

The United States magnetotelluric array program and the national impedance map

A. Kelbert¹, P. Bedrosian², A. Schultz³, G.D. Egbert³, L. Pellerin⁴, B. Murphy⁵, J.J. Love¹ and A. Frassetto⁶

¹ USGS Geologic Hazards Science Center, Geomagnetism Program, Golden, CO – USA,
akelbert@usgs.gov

² USGS Geology, Geophysics, and Geochemistry Science Center, Denver, CO - USA

³ Oregon State University, Corvallis, OR - USA

⁴ Green Geophysics, Inc., CA – USA

⁵ Murphy Geo Consulting, LLC, CO – USA

⁶ EarthScope Consortium – USA

SUMMARY

Since its inception in 2006, the United States magnetotelluric array (USMTArray) project has acquired more than 1,700 long-period magnetotelluric (MT) stations covering the entirety of the contiguous United States. Funding from multiple federal agencies has sustained this effort to its completion in 2024. Important components of the project include active guidance and participation from the scientific community, the open and timely availability of all data, and the application of consistent instrumentation and robust data processing. Together with parallel advancement in the development of publicly available three-dimensional (3D) inversion codes, the USMTArray project has revitalized the U.S. MT community and increased the visibility of MT within the broader Earth-sciences. Taken as a whole, these data comprise the USMTArray impedance map (USMTAIM) which, for the first time, permits visualization of the electrical architecture of the contiguous U.S. and has brought about the first continental-scale electrical conductivity models of the crust through upper mantle, and a corresponding gridded impedance map (USMTGAIM) obtained from this 3D electrical conductivity model. USMTArray data are used by researchers worldwide for fundamental and applied studies ranging from investigations of active and fossil tectonic margins to mineral systems assessment to estimating magnetic storm-induced geoelectric fields that interfere with electric power transmission. We review the history and development of the program, the challenges and successes in its execution, present the USMTAIM and the USMTGAIM, and highlight the breadth of research stemming from this rich data set.

Keywords: magnetotellurics, continent-wide geophysical array, Earth's electrical conductivity, space weather
