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A magnetotelluric investigation along a 40 km profile in Kangerlussuaq, West Greenland

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1. Introduction

Despite a well-mapped, interesting surface geology, deep sounding geophysical studies like seismics or magnetotellurics have been used very rarely in Greenland. Here we show the first magnetotelluric investigation of subsurface resistivity structures in the Nagssugtoqidian mountain building range (orogen). Additionally the influence of the electrically conductive ocean, as well as the source geometry in the auroral oval was tested. Five MT instruments were located along a 40km WSW-ENE profile near Kangerlussuaq, West Greenland (**Fig.1**) in the period from 5th of August 2010 to 17th of September 2010.

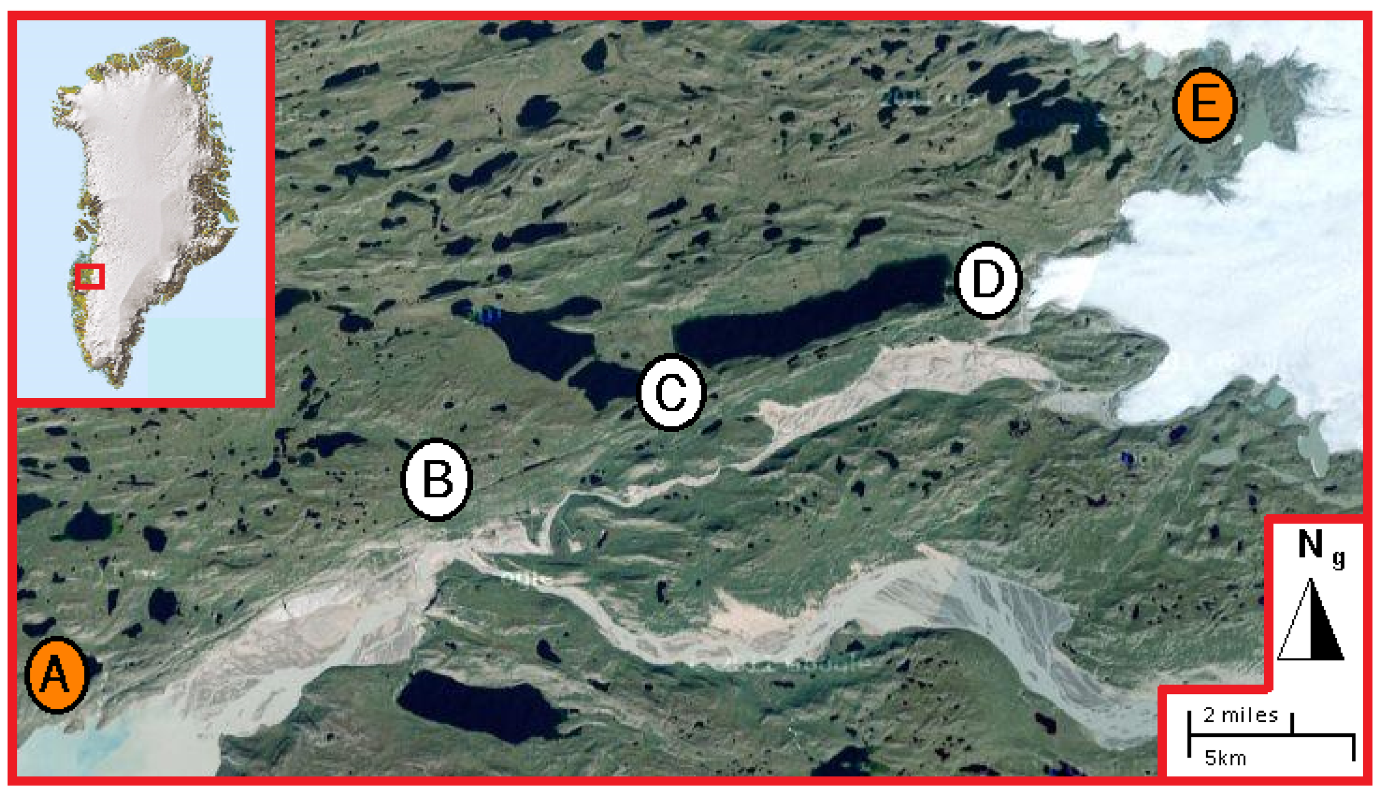

Fig.1: Map of Greenland (upper left panel) and detailed map of the Kangerlussuaq region including the locations of the five measurement stations. At stations A and E the three components of the magnetic field (B_x, B_y, B_z) and the horizontal components of the telluric field (E_x, E_y) were observed (orange circles), whereas at stations B, C and D only the telluric field was recorded (white circles). Transfer functions of these stations were calculated with respect to the magnetic fields at station E.

