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New explanation of an old magnetotelluric observation: source rock of the Transdanubian Range Conductivity Anomaly ascertained

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The so-called Transdanubian Conductivity Anomaly (TCA) at the Hungarian part of the NW Pannonian Basin has been well known for nearly four decades. Hungarian research institutions carried out several magnetotelluric soundings and exceptionally low resistivity (i.e. 1-2 Ohmm) zones were found with a large areal extent (on the order of few thousand square km). The low resistivity bodies are situated in the depth range of 4 to 10 km and no surface outcrops of such a highly conducting rock mass can be found in Hungary. This enigmatic geophysical anomaly was explained in a number of ways by different authors, invoking sub-horizontal Alpine nappe contacts to subvertical dikes with graphite and/or saline fluid content. Only one possible outcrop area of the high conductivity anomaly was considered so far, in the Drauzug/Gailtal area of the Eastern Alps in Austria, some 300 km to the West from the anomaly area.

Whereas there were previous attempts to find correspondence between the TCA and prominent seismic reflectors seen on 2D seismic reflection profiles, in this study we have systematically correlated, for the first time, the TCA with modern 2D and 3D industry seismic reflection data. Our results show a very strong correlation between the subsurface extent and position of TCA and various sub-horizontal Cretaceous Alpine nappe surfaces. In addition, we drew on the latest structural correlation of the Alpine nappe stack of the Transdanubian Central Range with its proper tectonic counterpart in the Eastern Alps. At the southern edge of the Upper Austroalpine units in northern Styria, in the Veitsch Nappe of the Greywacke Zone, numerous graphite localities are known historically.

We propose that the best explanation for the observed extent and geometry of the TCA is the presence of graphite in subhorizontal, tectonically thinned detachment surfaces in the Upper Austroalpine nappe edifice of NW Hungary. This explanation is supported by reinterpretation of old magnetotelluric measurements by the use of new inversion method and new measurements at critical localities.