Induction arrows in Eastern Tibet

A.V.Tereshyn, .I.I.Rokityansky
Subbotin Institute of Geophysics, Nat. Acad. Sci. of Ukraine. tereshynartemk@gmail.com,

SUMMARY

In the eastern Tibet, large-scale motions of the crust occur. For their explanation crustal flow channels were proposed and geophysical data are necessary to constrain the pattern of the flow. Electromagnetic studies are promising for this purpose. 54 geomagnetic observatories of Chinese network were carefully processed for 2008-2019 years and tippers (VTF, induction arrows) were estimated at periods 300 - 10000 s Unusually large tippers were discovered at three observatories in eastern Tibet (Xu et al 2023). The authors were so surprised that they titled the article in a rather strange way. They compiled model: 1000 km long, 100 km wide, 10 km thick conductor (Figure 1) at the depth 5 km in highly resistive ρ_e=10000 Ohm·m half-space ignoring high conductivity of the Earth's mantle. We calculated the anomalies from this model with and without conducting mantle – the tipper's values differ in ≈2.5 times. So, for realistic Earth (with conducting mantle) this model doesn't explain the experimental data on large tippers. All great arrows directed to west. We supposed that anomalous body plunges along an eastward inclined plane of Jinshajiang suture zone. We collected MTS data which show conducting layers in upper crust, which can strongly screen anomalous fields from the eastern submerged edge of the anomaly. The western edge most likely located at shallow depths. However, to attain observed arrows ≈3 units, also super-channeling effect should operate. It occurs in the places where strong decrease in the longitudinal conductance located. Results of the modeling will be given in presentation.

Keywords: induction arrow, electrical conductivity anomaly

Physics of the anomalous field formation

Anomalous currents in a conducting body arise due to local electromagnetic induction inside the body, as well as due to conductive redistribution (and concentration) of currents induced in the host medium on the large territory comparable with the external source size. Analytical solutions for a cylinder presented as an infinite series which first term is proportional to the applied electric field (it forms the anomaly of conductive type), the second – to magnetic field – it forms the magnetic type anomaly. The latter cannot exceed 1. The magnitude of conductive type anomaly is not limited. Analysis of natural situations showed that conductive type anomalies are predominate for elongated conductors, and a corresponding theory was developed for them (Rokityansky 1982). The frequency characteristics (FC) is equal to the product of the non-decreasing function of period V(T) (0≤V≤1) and the normal impedance (decreasing function of period). So FC has a maximum at some period T_O closely related with the total longitudinal conductance G [S×m] of the anomalous body. On the period T_O, the anomalous fields become real C=Cu, the imaginary Cv passes through zero changing sign. On shorter periods, Cu and Cv are parallel, on longer ones - anti-parallel.

References

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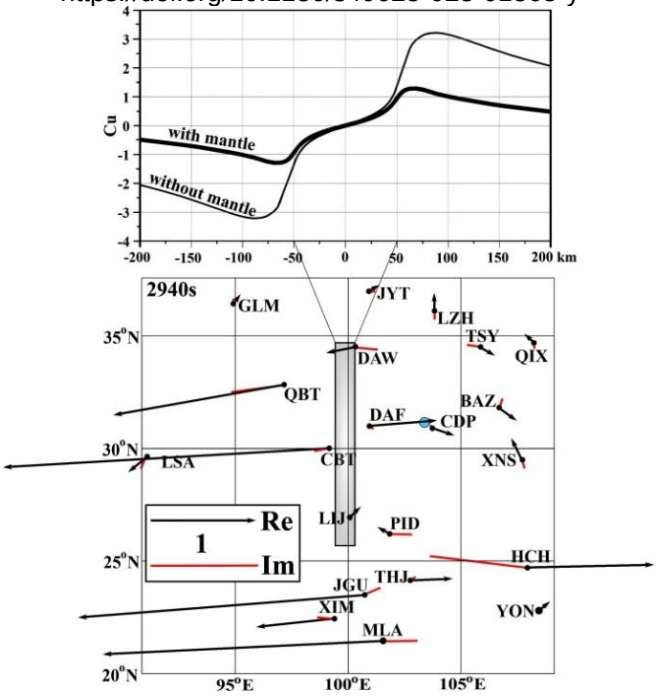

Figure 1. Observed induction arrows in Wiese convention. Upper graphs – calculated Cu from the rectangular 3D anomaly described in summary.