The sampling frequency was 4Hz and standard robust processing after Löwer et al. (2010) was applied to the measurements to calculate MT transfer functions such as impedance tensors and tipper vectors.

2. Data processing

The left panel of **Fig.2** illustrates the Kp-index for the measurement period, whereas the right panel shows one of the estimated offdiagonal impedance tensor components, Im(Z_{yx}) at target frequency 0.1Hz. This example illustrates the change in transfer functions during time intervals of high geomagnetic activity. Half days (00-12 UT, 12-24 UT) with a mean Kp value above 2 were therefore neglected during data processing.

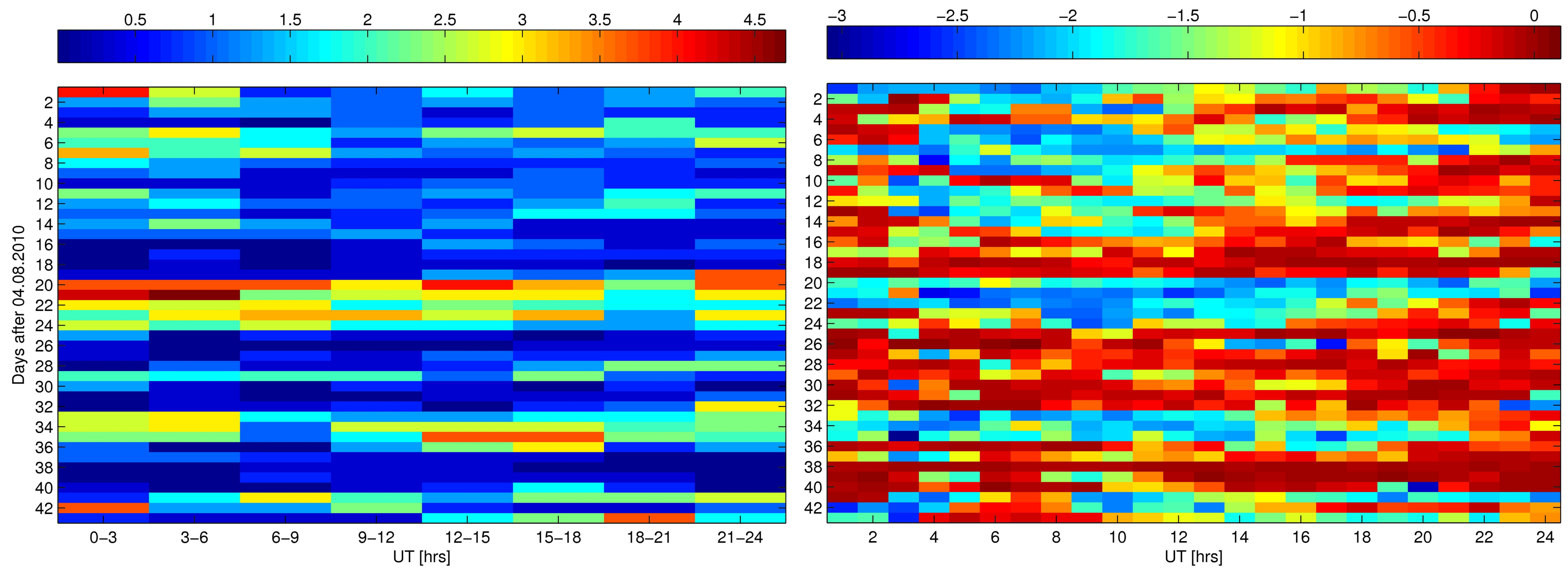

Fig.2: Kp-index (left) and Im(Z_{yx}) at 0.1Hz (right). High values for the Kp-index correlate with significant changes in amplitude of the measured transfer functions.

The upper panel of **Fig.3** displays the period and location dependency of the principal axes of the observed phase tensor ellipses (Häuserer et al., 2011), colored according to the corresponding phase values. The lower panel illustrates the tipper vectors at stations A and E.

