Electrical Imaging of Shallow and Deep Crust using MT Survey in Sikkim-Darjeeling Himalayas

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The objective of the investigation was "trial electrical imaging of deep crustal structure over the Sikkim-Darjeeling Himalayas and its bearing on the seismotectonics of the region. To achieve the above objective the area bounded by Lat: 26°12′N to 26°53′N and Long: 88°10′E to 88°30′E of the Degree sheet No. 78 B has been covered by magnetotelluric (MT) survey.

A total of 14 nos. of MT soundings have been carried out with a station spacing of 6-7 km along a traverse length of about 90 km from Islampur to Sevok. Two MT instruments ADU-101 and ADU-102 were deployed in the field site simultaneously for rapid coverage.

The area around Islampur-Siliguri and Sevoke forms a part of the northern extension of the peri-Cratonic Bengal basin covered by alluvium. Normally Lower Siwaliks (Tertiary) underlain by Gondwana formation is expected to underlie the pre-Quaternary and Quaternary alluvium.

The interpreted vertical resistivity distribution along Islampur-Sevoke traverse using Bostick and Occam 1D model are characterized by different resistivity values. The surface layer is interpreted as boulder bed with moderate to high resistivity. The highly conductive layer characterized by resistivity values ranging from 2 to 15 Ohm-m and thickness varying from 500 to 3000 m is inferred at each location of MT soundings. The highly conductive layer may be Siwalik is underlain by a layer having resistivity ranging from 30 to 500 Ohm-m and may be interpreted as Gondwana sediment of varying thickness 2000 to 3500 m. The high resistivity basement is interpreted at a depth level of 2600 to 5600 m. The compressional tectonics undergone by this region as is evident from the several thrusts, synclines and anticlines, some of which may be deep seated, do not permit the assumption of uniform resistivities at deeper levels. Steep gradient of basement could possibly be attributed to fault zones around Mailani Jote and Tuna no. 7. The basement slopes down towards foothill of Himalaya.

The apparent resistivity and phase pseudo-sections in the TE and TM mode indicates a highly conductive zone with apparent resistivity of the order of 2 Ohm-m representing Siwalik. The calculated vertical elongations of the apparent resistivity contours shows a static shift at stations between Mailani Jote to Shibnagar which is not reflected in the phase pseudo-sections. The static shift may be due to the presence of faults/lineament/fracture and accumulation of electric charges along the faulted

boundaries. Static shift effect part has been taken care for the preparation of model utilising WinGLink software.

The geoelectric cross section indicates of the intense thrusting and folding of the crust in the Siwalik region and with the thickness of the sedimentary layer varying from 1 to 15 km. The geoelectric section shows a thick conductive layer between stations Islampur and Kasiadaga overlying a resistive layer (128-512 Ohm-m) which may be the Gondwana sediments in the area. The section has brought out a prominent vertical conductive zone (<2 Ohm-m) below stations Mailani Jote-Tuna no. 7 at a depth of about 6 km and continuing up to 15 km. Attempts have been made to explain these deep crustal conductivities on the basis of the fluids in open pores, partial melting of the deep crustal rocks, possible serpentinization in the remnants of the oceanic crusts and grain boundary graphite films. Thus the high conductivity below the Siwalik crust seems to be due to partial melting of the deep crustal rocks. Thus the conductive layer seems to be located in the deep crust of the subducting Indian plate. The phase pseudo-sections some lateral phase variations at low frequencies. However information on the resistivity levels is not available in the phase data.