Ridge Migration and Oceanic Core Complexes: Implications for the Marine Magnetic Anomaly Source Layer

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MATERIALS & METHODS

• Obtained underway geophysical and bathymetric data from National Geophysical Data Center.
• Extracted magnetic anomaly data.
• Plotted ship tracks with times and dates.
• Identified starting dates and frames of magnetic anomaly profiles across the ridge.
• Isolated and plotted individual magnetic anomaly profiles.
• Created 2-D grid of magnetic intensity and plotted it.
• Created 2-D plot of bathymetric data and plotted it.
• Identified oceanic core complexes on bathymetry map.
• Depicted core complex contours.
• Plotted core complex contours on magnetic anomaly profiles, bathymetry map, magnetic intensity map.
• Extracted individual profiles that ran through oceanic core complexes.

INTRODUCTION

Understanding more about mid-ocean ridges is of crucial importance to humanity. Mid-ocean ridges are the site of formation of oceanic crust, which accounts for 60% of the Earth’s surface and has potential economic benefits as a natural resource, forming massive deposits of copper, zinc, and gold. Volcanism a mid-ocean ridges determines ocean chemistry which in turn affects climate.

The Mid-Atlantic Ridge is the boundary between two diverging tectonic plates at which new seafloor is forming. Magma rises and fills the void between the two spreading plates and solidifies, forming new seafloor. Ferromagnetic minerals within the magma locked in alignment with Earth’s magnetic field. The ferromagnetic minerals of the seafloor generate their own magnetic field of varying intensity and polarity. These variations are referred to as anomalies.

Marine magnetic anomalies are of critical importance in geophysical research due to the information that they reveal about mid-ocean ridges. These anomalies concern the source of magnetic anomalies. Previous studies have found a positive correlation between the thickness of seismic layer 2A and the magnetic anomaly signal, indicating that the source of the magnetic signal may stem from layer 2A. Mechanisms by which oceanic core complexes form generally expose upper mantle rocks onto the seafloor surface and can distort or destroy Layer 2A.

If Layer 2A is deformed or absent, it is possible that the magnetic signal normally generated by the seafloor is distorted at oceanic core complexes. This means measuring marine magnetic anomalies at oceanic core complexes provides a rational means of determining if the source of the magnetic anomaly signal actually is layer 2A.

RESULTS

Figure 2: Multibeam bathymetric map. The bathymetric map was used to find the locations of the oceanic core complexes. Oceanic core complexes that appear as dark stripes with numerous corrugations. Black map outlines show the locations of the oceanic core complexes. A total of 8 oceanic core complexes were located. Scale in meters.

Figure 3: Magnetic anomaly profiles. Map of magnetic anomaly profiles within the study area showing variation in magnetic intensity along ship tracks. Vertical scale: 0-75 Gs. Black map outlines show the locations of the oceanic core complexes.

CONCLUSIONS

By comparing the magnetic anomaly intensity at oceanic core complexes with that at the normal seafloor, we have shown that these geophysical structures have significant effects on seafloor magnetization. The magnetic intensity measured at the overwhelming majority of oceanic core complexes in the study area is significantly lower than normal seafloor. Although we cannot rule out superposition, our findings indicate deformation of layer 2A is the most likely cause of this decreased magnetization. We therefore conclude that layer 2A is indeed the source of the seafloor magnetic anomaly signal.

REFERENCES


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