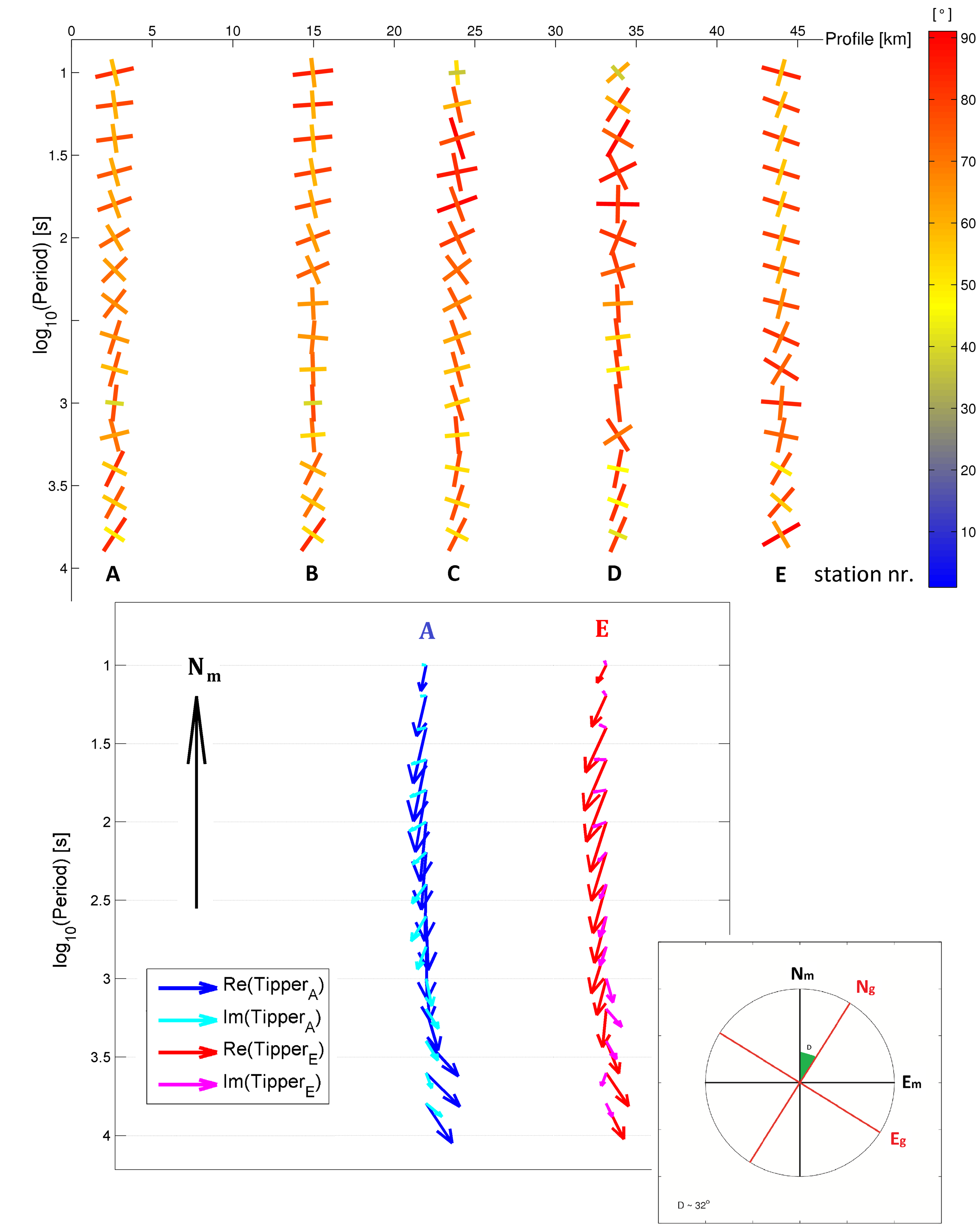

Fig.3: Top: Phase tensor bars along the measurement profile. Bottom left: Tipper vectors for stations A and E (Wiese convention). The black arrow indicates the unity arrow pointing towards local magnetic north. Bottom right: Orientation for the geographic (red) and local magnetic (black) coordinate system, shifted by the local westward declination angle of 32 degrees. Both phase tensor bars and tipper vectors are orientated after the local magnetic coordinate system.

3. Results

Comparing the measured tipper arrows and phase tensor bar orientations (**Fig.3**), the different phase values could be assigned to the polarisation modes TE and TM (**Fig.4**) under assumption of two-dimensionality. We observe a phase switch at periods around 100 sec as well as a distinctive phase split-up. The different measurement behaviour of station E is suggested to be caused by three dimensional effects and/or anisotropy.

