The Mid-Oceanic Ridge in the Greenland Sea

G. L. JOHNSON,
U. S. NAVAL OCEANOGRAPHIC OFFICE, WASHINGTON D. C. 20390

INTRODUCTION

The continuation of the Mid-Oceanic Ridge through the Greenland Sea (Knipovitch Ridge) has been postulated by numerous investigators on the basis of both earthquake epicenters and topography (*Heezen* and *Ewing* 1961, *Johnson* and *Eckhoff* 1966, *Demenitskaya* and *Dibner* 1966). Morphologically the Ridge is atypical in that in addition to the expected rough arch its eastern flank is bordered by a continuous linear trench (Fig. 1). This trench has generally been accepted as an axial rift valley or/and a fracture zone *Johnson* and *Heezen* (1967a) or trench *Vogt et al.,* 1970. The earthquake epicenters tend to lie in or very near to the axis (Fig. 1). The rift is narrow, generally 2 or 3 miles wide at the 1800 fm isobath (Fig. 2), and has well developed structural benches on its walls. The rift mountains generally lie at depths less than 1200 fms and to the east, are barely discernible, due to burial. The trench abruptly terminates at 78° 30′ N as it impinges upon the continental rise of Spitsbergen.

ORIGIN

A recently acquired seismic reflection line strongly suggests a rather intriguing possibility. It is well known that on a world-wide scale the crest of the Mid-Oceanic Ridge is characterized by an absence or almost total lack of sediment cover, *Schneider* and *Vogt,* 1968, *Ewing* and *Ewing,* 1967. Knipovitch Ridge (Fig. 2) has basement rock cropping out or at least sediment cover thinner than the resolution of the seismic system from 40—60 km west of the trench. Magnetic profiles across the Ridge do not show the characteristically high amplitude Brunches normal positive anomaly 50 km west of the trench. A negative anomaly is however present flanked by small positive anomalies and does possess apparent symmetry (Fig. 1), profiles 1—3. Possibilities for the lack of well defined magnetic anomalies over either the trench or ridge crest are:

1. Oblique spreading parallel to the Spitsbergen and Greenland Fracture Zones must occur in the Greenland Sea. Oblique spreading at a rate of probably less than 1 cm/yr with concommitant reduction in width of the normally and reversely magnetized strips of crust would significantly decrease the amplitudes of the magnetic anomalies (*Vine,* 1966).

2. If the sediment has free access to the axial rift valley the extrusion of highly magnetized pillow basalts will be restricted and buried coarser grained less highly magnetic rocks will tend to be created in the axial zone (*Johnson* and *Heezen,* 1967b, *Vogt et al.,* 1970). Bottom photographs and dredges have shown that pillow basalts are by far the most common rock type in the axial valley of the Mid-Oceanic Ridge (*Heezen et al.,* 1959, *Schilling et al.,* 1968, *Heezen* and *Ewing,* 1963). *Schilling et al.* (1968) demonstrated that the pillow basalts of the Reykjanes Ridge have a high value of magnetization ($J = 0.03$ e.m.u.) and that values away from the axial zone are smaller ($J = 0.012$). Recent studies by *Talwani et al.* (1971) support these findings and suggest the causitive layer of highly magnetized basalt is about 400 m thick. The decrease in magnetic intensity away from the ridge axis has been explained by *Haggerty* and *Irving* (1970) as being due to alteration of titanomagnetite to maghemite presumably by the subaqueous weathering of the basalt leaving the residual value at 0.012 e.m.u.

3. The Ridge became inactive during Matuyama reversed epoch and the negative anomaly in profiles 1—3 50 km west of the axis represent a relic axis with perhaps a very thin sediment cover which has accumulated in the last 700,000 years.