

Advances in marine EM applications to tectonophysics problems

C. Chesley¹

¹Woods Hole Oceanographic Institution, USA, christine.chesley@whoi.edu

SUMMARY

Over the past decade, the marine electromagnetic (EM) geophysics community has made pivotal progress in data acquisition and modeling, which, in turn, have sparked an abundance of novel discoveries in the realm of marine tectonophysics. Improvements to existing ocean bottom electromagnetometer pools and the advent of new instruments for controlled-source electromagnetic investigations combined with funding support for larger scale surveys have led to the amassing of datasets that can provide more detailed constraints on subsurface resistivity than ever before. Coupled with increased computing power and the development of sophisticated codes that can perform 2-D, and 3-D inversion of marine EM data, the complexity of Earth's resistivity structure beneath ocean basins can be characterized more completely than was previously possible.

Active plate boundaries, namely mid-ocean ridges, subduction zones, and transform faults, are the sites of dynamic processes involving earthquakes and volcanism. Fundamental open questions about these systems often involve melt storage and geometry or the role of fluids, for instance, in modulating slip behavior on faults. Because EM data are highly sensitive to conductive fluids within relatively more resistive crustal and mantle rocks, marine EM methods are an ideal geophysical tool for studying these systems.

This review will highlight contributions to the plate tectonics framework from recent marine EM studies. To put the results at plate boundaries in context, the general resistivity structure of the oceanic lithosphere and lithosphere-asthenosphere boundary (LAB) will first be discussed (SPOILER ALERT: this author struggled to define "normal oceanic lithosphere and LAB" from an electrical resistivity perspective). Then a number of EM surveys at mid-ocean ridges and subduction zones will be reviewed and overarching observations will be made. The available literature on oceanic transform faults, fracture zones, and intraplate volcanism will also be discussed.

Keywords: marine controlled-source electromagnetics, marine magnetotellurics, oceanic lithosphere-asthenosphere system, mid-ocean ridges, subduction zones