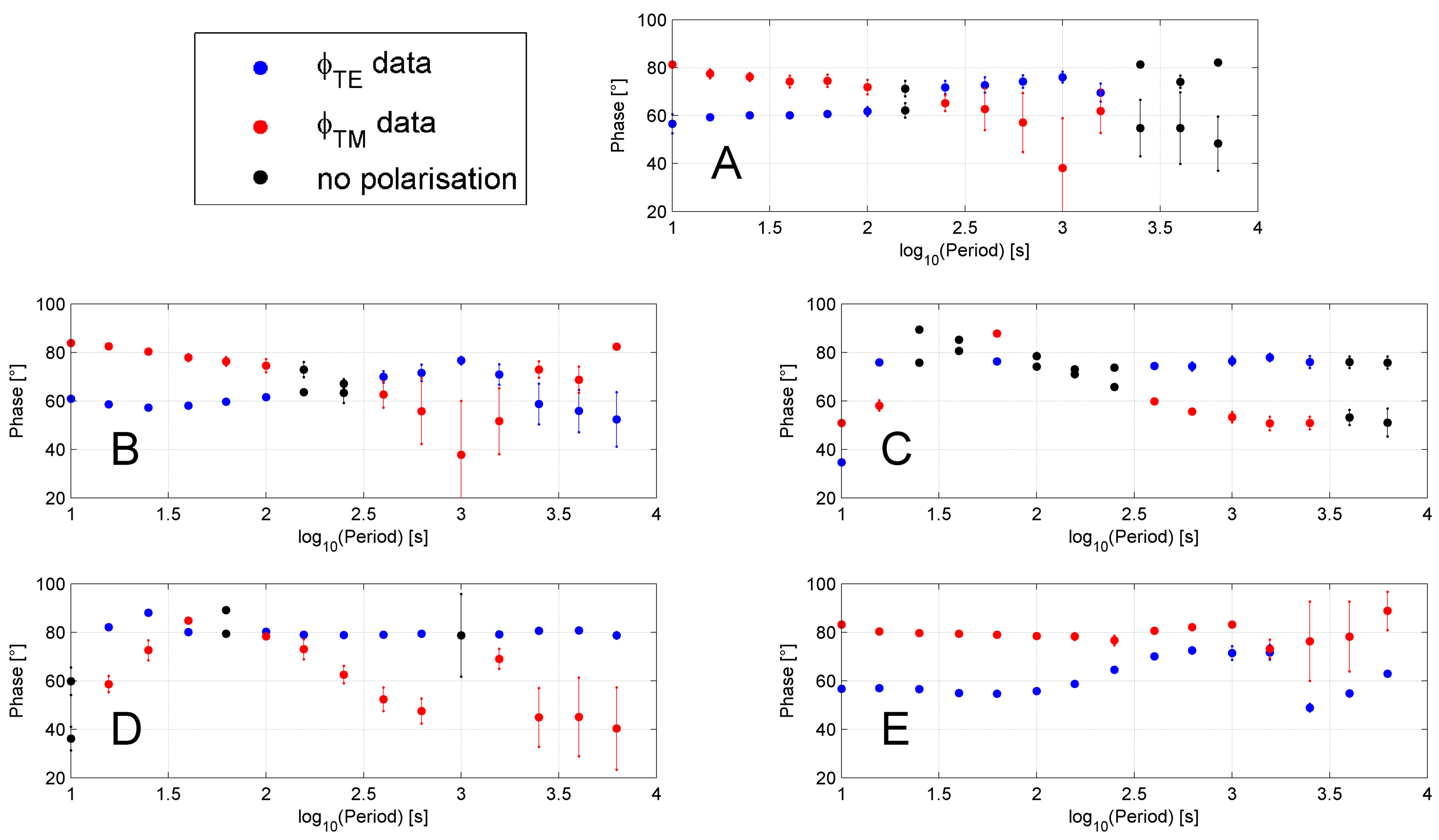

Fig.4: The estimated phase tensor bar values for stations A to E are illustrated with their corresponding polarisation mode affiliation for TE (blue) and TM (red). Black data points represent the measurements where a polarisation mode association was not possible.

The orientation of the tippe vectors (**Fig.3**) suggests a large and well conducting structure in the geographic northwest, and with a strike direction parallel to the measurement profile.

4. Conclusion

The orientation of the tipper vectors suggests a large and extremely conducting structure in the Earth's crust located northwest of Kangerlussuaq, and with a strike direction of similar orientation as the measurement profile. Future surveys should therefor aim at locations along a profile perpendicular to the strike direction identified here. Such studies could then be compared to similar MT-studies, especially from Canada, and potentially reveal conductivity structures along the proterozoic Nagssugtoqidian orogen, as predicted by Jones (1993).

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