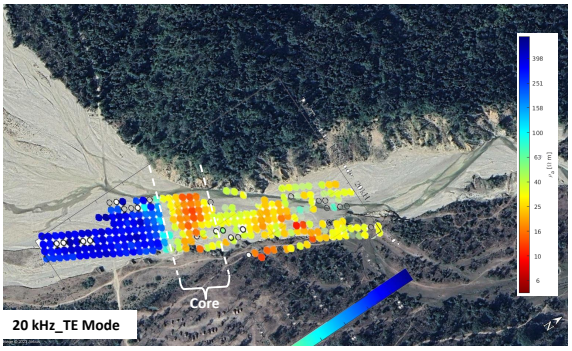
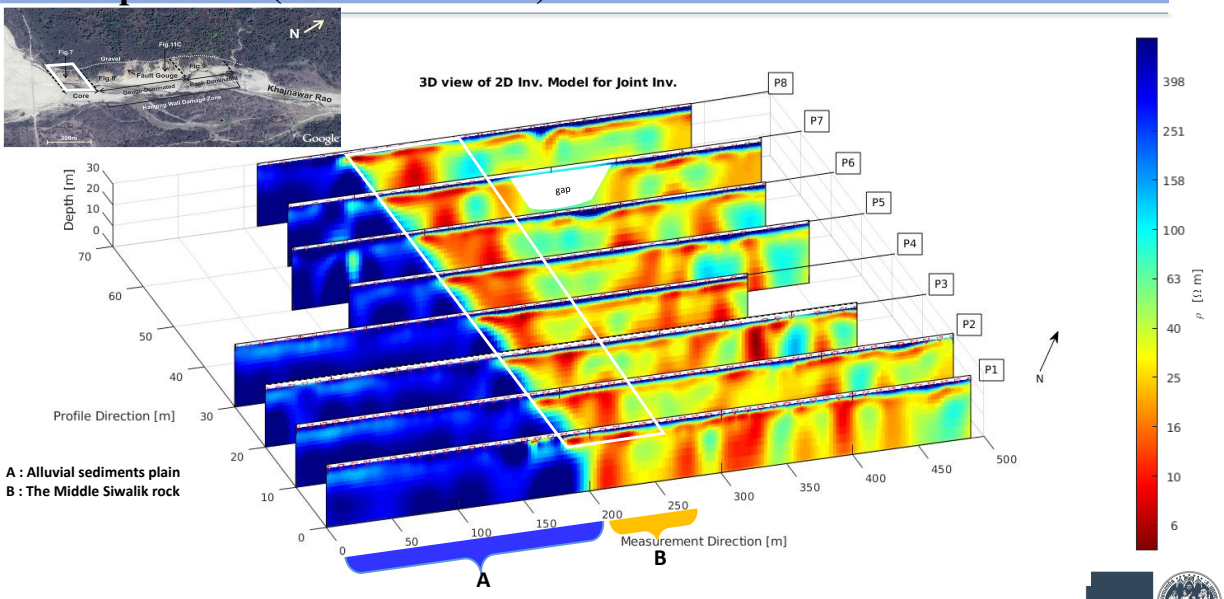



**Figure 12:** Scatter observed data plot for TE modes (20kHz).

## Interpretation (Scalar Inversion):

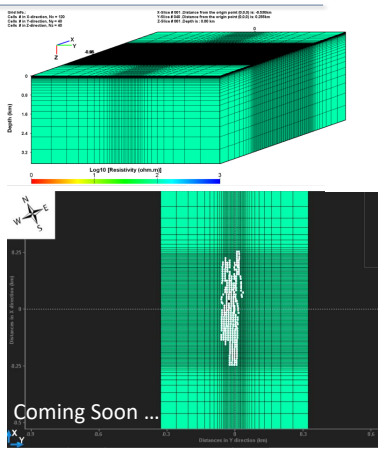





## Conclusion:

***Summary:***

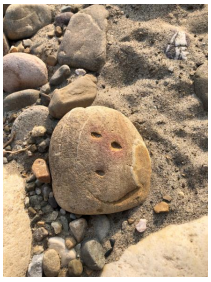
- Data was successfully acquited at 326 RMT stations.
- Scalar and tensor processings were finished.
- 2D scalar and tensor inversions were done.
- The applicability for 3D tensor inversion was checked.
- A conductivity contrast zone was detected.
- The derived RMT models were correlated well with geological information.




***Future Plans:***

- The dataset will be evaluated as scalar&tensor 3D inversion using ModEM.
- The possible geological formations and fault zone will be denoted by considering 2D & 3D inversion models.

***Acknowledgement :*** **INDO-GERMAN JOINT RESEARCH COLLABORATION (DAAD&DST)**



**Thanks for listening.**