Characteristics of the Polish contract area in the Mid-Atlantic Ridge

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Introduction

The Polish exploration area is located along the Mid-Atlantic Ridge (MAR), encompassed by the Hayes, Atlantis, and Kane transforms fracture zones (26°09'-32°50' N) that split the research area into two large segments. The total length of the area is 876 km, and it is a part of the international seabed area beyond the limits of national jurisdiction of any State and claimed continental shelf. From the north, it borders with the Portuguese extended continental shelf and from the south with the IFREMER (France) exploration area.

The Mid-Atlantic Ridge is one of the most promising areas for the occurrence of seafloor massive sulfides (SMS), but the key challenge is to depict the location of the most significant deposits with a mining value, considering the technical and legal framework. In turn, this requires understanding the conditions of their formation. Based on the available data set, a map of the Polish exploration area highlights the most prospective areas of the occurrence of massive sulfides (Fig. 1).

Morphostructural analysis of Polish contract area

The aforementioned segments of MAR (separated by the major transform faults) are also subdivided into smaller features by a non-transform offset which can be assigned to different structural type: magmatic with predominant volcanic processes or tectonic where magmatism is reduced (German et al., 2016). It is assumed that half of the SMS deposits in the Polish exploration area are associated with basalts (magmatic

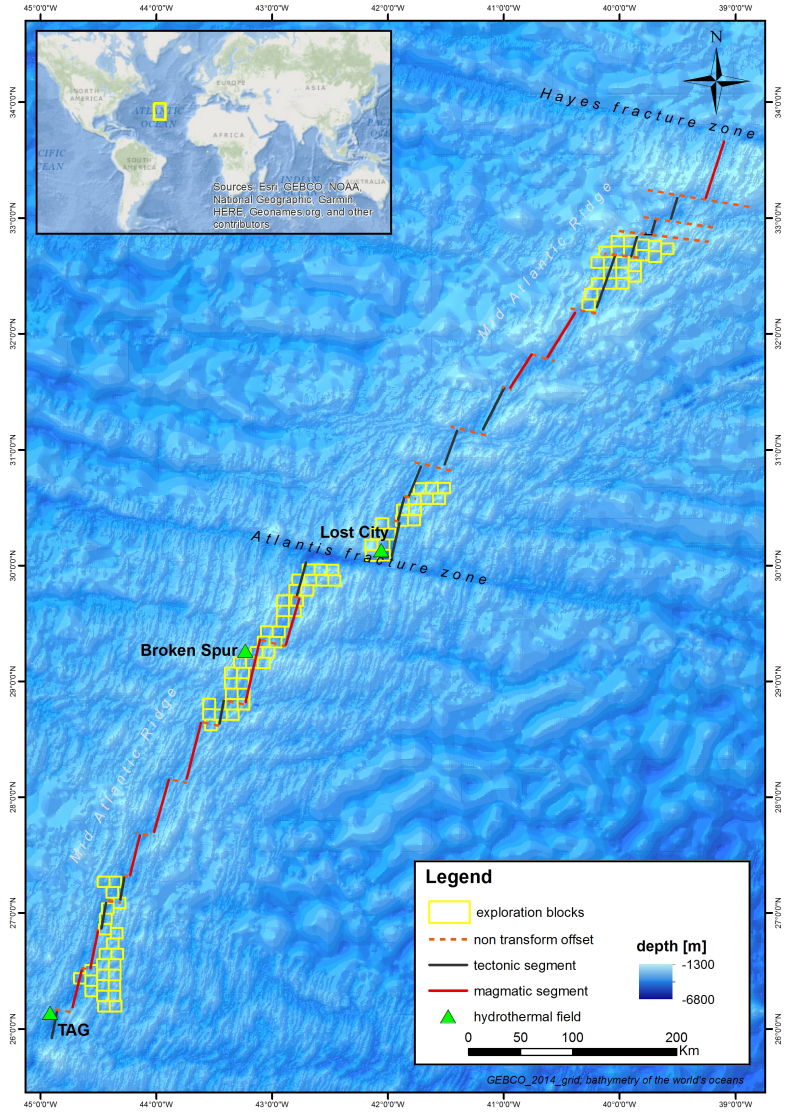

Figure 1. Map showing the detailed location of the polish exploration area with distinguished tectonic and magmatic segments and hydrothermal fields.

segments) and the other half (tectonic segments) with uplifted lower crust and mantle rocks (oceanic core complex – OCC).

The magmatic segments are mainly characterized by generally higher bathymetric level, at the average (about 1000 m) relative depth of the rift valley, and lack of major longitudinal tectonic steps, as well as significant intersegment dislocation intersects, and lack of uplifted plutonic gabbro-peridotite rocks. Magmatic activity is low, and seafloor spreading might be

accommodated by tectonic extension along faults [Escartin et al., 2008; Humphris et al., 2015].

The tectonic segments are characterized by relatively small length or expressed intersegment fragmentation, mosaic, and contrast of the flank structure, and extensive development of the major differently oriented tectonic dislocations. As a consequence, outcrops of plutonic rocks occur on one or both flanks of the rift valley [Cannat et al., 1995; Escartin and Cannat, 1999; Ciazela et al., 2015]. Based on available data, the SMS deposits associated with an asymmetrical mode of accretion and gabbro-peridotite rocks (tectonic segments) are considered as promising for large high-grade SMS deposits.

Nature Value

Several biophysical processes are imposed on the hydrogeological processes described above, causing different segments of the mid-ocean ridge (separated by faults) to form separate biogeographic units with ambiguously defined boundaries. Exploration polygons concentrated in five separate clusters (A-E) should be considered as diverse and different from each other, both geologically and biologically, despite their location within one geological feature (MAR). This will be taken into account when planning and preparing for the first research cruise for the Polish concession area in the MAR. The most significant attention of the international community is concentrated in the area of the Atlantis Massif (29°56' N), partly located in the Polish reserved zone (cluster C). Within this area, at a depth of 750 to 900 m is located the famous field of alkaline (non-metallic) hydrothermal vents with a height of up to 60 m called "Lost City." These white chimneys are characterized by significant activity and low-temperature hydrothermal fluids. They constitute a record of at least 30,000 years of changes in their functioning (Blackmann et al., 2002; Früh-Green et al., 2003; Kelly et al., 2005). Marine fauna living on their surface characterize valuable forms of adaptation to these extreme conditions (e.g., chemosynthesis) (Van Dover, 2000; 2011). The Atlantis Massif is the subject of intense and comprehensive international research conducted since 2000. Based on results obtained, with the consistent efforts of the international scientific community, efforts are made to approach this area with strict protections.

Next Steps

The basic (environmental) research planned as part of the cruise for the contract area aims for observation of the ocean floor, as well as physicochemical measurements of the water column and the collection of oceanographic, biological data, and geological samples. An important aspect is the observation and estimation of the size (occurrence and bulk) of polymetallic sulfide deposits. The research will comprise also active hydrothermal vents, which are rare and extreme habitats with extremely individual conditions. They are often places for the development of unique adaptations of living organisms and the concentration of mineral deposits. Planned research should provide helpful hints in response to several crucial questions related to hydrothermal areas. However, the main research potential will be directed to expired hydrothermal areas as well as inactive hydrothermal vents, which are also a potential source of polymetallic resources.

Keywords:
Mid-Atlantic Ridge, morphostructural analysis, hydrothermal fields, massive sulfides.

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